

Information in support of the electronic consultation

Action Plan & consultation process

Draft 0 was prepared by 11 pairs of African and European experts who have drafted the different chapters. The chapters are currently under discussion and therefore they **do not reflect a formal position of the AU and of the EU**.

The current version of the Action Plan, Draft 0 has been completed in 8 months of work and after 4 rounds of revision. It is an baseline version of the Action Plan. The consultation process should contribute to substantially improve it before its submission to the Heads of State Summit expected to take place at the end of 2010.

For the purpose of the consultation process, each chapter of Draft 0 must be read as an individual chapter. This crucial aspect must be taken into due consideration while reading and commenting the present Draft 0. The consistency among different chapters and harmonization into one consolidated document will be addressed during and following the consultation process.

For instance, each chapter includes a section suggesting an organizational scheme to optimize coordination, networking and management of EO information at different levels, continental, regional, national local, to be considered as first reflections.

It is worth noting that the pairs of African and European experts were asked to draft also two specific sections on “Cost estimation” and “Timetable” for the implementation of the recommendations according to the priorities identified. However, it has been decided by the African-European joint Coordination Team not to address those issues prior to the actual consultation, as needs deriving from the consultation itself would need to be ascertained and prioritized before any assessment of costs or implementation strategies is made. Those will be dully addressed by the Coordination team in a subsequent stage.

Also, important aspects of the current version of the Action Plan (Draft 0) have not yet been discussed in the appropriate fora and will be addressed in the validation phase, both via the electronic consultation and via the regional consultation processes that are scheduled to take place in the following months.

In particular, some crucial aspects for the operationalization of GMES&Africa need further reflection, such as:

- definition and prioritization of actions under GMES&Africa,
- African relevant policies, including access to and utilization of data,
- interface with GMES Europe,
- governance, coordination and financing aspects,
- definition of services (including the generation of tailored information for specific user communities and decision makers).

Draft 0 is a baseline document to feed those discussions. The African-European joint Coordination Team of GMES&Africa has now launched the consultation process as we are short before the Africa-EU Heads of State Summit end of 2010 and there is a strong need to further engage discussions both in Africa and in Europe for a consensual plan.



GMES&AFRICA Action Plan

Draft 0

Reference document for the consultation process

Section I – General considerations

1. Introduction to Draft 0

Section II – Cross-cutting issues

2. Policy and Institutional framework
3. Infrastructure framework
4. Capacity Building framework

Section III – Thematic issues

5. Long-term management of natural resources
6. Marine and coastal areas
7. Water resources management
8. Impacts of climate variability and change
9. Natural disasters
10. Food security and rural development
11. Infrastructures and territorial development
12. Conflicts and political crises

Towards a GMES&Africa Action Plan

Section I

1. Introduction to Draft 0

1. Context

Space applications are an important challenge and a great opportunity for Africa in addressing sustainable development and poverty alleviation. In this regard, the 8th Partnership on “*Science, Information Society and Space*” of the “*2008-2010 Action Plan for the implementation of the Africa-EU Joint Strategy*” underlines the relevance of space-based technologies for development policies.

Following the Maputo declaration on GMES and Africa (April 2006), the EU Portuguese Presidency together with other European and African governmental bodies and organisations¹, confirmed their commitment to work on the **Lisbon Process for "GMES and Africa"** (Lisbon declaration, December 2007)), and called upon the EU to plan an extension of its GMES European initiative to Africa, in order to make available to African decision makers all the data and tools needed for an operational implementation of policies targeting the sustainable management of the African environment.

The Lisbon Process, which evolves in the wider context of the Africa-EU Action Plan 2008 – 2010, focuses on the elaboration of a “GMES&Africa Action Plan” to set up a medium/long term strategy for Africa, aiming at making full use of the potential of space systems for sustainable development, locally, regionally and continent wide and to reinforce Africa’s capacity and ownership in using remote sensing technology, especially by implementing operational services in support to sustainable development . The Action Plan also initiates a long-term structured dialogue between Africa and Europe on Earth Observation related applications.

2 The “GMES&Africa Action Plan”

The “*GMES&Africa Action Plan*” has been identified as one of the two “*Early deliverables*” of the “*2008-2010 Africa-EU Action Plan*” for the Space component of the “*Africa-EU Partnership n° 8 on Science, Information Society and Space*”.

¹ The Participating Organisations and Governmental bodies to the Lisbon Declaration are the Portuguese Presidency of the Council of the European Union , the European Commission services, the Commission of the African Union, the Secretariat of the African, Caribbean and Pacific Group of States, the European Space Agency, the European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT), Economic Commission of the West Africa States (ECOWAS), the Intergovernmental Authority on Development of East Africa (IGAD), the Monetary and Economic Community of Central Africa (CEMAC), the Southern African Development Community (SADC), the Indian Ocean Commission (IOC).

2.1 Objectives of the “GMES&Africa Action Plan”

GMES&Africa focuses on Earth Observation applications.

The objectives of the “GMES&Africa Action Plan” are as follows:

- 1) to help decision makers in understanding the importance of Earth Observation for sustainable development and poverty alleviation (increased understanding of situations, trends and dynamics, improved environment and natural resources monitoring capacity and improved design of policies and programs);
- 2) to identify thematic priorities and priorities to enhance the use of EO in Africa;
- 3) to outline operational modalities reach GMES&Africa objectives, i.e. allowing Africa to make full use of the potential of space systems for sustainable development and reinforcing Africa’s capacity and ownership in using and contributing to remote sensing science.
- 4) to define modalities to establish African-European operational collaboration to make best use in Africa of GMES Europe services

As indicated in the “Lisbon process”, the “GMES&Africa Action Plan” shall address:

- *the **identification** of European and African users communities and stakeholders to be engaged in “GMES and Africa”;*
- *a **mapping exercise** aiming at the identification of relevant past and current activities, infrastructure, capacities and programmes on which “GMES and Africa” can build on (including the work done by the GEO capacity building committee and other international experiences);*
- *an efficient approach for a **long-term dialogue** among the European and the African stakeholders for the integration of African requirements and needs in the provision of GMES services to Africa. This long-term dialogue should **structure the cooperation** among the African and the European GMES stakeholders and user communities;*
- *the identification of the necessary **elements** to provide GMES services to Africa and to develop the complementary regional capabilities, and of a **strategy** to implement them. Data infrastructure initiatives in Africa, training programmes and capacity building on Earth Observation (e.g., in the context of GEO, AMESD, TIGER or regional initiatives) shall be fully identified and exploited;*
- ***prioritization of requirements and actions** based on the consultation with, and federation of, the African user communities and on the available portfolio and identified assets resulting from relevant projects, programmes, infrastructures and others;*
- ***identification of gaps** where action is needed;*
- *identification of **suitable programmes and funding instruments and schemes** for the “GMES and Africa” partnership (e.g., in the context of GMES, EC research and development programmes, GEOSS, AMESD, ESA and EUMETSAT programmes, EDF, regional initiatives, bilateral*

cooperation, etc.), when local African capacities and infrastructures are not sufficient and having in view the harmonisation of all assets for the long term sustainable development of services and the regional capabilities. Exploration of the typical communitarian instruments used for the general development of GMES, as well as the typical mechanisms in line with the EU external relation and cooperation policies, shall be pursued;

- *an approach to the **governance and data access policy issues**;*
- *the setting of a **timetable** for long term future actions in the development of “GMES and Africa” partnership.*

2.2 “GMES&Africa Action Plan” development and consultation processes

Meeting in Accra in October 2008, the Participating Organisations and Governmental bodies to the Lisbon Declaration have created an African-European joint Coordination Team² specifically appointed for the purposes of the Action Plan. The Coordination Team has mandated the members of the Human Resources, Science and Technology Department of the African Union Commission (AUC/HRST) and of the Joint Research Centre of the European Commission (JRC) to coordinate the drafting of the GMES&Africa Action Plan, expected to be submitted to the third African-EU Heads of State Summit foreseen end of 2010. African and European pairs of experts have been appointed to draft the 11 chapters of the Action Plan, in accordance with the general template of the document and of each single chapter, jointly defined in Accra by the African-European joint Coordination team.

Beyond the present introduction, the document is divided in 2 sections, the first one is composed by 3 chapters on cross-cutting issues and the second one addresses 8 thematic issues

Policy and Institutional Framework
Infrastructure Framework
Capacity building Framework

² The members of the Coordination team are : the European Commission (JRC, DEV, ENTR), France and Portugal, ESA and EUMETSAT, the African Union Commission, UNECA, the Chair and the vice-chair of the Steering Committee of AMESD, and AMCOST, AMCEN, AMCOW.

Long-term management of natural resources	Marine and coastal areas	Water resources management	Impacts of climate variability and change	Natural disasters	Food security and rural development	Infrastructures and territorial development	Conflicts and political crises
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The present version of the document corresponds to “Draft 0”. As agreed in Accra and in Ispra (March 2009) by the African-European joint Coordination Team, Draft 0 is submitted to a wide consultation process in Africa and in Europe to involve in the conception of such strategic document all relevant stakeholders and the civil society, to validate requirements in the areas where Earth Observation can have an impact and to prioritise future developments. In view of the finalization of the document for submission to the Heads of State Summit it is necessary to engage discussions at all levels, to ensure that the views and the expectations of African and European institutions and stakeholders are duly reflected in the Action Plan.

The consultation process will be carried out through an **electronic consultation** open from March to May 2010. To ensure an active participation of the African countries – expected to be the main beneficiaries of the Action Plan – it has also been decided to organize in Africa **five regional consultation workshops**, (*Northern Africa, Western Africa, Central Africa, Eastern Africa and Southern Africa*), under the auspices of AUC/HRST and the concerned Regional Economic Communities (RECs).

Participation to the workshops will be open to relevant stakeholders on an ad-hoc basis. A minimum participation of two representatives per country, tentatively from National services in charge of remote sensing and relevant policy making is sought (e.g. Ministry of Plan, Environment, Agriculture, or other relevant domain). In order to enrich the debates, a special section of the consultation Web-site will be dedicated to each regional workshop. This will allow regional stakeholders to raise important and critical issues for their region, as well as to indicate regional priorities.

2.3 Subsequent steps

Once the consultation process is concluded, the African-European joint Coordination Team, following the analysis of the inputs from the consultation process, will outline the main orientations for the finalization of the document with a focus on the priorities identified during the consultation.

This document will then be revised accordingly, and will include aspects on cost estimates and funding mechanisms, ensuring internal consistency of the different chapters.

Section II – Cross-cutting issues

2. “Policy and Institutional framework”

Experts

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1. Introduction

1.1 Thematic context

At the United Nations Millennium Summit held in September 2000, African countries and the international community adopted the Millennium Development Goals (MDGs) to which they committed themselves to adopt practical solutions. To attain the MDGs, African countries adopted the New Partnership for African Development (NEPAD) as a framework for their collective action to attain economic transformation and sustainable development of the continent, now under the African Union Commission responsibility.

In the process of developing the NEPAD Action Plan, space technology was identified as a powerful tool to address problems from a continental and regional perspective. For instance, space applications provide a unique opportunity to monitor the environment and the state of natural resources in a wide range resolution (from very high to low resolution) and from low frequency to near-real time monitoring, enabling the formulation of policies and plans for sustainable development.

Despite the crucial role that space technology can play to provide decision support tools for natural resources management and other utilisations, most African countries lack today the human, technical and financial resources to utilise space-based infrastructures for even the most basic applications in natural resources management and communications.

Currently, the African continent is host to numerous initiatives including projects, institutions and networks using satellite based and in-situ observation data to achieve their specific objectives. Generally supported by the donor community, international space agencies and participating national, regional or international organizations, these initiatives which are operating at local, national, regional or continental level are completely uncoordinated as there is no common vision, common purpose or community of action.

There is therefore a compelling need for an institutional framework through which coordination would be established to facilitate collaboration and networking between actors of the current and

future initiatives using space technology to achieve the economy of scale, build synergies and ensure collective vision, purpose and action towards the achievement of the MDGs on the African continent.

The need for a policy framework that will regulate EO data access, archiving and how to integrate EO data, products and services in the overall knowledge to support economic development of Africa at national, regional and continental level is also compelling. This framework will also allow for structuring the necessary African interface to make best use of "GMES Europe¹" services for sustainable development in Africa.

This institutional and policy framework will constitute the corner stone to build African capacity (human resources, infrastructures) to benefit from the current tremendous advances in space science and strengthen African participation in the global environmental monitoring initiatives and in the global implementation of international treaties such as those related to the environment.

1.2 Constraints

In the absence of a coordinated approach at the continental and regional levels, new initiatives will continue to be launched without taking into consideration the real needs ignoring existing knowledge, facilities and programmes from which positive synergies could be built for the benefits of all stakeholders. The consequence will be the lack of sustainability, frequent overlaps, limited ownership and absence of a long term approach. This will lead to little progress, limited added value to the development process despite the potential high value of space technology to inform policy programs and ensure African led, African managed and African owned socio-economic programmes.

2. Policy Drivers and Needs Analysis

2.1 Policy drivers

The initiative to enhance the use of space-based technologies for environmental monitoring and natural resources management to support sustainable socio-economic development in Africa is driven by bold policy decisions and strong recommendations from high level Summits and policy bodies at global (Earth Summits), European (European Union Summits) and Africa levels (Head of States Summits, Ministerial Declarations).

The *GMES and Africa* initiative is an integral part of the **EU-Africa 8th Partnership**, on the Information society, Science and Space. It has its roots in the consensus reached among European and African stakeholders on the need to define an Action Plan to be submitted to the AU/EU Summit in Lybia in 2010. The Lisbon declaration (2) commits stakeholders to delivery an Action Plan drafted along the lines of the Lisbon Process (2), agreed at the event organized in Lisbon in December 2007 (3,4).

A summary of major drivers is provided in table 1 below. Details about each specific policy driver are provided in annex 2.

¹ For info on GMES see e.g. <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2008:0748:FIN:EN:PDF>

(2) Lisbon Declaration and Process http://www.mundiconvenius.pt/2007/gmes/programme_final_conclusions.htm

(3) Lisbon event 2007 http://www.mundiconvenius.pt/2007/gmes/programme_final.htm

(4) Lisbon – Participants http://www.mundiconvenius.pt/2007/gmes/docs2/participants_list.PDF

1. Global	<ul style="list-style-type: none"> The 2002 WSSD 	<ul style="list-style-type: none"> International community called upon to promote the development and wider use of EO technologies to support sustainable development of African countries. NEPAD Environmental Action Plan adopted as the framework for implementation of the recommendation.
	<ul style="list-style-type: none"> 	<ul style="list-style-type: none">
	<ul style="list-style-type: none"> G8 and High level EO International Summits 	<ul style="list-style-type: none"> 28th G8 Summit in 2003 recommended that a specific summit be organized on EO First EO Summit, June 2003 decided on establishing GEOSS and the development of a 10 Year Operational Plan Second EO Summit in 2004 discussed the 10 Year Operational Plan (OP) Third EO Summit approved the 10 Year GEOSS OP.
	<ul style="list-style-type: none"> UN declarations 	<ul style="list-style-type: none"> UN Resolution 45/72 (1990) recommending establishment of regional centres of excellence for space science and technology in developing world including 2 centres in Africa.
2. European Union	<ul style="list-style-type: none"> European Consensus on Development (2005) 	<ul style="list-style-type: none"> Calls for a “European Policy Coherence for Development” explicitly referring to supporting the MDGs; Set EU vision for development and spells out EC objectives for development cooperation. States that reliable and continuous information on the state of environment and natural resources of Africa will improve effectiveness of EU development aid to Africa.
	<ul style="list-style-type: none"> Joint Africa-EU Strategy 	<ul style="list-style-type: none"> To be implemented through successive Actions Plans that identify short term political priorities, policy commitments , programmes and actions to achieve them. First Action Plan (2008-2010) identified specific “Africa-EU partnerships” including Partnership no. 8 on Science, Information Society and Space.
	<ul style="list-style-type: none"> European Space Policy (ESP) 	<ul style="list-style-type: none"> The ESP was adopted following a EU Council resolution in May 2007. It addresses Space Applications such as Navigation (through Galileo) and Earth Observation through the Global Monitoring for Environment and Security initiative (GMES). On International cooperation, reference is made to the potential of space systems for sustainable development, in particular in Africa. The ESP acknowledges that actions and projects will be based on requirements laid down by African stakeholders and identified through the consultation process initiated Dec 2007 by the Lisbon Declaration on GMES and Africa, in particular through the Action Plan to be submitted to the next EU/AU Summit.
	<ul style="list-style-type: none"> EU/AU College to College Meeting October 1, 2008 	<ul style="list-style-type: none"> Agreement to implement the Lisbon declaration on GMES Africa. Agreement to implement two projects including (i) Capacity building of the AUC on geospatial sciences through a mirror of the JRC’s Africa observatory and (ii) the African Reference Frame (AFREF) implemented by UNECA.
	<ul style="list-style-type: none"> EU Commitment to International Environment Treaties. 	<ul style="list-style-type: none"> UNFCCC; UNCCD; UNCBD; MDGs; WSSD.
	<ul style="list-style-type: none"> Other relevant EC policies 	<ul style="list-style-type: none"> EC supporting Thematic Programmes in specific areas including (i) Food Security; (ii) Environmental; and Natural Resources; (iii) Energy Initiative for Poverty Alleviation and Sustainable Development; (iv) Water Initiative; (v) Conflict prevention.
3. African Level	<ul style="list-style-type: none"> NEPAD Science and Technology Consolidated Action Plan 	<ul style="list-style-type: none"> NEPAD adopted in the 2001 AU Summit as the major framework to eradicate poverty and place African countries on the path to sustainable development. NEPAD and AU Human Resources, Science and Technology Department developed a Consolidated Action Plan articulated into 5 clusters. Cluster 4 focusing on Infrastructure, Communication and Space Science and Technologies. Decision to establish the African Institute of Science and technology under Program 4.2. of Cluster 4 of NEPAD Action Plan.
	<ul style="list-style-type: none"> The NEPAD Environmental Action Plan 	<ul style="list-style-type: none"> Endorsed by AU Summit in 2003. Is a framework for a strong partnership for protection of the environment between Africa and its partners. Organized into 7 priority sectors and 2 cross-cutting issues. Subdivided into Regional Action Plans under the RECS.
	<ul style="list-style-type: none"> AU/RECS Declarations 	<ul style="list-style-type: none"> The DAKAR (2002) Declaration calling upon Europe to provide funding to AMESD and Maputo Declaration (2006) calling for EU support to GMES Africa. The EU/Africa Lisbon Declaration (2007) establishing mechanisms for the development of an Action Plan for GMES Africa to be submitted to the 2010 Africa/EU Summit for endorsement.

	<ul style="list-style-type: none"> • African Ministerial Conferences Declarations 	<ul style="list-style-type: none"> • AMCEN, AMCOW, AMCOST and the AU Ministerial Conference on Finance have identified Space Technology as a priority area for their sector's strategies as indicated by numerous declarations and their Specific Action Plans.
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2.2 Needs Analysis

N.B.! It is the objective of the on-going consultation process to assess needs in terms of data and applications, which can only be achieved upon termination of the consultation process. This section gives an insight of likely needs taking into account experience of past and on-going projects in Africa.

The overall need for GMES Africa is 1) to build in a reasonable timetable for an African-owned, African-led and African-managed capacity for environmental and security monitoring and sustainable natural resources management in support of socio-economic development and 2) to ensure its permanent mainstreaming in the decision-making processes.

As such, needs at several geographic levels will have to be addressed by the GMES and Africa initiative.

- At Continental level: need for low and medium resolution images, maps and data indicating trends in the state of resources; climatic trends i.e climate change effects on environmental degradation; trends in crop, rangeland and fisheries production to assess food security for early warning; extent of soil degradation, deforestation and desertification; trends in availability of water and grazing resources; trend of water resources in terms of quantity and quality, large disaster risks, extent of deforestation and degradation of marine and coastal ecosystems etc.
- At regional level: need for a regional reference system for assessing and characterizing the state of resources including land, forestry, marine resources, rangeland degradation and desertification rates; low and medium scale land use maps, vegetation maps, forest cover maps, water resources, crop production and trends for early warning and food security etc. Capacity to determine seasonal characteristics of natural resources and patterns.
- At catchments level: need for high resolution images and maps on water resources, crop production; soil degradation; land use including capacity to estimate seasonal trends and quantification of available resources. Vulnerability analysis and trends.
- At national and local level: need for high resolution images, maps and tools to assess seasonal variation of resources including crop production, water resources; soil cover; rangeland resources. Need for techniques to quantify quantity of available resources throughout the year. Need for capacity to predict crop yields and rangeland resources and early warning.

There is a need to establish an **institutional and policy framework** to ensure that geoinformation will be made available as needed at all those levels.

The institutional framework will aim at establishing an effective governance and operational mechanism for coordination of GMES activities at Continental, Regional, Sub-regional and national levels to match the information needs at the different levels. This may involve strengthening and developing institutional bodies that will articulate the needs and requirements at the various levels and develop strategies in a coordinated manner. The framework will have to ensure sustainability in securing long-term availability of space-based observing tools and infrastructures as well as infrastructures for in-situ observations.

The Policy Framework will aim at formulating a strong African Policy on Earth Observations data collection, access and archiving. At regional and national levels, the Policy framework will ensure that policies regulating access to EO services and data acquisition, access and utilization are formulated and enforced.

Beyond the above considerations, it is crucial to highlight the necessity for ensuring articulation between EO and in situ information as there is a need to validate EO observations by in situ observations before they are used in decision-making processes.

Currently, expertise, infrastructures and mechanisms for in-situ data collection to validate EO data are very weak at all level in Africa and there is a critical need to invest in networks and infrastructures to build a robust in-situ observation system connected to EO to generate reliable information to support decision making.

One of the major challenges of the GMES and Africa policy and institutional framework will be to develop and implement programmes to build African expertise for EO and in-situ data analysis, packaging, dissemination and utilization through adequate training.

3. Identification of communities

GMES products and services will be used by various communities at local, national, regional and continental level. They include high level policy makers at various levels in Africa as well as at international level. Donor agencies, financial institutions are also expected to be among the major users as well as researchers, project and institutional managers at national, regional and pan-African levels. End users at local and national levels will also constitute a major component of GMES Africa users. A summary of major communities of users is provided in table 2:

Table 2: Communities of users of GMES Africa services

N.B.! These are preliminary findings. To be updated after the consultation process; Refer also to the communities identified in the different thematic chapters.

Level	Users	Needs
Political	<ul style="list-style-type: none"> - Head of State Conferences - Ministerial conferences including AMCEN, AMCOW, AMCOST. - AUC. - RECs: ECOWAS, COMESA; SADC; IGAD; CILSS; AMU; East African Community; ECCAS; IOC. - UN Agencies/programmes: WMO; FAO; UNEP; UNDP; UNECA; Office of Outer Space; UNESCO; WFP etc. - Conventions Secretariats - Governments of African countries - Aid Agencies (EU; USAID; CIDA etc.) - AfDB - Certain EU and EU Member States' government services (e.g. Aid and Development services) 	Decision support tools portraying global trends in status of the environment and resources (environmental outlook); global trends in food security situation; early warning, Peace and Security operations, Humanitarian aid, etc (see thematic chapters) .
Technical	<ul style="list-style-type: none"> - Global and Pan African wide institutions, networks and projects managers. They include NEPAD; ACMAD; GCCA; AGIRN; AARSE; Managers of pan African wide projects such as AMESD, AFREF, MAFA etc. - Specialized African Regional Centres and projects managers at regional level engaged in capacity building and utilization of remote sensing. They include <i>inter alia</i>: AGHRYMET, RECTAS, CRASTE-LF; ARCESSTE-E; RCMD; ICPAC; COMIFAC; OSS. - Mandated National Institutions including relevant 	<p>At pan-African and Regional levels, need for low and medium resolution data including vegetation maps, vegetation changes; water resources maps and data; forest cover; land use cover, disaster risk, etc.</p> <p>At national level and for national projects, need for high resolution data and images for</p>

	<p>ministries, project managers at national levels including NMHSs, National Geographical and mapping services; National Space Agencies; National Environmental Services; National Agriculture and Livestock services, National Forestry Services, National Disaster risk Civil Protection, etc.</p> <p>- Scientific community at international, regional and national levels including CGIAR Centres; Advanced Research Centres, Advanced Universities, Regional Research Centres; National Research Institutes; National Universities; Regional Networks.</p>	<p>vegetation, water resources, weather and crop forecast, land use data, land degradation, disaster risk, etc.</p>
Other End users	<p>NGOs (e.g. EIS-AFRICA); CBOs, Producers associations; private sector</p>	<p>Need for high resolution images and data on available resources, land use, vegetation etc.</p>

4. Mapping exercise

Relevant past and current institutions, projects or networks (Annex 3), which can constitute building blocks for GMES Africa, include:

N.B.! This is not a complete list of projects/initiatives and will be updated as result of the consultation exercise. Feedback is strongly encouraged for the sake of completeness.

- i. Global or developed countries institutions, agencies or networks with potential to provide support to GMES Africa activities. They include space agencies such as ESA, NASA, EUMETSAT; National Space Agencies and offices in and outside the EU; projects or global networks including GEOSS, GMES, Global Biodiversity Facility; INSPIRE; GEONET Cast; Global Climate Change Alliance; UN Agencies Global Projects (UNEP, FAO, UNESCO, UNFP, WMO, UNDP; UN Agency for Outer Space etc); Global Climate Change Alliance; Global Spatial Data Infrastructure Association etc.
- ii. Pan African wide projects funded by the United Nations, European Union or other international cooperation agencies. E.g. completed or on-going projects such as AMESD, PUMA, VG4AFRICA; JRC ACP Observatory;, GOOS AFRICA; ARSIMOWA; CLIMDEV; ODINAFRICA; AMIS; DESERT WATCH; GMFS; TIGER; IBAS; CBERS for AFRICA; UN Agencies projects (UNESCO –IOC, UNECA AFREF and MAFA; FAO; WMO; WFP; UNEP DEWA; UN OFFICE FOR OUTERSPACE AFFAIRS); ROOFS AFRICA; AFRICAN INSTITUTE FOR SPACE SCIENCE; SERVIR-AFRICA; ARM; DEIMOS etc.
- iii. Regional institutions and projects such as AGHRYMET, the Observatory of Central Africa Forests of the COMIFAC; OSS; ICPAC; CICOS; RECTAS, CASTRE-LF; ARCESSTE-E; RCMRD etc.
- iv. National institutions including national Space Agencies (South Africa; Nigeria; Kenya; Algeria, Morocco, Egypt etc.); NMHSs etc.

5. Identification of Gaps and Suitable Programmes

5.1 Gaps analysis

Despite strong policy drivers at global, European, African and Regional levels, there are major gaps in the current African Institutional and Policy Framework for use of space technologies.

Major gaps in the institutional framework include:

- Lack of coordination of geo-information activities in Africa. An operational institutional framework is yet to be established at continental, regional and sub-regional levels as current activities by the various actors are often not sufficiently coordinated.
- Numerous satellites from various space agencies have the potential to provide data to Africa but there is a global paucity of available infrastructures and capacity at national, regional and continental levels preventing Africa to access. The continent is therefore not in position to fully benefit from the space-based technology opportunities.
- Most of past and current programmes/projects were/are entirely donor dependant and there is lack of continuity and sustainability of most of the initiatives. Very few African governments have established or are supporting utilization of space-based technologies.
- In general, there is lack of consistency in approaches and methods for data collection, type and quality of data collected and utilized by the various institutions, networks and projects involved in geo-information technologies. The lack of standardization of data leads to difficulties in data sharing at the various levels.
- In Africa, the existing network of monitoring and field validation systems is insufficient and not very efficient. Environmental field data are limited and not always reliable and updated. The socio-economic statistics available are insufficient to respond to the needs and properly underpin decision-making processes in different domains. This situation seriously affects confirmation of validity of EO information and undermines the possibility to make best use of this information through integration with reliable and update information.
- Large areas of Africa are remote due to lack of road and communication infrastructures, rough topography and hostile climate. In-situ observations to support space- based data are difficult to organize in some of the most relevant sites.
- The high cost of infrastructures and infrastructures maintenance and the high cost of data acquisition is prohibitive.
- The potential of internet and other Information Technologies for communication/dissemination of data and information is not yet fully exploited in Africa.
- Inadequate expertise in EO technologies and weak capacity building programmes to exploit EO technologies.
- Inadequate quality of the information to support decision-making processes (available information is either insufficient, or not adapted/appropriate, not reliable, not updated or not formatted).

Major gaps in relation to the policy framework include:

- There is an overall lack of policy regulating access and sharing of geo-information data at continental, regional and sub-regional levels in Africa.
- Most of the providers of space-based data and information have their own access policy particularly in terms of pricing and conditions for utilization. The cost of access to near real time information requires licensing and the cost is generally prohibitive.
- Lack of agreements with relevant data providers for an operational and sustained provision/access to their information.
- Lack of coordination of activities and initiatives aimed at building capacity for enhanced utilization of EO technologies and services.

5.2 Existing or planned thematic programs

On going initiatives with funding support are indicated in Annex 3. The most important in terms of potential contribution to building GMES Africa include:

N.B.! This is not a complete list of projects/initiatives and will be updated as result of the consultation exercise. Feedback is strongly encouraged for the sake of completeness.

- EU funded GMES, AMESD, PUMA, VGT4AFRICA, EC-JRC “Africa, Caribbean and Pacific Observatory”, GEONETcast, Observatory of Central Africa Forests, INSPIRE; AMIS; EUMETCast; GEOSS, FP7 GMES Africa projects.
- UN funded projects including UNECA AFREF, MAFA and CLIMDEV Africa projects; UNESCO ROOFS AFRICA, GOOS Africa, Integrated Management of Ecosystems and Water Resources, ODINAFRICA; FAO projects on Early Warning for Food Security; WMO Africa projects; UNEP DEWA projects.
- Pan African Institutions such as NEPAD which mobilize funding from various donors. NEPAD has a plan to establish the African Institute for Space Science, initiative expected to be supported by UN.
- European Space Agency (TIGER, GMFS, Desert Watch, European national space agencies’ projects, and African National Space Agencies of South Africa; Nigeria; Algeria; Kenya; Egypt; Morocco; partnership initiatives between African countries or between African and external countries such as ARM, or CBERS for Africa.
- Eventually, an Intra-ACP program under the 10th European Development Fund (EDF) to support the consolidation of the achievements of AMESD, as contribution to the implementation of GMES&Africa. Links to other thematic programs earmarked in the “Intra-ACP EDF10” envelop could contribute to the implementation of aspects of thematic Action Plans of GMES&Africa.
- Programmes funded directly from AU core budget such as AU-STAT or support to activities of the AU HRST/NEPAD activities related to space Sciences and Technologies.

6. Building GMES Africa

6.1 Service Definition and Provision.

GMES Africa will guide effective integration of earth observation data, technologies and services in support of sustainable development. GMES&Africa should be set-up in a way that it provides timely, reliable and updated information in support of decision-making GMES Africa will strive at mainstreaming EO and field data, as well as scientific information, into the development agenda and particularly into development planning for Africa and program implementation. This necessitates institutional capacity strengthening, developing appropriate infrastructures, developing technologies, promoting an appropriate policy framework and building human resources supporting African ownership of the necessary capacities allowing the exploitation of EO technologies for sustainable development.

GMES Africa will require a coordinated approach to Earth Observation at national, regional and continental levels in view of formulating policies and laws governing access and utilization of Earth Observation data, which could be built leveraging also on existing institutional arrangements, infrastructures, operational mechanisms and achievements of on-going programs and projects (e.g. AMESD, TIGER, FP projects, etc.), with strong links to GMES Europe. Strong institutional and coordination mechanisms of Earth Observation activities on the African continent will *inter alia* enhance the African capacity for improving policy-making processes and for strengthening environmental management, including implementing international treaties and conventions and strengthen the contribution of Africa in the debate and programmes to mitigate the effects of climate change. This would also increase African capacity to play a role in the Global Earth Observation System of Systems Initiative (GEOSS).

The initial focus could be given to the set-up of an adequate sustainable African political framework, i.e. a solid continental coordination structure, with functional articulations at the regional and national levels, duly mandated and recognized, to address and organize the African approach towards E.O., including policy formulation and definition of regulations addressing data access and utilization. This framework would benefit from the support of a technical structure which could stimulate synergies and networking, support the articulation between the regional and the continental levels, support where appropriate existing and future EO initiatives, develop

baselines and references and ensure storage, processing and dissemination of data to relevant institutions, both at the decision-making and at the technical levels.

Also, decision-making, both at the political and the technical level – could benefit from targeted and tailored analysis based on the integration of EO, of *in situ* and of statistical information. The opportunity and the modalities to develop these services at the geographic and the thematic levels, should be carefully assessed in the frame of the overarching political framework.

6.2 Capacity building

Research and capacity building are fundamental issues for the success of GMES Africa. To ensure that GMES Africa services and products are user friendly in response to user demand (user-pull), GMES Africa will, through training, research and technology transfer activities, build the capacity of African experts, scientists and engineers to ensure that they have the required expertise and technical capabilities in Earth Observation data collection, analyses, processing, packaging and dissemination.

The strategy should be:

- To build on the existing activities and on the capacities of relevant Institutions and Research Centers, to ensure that they are efficient in building a critical mass of African experts. This should be done through carrying out a needs assessment throughout potential users and enhance the centres operational capacity through improving the facilities, strengthening human resources and developing appropriate training modules.
- To take in due consideration new initiatives, including the Pan African Universities (PAU) program carried out in the frame of the AU-EU Partnership n° 8 and the development of the African networks of Centres of Excellence in the Water and the Energy domains.
- To strengthen the capacity for GMES Africa data management, packaging and dissemination bodies at continental and regional levels to promote and coordinate the implementation of the GMES Action Plan.
- Support research programmes carried out by the centres and other relevant Academic /University institutions in Africa and strengthening partnerships between African researchers and advanced Research Institutions scientists.

6.3 Prioritization

Developing a response for an African coordinated approach towards an effective integration of Earth Observation data, technologies and services in support of sustainable development:

Discussions need to be engaged in África – at continental, regional and national levels - to stimulate the set-up of an adequate coordination mechanism and the appropriate political framework to make the best use of E.O. applications across the African Continent and enhance international cooperation, in particular with European partners.

The need to establish a governance mechanism, as well as cooperation mechanisms for increased thematic coordination, shall be extensively addressed, together with *ad hoc* reflections on the gradual implementation of GMES&África services along the priorities identified during the consultation.

The regional consultation workshops on the GMES&África Action Plan and the subsequent formal steps of the process will offer the opportunity to deepen the reflection and to confront and raise different African views and expectations.

6.4 Organisational scheme

This section will be completed following the organization of the regional validation workshops scheduled in Africa in the next months, taking into due consideration the organizational schemes envisaged for the other themes and cross-cutting aspects addressed by the present Action Plan GMES&Africa.

7. Recommendations

GMES Africa is an initiative aimed at positioning Africa to fully benefit from the progress in Space Earth Observation science, which can provide powerful decision support tools for natural resources management, environmental and security monitoring and communication to support economic transformation and achievement of the MDGs and sustainable development in the continent. The following recommendations can drive the reflexion:

- GMES and Africa is a user-led initiative, and understanding requirements and prioritising actions (through the on-going consultation process) is key before in depth analysis on governance, finance and implementation issues will take place.
- Nevertheless, success of GMES Africa will depend on the establishment of a strong institutional and policy framework that will ensure that GMES Africa is a self sustained program owned by Africans and ensuring appropriation by African countries of the necessary capacities to allow the exploitation of earth observation technologies and data through strengthening capacities, developing technologies and enhancing infrastructures.
- The mapping of completed, current and planned initiatives using satellite based technologies has shown that Africa is home of numerous projects, institutions and networks that use earth observations data and in-situ observations to achieve their specific objectives. Due to lack of a shared vision, all those initiatives are largely uncoordinated. This situation needs to be urgently addressed, starting from the continental and the regional levels.
- Sound and updated African-wide socio-economic statistics to integrate Earth Observation in situation analysis should be made available.
- The first step of building an institutional and policy framework for GMES Africa should start by organizing a policy dialogue between the major institutions, projects and networks involved in earth observation technology to build a strong and coordinated network of institutions that will be strengthened to constitute the building blocks of GMES Africa. The institutional arrangement will ensure that the dialogue is concluded by the emergence of a common vision, purpose and corporate objectives, characterizing the GMES Africa initiative.
- A need assessment study to identify strengths, weaknesses and opportunities for building centres of excellence in the GMES Africa network could be carried out. Competencies should match needs and priorities identified during the on-going consultation. The next step will be to mobilize resources to invest in building infrastructures for earth observations and in-situ data collection, packaging, archiving and dissemination to users, as well as build capacity to ensure that GMES Africa is operated by qualified resources across the various thematic areas. Capacity building programs will mainly be carried out at the appropriate centers of excellence components of the GMES Africa network.
- Beyond its “physiological” tasks of collecting, coordinating, processing, disseminating and storing Earth Observation Information, GMES&Africa aims at providing relevant, reliable and up-date information to decision-makers. With this objective in mind, an observatory for sustainable development in Africa could be developed in the medium term, to carry

out assessments and analyses building on EO and socio-economic statistical information and producing targeted thematic/geographic reports for decision-makers.

8. Summary

Although space based technologies and applications are largely recognized as powerful tools to support socio-economic development, most African countries lack the human, technical and financial resources to exploit space-based data and services for economic transformation and sustainable development.

The purpose of GMES Africa is to effectively guide integration of earth observation data, technologies and services in support of sustainable development. GMES Africa will strive at mainstreaming EO and field data, as well as scientific information, into the development agenda and particularly into sustainable development planning for Africa. It will be an African led, African managed and African owned initiative.

Following the Lisbon declaration, GMES and Africa is a user-led initiative and understanding requirements and prioritising actions is on-going consultation process. This will allow a better understanding of the challenges on implementation issues, including governance and financing.

Currently, the African continent is host to numerous initiatives including projects, institutions and networks using satellite based and in-situ observation data to achieve their specific objectives. These initiatives, which are operating at local, national, regional or continental level, are often uncoordinated and could benefit from synergic actions.

There is therefore a compelling need for a policy and an institutional framework through which coordination will be improved to facilitate networking and collaboration between actors (also across EU-AU continents), to share know-how and objectives, achieve economy of scale, increase synergies and action towards the achievement of the MDGs in the African continent. The policy framework will aim at facilitating the creation of services, eg. by regulating EO data access, archiving and integrating EO data, products and services in the overall information chain to support economic, sustainable and peaceful development in Africa.

Annex 1.**Acronyms**

AARSE	African Association of Remote Sensing for the Environment
ACMAD	African Centre for Meteorological Applications
ACP	African Caribbean and Pacific
AFREF	African Geodetic Reference Frame
AfDB	African Development Bank
AGIRN	African Geo-Information Research Network
AGRHYMET	Centre Régional de Formation et d'Application en Agrométéorologie et en Hydrologie Opérationnelle
AISS	African Institute of Space Science
AMCEN	African Ministerial Council Conference on Environment
AMCOST	African Ministers' Council on Science and Technology
AMCOW	African Ministers' Council on Water
AMU	Arab Maghreb Union
AMESD	African Monitoring of Environment for Sustainable Development
AMESD RIC	AMESD Regional Implementation Centre
AMIS	African Marine Information System
ARCESSTE-E	African Regional Centre for Space Science and Technology Education- in English
ARM	African Resource and Environmental Management
ARSIMEWA	Application of Remote Sensing for Integrated Management of Ecosystems and Water Resources
ASARECA	Association for Strengthening Agricultural Research in Eastern and Central Africa
AU	African Union
AUC	African Union Commission
AUC/ECO	
AUSTAT	
CAADP	Comprehensive Africa Agriculture Development Programme
CASTRE-LF	Centre Régional Africain des Sciences et Technologies de l'Espace en Langue Française
CBD	Convention on Biological Diversity
CBERS	China-Brazil Earth Resources Satellite
CGIAR	Consultative Group on International Agricultural Research
CICOS	Commission Internationale du Bassin Congo-Oubangui-Sanga
CIDA	Canadian International Development Agency
CILSS	Comité Inter-Etats de Lutte Contre la Sécheresse
CLIMDEV	Climate for Development in Africa
COMESA	Common Market for Eastern and Southern Africa
COMIFAC	Commission des Forêts d'Afrique Centrale
CR	Coarse Resolution
CSIR	Council for Scientific and Industrial Research (South Africa)
CSO	Civil Society Organisations
DCI	
DEWA	Division of Early Warning and Assessment
EC	European Commission
ECA	Economic Commission for Africa (United Nations)

ECCAS	Economic Community of Central African States
ECOWAS	Economic Community of West African States
EDF	European development Fund
EIS-AFRICA	Environmental Information Systems in Africa
EO	Earth Observation
ESA	European Space Agency
EU	European Union
EUMETCast	EUMETSAT's Broadcast Service for Environmental Data
EUMETSAT	European Organisation for the Exploitation of Meteorological Satellites
EUROSTAT	
FP	
GBIF	Global Biodiversity Information Facility
GCCA	Global Climate Change Alliance
GEO	Global Earth Observation
GEOSS	Global Earth Observation System of Systems
GMES	Global Monitoring for Environment and Security
GMFS	Global Monitoring for Food Security
GOOS Africa	Global Ocean Observing System
GSDIA	Global Data Infrastructure Association
ICPAC	IGAD Climate Prediction and Applications Centre
IGAD	Intergovernmental Authority on Development
INSPIRE	Infrastructure for Spatial Information in European Community
IOC	Indian Ocean Commission

JRC	Joint Research Centre
LANDSAT	Land Satellite
MAFA	Mapping Africa for Africa
MDGs	Millennium Development Goals
MSG	Metoosat Second Generation
NASA	National Space Agency
NEPAD	New Partnership for Africa Development
NESDA	Network for Environment and Sustainable Development in Africa
NGOs	Non-governmental Organizations
NMHSs	National Meteorological and Hydrological Services
NOAA	National Oceanic and Atmospheric Administration
ODINAFRICA	Ocean Data and Information Network in Africa
OFAC	Observatoire des Forêts d'Afrique Centrale
OSS	Observatoire du Sahara et du Sahel
PUMA	Préparation à l'Utilisation de Meteosat en Afrique
RCMRD	Regional Center for Mapping of Resources for Development
RECs	Regional Economic Communities
RECTAS	Regional Centre for Training in Aerospace Surveys
ROOFS AFRICA	Regional Ocean Observing and Forecasting System Africa
SAC	Satellite Application Centre (South Africa)

SADC	Southern Africa Development Community
SERVIR	Regional Visualisation and Monitoring System
SPOT	Satellite pour l'Observation de la Terre
UN	United Nations
UNCBD	United Nations Convention of Biological Diversity
UICN	Union Internationale pour la Conservation de la Nature
UNDP	United Nations Development Programme
UNECA	United Nations Economic Commission for Africa
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNCCD	United Nations Convention to Combat Desertification
UNFCCC	United Nations Framework Convention on Climate Change
UNOOSA	United Nations Office of Outer Space Affairs
USA	United States of America
USAID	United States Agency for International Development
VG4AFRICA	Vegetation for Africa
WB	World Bank
WFP	World Food Programme
WMO	World Meteorological Organization
WSSD	World Summit on Sustainable Development

Annex 2. – Policy Drivers

At Global level

The 2002 World Summit for Sustainable Development (WSSD)..

Organised in Johannesburg, the Summit called specifically the international community “to promote the development and wider use of earth observation technologies, including satellite remote sensing, global mapping and geographic information systems for environmental monitoring and natural resources management to support sustainable development of African countries. It is recommended that the NEPAD Environmental Action Plan be used as the framework for implementation of all its recommendations.

The G8 and other High Level Earth Observation International Summits.

The 29th G8 Summit held in Evian, France in June 2003 affirmed the importance of Earth Observations as a priority activity and recommended that a worldwide Summit be specifically on Earth Observations.

The First Earth Observation Summit was convened in Washington in July 2003. Attended by officials from 33 countries, the EC and 21 international organisations, the Summit adopted a declaration expressing a political commitment to move towards development of a comprehensive coordinated and sustained Global Earth Observation System of Systems (GEOSS) and established an *ad hoc* intergovernmental Group (GEO) tasked with the development of an initial 10 Year Implementation Plan for GEO. The Plan was discussed during the second Earth Observation Summit in Tokyo, Japan in 2004 and approved during the third Summit in Brussels in 2005.

GEOSS provides the overall conceptual and organizational framework towards integrated global Earth Observations to meet users needs at global level. GMES Africa could become one African contribution to the GEOSS.

The United Nations Declarations

The UN General Assembly adopted in 1990 the Resolution 45/72 recommending that UN lead, with the active support of its specialized agencies an international effort to establish regional centres for space science and technology education in developing countries.

At European Union Level

The European Union has committed itself to support development at global level through active international cooperation and support to programmes aimed at poverty alleviation, particularly supporting developing countries to attain the Millennium Development Goals. Key European policies and declarations that support the establishment of GMES Africa as a powerful tool for African socio-economic development include:

(i) The European Consensus on Development.

Formulated in 2005, the “European Consensus on Development” is a key policy statement that calls for a “European Policy Coherence for Development (PCD)”. It explicitly refers to supporting the achievement of the MDGs, sets out the EU vision of development and spells out EC and Member States common objectives for development cooperation. It identifies priorities to be reflected in cooperation programmes and states that reliable and continuous information on the state of environment and natural resources of Africa will help improve the effectiveness of European Development aid delivery and improve coherence between different policy domains underpinning development.

(ii) The Joint Africa-EU Strategy.

The Joint Africa-EU Strategy is another strong policy driver which will be implemented through successive Action Plans that identify short-term political priorities, policy commitments, programmes and actions to achieve them. The First Action Plan (2008-2010) has identified 8 specific "Africa-EU Partnerships" which include *inter alia* a Partnership on Science, Information Society and Space. GMES and Africa is an integral part of the 8th partnership.

(iii) European Space Policy (ESP)

The ESP was adopted following a EU Council resolution in May 2007. It addresses Space Applications such as Navigation (through Galileo) and Earth Observation through the Global Monitoring for Environment and Security initiative (GMES). On International cooperation, reference is made to the potential of space systems for sustainable development, in particular in Africa. The ESP acknowledges that actions and projects will be based on requirements laid down by African stakeholders and identified through the consultation process initiated Dec 2007 by the Lisbon Declaration on GMES and Africa, in particular through the Action Plan to be submitted to the next EU/AU Summit.

(iv) The EU Africa Declaration during the College to College meeting of October 1, 2008 in Brussels.

The EU and AU Commissions issued a statement that they agreed *inter alia* to implement the process launched in Lisbon on GMES and Africa and decided on early implementation of two projects under the space priority of Partnership no. 8. of the Joint Africa-EU Strategy. They include a project on Capacity Building of the AUC on geospatial sciences by implementing a "mirror" of the JRC's Africa Observatory so as to increase the use of scientific information by the AUC. The second project is the African Reference Frame (AFREF) aimed at setting up in each African Country a reference GPS receiving station to ensure harmonisation of basic maps via the establishment of a continental -wide highly accurate geodesic system.

(v) EU Commitment to international environmental treaties

The EU and Member States are Parties to many Multi-lateral Environmental Agreements (MEAs) including:

The UN Framework Convention on Climate Change (UNFCCC); the UN Convention to Combat Desertification (UNCCD); the UN Convention of Biological Diversity (UNCBD) and the UN Millennium Development Goals. Another important driver is the EU commitment to support the implementation of the recommendations from the 2002 WSSD. Its revised Strategy for Sustainable Development (SSD) integrates the outcomes and targets set by the WSSD including the target of protecting and managing the natural resource base with particular attention to Africa through the Cotonou Agreement and Support to NEPAD.

(vi) Other relevant EU policy drivers.

Other relevant EU policy drivers of GMES Africa are EC commitments, communications or regulations establishing Thematic Programmes funded by EC or articulating rationale for EC intervention in specific thematic areas. Programmes relevant to GMES Africa include (i) *the Thematic Strategy on Food Security* which gives details on priority areas for interventions for food security; (ii) *the Environmental and Natural Resources Thematic Programme* (ENRTP) which establishes a financing instrument for development cooperation in the areas of environment and natural resources management to meet their obligations under Multi-lateral Environmental Agreements and to take international policy leadership; (iii) *the EU Energy Initiative for Poverty Alleviation and Sustainable Development (EUEI)* which is a commitment to give priority to the role of energy in poverty alleviation ; (iv) *The EU Water Initiative (EUWI)*, a tool for meeting the international community's goals on water at global level in the context of an integrated approach to water resources management (v) *the EU Communication on Conflict Prevention* designed to address the root causes of conflicts and build sustainable peace and (vi) article 6 of *the EU*

Treaty that enshrine the EU long commitment to natural resources and environmental protection into EU legal obligations.

At African Level

Pursuing its vision of “ *an Integrated, Prosperous and Peaceful Africa Driven by its own Citizen; a Dynamic Force in the Global Arena*”, the African Union, the African Regional Economic Communities (RECs) and other Pan African wide institutions have formulated landmark policies and established institutions and programmes that are key drivers for the establishment of GMES and Africa.

(i) The NEPAD Science and Technology Consolidated Plan of Action

The New Partnership for Africa’s Development (NEPAD) was adopted by the African Union Summit in Lusaka, Zambia in 2001 as the major framework of endeavours to eradicate poverty on the continent and to place African countries, both individually and collectively, on a path of sustainable growth and development and, at the same time, to participate actively in the world economy.

Consistent with the 2003 Maputo AU Summit which instructed that the NEPAD structure be fully integrated into the structures of the African Union, NEPAD Secretariat and the African Union Commission for Human Resources, Science and Technology developed an Africa’s Science and Technology Consolidated Plan of Action articulated into five Programme Clusters including Programme Cluster 4 which is focusing at Infrastructure and Communication Technologies and Space Science and technologies. Programme 4.2. of Cluster 4 aims at establishing “**The African Institute of Space Science (AISS)**” which has been proposed since 2002 but has not yet materialized.

(ii) The NEPAD Environmental Action Plan

NEPAD developed an Environmental Action Plan to address Africa’s environmental challenges while at the same time combating poverty and promoting socio-economic development.

Endorsed by the AU Heads of States Summit in Maputo, Mozambique in 2003, the Plan provides a framework for the establishment of a strong partnership for the protection of the environment between Africa and its partners. It is organized into seven priority sectors and two cross-cutting issues including combating land degradation, drought and desertification, wetlands, invasive species, marine and coastal resources, cross-border conservation of natural resources, climate change, capacity building and technology transfer. The Plan is sub-divided into Regional Action Plans (RAPs) to be implemented by the Regional Economic Communities (RECs) i.e. ECOWAS, IGAD, COMESA, SADC, IOC, ECCAS.

(iii) The Dakar, Maputo and Lisbon Declarations

The African Union and the Regional Economic Communities in their Dakar (2002) and Maputo (2006) Declarations called upon Europe to provide funding for the “African Monitoring of the Environment for Sustainable Development – AMESD- ” project (Dakar) and to extend its GMES Europe Initiative to Africa (Maputo). The EU-AU 2007 Lisbon Declaration established mechanisms for the development of an Action Plan on GMES Africa to be submitted to the Africa-EU Heads of States Summit in 2010.

(iv) African Ministerial Conferences Declarations

The AU Ministerial Conference on Environment (AMCEN), the AU Ministerial Conference on Water (AMCOW) and the AU Ministerial Conference on Science and Technology (AMCOST) and the AU Ministerial Conference on Finance have identified space development as a priority area for their sectors strategy as indicated by various declarations. For instance, during their 12th Session in Johannesburg in June 2008, the AMCEN called upon Governments to take advantage of earth observation technologies to undertake regular national integrated environmental

assessments to strengthen the strategic positioning of the national environmental agencies and departments in national development planning processes.

Operating under the auspices of the African Council of Ministers of Finance, the United Nation Economic Commission for Africa (UNECA) has established a Geo-Information Division within its operational structure. The stated vision for Africa is “to ensure that special data permeates every aspect of society and that they are available to people who need them, when they need them and in a form that they can use to make decisions with minimal pre-processing”.

Annex 3 - Mapping Exercise

Existing institutions/projects	Objectives/activities	Implementers/membership	Supporting institutions/Partners	Coverage	Status
African Monitoring of the Environment for Sustainable Development (AMESD) project	Facilitating access to African-wide environmental information derived from EO technologies.	Project management unit at continental level; A Steering Committee at Continental level; regional coordination offices attached to the RECs; National focal points in all the 53 African countries	EU; AU; RECs; AMCEN.	Pan African	On going
Preparation for Use of Meteosat Second Generation in Africa (PUMA) project	Provision of meteorological and hydrological services to all African countries	National Meteorological and hydrological services of the 53 African countries	RECs: COMESA, ECOWAS, IGAD, SADC, ECCAS. EUMETSAT	Pan African	Completed (2001-2005)
Global Monitoring of Environment and Security (GMES) (see COM in annex)	Deliver Earth Observations-derived information on (1) Land monitoring(2) Marine environment (3) Emergency Response; (4) Atmosphere (5) Security; (6) Climate Change in support to EU policies, including International relations and development	EC; ESA; EUMETSAT; EU Agencies; EU Member States	EC; ESA; EUMETSAT; EU Agencies; EU Member States	Global, (including Africa) but with primary focus on Europe	Pre-operational ; Initial operations gradual as from 2011
Global Earth Observation System of Systems (GEOSS)	Provide the overall conceptual and organizational framework to build integrated global Earth Observations to meet users needs. System of systems consisting of existing and future Earth Observation systems.	National and international space agencies all over the World.	UN; EU; National and International Space Agencies of developed and developing countries.	Global	Under development
African Caribbean and Pacific (ACP) Observatory for Sustainable Development	To respond to the needs of the EC and ACP countries for data, maps and models in the areas of space based	JRC	EU; ACP countries	ACP countries	On going

	environmental monitoring and monitoring of Natural Resources.				
Tiger initiative	Provision of geo-information for integrated water management. Research and technology transfer projects	More than 200 experts from national water and basin authorities; universities and national technical centres; North-South joint projects.	ESA, AMCOW, Regional technical centres; UN organizations i.e. UNECA, UNESCO; AfDB	Pan African	Phase 2 on going
The Vegetation for Africa (VGT4Africa) Project	Setting up an operational and timely distribution system of vegetation data from SPOT satellites to African countries.	National institutions in African countries	EUMETSAT; EU; AU; SPOT Image	Pan African	Completed
Ocean Data and Information Network in Africa (ODINAFRICA)	Clearing house for coastal and ocean data and information	National institutions in 25 African countries with coastal areas	AU/NEPAD; UNESCO	Coastal areas of Africa	On going
Climate for Development in Africa (CLIMDEV AFRICA)	African Development Programme to integrate Climate Risk Management into pertinent policy and decision processes throughout the continent. Expected outcome is improved availability and use of climate information and services addressing needs of local, national and regional level decision makers in support of sustainable development in critical climate-sensitive sectors and areas of Africa.	Coordinated by UNECA and implemented by national Meteorological and Hydrological Institutions in all Africa member countries.	AU, UN (UNECA), EU.	All Africa	On going
Application of Remote Sensing for Integrated Management of Ecosystems and Water Resources (ARSIMEWA)	Education, training and research to promote the use of remote sensing , communication and information systems for integrated management of ecosystems and water resources	African Universities and specialized centres	UNESCO	Pan African	On going

Desert Watch project	Developing a decision support system based on EO technology to help some Western Europe Countries in reporting to the UNCCD Convention.	Implemented by national institutions in Italy, Turkey and by the ESA	ESA	Some Western Europe Countries	On going
African Marine Information System (AMIS)	Provide User communities with an appropriate set of bio-physical information to conduct water quality assessment and resource monitoring in the coastal and marine waters.	Implemented by JRC	EU, JRC	African coastal areas	On going
Global Monitoring for Food Security (GMFS)	Global network integrating Earth Observations and in-situ data collection for improved information on food security. Strengthen early warning systems.	Thirty users organizations and networks including FAO, WFP, JRC, AGRHYMET, RCMRD, SADC, etc.	ESA	Pan African	Ended in 2008
Observatory of Central Africa Forests	Regional platform for monitoring Central Africa forests.	National institutions in 10 central Africa countries under COMIFAC.	EC (JRC), FAO,	Central Africa	On going
Portuguese and Spain Satellite for Space Application for Africa: DEIMOS	High resolution satellite of the Portuguese and Spanish Governments providing high temporal resolution images for resource, environmental and disaster monitoring every two weeks in Africa. DEIMOS activities include data collection, processing and product development.	The Portuguese Government	Portuguese Government	Europe and Africa	On going
Global Biodiversity Information Facility	Is a global initiative to mobilize bio-diversity data to underpin sustainable development. Make the world's biodiversity data freely and universally available via internet.	Member countries all over the world. Managed by a governing board elected by member countries. Day to day activities carried out by a secretariat Located in Copenhagen,	Member countries governments	Global	On going

		Denmark			
BirdLife International, Africa Partnership projects	One of the most important project is Monitoring IBAS project, a global partnership for monitoring birds species and their habitats. Implemented by JRC, RSPS and RCMRD	More than 100 countries including 22 African countries	EC.	Pan African	On going
United Nations Economic Commission for Africa (UNECA) Geo-information Systems Section projects	The vision is to ensure that spatial data permeates every aspect of society in Africa and that they are made available to people who need them in a user friendly form for decision making. Is implementing three projects relevant to GMES Africa i.e. AFREF, MAFA and CODIST GEO	All African countries	AU; UN	Pan African	On going
Infrastructures for Spatial Information in European Community (INSPIRE)	Infrastructures for Spatial Information in the European Community to support environmental policies and activities which have an impact on the environment. Can be used as a model by GMES Africa	European Union	EC	European Union	On going
African Resource and Environmental Management (ARM)	Algeria, Kenya, Nigeria and South Africa partnership to launch and operate a constellation of low earth orbiting satellites. Provide a daily African imaging at high resolution. Can be one of the centres of excellence for GMES Africa	National Space Institutions of member governments	Member Governments	All Africa	On going
GEONETCast	Satellite receiving stations, based on the concept of EUMETCast system adopted by the GEO, transmitting data	All African countries	EUMETSAT, EU	All Africa	On going

	about diseases, drought, biodiversity, natural disasters, air and water quality, ocean conditions, ecosystems in near real time. South African ground stations are part of the GEONETCast value chain.				
Global Climate Change Alliance (GCCA)	Is an alliance on climate change between EU and developing countries to work jointly to integrate climate change into development cooperation and poverty reduction strategies. Potential framework for EU support to GMES activities	All African and EU countries	EU, AU	All Africa	On going
China Brazil Earth Resources Satellite (CBERS) for Africa	Partnership between China, Brazil, South Africa, Italy and Spain to develop and manage Earth Resources monitoring satellites. Distribute data to more than 20 countries. Plan to strengthen sustainable development and risk management throughout Africa.	National space agencies of participating countries	Member Governments	All Africa and European countries	<u>On going</u>
UNESCO-IOC Initiatives	UNESCO supporting implementation remote sensing based projects including Integrated Management of Ecosystems and Water Resources in Africa; GOOS Africa; AU/UNESCO High level Scientific and Technical Advisory Mechanism for Earth Observations and Geo-Information.	UNESCO and National Institutions participating in the projects.	UN; AU	African coastal countries	On going
OTHER UN	Besides UNESCO,	National, Regional	UN	Global	On going

AGENCIES	UNECA and WMO, other UN agencies such as UNEP (Division for Early Warning); FAO (Early Warning and Food Security projects) or the UN Office for Outer Space Affairs has established infrastructures for in-situ and EO observations for Early Warning, Environmental Monitoring or Capacity building for use of space science.	and International Institutions throughout the world, particularly in developing countries			
Regional Ocean Observing and Forecasting System (ROOFS) Africa project	Is a multi-modular approach for an integrated African ocean observing and forecasting and information delivery. Combine in situ observing stations and satellite based observations. Capacity building in participating countries. Modeling and forecasting. Is currently a component of the NEPAD Environmental Action Plan.	UNESCO and National institutions in 29 African coastal countries.	UN, AU (NEPAD)		
African Institute for Space Science (AISS)	Aimed at promoting and coordinating cross-cutting multidisciplinary research and applications in space science and technologies to address the development needs of Africa.	National space agencies and space related institutions in all African countries.	AU	All Africa	Still under discussion
World Meteorological Organization (WMO) African projects	The WMO has established a number of Global Observation Networks including the Global Climate Observing System; the Global Ocean Observing System;	National Meteorological and Hydrological Services (NMHSs) in all countries throughout the world.	UN	Global	On going

	the Global hydrological Observing System; the Global Weather Watch; the Global Aerosol Watch. WMO has also established communications systems in each country as well as product development and dissemination. Combination of <i>in situ</i> and Earth Observations.				
South Africa Earth Observation Strategy (SAEOS)	South African Earth Observation Strategy aimed at coordinating the collection, assimilation and dissemination of Earth Observation data for decision making, policy development to ensure economic growth and sustainable development. Provide a mechanism for the observing system to work together more effectively including systems at national, regional and global levels.	National Space Agency of South Africa	South Africa Government	Southern Africa	Strategy approved by the Government in 2003. On going
SERVIR	Is a visualization and monitoring system that integrate satellite and other geospatial data for improved scientific knowledge and decision making. Monitors and forecast ecological changes and severe events such as fires, floods, volcanoes, storms etc.	Implementing agencies include NASA, USAID, World Bank, the Water Centre for the Humid Tropics of Latin America and the Caribbean and the Central America Commission for Environment and Development (CCAD). Is developing a regional component for Africa named SERVIR Africa.	USA (NASA, USAID); World Bank; CCAD.	Global. Specific programme for Africa	On going
National Space Agencies in Africa	Well established space agencies with involvement in	National institutions or National Space Agencies (South	National Governments	National and regional coverage in	On going

	satellite launching and maintenance in South Africa, Nigeria, Kenya, Algeria. For instance; South Africa has established the Council for Science and Industrial Research (CSIR) which has the needed infrastructure for EO data acquisition, processing, archiving and analysis. Can be strengthened to become components of GMES Africa	Africa, Nigeria).		Africa	
Global Spatial Data Infrastructure Association	Is an inclusive organization of organizations, agencies, firms and individuals all over the world aimed at promoting international cooperation and collaboration in support of local, national and international spatial data infrastructure development that allow nations to better address social, economic and environmental issues of pressing importance.	Open to national, regional and international institutions, agencies and individual throughout the world.	National, Regional and International Organizations	Global network	On going

GMES AND AFRICA ACTION PLAN

Chapter on Infrastructure Framework

ACRONYMS

AARSE	African Association of Remote Sensing of Environment
AFREF	African Geodetic Reference Frame
AMESD	African Monitoring of the Environment for Sustainable Development
ARAPKE	African Regional Action Plan for Knowledge Economy
ARMC	African Resources Management Constellation
ASDI	Africa Spatial Data Infrastructure
AU	African Union
CBERS	China-Brazil Earth Resource Satellite
CEEPA	Centre for Environmental Economics and Policy in Africa
CEOS	Committee on Earth Observation Satellites
CSIR	Council for Science and Industrial Research
CSO	Civil Society Organization
EASSy	Eastern Africa Submarine Cable System
EIS	Environmental Information System
ESA	European Space Agency
EU	European Union
FAO	Food and Agriculture Organization
GEO	Group on Earth Observations
GLCN	Global Land cover Network
GMES	Global Monitoring for Environment and Security
GOOS	Global Ocean Observing System
GOSS	Global Earth Observation System of Systems
GSDI	Global Spatial Data Infrastructure
ICPAC	IGAD Climate Prediction and Application Centre
ICT	Information Communications Technology
IGAD	Intergovernmental Authority on Drought and Development
IT	Information Technology
IUCN	International Union for Conservation of Nature
MAfA	Mapping Africa for Africa
MDG	Millennium Development Goals
NASRDA	National Space Research & Development Agency
NGO	Non Governmental Organization
NICI	National Information Communication Infrastructure
NSDI	National Spatial Data Infrastructure
NUDC	Northern Uganda Data Centre
OECD	Organization for Economic Co-operation and Development
PUMA	Preparation for the Use of Meteosat Second Generation in Africa
RCMRD	Regional Centre of Mapping Resources for Development
REC	Regional Economic Community
RECTAS	Regional Centre for Training in Aerial Surveys
SADC	Southern African Development Community
SDI	Spatial Data Infrastructure
SPIDER	Space-Based Information for Disaster Management and Emergency Response
UNECA	United Nations Economic Commission for Africa
UNEP	United Nations Environment Programme
UNOOSA	United Nations Office for Outer Space Affairs
WFP	World Food Programme
WMO	World Meteorology Organization
WWF	World Wide Fund

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4. INTRODUCTION

4.1. Context

The advent of the GMES Africa Infrastructure depends on the availability of two main building blocks:

- the **observing infrastructure**: on one part the satellites and their on-board instruments, the ground segment to operate these satellites; on the other part all the in-situ equipments to collect data locally (meteorological station, hydrologic stations, sounder, buoys, airplane, etc...).
- the **“data management” infrastructure**, which is there to access, use, process and disseminate the information derived from the observing infrastructure. This infrastructure is closely linked to the advent of ICT infrastructure in Africa.

The emergence and convergence of information and communication technologies (ICT) remain at the centre of global, regional and national social and economic transformations. ICT infrastructure such satellite communication, internet and telecommunication networks, print and electronic media, libraries and archive centres, and the general ICT service providers have led to the development of global, regional and national information infrastructure networks. These provide the basic infrastructure for the implementation of the GMES Africa initiative. Most African countries have developed their National Information and Communications strategies that will facilitate the GMES infrastructure framework.

4.2. Constraints

Although efforts have been made to develop ICT infrastructure in form of policies and networks, this hardly addresses the infrastructure requirements to meet the data and information needs to support policy planning and decision making regarding provision of social services, environmental management and the associated monitoring and evaluation processes. Africa is characterized by high communication costs and low per capita internet access compared to Europe.

In order to support the planning and decision making process, there is need to develop appropriate data collection, processing and dissemination strategies that will provide reliable and timely data so as to make evidence based planning and decision making. The current state in most African countries can be summarised in the following context:

- Information exists but is not available for planning and decision making
- The available information is not accessible
- The accessible information is not usable or reliable
- The usable information is not shareable
- The shareable information is not timely or updated

The objectives of the Infrastructure framework of the GMES-Africa initiative is to improve availability, accessibility, usability and share-ability of data and information to guide the planning, coordination and monitoring as well as the decision making process.

4.3. Structure

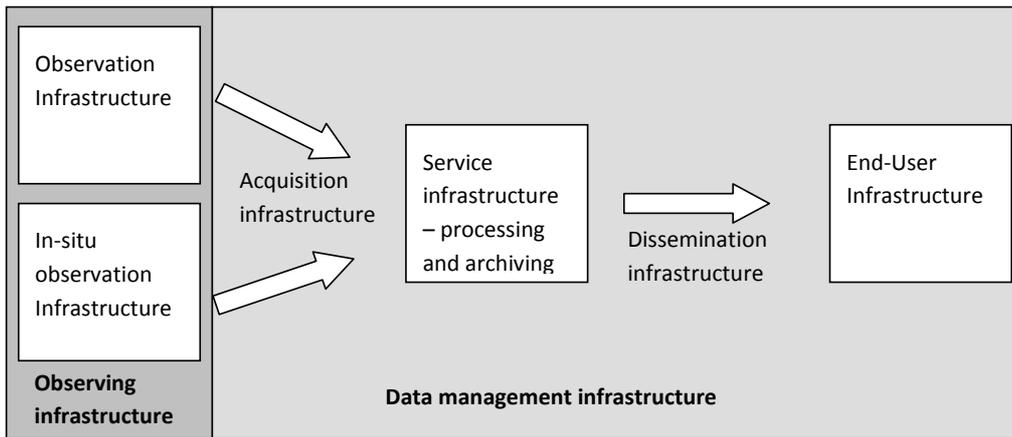
This chapter addresses the infrastructure framework to support the relevant thematic areas and is composed of five main components (one for the observation part and four components for the Data management part), namely;

- (i) **Observation infrastructure (satellite and in-situ);** this includes the Space Observation Infrastructure (ie satellites, ground segments, pre-processing centres) and the in-situ observation infrastructure necessary to exploit the space observations. More emphasis is put on the Space-based observation infrastructure in this chapter, in-situ contribution is explained in more details in the thematic chapter.
- (ii) **Data acquisition infrastructure;** this encompasses the infrastructure required to get access to the data provided by the “observing infrastructure” (satellite or in-situ instrument), either directly through appropriate ground “read-out” station, or indirectly through ICTs. Data acquisition can be done in “real time” or “off-line” (through access to archived data). Data acquisition infrastructure is very dependant of the volume/timeliness characteristics of the data to be acquired.
 - o Direct read-out from the satellite
 - o Real-time data acquisition (through the satellite operator)
 - o Off-line data acquisition (archive, web-based)
- (iii) **Service infrastructure (Data storage and processing);** this includes all necessary elements (hardware, software, processes, and support services to store and process the acquired data)
- (iv) **Data dissemination;** In order to ensure a good flow of data/information/products between the various components described below, there is a need to have good and reliable way to disseminate the data/products. This infrastructure is strongly linked to the ICT infrastructure.
- (v) **Data Utilization or end user infrastructure;** this includes decision support systems, data policies, procurement processes and other facilities. The end users need a certain infrastructure to be able to read, interpret and/or understand the product and its incorporated information. The “Data utilization” infrastructure is the necessary tools that an end-user need in order to benefit from the information provided by the service infrastructure through the data dissemination infrastructure. The complexity of this infrastructure can vary from simple text or image reader up to more sophisticated GIS layers.

Comment [S1]: What do you mean exactly?

The next sections are structured according to the five components.

The following graph schematises the information flow from the observation to the final user:



5. POLICY DRIVERS AND NEED ANALYSIS

5.1. Policies

The main **policies** related to the GMES Africa infrastructure are the followings.

Concerning the “**Observing**” part of the GMES Africa infrastructure, space data and products provide, by their very nature, an effective platform to address problems from a continental and regional perspective. The use of space

infrastructure presents considerable opportunities, and there is a need to establish institutional arrangements to enable Africa to take benefits of these opportunities.. Space-based systems can play a key enabling role in the attainment of Africa's sustainable development objectives and contribute to the monitoring of the environment and climate change.

Comment [S2]: Really unclear.

No relevant policy does exist at the moment in Africa at regional or continental level with respect to the space infrastructure. Two main trends can be however observed. On one hand several African nations have decided to build their own earth observation satellites; on the other hands Africans have concluded various type of agreement with worldwide space agencies and space operators to guarantee access to space data and products. These two elements are not contradictory, as in matter of Earth Observation, for most of the applications, the trends at international level is through cooperation (EU, USA, China, India) as none of the space power can afford fulfilling alone all its needs with its own satellite.

Therefore, for what concerns space infrastructure and access to space-based information, Africa should follow two parallel and complementary trends:

- Africa should organise itself to conclude agreement with worldwide Space operators to secure access to the data of the satellite covering Africa. This is particularly relevant for the GMES-European initiative. Africa should discuss with the EU a free data access policy of the GMES Data, based on the model established by EUMETSAT (all EUMETSAT data are available free of charge to African countries). This will secure Africa access to space-based information on the short-medium and longer term. However, this is highly depends upon the data policy decided by the space operators. Long term commitment for free data access (as with EUMETSAT) should serve as a model for GMES and Africa.
- The negotiated data-access with world-wide satellite operator should not prevent Africa in developing its own space infrastructure. This should be based on the work performed by the established space agencies in Africa (Nigeria, Egypt, Morocco, Algeria, South Africa, etc..). The Indian model for the development of space capabilities is a good inspiration for Africa. This model is user- application- based and as allowed India to develop relatively rapidly (15 years) space capabilities of direct usefulness for its citizens. It is however reminded that in the EO domain, international cooperation remains key to secure access to the sufficient level of space-based information..

The in-situ infrastructure is facing several constraints in Africa: the large size of the continent, problem of maintenance, availability of qualified human resources to operate and maintain, cost of the equipment, etc... therefore the deployment plan made in several user communities (meteo, oceano etc..) cannot be achieved or sustained on the longer term. Initiative such as CLIMDEV Africa, approved by the African Union, UNECA and the African Development Bank, are focusing on the in-situ infrastructure. This being said, there is a clear lack of policy with respect to in-situ infrastructure. It has to be notes that planning for in-situ infrastructure is particularly difficult due to the diversity of the necessary in-situ instrument, due to the large investment necessary and due to the different priorities in each country or regions. Referring to the European case, it is only through body such as the EUMETNet or the European Environmental Agency that such coordination of in-situ infrastructure (and related data exchange principle) have taken place.

Comment [S3]: Is relevant to section 4.2.

Comment [S4]: Is relevant to section 7.

Finally, the various *data policies* put in place by the satellite or in-situ operators or data providers is also important to consider. These policies can have an important impact on the possibilities to sustainably use some data and products delivered by space infrastructure operators or other in-situ data providers.

Concerning the **data management** part of the infrastructure, all policies related to ICT and to Geoinformation are relevant to the GMES Infrastructure. *The NEPAD* has identified ICT infrastructure as a key element for the development of Africa (see annex on NEPAD).

The Millennium Development Goals (MDGs): The MDGs identify information and communication technologies (ICTs) as key enablers for poverty reduction and growth. Although ICTs are multi-sectoral tools for socioeconomic development, a dedicated coherent strategy needs to be implemented in order to develop an inclusive information society in Africa. Adopted at the United Nations Millennium Summit in 2000, the attainment of the MDGs by African countries will require reorientation of development policies and programmes to focus on long-term sources of economic change and growth. The role that science and technology play in the attainment of the MDGs is implicit in the Millennium Declaration adopted by the Heads of States. It is on these principles, and in the context of the World Summit on Information Society, that the African Regional Action Plan for Knowledge Economy (ARAPKE), an AU initiative, was developed.

Africa - EU Joint Strategy: The Strategic partnership on Sciences, Information Society and Space. This strategy for Africa is to give the EU and Africa a comprehensive, integrated and long-term framework for their cooperation. The activities undertaken under the 8th partnership action on Science, Information Society and Space, can clearly

contribute to the GMES Africa Infrastructure. Indeed, ICT initiatives under the "Information Society" would definitively contribute to various component of the GMES Africa Infrastructure. Similarly, cooperation on Space technologies could also re-inforce on the longer term the GMES Africa "Observation Part" of the GMES Africa Infrastructure. The GMES and Africa initiative is part of the same strategic partnership.

Comment [S5]: More relevant to Section 7?

Bridging the digital and scientific divide within African countries and between Africa and other regions, as well as fostering cooperation on space applications and technology to support Africa's sustainable development objective underlie the Africa-EU Partnership on Science, Information Society and Space. Africa-EU Strategic Partnership Agreement 8th Priority Action on "Science, Information Society and Space (AUC-EU Book of Projects) identifies GMES and Africa as one of the projects to enhance AU-EU cooperation on Space Applications and Technology. GMSE aims to further bring satellite based technologies to the benefit of specific African development objectives. This was identified at the 2007 Lisbon summit between AU and EU stakeholders

5.2 Needs

In terms of "needs" for infrastructure, the analysis is structured following the five main infrastructure components described in the Introduction.

i. **Observation infrastructure** : The European GMES programme is considering observation from both in-situ and space segment to provide services. For the purpose of the GMES Africa Action plan, infrastructure chapter, a specific emphasis is put on the space segment, with respect to the "in-situ" part, for the following reasons:

- Satellite technologies are seen to be very appropriate to monitor a large continent such as Africa.
- in-situ observing infrastructure is currently poorly deployed in Africa, for various reasons. Including in-situ infrastructure would be the topic of a very specific action plan as its deployment would necessitate a specific programme in itself.
- GMES Africa initiative is part of the "Space" part of the Africa-EU Strategic Partnership #8. Thus, it is also expected that the GMES Africa initiative support EU-Africa cooperation on Space.

Comment [S6]: Relevant to the Needs?

Nevertheless the necessity of a performing in-situ observation infrastructure shall not be underestimated as it would allow providing complete and accurate information on the environment too. The in-situ infrastructure is also necessary to allow optimal use of space infrastructure (for calibration and validation purposes mainly).

In terms of need analysis for space based data and products, inputs are expected from the various thematic areas. Trade-off have to be made between the space and in-situ infrastructure in order to comply with the expressed needs. Due consideration of the existing space infrastructure, to the existing African earth observation missions and to existing commitments from space operators to provide space data and products on the long term shall be made. GMES Africa is a unique opportunity to address the various data providers with consolidated request to have the possibility to access their data. This could trigger change in some restrictive data policy or reduction of cost to acquire (i.e. buy) use licenses for the required data.

Comment [S7]: Relevant?

ii. **Data acquisition and access**: This infrastructure is key to allow the various user communities to get access to the space data and products needed for their applications and services. To the needs expressed by the various user communities in terms of access to the data (timeliness, volume) appropriate technologies have to be used (direct read-out, real-time access through Satellite communication or internet, off-line access to archive). The GMES Africa initiative is a unique opportunity to collect the needs from the various communities in terms of data acquisition in order

- to share existing data acquisition infrastructure
- to create synergies and favour creation of regional or national network for data sharing
- to avoid duplication and extra-cost in developing sometime costly infrastructure (e.g. direct read-out).

iii. **Data storage and processing**: Data processing is at the heart of the GMES Africa initiative: strengthening capacities in Africa for the processing of earth observation data in view of creating products and services pertinent for the African continent is one of the main objectives of the GMES Africa. Thus the need for an appropriate infrastructure for the processing of these data is key (existence of processing facility). Once again, the needs shall be expressed by the various user communities through the thematic areas.

iv. **Data dissemination**: This infrastructure is key to secure a good flow of information between the various components of the GMES Africa infrastructure. It is very linked to the advent of ICT infrastructure in Africa (web, internet)

- v. **Data utilisation:** As defined previously, this infrastructure is the one to be put in place at the end-user location. The needs for this kind of infrastructure can be very variable depending of the application, thematic area and type of end users (from scientists to decision maker). It is therefore expected that the various thematic area will also consider the necessary data utilization infrastructure to be put in place at the end-users level for an adequate use of the information

In view of the volume of data generated and used in the GMES Africa framework, it could be also appropriate to use dedicated data dissemination infrastructure, based on existing ones (e.g. GEONETCast, GTS).

6. IDENTIFICATION OF COMMUNITIES

The communities are also identified following the five main components of a “GMES Africa” infrastructure.

- i. **Observation infrastructure:** The CEOS, which is working in close cooperation with GEO is certainly the most appropriate framework to discuss space infrastructure issues. The CEOS group includes most of the space agencies and space operators involved in Earth Observation, including the African ones (e.g. Nigeria, South Africa). Huge efforts have been already made by CEOS members to make links between “user needs” and “space technologies” that could answer these needs for numerous thematic areas. Additionally CEOS maintain a database of space mission/instruments, which would be very relevant when addressing more concretely the need for space data expressed by the various thematic areas. For the in-situ infrastructure, some in-situ instruments operators are already organised into communities (e.g National Meteorological Services, Oceanographic Institutes...)
- ii. **Data acquisition and access:** In terms of data acquisition (real-time and offline), generally user community can be created around the technology, which is used, as they will share common issues and exchange good practices. For example, the African users of GEONETCast would face similar issues when using their reception stations. Thus, independently to the thematic area, GEONETCast users would benefit having a structured user community to address relevant questions. The same could apply for GEO-portal users, or users of a specific satellites or instruments,
- iii. **Data storage and processing:** Capacities for Earth Observation data processing exist in Africa. Several centres in various part of Africa do process everyday satellite data. The AARSE is certainly the largest existing platform involving most of the African Earth Observation **processing entities** (scientist, private user, public institutions, etc). User communities also exist in the various thematic areas. For example, the meteorological community, which is using satellite data in an operational way, is well structured and meets on a regular basis under WMO or EUMETSAT symposium and forum. As a generic “good practice”, data storage is organised by the data provider (not the user) to avoid duplication of work. The data provider should then obviously also organised the access to its archive in a user-friendly way.
- iv. **Data dissemination:** Under this infrastructure element, the user community cannot be defined as such. Strong link with the more generic “ICT” community should however be maintained and strengthened in order to ensure that the requirements coming from GMES Africa in terms of ICT are duly considered when development an African ICT infrastructure. Processing entities and final users are two user communities interested directly by the data dissemination infrastructure.
- v. **Data utilization:** The number of end-users of earth observation satellite is potentially so huge and from different background that it won't be efficient to address all of them through a single channel (apart for generic information, c.f. the very useful; and pertinent EIS newsletter). However, it should be the responsibility of the data provider to maintain close link with their users in order to train them, to keep them informed on the latest development and, obviously, to collect their needs and feedback on existing products and services.

The GMES and Africa Infrastructure communities fall in the following class categories; **Users, Producers and Disseminators**

Table 1: Identification of Communities

Component	Community
Observing Infrastructure	For the space observing infrastructure: CEOS members and more particularly European and African Space Agencies..

Comment [S8]: Why you mention this, as this is not used later?

Comment [S9]: Table needs to be coherent with the text above

	For the in-situ observing infrastructure: African operator of in-situ measurement system (e.g National Meteorological Services, Oceanographic Centre, etc...)
Data Acquisition and Access	For the direct read-out infrastructure The same user community as the observing infrastructure. For the real-time and for the off-line access to data, the same user community as for the "Service Infrastructure"
Service infrastructure "Data Storage and Processing"	Regional centres (ICPAC, RCMRD, AGHRYMET, SADC, RECTAS, etc...), Global, Continental, Regional and National Meteorological services, Private sector, both national and international, as a key supplier of investment, finance and technical services; Earth Observation Laboratories in Universities and Research Institutes. Government ministries, private sector as well as productive and service sectors;
Data Dissemination	The telecommunications sector with vital interest in sectoral policy reform, investment and services. Continental initiatives such as, SDI-Africa, ,
Data Utilization	Decision makers: EU and AU Commissions and the associated RECs, International and regional institutions involved in supporting NICI policy making process, Independent regulatory bodies as implementers of policy directives and responsible for managing regulatory system; Continental initiatives such as, SDI-Africa, CEEPA, National Spatial Data Infrastructure (NSDI) Networks, CEEPA: Centre for Environmental Economics and Policy in Africa, Scientists, IT personnel and other professional bodies as providers of input on the technological, scientific and human-resource implications and requirements of NICI, Academic, training, research institutes and universities, Professional Associations, National Spatial Data Infrastructure (NSDI) Networks, Centre for Environmental Economics and Policy in Africa, International and multilateral agencies such as World Bank, OECD, UN Agencies, WMO GCOS, FAO, WFP, IUCN, WWF) Planners, Decision Makers, Resource Managers and Environmentalists, Implementers of International Conventions and Agreements. The telecommunications sector with vital interest in sectoral policy reform, investment and services, Civil Society Organizations (CSOs), Governmental and Non-Governmental Organizations All users communities identified in the thematic chapter of the GMES-Africa Action Plan.

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7. MAPPING EXERCISE

The Mapping exercise has been conducted following the five main components presented above.

- i. **Space" infrastructure (or "observing infrastructure"):** CEOS has performed a complete mapping exercise of existing and planned space earth observation mission. The GMES Africa should build on this mapping. A database has been created and is regularly updated (c.f CEOS website).
- ii. **Data acquisition and access:** Several infrastructures already exist in Africa for data acquisition and access. For "direct read-out" infrastructure is existing. Part of this infrastructure has been installed by the African national space agencies for collecting data from their own satellite. Another part of this infrastructure has been installed by non-African entities to collect data from their own satellite (e.g. Malindi station).

Some "advanced" users have also installed direct read-out station to get access "instantaneously" to some earth observation data relevant for their region. Recently, South Africa installed a direct read-out station for the CBERS satellites, permitting the southern part of Africa to take benefit from the Brazilian and Chinese free of charge data policy for the CBERS data.

For real-time data acquisition, dedicated telecommunication system has been put in place in the recent years to facilitate quasi real-time access to some data. For example more than 100 users have now direct and real-time access to various earth observation data through the GEONETCast initiative. The African component of GEONETCast is actually the EUMETCast Africa system, which is now widely used in Africa for accessing earth observation data. The PUMA initiative: initiated at the request of five African RECs in 2000 and funded by the EU (EUR 11 million), has ensured the access to information on the environment and satellite data to all 53 African countries for early warning of natural disasters, improved food security, better health management, more efficient water and energy use, while strengthening environmental monitoring. The Commission has provided technical support (50 receiving stations) and capacity-building (training of a critical mass of 350 African professionals).

PUMA, successfully completed in September 2005, is the precursor of the African monitoring of the environment for sustainable development (AMESD) initiative requested by the same RECs, coordinated by the AU, in its 2002 Dakar declaration. AMESD will allow all African stakeholders to improve the management of their environment through a more efficient use of remote sensing and ICT data and information. AMESD will also be the African interface of the European GMES initiative. Regarding the "off-line" data access, a mapping exercise would be very difficult to conduct, as through normal internet access or through the mailing of IT support (CD-ROM, DVD, tape), earth observation data are regularly accessed in Africa for various usage and purposes.

ESA has also installed through the TIGER initiative real-time data acquisition equipment (IDDS stations) for accessing ENVISAT Data.

Concerning the off-line data acquisition, lot of African institutions are accessing through internet, earth observation data through the various "Data portal" put in place by various entities

- iii. **Data storage and processing:** As expressed in the previous paragraph, several African centres process currently earth observation data. The list of AARSE members provides a good overview of these entities. These institutions are using commercial SW, or SW developed by partners or by themselves.
- iv. **Data utilization:** The mapping of the infrastructure deployed at user level would be a too cumbersome exercise and would not contribute to the GMES Africa action plan. However, it has to be noted that the GMES Africa action plan shall fully take into account the necessity to ensure that an appropriate infrastructure is put in place at the end-user level. The infrastructure can be relatively simple (e.g PC with visualisation tool) or sophisticated (e.g. GIS).
- v. **Data dissemination:** Mapping the data dissemination infrastructure would be a too cumbersome exercise and would not contribute to the GMES Africa action plan. Several mapping have been done in the past (notably through CODIST) of ICT infrastructure that could be relevant for GMES Africa. The GEONETCast being a flexible system, it can also be used for data and product dissemination. Several EO products developed by African entities and made available to their user community through GEONETCast.

8. IDENTIFICATION OF GAPS AND OF EXISTING OR PLANNED FUNDING PROGRAMMES

Africa utilizes remote sensing technology less than any other continent, despite the important coverage of Africa by various satellite. The private-based promotion of remote sensing data, equipment and software, is thus, non-lucrative on the continent. Most of the commercial distributors of satellite images in Africa operate as representatives of a number of American and European companies, e.g. ERDAS Inc., Environmental Systems Research Institute (ESRI), European Image Company (EURIMAGE). Direct access from the African users to the data providers is sometimes difficult when it comes to commercial data.

Comment [S10]: What do you mean exactly?

Comment [S11]: What is the message of this sentence, why are you saying this?

- i. **Space infrastructure (satellite and associated ground segment):** Developing and operating an Observation Infrastructure (space based) is obviously technologically sophisticated and expensive. The most complex component is engineering design, construction and launching of satellites. This is currently feasible, only in technologically advanced economies, e.g. USA (NOAA), Europe (European Space Agency), Canada (Canadian Space Agency), Japan (Japanese Earth Resources Satellite), India, China, Russia, etc. A few African nations have developed their own Earth Observation missions (Nigeria, Algeria, Egypt,). The GMES

and Africa initiative will require the following categories of space-based observations based on the thematic areas:

- Low resolution satellites: These give regular (daily to several times per day) coverage. The data are useful for large-area, regular coverage needs, including sea surface temperature monitoring, regional vegetation vigour and drought studies. The satellites include; NOAA/AVHRR, MODIS TERRA, MODIS AQUA, SAR, and Envisat/MERIS, and EUMETSAT among others.
- Medium-resolution satellites: These give weekly to monthly coverage. The data have spatial resolutions from 10 to 30 m and relatively large areas are covered by each satellite overpass. These data are suitable for a variety of information uses involving mapping, monitoring, and detection of land cover and land use features at scales from 1:50 000 to 1:250 000. Examples include: Landsat TM, SPOT5,
- High-resolution satellites: These collect images over a particular area every 1–3 days. Spatial resolutions are typically between 1 and 4m and the swath widths are between 8 and 15 km.
- Very high-resolution satellites: These have a less than 1m multi-spectral resolution, ideal for large scale, highly dynamic and where high accuracy data is required; examples include; IKONOS, Quickbird, GeoEye-1, WorldView-1 and WorldView-2 among others

A gap analysis shall be conducted on the basis of the needs expressed by the various thematic area. The catalogue built by the CEOS would be the most appropriate tool to conduct this gap analysis.

- ii. **Data Acquisition and Access:** The majority of African countries are characterized by poor quality of data collection and management practices, lack of adequate data infrastructure and skilled human capacity in natural resource and environmental management which are root causes of under-development in Africa. There is need for Africa to invest in resource information and mapping, which requires commitment towards capacity building and knowledge transfer, joint participation and international cooperation. Africa needs well developed data acquisition and access infrastructure which include; hardware, software, data sources, skilled human resource, supportive access policies and legislation, coordination framework, acquisition methods, storage and dissemination mechanisms. Satellite images are available in Africa via the following main ways:

- Direct transmission through receiving stations (e.g. GEONETCast)
- Commercially packaged pre-processed CD-ROMs.
- Free packages arising from collaborative and joint-research projects with bi- and/or multi-national agencies.
- Free access to images displayed on the Internet (i.e. public domain output).
- Subscriptions to internet based tools such as Google Earth

At present, pre-processed images can be obtained via satellite receiving stations in only a few African countries e.g. Tunisia, Nigeria, Egypt, Gabon and South Africa. Even though sufficient remote sensing expertise and infrastructure is perceived in the region, no clearly defined networking or database exists. Both space and in-situ observations play a fundamental role in availing most of the data acquisition tools. Data acquisition from both space and in-situ observations will depend on the thematic area for which the data is required, the size and scale of the area to be covered, the level of detail and the feature dynamics.

Concerning the gap:

- for direct read-out access, no specific gap have been identified, however in case of need of more direct readout access, this should be discussed together with the satellite operator.
- for the "real-time" access, more GEONETCast station should be installed to ease the direct access to earth observation data and avoid unreliable internet access to earth observation data.
- for the off-line access, the gap lies clearly in the lack of good and high-speed internet connection in Africa.

- iii. **Data processing and archiving infrastructure:** A lot of organizations and institutions are involved in processing both EO and in-situ data. However, there is a general lack of data processing and archiving infrastructure which includes;

- Hardware
- Software
- Libraries and Registries
- Clearinghouse
- Archiving

Current status: not automated archiving system, very scattered and sparse, Data is disjointed, incomplete and out of date.

- iv. **Data dissemination infrastructure:** The GMES Africa infrastructure is highly connected with ICT infrastructure. Thus all existing and known gaps in ICT technology deployment in Africa do affect GMES Africa also. As indicated previously, there is a strong need for GMES Africa to work closely with the ICT community and express the GMES Africa needs in terms of ICT. ECA Science and Technology Network (ECA ESTNET); is a collaborative policy research network promoting the dissemination and exchange of information related to science and technology management and policy issues in Africa.
- v. **Data Utilization Infrastructure:** The identified gaps in terms of end-user infrastructure for the use of earth observation information are closely linked to the existing gap or shortcoming in the Spatial Data Infrastructure (policy driver), Numerous discussion about the SDI initiative in the continent are currently on-going (e.g. through UNECA) and GMES Africa shall build strong link with the SDI actors. Key elements that are addressed in the SDI are:
 - Data Sharing Principle – data policy
 - Standardization
 - Meta-data
 - Core data set (also relevant for in-situ)

This is very close to the INSPIRE directive that is currently being implemented in Europe. GMES Africa would certainly benefit of an “inspire-like” initiative in the African continent. The advent of a sound SDI Infrastructure in Africa would allow GMES Africa would allow a coherent use of EO data products. In turn GMES Africa would strongly contribute in providing very useful information that will “feed” the SDI.

8.1 GAPS

Table 2: Existing Gaps in the Infrastructure Framework

Component	Existing Gaps
Space Infrastructure	Space strategy at African level. Availability of low cost but high resolution satellites, African space technology policy, Research in space technology, and trained African expertise in space science
Data Acquisition and Access	Communication facilities such as internet connectivity, GEONETCast stations, One Stop Information Centres at continental, regional, national and local levels and Institutional capacity to acquire and process data
Data Storage and Processing	Data storage facilities such as servers and data processing capacity (software, skills and hardware)
Data Utilization	Core datasets at continental, regional, national and local levels, Compatible and interoperable systems
Data Dissemination	Lack of a clearinghouse, Data dissemination policies and strategies, Dissemination networks. Affordable high speed bandwidth for internet access

8.2 EXISTING OR PLANNED THEMATIC FUNDING PROGRAMMES

Table 3: Existing or Planned Thematic Funding Programmes

Component	Planned Thematic Funding Programmes
Space Infrastructure	Chinese-Brazilian Earth Resources Satellite; High resolution African Resources Management Constellation (ARMC) satellite, a joint satellite program proposed by South Africa and supported by Nigeria, Algeria and Kenya; SumbandilaSat by South Africa
Data Acquisition and Access	AMESD, EASSy, COMTEL, SRII, ICT Broadband Network for Central, West and Northern Africa, GeonetCast and EumetCast,, AFREF, Establishing

	connection between all African countries and to the rest of the world through submarine cable systems.
Data Storage and Processing	AMSED, MDG Mapper by UNECA, TIGER, FP7 projects, AMMA, EAWACS.
Data Utilization	African Information Society Initiative (AISI), AMESD Forum, EUMETSAT Forum
Data Dissemination	Completion of an optic fibre ring around Africa, Bi-annual AfricaGIS events coordinated by EIS-Africa, GeonetCast and EumetCast, MDG Mapper

9. BUILDING GMES – AFRICA SERVICE

The GMES and Africa building process involves: definition and provision of services, capacity building, prioritization of requirements and actions, organizational issues, scheduling of actions and developing a costed plan of the action. This process is described in the sections below.

9.1 SERVICE DEFINITION AND PROVISION

The GMES and Africa initiative will require the following services:

- Provision of data acquisition tools such as satellites receiving stations, high accuracy global positioning systems (GPS), high to low resolution satellite imagery in raw and processed forms
- Technical assistance to build national and local capacities in the data collection, processing, analysis and dissemination.
- Backstopping services in provision of hardware and software
- Development of ICT infrastructure
- Development of update continental, regional and national level datasets
- Provision of consultancy services to develop the requisite GMES-Africa infrastructure
- Development of appropriate and enabling policy framework for data acquisition, access and dissemination at continental, regional, national and local levels
- Training of Trainers in the relevant thematic areas.

These services could be provided by both institutions that have the required capacity to deliver them, at local, national and international levels. Target groups include;

- Government ministries as well as productive and service sectors;
- Private sector, both national and international, as a key supplier of investment, finance and technical services these include space agencies and software vendors
- Independent regulatory bodies as implementers of policy directives and responsible for managing regulatory system;
- The telecommunications sector with vital interest in sectoral policy reform, investment and services;
- Non-Governmental Organizations (NGO) with increasing role as providers of services in society;
- Scientists, IT personnel and other professional bodies as providers of input on the technological, scientific and human-resource implications and requirements of the GMES and Africa infrastructure
- International and regional institutions involved in the development policy making process.

9.2 CAPACITY BUILDING

Capacity development is a key ingredient to the GMES and Africa initiative; capacity development initiatives should target regional, national and local as well as individual capacity.

9.2a Necessary Elements

The GMES and Africa capacity building initiative should be anchored on the following elements;

- Articulation and prioritization of information needs by the users for policy and evidence based planning and decision making;
- Data Collection methodologies and techniques for both space and in-situ data
- Processing, analysis and interpretation of EO and In-situ data, i.e. conversion of raw data into usable information that will inform policy makers and provide policy guidance to the management of resources and development issues
- Data exchange and dissemination systems such as web and internet applications, customized systems such as GEONETCast and Google applications.

9.2b Strategy to implement the GMES and Africa Capacity Building Elements

The strategy to implement the GMES and Africa capacity building have been summarised in table 4.

Table 4: Strategy to Implement the GMES and Africa Capacity Building Elements

Element	Implementation Strategy
<ul style="list-style-type: none"> • Articulation and prioritization of information needs by the users for policy and evidence based planning and decision making; 	<ul style="list-style-type: none"> • Customised and tailored end user training courses in form of workshops, seminars, and focussed group discussions
<ul style="list-style-type: none"> • Data Collection methodologies and techniques for both space and in-situ data 	<ul style="list-style-type: none"> • Standardisation and harmonisation of thematic data collection techniques and methodologies • Specialised training on data collection methods and techniques.
<ul style="list-style-type: none"> • Processing, analysis and interpretation of EO and In-situ data, i.e. conversion of raw data into usable information that will inform policy makers and provide policy guidance to the management of resources and development issues 	<ul style="list-style-type: none"> • Provision of EO and in-situ data collection, processing and dissemination equipment such as computers, satellite receiving stations, internet access and other data dissemination platforms, library and archiving materials. • Enhancement of the capacity of the existing regional centres, national training institutions and universities with relevant skills in the field of remote sensing and GIS. • Establishment of a One-Stop National Information Centre.
<ul style="list-style-type: none"> • Data exchange and dissemination systems such as web and internet applications, customized systems such as GEONETCast and Google applications. 	<ul style="list-style-type: none"> • Development of state owned Spatial Data Infrastructures (NSDIs) • Enhancement of the National Communication infrastructures • Establishment of data and information user networks based on a GMES and Africa Domain.

9.3 PRIORITIZATION OF REQUIRED ACTIONS

The following prioritized infrastructure framework actions are required for the successful implementation of the GMES and Africa initiative;

- (i) Resource mobilization; this includes financial, institutional, legal and technical
- (ii) Stakeholder and user Needs Assessment to indentify the role and needs of each stakeholder in the GMES and Africa initiative
- (iii) Developing a checklist of the infrastructural requirements for the implementation of the GMES and Africa initiative in terms of actions, available data, hardware and software, methods, skills and capacities, policies and legislative frameworks.
- (iv) Inventory of the existing infrastructure and initiatives.
- (v) Detailed analysis of the inventoried infrastructure and gap identification
- (vi) Sensitization and Awareness creation on the GMES and Africa initiative i.e. the objectives, action plans, relationship with on-going initiatives as well as the anticipated benefits
- (vii) Assembling the core/fundamental datasets to meet the objectives of GMES and Africa
- (viii) Assembling the necessary infrastructure
- (ix) Implementation of the GMES and Africa initiative.

9.4 ORGANIZATIONAL SCHEME

The GMES and Africa infrastructure framework will require both EU and AU to contribute the best they can in terms of broad and balanced participation. The Organizational scheme of the GMES and Africa initiative should involve

engagement of a few stakeholder institutions and organizations to start with and more be included as the initiative gains momentum. The organizational structure should be flexible and open to all data producers, users and service providers. For the GMES and Africa initiative to be effective there should be a policy and organizational framework on which the infrastructure should operate. There should be a body or secretariat to coordinate all activities required to develop and maintain the GMES and Africa initiative. The established body or secretariat has the obligation to disseminate information about available infrastructure to all GMES and Africa stakeholders.

Participating institutions should develop a policy framework through which they can access data and adopt a free exchange of data and information. This will require high-level support at continental, RECs, Member States as well as Ministries, Departments and Agencies at national level . The policy should include the following among others;

- Institutional cooperation that provides mechanisms for sharing experience, technology transfer and coordination of the development of the fundamental datasets;
- Use of common technical standards, so that data from numerous databases can be integrated.
- Adoption of common policies on data access, privacy and custodianship.
- Implementation of agreements on utilizations of the GMES and Africa infrastructure
- Documentation of data collected or produced, either directly or indirectly, using an agreed set of standards
- Maintaining and updating the core datasets as per agreed updating frequency

9.5 TIMETABLE

Owing to the pre-implementation uncertainties, it is most unlikely that the GMES and Africa initiative will start in a less than three year period. The timetable drawn assumes that the actual implementation is envisaged to start in year 3, before which a number of preparatory activities have to be made and are listed below:

Year 1: Resource mobilization; (financial, institutional, legal and technical), developing a checklist of the infrastructural requirements for the implementation of the GMES and Africa initiative and assembling the core/fundamental datasets to meet the objectives of GMES and Africa

Year 2: Continued resource mobilization, Stakeholder and user Needs Assessment to identify the role and needs of each stakeholder in the GMES and Africa initiative, Continued development of the GMES and Africa checklist of the infrastructural requirements, Inventory of the existing infrastructure and initiatives., Detailed analysis of the inventoried infrastructure and gap identification, Sensitization and Awareness creation on the GMES and Africa initiative and Continued assembling the necessary infrastructure

Year 3: Implementation of the GMES and Africa initiative and finalization of year 2 spill over activities

9.6 INDICATIVE DEVELOPMENT PLAN AND BUDGET ESTIMATE

- Resource mobilization; this includes financial, institutional, legal and technical = **€1.5mill.**
- Stakeholder and user Needs Assessment = **€0.8mill.**
- Developing a checklist of the infrastructural requirements for the implementation of the GMES and Africa initiative **€0.5mill.**
- Inventory of the existing infrastructure and initiatives. = **€1.5mill.**
- Detailed analysis of the inventoried infrastructure and gap identification = **€1.5mill.**
- Sensitization and Awareness creation on the GMES and Africa initiative. = **€3.8mill.**
- Assembling the core/fundamental datasets to meet the objectives of GMES and Africa = **€3.0mill.**
- Assembling the necessary infrastructure = **€3.0mill.**
- Implementation of the GMES and Africa initiative = **12.0mill.**

TOTAL (MILL.EURO) = 27.6mill.

10. RECOMMENDATIONS

The following are key recommendations for the GMES and Africa Infrastructure framework;

- Provision of Earth Observation data and development of services should build upon initiatives such as TIGER, PUMA, AMESD, and African Observatory among others
- GMES and Africa should strengthen the ARMC initiative to enhance the African regionally owned space infrastructure acquire and distribute space data to the RECs, this should be supplemented by the EU data acquisition infrastructure to cover the existing gaps.

- The GMES and Africa initiative should promote the implementation of National, Regional and Continental Spatial Data Infrastructures.
- Data and infrastructure Needs Assessment should be undertaken in all the thematic areas in the GMES initiative so that acquisition is based on the identified needs. This assessment should include; the type of data required, by whom, when and for what purpose.
- An inventory of the existing infrastructure and data holding among the stakeholder organizations should be conducted to assess the status of the existing infrastructure and data to guide the identification of the supply side of the data and infrastructure available to support the GMES and Africa initiative, and an analysis of the existing data access policies should be undertaken so as to harmonize and standardize the data acquisition procedures.
- Encourage private public partnerships in the development of GMES and Africa infrastructure
- Establish shared international gateways
- GMES and Africa should aim at lowering the cost of bandwidth to increase internet access for ease of disseminating data among the stakeholders
- The GMES and Africa initiative needs to engage both users and producers of information and technologies in identification of information gaps and how to access and share information and sharing experiences, this may be done through sensitization and awareness such as workshops, seminars and user conferences at continental, regional and national levels.
- GMES and Africa Action Plan should be mainstreamed within the member state national development strategies of development plans.
- The development and deployment of technology will be fundamental to addressing long-term GMES challenges and for achieving sustainable development. The GMES and Africa innovation requires durable, long-term support.
- There is a need to increase efforts to stimulate research and development into new technologies. In addition to supporting new and innovative strategies and initiatives, the expertise and resources of existing fora and international agencies should be utilized where possible.
- Transfer of appropriate technology to developing countries, is both a development priority, and an important component of long-term sustainability
- To be sustainable, the GMES and Africa initiative needs to be compatible with future economic growth and development aspirations. The experiences and lessons learned with the implementation of the GMES Europe should be used to inform the African partners.

11. SUMMARY

In order to support the planning and decision making process, there is need to develop appropriate data collection, processing and dissemination strategies that will provide reliable and timely data so as to make evidence based planning and decision making. Africa has the least developed communications infrastructure to facilitate data acquisition, processing, storage, utilization and dissemination. Space infrastructure is seen to be very appropriate to monitor a large continent like Africa due to the poor deployment of in-situ infrastructure. The GMES and Africa initiative which is included in the "Space" part of the Africa-EU Strategic Partnership #8. is therefore focusing on the use of space-based information in support to the monitoring of the environment in Africa.

The objectives of the Infrastructure framework of the GMES and Africa initiative is to improve availability, accessibility, usability and share-ability of data and information to guide the planning, coordination and monitoring as well as the decision making process. The chapter identifies the Millennium Development Goals (MDGs), the Africa-EU Joint Strategy, the Africa's Science and Technology Consolidated Plan of Action by the New Partnership for Africa's Development (NEPAD), the Maputo Declaration and International conventions and protocols as key among the policy drivers of the GMES and Africa Initiative. Beneficiary communities have been identified at global, continental, regional and national levels, and then grouped into the five pillars of the GMES and Africa Infrastructure Framework namely; Space Infrastructure, Data Acquisition and Access, Data Storage and Processing, Data Utilization and Data Dissemination.

The mapping exercise identified 48 institutions and organizations that are key to the five pillars of the GMES and Africa Infrastructure framework. Of these, 20% operate at global, 55% continental, 15% regional and 10% national level. Africa has been identified as the lowest consumer of remote sensing technology compared to the other continents though the marketing of remote sensing data, equipment and software is a lucrative business. At present, pre-processed images can be obtained via satellite receiving stations in only a few African countries e.g. Tunisia, Nigeria Egypt, Gabon and South Africa. Even though sufficient remote sensing expertise and infrastructure

is perceived in the region, no clearly defined networking or database exists. The type of satellite data required by the GMES and Africa initiative ranges from low to very high resolution depending on the size, required level of accuracy and detail, and the use of data.

The following gaps have been identified in the mapping exercise; Availability of low cost but high resolution satellites, African space technology policy, Research in space technology, and trained African expertise in space science, Communication facilities such as internet connectivity, One Stop Information Centres at continental, regional, national and local levels and Institutional capacity to acquire and process data, Data storage facilities such as servers and data processing capacity (software, skills and hardware), Core datasets at continental, regional, national and local levels, Compatible and interoperable systems, Lack of a clearinghouse, data dissemination policies and strategies, dissemination networks, affordable high speed bandwidth for internet access. CBERS, ARMC, AMSED, EASSy, COMTEL, SRIL, GeonetCast, EumetCast, AFREF, EIS-Africa and MDG Mapper have been identified as existing and planned funding programmes.

The chapter also identifies the type of services required and to be provided under the GMES and Africa Initiative. These include; capacity building, ICT infrastructure development, software and hardware vending and consultancy. The required actions have been prioritized and a 29.8 mill Euro Five Year development plan developed. Key recommendations include; A Needs Assessment, Inventory of existing infrastructure and initiatives, building on the existing initiatives, policy analysis and harmonization, promotion of spatial data infrastructures and other observation services, encouraging public, private partnerships as well as establishment of shared international gateways and user networks among others.

12. ANNEXES

ANNEX 1: NEPAD and ICT

Africa's Science and Technology Consolidated Plan of Action, 2006 by the New Partnership for Africa's Development (NEPAD) secretariat. The African Ministerial Council on Science and Technology (AMCOST). The overall governance structure for setting continental priorities and policies pertaining to the development and application of science and technology for Africa's socio-economic transformation. Stresses the urgency of building the continent's capacities to harness, apply and develop science and technology in order to eradicate poverty, fight diseases, stem environmental degradation, and enhance competitiveness and economic development.

The 'Science and Technology Consolidated Plan of Action' articulates Africa's common objective of socio-economic transformation and full integration into the world economy. The Plan of Action reaffirms Africa's commitment to collective action for developing and using science and technology for the purpose of meeting this objective. The Plan is conceptualized and developed on three interrelated metaphors namely; capacity building, knowledge production, and technological innovation. The Plan of Action places emphasis on developing an African system of research and technological innovation by establishing networks of centers of excellence dedicated to specific Research and Development and capacity building programmes. It complements a series of other AU and NEPAD programmes for such areas as agriculture, environment, health, infrastructure, industrialization and education.

At continental, regional and national levels, African countries and their leaders have begun to accord priority to science and technology as important factors in efforts to attain MDGs and transform Africa's economies. They recognize that without investments in science and technology the continent will stay at the periphery of the global knowledge economy. This recognition is manifested in the kinds of new institutional arrangements and programmes that African countries are establishing. One of the fundamental steps by African political leaders to address Africa's development challenges is the creation of the NEPAD which recognizes the role science and technology will play in the economic transformation and sustainable development of the continent. One of NEPAD's overall objectives is to bridge the technological divide between Africa and the rest of the world. NEPAD will focus on the formulation and implementation of programmes to:

- promote cross-border co-operation and connectivity by utilizing knowledge currently available in existing centres of excellence in the continent;
- develop and adapt information collection and analysis capacity to support productive activities as well as for exports outside Africa".
- generate a critical mass of technology expertise in targeted areas that offer a high growth potential, especially in biotechnology and geo-science.

The NEPAD ICT Infrastructure Programme: aims to complete an optic fibre ring around Africa and establish connection between all African countries and to the rest of the world through submarine cable systems. The prime objective of the programme is to integrate the African continent by harmonizing ICT Infrastructure initiatives across the continent, enabling trade, social and cultural interchange to take place with ease and affordability and ultimately assist Africa to "Bridge the Digital Divide".

Key features of the NEPAD ICT Infrastructure Programme are:

- The establishment of the submarine cable for East Africa (EASSy), Completing the optic fibre ring around the African coastline in conjunction with other fibre submarine cable systems
- Rationalization and development of the ICT Broadband Network for East and Southern Africa. Connect countries to their neighbors and ensure that each land-locked country is connected to at least two cable landing stations.
- Rationalization and development of the ICT Broadband Network for Central, West and Northern Africa Ensure that each land-locked country is connected to at least two cable landing stations and connect countries to their neighbours.

The NEPAD e-Africa Commission, in collaboration with the Common Market for Eastern and Southern Africa (COMESA), the East African Community, the Inter Governmental Authority on Development (IGAD) and the Southern African Development Community (SADC), as well as other stakeholders, have undertaken to integrate and rationalise plans for the development of the fibre optic network in the Eastern and Southern region of the

continent. COMESA has an initiative known as COMTEL, while SADC has its own plan known as SRIL. There are other initiatives (including those of utility companies), for fibre-optic networks in this region. The Heads of States at the Algiers HSGIC, November 2004, endorsed this network and called upon the World Bank Group (WBG) and other development partners to support its implementation.

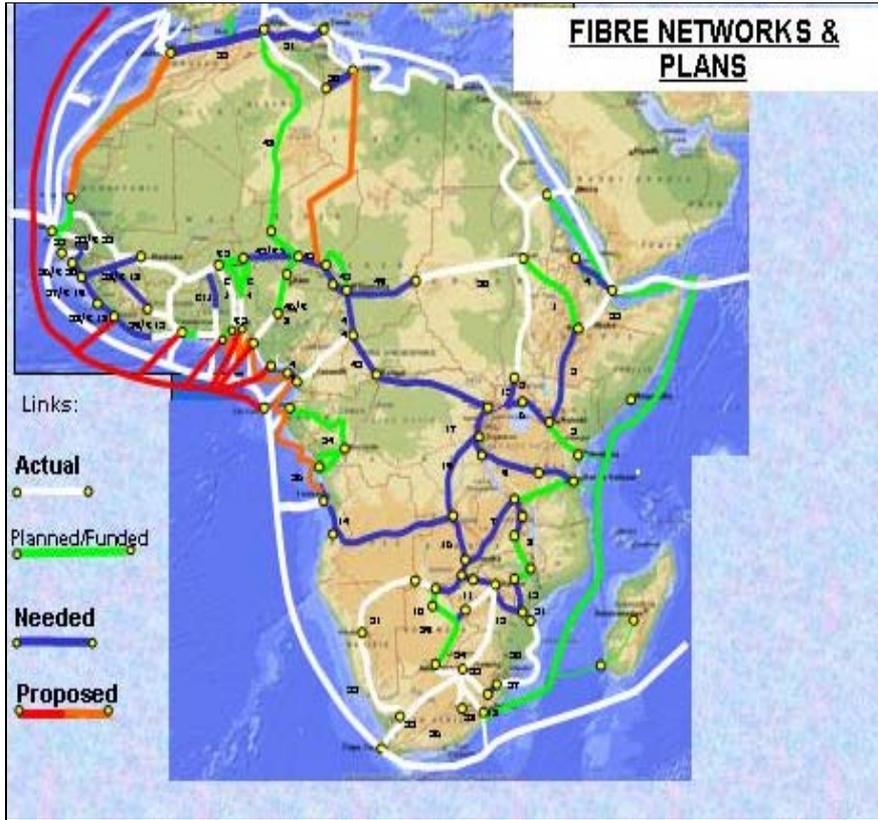


Figure 1: Existing, Proposed and Required Fibre Optic Networks in Africa

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GMES AND AFRICA: AFRICAN GLOBAL MONITORING FOR ENVIRONMENT AND SECURITY

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4. INTRODUCTION

4.1. Thematic context

Capacity Building (CB) as a cross-cutting activity, pertinent to all domains of *GMES and Africa*, is a key issue for the successful implementation and sustainability of GMES in Africa, in the best interests of all stakeholders and user communities involved. A fundamental goal of Capacity Building is to enhance abilities to evaluate and address essential questions related to policy choices and implementation of development options. In recognition of existing efforts and best practices, the definition should be broadened also to encompass “*capacity development*” and “*capacity utilization*” to address the importance of already existing knowledge and its mobilization through partnerships and networking to sustain and strengthen this capacity in the *GMES and Africa* process. CB encompasses various components including human, scientific, organizational and institutional resources and capabilities as well as technological and research infrastructures, usually summarized as the I³ of Capacity Building, Individual, Institutional and Infrastructure.

Earth Observation (EO) data have been proven essential for environmental monitoring in Africa. The African continent is largely depending on natural resources and it is necessary to exploit them through a sustainable and fundamented approach. The elaboration of strategies and common tools, the establishment or strengthening of networks and regional organizations aiming at promoting management of natural resources should also ensure the coordination of cross-border resources monitoring such as rivers, wildlife, vegetation species, and marine and coastal environments. In this respect CB is a vital issue for production, management, dissemination and effective use of geo-information (GI), calling for concerted and focused efforts towards reinforcing national and regional capacity-building institutions. The large knowledge gaps in natural resource assessment, in a context of inadequate infrastructures and insufficient skilled human resources, currently poses challenges to provide timely, accurate and sustained information which is needed for adequate planning, decision making and management. *GMES and Africa* CB strategy is one of the pillars to assure a successful implementation of this AU-EU partnership.

4.2. Constraints/pressures

The current availability of EO information and capacity to derive necessary products, especially in Africa and developing countries is still insufficient to enable and support environmental decision making. Previous surveys and analysis mainly in the GEO context identify important obstacles and constrains to EO capacity building:

- Limited access to CB resources and lack of knowledge transfer for EO applications;
- Lack of infrastructure for EO education and training (Internet access, e-science and e-learning);
- Need for criteria and standards for EO CB;
- Gaps between EO research and operational application;
- Connectivity inefficiency between providers and users of EO systems;
- Need for cooperation within and between developed and developing countries and regions (the very reason of the GMES partnership);
- Lack of awareness about the value of EO among decision makers; and
- Duplication of EO CB efforts.

This chapter focuses on implementing the cross-cutting aspects of CB since each of the *GMES and Africa* thematic chapters includes sub sections on developing specific CB activities.

5. POLICY DRIVERS AND NEED ANALYSIS

5.1 Policy drivers

To enhance the impact of CB in the context of *GMES and Africa*, it is pertinent to identify existing actions expressed at events or by Committees and Organizations active in the field of EO.

CB has been acknowledged by a sequence of events as a main concern for effective environment monitoring and use of EO information. Exemplifying this concern the **Agenda 21** agreed in 1992, at the United Nations Conference on Environment and Development (UNCED), includes a chapter on National Mechanisms and International Cooperation for Capacity Building in Developing Countries. Also in the 1st

Earth Observation Summit declaration the participants recognised the need to support: “A *coordinated effort to involve and assist developing countries in improving and sustaining their contributions to observing systems, as well as their access to and effective utilization of observations, data and products and the related technologies by addressing capacity-building needs related to Earth observations.*”

The following Earth Summits launched the Group on Earth Observations (GEO) including an active CB Committee (CBC) responsible for reference documents on this cross-cutting activity such as the **Capacity Building Strategy** (2006), a comprehensive guide comprising a vision, principles, objectives, a list of priority actions and a list of current initiatives, to be used as a driver for the GEO Work Plan. In 2007, the CBC launched the **Seville Roadmap** providing a general approach to efficiently engage donors.

The **CBC input for the GEO 2009-2011 Work Plan**, includes five tasks: the I³ of CB, the Resource (or Seville Roadmap) Mobilization and a Needs and Gap Assessment. It provides an overview of main CB aspects at a global level but also comprises sub-tasks with direct interest for Africa such as SERVIR expansion, geo-resources services for Africa or CBERS Capacity Building Network focusing on Lusophone African countries.

Global objectives identified as priorities include:

- (a) Strengthen contact between users and providers, supported by identification of communities, networks and needs
- (b) Strengthen and build networks: e.g. promoting the sharing of data, human and technical resources, enabling standardisation methods
- (c) Mobilize resources, marketing CB for EO as an investment rather than a cost
- (d) Establish mutual beneficial relations with private sector (PPP)
- (e) Develop synergies to facilitate cross-border CB

At regional African level, the New Partnership for Africa's Development (NEPAD) adopted by African heads of States and Governments has developed an environment initiative to address the region's environmental challenges while at the same time combating poverty and promoting socio-economic development. Under the leadership of the African Ministerial Conference on Environment (AMCEN) a consultative and participatory process has generated the **Action Plan of the environment initiative** which provides an appropriate framework for the establishment of a strong partnership for the protection of the environment between Africa and its partners based on the commitments contained in the UN Millennium Declaration.

The Action Plan is organized in clusters of programmatic and project activities to be implemented over an initial period of 10 years. The following clusters have been identified: combating land degradation, drought and desertification, wetlands, invasive species, marine and coastal resources, cross-border conservation of natural resources, climate change and cross cutting issues. The plan of actions builds upon related problems including capacity building and technology transfer. However the Action Plan recognizes that inadequate financial resources and lack of adequate human resources and institutional capacities have hampered the effectiveness of regional environmental agreements and international environmental conventions, which take care of these issues. It emphasizes the need to enhance the capacity of African countries to ensure that Africa interests are promoted. This can be done supporting the development of information systems including geospatial information.

The Africa Ministerial Conference on Science and Technology (AMCOST) has endorsed the recommendation for the creation of the African Institute for Space and Science under the NEPAD framework and supports strongly the training of Africans in information management aspects related to Conventions in order to generate critical mass of technological expertise in areas that offer high growth potential. There is also a need to support national and regional capacities to collect and use multi-sectoral information in decision-making process and build capacity to collect and analyze data and information for decision making.

Finally, in March 2008 (Addis Ababa) UNECA and AU convened the First Joint Conference of African Ministers of Economy and Finances which emphasized the necessity amongst other priorities to build and enhance capacities at continental level to meet the following objectives :

- Foster the development of **infrastructure and regional integration**;
- Tackle the **climate change challenges** by promoting sound **strategies** for adaptation at regional, national and local levels;
- Promote the fair **management** and improve the **governance of natural resources**;

- Strive to attain the **MDGs** through better implementation of **National Development Plans and strategies for poverty reduction and exchange of experiences.**

5.1. Needs to improve CB in Africa

By their very nature, space applications provide an effective platform to address problems from a regional perspective and present considerable opportunities, but there is a need to establish institutional arrangements to enable Africa to receive their benefits. Strengthening (cross-border) CB collaboration, facilitated by the GMES and Africa partnership, underpins global and African priorities and offers possibilities for long term cooperation between African and European (regional) institutions which is imperative to be successful.

Across Africa the main needs to be addressed by the GMES partnership to improve CB are related to:

- enhancing networking, i.e. fostering exchange of ideas and best practices and knowledge development
- facilitating data access and promoting the sharing of data, information, reports, articles, etc.
- alleviating financial constraints and providing access to resources for CB
- promoting coordination and synergies to avoid duplication of efforts and maximize investment on EO

6. Identification of communities

For *GMES and Africa* to be effective it needs to address information requirements with respect to environment and security in support of the various levels of the decision making process to assure access to and use of relevant information. Communities that are currently active (under AMESD) in the process of development of timely, sustained and accurate thematic information for Africa are presented in the table below, grouped per Economic Region. The general objective of these communities in terms of environmental information and data collection, is to improve the decision making-process in the fields of environmental resource and environmental risk management in Africa by increasing information management capacity of African regional and national institutions mandated for environmental related sectors, facilitating access to Africa-wide environmental information derived from EO technology to allow informed decisions. The operational objectives are:

- to improve access by African users to existing basic EO, field and ancillary data
- establishment of operational information services to improve decision making processes in the fields of environmental management and other policies
- political and policy development frameworks are strengthened to ensure active and sustainable participation of African governments in global environmental surveillance
- adequate technical level of African stakeholders will be permanently ensured

Capacity Building as a cross cutting activity within *GMES and Africa* framework, includes diverse communities related to the different Action Plan thematic groups. Existing initiatives, organizations and key institutions described in section 7 are indicative of already existing cooperation between both continents and between the various regions in Africa active in the field of CB.

The *GMES and Africa* CB component needs to built on and strengthen these existing initiatives, focusing on: i) Developer and Service Providers; ii) User Community; iii) Private Sector; iv) Decision Makers.

Community of developer and service providers

Community of developers span a large number of stakeholders including government technical services (e.g., forestry, agriculture, land managers, natural reserves), national projects, NGOs, local communities, decentralized administrations, etc. The community of users is mostly concerned with decision making for sustainable use of natural resources. Since the drought of seventies, several countries and transnational organization (SADC, CEMAC, IGAD, IOC and ECOWAS) have developed some initiatives for a better management of natural resources based on a swift knowledge of the natural capital. As most of those initiatives are building on trans-boundary resources the need to building capacities on monitoring shared resources and providing relevant information for multi-stakeholder dialogues on these becomes a priority.

On the other hand, several ministries have implemented departments for application of remote sensing in land monitoring, mainly related to urban management and agriculture. Some examples can be taken on cadastral application (data base of tax payers) and yield census data collection (national statistics on

agriculture). However, even with striking needs to use EO data and related GIS funding the activities of user communities still remains a main issue, which mostly relies on donors with short term funding schemes.

User Community

Well established communication between user and developer communities is essential. User communities include the decision makers and planners, as well as specialized institutions, students and other stakeholders at the community level. To ensure better use of EO data and products by African communities in general, there is a critical need to enhance capacities for data collection and analysis in order to better manage the ongoing and planned programs that will ultimately strengthen institutions and influence policies. In this regard the development of statistical management skills seems to be a cornerstone.

Table 1. Existing African regional thematic communities, services and products

Regional Economic Grouping	Theme	Services	Existing African Network and Key Partners
ECOWAS: Mauritania, Senegal, Gambia, Cape Verde, Guinea Bissau, Guinea (Conakry), Sierra Leone, Liberia, Ivory Coast, Ghana, Togo, Benin, Nigeria, Chad, Niger, Burkina Faso, Mali	Water management for Cropland and Rangeland Management	Production and distribution of indicators for 4 environmental themes: estimation of yields of cultural and pastoral lands, dry land areas and drought risk, filling level of small water bodies in support of livestock management, savannah fires (Key products: vegetation state, dry matter productivity, phenology, fraction vegetation cover, small water bodies, burnt areas)	Regional Centre Agrhyment (CRA), Niamey, Niger, CONEDD, Autorite Liptako Gourma (Burkina), Int. d'Economie Rurale (Mali), Centre de Suivi Ecologique (Senegal), National Env. Agency, DoP-DOSA (Gambia), Nigeria Hydrol. Service, University Ile-Ife (Nigeria), Centre National de Teledetection (Benin), Env. Protection Agency, Statistics Res.&Inform. Directorate (Ghana), Inst. Togolais de Reserche Agronomique (Togo) Key users: ECOWAS, CILSS, int., region. & nat. organizations - authorities
CEMAC: Cameroon, Central African Republic, Chad, DRC, Congo, Equatorial Guinee, Gabon	Management of Water Resources	1: Low waters 2: Water Cycle (Key products: water levels and Low water alert system for Oubanqui, rainfall, evapo-transpiration, water cycle / humid forests monitoring bulletins)	International commission for Congo-Oubangui-Sangha Basin (CICOS), Kinshasa, DRC, GIE-SCEVN, RVF, National Meteo Services, CRH Key users: Navigation Services, Ministries, Universities, research centres, Agropastoral services
IGAD: Djibouti, Eritrea, Ethiopia, Kenya, Somalia, Sudan, Uganda	Land Degradation Mitigation and Natural Habitat Conservation	1: Land Degradation Assessment 2: Natural Habitat Assessment (Key products: Land Degradation Index map, regular bulletins, Land Cover Change at High resolution on IGAD selected Natural Habitat areas)	IGAD Climate Prediction and Applications Centre (ICPAC), Nairobi, Kenya, RCRMD, KMD (Kenya), EMA (Ethiopia), NEMA (Uganda), HCENR (Sudan), DRSRS (Kenya), National Thematic Focal Points, JRC, Eumetsat, Uni-Nairobi (Dept Meteorology), UNEP-DEWA Key users: National Ministries of Environment, Meteorological services, IGAD secretariat, Regional Institutions, Researchers, IUNC, WWF
IOC: Mauritius, Madagascar, Seychelles, Comoros, La Reunion, Mozambique, Tanzania	Coastal and Marine Management	1: Fish Resources Monitoring 2: Data base in physical oceanography (Key products: Ocean colour, SST, sea-level, South West Indian Ocean (SWIO), waves, marine currents, fish resources indicators, climatological parameters, sea level elevation, wind and surge frequencies)	Mauritius Oceanography Centre (MOI), Quatre-Bornes, Ile Maurice, Ministre des Peches, IHSM (Madagascar), Centre Surveillance des Peches (Comoros), Seychelles Fishing Authority, Albion Fisheries Research Institute, Mauritius Meteo Service (Mauritius), Instituto Investigaçao Pesqueira (Mozamb), Kenya Marine Fisheries Res. Inst., Tanzania Fisheries Res. Inst., Zanzibar ministry of Fisheries Key Users: Ministries and Institutes of Fisheries, Fisheries Monitoring Centres, Oceanographic Institutes, marine operators
SADC: Angola, Botswana, Lesotho, Malawi, Namibia, South-Africa, Swaziland, Zambia, Zimbabwe	Agricultural and Environmental Resource Management	1: Agricultural Service 2: Natural Disaster Service (Key products: Crop Area Mapping, Yield estimates, CFSAM reports, Active Fires, Fire Risk, Drought early warning, drought indicators, Flood mapping service)	Botswana Department of Meteorological Service (BDMS) Gaborone, Botswana , CSIR-Meraka, SAWS, SADC-DMC, ARC Key Users: Ministries of Agriculture, National Disaster Management Units, Ministries of Environment, Meteorological Services

Private Sector

The private sector has often been a strong bridge between the developers of tools and assets and the users of EO information for development projects. It is responsible for a large geo-information market and is a strong job provider in several African countries (e.g., Kenya, Côte d'Ivoire, Senegal, Morocco, Algeria, Tunisia, Nigeria). In addition, the private sector has created a competitive service supply that boosts the knowledge of geosciences in several countries. The downside of the private sector has been the poor circulation of information and data, which is essential for survival of private structures. In addition there is a lack of financial support mechanisms from donors and financial institutions (banks, lending mechanisms). There is a need to build an enabling environment linked with funding opportunities and aware of market possibilities within countries and across the continent and create connections with Capacity Building schemes.

Community of decision makers

They are mainly characterized by a poor knowledge of possibilities associated with the use of EO data. In that respect a lot advocacy work is needed to bring decision makers, in particular at high level, to learn how to use the EO information for the sake of understanding global trends (climate change issues for example), and environmentally related events (drought early warning, fires) or impact of policies in MDG attainment at different levels. Raising awareness of decision makers is therefore needed.

7. Mapping exercise

The inventory of existing European and African networks, organizations, key institutions, projects and programs with a CB component provides a basis to analyse the main strengths and gaps and to support the process development, avoid duplication of efforts, etc. Table 2 provides an overview of relevant stakeholders.

Table 2. African and International communities involved in CB

Key Institutions	African Universities	
	European Universities	http://www.earsel.org/?target=earsel/membdir
	Non University institutions involved with Capacity Building	http://www.fig.net/jbgis/adhoc/jbgis_capacity_inst.pdf
	Mapping Agencies	http://www.agirn.org/nma
African Space related Initiatives	CNTS	Algerian Centre National des Techniques Spatiales (CNTS)
	ARCSSTE	http://www.oauiife.edu.ng/research/arcsstee/general.htm
	NASRDA	http://www.nasrda.net/
	NARSS	National Authority for Remote Sensing and Space Sciences (Egypt)
	SunSpace	http://www.sunspace.co.za/
International institutions and programs	GEO Capacity Building Committee (CBC)	http://www.earthobservations.org/ag_cbc.shtml
	ISPRS Commission 6 Education and Outreach	http://www.isprs.org/technical_commissions/wgtc_6.aspx
	FAO Remote Sensing Centre (AGRT)	http://www.inpe.br/unidades/cep/atividadescep/EducationDirectory/
	EUMETSAT Training	http://www.eumetsat.int/Home/Main/What_We_Do/Training/index.htm?l=en
	United Nations University	UNOOSA (http://www.unoosa.org) UNESCO (www.unesco.org) IOC-UNESCO (www.ioc-unesco.org)
African institutions and programs	Continental	SERVIR-Africa (http://www.servir.net/africa/)
		AMESD (http://www.amesd.org/)
		WATERNet (http://www.waternetonline.ihe.nl/)
		ESA-TIGER phase II (http://www.tiger.esa.int/)

		AARSE (http://www.itc.nl/aarse/) EIS-Africa (http://www.eis-africa.org/EIS-Africa/) GOOS-AFRICA (http://www.ioc-goos.org/content/view/159/89/)
	Regional	RECTAS (http://www.uneca.org/rectas/the_centre.htm) RCMRD (http://www.rcmrd.org/) CRASTE-LF Regional Meteorological oriented Training Centers (EAMAC, IMTR, CRFM, SAWS centres) Regional Implementation Centers (RIC's) under AMESD (CICOS, CRA, ICPAC, MOI, BDMS)
	National	Universities / higher and professional centers and specialized research institutions, UNESCO Chairs in, e.g., earth observations, ecosystems, water resources, agriculture, oceanography

8. Identification of gaps and of existing or planned funding programs

8.1 Gaps

Application of EO for GMES related domains requires knowledgeable resource persons. Universities and Regional centres both play a role in providing a sustainable human resources base in the field of EO for *GMES and Africa*. Universities have a clearly different mandate than regional centres. Both cater for different clients and hence do provide a different type of training (degree level training versus more tailor-made training). It is essential to build on the existing capacity within universities and regional centres, with the latter serving as nodes of EO data providers for different GMES components and services. Cooperation and collaboration between the various 'southern' institutions need to be promoted through network arrangements, joint development of curriculum and the promotion of joint/double degree training and credit transfer arrangements. For better interoperability and for setting clear performance indicators, it is necessary to work out standard settings, accreditation and certification procedures for education in the field of EO and the application domains relevant for GMES. Effective course credit transfer between institutions depends on assuring proven standards implementation.

In short, some of the major gaps on the current state of CB on EO are:

- i) Insufficient CB resources to provide a sustainable human resource base
- ii) Lack of infrastructure to access, use and develop EO data and products
- iii) Insufficient linkage between stakeholders, user communities defining the research agenda and CB requirements
- iv) Lack of performance indicators, standards for accreditation and certification procedures for education in the field of EO
- v) Insufficient collaborative research (between countries) on *GMES and Africa* related domains
- vi) Inadequate linkage to and dissemination of achievements / capabilities to various levels of decision making bodies
- vii) The insufficient link between research/results/scientific information and national services in charge of decision making and program design and implementation

Furthermore, facilities should be made available to update infrastructures needed for EO training. The high cost of software licenses and essential investments in hardware can not be the limiting factor for curriculum development. Use of, and development in open source software has to be further promoted. Easy and fast access to Internet is still a bottleneck in Africa. Universities and regional centres need additional investments to get sufficient Internet bandwidth. With sufficient bandwidth, advanced distance/E-learning modules could be offered with support from other international institutes. GMES-related institutions (stakeholders and user community) need be more deeply involved in identifying specific capacity building requirements, give future directions for the research agenda and provide (logistical, data and financial) support to study relevant contemporary problems.

EO capacity should be supported through research oriented centres/institutes, which should be developed 'around' universities and regional centres, to keep skilled human resources with the required knowledge in the country. Universities should promote and be able to carry out applied research in the domains covered by *GMES and Africa*. Research results and training-programs impact should be disseminated to the stakeholders and user communities involved.

8.2 Existing or planned thematic funding programs

Various initiatives dealing with EO and GMES domains, involving a significant CB component, that have been or are presently ongoing on the African continent, include:

- The African Monitoring of the Environment for Sustainable Development program (AMESD)
- The Group on Earth Observations (GEO) is coordinating international efforts to build a Global Earth Observation System of Systems (GEOSS). A public infrastructure interconnecting a diverse and increasing group of instruments and systems (space, airborne and in-situ) to monitor and forecast changes in the global environment.
- European Space Agency's (ESA) TIGER phase II initiative
- UNESCO programs related to the Man and Biosphere (MAB), Global Ocean Observing Systems in Africa, Applications of Satellite Remote Sensing for Integrated Management of Ecosystems and Water Resources in Africa, etc.
- Continued EUMETSAT involvement with the African Meteorological Community
- Calls by the European Commission (e.g., 7th Framework, EDF)

9. Building GMES and Africa Service

9.1 Service definition and Provision

As Capacity Building is regarded a cross cutting activity, the service definition is provided under section 9.2. For the provision of CB services a distinction has to be made between continental, regional and national CB activities. Generic CB activities, relevant for all components of GMES can be dealt with at continental level such as the development of E-learning materials, more specific GMES activities, e.g. thematic applications, can be treated at regional level. Training of the Trainer type of activities is important to subsequently provide training at national levels. A comprehensive CB plan, from continental and regional to national training provision should be further elaborated, relating to the various thematic CB components and corresponding CB tools.

9.2 Capacity Building

GMES and Africa CB strategy should be implemented considering the three main Capacity Building components, Individual (human), Institutional and Infrastructure:

9.2. a Necessary elements

- **Human Capacity** focuses on education and training of individuals on themes relevant to GMES and Africa with the ultimate aim to develop in partnership with the EU operational services based on EO systems. Human capacity building efforts should contribute to and foster the access, provision, development, production and use, on a sustained basis, of reliable and timely services related to environmental and security issues in support of a wide range of policy areas for the benefit of the African populations.
- **Institutional Capacity** contributes for the development and fostering of an adequate institutional framework for the use of EO enhancing sound decision-making. This includes building policies, programs and organizational structures aiming at understanding the value of EO data and applications.
- **Infrastructure Capacity** is related with technological and research infrastructures and platforms required to access, use and develop EO data and products for decision-making. Adequate infrastructure and timely and efficient processing and analysis routines are required to facilitate incorporation of these environmental data sources and products to improve national and regional policy and (timely) decision making for a better management of the natural resources and face the challenges posed by GMES. Building EO infrastructure is the responsibility of governments (national or local) therefore will only succeed if nested into the planning system. Some countries have launched National Geomatic Plan encompassing all sectors of activities. In the long term these efforts, coupled with GMES Africa initiative should result into a more “democratic” access to EO data.

9.2. b Strategy to implement them

- **Human Capacity** should be facilitated utilizing existing African formal and non-formal education systems through long lasting collaboration and networking between academia, regional centres of excellence, UN affiliated and African space centres, UNESCO Chairs in Earth Observations and related topics to *GMES and Africa*, private sector and their equivalents in Europe. Embedding the *GMES and Africa* initiative in the curriculum of African academic centres is only a first step, joint educational and degrees programs, “train the trainers” programs, collaborative research and joint development of (distance education based) training materials are necessary elements for human resource development. On job training including upgrade and professionalize skills, executive seminars, workshops, tailor made refresher training and other outreach activities should also be addressed with the leadership of national and regional centres of excellence reinforcing partnerships and collaboration with relevant European and African institutions. At the forefront of the training backbone is an efficient enhancement of capacities of trainers.

Networking is a key component of capacity building. Peer-to-peer relationships between African and European institutions will reinforce a sustained cooperation between partners involved in *GMES and Africa*. These partnerships are critical to address common, cross-border research and policy challenges. The use of a common endeavor framework will allow a group-based approach to produce transferable results that exceed what would be possible for a single researcher to accomplish through work in a single location.

- **Institutional Capacity** should focus on further improvement of links and collaboration between African platforms, African Space Science and Technology initiatives and their respective EU counterparts to further develop joint innovation programs (together with African universities, regional centers of excellence, research centres, private sector, space agencies, governments, etc) to strengthen technical and industrial capacity in Africa to take full ownership of GMES and Africa in due course. The use of a multi-location, collaborative research platform can be purposefully selected to help to build strong collegial relationships between the participating researchers and research institutions in Africa. Institutional capacity can be seen through the lenses of collaboration development (including south-south) that gives higher strength and skills of involved incumbents. Efforts deployed in various countries appear as small drops that cannot satisfy the overall critical need of information country wide. Therefore, creating complementary enabling working environment among centers of excellences is an important added value to face the challenges of building the GMES in Africa.
- **Infrastructure Capacity** will count with GEONETCast, an operational DVB based data dissemination system to fulfill a crucial role. This low cost, global, environmental information delivery system currently operates also an African service. The data stream transmitted via communication satellites can be received using a simple and cheap ground reception infrastructure. With the ongoing development of GEONETCast, broadcasting (globally) a multitude of satellite observations and associated products in conjunction with cheap ground receiving infrastructure, the data is now at the doorstep of the user community anywhere in the African continent. The low cost ground receiving segment coupled to open source and freeware software should address the requirements of the non-meteorological organizations dealing with environmental and security related application domains.

Next to an operational satellite communication based data dissemination system a multitude of data resources is available in archives that can be accessed via Internet, which in turn is also used for data transfer. Cheap and reliable Internet access is therefore a requirement, not only for successful human CB and collaboration but to provide a mean to retrieve and disseminate data and information as well as future GMES related services for Africa. Ongoing developments with respect to 3G-Networks that are currently installed at various locations in Africa, which will offer greater bandwidth, are important in this respect. By means of a 3G enabled modem or mobile phone, connected to a computer or laptop, larger bandwidth is obtained which can be utilized for various modes of training activities, irrespective of available fixed network infrastructure at affordable prices.

9.3 Prioritization of requirements and actions

Despite outstanding national, regional and international efforts, and substantial achievements over the past 30 years, spatial information science has remained rudimentary in decision-making in many parts of sub-Saharan Africa. The main defects of CB approaches in Africa include: (1) lack of multiplicative effect despite the huge critical mass of trainees most African countries need; (2) low rate in the introduction of EIS courses in the regular curricula of higher learning institutions (universities); (3) heavy financial constraints.

Networking at all levels and cooperation (among regional RS Centres and their partners, among national Centres, among universities), building a network of networks to better share resources and experiences, and networking of the efforts to build capacity are put forward to come to the end of the tunnel (Nkambwe, 2001).

Expanding and extending the use of EO data by measures and actions aiming at facilitating access to data is a requirement. This can only be achieved if capacity is primarily generated through a credible training system building on a good network of African universities and institutes collaborating with external partners.

There is also a need to alleviate financial constraints, especially on burgeoning EO business communities through better support by governments, promotion of financial mechanisms including private banks and regional institutions (like African Development Bank), and building economic value and market for spatial data services in Africa. For example the fast rate of urbanization in Africa is probably an opportunity to promote products and services related to urban planning (i.e. cadastre), land tenure management, health care, etc.

9.4 Organizational Scheme

GMES and Africa sustainability and representativeness will depend on the awareness and involvement established at continental, regional and national level. Identification of key partners at the different levels is crucial to assure the establishment of a structured policy supporting the flow of information and full participation of the main stakeholders. Identification of national providers and users of EO information as the basis of the organizational strategy should be able to connect to general policies avoiding duplication and joining efforts supporting decision makers. A common information platform is essential to assure cooperation between the different thematic networks and cross-cutting activities, namely CB, sharing EO data, technology and knowledge.

9.5 Timetable

GMES and Africa CB strategy should be consistently implemented assuring its sustainability concerning the I³ CB elements and the links with the respective themes. It should be built on previous experience and general framework, but it should be seen as an opportunity to support specific services identified by this process, with special pertinence for Africa. Considering a 10 Year Work Plan 2011-2021, three main phases should be taken into consideration:

Phase 1 (3 Years): Consolidation period and dialogue establishment

During this phase *GMES and Africa* chapters' requirements for CB will be evaluated and consolidated to come out with a coherent CB plan of action for the whole initiative based on existing efforts and best practices.

This consolidated PA will serve as basis for a continent wide stakeholders dialogue to fine tune CB needs, elaborate pilot programmes and establish a road map that will include all sectors identified in the current initial process.

This dialogue will be conducted by AU-EU in collaboration with UNECA and the African regional economic communities (IGAD, ECOWAS, SADC, IOC CEMAC,...).

Phase 2 (3 Years): Implementation and Scaling up

CB Pilot programs determined during previous phase will be commenced across the continent for each of the RECs. The selection of projects and programs will build on existing experience and ongoing collaboration between AU and EU (Africa-EU Partnership on Science, Information Society and Space).

Projects and programs implemented will be evaluated during this phase, corrections made where need be and lessons learnt widely shared to launch the operational phase.

Phase 3 (4 Years): Operational phase

During this phase amended Plan of Action will be fully implemented in operational way.

9.6 Indicative development plan and budget estimate

Adjustments to general estimates have to be performed based on specific analysis of the variables involving this cross-cutting activity:

Phase 1: Identification and Planning – 20 M€

Phase 2: Implementation Phase – 30M€

Phase 3: Operational Phase – 30M€

10. Recommendations

The following recommendation divided into four main overarching areas constitute specific and transversal proposals to launch an assertive GMES and Africa program to support and be sustained by CB cross-cutting activities:

Networking to enhance multiplicative effect

- Strengthen regional coordination and promote networking at all levels;
- Promote cooperation between African institutions and south-south cooperation through network arrangements;
- Improve access to regional and international EO communities;
- Build a network of networks to better share resources and experiences;

Expanding use of EO products

- Improve data availability, access, and distribution by inexpensive or no-cost data;
- Expand and extend data and information portals;
- Promote interoperability: standard setting, accreditation and certification;
- Improve infrastructure for data access, analyses, and distribution, including information technology, hardware and software;

Training

- Develop or enhance EO capacity and EO curricula at Universities and other tertiary institutions in Africa; massive training of trainers must be promoted to keep the pace with changing environment and technology;
- Promote formal and non-formal education systems through long lasting collaboration and networking between academia, regional centres of excellence, UN affiliated and African space centres, UNESCO Chairs in Earth Observations and related topics to *GMES and Africa*, private sector and their equivalents in Europe;
- Promote the participation of the African Research Community into European programs of space research and technology development;

Financial resources and sustainability

- Develop and implement awareness raising strategy so that African governments provide national budgets for geo-information;
- Conduct further evaluation on EO business models, sustainability, role of other regional institutions, associations, partnerships (e.g., CGIARs, UNEP, EIS-Africa, NEPAD);
- Institutionalize CB to support proficiency in the development of EO applications and awareness of new applications;

11. Summary

GMES and Africa strategy provides a unique opportunity to mobilize, coordinate and leverage the efficient use of EO data and applications with relevance for Africa, strengthening cooperation between European and African communities concerned with environmental monitoring based on geo-information (GI). CB as a cross-cutting activity is a key issue for implementation and sustainability of each service identified as pertinent for the process, through corresponding programs, but also comprises global initiatives and policies to face generic challenges. The development of a *GMES and Africa* CB coherent plan is crucial to

guarantee that available information and technology are fully balanced by readily available skilled Individuals, a supporting Institutional framework and enabling Infrastructures.

The foundation for effective CB future actions relies on a consistent survey of existing resources, initiatives, networks and policy drivers avoiding duplications and paving the way for a successful approach to mitigate the gaps and needs of capacity development in Africa. Identification of weaknesses and recommendations should cover the I³ of CB (Individual, Institutional and Infrastructure) and include incrementing number and quality of skilled human resources, strengthening institutional response and investing on technological reforms and updated infrastructures.

The various aspects of CB concerning GI have been investigated and African specific constrains were acknowledged. *GMES and Africa* framework should be used as an assertive approach to accomplish sound results, taking into account present circumstances and searching solutions involving:

- **Resourceful network** among the different geographic and decision making levels
- **Information sharing platforms** supporting communication optimization between EO provider and user communities and assuring **standardization**
- **Funding and Sustainability** to promote continuous updated CB

The success of *GMES and Africa* CB requires commitment of numerous intervenients at different levels and concerning the various thematic programs, to develop a robust consensus, necessary to contribute towards an integrated policy for environment and security. The new strategic partnership between African Union and European Union is expected to provide a novel framework of cooperation addressing African recognizable priorities, where CB in GI plays an unquestionable role. The viability of this 10 years plan will be based on the accomplishment of three phases comprising consolidation, testing and implementation.

12. Annexes

A1: References

A2: Acronyms

A1 - REFERENCES

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Plenary Session 2 – Capacity Building in Africa

- Stig Enemark, Vice President of FIG (Denmark): Capacity Building for Institutional Development in Surveying and Land Management
- Ian Dowman, President of ISPRS, University College London, Chair of Joint Board for Geoinformation Societies Ad Hoc Committee on Capacity Building for Africa, (United Kingdom): Capacity Building for Efficient Use of Geospatial Information
- Captain Hugo M. Gorziglia, Director of IHO (Chile): The IHO Capacity Building Efforts in the Region

Workshop – Education in Africa I

- Dr. B. E. Kesi Prah, President of GhIS and KNUST (Ghana): Education in Ghana and Western Africa
- Dr. Peter C. Nwilo (Nigeria): Education in Nigeria and Aspects on Surveying Education Situation in Central Africa
- Mr. Alain Bagré (Burkina Faso): Surveying Education in Sub-Saharan Francophone Africa. This paper has not been presented in the conference

A2 – ACRONYMS

3G	Third Generation
AARSE	African Association of Remote Sensing of the Environment
AMCEN	African Ministerial Conference on Environment
AMCOST	Africa Ministerial Conference on Science and Technology
AMESD	African Monitoring of the Environment for Sustainable Development
ARCSSTE	African Regional Centre for Space Science and Technology Education in English
AU	African Union
CB	Capacity Building
CBERS	China-Brazil Earth Resource Satellite
CEMAC	Communauté Economique et Monétaire de l'Afrique Centrale
CEOS	Committee on Earth Observation Satellites
CGIAR	Consultative Group on International Agricultural Research
CNTS	Centre National des Techniques Spatiales (Algeria)
CRASTE-LF	Centre Régional Africain des Sciences et Technologies de l'Espace en Langue Française
EAMAC	IEcole Africaine de la Météorologie et de l'Aviation Civile
ECOWAS	Economic Commission of Western African States
EDF	European Development Fund
EIS	Environmental Information System
EO	Earth Observation
ESA	European Space Agency
EU	European Union
EUMETSAT	European Organisation for the Exploitation of Meteorological Satellites
FAO	Food and Agriculture Organization
GEO	Group on Earth Observations
GEOSS	Global Earth Observation System of Systems
GI	Geo-Information
GIS	Geographic Information System
GMES	Global Monitoring for Environment and Security
GOOS	Global Ocean Observing System
IGAD	Intergovernmental Authority on Development
IMTR	Institute for Meteorological Training and Research (Kenya)
IOC	Indian Ocean Commission
ISPRS	International Society for Photogrammetry and Remote Sensing
I ³ (CB)	Individual, Institutional and Infrastructural
MAB	Man and Biosphere
MDG	Millennium Development Goals
NARSS	National Authority for Remote Sensing and Space Sciences (Egypt)
NASRDA	National Space Research & Development Agency (Nigeria)
NGO	Non-Governmental Organization
NEPAD	New Partnership for Africa's Development
PPP	Public Private Partnerships
PUMA	Preparation for the Use of METEOSAT Second Generation in Africa
RECTAS	Regional Centre For Training In Aerospace Surveys
RCMRD	Regional Center for Mapping of Resources for Development
RS	Remote Sensing
SADC	Southern African Development Community
SAWS	South African Weather Service
UN	United Nations
UNCED	United Nations Conference on Environment and Development
UNECA	United Nations Economic Commission for Africa
UNEP	United Nations Environment Programme
UNESCO	United Nations Education Science and Culture Organization
UNOOSA	United Nations Office for Outer Space Affairs
WHYCOS	World Hydrological Cycle Observing System

1. LONG-TERM MANAGEMENT OF NATURAL RESOURCES

2. EXPERTS

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4. INTRODUCTION

4.1. Thematic context

The African continent contains a wide variety of ecosystems, from the deserts to the tropical rain forests, providing huge ecosystems services to the local population and to the entire planet. In the continent, nearly 90% of the population draws its subsistence from exploitation of natural resources.

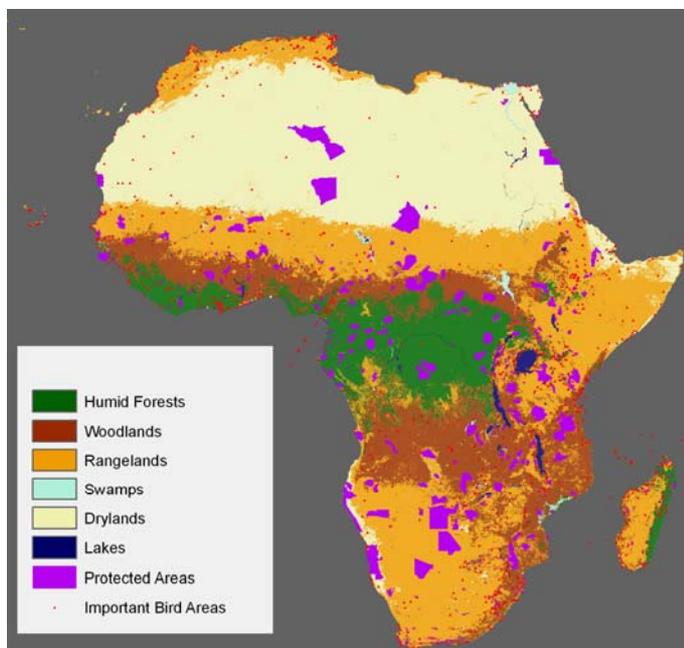


Figure 1: Main ecosystems of Africa (derived from GLC2000) with Protected Areas and Important Bird Areas

Continental and global services provided by the African ecosystems are also of first importance. The Congo Basin forests constitute the second largest area of contiguous moist tropical forest left in the world and play a major role in the carbon cycle; the biodiversity present in African landscapes is unique in terms of quantity and quality; fresh water resources represent an enormous potential for irrigated land and hydropower. In this chapter, we will concentrate on the following categories of natural resources for avoiding overlap with other parts of the GMES Africa action plan: forests, woodlands and rangelands, biodiversity.

While for forests, woodlands and rangelands, the status and the dynamics of the land-cover are the important parameters to measure over the entire continent, the monitoring of biological resources is essentially concentrated in territorial units (protected areas, important bird areas, RAMSAR sites...).

African environment is subject to rapid evolution under the influence of changing climatic conditions (e.g. recent droughts) and socio-economic pressure (e.g. rapid population growth, globalisation...). To satisfy the growing needs for food, several natural areas were cleared for agriculture production, mainly in the circum-Sahara zone. In other African regions, demand for timber also increased the pressure on natural areas. These changes have serious implications on the state of the environment, as well as on long-term ecosystem services for the population.

4.2. Pressure on the natural resources

The African natural resources are currently subject to many degradation phenomena:

Table 1: Main pressures existing on the Natural Resources in Africa

Resources	Phenomenon
Land resources	Land degradation Soil salination Loss of chemical fertility Water and wind erosion
Forest and rangeland resources	Deforestation Impoverishment of commercial species Forest fragmentation Illegal logging Conversion to croplands Overgrazing Increase of uncontrolled fires
Biological resources	Habitat degradation Species extinction Increase of invasive species Pressure around protected areas

Although there are many evidences of the changes above-listed, we are currently unable to answer in a quantitative way to several fundamental questions. For example, where and with which intensity demographic pressures generate more extensive utilization of lands? How the deforested areas are used? What is the magnitude and the speed of the land degradation and desertification processes? What is the pressure in and around protected areas? One does not have nowadays an exhaustive and precise knowledge on the nature and the magnitude of all these changes. The long term trend of land cover and land

use would give important key-answers for ensuring the sustainable exploitation of natural resources, i.e. guarantying needed services for the local population, increasing the economic growth of the countries, and maintaining the ecological value of the ecosystems. More importantly, these answers make it possible to forecast the future states of land cover and land use, which is a requirement for predicting other environmental, social and economic dimensions of ongoing global changes.

5. POLICY DRIVERS AND NEED ANALYSIS

5.1. Policy drivers

Environmental resources management and monitoring are very complex depending on the number of actors, factors, disciplines and the levels of spatial organization involved. Awareness in environmental degradation among decision makers is a reality today, as many countries have ratified several international conventions on environment. These conventions could be seen as a constraint to development by several governments, but now represent unique funding opportunities for the African environment. For example, mechanisms like the Clean Development Mechanisms (CDM) and the REDD mechanism (Reduction of Emissions by Deforestation and forest Degradation) in discussion can allow African countries to convert their forest covers into “carbon credits” which can be traded with developed countries.

However, it is worth mentioning that operational mechanism such as National Action Plan on Environment still lack full consideration in the national development agenda. Also, one can note the lack of synergy between these systems, since the action plan of a given convention barely refers to the program of another convention. And yet, the multiplicity of the sources and factors of environmental degradation require a strong synergy between these plans in order to set up coordinated and relevant solutions. With the ongoing decentralization processes in Africa, more synergistic systems are required for adequate local and regional environmental governance.

The 2002 World Summit on Sustainable Development (WSSD), identified priority areas that place emphasis on water and sanitation; energy; health and environment; agriculture; biodiversity and ecosystem management. The implementation plan of WSSD was built on the outcomes of landmark environmental Summits, especially the 1972 United Nations Conference on the Human Environment (Stockholm), the 1992 United Nations Conference on Environment and Development (Earth Summit), the UN Convention to Combat Desertification (UNCCD), the UN Framework Conventions on Climate Change (UNFCCC) and Convention on Biodiversity (CBD) and other multilateral environmental conventions at global or regional level.

All this environmental agreements have components that explicitly reference the need for Earth observations, to help achieve their goals. In particular, the third United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE III), held in 1999, in its resolution 54/68, the United Nations General Assembly endorsed the Vienna Declaration: Space Millennium for Human Development, which called for action, among other matters; i) to protect the Earth’s environment and manage its resources and; ii) to use space applications for human security, development and welfare. In line with these recommendations, there are several international agreements, constituencies and regulatory bodies in Africa that can benefit for long term monitoring of environment trends in Africa.

The Heads of State and Government of the African Union assembled in Abuja, Nigeria in December 2006, recalling the decision to adopt the Comprehensive Africa Agriculture Development Programme (CAADP) at the Maputo Summit in July 2003 as a framework for accelerating agriculture development and Food Security on the continent, declared their commitment to develop continental and regional market information systems and support the development of the same at national level by 2008.

In 2006, the African Union has issued a Strategy on Disaster Risk Reduction, calling for a coordinated, comprehensive and sustained global Earth observations, data analysis and information generation. In January 2007, the Meeting of the African Heads of State Summit has made the a decision and a declaration on Climate Change and endorsed the Climate for Development in Africa (CLIMDEV Africa) programme for Climate Change in Africa. The AU Executive Council decision EX.CL/Dec.254 (VIII) of January 2006 adopted the Science and Technology Consolidated Plan of Action (CPA) which introduce space science and its applications as flagship research and development area. The AU has also provided various mandates in environmental issues by the African Ministerial Council Conference on Environment (AMCEN) and the African Ministers’ Council on Water (AMCOW).

At regional level, long-term strategies have also been put in place by specialized agencies like the COMIFAC (Commission Ministérielle des Forêts d’Afrique Centrale) for exploiting the forest resources in a sustainable way. The “Plan de Convergence” insists on the need for knowing in detail the resources as a prerequisite for any sound management and exploitation of forests and biological resources.

5.2. Needs analysis

The purpose of regional monitoring and assessment for long term management of natural resource is to:

- Facilitate the development of a common information system through the improvement of the generation, organization and use of information for priority areas identified at local, regional and global level.
- Inform and influence national policies and decision-making processes
- Expand national and local constituencies for sustainable development
- Develop national and local capacities and effort and to identify and fill major gaps in sustainable management of natural resources
- Strengthen field programmes and projects
- Facilitate and increase the cost-effectiveness of thematic or sectoral system recurrent assessment.

The observed fragility in African ecosystems induces an urgent need for a continuous environmental monitoring. Any action should have the view to promoting mechanisms for diagnosing, continuously monitoring and managing the African environment on a global to local scale, particularly the long term trends. These include the strengthening of local, national and regional capacities for creating, updating and keeping on providing coherent spatial and statistical information on environmental variations and change towards improved management and decision-making. The table below summarize the rationale for long term assessment of environment at desired scales:

Table 2: Rationale for long term assessment of natural resources at different scales.

Scale	Type of action
Local	To set up multi-scale information systems enabling any user or decision maker to know what information resource is available locally <ul style="list-style-type: none"> - Seasonal trends and dynamic in rural area - Quantification of available resources : water, soil, vegetation - Vulnerability Analysis and Identification of risk area - Assessment of land tenure
Regional	To set up a regional reference system for assessing and characterizing the state of natural resources and the environment (stocktaking of the situation, basic mapping) <ul style="list-style-type: none"> - Vegetation: Cover, Biomass, Deforestation rate - Land: Degradation rate, available arable lands, etc. - Climat & Water: Seasonal characteristics, spatial patterns
Global	To assess and forecast environmental phenomena and set up operational early warning systems <ul style="list-style-type: none"> - Land use and Land Cover: Change and trends - Vegetation: Resilience, Carbon sequestration - Climate Change effects and impact - Ecosystems: dynamics monitoring and assessment - Global Changes intensity

It must be underlined that the land-cover and land-use dynamics has profound consequences in many other chapters of the GMES Africa Action Plan: Food Security and Rural Development (land availability), Water resources (protection of watersheds...), Land Degradation and Desertification (erosion...), Coastal Areas (coastal erosion, eutrophication...).

6. IDENTIFICATION OF COMMUNITIES

The GMES Africa Programme envisions to develop applications and provide products and service at local, national and regional level. In this regard, the programme needs strong coordination mechanism involving all stakeholders at all levels. Indeed, GMES Africa should assist in strengthening the existing political, institutional, technical and operational mechanisms and networks which will be in support of a synergetic action for diagnosing, continuously monitoring and managing the African environment.

There is a large spectrum of producers/users' community base in Africa for long term monitoring products.

Table 3: Communities of producers and users of geospatial information related to natural resources in Africa.

Level	Constituencies	Information needs
High Political	<ul style="list-style-type: none"> - Head of State Conferences - African Ministerial Conferences : AMCEN, AMCOW, AMCOST - AUC, AfDB - RECs : ECOWAS, SADC, IGAD, ECCAS, AMU - UN (ECA, FAO, UNEP, UNDP...) - EU Aid Agencies - Conventions' Secretariats 	Global trends in the status, quality and nature of the environment Carbon Potential The information should be global through an Early Warning System
Technical Decision-Makers	<ul style="list-style-type: none"> - Relevant National Ministries (Forests, Environment, Land planning, Agriculture, - Regional and national development agencies (COMIFAC, RAPAC...) 	All aspects of environment, such as vegetation status, vegetation change, surface water, fire, carbon stocks... The information should be in near real time

	<ul style="list-style-type: none"> - Managers of protected area - Development banks (WB, AfDB) - Technical services of development Agencies: EC, Member States, USAID, ACDI... 	at subregional to national scales and combined with ancillary input such as socio-economic data
Scientific Community and Information Producers	<ul style="list-style-type: none"> - Networks : GOFC-GOLD, NESDA, EIS-AFRICA, AARSE, UICN, OSS, FARA, ASARECA, CORAF, OFAC - RICs : AGRHYMET, RSAU, RCMRD, RECTAS - Regional and National Research Institutions: CGIAR, JRC, ITC, WRI, IRD, USGS - National Centers : SAC, CRTS, CSE, CERGIS, etc. 	Forest Cover status Land Use Land Cover Vegetation phenology (Biomass variation, foliar index, etc...) Biodiversity (change in the floristic composition), etc...
Ultimate Beneficiaries	<ul style="list-style-type: none"> - Producers of Goods : OIBT, OAB, National Forest Services, Private forest companies - International and local NGOs : WWF, BirdLife Africa, UICN, - Civil society : ROPPA 	Forest logging Deforestation

7. MAPPING EXERCISE

7.1. Existing capacities and programmes

Earth Observation in Africa must be “user-pull” and not “technology-push”. Therefore, research, Science and Capacity building must be regarded as fundamental issues. GMES Africa will help scientist and engineers from the continent to get a real expertise and scientific capabilities in Earth Observation to ensure that they can help meet the expanding needs of African. Partners in the project are expected to constitute a technical network of regional and national organizations and institutions able to operate continuous monitoring and assessment of natural resources in Africa. The operational features of continent-based institutions are shown in the table below.

Table 4: Major institutional capacities existing in assessment of African natural resources.

Institutions Organizations	Data collection, accessibility and integration			Monitoring and Assessment			Information Diffusion & Capacity Building	
	Data Collection	Data Access	Data Integration	Assessment	Monitoring	Forecast/ Early Warning	Information Diffusion	Capacity Building
Regional Implementation Centres: RECTAS RCMRD AGRHYMET OFAC RSAU	Base Datasets (Vegetation type) Earth Observation data (NDVI, DMP, ...)	Accessibility for processed data Access to Base data through technical services	Data are integrated through clearinghouse nodes	Agriculture domains Biomass	Land Use Land Cover Changes	SISEI SERVIR	Bulletin Web sites	Short terms training Diploma courses Workshops
National Centres CRTS CSE SAC SPAIF CENATEL	Field data	Payment of fees	No	Vegetation types	Biomass Biodiversity	No	Bulletin	Short term training Workshop
Research Institution Universities	Field data	No	No	No	Key environmental indicators	No	No	Diploma Courses
Regional Organizations Rivers Bassins OSS								

Table 5: Projects, programmes and networks involved in the assessment of African natural resources.

Programmes & Projects	Data collection, accessibility and integration			Monitoring and Assessment			Information Diffusion & Capacity Building	
	Data Collection	Data Access	Data Integration	Assessment	Monitoring	Forecast/ Early Warning	Information Diffusion	Capacity Building
Africover	Field Data EO data	Accessibility for value-added data	Processed data	Land Cover Land Use	No	No	Thematic databases	Workshops
GOFC-GOLD	EO Data							
Global Land Cover Network	No	No	No	Land Cover Land Use	No	No	No	Workshops
GLC2000	Field Data EO Data							
Globcover	EO Data	Thematic data	No	Land Cover Land Use	No	No	No	No
FAO/JRC - FRA								
AMESD	Field Data EO Data	Thematic data	No	Environmental Status	No	No	No	Short-term training Workshops
TIGER	EO Data	Yes		Water resources	Water Spatial Patterns	Flooding	DDS Stations	Short-terms training Workshops
CarboAfrica	Field Data	No	No	Carbon stock	No	No	Bulletin	Workshops
BIOTA-Africa	Field Data	No	No					

7.2. Human capacities

The current capacities to produce geospatial information in this thematic domain are unequally distributed in Africa, geographically and by type of institution. As a general rule, the stakeholders in charge of the management of the resources (forest companies, conservation NGOs, regional development agencies...) have completely integrated the use of Earth Observation for helping them in the decisions. The governmental services in charge of these issues are less prepared to produce and use the geospatial information in the definition and implementation of their policies, due to a lack of qualified human capacities and adapted infrastructure

In the domain of forestry and biodiversity, training activities consist mainly of professional training "on-project" of technicians for a specific task. At the level of graduates, there is a lack of remote sensing and GIS matters in the thematic training activities, which lead to an insufficient number of graduates (forest engineers, conservationists, rural developers...) able to use the geospatial information in an optimal way.

On the other hand, when human capacities exist, it is often underused by lack of hosting institution and facilities. In this case, the main challenge is to retain and maintain existing capacities.

7.3. Methods

Automated processing chains for extracting thematic information in forestry, biodiversity and land-cover exist for medium and coarse resolution data, but nowadays, there is no standardised methods for processing high resolution data for land-cover, land-use, and change detection.

Close to the decision-making process, there is still a need for developing expert systems for a better integration of in-situ information (including socio-economic data) with satellite-derived parameters for deriving composite indicators.

8. IDENTIFICATION OF GAPS AND OF EXISTING OR PLANNED FUNDING PROGRAMMES

8.1. Identification of gaps

In Africa, the current low level of infrastructure capacities for the collection and assessment of data, for their transformation into useful information and for their dissemination does not allow for exploiting at the optimal level the existing human capacities. GMES Africa should develop and deploy the necessary infrastructure in order to address the various sectoral thematic areas and cross-cutting issues. In order to complete regular monitoring operations, the strategy of data acquisition and collection must be comprehensive and include the various elements necessary for decision-making

- Earth Observation data covering the continent at the right resolution and accessible for the users at the acceptable price

- In-situ data regularly collected, harmonised, standardised, structured in accessible and interoperable databases. A special focus should be given to carbon tracking, biodiversity and socio-economic parameters.
- Acquisition and processing physical infrastructure.

Space-based observation

The following table details the spatial resolution, the acquisition strategy, the existing and planned capacities, and the gaps of the main EO data categories.

Table 6: Needs and gaps in terms of Earth Observation data useful for the long-term assessment of African natural resources.

Category of Data	Sensor / product	Acquisition strategy	Operational Environment (Ground Stations)	Identification of gaps
Low Resolution (300m-1km)	MSG NOAA SPOT-VGT MERIS MODIS ASAR	daily	53 African Countries AGRHYMET (Niger) RSAU (Botswana) ICPAC (Kenya) RCMRD (Kenya) CSE (Senegal)	
Medium Resolution (10-50m)	LANDSAT SPOT CBERS IRS ASTER	Complete coverage yearly	Maspalomas (Canary) Hartebeeshoek (South Africa) Aswan (Egypt) Jos (Nigeria) Malindi (Kenya)	Lack of receiving stations in large key regions (Central Africa, West Africa...)
High resolution (2-5m)	SPOT	Complete coverage 3-5 years	Murzuq (Lybia) Hartebeeshoek (South Africa) Maspalomas (Canary)	Few sensors are acquiring information but rarely on the African continent; lack of receiving stations or on-board recording
Very High resolution (<1m)		Sampling for statistical applications and validation		Few sensors are acquiring information but rarely on the African continent (low economic demand)
Radar high resolution (1-50m)		Complete coverage yearly		Lack of receiving stations in large key regions (Central Africa, West Africa...) Lack of fully validated procedures
Geodetic Measurement	GNSS GPS CORS		Hartebeesthoek EMA (Ethiopia) ECA-SROWA (Niger) CICOS (DRC) Kilimanjaro (Tanzania)	
Data Dissemination	EUMETCAST VGT4Africa ftp		53 African Countries RICs Programme / Projet	ftp transfer rate is very low in many countries

In situ observation

The in-situ component is at least as important as the Earth Observation component, since there is currently in Africa no sustained effort for systematically collecting and harmonising ground-based information on the natural resources. This category of information will serve two main uses: the calibration of EO data and validation of space-based products on the one hand, and the combination with geospatial information for providing real decision-tools on the other hand. The ultimate goal of the in-situ component would be a network of georeferenced field observations, representative of the different biophysical and human situations, statistically valid for reporting obligations and scientific models, collected according to harmonised and internationally recognised protocols and accessible to managers in simple and understandable formats. The long list of field parameters can be structured into three main categories: biophysical information, socio-economic information and management data.

Table 7: Needs and gaps in the availability of in-situ data useful for long-term assessment of African natural resources.

Biophysical parameters	Existing and planned capacities	Gaps
Soil	Carbon, Erosion, Moisture...	
Vegetation and forest	Basic forest parameters are collected in timber concessions; a network of carbon flux towers is starting under the CarboAfrica program	No network of forest inventories measurements Missing elements for biomass (allometric equations, dead wood, litter..)

			No network of phenology measurements
Biodiversity	Species inventories Habitat description	Excellent inventories exist in many protected areas Continental distribution (GBIF, IUCN)	No consolidation at national and African level for many species No systematic inclusion to GBIF or IUCN databases
Hydrology	River discharge River gauge		No recent observation in many critical basins (Congo)
Land-cover	LC attributes	Some national or regional initiatives exist (Senegal, South Africa)	No consolidated network of land-cover attributes No standardised protocol of data collection
Socio-economic parameters		Existing and planned capacities	Gaps
Population	Density, structure... Poverty		
Land tenure	Ownership		Nearly inexistent
Development	Energy Infrastructure		No information on status of transport infrastructure
Management parameters		Existing and planned capacities	Gaps
Territorial units	Protected areas, Logging concessions Mining concessions Climate projects	World Database of Protected Areas National databases for logging and mining	Global databases often obsolete Lack of accessibility of validated information
Management	Institutional capacities Efficiency		

Acquisition and processing Infrastructure

In terms of infrastructure, the access to data is still a weak point for the main users in forestry and biodiversity. In particular, the lack of receiving stations at high and medium resolution is considered as a major constraint for Central Africa and West Africa. Recent facilities installed in South Africa have drastically improved the situation in this part of the continent.

The access to coarse resolution data is facilitated by the Geonetcast system and the PUMA/AMESD receiving stations that give access to MSG, SPOT VEGETATION data and products. Other CR data (MERIS, MODIS...), freely accessible by Internet; are less accessible because of the low performance of Internet in many African countries. A detailed table of acquisition and processing infrastructure is proposed next page.

For the infrastructures dedicated to the production of added-value products for biodiversity and forestry, there is a lack of processing centres and storage of data and products, except in South Africa. Substitution solutions are found through some projects funded by USA in the frame of GOF-C-GOLD, but a real dynamics is still to build in many regions.

8.2. Future planned activities

Apart from the existing capacities already listed in section 7.1., new initiatives merit some attention.

- The Group on Earth Observations has put in place a specific working group on Biodiversity Observations, including space and field data;
- the model of OFAC is now under institutionalisation in a perennial structure funded by several donors;
- under the Intra-ACP budget line of EDF, a specific component is reserved for setting up a facility on biodiversity observations at panafrikan level;
- many programmes dealing with REDD are now trying to set up a reliable system for carbon accounting at national level, to strengthen the local capacities for monitoring, reporting and verifying the carbon fluxes, and to create the mechanisms of redistribution to the local population.

9. BUILDING GMES-AFRICA SERVICE

9.1. Service definition and provision

The generation of standard products can be envisaged in function of the current policies. However, the political context and the requirements can change in a close future due to external drivers (financial crisis, REDD, biofuels). In consequence, we will explain the main principles guiding the definition of products and concentrate on key generic multi-user proposed products. Three thematic categories of products must be realised with different coverage, spatial and temporal resolution.

(i) Near-real time monitoring systems

The systematic wall-to-wall information on seasonal trends in vegetation conditions (i.e. phenology, productivity, surface water availability and fires) is essential for characterising land-cover classes, detecting anomalies and drastic changes, and for evaluating ecosystem productivity, all components necessary for biodiversity management and carbon estimates. The biophysical parameters can have huge impact on the livelihood of local population, and on the payment of ecosystem services. This component should deliver

daily measurements of biophysical parameters, composed by periods of 10 days, and automatic detection of anomalies.

(ii) Land-cover characterisation

Two land-cover maps are recommended at continental scale following the international standards in terms of legend (LCCS-compliant), validation, and metadata:

- the regular land-cover characterisation at coarse resolution (300m) updated every 3 years locating the main land-cover types,
- the baseline map at medium resolution (20-50m) updated every 10 years, providing the baseline for land-cover change assessment.

Both products should adopt a compatible legend, with a focus on essential classes (forest resources, agricultural domain that can be related to specific ecosystem services (carbon content, biodiversity, water balance...)).

In specific regions of interest (subject to climate change debate, like the Congo Basin, or with high biodiversity patterns), the update frequency and the thematic content can be adapted in order to meet the reporting and management requirements. A specific product on the agricultural domain will be produced every 10 years at high resolution (2-5m spatial resolution)

(iii) Land-cover change estimates

The land-cover and forest-cover change estimates are necessary at national level for reporting to international conventions and for analysing general trends, and at local scale for managing the territorial units. Two different products are therefore necessary:

- national estimates based on a sampling design, with an intensity depending on the country size (from 1 degree to ¼ degree in order to get an accuracy required by UNFCCC) analysing extracts of medium resolution images every 5 years.
- local estimates with a finer spatial detail (2-5m) on specific regions of interest (i.e. protected areas, around urban settlements, logging concessions, climate projects...). In this case, the methods (sampling or the wall-to-wall, frequency, legend) will be selected according to the final objective of the estimates. For verification of forest management plans (national and FLEGT) and of reported afforestation and reforestation activities in the context of CDM and JI projects, annual mapping of forest cover disturbance at individual tree canopy level is needed on clearly identified sites.

Built upon these generic products, specific deliverables must be adapted to particular users, integrating field observation into added-value information: carbon stock and flux, biodiversity value and change maps, land suitability for energy and agriculture...

9.2. Capacity-building

9.2a Necessary elements

As in other thematic areas, the issue of capacities is critical and should be solved in a holistic manner. Different levels of capacities should be reinforced:

- technicians involved in the day-to-day management of natural resources
- technicians for the production of geospatial information
- managers of natural resources involved in the planning and implementation of policies
- high profile scientists for adapting scientific tools and methods to the African context.
- Local communities for using earth observation service into management problems solving and sustainable use of natural resources.

9.2b Strategy of implementation

According to the category, the reinforcement of capacities should take place in existing schools (forestry, fauna, rural development...) or in specific schools with a focus on Space-based technologies.

An important aspect for maintaining the African capacity to develop adapted solutions is the increase of research in these specific issues, in the frame of the Panafrican Universities.

9.3. Prioritisation of requirement and actions

The first priority for deriving reliable added-value products for the long-term management of natural resources is the installation of infrastructure acquiring and processing EO data in Africa. It should be based on the existing facilities when available and the creation of new centres when needed. In a second step, regional processing centres should be developed in each region of Africa, in order to adapt the generic GMES Africa products to each particular context. For example, the deforestation estimates should be available at national level for countries interested in the REDD process (essentially in Central Africa) and be compliant with the UNFCCC requirements.

For developing the regional processing centres, a massive effort of capacity-building must be put in the production of geo-spatial information, in specialised institutions and in thematic training institutions (agriculture, forestry, conservation).

In the mean time, the policy-makers should be trained to include geo-spatial information in their decisions by specific awareness-raising activities.

9.4. Organisational scheme

For the management of GMES Africa, a clear political vision is a pre-requisite. Thus, there is an important role to be played by the African Union and the African Regional Economic Communities (RECs). A participative approach for designing the project is needed to ensure that all stakeholders (technicians, politics and managers of various sectors) can express their view and concerns in the project.

The approach to be adopted is that of continental coordination and national implementation. For practical effectiveness, an intermediate coordinating structure should be set up in a form of a joint expert group UN-AU expanded to include key partners and scientist. During the operational phase, each partner of the network will have a role to play as part of the project implementation. Each directly involved stakeholder (technical core) should set up a project unit serving as a focal point for implementing the project's activities.

- Regional Institutions: EU, AUC, UNECA: in charge of the administrative and financial coordination and strategic orientation in conformity with the Programme's objectives.
- Sub-regional Institutions: RECs + RICs + Regional Centers of Excellence (RECTAS, RCMRD and AOCRS) : supervision of the technical activities on a daily basis
- National Agencies: CRTS, NASRDA, NARSS, SAC, CSE, etc: running the technical services in order to implement the project's activities at country level.
- Scientific partners and bilateral and multilateral co-operation partners: UNEP, FAO, CGIAR, WRI, EIS-Africa, OSS: play a role, which consists of providing support-advice, in the implementation of the project's activities as part of the already existing collaboration agreements with the institutions.
- Users: UNCCD, CBD, NGOs, CSOs: Users of the project's products include at least the technical services of the participating countries, and grassroots level users such as NGOs and local organizations.

9.5. Timetable

This long-term strategy should be articulated in 3 phases:

Phase 1 (2yrs): Exploratory phase with installation of the governance model and the political dialogue Europe-Africa, identification of pilot-products in selected areas, identification of the candidate training institutions, gap filling in HR data acquisition, identification of the model for in-situ data collection.

Phase 2 (4yrs): Pilot phase with test of exploratory products over large areas, training activities in specialised and thematic centres, awareness-raising of policy-makers, installation of national-regional processing facilities for satellite data and collection of in-situ data.

Phase 3 (4 yrs): Operational phase with provision of complete GMES services based on the pilot-products, full deployment of national and regional facilities, maintenance of a complete network of data acquisition (in-situ and satellite).

2010	Action plan adopted by Heads of State
2011	Installation of the political dialogue Installation of satellite data acquisition in missing regions
2012	Identification of regional processing and training centres Development of exploratory products
2013	Setting-up or strengthening of regional/national processing facilities
2014	Strengthening on training institutions for production of geo-spatial information
2015	Awareness-raising of policy-makers
2016	Test over large areas of exploratory products
2017	Development of operational services
2018	Full deployment of regional/national processing facilities
2019	Maintenance of acquisition infrastructure and processing facilities
2020	Amplification of the capacity-building activities

9.6. Indicative development plan and budget estimate

Taking into consideration the current state of capacities and the existing cost for existing regional centres, the first estimates for this component are

Phase 1: 10 M EUR

Phase 2: 15 M EUR

Phase 3: 20 M EUR

10. RECOMMENDATIONS

A sound management of natural resources, in particular forest and biodiversity, is necessary for guaranteeing the livelihood of huge populations on Africa and for maintaining the long-term ecosystem services. The recommendations for the GMES Africa programme related to the long term management of natural resources, with respect to data, products and capacities, are the following:

Data acquisition and processing

- an effort must be put in place for acquiring yearly cloud-free medium resolution images over the entire continent. Receiving stations must be installed in critical regions;
- the flow of coarse resolution images and products must be maintained by the current processing facilities (CTIV, LandSAF) and dissemination infrastructure (Geonetcast)
- A structured network of in-situ observations must be put in place on carbon, biodiversity, land use and tenure, taking profit on the starting initiatives

Products

- Information produced should combine near-real time monitoring systems, land-cover characterisation and land-cover change estimates
- Two scales should be targeted; the regional and national scales by coarse resolution maps and statistical estimates based on sample of medium resolution images, while the local information will be produced at medium and high resolution on selected areas

Capacity-building

- The capacities should be reinforced at all steps of the decision chain, from the production of information to the integration of the information in the decision process.
- The different levels should be targeted: technician, manager and high-level scientist

Institutional dialogue

- The regional information centres are the best level for developing the appropriate information and to discuss it with the decision-makers

To reach these different objectives, several implementation steps should be envisaged by the donor community:

- Consolidation of existing regional and national institutions by projects and programs funded by EU (EDF or budget) in the most appropriate mechanism. Examples like the Pan African AMESD or OFAC in Central Africa (Observatoire des Forêts d'Afrique Centrale) can provide first models to consider and learn from. In all cases, a solid link of technical implementation centres with the political institutions in charge of the management of natural resources is a key element of success.
- The above-mentioned projects and programs must strengthen the co-operation between European and African information producers (scientific community, universities and implementation centres) and users (political institutions). GMES Europe can provide some lessons in that respect for the system architecture and the implementation mechanisms.
- Targeted applications and institutions must be privileged in a first time (community of users well identified) with a further broadening of the spectrum of activities.
- As the main issues are common at regional level, it should be preferable to develop strong regional centres, with a good link with national services. The Panafrican scope of the monitoring systems could be ensured by a specific bureau, in liaison with the AUC.
- The financial and technical partners of GMES Africa should also envisage the permanent dialog with other programs involved in the long-term management of natural resources (SERVIR-Africa, CARPE, CBERS...)

11. SUMMARY

Ecosystem services provided by natural resources in Africa allow for the subsistence of nearly 90% of the population. On the other hand, African environment is essential for maintaining a stable climate and a biodiversity reservoir for the entire planet. For these local needs and the payment of the global services, a permanent monitoring of forests, rangelands and protected areas is required. When information systems are missing, reliable information to support management decisions is not readily available and accessible as it could be, and paradoxically donor institutions tend to privilege more immediate activities, maintaining the information gap for future decisions.

In this context GMES and Africa represents a unique opportunity to:

- Ensure data acquisition at the right scale (5-10 m for forest monitoring) and the right delivery time for long-term management of natural ecosystems (annual complete coverage at minimum);
- Develop processing facilities at national and regional level, able to produce updated information for the new challenges and opportunities (climate, forest management, biodiversity). The regional centres should be linked to political institutions.
- Build on existing human capacities in specialised schools of forestry and conservation and in training centres dedicated to geospatial information.
- Develop operational services for improving the decision making processes in the long-term management of natural resources in Africa

The programme can build upon existing regional initiatives, like OFAC in Central Africa, or national institutions, like the CSIR in South Africa or the CSE in Senegal.

The general policy-drivers are clear in this domain starting from the international conventions to the local management of resources. GMES Africa can give a general framework for the cooperation between Europe and Africa, but the concrete dialog between the different stakeholders is still missing. On the other hand, other stakeholders (USA, Brazil, Asia) are also involved in this process and should be consulted.

A 10-year three phase implementation strategy is proposed including an exploratory phase (2 years) followed by a scaling up period of 4 years and a final operational phase of 4 years. The budget proposed for each phase is 10 m, 15 m and 20 million Euro respectively.

LIST OF ACRONYMS

AARSE	African Association of Remote Sensing for the Environment
ACDI	Agence Canadienne de Développement International
AfDB	African Development Bank
AGRHYMET	Centre Régional de Formation et d'Application en Agrométéorologie et en Hydrologie Opérationnelle
AMCEN	African Ministerial Council Conference on Environment
AMCOST	African Ministers' Council on Science and Technology
AMCOW	African Ministers' Council on Water
AMU	Arab Maghreb Union
AMESD	African Monitoring of Environment for Sustainable Development
AOCRS	African Organization of Cartography and Remote Sensing
ASAR	Advanced Synthetic Aperture Radar
ASARECA	Association for Strengthening Agricultural Research in Eastern and Central Africa
ASTER	Advanced Spaceborne Thermal Emission and Reflection Radiometer
AU	African Union
AUC	African Union Commission
AVHRR	Advanced Very High Resolution Radiometer
CAADP	Comprehensive Africa Agriculture Development Programme
CARPE	Central African Regional Program for the Environment
CBD	Convention on Biological Diversity
CBERS	China-Brazil Earth Resources Satellite
CENATEL	Centre National de Télédétection (Benin)
CERGIS	Centre for Remote Sensing and Geographical Information Systems (Ghana)
CGIAR	Consultative Group on International Agricultural Research
CICOS	Commission Internationale du Bassin Congo-Oubangui-Sanga
CORAF	Conseil Ouest et Centre africain pour la recherche et le développement agricoles
CR	Coarse Resolution
CRTS	Centre Royal de Télédétection Spatiale (Maroc)
CSE	Centre de Suivi Ecologique (Sénégal)
CSIR	Council for Scientific and Industrial Research (South Africa)
CSO	Civil Society Organisations
CTIV	Centre de Traitement des Images Vegetation
DBH	Diameter Breast Height
DDS	Data Dissemination System (ESA satellite-based Earth Observation)
DMP	Dry Matter Productivity
ECA	Economic Commission for Africa (United Nations)
ECA-SROWA	Economic Commission for Africa – Sub-Regional Office for West Africa
ECCAS	Economic Community of Central African States
ECOWAS	Economic Community of West African States
EDF	European development Fund
EIS-AFRICA	Environmental Information Systems in Africa
EMA	Ethiopian Mapping Agency
EO	Earth Observation
EU	European Union
EUMETCAST	EUMETSAT's Broadcast Service for Environmental Data
EUMETSAT	European Organisation for the Exploitation of Meteorological Satellites
FAO FRA	UN Food and Agriculture Organisation - Global Forest Resources Assessment
FARA	Forum for Agricultural Research in Africa
FLEGT	Forest Law Enforcement Governance and Trade
GBIF	Global Biodiversity Information Facility
GEO	Global Earth Observation
GLC2000	Global Land Cover 2000
GMES	Global Monitoring for Environment and Security
GNSS	Global Navigation Satellite Systems
GOFC-GOLD	Global Observation of Forest Cover – Global Observation of Land Dynamics
GPS / CORS	Global Positioning System / Continuously Operating Reference Stations
ICPAC	IGAD Climate Prediction and Applications Centre
IGAD	Intergovernmental Authority on Development

IRD	Institut de Recherche pour le Développement (France)
IRS	Indian Remote Sensing satellites
ITC	International Institute for Geo-Information Science and Earth Observation
IUCN	International Union for Conservation of Nature
JRC	Joint Research Centre
LANDSAT	Land Satellite
MERIS	Medium Resolution Imaging Spectrometer
MODIS	Moderate Resolution Imaging Spectroradiometer
MSG	Meteosat Second Generation
NARSS	National Authority for Remote Sensing And Space Sciences (Egypt)
NASRDA	National Space Research & Development Agency (Nigeria)
NDVI	Normalised Differential Vegetation Index
NESDA	Network for Environment and Sustainable Development in Africa
NGOs	Non-governmental Organizations
NOAA	National Oceanic and Atmospheric Administration
OAB	Organisation Africaine du Bois
OFAC	Observatoire des Forêts d'Afrique Centrale
OIBT	Organisation Internationale des Bois Tropicaux
OSS	Observatoire du Sahara et du Sahel
PUMA	Préparation à l'Utilisation de Meteosat en Afrique
RAPAC	Réseau des Aires Protégées d'Afrique Centrale
RCMRD	Regional Center for Mapping of Resources for Development
RECs	Regional Economic Communities
RECTAS	Regional Centre for Training in Aerospace Surveys
REDD	Reducing Emissions due to Deforestation and forest Degradation
RICs	Regional Implementation Centres
ROPPA	Réseau des Organisations Paysannes et des Producteurs de l'Afrique de l'Ouest
RSAU	Remote Sensing Applications Unit (SADC)
SAC	Satellite Application Centre (South Africa)
SADC	Southern Africa Development Community
SAF	Satellite Application Facilities
SERVIR	Regional Visualisation and Monitoring System
SISEI	Système d'Information et de Suivi de l'Environnement sur Internet
SPIAF	Service Permanent d'Inventaire et d'Aménagement Forestier (Dem. Rep. Congo)
SPOT	Satellite pour l'Observation de la Terre
UN	United Nations
UICN	Union Internationale pour la Conservation de la Nature
UNDP	United Nations Development Programme
UNECA	United Nations Economic Commission for Africa
UNEP	United Nations Environment Programme
UNCCD	United Nations Convention to Combat Desertification
UNFCCC	United Nations Framework Convention on Climate Change
UNISPACE III	United Nations Conference on the Exploration and Peaceful Uses of Outer Space
USA	United States of America
USAID	United States Agency for International Development
USGS	United States Geological Survey
WB	World Bank
WRI	World Resources Institute
WSSD	World Summit on Sustainable Development
WWF	World Wildlife Fund

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THE GLOBAL MONITORING FOR ENVIRONMENT AND SECURITY (GMES) AND AFRICA ACTION PLAN

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4. INTRODUCTION

4.1 Thematic Content

With ca. 35.000 km of coastline, coastal and marine environments play a vital role in the economy and society of many African countries, contributing significantly to reducing the national balance of payments deficit, creating employment and meeting the protein needs of the local population. According to NEPAD (2005), the fishery sector provides vital contributions to food and nutrition security for 200 million people in Africa. Moreover, in several countries, fish-related food represents over 60% of the total protein intake. The biodiversity and natural assets of the African coast offer an ideal tourist destination to many people worldwide, giving substantial economic benefit including the creation of many jobs for men and women. In some countries, specifically Small Island Developing States (SIDS), tourism represents the largest employer making large contribution to the Gross Domestic Product, e.g. up to 60% in Seychelles (WTTC 2005).

In recent years both the increasing urban population occupying a narrow coastal margin (ca. 50% of the population lives within 100 km of the coast) and industrial development have created negative trends on the coastal environment and marine resources. The deterioration of water quality is severe around large cities (Dakar, Abidjan, Conakry, and Lagos). Land-based management (inducing soil erosion and deforestation) has promoted massive sediment inputs in the coastal zone, often degrading coastal habitats and reducing water productivity. Areas of high biodiversity such as mangrove forests and coral reefs have been severely impacted by coastal developments and natural hazards, with a net loss of several hundred thousands of hectares over the last 25 years.

Overfishing over four decades, whether illegal or through excessive international trade agreements, has contributed to an important decline in fish stocks, particularly off West Africa. By 2002, the biomass of demersal stocks in Northwest African coastal and shelf waters had been reduced to a quarter of its level in 1950 (OECD 2007), destabilizing the economy of several countries that rely on fisheries to achieve up to 20% of their gross domestic product. Overfishing is exacerbated by changes in the physical and biological environment resulting from climate variability and climate change.

According to the Intergovernmental Panel for Climate Change (IPCC), *“Africa is one of the most vulnerable continents to climate change and climate variability, a situation aggravated by the interaction of multiple stresses, occurring at various levels, and low adaptive capacity”* (Boko et al 2007). Coastal erosion in the Gulf of Guinea, including Ivory Coast, Ghana, Togo, Benin and Nigeria, has been linked to climate change, and in turn to rising sea levels. Projected sea level rise would increase coastal flooding, endangering even more the population and economy of continuously growing coastal megacities, and causing important damages on extremely valuable productive ecosystems in transitional waters due to an increased of salinity.

4.2 Pressures/Constraints.

In spite of the great potential of satellite data to achieve unprecedented instant examination of the marine and coastal waters around Africa, several constraints have been identified by the community to use these data operationally. These constraints are specifically a relatively poor access to data, limited frequency of measurements, lack of appropriate infrastructure, absence of local calibration/validation programmes (in situ

measurements), as well as an inadequate analysis and information dissemination approaches to communities outside the research system. It is clear that there is still a wide gap between the potential user community for marine information in Africa and the means for delivering and analyzing that information from currently planned Earth Observing missions

The sustainable use of the coastal and marine environment in Africa requires the development at continental scale of an integrated coastal analysis and monitoring system. The subsequent application over large marine areas of integrating Earth Observations data and field surveys can then be embedded into a high quality, useful geographic information system on water quality and coastal resource exploitation, supported by a consistent user-driven management structure and continuous funding mechanism. **The GMES Africa Service for Marine and Coastal Areas**, proposed in this Chapter, will provide such a system.

5. POLICY DRIVERS AND NEEDS ANALYSIS:

5.1 Policy Drivers

Global Environment Conventions have been enacted which are particularly relevant to Africa's needs. These have been complemented by Regional Conventions within Africa that address local priorities. All seek progress on sustainable development and ongoing prosperity for the people of Africa. GMES Africa will be at the forefront of providing the direct means through which the objectives are achieved and from which the benefits will flow.

Global Conventions of Relevance to Africa:

- The United Nations Convention on the Law of the Sea (1982) set down the rights and duties of coastal nations within their Exclusive Economic Zones.
- The United Nations Conference on Environment and Development, UNCED Rio de Janeiro, June 1992 led to the formation of the various Global Observing System initiatives, for the land, ocean and for climate, to the formation of the Alliance of Small Island Developing States, and to the United Nations Convention on Biological Diversity committed to the establishment of marine protected areas.
- The World Summit on Sustainable Development (WSSD Johannesburg 2002) sought to protect and manage the natural resource base of economic and social development.
- The WSSD also provided the platform for the Group on Earth Observations (GEO) to establish its Global Earth Observation System of Systems (GEOSS), which is addressing nine societal benefit areas (SBAs) of critical importance to people and society. It aims to empower the international community to protect itself against natural and human-induced disasters, understand the environmental sources of health hazards, manage energy resources, respond to climate change and its impacts, safeguard water resources, improve weather forecasts, manage ecosystems, promote sustainable agriculture and conserve biodiversity.
- Established in 1997, the Small Island Developing States network has been designed to improve globally sustainable development of small island States through enhanced information and communication technology

Pan African Conventions and the National Legislative Framework

A series of Regional Conventions have addressed local priorities around the entire coast of Africa;

- Barcelona Convention (1976) for the protection of the Mediterranean Sea against pollution.
- Abidjan Convention (1981) for the protection and development of the marine and coastal environment of the West and Central African Region.
- Jeddah Convention (1982) for the Conservation of Red Sea and Gulf of Aden environment.
- Nairobi Convention (1985) for the protection, management and development of the marine and coastal environment of the Eastern African region

Implementation of these Conventions is a priority for African nations and requires the reinforcement of research and operational infrastructures and the further development of existing capabilities.

The Cape Town Declaration (December 1998) sets out an African Process for the Development and Protection of the Coastal and Marine Environment, thereby strengthening the two sub-Saharan Conventions (Abidjan, Nairobi) with joint implementing mechanisms through the establishment of a continent-wide Commission on Sustainable Development (in relation to Agenda 21 of UNCED). This led directly to the formation of Pan African programmes in marine and coastal areas, such as the Global Ocean Observing System in Africa and the Ocean Data and Information Network in Africa. This has also led to supporting initiatives from the African Commission

of the African Union, the New Partnership for African Development through its Development Action Plan for the Marine and Coastal Environment, and the African Regional Economic Communities.

At a national level, each coastal country has enacted its own legislation to protect its marine and coastal areas. At the same time, each country recognises the value of seeking regional cooperation to address common needs and priorities through national contributions to the Regional Convention Funds and a reinforced cooperation through the Regional Economic Commissions.

5.2 Need Analysis

As operational oceanography grows scientifically and expands as a practical discipline in all Africa, the demand is increasing for data and information relevant to understanding the marine ecosystem at the continental level, unravelling the functions of the marine environment in a changing climate, and sustainable management of marine resources.

The implementation of Conventions, legislations, policies is a priority for African nations and requires the reinforcement of research and operational infrastructures and the further development of existing capabilities. There is a need for national and regional networking, image data acquisition and exchange, as well as the establishment of regional remote sensing databases that would efficiently support the implementation of national, regional and continental marine environmental programmes. Efficient networks would provide practical information on marine ecosystems for use at national and regional scales from a combination of Earth Observation data from satellite and in situ observations.

6. IDENTIFICATION OF COMMUNITIES

International:

United Nations agencies	UNESCO Intergovernmental Oceanographic Commission, UN Division of the Law of the Sea, UNEP Regional Seas, Programme, UNDP Marine BioDiversity Programme, World Meteorological Organisation, Food and Agriculture Organisation Fisheries
International bodies	International Maritime Organisation, International Hydrographic Organisation, Joint Commission on Oceanography and Marine Meteorology, European Commission, Group on Earth Observation Coastal Zone Community of Practice
Donor community	European Commission Framework Programme, Global Environment Facility International Waters, the World Bank
International conventions	UN Convention on Law of the Sea, UN Framework Convention on Climate Change, UN Convention on the Environment and Development, the London Dumping Convention, CCAMLR, International Commission for the Conservation of Atlantic Tuna, RAMSAR Convention, Safety of Life at Sea Convention

Pan African:

GMES Africa, African Union, Commission of the African Union, New Partnership for African Development

Regional:

Regional conventions	Abidjan and Nairobi Convention Clearing Houses
Economic communities	Economic Community of West African States, Southern African Development Community, Indian Ocean Commission, Economic Community of Central African States.
Regional bodies	Benguela Current Commission, Pan African Large Marine Ecosystems, South East Atlantic Fisheries Organisation,
Professional Associations	African Association for Remote Sensing of the Environment, Western Indian Ocean Marine Science Association, EIS Africa.

National:

Government departments	Navies, Environment, Fisheries and Marine Resources, Coastal Zone Planning, Minerals and Energy, Ports and Harbours, Coastguard, Marine Pollution, Maritime Surveillance
Offshore industry associations	Oil and Gas, Fisheries (coastal, deep sea, shellfish), Mining (diamonds, mineral sands, salt), Shipping, Coastal Tourism
Provincial Bodies	Coastal Planning and Environment

Key Academic and Research Institutions

There are a number of institutions around the coast of Africa that play an important role in both research and academic training. They are the centres at which many of the activities and programmes in the list above are based, and from which much of the marine and coastal capacity building for Africa is carried out. National Universities are also managing a range of research and development facilities dedicated to the marine and coastal environment.

7. MAPPING EXERCISE

The development and implementation of a GMES-Africa programme in Marine and Coastal Areas will build upon existing components and facilities, taking into account current developments specifically addressing African waters or with a global focus including applications around Africa.

Programmes and Services.

The emphasis here is on regional programmes and services that cut across national boundaries, arranged by application area. Each country has its own projects that contribute to the total effort within the marine and coastal areas of Africa.

	Coastal Programmes	Supporting Institutions	
ACCC-Africa	Adaptation to Climate and Coastal Change in West Africa	GEF/UNDP	www.accc-afr.net
CORDIO	Coastal Oceans Research and development in the Indian Ocean	IUCN, WIOMSA, World Bank, FAO,...	www.cordioea.org
ReCoMaP	Regional Programme for the Sustainable Management of the Coastal Zones of the Indian Ocean Countries	EU	www.progeco-oi.org
WIO-LaB	Addressing land-based activities in the Western Indian Ocean	GEF/UNEP	www.wiolab.org
RCMP	Regional Coastal and Marine Conservation Programme for West Africa	WWF/IUCN	
AMA	African Marine Atlas for coastal resource managers	FUST/IOC-UNESCO	www.africanmarineatlas.net
NASRP	IUCN North Africa Sub-Regional programme	IUCN	www.iucn.org
	Gulf of Gabes Marine and Coastal Resources Protection project	GEF	
	Marine Protected Areas		
AMP-COI	Marine Protected Areas of the Indian Ocean Commission	WWF/COI	www.amp-coi.org
TRANSMAP	Transboundary networks of marine protected areas in East Africa	EU	http://transmap.fc.pt
	Pollution		
PUMPSEA	Peri-urban mangrove forests as filters of domestic sewage in East Africa	EU	www.pumpsea.icat.fc.pt
WIO Marine Highway	Western Indian Ocean Marine Highway Development and Coastal and Marine Contamination Prevention Project	GEF/WB/COI	www.iwlearn.net
	Large Marine Ecosystems		
SWIOFP	South West Indian Ocean Fisheries Project	GEF/WB	www.swiofp.org
ASCLME	Agulhas and Somali Current Large Marine Ecosystem	GEF/UNDP	www.asclme.org
GCLME	Guinea Current Large Marine Ecosystem	GEF/UNDP	www.gclme.org
BCLME	Benguela Current Large Marine Ecosystem		www.bclme.org
SPMLME	Strategic Partnership for the Mediterranean Large	GEF/UNEP	www.medsp.org

	marine Ecosystem		
	Remote Sensing Servers		
AMIS	Africa Marine Information System	EU-JRC	www.amis.jrc.ec.europa.eu
RSSMS	Remote Sensing Server for Marine Sciences in Africa	DST-SA	www.afro-sea.org.za
NEODAAS	NERC Earth Observation Data Acquisition and Analysis Service	NERC	www.neodaas.ac.uk
	Observation Networks		
	Nairobi Convention Clearing House Mechanism	UNEP	www.unep.org
ODINAFRICA	Ocean Data and Information Network for Africa	FUST/IOC-UNESCO	www.odinafrica.org
GLOSS	Global sea level observing system in Africa	IOC-UNESCO	www.gloss-sealevel.org
	African sea level network	FUST/IOC-UNESCO	www.sealevelstation.net
AMESD	African Monitoring of the Environment for Sustainable Development	EU/COI	www.amesd.org
ChloroGIN	Chlorophyll Global Integrated Network in Africa	GEO	www.chlorogin.org
DevCoCast	GEONETCAST for and by developing countries	EU	www.itc.nl
SIMORC	System of Industry Met-Ocean data for the Offshore and Research Communities	OGP	www.simorc.org

Capacity Building

Many of these programmes include a strong building capacity component in the form of training courses regularly conducted in different places in Africa, or on-line tutorial addressing specific EO techniques and its applications. Training activities are crucial to help users exploit satellite data in most effective way. Other examples of programmes and key institutions in Africa are listed below:

	Capacity Development		
Coast-Map-IO	Improving Emergency Response to Ocean-based Extreme Events through Coastal Mapping Capacity Building in the Indian Ocean	IOC-UNESCO	www.ioc-cd.org
IOC-CD-WIO	Capacity Development Programme for the Western Indian Ocean	IOC-UNESCO	www.ioc-cd.org
Ocean Teacher	A training resource for Oceanography and Marine Meteorology	IOC-UNESCO	www.oceanteacher.org
CERGIS	Centre for Remote Sensing & Geographical Information, University of Ghana		
RECTAS	Regional Centre for Training in Aerospace Surveys (regroup Benin, Burkina, Cameroon, Ghana, Mali, Niger, Nigeria, and Senegal)	UN	www.rectas.org
University of Abomey-Calavi (Benin)	International Chair of Mathematical Physics and Applications. University	IOC-UNESCO UPS (France) IRD (France)	
ACCESS	African Centre for Climate and Earth System Science	UCT, Princeton Univ., Third World Academy of Science (Trieste)	www.africacimatescience.org
CRTEAN	Centre Regional de Teledetection des Etats de l'Afrique du Nord (North African Centre for Remote Sensing)	Algeria, Egypt, Lybia, Morocco, Mauritania, Sudan, Tunisia	

Funding instruments / potential donors

DST-SA	South African Department of Science and Technology	National
NERC	National Environmental Research Council of the United Kingdom	National
FUST	Flanders UNESCO Trust Fund	Regional
COI	Indian Ocean Commission	Regional
ECCAS	Economic Community of Central African States	Regional
COMESA	Common Market of Central African States	Regional

ECOWAS	Economic Community of West African States	Regional
SADC	Southern African Development Community	Regional
UMA	Union du Maghreb Arabe	Regional
WIOMSA	Western Indian Ocean Marine Science Association	Regional
EU	European Commission	Europe
UNDP	United Nations Development Programme	Global
UNEP	United Nations Environment Programme	Global
IOC-UNESCO	Intergovernmental Oceanographic Commission of UNESCO	Global
IUCN	World Conservation Union	Global
WB	World Bank	Global
GEF	Global Environment Facility	Global
WWF	World Wildlife Fund	Global
GEO	Group on Earth Observations	Global
OGP	Association of Oil and Gas Producers	Global

8. GAPS, SUITABLE PROGRAMMES and FUNDING INSTRUMENTS

8.1 Gaps

There are few operational programmes in position in the marine and coastal areas of Africa, just pre-operational and pilot projects. What exists are fragmented projects, lacking cohesion and without any integrated operational Africa-wide framework. It will be important to structure new initiatives as integrated programmes, with the necessary coordination support, extending throughout Africa and fully operational. An example could be a pan African network of coastal sentinel stations, gathering *in situ* observations of value to the local user community and to an Africa-wide Coastal Zone Community of Practice.

Elements that need strengthening include:

- *In situ* measurements in their own right, and as ground truth in support of satellite observations.
- Effective dissemination of value added products, in real time, and taking advantage of new and developing broadband links both within Africa and around the coast of Africa.
- A strong capacity building programme is needed, but effective maintenance and utilisation of existing capacity is the prerequisite.

8.2 Existing or planned thematic funding programmes

The European Union CORDIS provides a Practical Guide to funding opportunities in Research and Innovation, (see <http://cordis.europa.eu/eu-funding-guide/>). It is then possible to navigate through the Practical Guide and identify funding opportunities relevant to Global Monitoring for Environment and Security in Africa, in particular with respect to marine and coastal areas. Related funding programmes include Earth Observation opportunities announced by the European Space Agency and by EuMetSat. In a broader context, are the initiatives under the Global Earth Observation System of Systems, whilst regional African opportunities arise as part of the Pan African Large Marine Ecosystems, funded through the Global Environment Initiative to assist developing nations worldwide.

Programmes that have been funded under these initiatives include:

- 1. African Monitoring of the Environment for Sustainable Development, funded through regional thematic actions for the development of coastal and marine management in the Western Indian Ocean.**
- 2. The Guinea Current Large Marine System involving sixteen countries of West Africa.**
- 3. The Europe Africa Marine Network, funded through the Coordinating and Support Actions of European Union International Cooperation.**
- 4. The DevCoCast programme of infrastructure support for satellite transmission of remote sensing products, extending GEOSS GeoNetCast across the countries of Africa.**

All of these initiatives, and the funding programmes utilised, have a strong capacity development emphasis, entirely appropriate for empowerment within GMES Africa in the marine and coastal areas of Africa.

9. BUILDING THE GMES AFRICA SERVICE

9.1 Service Definition and Provision:

Coastal and marine environments play a vital role in the economy and society of many African countries, contributing significantly to reducing the national balance of payments deficit, creating employment and meeting the protein needs of the local population. The sustainable use of the coastal and marine environment in Africa requires the development at continental scale of an integrated coastal analysis and monitoring system. The subsequent application over large marine areas of integrating Earth Observations data and field surveys can then be embedded into a high quality, useful geographic information system on water quality and coastal resource exploitation, supported by a consistent user-driven management structure and continuous funding mechanism.

Earth Observations (GEO) can address societal benefit areas of critical importance to people and society through:

- Providing protection against natural and human-induced disasters,
- Understanding the environmental sources of health hazards,
- Managing energy resources,
- Responding to climate change and its impacts,
- Safeguarding water resources,
- Improving weather forecasts,
- Managing ecosystems,
- Promoting the sustainable utilisation of marine living resources, and
- Conserving marine and coastal biodiversity.

Moreover, it will be important to encourage the use of Best Practice in marine and coastal applications to societal benefit areas, and in developing networks to achieve these objectives.

This can be accomplished through the implementation of an operational, integrated service, built on existing programmes, and available throughout Africa. The Service should be:

- Pan African, reaching to all the coastal countries of Africa.
- Operational, utilizing Earth Observations from space agencies
- Comprehensive, an end-to-end service from observations, through analysis and forecasts, to the dissemination of value-added products.
- Built on existing research projects and pilot programmes.
- Maintained and operated by Africans, through developing and utilizing the necessary African capacity in African Centres of Excellence.
- Based on a governance scheme that ensures effective consultation process with all stakeholders.
- Relying on a continuous funding process so as to maintain long-term sustainability of the Service.

9.2 Capacity Building

9.2a Necessary elements

Institutions, Human capacity and skills training

There are serious gaps in the capacity of the countries in Africa to cope with the pressures arising in marine and coastal areas. Without addressing these gaps, the continent will fall further behind in its ability to respond to the challenges in societal benefit areas. As well as developing the necessary skills in people, especially through exposure to an integrated observing system, there needs to be a parallel investment in infrastructure within relevant institutions across the continent.

9.2b Strategy to develop the necessary elements

Capacity building must take on an “operational” profile, enabling nations to implement the marine and coastal services required by society, maintaining the vital links to science, technical infrastructure and international cooperation. It must be based on identified priorities as well as the utilisation of shared observations and data resources, and shared technical and scientific service tools. Not all of these background conditions are adequately present today. However, experience from existing services, the availability of data and sophisticated numerical models, and the expanding use of Internet technology provide the prospect of rapid implementation of marine and coastal systems.

The capacity building activities must find a balance between front-running high technology, and the realism needed for robust and sustained systems. The aim must be to make nations optimally self-sufficient in using ocean and coastal observing systems to protect the economic benefits to society from the coastal oceans. Full use should be made of support for capacity development in Africa provided by the programmes sponsored by the European Union and the Group on Earth Observations.

It will be necessary to form strong links in an Africa-wide network, comprising such elements as regional maritime Industries, local and federal governments and their coastal and marine research establishments, and to the Regional Economic Commissions. Professionally trained and empowered scientific, technical and management staff will be needed to generate, disseminate and utilise marine and coastal products of value to the people of Africa.

9.3 Prioritisation of Requirements and Actions

The Proposed GMES-Africa Service for Marine and Coastal Areas

The GMES Africa Service for Marine and Coastal Areas will be an operational, integrated service, building on existing programmes, and available throughout Africa. The structure of this Service should be founded on the following components:

A GMES Africa Network of Regional Early Warning Centres

A major need lies in the provision of value added products to the various user communities around the coast of Africa.

- State of the marine environment reporting, headed by satellite derived sea surface temperature, in real time and forecast mode for use by both the public and the private sector, on the coast and in the offshore zone.
- Operational coastal sea level, coastal circulation and coastal sea states, particularly downscaled to localities at risk. The products should be in a user-friendly format, having been interpreted for the relevant user communities: coastal flooding and coastal erosion events for planners and coastal managers, and coastal circulation for the offshore oil and gas industry, ports, shipping and for safety at sea.
- Operational biological productivity, low oxygen and harmful algal bloom as part of ecosystem health reporting from Long Term Ecosystem Research (LTER) observational networks, for coastal and marine resource managers.
- Coastal sensitivity atlases and state of environment reporting for coastal land use planners, city managers, and the beach resort and tourism industry.

Offshore industries, such as oil and gas producers, often require detailed products based on very specific observations, to help in ensuring safe operations in a hostile marine environment. However, many observations can lead to products that are of interest to multiple user communities. The leisure and tourism industry can make immediate use of many of the products generated for users in the public sector. The GMES Africa Network of Regional Early Warning Centres would rely on other operational facilities providing relevant observations, archives of historic data, powerful computer platforms and the means to disseminate the products in an effective manner. In addition, a strong capacity development programme would be needed. These are considered one by one.

A GMES Africa Network of Marine Remote Sensing Centres

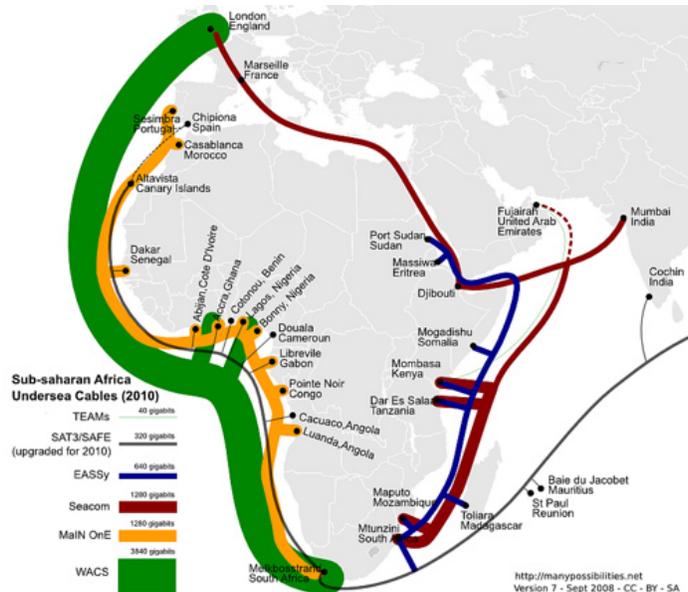
These regional centres would be the fully operational successors to various existing pilot facilities such as www.amis.jrc.ec.europa.eu and www.rsmarinesa.org.za which enable maps and statistics of various parameters to be displayed at continental scale and for selected regions. The development of new satellite products at an operational level, for example colour products for marine biological purposes, would be initiated and would be closely linked to the new generation of satellites from space agencies, including EUMETSAT and ESA. These centres would form an African Marine Remote Sensing Core Service, operating under the auspices of GMES Africa

A GMES Africa Network of Coastal Sentinel Stations

These coastal sentinel stations will be established at key locations around the coasts of Africa, and would be responsible for the collection of *in situ* observations. Mega cities, ports and areas of offshore industrial activity are clear examples of priority locations. The measurements from these stations would be of value in their own right, and as ground truth in support of satellite observations. The network would build on existing networks, such as the real time sea level observations from the African sector of www.sealevelstation.net . However, they will also add key elements to the existing suite of coastal observations, and operate with common objectives using common observational tools and infrastructure, and with common ground and satellite links. Regional needs will influence the priorities under which the various coastal sentinel stations will develop their capabilities. This network would form the basis of an African Coastal Core Service operating under the auspices of GMES Africa, which would fill a critical infrastructure capacity gap in the marine and coastal areas of Africa.

Supporting platforms will be needed to ensure that the GMES Africa Service can operate effectively. A Data Management Platform will be needed for the quality control of all observational data, for the archiving and retrieval of historic data, and for the generation of climatologies to place the products into a reliable context. A Marine and Coastal Modelling Platform will be needed to house the computing power and modelling software for the development of (prognostic) dynamic models and (diagnostic) empirical-statistical models for effective forecasting products. Extensive capacity building will be needed to ensure that these Platforms are utilised effectively.

Rapid uptake of the advantages of new communication technology, for example www.euroafrica-ict.org, will be needed. The initiatives aimed at increasing bandwidth across and around Africa provide new opportunities to ensure the speedy dissemination of value added products. A key example is making use of the various new fibre optics cables, which comprise the round Africa marine information highway due to be in place in 2010 (see figure).



The African component of the DevCoCast project is an important existing initiative to help in the distribution of various marine remote sensing products across Africa. Chlorophyll products derived from colour remote sensing imagery will be used as a demonstration of its effectiveness (the Chlorophyll Global Integrated Network). Both these projects already illustrate the values of cooperation between Europe and Africa. Within GMES Africa, it will be important to prioritise the extension of DevCoCast into fully operational mode.

A GMES Africa Capacity Development Network of Higher Education Institutions

This Network is the final link in the chain of Networks proposed for GMES Africa. The priorities within this Capacity Development Network should not only emphasise the building of new capacity in Africa, but also the effective utilisation of existing capacity. As well as to the chain of GMES Africa Regional Networks, the Network of Higher Educational Institutions should form strong links to regional maritime Industries, to local and federal governments and their coastal and marine research establishments, and to the Regional Economic Commissions. Professionally trained and empowered scientific, technical and management staff will be needed to generate, disseminate and utilise marine and coastal products of value from the GMES Africa Service.

How Can GMES Africa Be Made More Effective?

Regional Centres as Focal Points of Networks

Regional Centres should be developed within each region of Africa in order to provide the GMES Africa Service to all the countries of the region. This can be illustrated with the following list of regions, using the relevant Large Marine Ecosystems as examples, and listing some of the priority offshore interests of each region.

- **Southern Africa:** Temperate coastal areas subject to extreme weather events from the sea. Maritime industries, such as fisheries and diamond mining, and regional trade and shipping form important contributions to the economies of this region.
- **East Africa and the Tropical Western Indian Ocean Islands:** The Agulhas-Somali Current Large Marine Ecosystem is active in ensuring the long term productivity of its marine resources. Coral and mangrove ecosystems, and coastal tourism and the leisure industry are important in this region. Extreme and recurrent meteorological forcing often leads to additional perturbation of the marine ecosystems in these regions.
- **Tropical West Africa:** The Guinea Current Large Marine Ecosystem is active in the seventeen coastal countries of this region. Mega cities in an increasingly populated coastal zone, vulnerable to the impacts of global change, are a critical challenge. The dominant contribution to the economies of countries from Ghana to Angola is the production of oil and gas from the offshore oil fields.
- **Far West Africa:** The new Canary Current Large Marine Ecosystem will assess the potential of its coastal fisheries and offshore mining industries.
- **North Africa:** These countries from Morocco to Egypt are part of the Mediterranean Large Marine Ecosystem and benefit from European Union Mediterranean initiatives.

Build and Strengthen Flagship Programmes

Key programmes need to be consolidated to promote cross-border cooperation by using knowledge currently existing in centres of excellence; and to generate a critical mass of scientific and technological expertise.

For instance, ChloroGIN is already providing a focal point for development of international collaboration, networking and capacity building. ChloroGIN partners from Africa and Europe are participating in the EU DevCoCast (GEONETCast applications for and by Developing Countries) project, which uses the GEONETCast concept to provide satellite data on chlorophyll-a, ocean colour and SST from MODIS, AVHRR and MERIS from regional data providers in South Africa and Europe to countries in Africa (Namibia, Tanzania, Ghana and Senegal) and South America (Brazil) and Asia (China). It will also improve the infrastructure by installing a number of GEONETCast receivers at marine science institutes. As DevCoCast develops it is hoped that additional partners will join the team. It is also expected that additional products will be provided to the international user community.

Extending the Benefits beyond the Marine and Coastal Theme

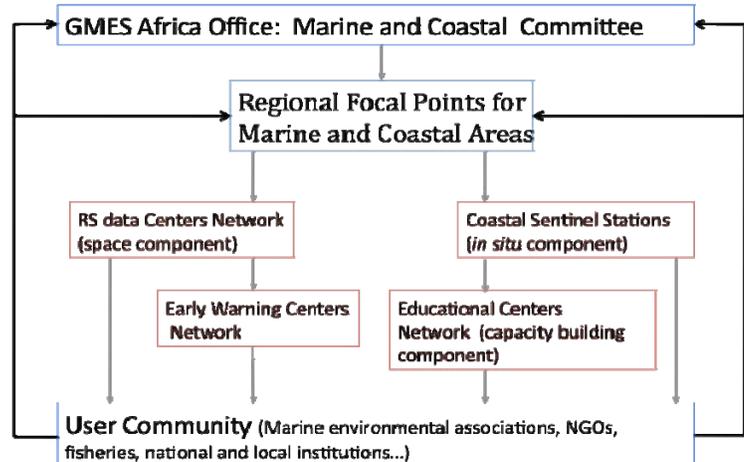
The Marine and Coastal Theme will seek to strengthen cooperation between African and European GMES stakeholders and user communities in other GMES Africa Themes, notably Natural Disasters and the Impacts of Climate Variability and Global Change. The joint use of new communication technologies such as GEONetCast will bring mutual advantage.

9.4 Organisational Scheme

An effective and long-lasting ocean and coastal stewardship in Africa can occur only when a predictable, efficient, and accountable governance system is in place. GMES Africa for marine and Coastal Areas should be designed in such a way that there is continuous user uptake through constant consultation with all stakeholders and integration of their changing needs in an iterative process.

Following the architecture of the GMES Service described previously, each component of the system of systems should have its own characteristics in terms of ownership, facilities, decision-making process and management.

In addition, an overall management structure established under the auspices of the African Union would facilitate the coordination of the user community among the various marine and coastal-related sectors, ensuring their consultation in the service development, and would set the priorities and distribution of resources between all the Service components.



Identification of candidates for future GMES Africa programmes:

A Round Africa Network of Coastal Sentinel Stations, with common objectives but focussing on their own regional needs and priorities, using common observational tools and infrastructure, and with common ground and satellite links. This would form the basis of an African Coastal Core Service operating under the auspices of GMES Africa.

An African Network of Marine Remote Sensing Analysis and Dissemination Centres responsible for the speedy distribution of value added satellite products to all countries of Africa. This would form the basis of an African Marine Remote Sensing Core Service, operating under the auspices of GMES Africa

An African Forecast/Early Warning Facility responsible for the dissemination of value-added products to relevant user communities within the public and private sectors. Effective data management would be a key responsibility within the Facility, which would also require powerful computer platforms for the generation of reliable forecasts. The utilisation of new communication technology would be essential.

An African Capacity Building Network of Higher Education Institutions linked to the Network of Coastal Sentinel Stations and to the Network of Marine Remote Sensing and Dissemination Centres. In addition, there should be strong links to Regional Industries and Governments, where trained and empowered scientific, technical and management staff will be needed to generate, disseminate and utilise marine and coastal products of value.

Identification of the funding instruments to use

The key conditions for long-term sustainability of a GMES Africa Service in Marine and Coastal areas require that the funding of the Service infrastructure should take place in the form of a stable level of resources, and not as discrete decisions on a project-like basis. The funding and decision making processes should be driven by public authorities, within a joint EU-African governance framework.

Potential sources of funding (see table in **Section 7 for existing funding instruments**) cover international organizations, and include European Commission instruments, space agencies such as EUMETSAT, contributions from the European Union (e.g. the geographical extension of the African Monitoring for the Environment and Sustainable Development project), African Regional Economic Communities and African countries, and other African financial instruments (such as the African Development Bank).

9.5 Timetable

Following the example of GMES development in Europe, it is proposed to address the complexity of a GMES Africa Service in Marine and Coastal waters in 3 phases with a view to long-term sustainability of the Service:

Initial Exploratory Phase (2 years): thematic projects will be conducted to set up the foundation of an African GMES capacity. During this phase, current monitoring and information production capabilities will be evaluated with the objective to identify needs for improvement in the scientific, technical and management sectors.

Pilot-Study Phase (4 years): building on the result from the Initial Period to outline an Action Plan toward an operational user-oriented Service. Large scale and multidisciplinary projects will be established for each Regional Area, on the basis of existing systems, the appropriate scientific and technical structure, data policy, governance, and funding scheme that will drive to an integrated operational Service.

Implementation Phase (4 years): in this phase, the Marine and Coastal Service will be implemented and run in an operational way.

9.6 Indicative Development Plan and Budget Estimate

Phase 1: Initial Exploratory Phase (2 years)	Ten Million Euros
Phase 2: Pilot Study Phase (4 years)	Thirty Million Euros
Phase 3: Implementation Phase (4 years)	Thirty Million Euros

For comparison, a limited demonstration (proof of concept) service has been established in South Africa, at a total development cost of half a million euros from national funds. Such a service would need to be expanded in the range of services offered. It would also need to be able to supply products to the almost forty coastal countries of Africa, where the communication infrastructure is less well-developed. Within the European Union, comparable services are much more advanced. The MERSEA IP received a European Community grant of fourteen million euros for 4 years (the project included 16 countries and 40 partners (this project corresponds to Phase 2: Pilot-Study phase of the GMES Africa Service). The fully operational MyOcean programme received a European Community grant of thirty four million euros for 3 years. The project includes 28 countries (22 EU member states with sea coastlines and 6 non-EU member states).

10. RECOMMENDATION

The GMES Africa Action Plan is a joint initiative between the African Union and the European Community. The Vision/Aim for the GMES Africa Service for Marine and Coastal Areas is the implementation of an operational, integrated service, built on existing programmes, and available throughout Africa. The Service should be:

- Pan African, reaching to all the coastal countries of Africa.
- Operational, utilizing Earth Observations from space agencies
- Comprehensive, an end-to-end service from observations, through analysis and forecasts, to the dissemination of value-added products.
- Built on existing research projects and pilot programmes.
- Maintained and operated by Africans, through developing and utilizing the necessary African capacity in African Centres of Excellence.
- Based on a governance scheme that ensures effective consultation process with all stakeholders.

- Relying on a continuous funding process so as to maintain long-term sustainability of the Service.

The recommended components of the GMES Africa Service for Marine and Coastal Areas are:

- A Network of Regional Early Warning Centres, providing products of value to the public and private user communities around the coast of Africa.
- A Network of Marine Remote Sensing Centres, as the fully operational successors to existing pilot facilities utilizing Earth Observations.
- A Network of Coastal Sentinel Stations, gathering *in situ* observations from priority areas such as mega cities, ports and areas of offshore industrial activity.

Supporting platforms would be needed in data management and high speed computing. There would need to be a rapid uptake of new communication technology such as the round Africa marine information highway and the GEO Net Cast so as to ensure the speedy dissemination of value added products to the entire African user community.

The successful implementation of the GMES Africa Service for the Marine and Coastal Areas will bring progress on sustainable development and ongoing benefits and prosperity to the people of Africa, and will be a worthy endeavour by the European Community and the African Union.

11. SUMMARY

The European Union Global Monitoring for Environment and Security (GMES) and the African Union wish to deepen the dialogue between African users and European and African policy makers, so as to identify and integrate the requirements for GMES Services to the countries of Africa. Included in this Summary are the rationale and recommendations for the GMES Africa Marine and Coastal Areas Theme, which will leverage relevant initiatives and projects for strengthening and building Earth Observation capacities in Africa. This will establish a long term partnership between European and African marine and coastal stakeholders.

The people of Africa, in common with other less developed parts of the world, are increasingly migrating to the coast, realizing the advantages of living and working there, and reaping the benefits of coastal and marine resources in the fishing, mining and tourism sectors. A high proportion of the National Gross Domestic Product of the countries of Africa is to be found in enterprises on the coast and within their offshore Exclusive Economic Zones. Coastal cities are growing in population, and this growth brings issues of adequate standards of health, shelter and environment for the well-being of their often poor inhabitants. The Regional Conventions of Abidjan, Nairobi, Jeddah and Barcelona, following on from events such as the United Nations Convention on Environment and Development and the World Summit on Sustainable Development, seek progress on sustainable development and coastal and marine protection around Africa, and provide the policy drivers for joint action by the countries of Africa. The Group on Earth Observations has recognized the need to empower countries to use best practice for the application of Earth Observations to bring benefits to communities around the world. The extension to Africa of the European GMES Programme, with its reliable observation-based information services, will greatly aid the countries of Africa in their quest for safe and sustainable development along their coasts. Beneficiaries will include government departments such as the Navy and Coastguard, Environment and Tourism, Fisheries and Marine Resources, Coastal Zone Planning, Mineral and Energy, and Ports and Harbours; Offshore Industry Associations such as Oil and Gas, Fisheries (coastal, deep-sea, aquaculture), Mining (diamonds, mineral sands, salt), Shipping, and Hotels and Beach Resorts; and Universities and Marine and Coastal Research Institutions in Africa.

Existing initiatives specifically addressing African waters and global initiatives with application around Africa will be used as the foundation for building a full GMES Africa Service in Marine and Coastal Areas. These can be readily identified in relevant fields such as coastal zone planning, the management of coastal cities, marine protected areas and coastal and offshore ecosystems, together with Earth Observation initiatives and projects for building the necessary capacity in Africa. Various international, regional and national funding instruments are being utilized which recognize African priorities and the need to strengthen African institutions.

From existing initiatives, it is possible to identify gaps and priorities where new investment is sorely needed. In a broad sense, the crucial priority is for operational programmes in the marine and coastal areas of Africa, which routinely bring information and products of value to policy makers in the user community. To rectify this, Africa needs a **GMES Africa Service for Marine and Coastal Areas** that is pan African, operational and a comprehensive end-to-end service from observations, through analysis and forecasting to the dissemination of carefully designed value added products. The recommended components of the GMES Africa Service for Marine and Coastal Areas are:

- A Network of Regional Early Warning Centres, providing products of value to the public and private user communities around the coast of Africa, such as state of the marine environment reports, operational

coastal sea level, circulation and sea state downscaled to localities at risk, ecosystem health reports and coastal vulnerability atlases.

- A Network of Marine Remote Sensing Centres, as the fully operational successors to existing pilot facilities, utilizing satellite observations and developing new capabilities linked to the new generation of sentinel satellites from Eumetsat.
- A Network of Coastal Sentinel Stations, gathering *in situ* observations from priority areas such as mega cities, ports and areas of offshore industrial activity, and localities at risk from natural disaster and the impacts of climate change.

Supporting platforms will be needed in data management and high speed computing, and there will need to be a rapid uptake of new communication technology and communication links. The effectiveness of these proposals will be enhanced through these Centres of Excellence and the further development of specific Earth Observation Flagship Programmes such as ChloroGIN Africa and DevCoCast Africa.

The successful implementation of the GMES Africa Service for the Marine and Coastal Areas will bring progress on sustainable development and ongoing benefits and prosperity to the people of Africa, and will be a worthy endeavour through the European Community and the African Union. The keys to its long term viability will be the provision of adequate capacity in personnel and infrastructure within its institutions, addressing the real priorities for marine and coastal areas of Africa within a coordinated framework, and of a stable level of financial support into the future. An indicative development plan and estimated budget is provided.

THE GMES & AFRICA ACTION PLAN

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4. INTRODUCTION

4.1. THEMATIC CONTEXT

With its 5400 km³ of renewable resources (10% of the world), water represents one of the major development drivers in Africa. It includes over 40 million ha of irrigation potential and 1.4 million GWh of hydro power potential. Today, major river systems suitable for navigation represent a major infrastructure for inland transport. In addition, water bodies, rivers lakes and wetlands represent a harbour of biodiversity, fisheries and an ecology attraction for tourist use. In spite of this potential, Africa still faces significant challenges to ensure effective use and efficient management of its water resources:

- The multiplicity of trans-boundary water resources (more than 60 trans-boundary basins) significantly increases water governance and risk;
- There is low level of development and water utilization. For instance, only about 4% of the available water is used in the whole continent. In the case of irrigated areas, the actual use amounts to less than 10 % of potential, while only the 6% of the hydropower potential has been developed. Concerning water supply and sanitation the figures are dramatic: over 300 million of Africans lack safe water supply and adequate sanitation.
- It is estimated that by 2025 about 600 million people will be exposed to water scarcity situation (<1000 m³/capita/yr).
- Huge infrastructure gaps with less than 50 m³/person storage capacity compared to over 3000 m³/person in Europe and 5000 m³/person in USA.

In this complex and challenging context, water information systems are fundamental for improving water governance and implementing Integrated Water Resource Management (IWRM) successfully. Today, in many African countries, policies and management decisions are based on sparse and unreliable information. This water information gap is a major limitation to attain the water-related Millennium Development Goals (MDGs) and put in practice IWRM plans to face the current and coming challenges of the African water sector.

4.2. PRESSURES (OR CONSTRAINTS).

Developing an IWRM information system is a huge challenge, even for the wealthier and more organized countries in Europe and Africa. This is particularly more demanding in Africa where, in several countries, water information systems are severely degraded¹, policies and management decisions are based on unreliable information and donor institutions are reluctant to provide long-term support for remnants of out-dated observation networks that will never become adequate for IWRM requirements². Consequently, resultant conflicts for competing demands of water both in terms of quantity and quality in Africa have not been resolved. Without an urgent action to assist African stakeholders in IWRM to bridge the information gap, IWRM will remain a dream, and the water related MDGs will remain unattainable in Africa.

GMES and Africa should enable full African participation in the rapidly evolving global 'Earth Observing' System, and so benefit from the coming GMES Space Component capacity (e.g., European Space Agency (ESA) Sentinel series, national contributing missions) to collect, manage and disseminate water related information, in cost effective and sustainable ways.

5. POLICY DRIVERS AND NEED ANALYSIS:

5.1. POLICY DRIVERS

The "Africa Water Vision for 2025"³, endorsed by the African Ministerial Conference on Water (AMCOW) and by the Heads of State of the African Union at the Extraordinary Summit on Water and Agriculture at Surte, Libya, in February 2004, serves as a basis for long-term national, sub-regional and regional policies and programmes for the equitable and sustainable use of water for socio-economic development of the continent. The framework for

¹ *Africa Water Vision for 2025.*

² *Report of the World Panel on Financing Water Infrastructure: Financing Water for All, M Camdessus, World Water Council et al, 2003.*

³ <http://www.uneca.org/awich>

achieving this vision calls for strengthened governance of water resources and considers the ability to generate and receive knowledge and information to be critical success factors in view of growing water scarcity due to natural phenomena and human factors. The importance of water Resource management cannot be overemphasized. Water, as one of the MDGs goals is intricately intertwined with agricultural productivity and energy generation in Africa, the main drivers of socio-economic development.

The African Union Science and Technology plan⁴ consolidates the science and technology plans of the African Union Commission and NEPAD. It places issues associated with the development, supply and management of water high on the agenda owing to the fact that water scarcity and related insecurity is one of the sources of the continent’s underdevelopment and increasing economic decline. It explicitly identifies scientific assessment of Africa’s water resources and systems, research and technologies to assess and monitor water-related disasters and water knowledge and technologies to improve water quality and quantity as the indicative water projects to be implemented in 2006 – 2010.

The WSSD plan of implementation recognizes the role of science and technology in meeting the water goals. In paragraph 27, it commits governments to:

“improve water resource management and scientific understanding of the water cycle through cooperation and joint observation and research, and for this purpose encourages and promotes knowledge sharing and provide capacity building and the transfer of technology, as mutually agreed, including remote sensing and satellite technologies, particularly in developing countries and countries with economies in transition”.

The table below mentions other policy drivers relevant to the Water thematic area besides the Sirte Declaration on Agriculture and Water in Africa, the African Water Vision 2025 and MDGs on Water supply and Sanitation already discussed above.

<ul style="list-style-type: none"> • AU Sharm El- Sheikh declaration on water and sanitation • eThekweni ministerial declaration on sanitation • Declaration on Climate Change in Africa • Tunis ministerial declaration on water security • Africa – EU statement on Sanitation • AU guideline on establishing cooperative framework in transboundary basins • AU Abuja action plan 	<ul style="list-style-type: none"> • AU comprehensive African agricultural development plan (CAADP) • NEPAD infrastructure Action plan • NEPAD Environmental Action plan • African programme on action on implementation of the African regional strategy on disaster risk reduction • African regional position paper launched at 5th World Water Forum, Istanbul.
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5.2. THE NEED ANALYSIS

The conclusion and recommendation derived from the First African Water Week organised in Tunis by the African Water facility under the AMCOW mandate in March 2008 states:

“Information about water is as essential to life as the water itself. Good information aids decision-making and enables better choice and design of infrastructure. Data enables monitoring progress towards the MDGs. Despite this, insufficient resources are invested in the supply and dissemination of water information and therefore not enough information is produced. In order to ensure water security, data and information on quantity and quality of available freshwater is crucial for the planning and efficient and sustainable water resources development and management in Africa. “

In December 2007, The ‘Lisbon Declaration on GMES and Africa’ was adopted under the aegis of the Portuguese Presidency of the Council of the European Union. This calls for the first draft of an action plan to be submitted to EU and African constituencies by end 2008. The European Commission and the Commission of

⁴ Africa’ Science and Technology Consolidated plan of Action. 2006, NEPAD Office of Science and Technology, Johannesburg, South Africa

the African Union will jointly prepare an action plan for endorsement at the next EU-Africa Summit foreseen for the end of 2009.

In this context, the objective of *GMES and Africa* water thematic area will be:

1. To enhance African technical, human and institutional capacity to meet the need for timely, quality long term information covering African national, regional, trans-boundary and continental scales as a basis for sound decision making, improved Integrated water resource management and effective climate change adaptation and mitigation plans;
2. To build upon existing initiatives and programs to establish long-term sustainable end-to-end information systems and services in major national and trans-boundary river basins in Africa enabling African water authorities and water sector stakeholder to fully exploit the global 'Earth Observing' System, and the coming GMES Space Component capacity to collect, manage and disseminate water related information, in cost effective and sustainable manner;

6. IDENTIFICATION OF COMMUNITIES:

To achieve the *GMES and Africa* objectives, it is of fundamental importance to mobilize resources, expertise and contributions from different sectors at National and International levels concerned with the problems faced by Africa countries in the collection of relevant geo-information for implementing integrated water management plans. In this context, *GMES and Africa* process should foster partnerships between the end beneficiaries (water authorities), space agencies and data providers, the expert centres in Earth Observation applications for water management (e.g., key universities and international research organizations), the private sector (e.g. value adding companies), NGOs and financial and development agencies. All these organizations collectively represent the **GMES and Africa Water Theme Stakeholder Group**. The table below categorizes the main stakeholders groups. Further details are available in the Annex 2:

Level	Category	Interests
UN agencies	UN-Water; UNESCO – IHP; UNEP DEWA programme; UN-Habitat Water and Sanitation Programme; World Hydrological Cycle Observing System (WHYCOS) of WMO; UN-ECA	<ul style="list-style-type: none"> • Global trends on the status, quality and quantity of water resources and improving access to water • Provision of in-situ networks and improving free exchange of data to compliment EO based observation and modelling • Capacity building • Early warning and assessment
International	GEO; CEOS; World Water Council; World Water Partnership; Ramsar Secretariat; Global Energy and Water Experiment (GEWEX); ESA; EUMETSAT; GEONETCast	<ul style="list-style-type: none"> • Earth Observation data providers for water management and dissemination • Promotion of better practices on water management in Africa • strategic framework for Water resource management • Provision of in-situ networks to compliment EO based observation and modelling
Continental	AU, AMCOW; Experts Centres for Water Science and Technology promoted by NEPAD; Regional Economic Communities in Africa (SADC, ECOWAS, CEMAC, IGAD, COI); African Space Agencies; AMESD; TIGER; ARSIMAWA; AARSE; African Water Academy; Groundwater Commission of Africa	<ul style="list-style-type: none"> • Political direction in water management issues across Africa • Ensuring the provision of African EO data to African stakeholders • Networking among African players involved in IWRM • Capacity building
Regional	River Basin Authorities (e.g. Réseau Africain des Organismes de Bassin, based in Dakar); Regional and trans-boundary organizations; Regional Remote Sensing Centres in Africa (e.g. AGRHYMET, RCMRD); OSS; NBI etc	<ul style="list-style-type: none"> • Networking, developing and implementing regional water management plans in Africa including capacity building • Potential providers of geo-information in support of envisaged water management plans • Provision of in-situ networks to compliment EO based observation and modelling
National	Local universities; Research Institutions; Water Resource management Authorities,	<ul style="list-style-type: none"> • Capacity building

	Ministries of Water; National institutions (e.g CERSGIS, CRTS; SAC; CSIR)	<ul style="list-style-type: none"> • Developing and implementing national water management plans in Africa • Provision of in-situ networks to compliment EO based observation and modelling • Scientific research on water related issues in areas of jurisdiction
Donors	African Water Facility; European Commission; World Bank; Global Environmental Facility; Development agencies	<ul style="list-style-type: none"> • Provision of resources aimed at supporting African Countries to achieve MDGs water targets
International and local NGOs	WaterNET etc.	<ul style="list-style-type: none"> • Water advocacy • Community based mobilization

7. MAPPING EXERCISE:

There are several projects, programmes and initiatives that are completed, ongoing or planned in Africa using EO technology dealing with water resource management and cannot all be highlighted in this document. TIGER Africa Initiative and AMESD programme typify African - European cooperation in water resource management applications using space technology and are continental in scale, operational in nature and thus relevant to and can be used as a model for *GMES and Africa*.

The Table below is not exhaustive and aims only at providing an overall panorama of potential information services that have been developed. Details of these major programmes are provided in Annex 3.

Programmes	Information services and scale		Data collection, accessibility		Products, Monitoring and Assessment	
	Service	Scale	Data Collection	Data Access	Products	Monitoring and Assessment
TIGER (2nd phase on-going)	<ul style="list-style-type: none"> • Ground water resources; • Catchments characterization; • Mapping of hydrological network; 	National (e.g., Morocco) ; National (e.g., Ghana)	EO Data Field data	Yes	<ul style="list-style-type: none"> • Mapping of the groundwater potential (Morocco); • Groundwater exploration maps (Ghana); • Infiltration areas (e.g., lineaments and geophysical features); • Hydrological network; • Water extraction estimates; • Irrigation areas; • Land use, land cover and crop maps; • DEMs; 	Derived water consumption and extraction estimations
		Trans-boundary shared aquifer systems (e.g., SASS involving Algeria, Libya and Tunisia and SAI shared aquifer involving Mali, Nigeria, Niger)	EO Data Field data	Yes	Land use changes; surface water extension and dynamics, water balance	
	Surface water mapping	National (e.g., Burkina Faso) National (e.g., Niger)	EO Data Field data	Yes	Mapping of surface water extent and changes; mapping transient natural waters in arid and semi-arid areas	water availability estimation and Flood mapping

		National (e.g., Zambia)			(Niger)	
	Water Quality	Regional (e.g., Lake Victoria, Alke Chad) National (Lake Manzalah, Egypt)	EO Data Field data	Yes	Operational turbidity; chlorophyll-a; temperatures; suspended sediment concentration; lake levels; water hyacinth monitoring	
	Wetlands management	Continental (Algeria, Egypt, Kenya, Lake Chad, Senegal and South Africa)	EO Data Field data	Yes	Land-cover/use information over complex landscapes	land change monitoring
	River and lake water levels	Continental	EO Data Field data	Yes	Relative values of water level variations at cm resolution	Water management
	Soil Moisture estimation	Regional (SADC)	EO Data Field data	Yes	NRT soil moisture maps	Estimation of drought and flooding "hot-spots" determination
AMESD (ongoing)	Water Management for Cropland and Rangeland Management	Regional (ECOWAS)	Field Data EO Data	Thematic data	Vegetation state; Extent and dynamics of small water bodies;	Yield estimation and drought risks delineation
	Water Resource Management focusing on environmental aspects of watersheds	Regional (CEMAC)	Field Data EO Data	Thematic data	NRT water level for the Oubangui river	Low water alert system
SERVIR Africa	Environmental monitoring and management	Continental	Field Data EO Data Modelling	Thematic data	Flooding and droughts	Mitigate against natural disasters
UNESCO G-WADI	Global Real-time Precipitation	Continental	Field Data EO Data Modelling	Visualize on server	Operational precipitation estimates	Forecast and mitigation of hydrologic disasters
Water Cycle and Drought Monitoring over Africa	Real-time monitoring of land surface hydrological conditions	Continental	Field Data EO Data Modelling	Thematic data	Precipitation, evapotranspiration, runoff, snow and soil moisture	Water Cycle and drought monitoring over Africa

8. IDENTIFICATION OF GAPS AND SUITABLE PROGRAMMES:

8.1. GAPS:

Based on the experience gained in the last years through the different activities dedicated to support service development in Africa, several general blocking factors and gaps have been identified that need to be addressed by the *GMES and Africa* process in order to ensure the successful development and implementation of operational sustainable services in Africa.

- **Institutional blockages** including lack of awareness of EO capabilities and limits; low level of penetration of Information Technology -IT in several African institutions, lack of solid links between users (water authorities) and potential service providers in Africa; lack of solid institutional established procedures to integrate geo-information into management practices and planning; lack of a solid consolidated group of potential service providers in Africa including technical centres, universities and private sector;
- **Human blockages:** including lack of skilled technicians and EO operators; training required to educate professional operators and the high turnover of skilled personnel, lack of skilled personnel in water authorities with a good knowledge of GIS and EO technologies, lack of sufficient high education curriculum in African universities ensuring the consolidation of a critical mass of African professional in the area of EO applications;

- **Technical blockages:** including the limit of current EO systems that will be significantly enhanced with the advent of the Sentinel series; needs for in situ data infrastructures; need for long-term granted continuity and easy EO data provision and access; need for suitable software and hardware infrastructures in African institutions; needs of fast internet connectivity;

GMES and Africa should build upon existing programs and implementation models with the long-term target of developing a end-to-end African ownership of the full service chain, which will allow the long-term sustainability and the required institutional and user acceptance of the GMES process.

Space- based observation needs

Scale	Identification of Gaps	Dimensions that GMES Africa service would provide
Continental	A core set of continental scale products covering different components of the water cycle: e.g., Precipitation; Evapo-transpiration; Soil moisture; Water levels;	GMES should ensure the provision and accessibility of these products at continental scale; Capacity Building in EO applications, in situ and modelling integration to forecast and produce hydrological process early warning tools.
Regional (trans-boundary river basins)	Local Operational observational incapacibilities for information services addressing the needs of riparian (member) states and stakeholders on major trans-boundary river basins : e.g., <ul style="list-style-type: none"> • Base mapping for supporting infrastructure development (water supply and sanitation); • Irrigation areas, Crop mapping; • Ephemeral water bodies);Flooding; 	GMES should support the empowerment of key African institutions at trans-boundary level being able to operate and run information services allowing the observation and monitoring of water resources over major trans-boundary river basins and lakes in Africa, while offering a coherent service to their riparian countries (e.g., national water authorities to better exploit and integrate potential GMES African water services into the national planning and decision making activities

In-situ based observation needs

Concerning in-situ networks, from 4.2 above, reference is made to severely degraded or out-dated in-situ networks for collection of water related data in Africa, hence information derived from them is unreliable to validate EO data. Some existing programs such as WHYCOS facilitates the installation and free exchange of data obtained from several in-situ networks to compliment EO based observation and modelling.

For *GMES and Africa* service, it is proposed that a strong effort shall be dedicated to enhance permanent in-situ network infrastructures allowing data to be regularly collected, harmonised, standardized, and structured in accessible and interoperable databases. This is mandatory in order to develop and validate effective operational services that may integrate both EO and in situ data in a scientifically sounded manner.

Scale	Identification of Gaps	Dimensions that GMES Africa service would provide
Continental	Inappropriate In-situ networks for water management and monitoring; In situ data is also mandatory for validation/calibration of EO based services in Africa;	Problem solving Focus on Basin –wide water budget (rainfall and evapo-transpiration), trans-boundary river discharges, water extraction (information on well depths, piezometric measurements, well density and pumping rate) for aquifer management, water consumption, water-related infrastructure and investments,

Gaps related to Global Climate change

Water resources are inextricably linked with climate, so the prospect of global climate change and variability has serious implications for water resources and regional development in Africa. In future, Climate change adaptation and mitigation strategies require hydrological data and information to enable assessment of the impacts of climate change. Earth Observation technology can provide a major contribution to face the water information gap in Africa. Within *GMES and Africa* water thematic area, beneficial synergies need to be created with Climate for Development in Africa Program (ClimDevAfrica) spearheaded by the African Union Commission.

8.2. EXISTING OR PLANNED THEMATIC FUNDING PROGRAMS:

- **European Water Facility:** In 2004, the EU Council decided to consider allocating a total amount of € 500 million for an ACP-EU Water Facility, to be funded from the conditional €1 billion of the 9th EDF. The establishment of the ACP-EU Water Facility and its funding was endorsed by the ACP-EU Council of Ministers at its meetings in Gaborone in May 2004 and Luxemburg in June 2005. The two tranches of € 250 million each have been made available.
- **European Development Funds:** The European Development Fund (EDF) funded by the Member States is the main instrument for providing Community aid for development cooperation in the ACP States and the OCT. ACP States will continue to be funded by EDF at least for the period 2008-2013. The tenth EDF covers the period from 2008 to 2013 and provides an overall budget of EUR 22,682 million. Of this amount, EUR 21,966 million is allocated to the ACP countries allocated accordingly: EUR 17,766 million to the national and regional indicative programmes, EUR 2,700 million to intra-ACP and intra-regional cooperation and EUR 1,500 million to Investment Facilities. An innovation in the tenth EDF is the creation of "incentive amounts" for each country.
- **7th Framework Program:** Research and development program of the European Union supporting also activities related to GMES and service development.
- **African Water Facility:** The African Water Facility (AWF) is an initiative led by the African Ministers' Council on Water (AMCOW) to mobilize resources to finance water resources development activities in Africa through the establishment of the African Water Facility Special Fund. The African Development Bank (AfDB) hosts the Facility on the request of AMCOW. AWF applies fast-approval and flexible procedures and can provide support to communities as well as to national and multinational institutions. For the duration 2008 – 2010, it is envisaged that EURO 236 million will be disbursed to support water projects in Africa.
- Dedicated programs also exist in other donors (World bank) and national developing agencies;

9. BUILDING GMES –AFRICA SERVICE

9.1. SERVICE DEFINITION AND PROVISION

It is worth noting from a technical viewpoint that to set up an operational observation and information program for water in Africa, it is mandatory to dedicate significant resources to further consolidate, develop and validate a solid portfolio of scientifically sound information services based on the results of existing initiatives, projects and programs in African and Europe. This should give special attention to the synergistic use of EO data, in situ networks and suitable models.

The following table provides a summary of some of the potential operational services that maybe the basis for *GMES and Africa* water component today. Some of the services listed below have already been demonstrated and validated in several areas within the TIGER initiative and other programmes:

Scale	Service description	Users
Continental	<p>A core set of continental scale products covering different components of the water cycle at low resolution (approx. 1 Km): e.g.,</p> <ul style="list-style-type: none"> • Soil moisture; • Rivers and lakes water levels; <p><i>Other continental scale products such as precipitation or evapo-transpiration are still in a research stage;</i></p>	<p>National authorities, basin authorities, hydrological services, local communities, farmer communities, fisheries industry.</p> <p>Many of the proposed service also address transversal needs. In particular many of them may cover the needs of:</p>
National and basin scales	<p>Base mapping for enhancing infrastructure development with focus on water supply and sanitation at high resolution (approx. 10m);</p> <p>Catchments characterization including a core set of products at basin scale at high resolution(10-20 meters): e.g.,</p> <ul style="list-style-type: none"> ○ Land cover and land use; ○ Crop mapping; ○ Irrigation areas; ○ DEMs; 	<ul style="list-style-type: none"> ○ Environmental agencies; ○ Developing agencies (monitoring and assessment purposes); ○ Forestry departments; ○ Weather services; ○ Civil protection services;

<ul style="list-style-type: none"> ○ Hydrological network; 	
Ephemeral water bodies identification and monitoring in arid and semi-arid regions at high resolution (10-20 meters);	
Water quality monitoring in large lakes at medium resolution (250 meters) including: <ul style="list-style-type: none"> ○ Chlorophyll; ○ Water turbidity; ○ Yellow matter; ○ Water surface temperature; ○ Floating vegetation; 	
Support ground water management including (from 10 to 250 meters): <ul style="list-style-type: none"> ○ Estimation of water extraction; ○ Ground water exploration (e.g., identification of infiltration areas); 	
Rapid mapping of flood maps at high resolution (10-20 m);	
Early warning for droughts;	
Wetlands monitoring and mapping at high resolution (10-20m) including: <ul style="list-style-type: none"> ○ Water extension dynamics monitoring; ○ Inundated vegetation dynamics; ○ Land mapping and change analysis; 	

Additionally, a number of advanced information services are still in the research domain may be considered as part of a long-term development process aimed at exploiting in a synergistic manner the next generation of EO data (e.g., Sentinels), in situ and suitable advance hydrological models: e.g., runoff modelling, risk of floods mapping, water availability and water balance, etc...

9.2. CAPACITY BUILDING:

9.2.a. NECESSARY ELEMENTS

A major component of *GMES and Africa* shall be devoted to ensuring the development of the required human, technical and institutional capacity to empower African institutions to implement and run the *GMES and Africa* services in a sustainable manner. This will require a significant effort dedicated to:

- Enhance the long-term formation of African operators, technicians and scientist with the capabilities to exploit EO technology for IWRM;
- Enhance the technical capacity of potential African service providers (institutions with technical competences, regional centres, remote sensing centres) with the capacity to provide upstream GMES services to water authorities;
- Ensure the enhancement of the in situ networks (e.g., via HYCOS) that may contribute establish GMES services;
- Develop an African private sector of value added companies being able to provide downstream GMES service to African users. This will require a significant effort in terms of subsidising the initial steps in the development process;
- Enhance the institutional links between service providers and water authorities establishing long-term links and partnerships that may be the basis for long-term Service Level Agreements;
- Enhance the capacity of water authorities to understand, integrate and use GMES services into their management and operational practices ensuring clear short-term impacts in the field.

9.2.b. STRATEGY

All this efforts need to be built upon the experiences of existing initiatives and capacity building efforts carried out by different institutions (developing agencies) and programs (e.g., TIGER Capacity Building Facility,

AMESD, WHYCOS, etc...) and taking into account key African players already involved in Capacity Building Activities in the water sector (e.g., regional technical centres such as RCMRD or AGRHYMET, WaterNET, etc.);

In this context, it is also worth mentioning the major role that the Experts Centres for Water Science and Technology promoted by NEPAD may play in *GMES and Africa*. In particular, *GMES and Africa* may further support the development of those key centres as a basis for service development, service provision and best practice sharing in Africa. However, *GMES and Africa* strategy for capacity building should mobilize significant dedicated resources in order to address the needs above identified with the major focus:

In the short term:

- A critical mass of African technical centres and value adding companies need to be established and supported with the capacity to develop, run and operate information services addressing the information needs of the African water sector.
- Users (water authorities) need to be supported with the capacity to exploit GMS services and EO-based geo-information to enhance water governance and decision making;

In the long-term:

- High-level educational programs in Africa need to be developed and supported in order to ensure the continuous provision of post-graduate technicians and managers with a solid knowledge of EO technology and their applications in the water sector (among others);

9.3. PRIORITIZATION OF REQUIREMENT AND ACTIONS

Implementing operational information services involving EO technology, in situ observations, and models is a complex process. In Europe the GMES initiative represents an excellent yet unique reference on how services can be defined, developed and implemented at large scales involving multiple partners and institutions at different political, technical and institutional levels. In this context, the *GMES and Africa* Program Implementation may follow a similar approach as the one used in GMES:

The following key points for implementation are crucial for the success of the *GMES and Africa* water thematic area:

- Suitable mechanisms shall be established in order to maintain a long-term dialogue with the different actors in the ***GMES and Africa* Water Theme Stakeholder Group**. This shall exploit existing mechanisms and forums such as the African Water Week, the World Water Week or the World Water Forum and organized relevant programs such as AMESD and TIGER may support this process. Such *GMES and Africa* forums shall be coordinated at high level by the EC and the AUC with the support of the *GMES and Africa* coordination group.
- A key element of the consultation process shall be dedicated to improve the communication between water authorities and service providers. In the specific case of the water thematic area, AMCOW shall play a key role in this process, being the African interlocutor in support of AU.
- *GMES and Africa* shall be an African driven process aimed at establishing long-term sustainable information services in Africa addressing African priorities and needs. In this context, governance shall ensure that African institutions retain the ownership and programmatic leadership of the process.
- Concerning the access to the data, GMES data policy shall enable long-term free access to GMES data (e.g., Sentinel data, contributing mission) to African institutions to implement *GMES and Africa* services. This data sharing policy will be harmonized with the GEO portal being developed by GEO as a single Internet gateway to the comprehensive and near-real-time data produced by GEOSS integrating diverse data sets and access to models and other decision-support tools. Also, more ground receiving stations covering Africa should be established at African Regional Centres and encouraged to broadcast data using the inexpensive GEONETCast system. EO data from weather satellites will be very important to provide key information on rainfall predictions to assist flood event mapping and forecasting.
- The essence of the value addition to EO data should be primarily to address Water resources monitoring systems and Early Warning systems capabilities. Also the data value addition should

address vulnerability assessment and formulation of adaptation strategies in IWRM especially within the global climate change domain. Modelling techniques will be used to enhance the predictive capabilities of the information services

- Similarly, within *GMES and Africa*, African Space Organizations (Nigeria, Algeria, Egypt, and South Africa) should be persuaded to contribute to the GEO data-sharing principles thus allowing free access of data from their missions to ensure the full and open exchange of data, metadata and products.
- Observational infrastructure and network integration will also a key feature to achieving the operational sustainability of *GMES and Africa* initiative. This will harmonize the structures for collecting and sharing in-situ data since some countries have more advanced structures than others and therefore an independent coordination and harmonization exercise of networks at the African and European level is necessary.

9.4. ORGANIZATIONAL SCHEME:

The African ownership of the service definition and development of decision-support tools for (African) users is the key element that should be taken into account for *GMES and Africa* service model. In this context, the organization scheme for *GMES and Africa* shall ensure an African driven process involving the following points:

- AMCOW should represent the main political driver for the initiative. In this context, *GMES and Africa* shall be endorsed by AMCOW as far as the water implementation plan is concerned.
- *GMES and Africa* should consider the basin authorities from sub-national to trans-boundary scales and national water authorities as the main user of the services and hence the main end-beneficiaries of the process;
- Services should be operated from a number of technical centres (or value adding companies) in Africa at regional or local level with the required capacity. It is worth noting that in many cases, the trans-boundary water authority incorporate technical units with the capacity to operate and run a number of information services. In this context, the trans-boundary basin commissions may play the role of regional service providers for the different national authorities (e.g., LCBC);

9.5. TIMETABLE

A three phase implementation strategy is suggested covering the following:

- **Phase 1 (3 years). Consolidation period:** aimed at fully developing, validating and consolidating an initial set of services on the basis of existing initiatives, projects and programs in African and Europe. In this context, to successfully define sustainable and fully accepted GMES services for the African water sector, a number of key issues should be taken into consideration:
 - Identification of needs and service definition shall involve a close consultation process with water authorities and national and basin level under the leadership of AMCOW;
 - Ownership of the service definition and implementation at all levels shall remain African: defined by African and implemented by African Institutions.
 - The identification of needs and service definition shall ensure that the different characteristics, conditions and requirements of different institutions and regions are taking into consideration. A one-fits-all approach will not work: e.g., water scarcity is a problem in certain areas of Africa and not in others, where the key problem may be associated with floods or infrastructure management.
 - Suitable service models shall be developed depending on the regional and national existing institutional set ups and partnerships (e.g., maximising the roles or Tran-boundary basin authorities).
- **Phase 2 (3 years): Scaling up period,** where on the basis of the results achieved on the previous phase, a number of selected services shall be further developed and scaled up extending the user base and further developing the African capacity to operate and run the selected services. This shall involve a large capacity building effort and institutional development process in order to build a solid basis to establish operational and sustainable services in the 3rd phase

- **Phase 3 (4 years): Implementation Period**, In this phase services shall be implemented and run in an operational manner.

9.6. INDICATIVE DEVELOPMENT PLAN AND BUDGET ESTIMATE:

Taking into account the required effort against the existing pre-conditions in Africa and with the example of the GMES process in Europe, a proposed budget to implement the water component shall amount to no less than 60 Million distributed as:

- Phase 1: 10 Million;
- Phase 2: 20 Million;
- Phase 3: 30 Million;

In this context, suitable funding programs (European development Funds) shall be mobilised in order to cover the needs to develop and implement *GMES and Africa* water thematic area.

10. RECOMMENDATIONS:

In section 9 above, the following priority actions were highlighted:

- Development of information services addressing water resources monitoring and early warning systems including vulnerability assessment and formulation of adaptation strategies in IWRM especially within the global climate change domain;
- Broadcasting of EO data using inexpensive GEONETCast system amongst other channels;
- A proposed initiative for data calibration and validation;

The following recommendations are proposed for the *GMES and Africa* water thematic area:

Ownership

- It is recommended that African ownership of the service definition and development of decision-support tools for (African) users is the key element that should be taken into account for *GMES and Africa* service model

Operational scale

- It is recommended that the basin authorities from sub-national to trans-boundary scales and national water authorities will be the main user of the services and hence the main end-beneficiaries of the process

Capacity building

- It is recommended that a dedicated Capacity Building Program at continental scale is created to develop a critical mass of expertise, African technical centres and value adding companies with the capacity to develop and operate EO-based water information services.

Partnerships

- It is recommended that a mechanism be created to interface the Basin Authorities with international programmes e.g. ESA, EUMETSAT for EO data acquisitions including supplementary EO data from ARMC, WHYCOS for in-situ measurements/ networks and other international projects e.g. EC / JRC AQUAKNOW.

11. SUMMARY

Water, one of the MDGs is intricately intertwined with agricultural productivity and energy generation in Africa, the main drivers of socio-economic development. In the case of irrigated areas, the actual water use amounts to less than 10 % of 40 million ha irrigation potential and only about 4% of the 1.4 million GWh of hydro power potential is developed within the Continent. Despite all this potentiality, Africa faces significant challenges to ensure an effective use and efficient management of its water resources. It is further estimated that by 2025 about 600 million people on the African continent will be exposed to water scarcity situation (<1000 m³/capita/yr).

Developing an Integrated Water Resource Management (IWRM) information system is challenging in Africa, where, water information systems are severely degraded, policies and management decisions are based on unreliable information, and donor institutions are reluctant to provide long-term support for upgrading out-dated observation networks.

In this context, *GMES and Africa* represents a unique opportunity to:

- Enhance African human, technical and institutional capacities to meet the need for timely, quality long term information covering African national, regional and trans-boundary scales as a basis for sound decision making and improved Integrated water resource management and water governance.
- Improve the decision making processes and planning in water resource management in Africa by establishing long-terms sustainable information services that overcome the water information gap in Africa by fully exploiting the increasing global EO capacity.

The *GMES and Africa* water resource model can build upon the solid basis of several initiatives (PUMA, AMESD, TIGER, UNESCO IHP, WHYCOS and HYCOS). These activities have demonstrated the strong potential of EO-based information to support African progress towards Integrated Water Management, at both national and trans-boundary levels. Key African stakeholders including the African Ministerial Council on Water have strongly supported some of these approaches (e.g., TIGER, WHYCOS).

Today, the policy basis is clear; user needs are identified, an initial set of users are strongly engaged, and methodologies have been validated and demonstrated in several countries. The critical issue for Africa is long-term sustainability.

The Lisbon Declaration now opens the prospect of a long-term cooperative AU-EU framework which could enable information services to be fully transferred to African partners and reach sustainability. In order to underpin the high-level Lisbon process, it is necessary to continue to build upon existing capacities in Africa, further develop existing cooperation with African partners, maintaining existing service capabilities, with special emphasis on capacity-building and building-on-capacity.

The information needs are broad, including support for establishing national and regional monitoring and evaluation mechanisms, for assessment of water quality and quantity, and for assessment and monitoring activities by River Basin Organizations. There are many relevant EO-based precursor services such as: Base mapping, Hydrological network mapping; Water availability estimation; Catchments characterization ; Large lake water quality; Ground water exploration; Water Infrastructure monitoring among others.

The proposed *GMES and Africa* will accelerate cooperation between African water authorities, European, and African service providers in the context of the AU-EU framework. The African water ministries, river basin authorities, regional and trans-boundary organizations are the principal users concerned. African Regional and National Technical Centres are the main service providers, along with universities, research centres and other national institutions.

A 10-year three phase implementation strategy is proposed including a consolidation phase (3 years) followed by a scaling up period of 3 years and a final implementation period of 4 years. The budget proposed for each phase is 15 M, 20 M and 30 Million Euro respectively.

12. ANNEXES

ANNEX 1: ABBREVIATIONS

AARSE	African Association of Remote Sensing of the Environment
ACP:	Africa Caribbean Pacific
AGRHYMET:	Centre Regional de Formation et d'Application en Agrométéorologie et Hydrologie Opérationnelle, Niamey, Niger
AMCOW:	African Ministers' Council on Water
AMESD:	African Management of the Environment for Sustainable Development
AQUAKNOW:	Dynamic Virtual Space for Information sharing for water sector stakeholders
ARMC:	African Resource management Satellite Constellation
ARSIMEWA:	Applications of Remote Sensing for Integrated Management of Water Resources in Africa
AU:	African Union
AUC:	African Union Commission
CB:	Capacity Building
CEMAC:	Communauté Economique et Monétaire de l'Afrique Centrale
CEOS:	Committee of Earth Observation Satellites
CERSGIS:	Centre for Remote Sensing and Geographic Information Services
ClimDevAfrica:	Climate for Development in Africa Program
COI:	Commission de l'Océan Indien
CRTS:	Royal Centre for Remote Sensing, Morocco
CSIR:	Council for Scientific and Industrial Research, South Africa
DTM:	Digital Terrain Model
EC:	European Commission
ECOWAS:	Economic Community Of West African States
EDF:	European Development Fund
EO:	Earth Observation
ESA:	European Space Agency
EUMETCast:	EUMETSAT Broadcast system for Environmental Data
EUMETSAT:	European Organisation for the Exploitation of Meteorological Satellites
GEO:	Group on Earth Observations
GEONETCast:	Global Network of Satellite-based Data Dissemination Systems
GEOSS :	Global Earth Observation System of Systems
GEWEX:	Global Energy and Water Cycle Experiment
GIS:	Geographical Information System
GMES:	Global Monitoring for Environment and Security
GWh:	Gigawatt Hour
IGAD:	Intergovernmental Authority on Development
IT:	Information Technology
ITC:	International Institute for Geo-Information Science and Earth Observation
IWRM:	Integrated Water Resource Management
JRC:	Joint Research Commission of the EC
LC:	Land Cover
LCBC:	Lake Chad Basin Commission
LU:	Land Use
MDG	Millennium Development Goals
NBI :	Nile Basin Initiative
NEPAD:	New Partnership for Africa's Development
NGO	Non Governmental Organization
NHS:	National Hydrological Services
OSS:	Sahara and Sahel Observatory
PUMA:	Preparation for the use of Meteosat Second Generation in Africa
RCMRD:	Regional Centre for Mapping of Resources for Development
REC:	Regional Economic Countries
RS:	Remote Sensing
SAC:	Satellite Application Centre, CSIR, South Africa
SADC:	Southern African Development Community
SAI:	Iullemeden Aquifer System
SASS:	Système Aquifère du Sahara Septentrional or North-Western Sahara Aquifer System
SRTM:	Shuttle Radar Topography Mission
TCBF:	TIGER Capacity Building Facility based at ITC, Netherlands

TIGER: A European Space Agency led initiative dealing with Integrated Water Resource Management for Africa using Space Technology

UN-ECA: United Nations Economic Commission for Africa

UNEP – DEWA: United Nations Environmental Programme Division of Early Warning and Assessment

UNESCO -IHP: United Nations Education, Scientific and Cultural Organization International Hydrological Programmes

WHYCOS: World Hydrological Cycle Observing System

WMO: World Meteorological Organization of the United Nations

WSSD: World Summit on Sustainable Development

ANNEX 2: GMES WATER THEMATIC AREA STAKEHOLDERS

- **AU and the African Ministerial Council On Water (AMCOW):** Shall represent the main political drivers of the process. *GMES and Africa* shall directly respond to their needs and priorities.
- **African Water Authorities:** The main end-beneficiaries of the *GMES and Africa* Water Component are the African Water Authorities (represented at continental scale by the AMCOW), the Ministries of Water, and the relevant River Basin Authorities and other Regional and trans-boundary organizations with responsibilities to develop and implement water management plans in Africa.
- **The African Regional And National Technical Centres:** The main potential providers of geo-information for water management. This include not only the National or Regional Remote Sensing Centres in Africa but also Universities, Research centres and other agencies with the capabilities and mandate to provide geo-information in support of envisaged water management plans (e.g., AGRHYMET, RCMRD). An important role will be played by the Experts Centres for Water Science and Technology promoted by NEPAD.
- The **African Development Institutions:** such as NEPAD.
- The **African Regional Economic Institutions:** such as SADC, ECOWAS, CEMAC, IGAD or COI.
- **African and International Space Agencies:** Space Agencies and EO data providers will represent a key element in *GMES and Africa*. In this context, it is worth noting the role of CEOS, which coordinates the efforts of the Space Agencies worldwide in the planning of Earth Observation satellite missions and their applications. In addition, it is worth mentioning the role of African Space Agencies, which should joint the GMES Africa process ensuring the provision of African EO data to African stakeholders.
- **GEO:** GEO provides a framework within which governments and international partners can develop new projects and coordinate their strategies and investments in order to coordinate international efforts to develop a Global Observation System of Systems integrating satellite, in situ and airborne elements. As of March 2009, GEO's Members include 77 Governments and the European Commission. In addition, 56 intergovernmental, international, and regional organizations with a mandate in Earth observation or related issues have been recognized as Participating Organizations. GEO includes water as an strategic target and Societal Benefit Areas (SBA) of interest.
- **The International and African Agencies and groups which sponsor Integrated Water Management:** Integrated Water Resource Management is sponsored and promoted by different International organizations: e.g., UN Water African Group, Ramsar Secretariat, World Water Council, World Water Partnership, etc. In addition there are a number of African institutions that support the wide spread of better practices on water management in Africa such as the African Water Academy or the Water Operators Partnership.
- **The international and National funding Agencies for Integrated Water Resource Management:** National and International funding agencies and Ministries of Foreign Affairs involved in programming and funding development and implementation projects aimed at supporting African countries to develop and implement Integrated Water Resource Management Plans. The African Water Facility hosted at the African Development Bank, the Development program of the EC, the World Bank, The Global Environmental Facility and several National developing agencies (e.g., GTZ) are but few examples of such agencies.
- **The Private Sector:** Value adding companies (VAC) and service providers in Europe and Africa, who possess the capability and experience to develop, implement and operate geo-information services based on EO technology.
- **Non-Governmental Organizations (NGOs):** Number of National and International NGOs with operational capabilities to support African countries to improve the development and implementation of Integrated Water Management Plans. It is worth noting the role of NGOs (such as WaterNET) in capacity building activities for Africa as well as several existing networks of European-African Universities dedicated to sponsor exchange and Europe-Africa collaborations in Science and Technology. .

ANNEX 3: ELABORATION OF IWRM EO PROJECTS IN AFRICA

1. **The TIGER Initiative:** Recognizing the utility of satellite data for Integrated Water Resource Management and the need for action in Africa expressed at the World Summit on Sustainable Development (WSSD) held in Johannesburg, South Africa, the European Space Agency (ESA) in the context of the Committee of Earth Observation Satellites (CEOS), launched in 2002 the TIGER initiative aimed at: **“assisting African countries to overcome problems faced in the collection, analysis and dissemination of water related geo-information by exploiting the advantages of Earth Observation (EO) technology”**.

Since 2005, under the guidance of the African Ministerial Council on Water (AMCOW), with contributions from CEOS (e.g., ESA, the Canadian Space Agency), UNESCO, the African Water Facility (AWF) of the African Development Bank and in collaboration with the UN Economic Commission for Africa (UN-ECA) and several other African and international organizations (e.g. CSIR, CRTS, Ramsar-Africa, South African Department of Water Affairs) TIGER has supported African partners with access to space-borne data and products, by providing dedicated training on EO applications for water management, by funding North-South collaborative projects aimed at developing and demonstrating EO-based water information systems, and by favouring take-off, operationalization and technology transfer to African water authorities.

The projects covered:

- *Base mapping for enhancing infrastructure development with focus on water supply and sanitation;*
- *Catchments characterization and mapping of hydrological network;*
- *Monitoring agriculture and irrigation areas;*
- *Crop production forecast and information services in support to food security;*
- *Ephemeral water bodies identification in arid and semi-arid regions;*
- *Rivers and lakes water level monitoring service;*
- *Water quality monitoring in large lakes;*
- *Support ground water management and estimation of water extraction;*
- *Support ground water exploration (e.g., identification of infiltration areas);*
- *Flood mapping;*
- *Drought early warning systems;*
- *Soil moisture monitoring service;*

TIGER has completed its first implementation period (2005-2008) involving more than 150 African institutions (water authorities, universities, technical centres) through its projects and capacity building activities. The results and achievements of the first implementation period have been recognized at the First African Water Week organized by AMCOW in Tunis on 25-29 March 2008 with a direct recommendation:

“International initiatives like ... TIGER which provide useful tools to the countries to strengthen their capacities for ensuring water security should be encouraged and supported.”

As a direct response to this explicit African request, a second implementation period, 2009-2011, of the TIGER initiative was proposed by the Steering Committee at its 3rd meeting hosted by UNESCO in July 2008. In this context, ESA launched the TIGER second implementation period at the 5th World Water forum in Istanbul.

TIGER has established a long-term development process based on a three stages (support research, pre-operational development, and transitions to operations)⁵ aimed at supporting the consolidation of a full end-to-end African capacity to exploit the coming EO observational capabilities and translate it into operational services in support of the African Water authorities.

5

- **Research Stage:** *aimed at supporting the consolidation of a critical mass of technical centres in Africa with the skills and capabilities to derive and disseminate space-based water relevant information to water authorities and the relevant stakeholders for IWRM.*
- **Pre-operational stage:** *aimed at developing and demonstrating tailored EO-based information services and systems to support African water authorities in collecting water-relevant information in a regular basis.*
- **Towards Operations:** *On the basis of successful development and demonstration results, sub-regional (e.g. trans-boundary river basins) or national projects lead by African water authorities will be implemented, aimed at supporting the transition from a pre-operational stage to a sustainable operational phase. This process is carried out in collaboration with development partners and donors, who support such a transition financially.*

2. **PUMA**, a EUMETSAT and WMO initiative spanned from 2001 to 2005 and equipped a Pan-African network of 53 countries in the five sub-regional economic communities with the infrastructure, training for 275 professionals and support required for receiving the latest space-based low resolution meteorological and environmental MSG data, images and products from EUMETSAT via the EUMETCast distribution system. The project received funding of about 11.4 million euro from the European Commission through the European Development Fund.

One of the six PUMA pilot projects to foster the use of Earth observation data for non-meteorological purposes in a pre-operational basis was "*The evaluation of water resources in Kasai River sub-basin*". The project, relevant to the water resources thematic area of *GMES and Africa* led to the rationale and integrated management taking inland navigation into account.

3. **The African Monitoring of the Environment for Sustainable Development (AMESD)** initiative takes the Preparation for Use of MSG in Africa (PUMA) project a stage further by extending the systematic distribution and promotion of the use of meteorological earth observation technologies and low resolution data products to environmental and climate monitoring applications. The importance and relevance of operational water resource management in Africa is clearly manifested by the approval of two projects out of five AMESD projects dealing directly to water resource management thematic area of *GMES and Africa*. One of the projects, *Water Management for Cropland and Rangeland Management* is being implemented in the ECOWAS Regional Economic Community. The key products to be developed include vegetation state for estimation of yields of cultural and pastoral land, dryland areas and drought risks delineation by dry matter productivity, phenology and fraction cover extent. Also the extent and dynamics of small water bodies to support livestock management and savannah fires products will also be distributed in near real time via EUMETCast.

The other project, *Water Resource Management focusing on environmental aspects of watersheds* thematic action is being implemented by CEMAC Regional Economic Community. Two services will be provided, one a near-real time water level product for the Oubangui river incorporating a low water alert system for navigation. The other service will be an offline water cycle service specifically targeting rainfall and evatranspiration for the Oubangui sub-basin. The services are in synergy with the African Network of Basin Organization, WMO -Congo-HYCOS programme and forests- water resources FORAF/OFAC project.

4. The **UNESCO IHP** programme is UNESCO's international scientific cooperative programme in water research, water resources management, education and capacity-building, and the only broadly-based science programme of the UN system in this area. The program objectives include : 1) to act as a vehicle through which Member States, cooperating professional and scientific organizations and individual experts can upgrade their knowledge of the water cycle, thereby increasing their capacity to better manage and develop their water resources; 2) to develop techniques, methodologies and approaches to better define hydrological phenomena; 3) to improve water management, locally and globally; 4) to act as a catalyst to stimulate cooperation and dialogue in water science and management; 5) to assess the sustainable development of vulnerable water resources; 6) to serve as a platform for increasing awareness of global water issues.
5. The **Applications of Remote Sensing for Integrated Management of Water Resources in Africa (ARSIMEWA)** project. ARSIMEWA seeks to develop infrastructural support that will enable African countries to access and use satellite data and information and communication technologies, including the Internet, Remote Sensing (RS) and Geographic Information Systems (GIS) for monitoring, assessing and managing their Water Resources, thereby playing a complimentary role to operational use of EO technology. The pilot project covers the participating countries Benin, Botswana, Côte d'Ivoire, Democratic Republic of Congo, Equatorial Guinea, Guinea, Mozambique, Niger, Nigeria, Senegal, South Africa and Zimbabwe.
6. Another initiative, the **World Hydrological Cycle Observing System (WHYCOS)** is a WMO programme aimed at improving the basic observation activities in the field of hydrology by primarily focusing on strengthening technical and institutional capacities of National Hydrological Services (NHSs) and improving their cooperation in the management of shared water resources.

8. “Impacts on climate variability and change”

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1. Introduction

1.1 Thematic Context

Africa has already been identified by researchers worldwide as a continent particularly vulnerable to the consequences of climate variability and change (Odada et. al 2008). The recent fourth assessment from the Intergovernmental Panel on Climate Change (IPCC,2007) looking at vulnerability also confirmed it. The effects of climate variability and change are already evident on the ground and the continent’s policymakers cannot afford to ignore it anymore (Stern,2007)

Many countries in Africa depend on natural resources that are sensitive to changes in climate. Water supplies, for example, already suffer from high rainfall variability in many parts of the continent. With reservoir levels already dangerously low, projected changes in climate look set to put further pressure on water availability, which may lead to conflict and are certain to affect economic development (World Bank,2005) Land conditions, especially in areas already vulnerable to degradation, are expected to deteriorate under climate change, and new fragile drylands can be created.

Climate variability and change is likely to affect food security as well. Over half the African population live in rural areas, dependent on the local environment for food. But the marginal cropping conditions in semi-arid and sub-humid area, where rainfall is extremely unreliable, have already led to widespread malnutrition. Further climatic variability and change could leave many African countries reliant on food aid from the developed countries (UNDP,2004)

Climate variability and change will affect not only natural resource bases but could also have implication for human health. Vector-borne diseases such as malaria are already placing national healthcare systems under strain. Such diseases are driven in part by climate change with several Africa countries experiencing increases in Malaria outbreaks that can largely be explained by recent changes in temperature and rainfall (IPCC,2007)

1..2. Pressures/Constraints: Impact of Climate Change

Climate change has long since ceased to be a scientific curiosity, and is no longer just one of the many environmental and regulatory concerns. It is the major, overriding environmental issue of our time, and the single greatest challenge facing decision-makers at many levels. It is a growing crisis in economic, health and safety, food production, security, and other dimensions. Shifting weather patterns threaten land conditions and related food production through increased unreliability of precipitation, rising sea levels contaminate coastal freshwater reserves and increase the risk of catastrophic flooding, and a warming atmosphere aids the pole-ward spread of pests and diseases once limited to the tropics. While, the exact nature of the changes in temperature,

precipitation is not known, there is agreement about the following table of multiple impacts of climate variability and change in Africa that will need to be addressed by adapted and knowledge based policies:

Table. Impacts of Climate Change and Variability

Resources	Impacts
Humans	<ul style="list-style-type: none"> • Decreased agricultural production and food security. • Reduced water availability. • Increased pests and diseases. • Human conflicts over resources.
Animals	<ul style="list-style-type: none"> • Loss of biodiversity. • Loss of habitats. • Increased pests and diseases. • Increased human/animal conflicts.
Plants	<ul style="list-style-type: none"> • Loss of biodiversity. • Loss of habitats. • Increased invasive species.
Land and Ecosystems	<ul style="list-style-type: none"> • Worsening of land degradation. • Increased areas under Desertification and Deforestation. • Unfavourable land Transformations. • Increased hazard for vegetation Burning. • Change of land cover.
Water and Ecosystems	<ul style="list-style-type: none"> • More events of drought and flooding • Loss of biodiversity. • Loss of wetlands. • Groundwater pollution. • Sea-level rise. • Snow and glaciers melting.

2. Policy Drivers and need analysis.

2.1 Policy drivers

National decision makers are flooded with urgent demands for action on a wide range of issues, and must make choices among them. A major factor influencing such decision is the prospective return on investment, as demonstrated by the impressive impacts of the Stern Review on the Economics of Climate Change (DLD, 2009). Information that satisfies such demand is needed as first priority. Information on the changing environmental status and climate change impacts will be needed in the argumentation or negotiation phases of policy making and international treaties. On the contrary, climate observing system in Africa is currently the worst in the world and is deteriorating. Ways of securing climate observing and integrating climate information into development are therefore urgently required. Africa need to build effective partnership systems linking stakeholders, users and decision-making sector with climate information providers (including climate prediction providers, climate observation providers as well as climate operational sectors). Synergies with sister conventions, UNFCCC, CBD, are rather obvious and need to be consolidated optimizing use of resources, obtained information and reporting obligations.

The Global Monitoring for Environment and Security (GMES) European Initiative that is currently on the political agenda of the European Union (EU) and the Arican Union (AU) can provide on a sustained basis, reliable and timely services related to environmental and security issues in support of public policy makers needs as stipulated in the joint EU-Africa strategy document of October,2006. GMES has a global reach and can contribute to the international efforts consistent with the Johannesburg 2002 Action Plan, the Mauritius Strategy

for small island developing states (SIDS) as well as with G8 recommendation made in July 2005 to strengthen the global climate observing system.

The Lisbon Declaration on “GMES and Africa” of December 2007 also recognized that the environmental degradation and climate change undermine sustainable development and represent threats to the achievement of the Millennium Development Goals (MDG’s). The EU is therefore committed to support Africa’s capacity Building efforts in the sustainable management of natural resources, including on weather observation, climate monitoring and early warning systems, as well as helping to tackle illegal logging and associated trade. The strategy recognized also that in order to achieve the MDG’s, a special global effort to build scientific and technological capacity in Africa is required and thus inadequate technical capacity of Africa will be upgraded inter alia through specialised networks at regional and sub-regional levels, focusing on identified priorities so as to underpin economic growth and sustainable development of the African Continent.

2.2 Need analysis

The Intergovernmental Panel on Climate Change (IPCC) and many other recent assessments have shown that Africa is one of the most vulnerable region to the negative impacts of present and any future climate variability and change. Availability of long-term, high quality data with good spatial coverage that is representative of all climatological zones , is critical for understanding past and present climates as well as projecting climate expectations of the future; assessment of the impacts and vulnerability; and the development of appropriate mitigation and response policies.

The parties to the United Nations Framework Convention on Climate Change (UNFCCC) have recognized the importance of improving climate related observations to meet convention needs, and in a series of decisions, have urged parties to take actions to improve all types of observations, including atmospheric, oceanographic and terrestrial components of the climate system. The Global Climate Observing System (GCOS) was therefore established in 1992 to ensure that the observations and information needed to address climate-related issues are obtained and made available to all potential users.

GCOS and its regional partners in Africa (e.g. the Drought Monitoring Centre in Nairobi-DMCN and Harare (DMCH) have identified regional deficiencies and needs in atmospheric, oceanographic and terrestrial observing systems for climate monitoring and developed regional plans and projects to address the identified needs. The three major regional issues that were identified include:

- (i) Establishment of regional system for monitoring changes in the glaciers of the tropical mountains of Eastern Africa;
- (ii) Development of some urban climate/air pollution observation system and
- (iii) Development of regional climate change data and information centre to enable the region undertake effective climate change monitoring; detection; attribution; together with assessments of the impacts/vulnerability of the society;and development of appropriate mitigation and adaptation policies.The specific activities currently undertaken are outlined below:

OBJECTIVES	ACTIVITIES
1.Establishment of regional mountain glacier observing system and information/database.	1.1 Identify and delineate location of glaciers to be monitored. 1.2 Survey/develop baseline reference points for monitoring using all possible methods in space based methods. 1.3 Set up automated climate observing stations at the three mountains. 1.4 Set up relevant automatic hydrological system. 1.5 Develop relevant Model of the glaciers, climatic, vegetation, Hydrological and other relevant data. 1.6 First assessment and statement regarding the state of glaciers at the three mountains.This would be the reference baseline for all future assessments. 1.7 Conduct capacity building workshops. 1.8 Publication and Exchange of relevant information; and annual statement regarding the state of the regional glaciers. 1.9 Regional education and awareness workshop. 1.10Develop short, medium and long term capacity plan to ensure

	<p>sustainability of the observation programme.</p> <p>1.11 With some potential partners like START, PAGES etc; undertake some ice core studies to understand past climate variabilities and changes.</p>
2. Development of national and regional climate change indices database Centres.	<p>2.1 Identify data that may be relevant to regional climate change, detection and attribution including re-analysis, space based and model output products.</p> <p>2.2 Identify GCOS regional data adequacy including regional data / observation network.</p> <p>2.3 Develop framework for rescue and storage in digital form of regional data currently in magnetic tapes.</p> <p>2.4 Conduct capacity building training workshops on GCOS data quality control, data mangement; climate change indices, etc</p> <p>2.5 Develop appropriate formats for data storage on appropriate media and design.</p> <p>2.6 Acquire relevant equipment for data rescue, data processing and software for the NMHS's.</p> <p>2.7 Set up a regional / national climate change database centres.</p> <p>2.8 Purchase install hardware and software at the NHMS's and ICPAC.</p>
3. Establishment of urban climate and air pollution observation platforms, and data base.	<p>3.1 Workshop of experts and national representatives on urban climate change and pollution monitoring to address regional requirements.</p> <p>3.2 Assess suitability of the existing meteorological stations for incorporations into the urban observing network.</p> <p>3.3 Development of one platform per country on urban climate / urban air pollution measurements.</p> <p>3.4 Develop national and regional data base on urban climate/ urban air pollution for the countries.</p>

In addition to the above initiatives, the scientific community recently formulated the user needs related to monitoring and assessment of desertification/land degradation (DLD) (DSD WP1, 2009) and listed that all users groups needs to have information at hand to be able to derive:

- the spatial location, severity and extent of DLD
- nature of DLD, e.g. loss of primary production, impacts on water resources, etc.
- the cause of DLD and what are the options to counter these
- Hazards and risks
- financial considerations and the social implications of mitigation

Such information needs are similar in other fields of the above identified climate variability impacts and require integrated assessments that will need to be based on earth observation data providing the spatial continuum to be complemented with in-situ observations.

(a) Knowledge and methods:

Pijanowski, B.C.. et al. (2007), describe very well the need and requirements of integrating climate-land change interactions: "Understanding the interplay of interactions between the human-environment system and the climate change, requires assessment of how various factors within the climate system, such as temperature, precipitation patterns, impact on the human behaviour and socio-economic systems. Behaviourial and socio-economic factors influenced by climate, include food production systems, crop prices and market dynamics, human behavioural factors such as risk and cultural norms, migration and population dynamics and land tenure systems. Land use/cover properties in combination with bio-physical factors such as topography, soils, influence of large water bodies, combine with atmospheric trends such as greenhouse gas concentrations, to loop back to regional and global climate change dynamics."

This confirms the need for knowledge and understanding of interrelations of drivers and impacts in the cause-effect of climate change. However, there is a lack of standardized procedures and methods to perform this at operational scales. Building required capacity and knowledge bases, together with the routine provision of

focused spatial information products, whether derived from satellite imagery and/or integrated with ground observations, can be obtained through a focused and continent wide programme that includes all key stakeholders. GMES is an excellent basis for such contraction.

(b) Analyzed and integrated Information

Spatio-temporal analysis of the above in point 4. mentioned impacts should reveal fields where relevant management options to counter them can be identified.

Cost-benefit analyses are needed that includes the value of environmental services. Not all values are monetary; the land provides a range of ecosystem services that are beneficial to humans in tangible on intangible ways, such as culturally.

International payments for carbon sequestration linked to the proposed United Nations Collaborative Programme on Reducing Emissions from Deforestation and Forest Degradation in Developing Countries (UN-REDD Programme, <http://www.un-redd.org/>) mechanism under the UNFCCC could generate financial resources for dryland countries.

(c) Products

Inherent to the subject, products will need to be produced at regular intervals. Results will need to be presented in user adapted understandable formats, and more science-to-policy dialogue is needed for that. Ideally product definition are obtained through an iterative scoping process that includes stakeholders from producers of data to users at technical and political levels.

Impacts	Needs and Potential Products (examples only. not exhaustive)
<ul style="list-style-type: none"> • Decreased agricultural production and food security. • Reduced water availability. • Increased pests and diseases. • Human conflicts over resources. 	<ul style="list-style-type: none"> - statistic and satellite based production estimates (including NDVI derivates and RFE) - integrated info from RFE, Soil properties, Cloud presence, DEM, groundwater resources (sat. based soil moisture products), etc. - inventory of main ecosystem service resources: based on satellite info on vegetation land cover, Soil Organic Matter, Ground water, livestock densities, habitat characterization
<ul style="list-style-type: none"> • Loss of biodiversity. • Loss of habitats. • Increased pests and diseases. • Increased human/animal conflict • Increased invasive species.ts. 	<ul style="list-style-type: none"> - habitat characterization; dynamics based on long term low resolution sat. data; habitat patterns, segmentation and connections calculated on combined ground and space based information; and land cover/use based on multitemproal high resolution imagery - spatial databases on plant species composition, biodiversity 'needs' and pest occurrence
<ul style="list-style-type: none"> • Worsening of land degradation. • Increased areas under Desertification and Deforestation. • Unfavourable land Transformations. • Increased hazard for vegetation Burning. • Change of land cover. 	<ul style="list-style-type: none"> - products on state and trends of the key state variables, vegetation and soil, complemented with spatial continuous climate data and soico-economic data layers., - satellite derived burn scar products

<ul style="list-style-type: none"> • More events of drought and flooding • Loss of wetlands. <ul style="list-style-type: none"> • Groundwater pollution. • Sea-level rise. <p>Snow and glaciers melting.</p>	<ul style="list-style-type: none"> - interpolated rainfall products and drought indices, such as SPI and anomaly products. - high resolution DEMs,
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3. Identification of Communities

The European and African users communities and stakeholders to be engaged in “GMES and Africa” initiative include the following:

European institutions and agencies	<p>DG DEV, DG AIDCO, DG ENV, DG AGRI, EEA</p> <p>National, regional or local governments among EU Member States and Partner countries</p>	<p>need the information to assist policy development and implementation</p> <p>need the information to assist for policy development and implementation and to help mandatory reporting requirements (e.g National Development of Foreign Affairs)</p>
African institutions and agencies	<p>AU, UNECA, ECOWAS, IGAD, CEMAC, SADC, SIL, IOC, NEPAD, AMCOW, AMCEN, AMCST,</p> <p>National or local governments among AU Member States and Development Partners</p>	<p>need useful information on a wide range of areas such as food security, management of natural resources, desertification, climate monitoring, conflict prevention and humanitarian aid</p> <p>need the information to assist for policy development and implementation and to help meet mandatory reporting requirements (MDGs, UNFCCC, UNCCD, UNCBD, etc)</p>
International institutions and development partners	<p>UN System’s Organizations, World Bank, Global Environment Facility, European Commission,</p>	<p>helping African countries build and fund environment, development and disaster reduction programmes</p> <p>need the information for the development of their policies and operational strategies and to direct the utilization of their resources in the continent</p>
International initiatives and bodies	<p>WMO, GCOS, IPCC</p> <p>International agencies: FAO-GIEWS, UNEP-DEWA, ECMWF, JRC-ACP Observatory, JRC/FOODSEC and AGRI4CAST, World Bank, UNHABITAT, UNDP,</p>	<p>in support of international conventions (e.g UNFCC, UNCCD, UNCBD)</p> <p>operate their own Early Warning and Monitoring Systems from continental to global scales</p>
Scientific Research programmes	<p>RCP, IGBP, IHDP, START, DIVERSITAS, ESSP, AfricanNESS</p>	<p>working in Africa on improving the understanding of the processes and</p>

		uncertainties associated with Earth System Science
Private sector	cash crop production, mining, infrastructure, forest exploitation, non-governmental organizations (NGOs) civil society	Need for policy direction and project implementation, to access understandable and reliable information on global environmental trends for public participation on decision making.

4. Mapping Exercise

This is aimed at the identification of relevant past and current activities (e.g. infrastructure), existing capacities and programmes in Africa as well as in Europe on which “GMES and Africa” can build on (including the work done by the GEO capacity building committee and other international experience (e.g. capacity building - education, training and research); key institutions (at national, regional and continental levels), including networking (thematic, geographic, etc).

<i>Initiatives</i>	<i>Specific programmes</i>	<i>Nature and basis for linkage</i>
GEO	GEOSS, Terrestrial component of GCOS, GTOS IGOS CEOSS/LSI	<ul style="list-style-type: none"> • achieve a stronger role in international organizations, consolidating the European contributions to the GEO/GEOSS • enhance delivery of benefits to society in understanding, assessing, predicting, mitigating, and adapting to climate variability and change • providing the comprehensive observations required for monitoring the climate system, for detecting and attributing climate change, for assessing the impacts of climate variability and change, and for supporting research toward improved understanding, modeling and prediction of the climate system. • to address the effects on food security, the environment and sustainable development • to produce comprehensive global, region, and national data and information • to define standards (or guidelines) based on a thorough understanding of user requirements that describe optimal future LSI constellation capacities, characteristics, and practices. • aims at promoting the efficient, effective and comprehensive collection, distribution, and application of space-acquired data of the global land surface.
European international initiatives	GMES LMCS	<ul style="list-style-type: none"> • provide information concerning global land surface processes and strengthen capacity for international cooperation on regulatory issues and enhance Europe's in the development of global standards
African institutions and initiatives	regional partners of GCOS in east and southern Africa and Drought Monitoring Centres in Nairobi	<ul style="list-style-type: none"> • to identify regional deficiencies and needs in atmospheric, oceanographic and terrestrial observing systems for climate monitoring and to develop regional plans and proposals to address the identified priority needs. • monitoring changes in the glaciers of the tropical mountains of eastern Africa;

		(DMCN) and Harare (DMCH)	<ul style="list-style-type: none"> • development of some urban climate/air pollution observation system, and • development of regional climate change data and information centre to enable the region undertake effective climate change monitoring; detection; attribution; together with assessments of the impacts/vulnerability of the society; and development of appropriate mitigation and adaptation policies.
African research activities	GEC	AfricanNESS	<ul style="list-style-type: none"> • food and nutritional security, including crops, wild-gathered resources, livestock resources and fisheries; • water resources, particularly in the water limited sub-humid, semi-arid and arid regions; • health, especially in relation to the biodiversity-linked, environmentally-mediated and vector-borne diseases that are responsible for the high disease burden in Africa, and • ecosystem integrity, on which the presence of biodiversity and the delivery of ecosystem services depends (Odada et. al., 2008). • outlines the kinds of international, multidisciplinary research approaches necessary to approach these issues, give examples of specific questions and projects.

5. Identification of Gaps and Suitable Programmes

5.1 Identification of gaps.

A. Thematic gaps.

The major gaps where “GMES and Africa action is needed are Land and Water knowledge and information. Land processes are characterized by a great complexity associated with the multiple elements in play and various relations between these elements. Land resources are the most important basis of African communities’ survival. Over the years, following various human and natural shocks, land resources have been seriously damaged with serious environmental and socio-economic consequences. This degradation process has international connections both from its origin (globalization, multinationals, climate change etc) and in terms of its impacts (climate change, poverty issues). Improvement of land resource management in Africa is becoming a central concern of the international community and is acknowledged by several UN Framework conventions (UNCB, UNCCD, UNFCCC) but links need to be consolidated with these conventions.

B. Data gaps

* Institutional capacity: Up to date, no harmonized data collection systems are in place. Data gathering in-site at national level is not fully coordinated and if data is collected for one purpose it might not be available to other stakeholders for other use. In many cases institutional capacity or motivation is missing to cover less common, but needed, data needs.

* Data collection methods and storage are mostly dispersed and not harmonized. The scientific community therefore proposed the development of a GDOS system (Global Dryland/Desertification Observing System)(DSD, 2009).

* Baselines for most of the variable and integrated products need to be compiled.

C. Methodological gaps:

Earth Observation is complementary, not alternative, to in-situ observations, but provides a good basis for spatio-temporal integration of both data types. Contextual knowledge acquired in the field can be used to orient and calibrate the satellite data analysis. Obviously for DLD long term satellite data series are needed to derive required trends. Ideally higher resolution, spectral better focused and more consistent satellite data series have less time span, e.g. SPOT VGT has 10 years now. However, these should be combined with the available long term series through innovative approaches.

D. Knowledge gaps

These analyses for climate change impact purposes need to better integrate climate aspects to provide further understanding of the cause-effect relations that can lead to identify potential fields for adaptation management and policy orientation. For climate change impact assessment, earth observation can provide data required to drive e.g. water regulation models and carbon models. However integrating of bio-physical, including climate aspects, and socio-economic aspects is the only way to obtain relevant information. Holistic assessments are only at the brink of development and need to be further developed.

6. Building GMES and Africa Service

6.1 Service definition and provision

(a) Basic Services to be set up and provided need to focus on the provision of data and information:

Data acquisition services include:

* From regional, national, local institutions

- Harmonized meteorological information
- Harmonized in-site bio-physical and socio-economic observations

* From the space segment

- Earth Observation data for the elaboration of the following continuous harmonized datasets:

- Factors of the climate system:

- Temperature, Precipitation patterns, radiation, albedo, evapotranspiration, Wind, Sunshine, Greenhouse gas concentrations.

- Bio-physical

Land cover – land use – and change:

- Land cover and land cover change maps, land use and management information (high spatial resolution based imagery with temporal update of 5 years – FAO Africover and GLCN networks provide basis for this)

- Vegetation changes, e.g trends in cover density, trends of phenological parameters and productivity: (based on long term low resolution times series)

DEM, geology

Soil property/soil condition trends, e.g of SOM, salinity, moisture, erosion etc.

Larger water bodies.

For many of the above non-exhaustive list of data requirements, space born observations can contribute to the compilation and integration into spatio-temporal continuous datasets and the build up of highly necessary time series. E.g. Multiple satellite and sensor merging techniques can be used to improve the precipitation estimates from space. Advantages are a better spatial resolution, a continuous temporal coverage and constant know uncertainties.

A minimum time series length will be 10 years, allowing the understanding of interplay between certain bio-physical and climate factors. Longer time series are needed for trend analysis.

(b) Advanced services:

Specific variables measured by space systems can be directly assimilated into relevant process models where it concerns climate change assessment. However, for the impact assessment of climate variability and change it is not sufficient to define a set of primarily physical or categorical variables which drive a single generic model.

Therefore, products to be serviced will have different levels of integration. The White Paper prepared for the UNCCD scientific conference (DLD, 2009) provides insight in various modelling techniques that are available for producing integrated assessment products. One of them is e.g. syndrome or scenario based modelling (Petschel-Held et al., 1999). This looks at large scale processes and interactions. Impacts, such as from climate variability, are characterized by a suite of properties that affect resources, economies and populations. Syndromes, well known in land degradation assessments, link such state or symptomatic variables and can be used to produce spatial products indicating the probability for the syndrome to happen. Being deterministic they can be adapted for scenario building. Key state variables are dependent from the scale and the objective of the integration. Reynolds et al. (2007) propose to focus on slow variables and link these to ecosystem services.

GMES as such will need to provide integrated products. As GMES node, at regional level there will be more competence for processing, hence products are level 2 or higher and can include an advanced level of modelling. For data type and thematic integration, many dispersed science approaches are available, but need to be scrutinized for effectiveness and applicability. This is a research question to be solved first. On-going activities and guidance as provided through the IPCC and the recent science integration into the UNCCD process, can provide further support to solving this issue. Stakeholder participation in such process contributes to understand the various aspect of the complex interactions within the human-environment system. This is field to which GMES can contribute substantially and ensure progress and breakthroughs that lead to higher level information focused on impact identification and mitigation options.

Table : Relevance of identified multi-purpose products
(source: GMES-LMCS WG final report, 2007)

			Application areas	
			Climate change	Desertification
Near Real Time Bio-geophysical monitoring service	Vegetation	Fraction of Vegetation Cover	x	x
		Leaf Area Index		x
		NDVI	x	x
		FAPAR		x
	Fire	Burnt area maps		x
		Active Fire maps	x	
		Fire Radiated power	x	
	Radiation	Land surface albedo	x	x
		Land surface temperature		x
		Surface fluxes - Short-wave		
		Surface fluxes - downward long-wave		
		Emissivity		
	Water	Lakes maps	x	x
		Level of lakes and big rivers	x	x

	Lake surface temperature	x	
	Ground water	x	x
	Actual Evapotranspiration		x
Snow	Snow area extent	x	
	Snow depth	x	
	Snow water equivalent (SWE)	x	
Permafrost	Permafrost extent	x	
	Permafrost depth	x	
	Permafrost seasonality	x	
	Soil moisture (up to 10-cm soil depth)	x	x
Periodical land cover and changes mapping service	MR Land cover and change maps	x	x
	HR Land cover and change maps		x
	HR Forest cover and change maps	x	X
	HR Urban area and change maps		X
	HR Cropland and change maps		X
	Glacier and ice sheet maps	x	
	Ice sheet topography and elevation changes	x	
Other data	Rainfall estimations		x
	Temperature		x
	Land surface topography (DTM)	x	x

6.2 Capacity building

The overarching constraint reported by ministries, agencies, non-governmental organizations, scientists, research projects and others in developing countries, and identified by virtually all studies and reports on the implementation of MEAs, is a lack of institutional, financial and human capacity to address physical and human resources and skills requirements adequately. Capacity affects responses to, and the effectiveness of, monitoring and knowledge exchange, along with the ability to implement treaties effectively (DLD, 2009). Knowledge management can help to overcome this constraint if barriers to knowledge sharing and knowledge management between local, national, regional and international levels are eased. Capacity-building needs to be cross-sectoral to overcome past shortcomings in addressing the complexities of DLDD, including the need to incorporate actions into government agendas, analyses, frameworks and policies. In addition, capacity-building needs to foster greater collaboration and coordination of activities at regional, national and local levels.

This is specifically true in the field of earth observation related to climate change impact integrated assessments. Capacity building needs to construct on improving or operationalizing existing structures. The complex nature, however, of integrated assessment strategically including earth observation data and information, suggests a capacity building that most probably focuses at regional levels first, with secondary extensions to the national scale. European academic institutions, assisted by funding agencies, should play a pivotal and fore front role in not only technology transfer, but also on what is needed to use this technology and to translate it into policy relevant information. Regional and national science-to-policy dialogues should be organized to answer to the latter.

6.2.a Necessary Elements

Besides the requirement of reliable space and in-situ data collection systems, the assessment needed for the successful implementation of the mentioned indicators will to a good deal depend on the creation of a robust information baseline for which monitoring and assessment capabilities include

- common principles of data collection, data handling and reliable methodologies for the integration of available archived data and continuous monitoring data, in view of deriving biophysical and socio-economic trends;
- concepts for streamlining and optimization of the integration of knowledge on biophysical and socio-economic factors and on their interactions;
- improved knowledge and models of the interactions between climate change adaptation, and mitigation and impacts on the human-environment systems;

6.2.b Strategy to Implement Them

Capacities should be built in a way that strengthens existing institutions, increasing the acceptance of the continuing need for monitoring and assessment and its flow into the policy making process. Capacity building starts with knowledge sharing based on proper and adapted knowledge management. It further needs a transparent, active collaboration and coordination of activities at regional and national scales. There are many diverse interest groups, people, governments, institutions, that hold stakes in land issues, monitoring and assessment must utilize multiple knowledge sources at different scales. (DLD, 2009).p12

Once knowledge improves, this catalyzes needs and use of information. The initial capacity is fostered through existing institutional capacity and gradually increased by the process itself of (improved) monitoring, (focused) assessment and (adapted) use of information.

Planned Services under GMES & Africa Initiative will need to deal with a certain initial inertia of product take-up and maybe focus more on knowledge management and transfer than the product generation itself during the initial phase. Such knowledge transfer needs to illustrate the added value of the products for the stakeholder's decision making. Services will need a programme that addresses this gradual process starting from information and product value awareness raising, capacity building to ensure the take-up and use of the products leading toward the product generation itself

Further steps to consider are:

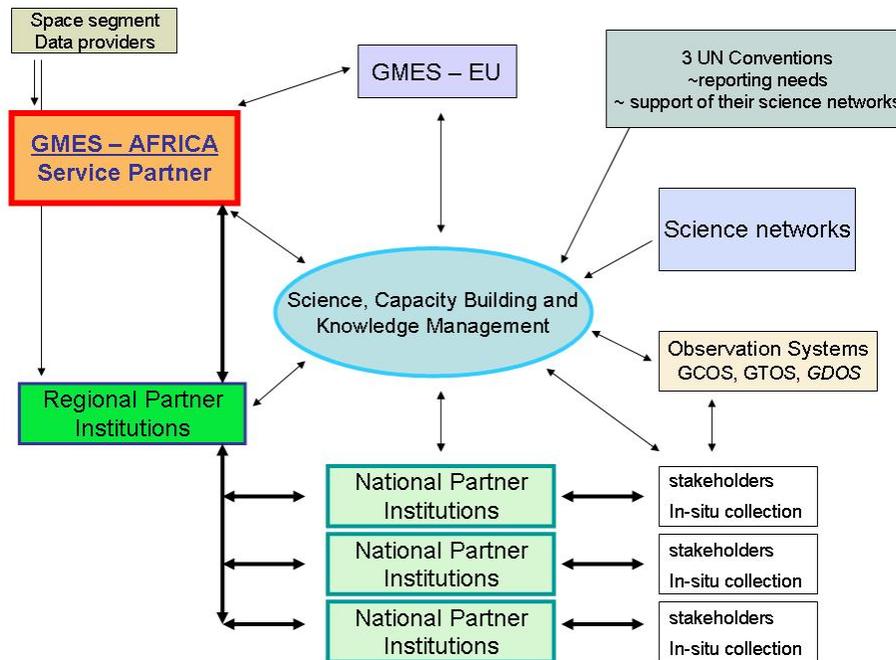
- Organizing and actively running of proper science networking: ensuring a proper, comprehensive and responsive science input into the whole process on a continued basis, a networking and coordination mechanism could be fostered through GMES. This can of course build and group on existing networks.
Activation of monitoring mechanisms such as the existing GTOS and the would-be GDOS, and their linking with GCOS. Other existing initiative can be incorporated and/or reinforced:
 - FAO Africover
 - GLCN
 - OSS-ROSELT
 - Others....
- Finalization of the inventory of all needs and scientific methodological options to satisfy user needs in this thematic field .
- reinforce existing initiatives

6.3 Prioritisation of requirements and actions

(1) Awareness raising at the various institutions involved:
Stakeholder processes for awareness rising from the GMES side and involvement in product definition from the stakeholders at the other side, increasing the ownership feeling and stimulating involvement and sustainability of the process.

(2) Coordination of in-situ observation and data collection
(3) Coordination of compilation of fundamental datasets: from in-situ and space campaigns
(4) Identification and selection of models and methods for integration of data into version 1. products (using science network throughout all process)
(5) Service-stakeholder iterations on use, improvements and increased capacity building
(6) Product generation
(7) User and use follow-up; added value evaluation
(8) Routine production, refinements and continued use adaptation

6.4 Organizational scheme



7. Recommendations

- Working linkages need to be established with identified regional partners and national partners.
- Sensitivity and awareness need to be raised with those partners on the importance of climate change impact monitoring, knowledge management and science based capacity building is at the centre and is driving main interrelations and connections, ensuring sustainability of the GMES set-up.
- Climate change impact assessment and the required data collection need to be based on agreed methodological principles and harmonization procedures
- Sets of key variables need to be identified. Connected science networks and insights gained through e.g. the UN convention community are crucial to be involved
- Data collection, in-situ or space borne, need to be interconnected with on-going initiatives
- Appropriate scientific based knowledge management approaches need to be utilized in the phase of individual need and product evaluation and definition; this also is expected to initiate mobilization of existing capacity; vital gaps need to be identified and addressed

- All partners will need to adopt coherent and open data policies. Clearly identified and properly setup communication channels and access right must be established to facilitate exploitation of all information by all concerned actors, while preserving the rights and addressing the concerns of the original data providers. Such should be coordinated by the GMES-Africa.
- methods for data and thematic integration will need to be identified in collaboration with all partners and the scientific community in the early stage of the programme.

8. Summary

Africa is endowed with immense renewable natural resources. Yet, natural phenomena such as climate change and variability, and human factors, such as population growth, competition over water and pollution, increasingly threaten the sustainability of Africa's natural resources, and hence, the livelihoods of the many poor living in Africa. The continent suffers from one of the most unstable rainfall regimes worldwide, causing severe aridity in areas such as the Sahara and extreme humid tropical conditions in areas such as the Congo Basin. The high temporal and spatial rainfall variability has also repeatedly led to extreme climate events (droughts and floods) that pose a continuous risk to Africa's people and their livelihoods and its national economies.

Climate change and variability, population growth and increasing water demand, over-exploitation and environmental degradation will contribute to a worsening of the state of natural resources in Africa. The over-exploitation and regulation of water resources for example, have caused significant changes in the flow regimes of rivers resulting in negative impacts on the environment and loss of ecosystem functioning. The outcome of poor land use practices has resulted in sedimentation of river channels, lakes and reservoirs and changes in the hydrological processes. Among the many factors leading to the degradation of watershed ecosystems, dams are the main physical threat; fragmenting and transforming aquatic and terrestrial ecosystems with a range of effects that vary in duration, scale and degree of reversibility (World Commission on Dams, 2000). The continent is marked by recurrence of climatic extremes in the form of flooding and drought. Global change scenarios predict a continuing global warming for this century-between 1 and 6°C and a sea level rise of between 0.1 and 0.9m (IPCC, 2001) and an increasing frequency of climatic extremes that may further aggravate the state of available freshwater resources.

Not only is the quantity of freshwater a fundamental instrument in the development of all regions of the continent, but also the quality of the resources. Deterioration of the quality of water resources resulting from further increases in salinity and nutrient loads from irrigation (irrigated agriculture) and the domestic, industrial and mining sectors will significantly deplete available resources and increase water scarcity. Increased human activities lead to the exposure of the water environment to a range of chemical, microbial and biological pollutants as well as micro-pollutants. The mining and industrial sectors especially produce high concentration of wastes and effluents that act as non-point sources of water quality degradation and acid mine drainage. Increased groundwater pollution is a particular concern for the more arid countries of northern and southern Africa. All these challenges will be addressed through the enhanced knowledge, improved data and integration of information by "GMES and Africa" initiative.

Annexes

Summary of relevant reports

- (1) The Dryland Science for Development (DSD) White Papers in preparation of the first UNCCD Science Conference (Sep.. 2009) See www.drylandscience.org.
The Dryland Science for Development (DSD) consortium convened three global working groups of scientists to analyse and summarize the leading scientific knowledge on the priority theme on *“bio-physical and socio-economic monitoring and assessment of desertification and land degradation, to support decision-making in land and water management”*, in order to generate practical recommendations. The document describes state-of-the-art knowledge and derives innovative solutions for the monitoring and assessment of desertification, Land degradation and drought. Both the technical aspects, including remote sensing options, integration and solutions . as well as the knowledge management aspects are dealt with in depth. Furthermore, synergies between existing operational systems and the various UN conventions are explored. Final recommendations are formulated for decision makers.
- (2) The Roadmap towards a New World Atlas on Desertification, Land Degradation and Drought, describes the context and needs for a New Atlas on DLDD in support of policy framing and to improve the scientific input into policies in that filed. A methodology for regular application of indicator systems for monitoring and assessment of desertification processes is described.

African strategy for GEC,

<http://www.igbp.net/documents/AFRICANESS-REPORT.pdf>

Terrafrica, 2004,

<http://web.worldbank.org/WBSITE/EXTERNAL/COUNTRIES/AFRICAEXT/0,,contentMDK:20221507~menuPK:258659~pagePK:146736~piPK:146830~theSitePK:258644,00.html>

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approach to assist global environmental management. In: *Environmental Modelling and Assessment*. 4: 295-314

- 9) **Pijanowski, B.C., Olson, J.M. et al. (2007)**, Pluralistic modelling approaches to stimulating Climate-land change interactions in East Africa. In Oxley, L. and Kulasiri, D. (eds) MODSIM 2007 International Congress on Modelling and Simulation. Modelling and Simulation Society of Australia and New Zealand, December 2007, pp. 636-642. ISBN : 978-0-9758400-4-7.
- 10) **Reynolds J.F., et al. (2007)**, Global Desertification: Building a Science for Dryland Development, *Science* 316, 847 (2007), DOI: 10.1126/science.1131634
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- 12) **UNDP,2004**.Human Development Report 2004,New York,USA.
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1. **TITLE:** Thematic area - **Natural and Human Induced Disaster [Natural Disasters]**

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4. INTRODUCTION

4.1 Thematic Context

Disasters that are linked to hydro-meteorological and geophysical hazards are increasing worldwide. Geophysical hazards are very destructive in terms of property and loss of life. Hazards of hydro-meteorological origin i.e. linked to processes of atmospheric, hydrological or oceanographic nature constituted about 90% of all natural hazards globally and are likely to intensify due to climate change¹. Africa experiences a variety of geophysical and hydro-meteorological trigger disasters including floods, tropical cyclones, drought, wild fires, dust storms, pest plagues, volcanoes, earthquakes, and tsunamis. Africa's share of these disasters increased significantly over the last 50 years. Among the hydro-meteorological disasters drought, flooding and wind storms accounted for 90% of the total number of people affected over the 1975-2002² period. But, in terms of geophysical hazards, Sub-Saharan Africa is largely a stable intra-plate region with relatively low level of seismic activity with exception to the East African Rift System and the Cameroon Volcanic Line.

Disaster proneness is strongly linked to level of development. Africa hosts the largest number of least developed countries (LDCs), 33 out of 49. Mortality and economic losses from disasters is highest in these countries resulting in large resources diverted into relief and rehabilitation. Investing in disaster reduction is critical for Millennium Development Goals (MGDs) and sustainable development. It is for this reason that the provision of reliable and timely services for disaster risk reduction in Africa was considered of prime importance under the "Lisbon process on GMES and Africa". The main GMES programme recognizes the need to support the development of an infrastructure for spatial information for environmental monitoring and assessment and the need to forge a series of international cooperation initiatives and partnerships, a framework that Africa can tap into to address natural hazards and disasters.

4.2 Pressures /Constraints

Disaster risk reduction can be achieved through timely observation of hazards e.g. wildland fires, volcanic eruptions, earthquakes, tsunamis and extreme weather. Africa has limited capacity to characterize, monitor and forecast hazards and disaster, set up early warning infrastructure and make required assessments after a disaster to provide critical information for policy. Africa lacks capacity to model and predict interrelationships between socio-economic factors and natural hazards and implement disaster risk reduction guidelines advanced under the United Nation International Strategy for Disaster Reduction (UN/ISDR) Africa framework.

5. POLICY DRIVERS AND NEED ANALYSIS

Services from GMES Africa disasters theme will be crucial in guiding African governments and their European partners to invest in geospatial information services for risk reduction and also guide EU policy on appropriate interventions on disasters management in Africa. The current EU-AU partnership includes environmental sustainability as a key policy area and sets out steps EU will take with Africa up to 2015, to support African efforts to meet the MDGs and promote sustainable development. EU-AU partnership policy drivers and expected beneficiaries of the GMES Africa disaster (GAD) services range from the broad generic international drivers and benefits, to Africa specific ones at continental, regional to national to level.

5.1 Global Policy Drivers

5.1.1 United Nations: The 2002 World Summit on Sustainable Development (WSSD) and the 2005 World Conference on Disaster Reduction (Kobe, Hyogo, Japan) that resulted in the Hyogo framework for Action 2005-2015 are key international policy drivers. UNEP and WMO in their role in the implementation of the WSSD Action Plan and the Hyogo framework are also important policy drivers. For e.g. WMO supports continent wide monitoring of climate extremes e.g. Tropical cyclone and storms through its network of meteorological services. While UN Office for the Coordination of Humanitarian Affairs (UN OCHA) will benefit from the spatial information services provided under GAD e.g. to assess disasters and determine how best to intervene. UNFCCC is another important policy driver for GAD services for purposes of addressing climate change mitigation and adaptation. While IPCC is a key information source for UNFCCC. IPCC is a policy driver and a beneficiary of GAD disaster services e.g. on characterizing and determining the degree of exposure and defining degrees of vulnerability.

5.1.2. Major Political Groupings: The Group of 77 countries have embraced the Hyogo Framework and GAD will provide critical information that will inform negotiations by this Group in the UN systems and also help form the basis to address disasters in these countries. GAD service assist the Group of 8 countries (G8) in formulating appropriate disaster relief policy intervention in Africa and assist to build resilience that will also benefit their investments.

5.1.3 Development/Funding Agencies: Numerous development agencies operating in Africa address various segments of disaster management that require the proposed services under GAD e.g.: The Agence Française de Développement (AFD), USAID and DFID.

5.1.4 European Civil Protection: The Monitoring and Information Centre (MIC), operated by the European Commission in Brussels gives countries access to the community civil protection platform. Any country affected by a major disaster – inside or outside the EU – can launch a request for assistance through the MIC. Thus, the MIC also needs global information and early-warning tools on natural disasters.

5.2 Africa Specific Policy Drivers

GAD will benefit the UNEP Africa Environmental Outlook (AEO) reporting process, which is mandated to provide a comprehensive scientific assessment of the environment, policies and environmental management programmes in Africa to support policy. Even more important the GAD theme is driven by the AU 2004 disaster policy and strategy provided under the 'Africa Strategy For Disaster Risk Reduction (ARSDRR) (2005 - 2010)' through NEPAD. The ARSDRR aims "to contribute to the attainment of sustainable development and poverty eradication by facilitating the integration of disaster risk reduction into development". The strategy which is to be implemented with support from UN/ISDR in cooperation with UNDP and UNEP has the following specific objectives:

- i. Increase political commitment to disaster risk reduction
- ii. Improve identification and assessment of disaster risks
- iii. Enhance knowledge management for disaster risk reduction
- iv. Increase public awareness of disaster risk reduction
- v. Improve governance of disaster risk reduction institution and
- vi• Integrate disaster risk reduction in emergency response management

GAD will particularly address objective 2 and provide services to facilitate objectives 3 to 6 which will contribute towards the realization of objective 1.

Following the development of the ARSDRR, Africa Regional Economic Communities (RECs) are also developing their own disaster reduction frameworks e.g. the Economic Community of West African States (ECOWAS) and Southern African Development Community (SADC) have specific disaster policy guidelines and strategies which will benefit from the GAD services. GAD services will be crucial in the implementation of the Hyogo Declaration and Hyogo Framework for Action in Africa (UN/ISDR Africa) at the national level. For short to medium time scale GAD will feed into National Disaster Management Departments to address disaster at village, district to national level while on long-term basis it will assist in integrating disaster risk reduction into national development plans, and making GAD valuable to decision makers, disaster managers and development practitioners at various levels.

Clearly the need to provide services of the type proposed under GMES Africa theme on natural hazards and disaster is long overdue and will have a hierarchy of benefits filtering to NGOs and to the private sector.

5.2 Need Analysis

A needs analysis shows that up to date information on hazards and disasters in Africa is needed to inform negotiations at the UNFCCC, G77 for e.g. and to guide policies and strategies of development agencies, the G8 and others. The implementation of the ARSDRR goal i.e. *“to contribute to the attainment of sustainable development and poverty eradication by facilitating the integration of disaster risk reduction into development”* requires sustained information and products on disaster risk reduction at continental, sub-regional, national to local level on Africa. A detailed needs analysis is given in Table 1 and this links with section 9.1 on Service Definition and Provision where actions to address these needs are suggested.

Table 1 Needs analysis for disaster risk reduction in Africa

Institutions	Disaster risk reduction is not fully institutionalized in Africa e.g. AU has limited engagement confined to emergence assistance fund; most RECs do not have functional disaster programmes; majority of African countries lack comprehensive policies, institutional frameworks and a mechanism for financing operational disaster risk reduction hence re-active approaches are common. There is usually unclear specification of responsibilities and lack coordination of disaster management. Capacity to monitor compliance and enforce policies, codes and regulations is needed over the whole continent.
Characterizing hazards and assessing disasters	Africa lacks capacity to characterize hazards and map vulnerabilities as part of risk identification and assessment. Although changes are emerging, subjective risk estimation is still widely practiced with a strong top-down approach. There is great need to link land use planning to disaster risk reduction and emphasize on anticipatory risk assessment.
Information generation and dissemination	Sub-regional early warning systems for climate e.g. for drought exist but these require further development e.g. to improve quality of information and extend to other hazards. Technical facilities for providing hazards and disaster information services are few and have numerous constraints linked to inadequate technical infrastructure such as laboratories, in situ and satellite data, manpower resources etc. There is inadequate attention to information management, training and research. Capacity is lacking to develop products tailored for different stakeholders, deliver these to where they are required and disseminate information on their potential value to facilitate operationalisation needs to be developed. Inadequate communication infrastructure in terms of e.g. telecommunication and internet services is a major constraint in information access, generation and flow.
Development infrastructure	In addition to communication noted above disaster risk reduction in Africa is hampered by lack of basic infrastructure such as efficient transport systems, storm water drainage and waste management, evacuation facilities, hospitals etc. Also essential is provision of sufficient education to effectively access and use different disaster management products and information available.

6. IDENTIFICATION OF COMMUNITIES

There are various user communities, data providers and information service providers and other stakeholders in Europe and in Africa that can be engaged in the activities of GAD. They include AU/NEPAD, RECs, the Africa Working Group on Disaster Risk Reduction, national governments and their disaster officers, natural resource managers, local authorities, educators, health service providers, civil society, NGOs and the private sector. In addition international development partners, United Nations bodies and agencies, scientists (e.g. engineers, meteorologist, fire scientist etc) and satellite data providers will find great value in GAD (Table 1).

Table 1. Examples of stakeholders that could be engaged in GAD

Types of Stakeholders		Description
Africa-Policy makers:	National Government	National Hydrological Meteorological Services (NHMS); Different line Ministries e.g. Agriculture, Environment; National Disaster Management Offices linked to UNISDR Multi-stakeholders National Platforms for Disaster Risk Reduction (DRR).
	Regional	RECs e.g. the SADC seasonal forecasts and Regional Disaster Emergence Response.
Satellite data providers		EUMETSAT and AMESD, ESA, NASA & data receiving stations e.g. Satellite Application Center (SAC) in South Africa will be data & information service providers; But also communication satellites programmes e.g. ARMC.
International Bodies		In the UN system: UNEP, WMO and UNESCO and UN OCHA ReliefWeb, UNOOSA; International Disaster charter provides space data acquisition and delivery.
Academic & Research		African and European researchers/scientists in Universities, technical institutions and Regional Remote sensing centers
Networks		E.g.- FAO/GTOS/GOFC-GOLD linked networks e.g. SAFNet; ICSU/IGBP African Network for Earth System Science (Africaness); Disaster Management Institute of Southern Africa (DMISA).
NGOs		E.g.: Red Cross and Oxfam
Development Agencies		E.g. - USAID with its programmes e.g. CARPE also operates OSFAC, OFDA & FEWS

	carried out in partnership with USGS.
Private sector	Includes e.g. fire fighting services, South Africa ESKOM electric Company, those engaged in transport, construction, Insurance etc.
European Commission organizations	Several Directorate Generals of the EC dealing with disaster management (ENV, RELEX, ECHO, REGIO, JLS, SANCO, TREN, DEV, JRC, RTD, ENTR, INFSO, AIDCO, ELARG), under the coordination of the EC Secretariat General; DG JRC running early warning tools for natural disasters (EFAS, EFFIS), as well as monitoring and detection systems for disasters (GDACS)

7. MAPPING EXERCISE

There are various projects, academic institutions, national and regional centers and networks engaged in different aspects of natural disasters that GAD could build upon. As a result only examples from Africa and Europe are provided here (Table 2 and 3) while examples from elsewhere are given in Appendix 1a.

7.1 Capacities in Africa

7.1.1 Capacities-Project Oriented

Table 2. Africa - project oriented initiatives relevant for GMES Africa Disaster (GAD) Theme

AMESD operates in 5 RECs	An Africa link to GEOSS activity– use of satellite data for meteorological, climate monitoring & environmental needs.
The SADC	RRSU, NOAA & Meteosat Seasonal Forecast; SARCOF; DMC & Landsat archive.
IGAD (East Africa)–ICPAC and REWS -	IGAD, operates Climate Prediction & Application Centre & REWS for national drought & flood preparedness in the Horn of Africa and the GACOF
ACMAD – Africa wide	Engaged in weather prediction, climate monitoring, technology transfer & research.
AGRHYMET – Sahel based	Building geo-information based capacity in drought control in eight countries
IFC – 9 Niger Basin countries	Real time hydrological forecasting system for Niger river.
TIGER – continent wide	Has 50 water-related, Africa wide geo-information projects in progress
FAO Land degradation in dry lands (LADA) project - A global project	Covers Africa collaborating with OSS, SWALIM, Centre de Suivi Ecologique (Senegal); Direction Générale de l'Aménagement et la Conservation des Terres Agricoles (Tunisia) and Department of Agriculture (South Africa)
SAC- South Africa	Satellite receiving station & Developed AFIS rapid fire alert system.
UNISDR Tsunami project - East Coast of Africa	Multi stakeholder approach to disaster risk reduction; multi hazard early warning system.

7.1.2 Education, Training and Research Capacities

In response to the Hyogo framework for disaster management and the Africa Strategy For Disaster Risk Reduction a range of formal academic and technical programmes, mostly at post-graduate level are evolving across the continent to address disaster risk reduction. A major academic initiative is the Periperi U initiative (Partners Enhancing Resilience to People Exposed to Risks) which is a platform for university partnership to reduce disaster risks in Africa and involves a range of institutions in Ethiopia Tanzania, Algeria, Ghana, Moçambique, Uganda, South Africa (<http://www.riskreductionafrica.org/>). AfricaArray formed in 2004 is another relevant initiative, addressing the gap in human-resource capacity with a focus on geoscience training in Africa (<http://africaarray.psu.edu/>). Other relevant initiatives and infrastructure capacities include: University of Stellenbosch, South Africa - strong in geospatial information infrastructure; Eduardo Mondlane University, Mozambique- geospatial information data handling laboratory; University of Ghana - Centre for Remote Sensing and GIS (CERSGIS); University of Botswana - geospatial information capability and University of Kinshasa (DRC) - Remote sensing Laboratory.

7. 1.3 Networks

Several networks provide forums for activities, infrastructure and capacity building that is line with the proposed GAD and examples include:

- i. SAFNet - concerned with use of geospatial data fire management (<http://afis.meraka.org.za/safnet/>)
- ii. Risk Reduction Africa (RRA) – Supports capacity in disaster risk reduction in Africa.
- iii. National GIS and remote sensing groups e.g. Tanzania Geographic Information Systems Users Group (TZGISUG) and The Botswana Remote Sensing and GIS committee.
- iv. Somalia Water and Information Network (SWALIM) in the Horn of Africa - an information management unit facilitating better assessment of rainfall, river flow and groundwater resources, land degradation and flood warning and flood management carried out jointly with EC JRC.

- v. OSS - North-South partnership based in Tunis - Aims to improve early warning and monitoring systems for agriculture, food security and drought and desertification monitoring in Africa, extends to 4 sub-regional organizations representing West Africa (CILSS and Côte d'Ivoire), East Africa (IGAD) and North Africa (AMU and Egypt), a sub-regional organization covering the whole circum-Sahara (CEN-SAD), etc.
- vi. NHMS networks in Africa – involved in forecasting climate related hazards, some have geospatial information capability e.g. Botswana Meteorological Services hosts the SADC drought Monitoring center, receives NOAA and Meteosat data, handles SPOT VGT data and implements with SADC the AMESD project in Southern Africa.

7.2 Global/European Capabilities Relevant for GAD.

7.2.1 GMES Europe Program

GAD will draw from the overall GMES Europe programme under the EC, whose goal is to build high capacity in satellite observation and ground based data for integrated environmental monitoring capability. Cross fertilization will be achieved through GMES Europe fast track pilot projects: i) Land Monitoring and ii) Emergency Response.

7.2.2 GEO Capacity Building, GEOSS and GAD

GEO and GEOSS initiatives provide wide ranging resource base for building the GAD programme. Under GEOSS e.g. are the disaster programme, Global Wildland Fire Early Warning System, the International Federation of Digital Seismograph Network and the GEOSS priorities on Improvements in Real-time Flood Forecasting for Developing Countries and Risk Management led by Tunisia. GEOSS also aims to facilitate ongoing capacity building, with a focus on transferring technologies and best practices to developing countries. While GEO has strong links to Africa through UNECA and other Africa based participating organizations such as AARSE, EIS-AFRICA and ClimDevAfrica.

Table 3. Examples of Europe based capabilities relevant to GMES Africa Disaster (GAD) theme

<p>EC Joint Research Centre – strong disaster and geo-information capability e.g.: Early warning systems – i.EFFIS (fire), ii.EFAS (floods alert system),iii. European drought observatory - Post-Crisis Assessment</p> <p>iv. Global rapid hazards detection/alert (Tsunami and earthquake, volcanoes, hurricane, typhoons, floods, storms etc) e.g. GDACS and v. Disaster Risk reduction – vulnerability mapping and preparedness</p> <p>Global Fire Monitoring Centre in collaboration with UNEP- facilitates coordination of actions to combat large international forest fires & has a website on fire information.</p> <p>MeteoAlarm (EUMETNET) provides a pan-European overview of weather alarms to the general public</p> <p>European Mediterranean Seismological Center</p> <p>European Center for Medium-range Weather Forecasts (ECMWF), in Reading, UK provides global weather forecasting services and data</p> <p>Global Runoff Data Centre (GRDC) (in Kolbenz, Germany) collects and distributes global river flow data</p> <p>Italian Landslide Inventory (IFFI Project) – Identifying and mapping landslides over Italy</p> <p>International Seismological Centre in the UK –determine earthquake locations and searches for new ones</p>
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8. IDENTIFICATION OF GAPS AND SUITABLE PROGRAMMES

Africa lacks resources for effective and sustained measures for disaster preparedness hence re-active disaster policies predominates. There is critical lack of information at a planning scale i.e. village, district level, to national level to map vulnerability, produce disaster risk maps, monitor and assess severity of a disasters.

8.1 GAPS: Identification Of Gaps.

8.1.1 Gaps: Hydro meteorological hazards: Infrastructures to forecast these hazards are lacking and capacity for early warning systems is limited. Greater understanding of the effect of global warming on the climates of Africa is required to predict and forecast climate related hazards. The following commonly occurring hydro-meteorological hazards in Africa will be given priority under GAD:

- **Drought:** Reasonably developed infrastructure for drought monitoring exists e.g. under SADC, IGAD and ACMAD (Table 1) but lack skilled manpower, sustained facilities for satellite and in-situ data and resources to meet running costs. Under GAD such technical institutions will be enhanced for e.g. strengthening Remote Sensing Units and providing support for in-situ observation and for research through selected academic institutions, the EC-JRC and enhancing the networks of NHMS.
- **Floods:** The capacity to deal with floods is far less developed. Southern Africa has no flood early warning system in place as shown by the Namibia/Angola and Botswana floods disasters of March 2009 and the same applies to West Africa which also experiences flood disasters. Countries such as Madagascar, Comoros, and Mozambique are vulnerable to cyclones which occur annually in the south-western Indian Ocean and trends

show increasing tendency for these cyclones to penetrate inland as far as Botswana. Through GAD technologies such as developed in the European Flood Alert System (EFAS, collaboration between EC-JRC, ECMWF, DWD and European Hydro Services) could be accessed and applied for flood risk reduction hazards.

- **Fire monitoring:** Africa is a fire continent and fire is likely to increase in future. The continent has limited infrastructure for fire information generation, monitoring and dissemination to support policy formulation and implementation. Research on fire ecology and on traditional fire management is also lacking. GAD will focus on capacity building in terms of manpower development, in-situ fire research, and greater incorporation of satellite derived information in fire management. The activity can benefit from techniques developed in the European Forest Fire Information System (EFFIS)

- **Dust Storms:** The Sahara and the Sahel region is one of the largest sources of dust storms in the world and there is a potential for this to increase under climate change. There is no consistent sand and dust storm research and monitoring over Africa relying on both EO and in-situ observations. The climate, ecosystem and health implications for both the source and area of deposition need investigation. GAD will focus on developing models for forecasting mineral aerosol transport and deposition using geospatial data for risk reduction.

- **Biological hazards:** Sustained work linking climate extremes e.g. temperature extremes, floods and droughts to health epidemics such as meningitis and water and vector borne diseases outbreaks are limited. The link between climate extremes and decline in food production with non-climate related pandemics such as HIV/AIDs is yet to be investigated. GAD using geo-spatial technologies will improve monitoring and forecasting of these hazards through integration of biophysical and socio-economic factors.

8.1.2 Gaps: Geophysical hazards: Damaging earthquakes of magnitudes of more than 6 ($M > 6$) occur almost annually in the East African Rift Valley system. *Volcanoes and explosive crater lakes also occur e.g. the most disastrous was the Mt Nyirangogo (DRC, January 2002) and Mt Karthala (Comoros, April 2006) with a cycle of approximately 11 years.* Tsunamis are also potential hazards too as shown by the 2004 Indian Ocean undersea earthquake. Africa has limited capabilities to mitigate and respond to earthquakes and volcanic hazards. While there are systems to monitor seismic, thermal and gas emissions these are insufficient, poorly maintained and there is need for this data to be augmented with data from satellite observations, telemetered monitoring of magnetic and electric fields, gases, temperature, use of GPS and radar techniques.

8.2. Existing or Planned thematic funding Programs

8.2.1 Hydrometeorological: GAD will link with the GMES Africa climate theme e.g. through the EUMESAT program on Understanding Climate Processes; align with the EDF supported AMESD project operating in 5 RECs (SADC, IOC, ECOWAS, CEMAC, and IGAC) and with ESA programs. Other existing programs of value are: the Global Climate Observing System; the comprehensive GEOSS Climate programmes in particular the ClimDevAfrica; WCRP and Seasonal Prediction activities e.g. CLIVAR; PUMA project on training in Africa and others e.g. GEWEX focusing on extremes. Collaboration with GEO will assist in resource mobilization and potential funding under the EU FP7 Environment. For fire there are emerging capacities e.g. GTOs GOF-GOLD networks in Southern, central and West Africa and the South Africa SAC fire alert AFIS, although these need to be enhanced for operational purposes. The GEO Global Wildland Fire Early Warning Systems Africa component will also be very important. The sand and dust component of GAD could be accomplished through partnership with the WMO WWRP-THORPEX program which is also part of GEO task on forecasting health hazards in Africa. Through the EU International cooperation program GAD biological hazards activities conducted with appropriate European partners could benefit from the FP7 Environment and Health themes. Other potential sponsors under biological hazards are UNESCO, Wellcome Trust, WHO and EU Marie Curie Programme.

8.2.2 Geophysical hazards: GAD will enhance cooperation among existing institutions and networks e.g. AfricaArray and facilitate partnership with similar institutions and initiatives in Europe. The Indian Ocean Tsunami Warning System initiative will be valuable for GAD. For volcanic hazards the programme could build on the Royal Museum of Central Africa in Tervuren (Belgium) an initiative focusing on monitoring African active volcanoes, the IUGS working on earthquakes and volcanoes and others e.g. WOVO. The earthquake and volcanic hazards gaps will draw on the GEO Task D1-06-07: Multi-hazard Zonation and Maps, Lead IGOS-P and WMO, aimed at conducting an inventory of existing geologic and multi-hazard zonation maps.

Other possible sources of funding for hydrometeorological and geophysical risk reduction gaps noted above include, DFID, USAID, and the World Bank, the Africa Development Bank as well as national Governments.

9. BUILDING GMES – AFRICA SERVICE

9.1 Service Definition and Provision

Needs for Africa which when addressed under GAD will provide services of major societal value include enhanced institutional framework for geospatial based disaster management, improved communication infrastructure and access to key resources to facilitate disaster information generation, dissemination and use in decision-making processes (Table 4 and Appendix 2).

Table 4. African needs for GMES Africa GAD programme and possible actions to address these needs

Key areas	Need	Action
Institutional	-Strong institutional framework for sustained research, training, information dissemination and use of geospatial services in an operational environment i.e. incorporating of geo-spatial information in decision-making processes.	- Policy interventions: Use EU/EC link with AU/AUC and RECs to influence governments, engaged ACP, ECA, NEPAD and the UN/ISDR Africa which will work with National Platforms of DRR to reach national Governments. - Increase advocacy through hazards and disaster networks - Enhance institutional capacity for geo-spatial information
Technical Facilities	-Sustained laboratories with updated hardware and software linked to in-situ observation sites for geo-spatial data at multi-scales; efficient internet facilities; and data storage and retrieval facilities.	- Different levels of facilities to be enhanced e.g. At key institutions, linked to Medium and Minor centers/nodes. - Draw on the FP7 funding in partnership with African Governments and leverage on the focus thematic areas of ECA; ICT, Science and Technology for Development.
Data availability	-Multi-scale raw data for hazards and disasters at various levels & resulting products generated and models used to generate these products. -Database harmonization, archiving, retrieval and data sharing policies.	- Engage user community and stakeholders, link to GEOSS on data access; draw on the GEO Data Sharing policy and its training program on managing large database; link to CODATA on disaster databases etc. - Funding and capacity established through partnership with Europe e.g. used on key centers and their nodes.
Manpower requirements	- Skilled personnel in geospatial information handling and modeling to define vulnerability, risk reduction measures, assess damage and recovery. - Hazards and disaster geo-spatial oriented communicators	A capacity building plan that leverages on GEO Capacity Building framework but with emphasis on "learning by doing"; Network key institutions engage in exchange programmes across Africa and Europe. - Bilateral or multilateral agreements through e.g. RECs for operational exchange programmes.
Infrastructure	Need for basic developmental infrastructure e.g. maintained transport network, Communication infrastructure to support efficient Internet, radio/TV, telephone services with adequate reception ranges and sustained by clean energy supply.	- Use the AUC, ECA, NEPAD and EC linkages to source funding from e.g. EU International Cooperation, EDF but also ACP schemes, AfDB and the World Bank. E.g. of communication schemes to support are AISS and ARMC. - Enhance advocacy for greater support for developmental infrastructure by African Governments through e.g. National Platform for DRR and UN/ISDR.

9.2 Capacity Building

Under GAD, capacity or capability is a combination of all the strengths and resources that can be used to reduce the level of risk, or the effects of a disaster.

9.2.1 Necessary elements and complimentary regional capabilities:

- i. Political stability: Although pockets of instability occur, much of Africa is political stable for GAD to operate.
- ii. International collaboration frameworks put in place e.g. the EU-AU partnership. Commitment on the part of Europe to true and sustained partnership with Africa, on equal grounds in terms of technology access and development in knowledge generation, fair and timely sharing of data when required.
- iii. Political commitment at national, regional and continental level to disaster management.
- iv. Basic developmental infrastructure in particular communications, transport, and human wellbeing needs.
- v. Mechanism to harness and coordinate existing capabilities.
- vi. Dedicated user communities for GAD services and products in Europe and Africa e.g. Insurance companies
- vii. Institutions that have geo-spatial data handling capacity and working natural hazards and disaster
- Viii. Clear Terms of References to guide linkages between data providers, geo-product generators and users
- ix. Funding mechanism for national, transnational and international collaborative work
- x. A strong GMES Africa and GMES Europe coordinating team.

9.2.2 Implementation strategy

Existing capacity in Africa in terms of manpower, institutions and infrastructure found in e.g. Universities, meteorological departments and regional centers will form the basis for launching capacity building under GAD. Action items in Table 4 will be critical for implementing the capacity building strategy. GMES Africa working with

EC, AUC/ECA and NEPAD will establish i. political commitment for sustained support with the aid of e.g. AU, G77 and ACP platforms; ii. sustained commitment from EU to support and work in partnership with Africa; iii. greater support for infrastructural development; iv. support for research on hazards and disasters and for an Africa wide climate early warning system, collaboration with UN/ISDR to develop an Africa wide multi-hazards and disaster network (AMDNet); and vi. Initiate development of an Africa wide geospatial data base on disasters.

- **RECs institutions with geo-spatial data and or disaster capability:** GMES Africa will, in consultation with NEPAD work with RECs that have a foundation capacity (see Table 1) to accomplish the following:
 - i. Link with GEONETCast and access required data; ii. Build infrastructure for GAD databases (working with e.g. CODATA, GEO, TIGER etc (Table 1) emphasizing commonly occurring hazards in their regions and tap into the FP7 GEOSS theme on “building a Geo-resource information system for Africa”; ii. Stimulate research on climate systems, forecast hazards, map vulnerability etc; iii Work with National Platforms for DRR to initiate national geospatial based operational disaster management systems; iv. Support establishment of long-term natural hazards and disaster sites and systematic in-situ observations e.g. linked to ICSU IRDR; v. Organize regional training and demonstrations of innovative or latest technology in disaster management in partnership with GEO, etc; and vi. Oversee, in collaborate with JRC the development of a regional disaster rapid information generation system for rapid responses in case of a disaster.
- **PUMA and AMESD linked Meteorological Satellite Services** with functioning Remote Sensing and GIS laboratories and or data receiving capabilities: e.g. Botswana, South Africa, Ghana will be focus areas for region wide climate monitoring and provision of processed satellite data for other disaster management needs.
 - **Regional Receiving Stations:** GAD to enhance provision of high spatial resolution data, and, development of satellite based disaster management instruments e.g. the SAC AFIS (Table 1).
- **Institutions with mandate for information generation and dissemination and training** e.g. Universities:
 - i. GAD to emphasis on capacity through “learning by doing” and build on their geo-spatial hazards and disaster capacities through tapping into resources organized under RECs, linking to GEO and relevant TIGER initiatives and developing collaborative projects that can be funded under e.g. FP7; ii. Strengthening disaster management curriculum – i.e. students and staff exchange programmes, and short courses; iii. Strengthening University based disaster networks that link African institutions and ties to Europe e.g. Periperi U.; iii Setting up long-term research sites on relevant hazards in collaboration with institutions or programmes in Europe and elsewhere; iv Facilitate production of tailor made policy maker geo-hazards and disasters products and information dissemination through e.g. workshops, seminars.

9.3 Prioritization Of Requirement And Actions

The priority is to build a foundation for self-sustaining capacity at various levels for geo-spatial information generation for different hazards and the use of this information in decision-making for disaster risk reduction.

- i. *Development of communication facilities* e.g. building on satellite initiatives such as AISS and ARMC to improve information flow through increased access to affordable high-bandwidth internet services and radio and TV.
- ii. *Manpower development* – a. on all aspects of geo-spatial information systems for disaster management and should cover both training and ‘learn by doing’ schemes for scientists, technicians, communicators, disaster management practitioners and policy makers heading facilitating institutions for GAD; b. Capacity to attract funding and take leadership of projects from inception to the end for resource generation and sustainability. c. Capacity to publish – often taken for granted is in fact a ‘learn on the job’, best achieved through attachment; d. Resources for salaries – poorly paid skilled manpower will be unproductive and are sure to leave; e. A networking manpower resource – i.e. resources for travel, attend meetings and networking.
- iii. *Facilities for geo-spatial disaster management* information generation, transfer and dissemination i.e. access to satellite data at multi-scales, laboratories equipped with networked hardware and software and resources for running costs and in-situ observations
- iv. Mechanism for data sharing based on wide consultation among data generators, information suppliers and users and provision of appropriate facilities such as communication infrastructure to share data, enhancing capacity to assimilate accessed data to appreciate the benefit of sharing. GEO and GEOSS data sharing principles, CODATA, UN Principles Relating to Remote Sensing of Earth from Space and the International Disaster charter will provide useful guidelines a data sharing framework bearing in mind the uniqueness of Africa related to its low development status.
- v. Establishing plans for developing a natural and human induced hazards and disasters data base
- vi. Development of an Africa wide hazard and disaster rapid information generation system.

9.4 Organizational Scheme

The organization of GAD needs to have a clear link to policy-decision-makers in addition to data and information generators, key service providers and user community (Appendix 4 - Organization Structure of GAD). We suggest initiating 10 GMES Africa themes each with a steering committee. We suggest GMES Africa to have a coordinating body formed among others by the GMES Africa Programme Officer (GAPO), chairs of the GMES Africa themes, representatives from EC-JRC, GMES Europe, relevant portfolios of the AUC, NEPAD-Environment theme, key sponsors and selected representatives from major GMES Africa projects (e.g. AMESD) and other relevant international initiatives.

9.5 Timetable for long-term GMES Africa Partnership

In setting long-term actions for GMES Africa the aim is to, i. Put in place a robust information service that will contribute towards the ongoing negotiations and subsequent agreements in the climate change Kyoto Protocol given the widespread challenge by meteorological hazards to sustainable development; ii. Strive to provide information required and network needed resources in Africa for implementation of the Hyogo framework and action plan; and iii. Facilitate actions towards meeting the MDGs and a foundation to work towards sustainable development in both Africa and Europe (Table 5 and Appendix 3).

Table 5. Summary of envisaged timetable for long-term GMES Africa Partnership

Time	Description
PHASE 1 : Preparation for Planning: 2007- 2010	<ul style="list-style-type: none"> - Establish EU-AU Partnership & Lisbon declaration & define broad GMES Africa themes - Begin Africa & EU/EC wide consultation, identify funding potential and raise issues of data sharing - Identify priority areas & possible pilot projects & establish process of implementation - Build the GMES Africa Organization structure & the required political commitment at multiple levels.
PHASE 2 : Implementation Action Plan (3 yrs): 2011-2012	<ul style="list-style-type: none"> - Assess the feasibility to meet identified user requirements – specifically what needs to be done to commence the process of delivering user needs – e.g. infrastructure, human capacity etc - Commence implementation of agreed priority areas of action and pilot GMES Africa projects -- Engage sponsors and allocate responsibility to start pilot projects e.g. floods, fire and dust storms
PHASE 3: Implementation of GMES Africa (10 yrs): 2013-2023	<ul style="list-style-type: none"> - Evaluate the pilot projects- lessons learnt and use as basis for a 10 year Implementation strategy - Establish dedicated sponsors, and set implementation of pre-operational fast-track services to show likely benefits of the programme. - Consider proposals from networked key, medium and minor institutions on implementation of priority areas and commence research activity on the priority areas to develop products and services - About half of the priority areas to have working projects by 2017 and supported by active networks - Long-term natural hazards and disaster sites with in situ observation stations to be set up and a capacity building programme should be implemented through networked institutions and projects. - Experience form above used to develop an Africa wide hazard and disaster rapid information generation system for rapid responses
PHASE 4: Evaluation & definition of the next phase (2 yrs): 2024-2025	<p>Implement a GMES Africa evaluation process based on GMES Dynamic Model (<i>Source: Europe Approach to GMES, 2001</i>) to determine after 10 years: How did GMES Africa achieve the 3 goals noted below:</p> <ul style="list-style-type: none"> - Deliver specific information and information services as per user needs and learn from these; - Assess the information production processes and structure the demand and supply sides; - Develop the required infrastructure and the knowledge base in order to secure and improve a sustainable approach to the delivery of information.
PHASE 5: Programme Taking Shape (10 yrs): 2026-2036	<ul style="list-style-type: none"> - Benefit of GMES Africa must begin to be realized and incorporated into operational systems and a strong Africa ownership with user demand drive for services should be in place. Commercial viability should be established to provide a dynamic self – sustaining data-product - service delivery process and user chain.
PHASE 6: Evaluation of GMES Africa (2 yrs) – 2037-2038	<ul style="list-style-type: none"> - Evaluation to cover societal benefits of GMES Africa to Africa and Europe, contribution to Hyogo framework and Kyoto Protocol – climate change mitigation and adaptation: and also to consider the necessity to maintain the GMES Africa structure or establish different mechanisms e.g. encompassing other continents?
PHASE 7	The way forward to depend on Phase 6 evaluation outcome

9.6 Indicative Development Plan and Budget for GAD

GAD is to build as much as possible on existing structures and capabilities and use these as a platform from which to improve or set new coordinated and effective information delivery systems as per user needs. GAD will leverage fully on its European partnership programmes but aim to create African ownership by vigorously engaging both African public and private sector to commit resources on GAD. It is however, expected that the cost of remote sensing satellite systems and data delivery will be under GEOSS/GEO/EAS and GMES Europe.

Below a 30 year indicative plan is provided taking into consideration that it usually takes long before society fully assimilates new technology to the stage of operationalising for everyday use.

Table 6. GMES Africa Disaster (GAD) Theme – 30 year Indicative Development Plan and Budget Estimate

Time schedule	Activity/Sub-programme	Budget estimate (Euro)
Up to 2010	-Introduction of the Programme and Planning phase, Set a secretariat & priorities of focus areas, regions & institutions to engage - Consider Pilot projects	140,685
2011-2012	Detailed Action Plan put in place and 2 pilot projects identified and ready to commence	351,620
2013-2023	- Commence Pilot projects - Build networks & enhance key institutions - Human capacity building and enabling - Setting long term research sites - Facilities and Infrastructure development & enhance technologies for information delivery/communication	140 million
2024-2025	Evaluation of the programme	70,324
2026-2036	- E.g. of products and services that move from research to operational systems - More research sponsored, sustaining installed facilities, infrastructure and manpower developing - Stronger Africa ownership in terms of needs and their provision (funding, capacity building, information generation)	106 million
2037-2038	Project evaluation	70,324
	Total	246,632,953
<i>Beyond 2038</i>	<i>Full fledged GAD operational services – meeting Hyogo framework and action Plan.</i>	

10. RECOMMENDATIONS

10.1 The ownership and management of GMES Africa should be the full responsibility of Africa i.e. Africa should take the lead in planning and defining priority areas, sourcing of resources and partnership and overseeing of the implementation process while maintaining collaboration, dialogue and planning processes with its European partners.

10.2 The GMES Africa Disaster (GAD) theme should be closely aligned to the UN disaster programmes particularly UN/ISDR Africa and the National Platforms for Disaster Risk Reduction (DRR) and build on existing structures, resources and capabilities in Africa and Europe to launch its programmes on geo-spatial disaster information generation and delivery systems per user needs.

10.3 GMES Africa should establish resources for capacity building in manpower development, infrastructure for data gathering and accessing, information generation and consumption and set up sustainable and enabled institutions e.g. in collaboration with GEO capacity building model but with a component for 'learning by doing' (in addition to conventional training) and with a strong emphasis on mechanisms for incorporating geo-disaster products in the decision making process.

10.4 As for data supply and information delivery, priority should be on hazard characterization, prediction, early warning and mapping vulnerability with emphasis on the following common hazards in Africa: drought, fires, dust storms, floods, biological hazards and rare but potentially destructive geophysical hazards e.g. earthquakes, volcanoes, explosive crater lakes and tsunamis.

10.5 Communication and data transfer infrastructure is fundamental for GMES but more so for GAD where disaster management is the focus. Special attention should be given to developing effective communication systems over Africa through for e.g. enhancing development of communication satellites. However, communication should be extended to transport and cover supporting sectors such as energy. National Governments, RECs and AUC should in collaboration with Europe and other partners e.g. ACP seek resources to address these gaps.

10.6 Three pilot projects focusing on floods, fire and dust storms should be implemented in different regions of Africa to generate the experience needed for an Africa wide – Europe partnership GAD programme. The

research should deliver user defined products and services for the benefit of both parties and the international community.

10.7 Start of full implementation of GAD should be based on the outputs of the above pilot projects.

10.8 Satellite data for GMES Africa disaster (GAD) theme should be made available in multiple scales to produce information for various levels of disaster management in line with the high diversity both in terms of natural and human systems in Africa. High spatial resolution data should be available for validation of low spatial resolution data and generation of information at national, district to sub-District level particularly for National Platforms for DRR. This data should be handled by e.g. national research centers or Universities and made available for training and research. While Regional disaster geo-information Centers and Meteorological Services should handle low spatial resolution data e.g. SPOT VGT and Meteosat provided under for instance AMESD.

10.9 Both the data and resulting products generated under GAD should be made available to both African and European partners. Models used to generate products should be developed in partnership and made accessible to both participating parties. The aim should be a fair and equitable enhancement of geo-spatial knowledge generation capabilities for disaster management in both EU and AU members.

11. SUMMARY

An increasing number of geophysical and hydro-meteorological disasters in Africa are a major constrain to sustainable development and efforts to meet the Millennium Development Goals. Climate related disasters are the most widespread and are projected to increase due to climate change. Disaster management initiatives in Africa are fragmented, under-resourced and incapacitated by lack of institutional support, basic development infrastructure such as communication and transport and suffer critical lack of information at all levels of planning, leaving most countries to rely on reactive disaster strategies. Communication and data transfer are the major obstacles in Africa. Concerted effort is needed towards disasters risk reduction in Africa and globally. Among the ten identified GMES Africa themes are natural hazards and disasters, hereafter referred to as the "GMES Africa Disaster" (GAD) theme.

The focus of GAD is to facilitate partnership between Europe and Africa to provide services of major societal value in terms of disaster risk reduction. These services include provision of key facilities and infrastructure for disaster information generation and dissemination, data access to address multi-scale challenges of disasters, skilled manpower resources and an enhanced institutional framework that incorporates geo-information in operational disaster management. Improving information on climate systems of Africa in collaboration with the GMES Africa climate theme will be crucial for GAD as a basis for forecasting and developing early warning for common hazards in Africa such as drought, floods, fire, dust storms and biological hazards. While there are rudimentary services for geophysical hazards, these need to be augmented with data from satellite monitoring, telemetric monitoring of magnetic and electric fields, gases, temperature, use of GPS and radar to reduce disaster risks from earthquakes, tsunamis, volcanoes and explosive crater lakes.

Partnership with Europe should enable access to data, information generation resources and capacity building i.e. a link to GEOSS programmes and alignment with GEO and ongoing programmes such as AMESD, ESA and EUMETSAT. Linkages with several EC Directorate Generals will provide GAD access to geo-disaster information and service generation. Initiatives in Africa on communication satellites such as ARMC are key to GAD.

Implementation of GAD should be facilitated by a GAD Steering Committee (GAD-SC) that should establish a dialogue along policy/administrative lines (AUC/NEPAD, RECs and EC) and research, science and technology communities. A data information sharing policy should be established that will have tangible and intangible benefits for both African and European partners. The GAD-SC should, after wide consultation, select key institutions on the basis of facilities and strong history of use of geospatial data or disaster management as main GAD Centers of Excellence.

Three pilot projects on floods, fire and dust storms need to be established and used as platforms for practical demonstrations of the value of geo-spatial information in disaster management. These projects should focus on monitoring, prediction and early warning at local, regional and continental level, demonstrating the added value of data from different observations platforms with different scales. The results should be integrated with disaster

prevention, mitigation and recovery systems in place. Further aims of these pilot projects are to demonstrate the need in Africa for both high spatial resolution - low coverage data and wide coverage - high temporal but low spatial resolution data e.g. from Meteosat. Next, these projects should demonstrate the importance of delivering both the processed products (particularly in times of urgent need) and the unprocessed products, while assisting the African partners in developing models to manipulate the unprocessed data.

Resource mobilization for GAD should include:

- contribution by African governments in national GAD initiatives through the National Platforms for DRR, local institutions such as Meteorological Services and Universities and through links to UN/ISDR Africa programmes.
- Collaborative projects with sister programmes under GMES Europe, facilitating access to EU Framework Programme funding which comprises Specific International Cooperation Actions (SICA) and address research problems of mutual interest and benefit between the EU and international co-operation partner countries (ICPC). Under these schemes developing countries and emerging economies can secure support in the field of environmental research including natural hazards, forecasting methods and assessment tools, predicting climate etc.
- Alignment with the GEO capacity building programme to enable possibilities for resources.
- Other potential sources, including G-8 countries, DFID, USAID, the World Bank, the Africa Development Bank and others with schemes for disaster management extending to Africa.

12. ANNEXES

12.1 LIST OF ACRONYMS

AARSE	African Association of Remote Sensing of the Environment
ACMAD	African Centre of Meteorological Application for Development
ACP	Africa, Caribbean, Pacific
AEO	Africa Environmental Outlook
AFD	Agence Française de Développement
AIDCO	see EuropeAid
AMCEN	African Ministerial Conference on Environment
AMESD	African Monitoring of the Environment for Sustainable Development
AMU / AUM	Arab Maghreb Union
ARMEC	African Resource Management and Environmental Constellation
ARSDRR	Africa Strategy For Disaster Risk Reduction
AU	African Union
CARPE	Central African Regional Program for the Environment
CCAA	Climate Change and Adaptation in Africa programme
CODATA	International Council for Science: Committee on Data for Science and Technology
COMESA	Common Market for Eastern and Southern Africa
DEV	Directorate-General of the European Commission on Development and relations with African, Caribbean and Pacific States
DFID	Department for International Development (UK)
DRR	Disaster Risk Reduction
EC	European Commission
ECCAS	Economic Community of Central African States
ECMWF	European Center for Medium-range Weather Forecasts
ECOWAS	Economic Community of West African States
EIS-AFRICA	Environmental Information Systems – Africa.
EuropeAid	Directorate-General of the European Commission that is responsible for implementing external aid programmes and projects across the world.
EFAS	European Flood Alert System
EFFIS	European Forest Fire Information System
ESA	European Space Agency
EU	European Union
EUMETSAT	European Organisation for the Exploitation of Meteorological Satellites
FEWS	Famine Early Warning System
G8	Group of eight countries

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GAD	GMES Africa Disaster (services)
GDACS	Global Disaster Alert and Coordination System
GDP	Gross Domestic Product
GEO	Global Environment Outlook
GEOSS	Global Earth Observation System of Systems
GEWEX	Global Energy and Water Cycle Experiment
GMES	Global Monitoring of Environment and Security
GRDC	Global Runoff Data Centre
ICPC	International Co-operation Partner Countries
ICSU	International Council for Science
IGAD	Inter-Governmental Authority on Development
IPCC	Inter-governmental Panel on Climate Change
JRC	Joint Research Centre - Directorate-General of the European Commission
LDC	Least Developed Countries
MA	Millennium Assessment
MDG	Millennium Development Goals
MIC	Monitoring and Information Centre of the European Commission
NASA	National Space Agency (USA)
NDMO	(Botswana) National Disaster Management Office
NEPAD	New Partnership for Africa's Development
NGO	Non Governmental Organisation
NHMS	National Hydrological Meteorological Services
NOAA	National Oceanic and Atmospheric Administration
REC	(Africa) Regional Economic Communities
RELEX	Directorate-General of the European Commission on External Relations
SADC	Southern African Development Community
SC	Steering Committee
SICA	Specific International Cooperation Actions
SRTM	Shuttle Radar Topography Mission
UNCTD	United Nations Conference on Trade and Development
UNDP	United Nations Development Programme
UNECA	United Nations Economic Commission for Africa
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organisation
UN/ISDR	United Nations Disaster Reduction Programme
UN OCHA	United Nations Office for the Coordination of Humanitarian Affairs
USAID	United States Agency for International Development
USGS	United States Geological Survey
WMO	World Meteorological Organization
WSSD	World Summit on Sustainable Development

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12. 3 APPENDICES

12.3.1 Appendix1

Examples of International based capabilities relevant to GMES Africa Disaster (GAD) theme

UN FAO – Environment and Natural Resources for sustainable Development (GEC-GTOS, Geospatial data), FAO Climpag – Natural disasters component
USGS Earthquake, volcanoes and faults in Africa program
The World Organization of Volcano Observatories (WOVO) - the foremost international body dealing with volcanic eruptions -run under the auspices of IAVCEI.
OECD Global Science Forum with a public-private partnership, including Munich Re.- Global Earthquake Model - develop a global, open-source earthquake model under
International Association of Seismology and Physics of the Earth Interior (IASPEI/ IUGG/ICSU) - brings together operators of broadband networks throughout the world, coordination of in-situ data collection, standardization and exchange
WMO - Regional Specialized Meteorological Centre in Réunion works with the South West Indian Cyclone Committee (SWIO); Sand and dust Storm Warning Systems (SDSWS) – 13 African countries;
Natural Disaster Prevention and Mitigation Programme which contributes to different stages of disaster risk reduction and World Weather Research Programme's THORPEX ten-year international study aiming to reduce and mitigate natural disasters by transforming timely and accurate weather forecasts into specific and definite information in support of decision-making.
WCRP-The Global Energy and Water Cycle Experiment (GEWEX) – modeling occurrence of climate extremes with focus on drought and wet periods

ICSU Initiatives: ICSU Regional Office of Africa (ICSU ROA) natural hazards and disasters Science Plan provides the rationale for GAD. In addition GAD programme will also be able to build upon the ICSU global environmental change programmes such as the World Climate Research Programme (WCRP); the International Geosphere-Biosphere Programme (IGBP); the International Human Dimensions Programme (IHDP); and DIVERSITAS addressing different aspects of hazards and disaster. The five ICSU Geo-Unions – IUGG, IUGS, IUSS, IGU and ISPRS – also have various hazards and disaster initiatives that have inbuilt capacity building that will be in line with GAD and have established the International Year of the Planet Earth (IYPE), which cover different aspects of geohazards e.g. The ILP working on evaluation of seismic exposure; IUGG with a series of activities on geohazards and on geophysical risk and sustainability (GeoRisk) to study the interaction between hazards, their likelihood and their wider social dimension; and IUGS with a program for Environmental Management that deals with urban hazards. IUGS also collaborates with UNESCO in the International Consortium on Landslides and other hazards linked initiatives such as the Global

Earthquake Potential, Global Seismic Hazard Assessment Programme Earthquakes and Megacities Initiative.

The International Disaster and Risk Conference (IDRC), Davos - a gathering of global technical and operational disaster experts and risk management professionals to provide a forum for disaster science, practice, policy-making and decision-making.

ii. The Global Risk Identification Programme (GRIP)- an inter-institutional global framework created to support and coordinate activities to promote systematic improvement and application of risk information. GRIP is a program for assessing, identifying, and analyzing information on disaster risks and losses.

Examples of Academic Institutions Outside Africa with capacities that GAD can build upon in terms of projects, training and infrastructure.

- i. Centre for Research on the Epidemiology of Disasters (CRED) at Louvain University in Belgium.
- ii. The Dartmouth Flood Observatory - Department of Geography and EarthSciences, at Dartmouth College USA specializes in on Space-based Measurement of Surface Water globally.
- iii. University of Geneva with the Certificat de specialization en évaluation et management des Risques Géologiques (CERG) - specializes in geological risk and emphasis a multidisciplinary approach to management of risk from natural hazards and training to incorporate disaster risk in daily operation and how best to communicate with disaster management to government agencies, media, public and private sectors before, during and after natural hazard events.
- iv. Natural Hazards Research and Applications Information Center at University of Colorado at Boulder USA – focuses on links between sustainable development and hazard mitigation.
- v. Royal Museum of Central Africa in Tervuren (Belgium) - monitoring African active volcanoes (SAMAAV) using radar interferometry and works with University of Buea, Cameroon. Project covers four active volcanoes: Mt Nyirangogo, Mt Cameroon, Mt Fogo, and Mt Oldoinyo Lengai.
- vi. Université de Rennes, Campus de Beaulieu, France initiated the TOPOAFRICA Project: Aims to deliver a set of continental-scale paleotopographic maps based on a large novel paleogeographical dataset of Africa over the last 250 My made available to the entire community as a GIS (ArcGIS) database – has collaboration with University of Botswana and University of Cape Town.
- viii. International Institute for Geo-Information Science and Earth Observation (ITC) in Enschede (The Netherlands) is an internationally recognized centre of excellence in international education. ITC aims at capacity building and institutional development of professional and academic organizations and individuals specifically in countries that are economically and/or technologically less developed. The knowledge field of ITC is geo-information science and earth observation, which consists of a combination of tools and methods for the collection - through aerospace survey techniques -, storage and processing of geo-spatial data, for the dissemination and use of these data and of services based on these data.
- x. UNESCO-IHE Institute for Water Education (in Delft, The Netherlands) carries out research, education and capacity building activities in the fields of water, environment and infrastructure.
- i. UN University in Bonn (Germany)
- ii. NASA and University of Maryland MODIS Rapid Response systems – provides MODIS satellite data in particular active fires.
- ii. University of Virginia linked to University of Witwatersrand- Champoined the SAFARI campaigns with focused on dust, aerosols and fire.
- iii. Columbia University's Center for Hazards and Risk Research (CHRR) – advancement of predictive capability for hazard and risk

International networks:

The International Federation of Digital Seismograph Network(FDSN)- aims at increasing coverage and data availability for global earthquake monitoring.

The Hydrological ENSEMBLE Prediction Experiment (HEPEX) network (members mostly from Europe, North America and Asia) - explores research challenges and the added value of probabilistic weather forecasting applied in hydrological applications.

The United Nations Platform for Space-based Information for Disaster Management and Emergency Response (UNSPIDER) - Provides universal access to all types of space-based information and services relevant to disaster management by being a gateway to space information for disaster management support; serving as a bridge to connect the disaster management and space communities; and being a facilitator of capacity-building and institutional strengthening is another strong base that GAD will link with for developing its services.

12.3.2 Appendix 2

Detailed description of African needs for GMES Africa GAD programme and possible actions to address these needs

a. Institutional framework

Requirement: Although the value of geo-spatial information is largely appreciated in Africa there is still a weak institutional base to support sustained and effective use of this data. There is low priority in investing on information generation processes and mechanism for incorporating geo-spatial information in decision-making processes. An appropriate institutional framework for research, information dissemination and for the operational level that facilitates integration of geo-spatial information systems in disaster management is required in Africa.

Action Plan: Interventions at the policy level will be carried out to help build an appropriate institutional framework for incorporation of geo-spatial data in daily disaster management operations: GMES Africa program will use the EU/EC link with AU/AUC and RECs to influence African government policies on incorporation of geospatial information in daily operations of government, NGO and private sector institutions where this is relevant. Organisations include the African, Caribbean and Pacific Group of States (ACP), ECA/NEPAD and the UN/ISDR Africa which will work through National Platforms of DRR to reach national Governments. Further advocacy for institutional support will be made through hazards and disaster networks that will be formed under GAD to provide a framework for defining continent wide disaster risk reduction needs for Africa.

b. Technical Facilities for Geospatial data

Need: To build GMES Africa services, equipped laboratories with sustained resources to update hardware and software to handle different types of geo-spatial data ranging from digital aerial photographs to airborne multispectral data; low, medium to high spatial and temporal resolution satellite data sets linked to maintained in-situ observation sites are required. Efficient internet facilities to download and exchange data is critical as are data storage and retrieval facilities. These facilities are needed e.g. for GAD to take full advantage of EU EUMESAT, ESA and AMESD services.

Action: Success in the policy on use of geo-spatial data and institutional support noted above will help improve resource allocation at national level for sustained geospatial information laboratories. For GAD, different levels of laboratory facility support structure will be used. Key institutions already with some facilities and strong history of use of geospatial data or disaster management will be identified developed into main centers of excellence e.g. SAC in South Africa, Meteorological Services receiving satellite data and working on AMESD and universities e.g. University of Ghana, Cape Town and the University of Botswana. These will be linked to Medium to minor institutions/centers forming nodes selected with consideration to geographical distribution. GAD will draw on the EP7 funding strategy to help in building laboratory facilities in partnership with African Governments and also draw from resources established through one of the focus thematic areas of ECA; ICT, Science and Technology for Development.

c. Data availability

Need: i. For GAD multi-scale data is required to tackle hazards and disasters at various levels, from regional to national, district to village level. Lack of high spatial resolution data in Africa has contributed to the limited incorporation of this data in disaster management. Lack of resources has restricted access to high spatial resolution data even where this is available. Delivery of processed products as opposed to raw data to avert low capacity to process and store data serves to maintain high dependence of Africa on outside capacities. *Both the raw data and resulting products generated should be made available and the models used to generate these products should be developed in partnership with Africa and made accessible to all member countries participating in GAD.* Further lack of database harmonization, archiving, retrieval and data sharing policies in Africa constrain long-term studies and comparative analysis.

Action: A systems where user community and stakeholders have a role in the satellite data and products to be provided and are part of the process of data manipulation will be developed. GAD will work with GEOSS on provision of multi-scale satellite data; draw on the ongoing GEO Data Sharing Principles Implementation policy that is being crafted as well as its programme on training of manpower in managing large database for natural hazards and work closely with CODATA on issues of data harmonization, disaster databases and metadata. Funding and capacity established through partnership with Europe will be used e.g. in key institutions noted above to build open sources software, computer facilities with effective Internet access and a Web browsers for data and geo-product access. .

d. Manpower requirements

Needs: Skilled personnel in geospatial information handling and modeling capability to integrate biophysical spatial data with socio-economic factors that define vulnerability to hazards and layout prevention methods assess damage and recovery is need. Hazards and disaster communicators with ability to comprehend tailor made geo-spatial products are required. The manpower resources will drive the hazards and disaster networks and feed into National Platforms for DRR and thereby contribute to mainstreaming disasters into national development plans.

Action: Manpower development will be based on a capacity building plan that will leverage on the GEO Capacity Building framework but with emphasis on "learning by doing". Networked key institutions noted above will engage in student and staff exchange across Africa and between Africa and Europe. The emerging Pan African University concept will be a useful addition in GMES Africa capacity building. Project or in-service based capacity building will be built through exchange programmes in an operational environment and collaborative disaster related research with Europe and Africa. Bilateral or multilateral agreements through e.g. RECs will be explored for a system which allows disaster experts from other countries to participate in specially organized disaster risk reduction exercises or in disaster relief exercise to share experiences and offer practical exposure.

e. Infrastructure:

Need: It is well known that Africa is badly hindered by inadequate, deteriorating or even non-existent infrastructure which increases vulnerability even to mild hazards. Inadequate development of communication infrastructure to support efficient Internet, radio/TV and telephone services are a major constrain. Despite the widely adopted mobile phone technology its reception range is inadequate and there is limited access to internet from mobile phones. Poor transport networks and shortage of energy further exacerbates the problem

Action: While the infrastructure indicated constitute the basic development infrastructure GMES Africa will endeavor through e.g. AUC/ECA/NEPAD and EC dialogue to source funding from EU for e.g. International Cooperation, EDF and ACP schemes as well as the AfDB and the World Bank to support infrastructural development schemes. For communication the African Institute of Space Science (AISS) and African Resources Management Constellation (ARMC) satellite are examples of some of the schemes to be supported. information flow is critical in disaster management as a result in addition to outside resources GAD, working with National Platform for DRR and UN/ISDR will push for African Governments to give priority to development and maintenance of these basic infrastructures given their multiple benefits in the development process.

12.3.3 Appendix 3

Detailed description of the timetable for long-term GMES Africa Partnership

In setting long-term actions for GMES Africa the aim should be to, i. Put in place a robust information service that will contribute towards the ongoing negotiations and subsequent agreements in the climate change Kyoto Protocol given the widespread challenge by meteorological hazards to sustainable development; ii. Strive to provide information requirements and network needed resources in Africa for implementation of the Hyogo framework and action plan; and iii. Facilitate actions towards meeting the MDGs and a foundation to work towards sustainable development in both Africa and Europe. Under this the GMES Africa timeline of actions can be outlined as indicated below.

PHASE 1 – Preparation for Planning GMES Africa: 2007-2010

- EU-AU Partnership and the Lisbon declaration; GMES Africa and Europe coordinating Team established
- Defined broad theme areas and engaged consultants to map activities, institutions, networks, gaps, priority areas, constraints and potential sources of resources for each theme
- Begin Africa and EU/EC wide consultation to introduce the idea, debate its desirability and feasibility
- Consider funding potential and raise issues of data sharing
- Consider possible areas for pilot projects in each theme and funding possibilities

PHASE 2 – Define Action Plan for Implementation – 3 years: 2011-2012

- Agree on priority themes and main user requirements in Africa that should be GMES Africa priority areas i.e. priority areas of action
Select 3 or so pilot GMES Africa projects from different themes where research is to be applied, source funding and commence implementation of these projects
- Assess the feasibility to meet identified user requirements for information/services– specifically what needs to be done to commence the process of delivering user needs – e.g. infrastructure, human capacity, scientific, technical and institutional needs and socio-economic requirements and how to pull together exiting initiatives
- Assess GMES Africa inter-theme leverage/collaboration etc
- Allocate responsibility to institutions in Africa and corresponding ones in Europe to kick start the programme focusing on priority areas and pilot projects
- Agree on key networks and or associations providing platforms for advocacy of GMES Africa work, setting ground for its development through mobilization of human and material resources required
- Put the GMES Africa dialogue structure at work and build required political commitment for GMES Africa and gain support and commitment among actors to be engaged in delivering Africa oriented GMES needs
- Dialogue on data sharing mechanisms and produce a draft policy
- Engaged potential sponsors

PHASE 3 Implementation of GMES Africa – 10 years: 2013-2023

- Evaluate the pilot projects- Lessons learnt and use the experience to set up a 10 year Implementation strategy Africa-Europe partnership on GMES-Africa programme covering different themes – with clear objectives and expected outputs and data sharing mechanism
- Have sponsors ready to cover implementation
- Set implementation of pre-operational fast-track services to show likely benefits of the programme
- Have institutions/organization with detailed proposals and identified financial, human and other capacities to implement identified segment of GMES Africa
- Set research activity on the priority areas to develop products and services
- Have at least half the themes identified with working projects by 2017-mid way of the 10 year plan
- Develop active networks for research provider and user knowledge and facility sharing
- Commence long-term natural hazards and disaster sites
- Commence a capacity building programme that covers human training and learning on the job, data availability, appropriate geo-product development and information transfer facilities and ability to assimilate services provided.

PHASE 4 GMES Africa Evaluated and next phase defined – 2 years: 2024-2025

The evaluation will be based on GMES Dynamic Model (Source: Europe Approach to GMES, 2001) and will aim to determine after 10 years: How did GMES Africa achieve the 3 goals noted below, what were the strengths and weaknesses and constraints etc:

- **Deliver** specific information and information services on the basis of user driven applications and **learn** from these;
- **Assess** the information production processes and **structure** the demand and supply sides;
- **Develop** the required infrastructure and the knowledge base in order to secure and **improve** a sustainable approach to the delivery of information.

PHASE 5 GMES Africa Programme Taking Shape – 10 years: 2026-2036

- Benefit of GMES Africa must begin to be realized and incorporated into operational systems
- Strong Africa ownership – Africa contribution to funding should grow – private and public user demand driving national and regional needs to contribute resources to GMES Africa
- Commercial viability established to provide the dynamic self – sustaining product and service delivery process

PHASE 6 Evaluation of GMES Africa 2 years – 2037-2038

- Evaluation to cover societal benefits of GMES Africa to Africa and Europe, contribution to Hyogo framework and Kyoto Protocol – climate change mitigation and adaptation
- Evaluation also to consider if it is still necessary to maintain the GMES Africa structure or different mechanisms may be required e.g. encompassing other continents?

PHASE 7 - The way forward to depend on Phase 6 evaluation outcome.

12.3.4 APPENDIX 4

Organizational of GMES Africa and GAD theme

The organization scheme of GAD will be of high standing with a clear link to policy-decision-makers in addition to data and information generators, key service providers and user community.

Organization at GMES Africa theme level: Each of the 10 GMES Africa themes will have a steering committee, hence there will be a GAD Steering Committee (GAD-SC). GAPO will facilitate the setting up of the steering committees (SCs). Each SC will elect a chair and will oversee the whole theme programme; facilitate dialogue, provide policy direction, prioritize activities, mobilize key resources and institutions and make sure that the theme is integrated to the rest of the GMES Africa programme.

GAD Organization structure: The GAD-SC will have about 15 rotating members with provision to co-opt where need arises. A single membership term will extend over 3 years with a provision for 2 terms for each member. Members of the GAD-SC will be formed among others by representatives from: **i.** The most relevant GMES Africa themes, **ii.** Relevant AUC portfolio division e.g. AUC/HRST, UN/ISDR Africa and UN/ECA, **iii.** RECs – nominated on the basis of their role in relevant regional programmes (e.g. to help link to the UN/ISDR National Platforms of DRR in their regions), **iv.** Major science and user community e.g. key centers of excellence noted above, disaster relief organizations, networks i.e. AMDNet or networks of long-term natural hazards and disasters and in situ observations, **v.** the main Europe Africa oriented geo-spatial information disaster programmes (e.g. GMES Europe, GEO disaster initiatives etc) and **vi** key sponsors.

Appointments to the GAD-SC will be made by the chair of GMES-Africa Coordinating body which will have a secretariat located under the AUC/ECA office. GAD-SC will have two co-chairs one identified through the RECs (i.e. one of the RECs nominees to GAD-SC) and the other identified among the remaining members of GAD-SC that are not representatives of other GMES Africa themes. The GAD-SC will meet periodically e.g. at least once a year, to examine issues of program development and implementation. All African countries should be legible for GAD membership regardless of their political situation given the non-selective nature of natural hazards although political stability will determine the effectiveness of GAD in each country. Initially, GAD could piggy back secretariat services from AUC/ECA or NEPAD Environmental Programme, UN/ISDR, UNEP or WMO and

where none of these are possible the ICSU RAO in Pretoria could be an alternative. However, GAD-SC will in the long-run be expected to identify its host secretariat preferably an African country providing sponsorship. Another possibility is for two or more programmes of GMES Africa to share secretariat services in one location.

THE GLOBAL MONITORING FOR ENVIRONMENT AND SECURITY (GMES), THE AFRICA ACTION PLAN

1, COMPONENT

Food Security and Rural development

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4. INTRODUCTION

Sub-Saharan Africa gathers 626 million inhabitants of which 61% work in the agriculture sector. The total surface of Sub-Saharan Africa is 2455 billion hectares including 173 million hectares cultivated, that is to say the quarter of the potentially exploitable surface. In spite of abundant natural resources, the regional GDP per capita was lower at the end of the Nineties than it was in 1970. 19 of the 25 poorest countries of the world are localized in sub-Saharan Africa, region characterized by a strong disparity of incomes. In Eastern and Southern Africa, rural poverty represents up to 90% of total poverty. During the last 30 years, the number of people undernourished in the area increased considerably, reaching 200 million in 2000.

Agriculture constitutes an essential component of the African economy, from its contribution to the creation of wealth, the returns of exportation and the satisfaction of food needs of the local population. It constitutes the base of the economy for many of the States of the continent. The agricultural sector constitutes the means of subsistence of more than 60% of the working population of Africa. However, the sector represents only about 30% of the GDP in Africa.

Cash Crops as staple crops contribute to the economy of the states and to household livelihood but they depend on the world market prices and their intensive cultivation has often led to soil impoverishment and to land and forest cover degradation. The agricultural yields have been stagnating for dozens of years. The slight increase in the agricultural production, linked to the simple increase of land cultivation, hardly compensates for the demographic growth of Africa. The low food production leads to an increase in the number of people chronically underfed, which goes from 173 million people in 1990-1992 to 200 million in 1997-1999, according to the last available statistics. On this total, 194 million people live in sub-Saharan Africa. This progression of the hunger occurs in spite of the importance of the food imports, which cost 18.7 billion dollars in 2000 only.

Today, the economic activities of the African populations also undergo the effects of the variability and change of climate. In addition to the important droughts, the African farmers are often seriously affected by property damages due to natural disasters, to economic, political or social instability, and to conflicts. This puts the countries on a fragile food situation with large part of the population vulnerable to food insecurity and worrying rates of acute malnutrition. Several Sahelian countries face a structural food deficit in semi-arid areas, where the potential and the limited means of production do not allow to maintain food self-sufficiency.

In addition, any action of agricultural development must be based on reliable information with regards to agricultural production and land capacities. In the African countries, the agricultural statistics are traditionally collected through household surveys. During these surveys, agricultural surfaces are measured and the crop yields are estimated by crop cutting. In addition to the errors of measurements, the design of the surveys faces many problems such as the size of the territories to cover, the difficulties of access of certain regions or the inaccuracy of the basic information necessary to the development of the survey sampling base (population and village list). Overall, the resulting statistics lacks precision, both for the yield and cultivated areas figures, which are essential to define any appropriate agricultural policy.

To deal with these constraints in agriculture and food security, decision-making tools are of capital importance to help the various actors to better manage and monitor their activities. In African countries, subject for a long time to structural adjustment creating a progressive deterioration of the structures in charge of rural development, it is urgent to implement a dynamics of dissemination at the benefit of all the actors, providing on the one hand, reliable information to the political or technical decision makers, and on the other hand, of technical advices to farmers.

5. POLICY DRIVERS AND NEED ANALYSIS

At global level, Food Security is a priority. The G8 Summit of July 2009 stated clearly the urgent need for decisive action to free humankind from hunger and poverty. Food security, nutrition and sustainable agriculture must remain a priority issue on the political agenda, to be addressed through a cross-cutting and inclusive approach. Effective food security actions must be coupled with adaptation and mitigation measures in relation to climate change, sustainable management of water, land, soil and other natural resources, including the protection of biodiversity.

There is also now a global consensus on the fact that short term responses have to be coupled with longer term agricultural development and as stated recently by the WFP, Executive Director "It's a false logic for the world to say that we will either invest in tomorrow's agriculture or today's urgent food needs. There is no question that we must do both."

In this context, African agriculture is the subject of multiple requests and pressure, resulting in the development of many strategies at national level and regional level. The most visible strategies were observed either on the level of the regional institutions in charge of the co-operation and integration (UEMOA, CEDEAO, CEMAC, COMESA, CEN-SAD, etc) through their regional policies, or on the level of the intergovernmental organizations like the CILSS with its Food Security Strategic Framework (CSSA). Nevertheless, it has been necessary to wait for the year 2000 to see a stronger coordination of the policies and strategies for agricultural development, in liaison with the emergence of the agricultural aspect of the NEPAD and the Common Agricultural Policy of the Economic Community of the West Africa States (ECOWAP).

Thus in 2003, the Heads of State and Government of the African Union (UA) ratified the Comprehensive Africa Agriculture Development Program (CAADP) as a vision for a return to agricultural growth, food and nutritional security and rural development in Africa. The precise objective of CAADP is to reach an average rate of annual growth of 6 % in the agricultural sector. With this intention, the CAADP channels the investments towards four "pillars", each tackling key issues :

- Pillar I: To extend the area under sustainable land management and reliable water control systems;

- Pillar II: To increase market access through improved rural infrastructure and other trade-related interventions;
- Pillar III: To increase food supply and reduce hunger across the region by raising smallholder productivity and improving responses to food emergencies; and
- Pillar IV: to improve agricultural research and systems in order to disseminate appropriate new technologies.

The program is part of the national efforts to promote agricultural sector growth and economic development. It identified the common priorities of the Member States.

The following principles and main objectives define the framework of the CAADP :

- A growth based on agriculture as the main strategy for achieving the Millennium Development Goal (MDG) aiming at reducing poverty,
- The search for an average rate of agricultural growth of 6 % per annum at the national level,
- To assign 10 % of the national budgets to the agricultural sector, and,
- To take advantage of the complementarities and the regional co-operation to stimulate the growth.

The African Food Security Framework (CSAA), formulated in September 2007 at the request of the African Union (AU) and NEPAD, tries to answer to the challenges of Pillar III of the CAADP and establishes the priority strategies and responses in order to help the decision makers to identify clear solutions, founded on best practices, to the problem of the hunger and malnutrition. The pillar targets precisely the people suffering from chronic food insecurity, as those which are affected by emergencies and crises.

The challenge associated with the reduction of hunger and malnutrition cannot be taken up without achieving the goals of the three other pillars of the CAADP. The third pillar must also seek that the policies and strategies of the other pillars support the efforts aiming to reduce and/or to eliminate hunger and malnutrition. The CSAA tries to harmonize the existing efforts and provides a platform which benefits from synergies and from the capacities of the multi-sectors programs. While bringing multidimensional answers to the problem of food security and nutrition, the CSAA engages a cycle of synergistic advantages which will reduce hunger and malnutrition.

As example, the Regional Program of Agricultural Investment (PRIA) of CEDEAO falls under the joint implementation of the ECOWAP and the CAADP. It is practically implemented through six topics: The improvement of the water management, the sustainable development of the farms, the improved management of the natural resources, the development of new agricultural opportunities, the promotion of the international trade, the prevention and the management of food crises and other natural disasters and, finally, of the strengthening of the institutions. PRIA seeks to define regional programs of investment which could complement and add value to the National Programs of Agricultural Investment (PNIA).

These strategies of food security and agricultural policies laid down by the regional institutions raise many challenges to be dealt with in the framework of the implementation plans. GMES Africa Program could contribute to this dynamic while meeting some specific information's needs defined within these strategic frameworks.

The needs are mainly related to:

- The Early warning systems,
- The prevention and the management of the food crises,

- The support to the rural development,
- The analysis of household vulnerability, and
- The actions to help decision-making, communication and dissemination of the value added products to the stakeholders.

Table 1. Main general actions to be implemented in the short and in the long term at the different scales.

Level	Type of Action
Continental	Coordination of programs of continental interest : <ul style="list-style-type: none"> - Climate Change Impact on Agriculture and Food Security, - Prevention, management and monitoring of drought and soil degradation, - Prevention and control of locust invasion and other trans-boundaries risks
Regional	Regional Program set up : <ul style="list-style-type: none"> - Seasonal meteorological Forecast, - Coordination of Early Warning Systems, - Management system for water resources. Development of programs for decision-makers and support to the producers; Development of information system and vulnerability mapping; Reinforcement of the capacities of the actors in all the fields concerned.
National	Implementation of the actions to support the data producers : <ul style="list-style-type: none"> - Biophysical and socio-economic data reliable and delivered in real time, - Tools to support decision-makers, - Early warning and assistance systems for the populations. Implementation of the programs to support decision-makers for : <ul style="list-style-type: none"> - The agricultural investment, - The rural planning, - The land tenure, - The projects interventions in the regions facing structural risks, - The assistance to the vulnerable populations, - The land and conflict management between farmers and pastoralists
Local	Support to users and local communities : <ul style="list-style-type: none"> - Short term meteorological forecast, - Advices to local communities for the implementation of their agricultural, pastoral and commercial activities - Sustainable management of land (conservation and restoration of the soils).

6. IDENTIFICATION OF COMMUNITIES

The communities of users and the stakeholders linked to food security and rural development initiatives are numerous at regional level as well as at national. They can be classified based on their needs. Thus, the GMES Africa activities, to be effective, must be based on these existing communities of users, according to the different policy, institutional, and technical level. The program needs to create synergies of actions setting them into networks and reinforcing them consequently.

Table 2. The Producers and Users Community in Food Security and Rural Development sectors.

Level	Institutions/Actors	Information needs
Political	- Chiefs of State Summits	Information to help decision-making for

stakeholders	<ul style="list-style-type: none"> - Council of Ministers (UA, CMA/OC, ...) - OIG (CEDEAO, SADC, IGAD, CEN-SAD, CILSS, etc.) - SNU (UNDP, FAO, WFP, UNICEF...) - Bilateral Cooperation 	agricultural investment, for project interventions in the areas facing structural risks, for the assistance to vulnerable populations, for the land and conflict management between farmers and pastoralists
Technical and financial decision makers	<ul style="list-style-type: none"> - National Ministers in charge of Agriculture matters - Technical regional institutions - Technical agencies of UN Cooperation (IFAD, FAO, WFP, OCHA, WMO ...) - Technical agencies of bilateral cooperation (EU, USAID, National Coop, CIDA, ECHO ...) - Other national operators in the FS and RD domain 	<p>Long-term climatic forecast</p> <p>Land Use and soil capacity</p> <p>Biophysical and socio-economic information for the monitoring of the agricultural season, on the food balance, on the definition of the regions at risks, to support the targeting of the vulnerable population and to answer to emergencies</p>
Scientific community and information providers	<ul style="list-style-type: none"> - Regional agriculture research networks (CORAF, FARA, OSS, USGS, JRC, IRD,...) - Technical research institutions (AGRHYMET, RCMRD, RECTAS, AFRISTAT, IFPRI, ReSAKSS ...) - National rural development and food security institutions (CSE, CNRA, SAP, etc.) 	<p>Scenarios on climatic change and on the sea surface temperature evolution</p> <p>Reliable biophysical and socio-economic data in real time</p> <p>Tools to help decision-makers</p>
Final users	<ul style="list-style-type: none"> - Farmers, pastoralists, traders, - NGOs (CARE, AFRICARE, Save the Children, OXFAM, etc.) - Press (media) - Civil Society (ROPPA, REOSAO, etc.) 	<p>Short term meteorological forecasts</p> <p>Advices for activities implementation</p> <p>Sustainable land management (soils conservation and restoration)</p> <p>Local Governance for food security</p>

7. MAPPING EXERCISE

The GMES Africa program as regards to food security and sustainable rural development must ensure in a continuous way a reinforcement of the capacities of the experts, engineers and technicians in the field of new technologies, of collection, treatment, transmission, management, analyzes and diffusion of the biophysics and socio-economic data and information. This will allow them to better work out products of decision-making aids for the various users. These actions of training and institutional support must fall under the reinforcement of the capacities of the existing institutions of the continent working in the field of food security and the rural development.

Table 3. Current EO data acquisition capacities of the main existing institutions, programs and projects, the type of product developed and the financial and technical supports they benefit.

Institutions Organisations	Theme		Coverage	Time frame	Data		Services / Products	Capacity Building	Support		Contact
	FS	RD			EO	Others			Funding	Technical	
International stakeholders : FAO GIEWS, WFP, FEWS NET, WMO	FS		Earth Continent	Continuous	FS - Low res – NOAA AVHRR, SPOT VGT, MSG, MODIS, MERIS (Earth Observation data (NDVI, DMP, CDD, rainfall estimates, etc.) RD - Medium to High Res – LANDSAT, SPOT, QuickBird, Ikonos	Administrative boundaries, topographic maps, other existing maps (roads, rivers, parks, etc)	EWS Bulletins RFE monitoring	Short term training (regular and tailor-made), Workshops / Seminars	FS - Development partners (USAID, FAO, WFP, etc.) RD –Development partners (UNDP, FAO, IFAD, USAID, WMO, etc.)	FS – FEWSNET FAO, WFP,	www.fao.org www.fews.net www.wfp.org www.wmo.org
Regional Implementation Centres: RECTAS, RCMRD AGRHYMET, ICPAC ReSAKSS, IFPRI AFRISTAT, ACMAD	FS	RD	West Africa, Eastern and Southern Africa IGAD	Continuous	FS - Low res – NOAA AVHRR, SPOT VGT, MSG, MODIS, MERIS Base Datasets (Vegetation type) Earth Observation data (NDVI, DMP, SST, CDD, rainfall estimates) RD - Medium to High Res – Landsat, SPOT, QuickBird, Ikonos	Administrative boundaries, topographic maps, other existing maps (roads, rivers, parks, etc) Agricultural Statistics Market data	EWS Monthly Bulletins, RFE monitoring, Yields forecast, Cereals balance, Food balance, LU/LC maps Seasonal climate outlook, Climate monitoring, Vulnerability map	Short term training (regular and tailor-made), Diploma courses Masters Workshops / Seminars	FS - Development partners (USAID, Dutch Government, FAO RD – Member States, Development partners (UNEP, FAO, UN-Habitat, IFAD, USAID, WMO, UNDP, etc.)	FS – FEWSNET RCMRD, FEWSNET, National Met. Departments,	www.agrhyet.ne www.rcmrd.org www.icpac.net www.ifpri.org www.resakss.org www.afristat.org www.acmad.ne
National Centres CSE		RD	National	Continuous	FS - Low res – NOAA AVHRR Field data Earth Observation data (NDVI)	Administrative boundaries, topographic maps, other existing maps (roads, rivers, parks, etc)	EWS Decadal Bulletins Vegetation types Biomass estimates	Short term training (regular and tailor-made)	FS - Development partners, Government		www.cse.sn
Research Institution Universities	FS	RD						Diploma courses Masters			
Regional Organizations Rivers Basins (OMVS, ABN, CBLT, Nile Basin Initiative), OSS		RD	West Africa Eastern and Southern Africa IGAD	Continuous	FS - Low res – NOAA AVHRR, SPOT VGT, MSG (Flow rate, volume water height) RD - Medium to High Res – LANDSAT, SPOT	Administrative boundaries, topographic maps, other existing maps (roads, rivers, parks, etc)	EW Water Resources Bulletins, Environment monitoring, Use and Governance in Trans-boundaries Water Management	Short term training	FS – Government, Development partners	AGRHYMET ACMAD, WMO, UCRE/ECOWAS, RIOB, GWP	www.omvs.org www.abn.ne www.lakechadbc.org www.nilebasin.org www.riob.org

Projects and programs	Theme		Coverage	Time frame	Data		Services / Products	Capacity Building	Support		Contact
	FS	RD			EO	others			Funding	Technical	
AFRICOVER	FS	RD	East Africa, RDC	2000-2004	LANDSAT		Land Use map, LCC system	Short term	Italian Coop	FAO, U. Firenze	
GLC2000	FS	RD	World	2000-2002	SPOT VGT		Land Cover map 2000		EU	JRC	
GIORCOVER	FS	RD	World	2006-2007	MERIS		Land Cover map 2005		EU	Medias France	www.mediasfrance.org
AMESD	FS	RD	Africa, Regional approach	From 2008	SPOT VGT – Low resolution	Field data	ICN, VCI, NDVI, Early Warning System	Short term training	EU-AU	JRC, Vito, AGRHYMET, FEWS, SADC	www.jrc.ec.europa.eu www.vito.be www.agrhyet.ne
GMFS	FS		Africa, sampling of Countries	From 2005	SPOT VEGETATION, RADAR, LANDSAT, IRS, ...	Field data	VPI, Agro-Met modeling	Short term training	ESA	VITO, EFTAS, SARMAP, FUL, AGRHYMET	www.dsge.ulg.ac.be www.agrhyet.ne
VTG4Africa	FS	RD	EO data, Fields data	From 2006	Low resolution – SPOT VGT		Small Water Body, Dry Matter Production, Phenology, NDWI, data dissemination tool		EU	VITO, JRC	
FS national project (FSAU, SIFSIA, etc...)	FS		National	-	SPOT VGT, SPOT, LANDSAT	Field Survey	Agro-Met modeling, Rainfall estimates	Short term	EU - FAO	FAO	
FAO Agriculture statistics projects		RD	National	-	SPOT, LANDSAT	Field survey	Statistics		EU - FAO	FAO	
TIGER	FS	RD	EO, Fields data	2005-2008	EO (ENVISAT, Radarsat, Landsat, Spot4)		Water resources monitoring and management from EO data	Short term training, Workshops	EU	ESA, AGRHYMET	www.esa.int www.tiger.esa.int www.agrhyet.ne
FAO-SWALIM		RD	Somalia	2004 - present	LANDSAT, IKONOS	Administrative boundaries, topographic maps, roads, rivers, ...	LU/LC maps, Meteo stations	Short term training, Workshops	EU	FAO	
SERVIR-Africa	FS	RD	East Africa	2008 - present	Landsat, EO1, Aster, MODIS,		Geospatial Portal	Short-term training, Workshops	USAID, NASA	NOAA, WRI, USGS, CIESIN, NASA GSFC	www.servir.net
Livestock (LEWS)	FS		East Africa	1999-2003	NOAA AVHRR	Rainfall, field data	Biomass estimates	WorkShops	USAID	TEXAS AM	

8. IDENTIFICATION OF GAPS AND EXISTING OR PLANNED PROGRAMMES

The capacities and the expertise in Food Security Early Warning System exist at regional level in Africa : AGHYMET centre in Niamey, SADC Centre in Gaborone, RCMRD in Nairobi, ... these Centres need nevertheless to be reinforced in terms of infrastructure in order to act as the main and central structure for knowledge transfer to the national levels. The development of the system can count on international activities already carried out in Africa : FEWS net, FAO GIEWS, JRC FOOD Sec, ... These activities and the best practices developed should be internalized in Africa.

Earth Observation data are or can now be directly received in Africa thanks to the PUMA stations reinforced by AMESD program or even via INTERNET using the VGT4AFRICA data flow. At national level, the data are unfortunately often not disseminated outside of the **receiving institution, more by a lack of a clear data exchange policy.** In the same context, an EO data archiving system needs to be constituted for long time series analysis.

The processing of the EO data should be supported by field data. Networks for field data acquisition exist in many countries but need to be reinforced, complemented and need to be made operational with a reliable data delivery on real time.

Rural development activities will make use of specific national competencies and international success stories mainly acquired through specific projects. For this topic, an ad hoc EO data acquisition strategy must be set up including very high resolution data acquisition.

GMES Africa should act at different levels :

- Improvement of low and mid resolution EO data acquisition, the data delivery on real time is crucial for early warning activities and monitoring, to ensure an operational system
- Development of a strategy for very high resolution data collection at local level for ad hoc applications, the cost-effectiveness factor is essential
- Strengthening field data acquisition and network
- Ensuring a robust data infrastructure, allowing secure archiving capacities
- Definition of best practices leading to standard data processing methods and standard products allowing comparison of regional approaches and an easy continental integration
- Identification and implementation of an open data dissemination policy and strategy taking into account data cost and multi-user issues.

In line with the other GMES Africa components, the data and product flows have to be well analyzed and clearly defined.

Earth Observation needs

The section summarizes the spatial resolution, the acquisition strategy and the gaps of the main EO data categories requested in the FS and RD component. The list is not restricted to satellite observation data but should also cover airborne imagery.

Table 4. Needs and gaps in terms of Earth Observation data useful for the Food Security and Rural Development component.

<i>Category of Data</i>	<i>Sensor</i>	<i>Acquisition strategy</i>	<i>Identification of gaps</i>
Low Resolution	MSG	Daily acquisition for crop monitoring	Lack of validated products (indicators still under development with different processing chain)
Low Resolution (300 m -1 km)	NOAA METOP SPOT-VGT MERIS MODIS ASAR	Daily acquisition for crop monitoring and cropland mapping	Lack of clear inter-comparability of the data, lack of a standard well-documented pre-processing strategy, lack of program continuity
Medium Resolution (10 -50 m)	LANDSAT SPOT DMC CBERS IRS ASTER	Complete coverage yearly for cropland and land use mapping, for agriculture statistics stratification	Lack of satellite possibilities for complete acquisition
High resolution (2 -5 m)	SPOT	Complete coverage 3-5 years for agriculture statistics and land use mapping	Lack of satellite possibilities for complete acquisition; lack of receiving stations or on-board recording
Very High resolution (< 1 m)	IKONOS QUICKBIRD AIRBORNE	Sampling for agriculture statistics applications and products validation Ad hoc acquisition for specific projects on land administration	Prohibitive cost and poor acquisition strategy in Africa
Radar high resolution (1-50 m)	RADARSAT	Specific areas, Ad hoc request, multiple acquisition coverage yearly for land use mapping	Lack of secure acquisition strategy Lack of clearly validated and thus operational products

In situ and other information needs

Field information is a key component to the Early Warning System for the calibration and the validation of the model based crop condition assessments. Many field data collection networks exist in Africa but they have often of a poor spatial coverage. They are also, for different reasons, not reporting regularly the information needed and suffering from a lack of standardized data collection procedures and nomenclatures. They need to be reinforced in collaboration with the institutions in charge of their current maintenance, leading to the set up of a network of references stations. Geo-referenced field data collection using GPS technique should be promoted as a standard. A standard

spatial data infrastructure for data integration should be built with the involvement of National Geographic institutions. A coherent SDI will facilitate easy data sharing and database enrichment. Socio-economic data should be integrated into the interoperable database.

Attention should be paid to the data exchange policy to allow the free exchange of information. Many information needs are shared between thematic. Existing information should be collected and harmonized before being improved and completed.

Table 5 : Needs and gaps in the availability of complementary data useful for Food Security and Rural Development component.

Biophysical parameters		Existing and planned capacities	Gaps
Meteorological	Rainfall, temperature, radiation, wind speed, ...	Synoptic stations	Poor reporting, low coverage in Africa, poor data accessibility
Soil	Structure, water holding capacity, erosion, soil moisture...	Global FAO map, IIASA-HWSD database, JRC-FAO-ISRIC initiative on soil atlas of Africa	Local knowledge, harmonization of soil definition and procedure for extracting the key parameters
Crop	Crop cycles, varieties, crop phenology, biomass	Local knowledge exists and partial information	No real and consistent network of phenology information collection
Hydrology	River network and attributes		Need to be harmonized, complemented and validated
Land-cover	LC maps and attributes	Some local, national and regional information	Lack of uniform classification, legend and scale, lack of validation, old information
Crop Production	Agriculture statistics (area, yield and production)	Reinforcement of agriculture statistics by FAO in many countries	Lack of reliability of the data, aggregation level
Socio-economic parameters		Existing and planned capacities	Gaps
Population	Density, characteristics, structure...		
Infrastructure	Road network, exploitation, markets, ...	Information exist	Lack of consistency and harmonization
Land tenure	Large scale parcel mapping, land use rights and status	On going FAO and WB projects	Nearly inexistent

Infrastructure needs

The lack of accurate and/or up-to-date information has been mentioned, as well as often the poor spatial coverage of the existing information. New information to be developed must follow strict rules and standard to be integrated into the decision process and to be accessible to the community.

The common data infrastructure should be built with standard information including official and accepted administrative limits, river and road network ... In the construction of this data infrastructure, the official mandate of each institution responsible for each data should be respected in order to guarantee the official value of the information. Furthermore, the data policy should encourage a free access to these data.

Accessibility to the data should be facilitated in terms of condition (cost, legal aspect ...) and physical availability (transfer). International network exist through the EUMETCAST service, PUMA and AMESD initiatives but locally, in country, the exchange must be improved to allow the delivery of the data on time and on the right support and format. For each activity, the data flow needs to be defined and approved before implementation.

In the processing of the data, the procedure used should be well documented. Best practices should be defined, accepted and disseminated between the partners. An archiving system including backup facilities should be set up allowing a back processing of the data when necessary. A standard validation procedure of the product has to be included in each data processing.

In the production of the information for decision makers, the lack of collaboration between institutions has been noticed. Being of a multidisciplinary nature, the Food Security and Rural Development activities should be built around a network of institutions. Food Security Commissions which exist in many countries could serve as example of efficient institutional network.

9. BUILDING GMES AFRICA SERVICE

9.1. Service definition and provision

The GMES Service has been described in terms of support to activities. In the service definition, we concentrate on the generic products for building the four categories of activities previously retained. This presentation may results in some case by overlapping products which will be mentioned..

(i) Food security early warning systems

The system must provide an exhaustive view at regional and national level of crop development during the agriculture season. The monitoring must detect anomalies compared to previous season or to the historical average. At the end of the season, crop yield could be forecasted based on remote sensing indices and agro-meteorological models with a calibration with national statistics. The system is based on remote sensing observation data, agro-meteorological information, field information and national statistics. In the reinforcement of the FS EWS, the main objective of the GMES component is to provide, daily and ten daily :

- Bio parameters information from remote sensing
- Satellite data rainfall estimates and meteorological parameters (radiation, surface temp ...)
- Soil moisture products

The satellite information should be calibrated with field data. The second objective of the component is thus to ensure, through a consistent field network, the regular availability during the agriculture seasons of :

- Crop phenology information

- Meteorological information from synoptic stations

When necessary the field data collection network should be reinforced.

The development of the system will make use of land cover maps, agriculture and crop maps, and agriculture statistics. The component should also ensure the continuity and the standardization of the products. A consistent archive should be built allowing long time series analysis. Back processing of the archive should be allowed when necessary.

The third objective of the component is to support the exchange and the comparison of information and processing techniques, particularly in two topics :

- Real time rainfall estimation models
- Meteorological seasonal forecast

Several national and international institutions are working on the two topics. The set up of an information dissemination platform could help to define the best practices.

(ii) Agriculture statistics

Due to the nature of the African agriculture (multiple crop fields, small size of the fields, and high heterogeneity of the cover...), the collection of agriculture statistics should be mainly based on field surveys. Earth Observation could nevertheless support these field surveys and improve the quality of the estimations as the land to cover is often large.

To improve the efficiency of the survey, land stratification could be developed. This stratification can be based on an accurate land cover map. The component should develop this land cover map with a specific focus on an accurate mapping of the agriculture domain for each country. It should be a medium resolution product (20 m) to be updated every five years. In regions of high rate of Land Cover change, the frequency of updating the product could be higher, possibly of two years. The product should follow a multipurpose and standard classification scheme, a good example being the FAO LCCS approach.

In countries where the population based surveys can not be considered as reliable, the component should also support the definition of an Area Frame Sampling approach to collect statistics. This will imply the provision of a wall to wall coverage of high resolution (2-5 m) Earth Observation data to allow field segment delimitation. A 5 years update of the product can be envisaged. The imageries will be photo-interpreted.

For validation and control activities, the component should make available very high resolution (1 m or less) imagery. They should be acquired on a 1-2 % sampling basis and at request for specific countries. The imageries will be photo-interpreted (point sampling) and used in the field for crop identification and area measurement.

(iii) Land use suitability and planning

Land use suitability definition and land planning need the integration of various sources of information. The main information is a land cover characterization map. As for agriculture statistics stratification, this map can be produced based on earth observation techniques. The objective is to provide a 20 m resolution map on a five years frequency, following a standard classification scheme and legend.

In some specific areas, around settlements for example, and considering some key features like infrastructure, a 5 m product could be necessary. This necessity will be defined according to the

needs and on the already existing information. The update frequency can also be adjusted to the change rate of the land cover.

The technical specifications of the products should be defined to ensure its compatibility and integration with other information sources. If necessary a national standard for geospatial data should be set up.

(iv) Land administration

Earth Observation imagery will support Land Administration activities. This support should be based on very high resolution products (less than 1 m resolution) acquired on an ad hoc request and for pilot sites. This component can be considered as pilot and should be linked to and support existing initiatives of FAO and the World Bank. The activity needs a well defined socio-political context to be efficient. The EO imagery will be precisely geo-rectified and will be photo-interpreted to serve as a spatial database for land administration.

9.2. Capacity-building

The capacity reinforcement should be **appropriate to the beneficiaries**. African existing capacities should be fully exploited and be complemented by international projects (FEWS, GMFS, ...) and institutions (FAO, JRC, ...) working already in the domain when necessary. For the FS&RD component, EO techniques should be integrated in the current training courses with clear thematic applications instead of creating pure EO training.

9.2.1. Target expert categories

Specific capacity building should be implemented for the different expert groups to ensure and consolidate the long term sustainability of the activities and the acceptance of the final products by the users. Four target groups are identified :

- (i) Data producer, national and regional technicians and scientists
- (ii) Managers and Directors in charge of the supervision and the allocation of funding and human resources for data production
- (iii) Decision makers at Governmental level who will integrate the information produced into their decision process
- (iv) Local communities who may use the final products at local level and who liaise with the farmers

9.2.1. Implementation strategy

At first, data producers should be trained directly on site on the data production. At medium term, follow ups of the training must be organized regularly, with an evaluation of the quality of the products and the efficiency of the processing line.

Scientists must be encouraged to join PHD programs to ensure long term high level human resources. African universities and African Centers of Excellence must be identified and reinforced to ensure a proper training. The participation and the representativeness of African experts in international conventions, discussions and meetings will also facilitate the exchange of information and the valorization of the activities.

Seminars must be organized for Managers and Directors to stress the importance of the activities, and the innovation, and to present the characteristics of the products.

Decision makers and local communities must participate to product presentations to be aware of their existence, of their potential use and certainly to acquire confidence in the quality of the products.

When appropriate, preference should be given to regional level capacity building and training with the objective of transferring it at national level on a second step.

9.3. Prioritisation of requirement and actions

The Food Security Early Warning System should be first implement at regional level, taking advantage of the capacity and quality of the existing centers. These centers could share their experience leading to best practices and common and accepted approaches. The first requirement will thus be to secure the EO data reception and the definition of common standard products. Processing facilities should also be installed at that geographic level, as well as secure archiving capacities. On a second step, the FS Early Warning System could be transferred at national level with adaptation to the specific national contexts. In the same step, data flow to continental level (African Union and /or UNECA) should be organized and implemented as a harmonized mirror of regional outputs. Regional centers will serve as coordinator of the national actions in the EWS topic.

Link to their nature and the political decision level, agriculture statistics, land planning and land administration activities must be implemented at national level. In this context, key advanced countries will be selected for a first implementation. The activities will be developed at national level but regional centers could play a key role of support, respect of the product standards, then dissemination. On a second step, leading countries will share their experience with their neighboring countries and will help the implementation of the activities in these countries.

9.4. Organisational scheme

The Commission of the African Union (AUC) and the Commission of the European Union (EC) will ensure the control and the general coordination of the implementation of the Initiative. They will ensure the coordination in collaboration with the Regional Economic Communities (REC) such as the CEDEAO, the IGAD, the SADC, the CEN-SAD ... in order to achieve the objectives.

The AUC and the EC will be also in charge of coordinating the meetings of the technical and Steering committees which will be composed of the National Authorities nominated by the Member States, the Authorities of the REC and the financial partners.

The Steering committee will give strategic orientations for the implementation of the program. It will meet once a year to examine the annual reports of the technical committee and to ensure the follow-up of the strategic orientations.

The technical committee will control technically the implementation of the activities and will deliver recommendations to the steering committee on the necessary strategic orientations. The technical committee will meet every six months.

At the national level, we have mentioned the diversity and the multitude of actors. It is mandatory for the implementation of each activity to ensure a strict respect of the defined national mandates, in particular in FS between the Services of the Ministries for Agriculture and the Meteorological Agencies. The non respect of these mandates can lead to insoluble political dead ends. One will also take care of a reinforced implication of the National Geographical Institutes (NGI) for land mapping. For FS and RD issues which are clearly of multidisciplinary nature, the constitution of multidisciplinary groups must be encouraged.

The FAO evaluation on the Early Warning Systems for Food Security in sub-Saharan Africa mentions that the most efficient systems are those where the government recognizes their importance in the process of decision-making. This implies: a political and financial commitment of the government, a will of transparency of the system and autonomy for the analysis, collaboration between the government and the development partners, and an effective partnership between all the operators to increase the capacities in human resources within the framework of the analysis. In the same context, a favorable institutional and administrative framework must be set up or must be reinforced to ensure the flow of information and an optimal access to the data. The long term sustainability of the activity passes by a clarification of the mandates, a definition of the objectives according to the needs and financially, by the implementation of methods ensuring the best cost-effectiveness ratio.

As mentioned before the activities within the framework of the land administration system are very sensitive and can not be developed without a national political framework and without a collaboration and support from the existing programs (FAO, BM).

The data access will be facilitated by the definition and application of a charter defined to this end, taking example of the charter developed in West Africa by Center AGHRYMET. It describes the rules of transfer, access and valorization of the data. An inventory and a collection of the freely accessible data will be carried out. On the level of the data-processing, the use of products available freely will be privileged, for example software developed by the African Regional Centers, FAO, FEWS Net or the JRC.

9.5. Timetable

The time table could be organized around three phases :

Exploratory Phase 2 years

- Set up of the political context
- Identification of the key areas of intervention, definition of products (EO and others), standard and definition of the data flow
- Institutional review, mandate analysis, identification and selection of regional and national leading centers
- Identification of capacity building needs
- Set up of the inter-regional dialogue and the cooperation between centers
- First step for High Resolution data acquisition

Pilot Phase 4 years

- Installation of processing facilities for EWS at regional center
- Capacity Building and training
- Elaboration and implementation of the data dissemination model
- Dissemination of information to decision makers and local communities, product adaptation
- Transfer of EWS activities at national level
- Development of the Rural Development activities in selected countries, installation of processing tools at national level, networking activities
- Guidelines development

Operational Phase 4 years

- Operational implementation
- Capacity building for second step countries
- Transfer national – national
- Networking activities
- Sustainability analysis

9.6 Indicative budget

Exploratory Phase : 10 M

Pilot Phase : 15 M

Operational Phase : 30 M

This budget (mean 5.5 Mio/ year) is very indicative and limited.

- It corresponds to the development of Rural development information systems or Large scale mapping on 4 - 6 countries of SSA.
- 10 or 50 times this budget could be justify to reach only 0.1% of the investment ranges indicated by FAO (40 Bio Euros / year)

As an indication

- The EU spent almost 1% of the Common Agriculture Policy for the implementation and operating of Information and control systems using GIS and Remote sensing
- The cost of Large scale parcel identification system (EO data processing and GIS infrastructure) can be assessed at 100 – 200 000 Euros for 1000 Km² of territory.

10. RECOMMENDATIONS

The main recommendations are the following:

Input Data

- EWS needs real time data delivery, this should be secured in line with PUMA and AMESD initiatives. A network of field data collection has to be set up to feed the system on real time. A secure archiving system is necessary to allow long time series analysis and the back processing of historical data when necessary.
- To facilitate the processing and the dissemination of the data, standard data format must be adopted between the different institutions.
- A clear data policy should be defined to allow the easy exchange of data, particularly for the expensive VHR satellite data which should be acquired under multi-users conditions.
- To ensure the temporal continuity of Earth Observation indicators, inter-comparability between indicators and systems must be analyzed and guaranteed.

Value Added Product

- The processing should be based on existing software or techniques freely available. A precise analysis of the existing processing tools is a requirement.
- The comparison of processing methods should allow the definition of best practices and the selection of operational and efficient methods.
- The value added products should be independent from a specific EO sensor allowing the long term continuity of the product.

Implementation

- The EWS implementation is foreseen to cover the whole sub Saharan Africa , based on the Regional Centers, when Statistics and Rural or land tenure information systems have to be based at national level and will be limited to a few Countries.
- Current regional centers must be reinforced to support the national activities in terms of training, information flow, or technical backstopping. They will also constitute efficient platform for exchange the dissemination of experience between countries.
- Coordination, or at least dialogue, between regional centers is essential, involving technical exchanges and the sharing of experiences.
- Selection of the pilot countries is essential for the success of the rural development and land tenure activities. It will have to be carried out during the first phase, taking into account the political and legislative context of the countries, the mandate of the various institutions involved, ministries and National Geographic Institutes, Existing programs funded by Development Banks or UN organizations, synergies between private and public sectors.
- The continental level should not be forgotten. EW products developed at regional level should be transferred and synthesized at continental level (African Union, UNECA) to offer a continental vision and strategy in this area.
- In the implementation of the component, international UN actors, FAO, WFP, IFAD must be involved, to contribute to the overall sustainability and political integration of the component.
- In the technical implementation, international initiatives and their experiences, like USAID FEWS net, EU JRC Food Sec, ESA GMFS ... must be taken into account and benefit the component. During the implementation duplication of efforts must be avoided through an open dialogue with the existing projects, consolidation of activities should be the objective for a long term sustainability of the developments.

11. SUMMARY

Food Security and Agriculture are one of the key challenges for eradicating poverty and to ensure sustainable development in Africa and especially in Sub Saharan Africa. In this region, Agriculture account for more than 50% of the GDP and employ more than 60% of the population.

Sub Saharan Africa did not benefited much from « green revolution » and is still characterised by low use of inputs and low yields, high post harvest losses and weak market infrastructures.

Between 1980 and 2000 the share of ODA dedicated to agriculture dramatically dropped from 17% to less than 4%. And the adjustment phase imposed by IMF has resulted in a general degradation of the statistics and information system available on agriculture.

In 2007, WB acknowledge that Rural Development was indeed the most efficient way to support sustainable development and reduce poverty, as the majority of the poor leaves in rural areas. The recent soaring food prices crisis demonstrated that Food security was closely inter-related to Agriculture development, trough increased productivity, pro-poor development policies, investments and micro-credits, adequate market and regional policies.

The global consensus between UN organisations, Development banks, Donors (cf G8) or private organisation lead to massive investment in this sector, that FAO recently estimated it to 44 Bio US\$ per year. This development is also challenged by demographic growth and climate change as well as the recent “Land grabbing” issue.

This is a unique opportunity for the SSA countries to develop comprehensive Agricultural information systems (Early warning systems+ Agricultural statistics + Large scale mapping infrastructures on Rural areas + possibly Land tenure information system) that will be require to support rural development policies, provide information to farmers (including adaptation to CC) and market organisations and more generally contribute to a sustainable management of the natural resources.

12. BIBLOGRAPHY

13. ACRONYMS

AFRICARE : American-African NGO
AFRISTAT : Observatoire Economique et Statistique d'Afrique SubSaharienne
AGHRYMET : Regional Center of the CILSS in charge of FS and Natural Resources monitoring
AMESD : African Monitoring of the Environment for Sustainable Development, EU project
ASAR : Advanced Synthetic Aperture Radar satellite
ASTER : Advanced Space borne Thermal Emission and Reflection Radiometer satellite
CAADP : Comprehensive Africa Agriculture Development Program
CBERS : China – Brazil Earth Resources Satellite
CEDEAO : Communauté Economique des Etats de l'Afrique de l'Ouest
CEMAC : Communauté Economique et Monétaire de l'Afrique Centrale
CEN-SAD : Communauté des Etats Sahelo-Sahariens
CIDA – ACDI : Canadian International Development Agency
CILSS : Comité permanent Inter-Etats de Lutte contre la Sécheresse dans le Sahel
CMA/OC : Conférence des Ministres Africains de l'Agriculture de l'Ouest et du Centre
CNRA : Centre National de Recherche Agronomique
COMESA : Common Market for Eastern and Southern Africa
CORAF : Conseil Ouest et Centre Africain pour la Recherche et le Développement
CSAA : African Food Security Framework
CSE : Centre de Suivi Ecologique, Senegal
CSSA : Cadre Stratégique de Sécurité Alimentaire
DMC : Disaster Monitoring Constellation satellite
ECHO : European Commission Humanitarian Office
ECOWAP : Common Agricultural Policy of the Economic Community of the West Africa States
ESA : European Space Agency
EU : European Union
EUMETCAST : Broadcast System for Environmental Data of EUMETSAT
EUMETSAT : European Organization for the Exploitation of Meteorological Satellites
EWS : Early Warning System
FAO : Food and Agriculture Organization
FAO LCCS : FAO Land Cover Classification System
FARA : Forum for Agricultural Research in Africa
FEWS : USAID Famine Early Warning System
FS : Food Security
GDP : Gross Domestic Product
GIEWS : global Information and Early Warning System
GMFS : Global Monitoring for Food Security
GNP : Gross National Product
GPS : Global Positioning System
HWSD : Harmonized World Soil Database
IFAD : International Fund for Agricultural Development
IFPRI : International Food Policy Research Institute
IGAD : Intergovernmental Authority on Development in Eastern Africa
IIASA : International Institute for Applied Systems Analysis
IKONOS : Commercial Earth Observation Satellite
IMF : International Monetary Fund
IRD : Institut de Recherche pour le Développement, France
IRS : Indian Remote Sensing Satellite
ISRIC : World Soil Information, The Netherlands
JRC : Joint Research Center (EU)

LANDSAT : Land Observation Satellite (US)
MDG : Millennium Development Goal
MERIS : Medium Resolution Imaging Spectrometer Instrument
METOP : Meteorological Operational satellite
MODIS : Moderate Resolution Imaging Spectroradiometer (US)
MSG : Meteosat Second Generation satellite
NEPAD : Nouveau Partenariat pour le Developpement de l'Afrique
NGI : National Geographic Institutes
NGO : Non Governmental Organization
NOAA : National Oceanic and Atmospheric Administration (US)
OCHA : Office for the Coordination of Humanitarian Affairs (UN)
ODA : Official Development Assistance
OIG : Organisations Inter-Gouvernementales
OSS : Observatoire du Sahara et du Sahel
PNIA : National Programs of Agricultural Investment
PRIA : Regional Program of Agricultural Investment
PUMA : "Preparation for the Use of the Meteosat second generation satellite in Africa" project
QUICKBIRD : Commercial High Resolution Satellite
RADARSAT : Canadian SAR sensor satellite
RCMRD : Regional Center for Mapping of Resources for Development, Kenya
RD : Rural Development
REC : Regional Economic Communities
RECTAS : Regional Centre for Training in Aerospace Surveys, Nigeria
REOSAO : Reseau des Operateurs Economiques du Secteur Agro-Alimentaire (Afrique de l'Ouest)
ReSAKSS : Regional Strategic Analysis and Knowledge Support System
ROPPA : Reseau des Organisations Paysannes et des Producteurs Agricoles
SAP : Service d'Alerte Precoce
SDI : Spatial Data Infrastructure
SNU : Systeme des Nations-Unies
SPOT : Systeme Probatoire d'Observation de la Terre
SPOT-VGT : SPOT Vegetation sensor
UA : Union Africaine – African Union
UEMOA : Union Economique et Monetaire Ouest-Africaine
UN : United Nations
UNDP : United Nations Development Program
UNECA : United States Economic Commission for Africa
UNICEF : United Nations Children's Fund
USAID : United States Development Aid
USGS : United States Geological Survey
VHR : Very High Resolution
WB : World Bank
WFP : World Food Program
WMO : World Meteorological Organization

1. TITLE: INFRASTRUCTURE ET DEVELOPPEMENT DU TERRITOIRE.

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4. INTRODUCTION

Les infrastructures constituent l'ensemble des installations des équipements et des services nécessaires à assurer le développement (durable) du territoire à savoir un processus de progrès qui concilie la croissance économique, le respect de l'environnement l'équité sociale et la diversité culturelle en assurant la satisfaction des besoins des générations actuelles tout en préservant, voire en améliorant, les possibilités de satisfaire celles des générations futures.

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En matière d'infrastructures, l'Afrique présente un déficit important. Actuellement, les services d'infrastructures inefficaces, peu fiables et à coûts élevés sont reconnus comme étant les contraintes les plus graves à la compétitivité de l'Afrique. Ce retard est particulièrement marqué pour l'assainissement (où la couverture dans les pays sub-sahéliens est de 65 % contre 82 % dans les pays en développement dans leur ensemble), l'électricité (24 % contre 58 %) et l'accès rural aux routes (34 % contre 90 %) (*annexe 12.1*). Cela se traduit par un indice de développement humain très faible, on retrouve au niveau du continent que les pays les mieux dotés en infrastructure (en Afrique du Nord et en Afrique du Sud) présentent un meilleur IDH, que les pays les plus déficitaires en infrastructure et qui sont de plus enclavés et sans façade maritime (*annexe 12.2*).

Une croissance annuelle de 7 %, qui permettrait d'atteindre les OMD en matière de réduction de la pauvreté nécessiterait un investissement annuel de 22 milliards de dollars US dans les infrastructures en Afrique, dont 40 % dans les transports, 25 % à l'énergie, 20 % à l'eau et le reste aux télécommunications.

Contraintes : L'Afrique doit mener à bien la mise à niveau de ses infrastructures en affrontant 2 défis majeurs le manque de techniciens et une augmentation de la population africaine : coûts prohibitifs et manque de moyens.

Coûts prohibitifs : le coût des infrastructures est prohibitif en Afrique même par rapport aux autres pays à faible revenus (en moyenne l'énergie coûte jusqu'à quatre fois plus cher, l'eau jusqu'à dix fois et les TIC 5 à 10 fois plus cher).

Le manque de moyens scientifiques et techniques (matériels et humains) : L'Afrique doit gérer le développement de son territoire avec un déficit en personnel (elle compte 1 scientifique ou ingénieur pour 10 000 habitants, contre 2 à 5 pour l'Asie et 20 à 50 pour les pays industrialisés). De même seuls 20 % de la cartographie africaine serait fiable (d'après Africover)

Défis Le secteur des infrastructures et du développement du territoire doit relever plusieurs défis, à savoir : importance croissance démographique urbaine et réduction des délais de réalisation des projets

Une importante croissance démographique : la population africaine présente globalement une importante croissance démographique et particulièrement en milieu urbain (Figure 1).

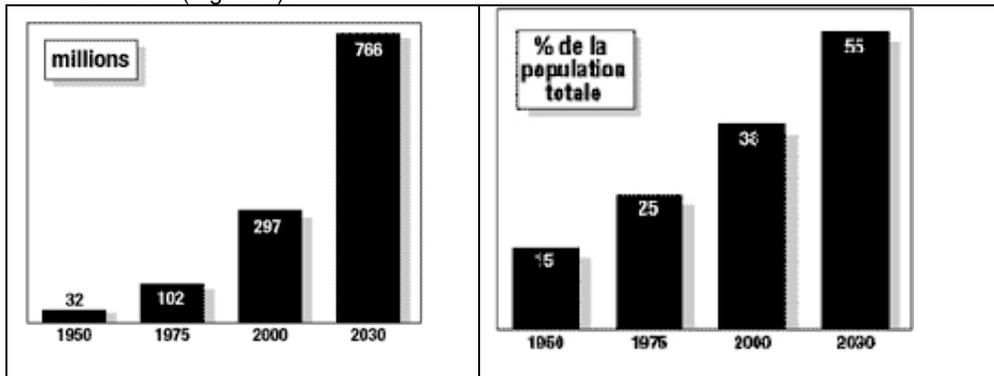


Figure 1. Urban population in Africa from 1950 and estimated to 2030 (UN Demographic division)

Une réduction des délais de réalisation : le processus de réalisation des projets d'investissement sont de l'ordre de dix ans (d'après NEPAD : Synthèse sur le continent Rapport 2004); il est impératif de disposer des moyens pour réduire ces délais (moyens d'aide à la décision et moyens techniques pour la réalisation)

Il est donc impératif à l'ensemble des intervenants (responsables politiques et économiques) de disposer des moyens nécessaires afin de programmer au mieux le développement des infrastructures et du territoire africain et ainsi réaliser les OMD (annexe 12.3). Cette tâche sera facilitée par les produits de GMES Afrique qui devraient participer à ces objectifs.

5. POLICY DRIVERS AND NEED ANALYSIS

There are a number of documents that have defined a strategy for improving infrastructures in Africa. Le document fondateur du NEPAD de 2001 a désigné les infrastructures comme domaine sectoriel prioritaire. Ainsi le NEPAD a élaboré un Plan d'Action à Court Terme et un Cadre Stratégique à Moyen Terme afin d'accélérer les progrès dans ce secteur. A Monterrey en mars 2002, les pays développés et en développement sont convenus que l'amélioration des infrastructures était fondamentale pour l'instauration d'une croissance économique soutenue. Ainsi en 2003 à Evian les pays du G8 préconisait de donner la priorité à l'alimentation en eau potable et à la promotion de la coopération à l'intérieur des bassins fluviaux. A Gleneagles en 2005, les pays du G8 se sont engagés à soutenir l'augmentation rapide de la production d'électricité et des interconnexions et à la suite de ce sommet le Consortium pour les Infrastructures en Afrique (ICA) a été créé en 2005 à la suite du sommet du G8 de Gleneagles. Son objectif est d'accélérer les progrès en matière de développement des infrastructures en Afrique, en soutien au développement économique. Il s'adresse aux besoins et contraintes d'infrastructures nationales et régionales, avec une emphase sur les infrastructures régionales.

Une des priorités émises dans le cadre du partenariat UE–UA est le développement et le renforcement des réseaux d'infrastructures et des services qui y sont liés. Cela est nécessaire pour la circulation des personnes, des marchandises, de l'information et pour l'intégration commerciale, ce qui est indispensable pour accroître les flux commerciaux aussi bien Sud-Sud que Sud – Nord.

En particulier dans le cadre du Partenariat UE- Afrique pour les infrastructures adopté en 2006, les deux parties se sont engagées à faire progresser la promotion de l'interconnexion des infrastructures africaines à tous les niveaux, ce qui va dans le sens des priorités de l'UA/NEPAD. Pour atteindre ces objectifs, les deux parties disposent entre autres de deux instruments : le Fonds fiduciaire UE-Afrique lancé en 2007 et géré par la BEI et d'autre part le Fonds panafricain de développement des infrastructures (dont la BAD est un des principaux actionnaires). Ce partenariat définit la stratégie qui permettra d'assurer l'interconnexion à travers le continent et entre ses différentes régions afin de résoudre le problème de la fourniture de services d'infrastructures, et définit les priorités stratégiques suivantes :

- Secteur du transport : amélioration des infrastructures le long des corridors de transport (routier, ferroviaire, voire même fluvial, ainsi que l'amélioration des services portuaires aériens et maritimes).
- Secteur de l'eau et de l'assainissement : intensification des efforts pour sécuriser l'approvisionnement en eau potable de façon saine, durable et économique.
- Secteur de l'énergie : garantie et sécurisation de l'approvisionnement en énergie en diversifiant les sources (énergies renouvelables) et même nucléaire dans le cadre de l'AIEA.
- Secteur des NTICs : réduction de la fracture numérique surtout en harmonisant les cadres politique, technique et réglementaire.

A part ces secteurs retenus par les décideurs il est nécessaire de prévoir des programmes portant :

- Sur les zones situées en amont de ces axes structurants (par un exemple un corridor de transport sera peu efficace si les biens et les personnes situés en amont de part et d'autre éprouvent des difficultés pour y parvenir), c'est à dire dépasser les indicateurs macro-économiques pour des indicateurs infranationaux ou locaux
- L'extension urbaine et ses besoins en aménagement doivent faire partie des domaines prioritaires.

L'objectif final étant d'optimiser la réalisation des infrastructures afin de permettre à l'Afrique d'atteindre les OMD et d'améliorer sa compétitivité et par conséquence les indicateurs socio-économiques.

6. IDENTIFICATION OF COMMUNITIES

Afin d'appréhender l'ensemble des utilisateurs pouvant avoir besoins des produits de GMES, nous pouvons nous basés sur le processus de décision et de réalisation des projets d'aménagement, axé principalement autour de l'Union Africaine, que l'on peut schématiser in three groups of users : International organizations, regional bodies, and national and local authorities. A summary is available in Appendix 12.4.

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International organisations and donors

Les Agences des Nations Unies et la Banque Mondiale sont fortement impliquées en Afrique. Un certain nombre des Agences se penchent sur le développement des infrastructures et la planification territoriale. Par exemple, la Banque Mondiale finance la construction de grandes infrastructures comme les programmes hydroélectriques, des réseaux de transport ainsi que la reconstruction après des catastrophes. La plupart des agences de l'ONU sont actives dans l'une ou l'autre partie de l'Afrique. Ceux qui sont les plus liées à la planification territoriale sont ONU-Habitat, PNUD, UNESCO, UNICEF, FAO, FMI qui visent une amélioration des indicateurs socio-économiques de la population urbaine.

L'Union Européenne par la Commission Européenne et ses États membres, supervise les départements de développement qui sont intéressés à être informés sur les mesures qui montrent les progrès réalisés en Afrique par le biais soit d'actions de développement soit d'aide humanitaire. Un certain nombre de grands projets d'infrastructure sont financés par la Commission européenne et les États membres de l'UE.

Les pays donateurs qui investissent massivement en Afrique comprennent aussi les Etats-Unis, la Chine, les pays arabes, ainsi que dans une moindre mesure l'Inde, la Turquie, la Corée du Sud qui interviennent avec des fonds et la mise en œuvre des projets d'infrastructure (par exemple en agriculture) au moyen d'accords bilatéraux avec les pays africains. Notons que dans ce cas ce sont plutôt les acteurs économiques de ces pays qui sont concernés.

Les ONG interviennent aussi dans les cas extrêmes et dans les zones à faible indicateurs socio-économiques afin d'essayer d'améliorer la situation .

Continental level

On serait tenté d'affirmer que tous les Africains ont besoin des produits de GMES Afrique, toutefois il nous faut cerner les utilisateurs directs des produits GMES Afrique à savoir les planificateurs, les techniciens et les chercheurs. Afin de mieux les identifier il convient d'analyser le processus général de développement des infrastructures au niveau national et au niveau régional et africain et il apparait que le secteur des infrastructures en Afrique présente un aspect plus technique et socio-économique que scientifique.

Vu l'important retard qu'accuse l'Afrique, le développement du territoire ne pourra être réalisé que grâce aux partenariats avec les communautés plus riches et plus développés possédant les moyens matériels, scientifiques et techniques. Ainsi le partenariat Europe/ Afrique avec comme programme, entre autres, le projet GMES Afrique, peut largement contribuer au développement du continent et cela en prenant en compte aussi bien le développement matériel que le développement scientifique et technique, et en assurant la possibilité d'actions sur le long terme.

Au niveau du continent les institutions directement utilisatrice du programme GMES Afrique sont celles directement impliqués dans l'aménagement du territoire :

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- LA CONFÉRENCE DE L'UNION

- LA COMMISSION DE L'UNION AFRICAINE
- LE SECRÉTARIAT DU NEPAD
- LA COMMISSION ECONOMIQUE POUR L'AFRIQUE
- LA BANQUE AFRICAINE DE DÉVELOPPEMENT
- LES INSTITUTIONS SPÉCIALISÉES

Au niveau régional ce sont les CERs qui assure la coordination entre les états membres, les organismes spécialisés, les états membres avec l'Union Africaine.

Au niveau national

Le secteur des infrastructures et du développement du territoire est généralement divisé en : un **niveau stratégique** et un **niveau technique**.

Le niveau stratégique national a pour objet l'élaboration à moyen et long termes des schémas de développement du territoire compte tenu: (a) des potentialités et des contraintes du pays, (b) des engagements du pays, vis à vis des organisations régionales (CERs) auxquelles il est rattaché (c) -des principaux indicateurs d'évolution du pays (caractéristiques de développement humain, économiques...). La structure responsable de ces orientations est en fait une structure supra ministérielle, qui travaille en relation avec des responsables de tous les ministères. Cette structure « l'Institut des Etudes Stratégiques » établit les orientations et les perspectives de développement à long terme (plusieurs décennies).

Le niveau stratégique sectoriel - Une fois les orientations et les perspectives stratégiques nationales retenues, elles se déclineront en schémas directeurs sectorielles de développement (schéma directeur d'alimentation en eau potable, schéma directeur de transport...).

Les schémas directeurs régionaux d'engagement à long terme - Ces schémas traduisent les stratégies sectorielles adaptées à chaque région administrative.

Les plans de développement pluriannuels - La concrétisation des orientations et des schémas directeurs de développement pluriannuel (en général quinquennaux) dans lesquels toutes les actions à entreprendre sont listées et budgétisées. Ces plans de développement pluriannuels sont réalisés en concertation avec tous les Ministères.

La gestion au **niveau technique** des actions d'infrastructure de développement du territoire à entreprendre dans le cadre des plans de développement sont généralement de la responsabilité de 3 institutions ministérielles :

- le ministère chargé des travaux publics qui assure le développement des infrastructures et du développement du territoire en milieu urbain.
- le ministère chargé de l'agriculture qui assure le développement du territoire en milieu rural
- le ministère chargé de l'énergie, des ressources minières et de l'industrie en ce qui concerne le développement des ressources non agricoles du pays.

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Ainsi, le suivi et la réalisation de ces actions nécessitent la conception de plan d'aménagement (plan d'aménagement urbain, plan d'aménagement de zone agricoles, plan d'aménagement de bassins miniers ...) qui peuvent s'appuyer facilement sur les produits GMES Afrique.

Au niveau local

La croissance remarquable de la population africaine associée à l'urbanisation rapide génère le processus d'urbanisation le plus spectaculaire dans le monde. L'urbanisation est particulièrement forte dans les centres économiques qui coïncident généralement avec les capitales. La gestion de l'étalement est identifiée comme étant l'un des défis majeurs pour les communes urbaines.

GMES peut générer des services qui incluent l'imagerie satellitaire haute résolution et des informations sur la nature et la densité du parc immobilier (et donc la population), la voirie et les infrastructures, les espaces verts, et fournir des outils efficaces d'information pour gérer les villes. Ainsi chaque ville pourra gérer son développement de la façon la plus appropriée que ce soit au niveau des infrastructures qu'au niveau des activités socio-économiques, c'est là l'un des grands défis qui répondent directement aux OMD. C'est dans les zones urbaines que la pauvreté est en forte croissance particulièrement en Afrique. Les services essentiels à mettre en œuvre sont l'alimentation en eau potable, l'assainissement, l'énergie et les transports et les réseaux de télécommunication. Et ce sont donc les services techniques des municipalités qui ont besoin des services GMES Afrique pour mener à bien leurs missions.

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On s'aperçoit donc qu'il serait judicieux aux décideurs et aux aménageurs de disposer d'un support cartographique et comptable (logiciel paramétrable) permettant de simuler aussi objectivement que possible les différents scénarii de développement (durable) des infrastructures et des différents aménagements du territoire. Ainsi GMES Afrique peut contribuer à fournir ces éléments.

Ainsi les utilisateurs potentiels au niveau national et local seraient :

- Les bureaux d'études privés ou publics
- Les centres de recherche relevant soit du milieu universitaire ou du domaine public
- Les collectivités territoriales
- Les organismes chargés de l'équipement du territoire (sociétés chargés de l'eau, de l'électricité, des télécommunications, de l'assainissement,...)
- Les ministères en charge directement de l'aménagement du territoire : travaux publics, agriculture, énergie, environnement

7. MAPPING EXERCISE:

Table 1 lists current infrastructure projects. The planning of this type of projects requires geo-spatial information. Updated geo-spatial information on the state of the infrastructure and the implementation are the data used to derive indicators. This geo-spatial information can be provided in part also by GMES Africa.

Tableau 1 : Répertoire des projets structurants existants (annexe 12.5):

Energie	UMA/COMELEC : EAC/East Africa Power Pool (EAPP) : ECOWAS/West Africa Power Pool (WAPP) : ECCAS/Central Africa Power Pool (CAPP) : SADC/COMESA/Southern Africa Power Pool (SAPP) :
Eau	Projets de bassins fluviaux transfrontaliers : Sénégal, Niger, Volta, Tchad, Nil, Congo, Zambéze, Orange , Senqu
TIC	Projets de liaison : EASY : Câble sous-marin le long de la côte est pour fermer la boucle autour de l'Afrique COMTEL consortium regroupant 21 pays (COMESA) CENTRAL AFRICAN RING réseau d'infrastructure qui relie : Kenya, Malawi, Ouganda,

	Tanzanie et Bukoba à l'est de la RDC COM-7 relie 7 pays à l'est et au sud de l'Afrique WEST-EAST-WEST LINKAGES E2-E3-E4-E5:L'axe principale trans- Sahel reliant le Burkina Faso, le Niger, le Tchad, le Soudan et l'Ouganda pouvant créer une boucle avec le CENTRAL AFRICAN RING
Transport	Projets de corridors Le corridor Dakar – N'Djamena, le corridor Nouackchott – Lagos, Le corridor Khartoum – Djibouti, Le corridor Lagos Monbassa, Le corridor Le Caire-Gaborone, Le corridor N'Djamena – Windhoek, Le corridor Beira-Lobito, Le corridor Dar-Es Salam – Kigali (Le corridor Le Caire- Agadir et les différents couloirs de l'Afrique du Sud avec ses voisins (ex. Johannesburg-Maputo)

Table 2: Institutions that can constitute building blocks for GMES Africa

Zone	Institution	Pays
Afrique du Nord	le Centre pour l'Environnement et le Développement de la région Arabe et de l'Europe (CEDARE)	Algérie, Égypte, Libye, Maroc, Tunisie
Afrique australe	Unité Régionale de Télédétection (RRSU) de la SADC	Angola, Botswana, Lesotho, Madagascar, Malawi, Mozambique, Namibie, Afrique du Sud, Swaziland, Zambie, Zimbabwe
Afrique de l'Est	Centre Régional de cartographie des ressources pour le développement (RCMRD)	Burundi, Érythrée, Éthiopie, Kenya, Ruanda, Somalie, Soudan, Tanzanie, Ouganda
Afrique centrale	Association pour le Développement de l'Information Environnementale (ADIE)	Cameroun, République Centrafricaine, République Démocratique du Congo, Guinée Équatoriale, Gabon, République du Congo, Sao Tomé & Principe
Afrique de l'Ouest	Centre Régional de formation aux techniques des levés aériens (RECTAS)	Bénin, Ghana, Libéria, Nigeria, Sénégal, Sierra Léone, Togo
Afrique de l'Ouest	Centre Régional AGRHYMET	Burkina Faso, République du Cap-Vert, Tchad, Côte d'Ivoire, Gambie, Guinée, Bissau, Niger, Mali, Mauritanie

L' Organisation Africaine de Cartographie et de Télédétection, sous la tutelle de l'UA et de la commission économique des Nations Unies compte 24 pays membres avec 3 centre spécialisés le [RECTAS](#) à Ile-Ife (Nigeria), le [RCMRD](#) à Nairobi (Kenya) et le [CRTEAN](#) à Tunis (Tunisie).

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8. IDENTIFICATION OF GAPS AND OF EXISTING OR PLANNED FUNDING PROGRAMMES

Le projet GMES Afrique permettra de fournir aux décideurs un outil d'aide à la décision afin de gérer au mieux l'aménagement de l'espace dans le cadre du développement (durable) de l'espace urbain et des infrastructures.

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8.1 GAPS

L'ensemble des réflexions est en général mené à l'échelle régionale (supranationale). Il faut que l'ensemble des projets s'appuie sur des indicateurs infrarégionaux afin d'optimiser les projets en faisant émerger des pôles, des axes, rendant visible des effets frontières, mettant en évidence des phénomènes de proximité, de diffusion ou d'influence autour des pôles.

Et mettant ainsi en évidence les zones déprimées ou au contraire prospère, permettant de mettre en évidence les interactions et les dynamiques. Ainsi les réflexions pourront porter sur

- des indicateurs démographiques et de peuplement : croissance de la population, taux d'actifs potentiels, répartition de la population, densités et dynamiques
- Indicateurs d'urbanisation et de polarité urbaine : différenciation population rurale et urbaine (taille des villes, typologie de polarité urbaine), ces données sont importantes pour travailler sur les infrastructures de transport.

D'autre part outre les secteurs prioritaires retenus par les décideurs (Eau, Energie, Transport, TICs), des programmes doivent être entrepris pour la gestion de l'urbanisation et du développement des villes.

Il apparait clairement que la réalisation des objectifs de développement peut provenir des informations et des services de GMES Afrique, à savoir :

- L'observation objective, pertinente et permanente des milieux à étudier (observation)
- La fabrication de l'information environnementale nécessaire (simulation)
- La fourniture d'aide à la décision

Au niveau pratique, il est nécessaire que tous les programmes de cartographie ou d'imagerie satellitaire, prévoit la mise à disposition de ces produits à l'ensemble de la communauté technique de chaque pays (institution étatique ou privée).

8.2 EXISTING OR PLANNED THEMATIC FUNDING PROGRAMS

Ci-après nous reprenons les principaux programmes d'envergure en relation directe avec les perspectives de GMES Afrique. Il existe aussi des projets de moindre envergure pouvant intervenir dans le contexte de GMES Afrique comme ADDISAAF (Assimilation de Données et Images satellites pour l'Afrique), ou AFRISAT pour une éventuelle compilation des données statistiques et l'alimentation des diverses couches d'information du programme GMES Afrique. De même le projet Africover a établi un état de la géodésie en Afrique (annexe 12.6)

Table 3: Programmes that can be pre-cursors of future GMES Africa services

Programme	Organisme de tutelle	Membre	Objectifs
Africover	FAO	Ensemble du continent	rassembler - selon des normes communes - des informations géographiques de base fournissant des données pour les programmes futurs sur

			les ressources naturelles
Référentiel géodésique africain AFREF		Ensemble du continent	Création d'un système de référence unique et transfert de technologie
AICD (Africa Infrastructure Country Diagnostic)	Banque Mondiale	24 pays (afrique sub saharienne)	Données statistiques sur les infrastructures
MLTSF Medium to Long Term Strategic Framework	Banque africaine du développement pour le compte du NEPAD	24 pays d'Afrique subsaharienne	fournir un cadre stratégique pour le développement du secteur des infrastructures en Afrique, sur la base d'objectifs stratégiques cohérents,

9. BUILDING GMES –AFRICA SERVICE

L'importance de la tâche nécessaire à la réussite du projet GMES Afrique et de façon générale du partenariat UE-UA demande une coopération continue sur le long terme. Ainsi, en relation directe avec le programme GMES et le secteur des infrastructures et du développement du territoire, il serait judicieux de créer des agences euro-africaines de soutien au projet GMES Afrique: création d'une (1) agence euro-africaine de géomatique, d'une (2) agence euro-africaine de normalisation pour le développement du territoire et d'un (3) observatoire du territoire.

9.1 SERVICE DEFINITION AND PROVISION

Le tableau présenté en annexe (12.7) reprend de façon synthétique les différentes composantes, les objectifs recherchés ainsi que les horizons temporels de réalisations, des institutions préconisées dans le cadre de GMES Afrique.

La priorité est donnée à la réalisation d'un « géo portail » performant ainsi qu'à la formation surtout pour l'assimilation des données à partir d'images satellitaires.

Agence euro-africaine de géomatique qui devra être centralisée et disposant de compétences des deux continents aura pour tâches essentielles, (en coordination avec les institutions nationales concernées : centres de géomatique, de télédétection ou de cartographie, institut de géographie,...ainsi que les organismes régionaux : AFREF,...) :

- Audit sur les compétences de chaque pays (infrastructure et utilisation des données reliées aux images satellitaires).
- Création et gestion d'un « géoportail » GMES Afrique
- Standardisation des informations géographiques sous un référentiel universel
- Création et gestion des centres et des réseaux de collaborateurs GMES Afrique
- Formation de cadres et techniciens
- Aide à l'élaboration sur le long terme des cadastres fonciers nationaux

Cela pourrait se réaliser en coordination avec le projet AFRICOVER de la FAO.

Agence euro-africaine de normalisation pour le développement du territoire Cette agence n'est pas vraiment hors du domaine du GMES, car elle se basera sur les données fournies par les images satellitaires et les bases de données afférentes pour régionaliser les normes sachant que le territoire africain possède des zones désertiques avec des problèmes d'ensablement, des zones tropicales avec des problèmes de pluviométrie et d'inondation, des zones montagneuses et des zones littorales et insulaires soumises aux conséquences du changement climatiques.

De même comme l'Afrique est soumise à un important développement urbain, il est nécessaire de mettre en place d'une grille d'aménagement assurant à terme le bien être de la population c'est-à-dire élaborer des codes d'aménagement (urbain, rural, industriel, et des guides de conception (voirie, transport d'énergie, télécommunication,...).

Observatoire africain de l'environnement et du développement du territoire. Cet organisme placé sous l'Autorité de la Commission Africaine sera chargé de mettre en place un dispositif permanent de collecte, de production, d'analyse de gestion et de diffusion sur l'état de l'environnement (durable) et ce afin d'aider les planificateurs à prendre les décisions tenant compte des impératifs de la protection de l'environnement et de ceux du développement. Cet organisme aura pour mission de : Standardiser les indicateurs sur l'environnement et le développement, Produire des statistiques notamment sur les indicateurs de développement durable.

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9.2 CAPACITY BUILDING

Afin de mener à bien ces objectifs, il faut que le programme GMES Afrique s'articule autour de 2 principaux axes : la formation scientifique et technique, et la fourniture de moyens et de produits fiables :

Formation technique et scientifique : il faut une formation permanente du personnel scientifique et technique pour « l'assimilation des données », en l'occurrence les données directement liées aux images satellitaires : pour d'une part la manipulation et l'utilisation des images satellitaires avec les différentes couches d'information, et d'autre part pouvoir alimenter les bases de données des différentes couches.

Fourniture de moyens et de produits fiables : il faut que toutes les parties du développement du continent africain puissent disposer de données et de méthodes d'études fiables présentant une homogénéité pour faciliter l'intégration régionale et le transfert de compétences.

9.3 PRIORITISATION OF REQUIREMENT AND ACTIONS

Priority should be given to establish the agencies. In the beginning, the agencies should be made from existing network of existing national or regional research centres working under a common program and the goals set by the Agencies. It would thus be distributed operational centres rather than a centralized facility Africa. The centres would be linked by the fast developing internet infrastructure currently being established. Gradually the centres could equip themselves with new physical infrastructure as well as informatics infrastructure. Eventually the agencies may be centralized. The existing projects should be mapped to the agencies. These projects should then be absorbed by the agencies within the lifetime of these projects.

9.4 ORGANISATIONAL SCHEME

The organization should be very simple. Agencies should be seen first as a network of existing geomatic centres that work toward a common goal. Expert staff from each center should be grouped in thematic committee that draft the work plan of the agency. The plan implementation would be managed by a secretariat and supervised by director and a steering committee. The steering committee would also be composed of scientific staff nominated and funded by donor institutions. The plan should be backed by proper financial instruments and implemented in the different centres based on their expertise. Gradually, these centres could become reference laboratories for specific domains. In a second phase some type of centralization could envisioned. The priority issues should be as follows:

All the current projects should be mapped and organized and absorbed by each agencies competence. The issues to be addressed are depicted in Appendix A and summarised below.

The Geomatics plan should address the development of a geo-portal that provides a one-stop shop for spatial datasets over Africa. The information layers should be made available under a common African geographical reference system. A training plan should be drafted that envisions short term and long term training goals. Special emphasis should be devoted to train technicians and technical managers for managing cadastre information.

The agencies for normalization of infrastructure and sustainable development should prioritize the establishment of management codes related to urban, rural, industrial issues, and draft guidelines for management of transport of goods, people, energy and telecommunication. The agency for environment and territorial development should define environmental indicators, establish the network of GMES cooperation institutions and work towards the development and monitoring of indicators.

9.5. TIMETABLE

The development of the agencies should follow a fast track and a long term plan. The fast track to be implemented within 6 years should establish the service and the long term should reinforce and make the services permanent.

The Fast track service for the Euro-African Geomatic Agencies should foresee the following: Creation for a geo-portal for Africa, Standardization of geographical information based on a universal reference system, creation of network of GMES Africa co-operation, train professional and technicians and help to develop cadastre systems.

The fast track for the Euro-African territorial development should foresee:

Effectuer un audit pour estimer les capacités, les compétences de chaque pays africain (et donc les besoins) dans le domaine des infrastructures et de la manipulation des données cartographiques (de toutes origines images satellitaires, données Radar, levés topographiques, ...)

Elaborer un programme de formation technique et scientifique assurée soit des capacités africaines lorsqu'elles existent, soit en Europe ; de façon qu'à court terme toutes les CERs puissent disposer d'équipes qualifiées pour assurer la formation à des équipes qui à leur tour pourront « vulgariser » les techniques et les méthodes au niveau national et local.

Viser à une homogénéisation des méthodes et des pratiques techniques pour faciliter la diffusion des données, le transfert de compétences et l'intégration régionale.

L'apport de la partie européenne sera essentiel non seulement au niveau technique et scientifique, mais aussi au niveau pratique avec l'expérience acquise dans le cadre de l'intégration européenne surtout pour les nouveaux pays adhérant à l'UE.

9.6. INDICATIVE DEVELOPMENT PLAN AND BUDGET ESTIMATE

Each agency should receive 5 million Euros for the first 3 years. The initial funding should be used to identify a common set of centres that would agree to work together and draft a vision and a working plan. The plan should include the priority areas and short term, medium term and long term goals. The plan should include a quantitative assessment on how GMES product and services can contribute to achieve these goals. It should also identify the funding, that should be mix between donor and direct investment of the centres funded through national programs. The review of the first three years should be used to revise objectives and priorities and provide a new plan that may foresee the centralization of the agencies.

10. RECOMMENDATIONS

Les initiatives préconisées dans ce document visent à tirer le meilleur parti des produits que peut offrir GMES Afrique. Ces actions visent à promouvoir l'interconnexion des services et des infrastructures à tous les niveaux (intégration africaine et partenariat Europe-Afrique).

Les produits que peut offrir GMES Afrique, en particulier les informations finales sous forme de cartes, fichiers de données, rapports, alertes ciblées, provenant des données de surveillance de la Terre recueillies dans l'espace (satellites), l'atmosphère (instruments aéroportés, ballons stratosphériques, etc.), l'eau (flotteurs, instruments embarqués sur des navires, etc.) ou sur terre (stations de mesure, sismographes, etc.) permettront d'optimiser les programmes de développement des infrastructures, en optimisant leur implantation géographique, en améliorant leur conception et en garantissant leur viabilité et leur pérennité.

Ainsi, l'utilisation judicieuse des produits GMES Afrique pour une programmation efficace des projets de développement des infrastructures et du territoire permettra d'initier un cercle vertueux pouvant conduire l'Afrique à atteindre ses OMD. Ainsi GMES Afrique sera régi au point de vue institutionnel par le partenariat UA/UE avec une coordination technique avec GMES. Les institutions qui seront créées dans le cadre de GMES Afrique auront la responsabilité de gérer des directions sectorielles (transport, énergie, ...) ou régionales, suivant le cas, qui à leur tour auront en charge les unités locales (nationales) lorsqu'elles existent.

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L'activité de GMES Afrique sera gérée sous la forme Programme-Bilan avec pour objectif un compte rendu lors des sommets Afrique/UE. Le bilan des activités pouvant suivre le thème ou le secteur abordé être réalisé soit semestriellement ou annuellement, de même les différentes institutions sont encouragées pour la constitution des « Communautés de Travail Scientifiques et Techniques » sur des thèmes précis avec des partenaires extérieurs afin de partager les expériences.

11. SUMMARY

Le projet GMES Afrique est une opportunité pour l'Afrique d'accéder à des technologies modernes et efficaces pour essayer d'atteindre ses Objectifs du Millénaire pour le Développement (OMD), en particulier dans le secteur des infrastructures et du développement (durable) du territoire. Actuellement, pour le secteur des infrastructures et du développement du territoire, le constat est le suivant :

La quasi-totalité des projets structurant et d'intégration régionale sont inachevés

- L'Afrique présente un déficit important en techniciens, ingénieurs et scientifiques
- De façon globale les indicateurs d'infrastructure sont très faibles (réseau routier peu efficace, déficit en réseau d'eau potable, d'assainissement, d'énergie,...)
- D'autre part l'Afrique présente un déficit d'entretien des infrastructures existantes (pour manque de fonds) et un fort taux de croissance de l'urbanisation qui en général se développe de façon peu structurée, ce qui risque de freiner les possibilités d'atteindre les OMD
- La conclusion de ce constat est que le manque d'infrastructure est un frein considérable au développement du continent et à l'amélioration des conditions de vie de la population.

En analysant les procédures d'organisation des projets de développement du territoire aussi bien au niveau des états qu'à l'échelle du continent, on peut dire que l'ensemble de la société africaine est demandeuse du programme GMES Afrique et des produits qu'il pourrait offrir, à savoir : des supports cartographiques, des procédures de prévision et de simulation, des données diverses concernant l'état de l'environnement.

Afin d'optimiser le projet GMES Afrique, il est nécessaire que ce programme intègre les principales actions suivantes :

- Une disponibilité des données à tous les acteurs du développement du territoire
- Une action de formation
- Une action de normalisation et d'harmonisation des caractéristiques des aménagements
- Une action de suivi environnemental afin de garantir le caractère « durable » des projets

Pour cela GMES Afrique pour le secteur des infrastructures et du développement du territoire, pourrait s'articuler autour de 3 institutions :

Agence Euro-Africaine de Géomatique, dont les principales actions seraient: création et gestion d'un « géoportail » GMES Afrique, standardisation des informations géographiques sous un référentiel universel, création et gestion des centres et des réseaux de collaborateurs GMES Afrique, formation de cadres et techniciens et aide à l'élaboration sur le long terme des cadastres fonciers nationaux.

Agence Euro-Africaine de Normalisation pour les Infrastructures et le Développement du Territoire, dont les principales actions seraient: élaboration et diffusion des grilles et des codes d'aménagement: urbain, rural, industriel, littoral et insulaire et des guides de conception des aménagements de transport des biens et des personnes, de l'énergie et des télécommunications, normalisation régulièrement une liste précise d'aménagements et promotion des recommandations (HQE).

Observatoire africain de l'environnement et du développement du territoire dont les principales actions seraient : standardisation des indicateurs environnementaux, création et gestion des centres et des réseaux de collaborateurs GMES Afrique, publications des études sur l'évolution des indicateurs et vérification de la compatibilité des aménagements avec les conventions internationales de protection de l'environnement

L'activité de GMES Afrique sera gérée sous la forme Programme-Bilan avec pour objectif un compte rendu lors des sommets Afrique/UE. Le bilan des activités pouvant suivant le thème ou le secteur abordé être réalisé soit semestriellement ou annuellement, de même les différentes institutions sont encouragées des « Communautés de Travail Scientifiques et Techniques » sur des thèmes précis avec des partenaires extérieurs afin de partager les expériences.

ANNEXES :

Annexe 12.1 Données illustratives sur les infrastructures en Afrique : déficit et coût prohibitif

Annexe 12.2 Indice de développement humain en Afrique

Annexe 12.3 Les huit objectifs du Millénaire pour le développement

Annexe 12.4 Schématisation du processus de décision et de réalisation des projets d'aménagement

Annexe 12.5 Répertoire des projets structurants existants

Annexe 12.6 Résumé de l'état de la géodésie et de la cartographie

Annexe 12.7 Programme de réalisation : actions et priorités

1. CONFLITS ET CRISES POLITIQUES

2. EXPERTS

3. INSTITUTIONS

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4. INTRODUCTION

4.1. Etat des lieux

Plusieurs pays africains ont connu dans les années 90 des conflits violents et des crises politiques qui ont causé des destructions et des pertes considérables sur le plan humain, matériel et des infrastructures socioéconomiques. Les conséquences se font encore sentir au niveau de ces pays mais aussi des régions entières comme l'Afrique centrale (guerres civiles en RD Congo, au Burundi, Congo Brazzaville, génocide au Rwanda, etc.) ou en Afrique de l'Ouest (guerres civiles au Libéria, Sierra Leone, Cote d'Ivoire). Elles rendent plus difficiles les efforts de réduction de la pauvreté et de promotion du développement durable dans un contexte où les ressources de la coopération internationale sont rares. Il en résulte un consensus relativement important sur l'existence de liens étroits entre le développement durable, la réduction de la pauvreté et la gestion des conflits et des crises. Contrairement à une conception dominante avant les années 90, les questions de développement et de la sécurité sont aujourd'hui considérées comme intimement liées, à la fois aux niveaux national, régional et continental.

Dans ce contexte, la prévention des conflits et l'identification des approches efficaces de gestion des crises politiques et de leurs conséquences sont devenues des priorités pour tous les acteurs du développement. Dans la pratique toutefois, peu d'avancées en termes d'approches méthodologiques et opérationnelles ont été enregistrées à cause de la complexité de la problématique. Les causes des conflits et des crises politiques sont multiples et s'insèrent dans l'histoire spécifique de chaque pays. Elles relèvent non seulement des déséquilibres hérités de la colonisation tel que le tracé des frontières, mais aussi de la mauvaise gestion de l'Etat et des ressources naturelles, de l'instrumentalisation des appartenances ethniques à des fins politiques, de la faiblesse des institutions publiques, des inégalités croissantes et de la corruption.

La recherche d'approches novatrices pour la prévention et la gestion des conflits ne peut pas ignorer le développement des nouvelles technologies qui ont fait leurs preuves en matière de collecte et de traitement des informations. La mise en place d'un plan d'action permettant de tirer profit des acquis et du développement des technologies spatiales, dans la prévention, la gestion et la résolution des conflits et des crises politiques en Afrique est dès lors opportune.

4.2. Les contraintes

La découverte des ressources naturelles dans les zones transfrontalières augmente de plus en plus les tensions entre les pays et exige ainsi une définition claire des frontières. La croissance démographique et le développement des migrations économique et politique attisent aussi les conflits pour le contrôle des zones frontalières. Le déplacement des populations dans les pays voisins en cas de conflits constitue également

un obstacle à plusieurs égards : difficultés d'accès à ces populations pour les organisations humanitaires ; une concurrence entre les réfugiés et les populations du pays d'accueil dans le contrôle des ressources (eau, bois, terres cultivables, etc.). Les interventions des pouvoirs publics et des organisations humanitaires ainsi que la collecte d'information en situation de crise sont souvent limitées par un manque d'infrastructures adéquates.

La complexité des questions des conflits et la volatilité de leur évolution exigent d'inscrire tout programme de soutien aux interventions dans un cadre large et susceptible de s'adapter aux multiples situations qui surviennent dans différents pays.

La multiplicité des conflits armés et des violences politiques sur le continent mettent à l'épreuve les capacités d'intervention de l'Union africaine (UA), des organisations régionales et leurs partenaires. Le manque d'information récente et fiable sur les zones d'intervention, notamment en matière de cartographie, est un défi récurrent.

5. LE CADRE STRATÉGIQUE ET ANALYSE DES BESOINS

Pour faire face aux conséquences néfastes des conflits et des crises politiques des années 90 en Afrique, plusieurs initiatives ont été prises aux niveaux panafricain, régional et national. Certaines d'entre elles sont déjà en place et d'autres sont en cours d'opérationnalisation. Les Etats africains et leurs partenaires internationaux sont engagés dans la mise en place d'une architecture panafricaine qui assure le leadership des initiatives nationales et régionales pour plus d'efficacité et cela dans une perspective de subsidiarité.

5.1. Les principaux acteurs

L'Acte constitutif de l'UA énumère 24 objectifs dont promouvoir la paix, la sécurité et la stabilité sur le continent. Il précise les principes qui guident le fonctionnement de l'UA dont notamment: le respect des frontières existant au moment de l'indépendance, la mise en place d'une politique commune de défense, le droit de l'Union d'intervenir dans un Etat membre dans certaines circonstances graves (crimes de guerre, génocide, crimes contre l'humanité), le droit des Etats membres de solliciter l'intervention de l'Union pour restaurer la paix et la sécurité.

L'UA a le mandat de promouvoir l'intégration politique continentale avec des compétences supranationales en matière de paix, de sécurité et des affaires politiques. L'architecture africaine de paix et de sécurité constitue aujourd'hui le cadre stratégique en matière de prévention, de gestion et de résolution des conflits et des crises politiques. Elle a été mise en place dans le cadre de la redynamisation des institutions panafricaines, notamment lors de l'adoption de l'Acte constitutif de l'UA.

Elle est dotée d'organes et de mécanismes chargés de gérer ces compétences en partenariat avec les Etats membres et les communautés économiques régionales.

Au niveau continental, le Conseil de paix et de sécurité (CPS) de l'UA est l'organe de décision permanent pour la prévention, la gestion et la résolution des conflits. Son protocole, adopté à Durban le 9 juillet 2002 par la Conférence des Chefs d'Etat et de Gouvernement de l'UA, a remplacé le Mécanisme pour la prévention, la gestion et le règlement des conflits de l'OUA qui s'était révélé peu efficace. Il collabore étroitement avec le Président de la Commission de l'UA, assisté par les commissaires des départements paix et sécurité d'une part, et affaires politiques d'autre part.

Sur le plan opérationnel, le CPS s'appuie sur le système continental d'alerte précoce (CEWS) qui est constitué d'un centre d'observation et de contrôle, et d'unités d'observation et de contrôle régionales. Le CPS est en effet mandaté pour harmoniser, coordonner et travailler directement avec les centres d'observation des Communautés économiques régionales (CER). En outre, il collabore avec les Nations Unies, les centres de recherche et les ONG dans la recherche d'informations utiles. Lorsque la médiation s'avère très lente ou échoue, le CPS peut recourir à la force armée pour éviter l'escalade de la violence. D'où le processus en cours pour mettre en place la Force Africaine en Attente (FAA). L'objectif est de doter l'UA d'un dispositif susceptible d'être déployé rapidement en cas de nécessité par le CPS ou en partenariat avec l'ONU. Les chefs d'état-major des pays membres du CPS se rencontrent aussi et soumettent des recommandations au Président de la Commission sur les meilleurs moyens de renforcer les capacités de l'Afrique dans les opérations de paix.

Au niveau régional, plusieurs initiatives sont également mises en œuvre. D'une part, les démembrements de l'architecture panafricaine de paix et sécurité sont mis en place dans les cinq CER d'intégration (CEDEAO, CEEAC, SADC, IGAD et UMA). Ainsi cinq brigades régionales en attente sont en cours de création, les systèmes d'alerte précoce régionaux sont en place et des départements chargés des affaires politiques, de la paix et de la sécurité existent au sein des secrétariats des CER. D'autre part, certaines organisations sous-régionales prennent aussi en charge les questions de sécurité et de gestion de crises. La Conférence

internationale sur la région des Grands Lacs (CIRGL), créée en 2006, vise à contribuer à relever les défis de la paix, de la sécurité, de développement et des questions humanitaires dans les 11 pays d'Afrique centrale et orientale.

Au niveau national, des pays qui ont connu des guerres civiles ou des crises politiques ont pris des initiatives en partenariat avec les partenaires internationaux pour se reconstruire et gérer les conséquences y relatives, telles que le déplacement de populations, les réfugiés, le désarmement et la démobilisation des anciens combattants.

Par ailleurs, de nombreux intervenants extérieurs jouent un rôle dans la prévention et la gestion des conflits en Afrique. Le Conseil de sécurité et les agences de l'ONU (DPKO, HCR, PAM, OMS, PNUD, etc.), les donateurs bilatéraux et multilatéraux (Banque mondiale, BAD et autres banques régionales) qui jouent un rôle important dans les actions de reconstruction post-conflits, ainsi que les organisations humanitaires ont des besoins en matière de collecte de l'information et de coordination avec les intervenants africains. Il convient aussi de souligner qu'en matière de gestion des conflits, certains services peuvent être conçus de façon à être utilisés par le grand public et les médias : produits cartographiques et de localisation des événements pour aider les médias à couvrir convenablement les événements. En effet, les événements en Afrique sont généralement couverts avec très peu de précision spatiale, et les informations sont ainsi biaisées.

5.2. Analyse des besoins

Globalement, les acteurs des politiques de prévention et gestion des conflits en Afrique sont multiples et se situent à différents niveaux. Leurs besoins sont multidimensionnels, parce qu'ils sont d'ordre humain (ressources humaines compétentes), matériel (équipements nécessaires à la collecte et au traitement des informations indispensables à l'exécution des politiques), financier et de renforcement permanent des capacités dans un environnement très volatile. En outre la question des capacités de coordination des actions aux niveaux national, régional, continental et international est aussi capitale. Elle doit être prise en compte selon le principe de subsidiarité. Le tableau ci-dessous donne un aperçu des besoins des principaux acteurs de ces politiques aux niveaux régional et continental.

Organe ou mécanisme	Besoins par rapport à GMES & Afrique
Le Conseil de paix et de sécurité (CPS) de l'UA	Fournir à ses mécanismes opérationnels (système d'alerte précoce, FAA, etc.) et à leurs agents les équipements et les compétences nécessaires pour utiliser les technologies spatiales dans l'analyse des situations conflictuelles et dans la détection des crises avant leur éclatement. L'augmentation du personnel qualifié de différentes structures devrait être prioritaire pour leur permettre d'assumer les nombreuses missions qui leur sont confiées.
Le Système continental et les mécanismes régionaux d'alerte précoce	Des technologies spatiales et des compétences suffisantes pour les utiliser dans la collecte des informations et l'évaluation des risques d'éclatement des conflits et la formulation des propositions respectivement au CPS et à la présidence de la CUA d'une part, aux autorités des Communautés économiques régionales d'autre part. Le renforcement de la coordination et de l'échange d'informations entre les structures nationales, régionales et continentales constitue un besoin non négligeable.
La Force africaine en attente (FAA) et les brigades régionales	Des équipements pour l'utilisation des technologies spatiales dans la préparation des opérations de paix et des compétences nécessaires pour les utiliser efficacement.
Le Comité d'état-major (des pays membres du CPS)	Des équipements utilisant des technologies spatiales dans l'analyse des situations conflictuelles ; et des compétences nécessaires pour les utiliser efficacement. Les membres du CPS étant renouvelés partiellement tous les 2 ou 3 ans, un programme de renforcement des capacités serait mis en place pour former des personnes ressources dans les Etats major des 53 pays de l'UA.
Le Président de la Commission de l'UA	Le Département de paix et sécurité de la CUA, notamment l'Unité du système d'information géographique et cartographie, a besoin des outils de collecte et d'analyse de données utilisant l'imagerie satellitaire pour renforcer ses capacités de production de cartes pour tout le Département et la CUA en général. Comme l'Unité compte à ce stade trois personnes, une augmentation des effectifs et un renforcement des capacités de ses cadres s'avèrent urgents.
La présidence des	La plupart des CER sont engagées dans la mise en place des structures de

commissions ou secrétariat des CER	gestion des questions de paix et sécurité. Les mécanismes régionaux d'alerte précoce ont été créés mais ils manquent de moyens humains, matériels et financiers pour jouer réellement leurs rôles. Un renforcement de leurs capacités, y compris dans l'utilisation des technologies spatiales, serait d'une grande utilité. En outre, l'autorité politique des présidents ou secrétaires généraux des CERs mérite d'être renforcée pour leur permettre de jouer un rôle proactif dans la prévention et la gestion des conflits au niveau régional.
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6. IDENTIFICATION DES COMMUNAUTES

La réussite de la mise en place et des actions développées dépendra de l'identification la plus exhaustive possible des partenaires et utilisateurs pertinents pour GMES&Afrique. La liste des acteurs impliqués dans la gestion des crises politiques et des conflits est sujette aux variations aussi rapides qu'imprévisibles, à l'instar du thème lui-même. Par conséquent, les organisations et institutions mentionnées dans ce paragraphe constitue un état des lieux actuels qui devra être adapté au cours du temps.

Le tableau ci-après synthétise par niveau hiérarchique les principaux organes qui ont un intérêt direct dans la thématique « conflits et crises politiques » de la stratégie GMES&Afrique. Il s'agit d'abord des décideurs politiques au plus haut niveau qui ont la responsabilité ultime dans la prévention, la gestion et la résolution des conflits sur le continent. En plus des organes de l'UA et des Communautés régionales, le Secrétariat général et le Conseil de Sécurité de l'ONU jouent également un rôle central. Ensuite, les services en charge de la mise en œuvre des politiques qui sont en dialogue permanent avec les décideurs politiques d'une part, et les techniciens en charge du développement effectif des services d'autre part. Enfin, les utilisateurs finaux qui incluent certains services d'implémentation des politiques, la société civile et les médias. En effet, les médias pourraient utiliser efficacement les services de GMES&Afrique pour mieux informer le public sur les mécanismes de prévention des conflits en place et sur le cours des conflits et d'autres crises.

Niveau	Organes	Besoins/Services
Décideurs politiques	Conférence des Chefs d'Etat, Présidence de la CUA, CUA, Département des affaires politiques ONU (Secrétariat général, Conseil de sécurité) Département paix et sécurité (opérations de paix, système d'information géographique et cartographie, secrétariat du CPS, système d'alerte précoce) Présidence des Communautés régionales.	Cartographie des risques à court et long termes Cartographie des interventions Etat des lieux stratégique pour des actions imminentes Evolution de la mise en place des mécanismes de prévention de conflits (e.g. démarcation des frontières).
Acteurs chargés de la mise en œuvre des politiques	Force Africaine en Attente Unité des opérations de paix (CUA) Département des Opérations de Maintien de la Paix (DPKO - ONU) Les systèmes régionaux d'alerte précoce Agences de l'ONU en charge d'aide humanitaire (HCR, PAM, UNICEF, OMS, etc.) Autorités nationales en charge de la délimitation des frontières Départements paix et sécurité des CER Secrétariat de la CIRGL UE (ECHO, DG AidCo, DG RELEX) Etat-major de brigades régionales	Système d'information sur les zones d'intervention Cartographie des risques Intégration des informations reçues en feed back au cours des opérations
Mise en place de services	Agences spatiales et fournisseurs de données Universités et Centres de recherche Services nationaux de cartographie Entreprises privées impliquées dans le développement de solutions géospaciales et la collecte de données géospaciales Centre de recherche de l'UA sur le terrorisme	Systèmes d'acquisition et réception de données (imagerie satellitale, positionnement spatial, données de terrain en temps réel) Données géospaciales de base (cartes topographiques, référentiel spatial, etc.) Systèmes de cartographie rapide (y compris la distribution électronique des produits) Analyse des risques intégrant les

		technologies d'observation de la Terre.
Utilisateurs finaux	Secrétariat du CPS Forces de maintien de la paix Systèmes d'alerte précoce (continental, régionaux) Gouvernements des Etats membres de l'UA Autorités nationales chargées des frontières Organisations humanitaires et autres organisations de la société civile Médias	Système d'information sur les conflits et crises politiques en cours (y compris la cartographie détaillée des lieux) Système d'information sur les programmes de prévention de conflits tels que la démarcation des frontières Cartographie des interventions humanitaires et des programmes de relèvement après les crises, etc.

7. CARTOGRAPHIE DES INITIATIVES PASSÉES ET PRÉSENTES

Les différents acteurs des politiques de prévention et gestion des conflits en Afrique ont pris plusieurs initiatives pour faire face aux crises des années 90 et 2000. Elles peuvent être regroupées en trois catégories principales :

- Des engagements politiques et juridiques pris par les Chefs d'Etat et de Gouvernement en matière de gestion des questions de paix et de sécurité aux niveaux national, régional et continental. La liste des instruments présentés à l'annexe 1 illustre la volonté de créer un cadre juridique contraignant pour régler les problèmes de façon concertée et pacifique.
- Les opérations de maintien de la paix mises en place pour stabiliser la situation et aider les protagonistes à résoudre leurs conflits. Elles sont l'œuvre des organisations régionales (CEDEAO, IGAD), continentale (UA) ou internationales (ONU, Union européenne). La liste des opérations passées ou en cours se trouve aux annexes 2 et 3.
- Les programmes de prévention structurelle des conflits à travers la mise en place des politiques permettant de prendre en compte les causes potentielles des conflits. L'augmentation des programmes de gestion des problèmes transfrontaliers ou de lutte contre les trafics illicites d'armes s'inscrit dans cette perspective (Annexe 4).

L'intégration de l'usage des technologies spatiales dans ces initiatives est rare et très ponctuel. Le programme RESPOND (un service GMES) constitue une tentative de réponse à cette carence, mais il n'est pas conçu pour répondre spécifiquement aux besoins des intervenants africains.

8. IDENTIFICATION DE LACUNES ET DE PROGRAMMES DE FINANCEMENT

8.1. Identification de lacunes

- Absence de ressources humaines suffisantes et formées dans l'utilisation des technologies spatiales. A titre d'exemple, l'Unité de système d'information géographique et cartographie du Département Paix et sécurité de la CUA compte seulement trois personnes. Sensée servir tous les départements, elle se limite pour l'instant à la division de la gestion des conflits¹. Mise en place dans le cadre de l'appui à la mission de l'UA au Darfour (MUAS), cette unité produit maintenant des cartes pour l'AMISOM.
- Manque de ressources financières et matérielles pour permettre à la Commission de l'UA et des CERs d'assumer leurs nouvelles missions en matière de paix et sécurité, notamment le déploiement des opérations de paix.
- Les mécanismes de l'architecture africaine de paix et sécurité ne sont pas encore totalement opérationnels, notamment la FAA et les brigades régionales en attente.
- Les systèmes d'alerte précoce au niveau régional ne sont pas partout opérationnels.
- Les unités de cartographie ne sont pas encore suffisamment outillées pour tirer profit des services qui seraient offerts.
- Le développement de services répondant spécifiquement aux besoins des utilisateurs africains en matière de sécurité fait encore défaut.

8.2. Programmes de financement existants ou prévus

Depuis la reconnaissance des liens étroits entre la sécurité et le développement, de plus en plus de donateurs acceptent de financer des initiatives de prévention et de gestion des conflits dans le cadre de

¹ La division de la gestion des conflits fait partie des 4 divisions du Département Paix et Sécurité, à savoir la gestion des conflits (y compris l'Unité de système d'information géographique et cartographie) ; le soutien à la paix (y compris la création de la FAA); la défense et sécurité ; le secrétariat du CPS de l'UA.

l'aide publique au développement. Cela facilite la mobilisation des ressources pour la gestion des crises et surtout pour les programmes de reconstruction post-conflit. D'autres programmes de financement s'inscrivent dans le cadre de la consolidation de la paix et la stabilité mondiales. Les programmes récents disposant d'un volet consistant d'intervention dans le domaine des conflits et crises politiques sont notamment :

- Les programmes indicatifs régionaux (PIR) du FED dans le cadre de l'Accord de Cotonou entre l'UA et les Etats ACP jusqu'en 2020.
- L'Instrument de Stabilité² de l'Union Européenne : le volet à court terme de cet instrument («Préparation et réaction aux crises») vise à prévenir les conflits, à encourager la stabilisation politique post-conflit, et à assurer une récupération rapide après une catastrophe naturelle. Le volet à long terme vise trois priorités principales. Il s'agit de (i) la lutte et la protection contre la prolifération d'armes de destruction massive; (ii) le renforcement des capacités de réponse des pays non-UE aux menaces transfrontalières comme le terrorisme et le crime organisé, dont le trafic illégal d'armes, de drogue et d'êtres humains; et (iii) l'amélioration du développement des capacités de préparation aux situations d'avant- et d'après-crise.
- La Facilité de paix de l'UA financée par l'UE dans le cadre du FED.
- Le Fonds de la paix : créé pour fournir au CPS les ressources financières nécessaires pour les missions de paix et d'autres activités opérationnelles liées à la paix et à la sécurité. Il a permis, depuis 2002, de soutenir le déploiement d'opérations de maintien ou d'imposition de la paix, au Burundi, au Darfour (Soudan), aux Comores, en Somalie, etc.
- Les donateurs bilatéraux et multilatéraux dans le cadre des programmes de reconstruction post-conflit.
- Les opérations de paix de l'ONU en cours : MONUC, MINUAD, MINURCAT, ONUCI, MINUL.
- Le Programme paix et sécurité de la Conférence internationale sur la Région des Grands Lacs.

9. MISE EN PLACE DES SERVICES DE GMES ET AFRIQUE

9.1. Définition des services

L'utilisation civile des technologies spatiales dans le domaine de la sécurité est encore peu développée même en dehors de l'Afrique. La recherche dans ce domaine est encore à ses débuts et peu de solutions sont réellement disponibles sur le marché. L'approche classique de définition des services dans les domaines autres que la sécurité se base sur les produits spécifiques susceptibles d'être obtenus en utilisant les techniques disponibles. Etant donné l'évolution rapide des technologies et la difficulté à définir un produit générique (comme l'occupation du sol) dans le domaine de la sécurité, une approche orientée vers l'utilisateur conviendrait mieux. Quatre services sont proposés ci-après, avec indication du principal bénéficiaire mais des passerelles et des collaborations entre eux devraient être développées au moment de leur mise en place opérationnelle.

i) Appuyer la mise en œuvre du Programme frontières de l'UA par l'utilisation des technologies spatiales dans l'inventaire, la délimitation et la démarcation.

Il s'agit de développer un système d'information contenant toutes les données relatives à la délimitation et la démarcation des frontières entre les Etats membres. Le système contiendra une couverture complète des zones frontalières en imagerie satellitale à très haute résolution spatiale. Un tel système facilitera le dialogue entre les Etats et l'intervention de la CUA dans le cadre de son programme sur les frontières, et s'intègre parfaitement dans ce dernier. Ce service constitue une priorité compte tenu de l'importance du programme frontières dans l'agenda de la CUA.

Activités à mener :

- Renforcer les équipements et les ressources humaines et financières de l'Unité de système d'information géographique et cartographie du Département paix et sécurité de la CUA.
- Former les cadres de l'Unité de cartographie dans l'utilisation et la gestion de nouveaux logiciels et équipements.
- Former les cadres des Unités de cartographie des communautés économiques régionales (CERs) dans l'utilisation et la gestion de nouveaux logiciels et équipements afin qu'ils puissent collaborer efficacement avec leurs homologues de la CUA.
- Acquisition d'images satellitales à très haute résolution spatiale sur toutes les zones de frontières internes (zone tampon large d'environ 10km) sur le continent.

² Règlement (CE) No 1717/2006

- Appuyer techniquement les opérations de démarcation et délimitation des frontières.
- Produire des cartes des zones frontalières avant et après la délimitation et la démarcation.

Résultats attendus :

- L'Unité de système d'information géographique est équipée de nouveaux matériels.
- Les cadres de cette Unité maîtrisent l'utilisation des technologies spatiales et disposent de moyens de répondre à la demande des principaux utilisateurs.
- Les cadres des Unités de cartographie des CERs maîtrisent l'utilisation des technologies spatiales et collaborent efficacement avec leurs homologues de la CUA.
- Le programme de travail 2008 – 2010 du Programme frontières de l'UA est réalisé.
- Une diminution des conflits frontaliers grâce au système de démarcation plus fiable.

ii) Renforcer l'appui aux opérations de paix de l'UA et des CERs par l'utilisation des technologies spatiales.

Les opérations de paix nécessitent des services de cartographie rapide lors de la planification d'une mission, et une cartographie détaillée des lieux lors du déploiement des troupes. Souvent une telle cartographie détaillée n'est pas réalisable durant la phase de déploiement, mais plutôt complétée au fur et à mesure pendant la mission. Il faut développer une chaîne de traitement qui permet de fournir ces produits avec des délais raisonnables. Le service doit également prévoir la possibilité de collecte de données complémentaires par les troupes sur le terrain, les intégrer presque en temps réel dans le système et mettre à jour les produits cartographiques. La couche d'information de base est constituée par des images satellitaires aussi récentes que possibles. Il y a lieu de prévoir la possibilité de réception directe des données satellitaires par les organisations en charge de délivrer ce service.

Activités à mener :

- Renforcer les équipements et les ressources humaines et financières des Unités de cartographie et de l'alerte précoce du Département de paix et sécurité de la CUA.
- Former les cadres chargés de l'utilisation et la gestion de nouveaux équipements nécessaires à la production de supports aux opérations de paix.
- Organiser des concertations entre la CUA et les CERs pour harmoniser les procédures de partage des informations et les bonnes pratiques dans l'utilisation des technologies spatiales.
- Evaluer les risques de conflits dans des régions riches en ressources naturelles grâce à l'utilisation des images satellitaires.

Résultats attendus :

- L'unité de système d'information géographique et de cartographie de la CUA est équipée de matériels adéquats pour l'utilisation des technologies spatiales.
- Les cadres de cette Unité maîtrisent l'utilisation de nouveaux équipements.
- Des rencontres semestrielles entre les responsables du Département paix et sécurité de l'UA et ceux des CER sont organisées et des synergies sont développées.
- Une diminution des conflits liés à l'exploitation de ressources naturelles.

iii) Renforcer les capacités d'analyse et de prévision de la CUA et des CER grâce aux technologies spatiales.

Activités à mener :

- Identifier un centre de recherche sur la sécurité dans chacune des 5 régions africaines et former ses cadres pour l'utilisation des services de GMES & Afrique.
- Produire des analyses sociopolitiques et prospectives sur les régions ou pays en crise, y compris des analyses faites avec des technologies spatiales.
- Disséminer les résultats de ces analyses prospectives auprès des décideurs de la CUA et des CER notamment, mais aussi des Etats membres, des acteurs de développement, de la société civile.

Résultats attendus

- Des centres de référence en matière de recherche sur la sécurité sont identifiés et collaborent avec leurs homologues européens.
- Des analyses sociopolitiques et géostratégiques sur les régions en conflits ou à risque sont produites et disséminées auprès des décideurs au niveau continental, régional et national.
- Des analyses sociopolitiques et géostratégiques produites en Afrique sont diffusées sur des supports papier et internet, y compris la composante cartographique s'appuyant sur l'imagerie satellitale.

iv) Soutien aux opérations humanitaires des Etats membres de l'Union Africaine et des ONGs

Activités à mener :

- Renforcer les équipements et les ressources humaines et financières des centres de recherche et des universités africains pour mener la recherche sur et développer des services spécifiques aux interventions humanitaires.
- Renforcer la collaboration entre le secteur privé et les centres de recherche pour la fourniture de soutien aux acteurs humanitaires.
- Former les cadres des services chargés d'interventions humanitaires des états membres et des ONGs dans l'utilisation des services de GMES&Afrique.
- Assurer la continuité des services au-delà de la phase de recherche.

Résultats attendus :

- Les interventions humanitaires sont mieux planifiées et organisées grâce aux produits cartographiques et d'analyse fournis.
- Les délais d'intervention sont raccourcis grâce à la disponibilité des produits cartographiques et des analyses.
- Les données produites sont mises à la disposition des autres acteurs dans le domaine pour la dissémination de bonnes pratiques.

9.2. Renforcement des capacités

9.2. a. Eléments nécessaires

La fourniture des services GMES&Afrique nécessitera le renforcement des capacités actuelles tant au niveau des infrastructures qu'au niveau des ressources humaines. Sur le plan des infrastructures, les éléments suivants seront prioritaires :

- Infrastructure d'accès au réseau internet et de fourniture de services internet permettant la réception et la distribution de larges quantités de données. Cet élément n'étant pas spécifique au thème de ce chapitre, il convient de l'aborder dans le cadre général du plan d'action GMES&Afrique. L'exigence supplémentaire pour le présent thème est la sécurité de l'infrastructure et des données.
- Infrastructure d'exploitation des services : il s'agit de s'assurer de la disponibilité d'équipements adéquats (ordinateurs, logiciels, outils de collecte de données de terrain, production de supports imprimés, etc.), de fournir et d'exploiter les services GMES.

Sur le plan des ressources humaines, il s'agit d'assurer la formation des utilisateurs des services GMES ainsi que la création d'un cadre d'échange d'expérience/connaissance au sein de la communauté des scientifiques/experts producteurs des services GMES.

- La formation des utilisateurs sera organisée pour les unités de la CUA engagées dans le programme des frontières, les opérations de paix et dans les systèmes d'alerte précoce; pour le personnel des CER, et le cas échéant les cadres des états membres et des organisations de la société civile souhaitant utiliser les services GMES.
- Le renforcement des capacités en matière de ressources humaines doit également se faire à travers l'implication des universités africaines et des centres de recherche africains dans le développement des services GMES spécifiques pour les applications de sécurité. Des projets de recherche et de développement des services GMES devraient être encouragés par la création d'instruments de financement et la mise à disposition de données. Des conférences scientifiques sur l'utilisation des technologies spatiales dans le domaine de la sécurité civile seront organisées régulièrement conjointement par les universités et centres de recherche africains d'une part, et leurs partenaires européens d'autre part.

9.2.b. Stratégie de mise en œuvre

Des centres de recherche spécialisés dans le domaine des technologies spatiales et des Systèmes d'Information Géographique, les réseaux d'experts dans ce domaine (tel que AARSE³) ainsi que des centres de formation pour le maintien de la paix constituent un pilier important de la stratégie de mise en œuvre des éléments de renforcement des capacités énumérées ci-dessus.

En effet, la formation des cadres de la CUA, des CER et des centres de recherche sur la production et l'utilisation des services GMES devrait se faire en collaboration avec les centres de recherche qui seront appelés à participer dans la mise en œuvre du programme. L'objectif sera dans ce cadre de partir des structures existantes sur le continent. Dans cette perspective, l'Ecole de maintien de la paix de Bamako (Mali), le Centre international Kofi Annan de formation au maintien de la paix (The Kofi Annan International Peacekeeping Training Centre (KA IPTC)) et l'Institute for Security Studies (ISS) d'Afrique du Sud, pour ne citer que ceux-là, joueraient un grand rôle important.

³ AARSE: African Association of Remote Sensing of the Environment

Plus concrètement, il s'agirait d'équiper les centres de matériels nécessaires à la formation et à la production des services GMES. Ensuite l'organisation des sessions de formations pour différentes catégories de cadres se ferait en fonction des besoins et conformément aux trois phases identifiées ci-dessous.

9.3. Besoins et actions prioritaires

Les besoins prioritaires concernent la mise en place d'infrastructures permettant l'utilisation des technologies spatiales ainsi que le renforcement des capacités des utilisateurs au niveau des unités de la CUA chargées de piloter les différents programmes au niveau continental et de d'assurer une bonne coordination avec leurs homologues des CER.

Les actions prioritaires permettant le démarrage rapide du plan d'action sont les suivantes:

- Mettre en place les infrastructures d'accès au réseau Internet, de fourniture et d'exploitation de services GMES au niveau du Département paix et sécurité de la CUA (notamment les Unités de cartographie et de soutien aux opérations de paix).
- Le renforcement des capacités des cadres (utilisateurs) du Département paix et sécurité de la CUA en matière d'utilisation des technologies spatiales et le recrutement du personnel supplémentaire pour répondre aux demandes croissantes venant du Programme frontières, des opérations de paix et des interventions humanitaires.
- Le renforcement des capacités des cadres des Unités de cartographie des communautés économiques régionales (CERs) dans l'utilisation et la gestion de nouveaux logiciels et équipements afin qu'ils puissent collaborer efficacement avec leurs homologues de la CUA.

9.4. Structure

Le succès de GMES&Afrique repose sur l'efficacité de la coopération entre les institutions et organisations européennes et africaines impliquées dans l'initiative. Il convient de créer un cadre de coopération qui valorise l'apport de chaque partenaire, crée des synergies et facilite le dialogue entre les partenaires. Comme schématisé ci-après, un dialogue privilégié devrait être établi entre, d'une part, les institutions européennes et africaines (notamment les deux Commissions), et d'autre part entre les chercheurs africains et européens. Le secteur privé joue un rôle important dans la provision des services. On s'attend à ce que le secteur privé européen soit essentiellement constitué de producteurs et fournisseurs de données (telles que les données acquises par télédétection), alors que du côté africain, ce sont essentiellement les entreprises qui développent les applications. Les scientifiques africains, en collaboration avec le secteur privé, devraient s'attacher aussi à développer les outils et les applications de collecte de données de terrain et leur intégration dans le système.

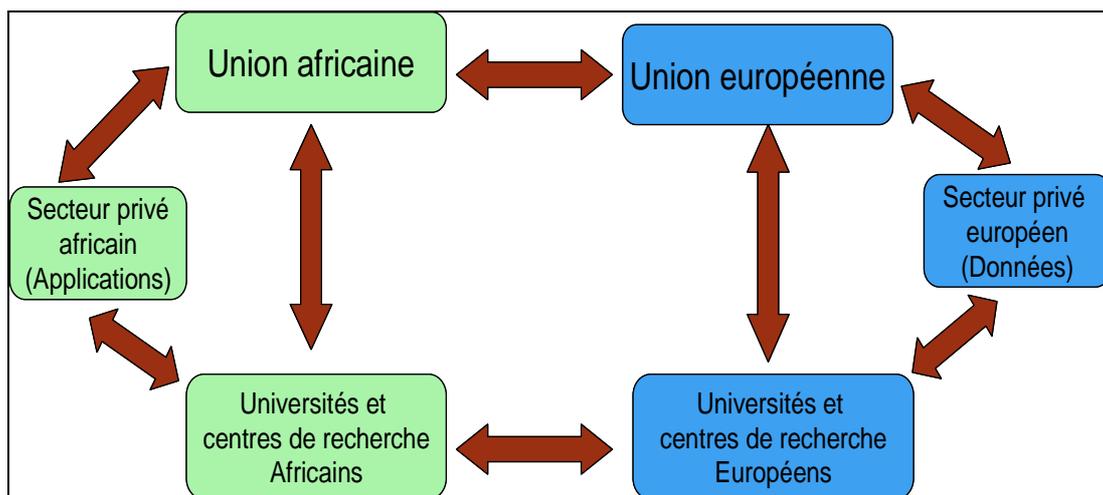


Fig.1 : Principaux acteurs de la mise en place de GMES&Afrique et les liens de la structure de coopération à privilégier.

L'Union africaine supervisera la politique générale et les aspects de coopération étrangère, mais la mise en place des services impliquera aussi les Communautés régionales. Une telle organisation garantirait la cohérence des activités et une utilisation rationnelle des ressources disponibles en évitant les doubles emplois et en réalisant des économies d'échelle.

9.5. Calendrier

Le développement des services relatifs aux conflits et crises politiques est complexe du fait de la nature très changeante et évolutive des situations politiques.

Phase 1 (2 ans) :

Identification détaillée des acteurs, leurs besoins et leurs capacités actuelles
Sensibilisation des utilisateurs potentiels, notamment les unités de cartographies de la CUA, des CER et la communauté scientifique africaine sur les programmes projetés ;

Phase 2 (3 ans) :

Mise en œuvre des actions de soutien au Programme frontières (section i) ci-dessus) ;
Développement des solutions relatives aux autres services et les tests à petite échelle ;
Mise en place des programmes de formation des acteurs et renforcement des capacités des cadres de la CUA, des CER et de la communauté scientifique africaine ;
Mise en place de programme de soutien au secteur privé actif dans les thèmes de GMES&Afrique ;

Phase 3 (5 ans) :

Déploiement des services au niveau continental (mise en place des infrastructures aux lieux mêmes d'utilisation des produits, renforcement des infrastructures de communication) ;
Compléter et terminer le Programme frontières ;
Mettre en place les mécanismes de soutien a long terme des actions de recherche et développement.

9.6. Eléments pour l'estimation du budget :

1. **Phase 1** : 2 millions d'euros, sur 2 ans.
2. **Programme frontières** : les images satellitales à utiliser coûteraient environ 30 millions d'euros. Les zones frontalières à couvrir représentent environ 1.000.000 km². Les images coûtent environ 30EUR/km². Le coût de traitement et de stockage est estimé à 15 millions d'euros. Le coût d'analyse des images serait supporté par le budget propre du programme et il est difficile à estimer puisqu'il fait intervenir les phases de négociations entre les états membres pour se mettre d'accord sur l'analyse (délimitation des frontières). Coût total pour GMES&Afrique : **45 millions** sur 4 ans.
3. **Soutien aux missions de maintien de la paix** : 2 millions par an en phase 2, et environ 20 millions d'euros par an en phase opérationnelle (phase 3), soit **106 millions d'euros** sur 8 ans.
4. **Soutien aux opérations humanitaires** : 2 millions par an en phase 2, et environ 10 millions d'euros par an en phase opérationnelle (phase 3), soit **56 millions** sur 8 ans.

Au total, environ 207 millions d'euros sur 10 ans.

10. RECOMMANDATIONS

La problématique des conflits et des crises politiques est complexe et se pose de façon spécifique en fonction des pays ou des régions. Des solutions standards n'existent pas. La meilleure démarche consiste dès lors à renforcer ou à mettre en place des structures capables de prendre en charge les problèmes quand ils apparaissent et d'agir efficacement au niveau de la prévention. Dans cette perspective, tous les acteurs impliqués devraient accorder une attention particulière aux aspects suivants :

- Reconnaître l'architecture africaine de paix et de sécurité de l'UA et ses démembrements au niveau régional comme cadre par excellence de coordination de toutes les initiatives en matière de paix et de sécurité en Afrique.
- Sensibiliser les décideurs politiques et les utilisateurs potentiels aux niveaux continental, régional et national sur l'utilité des services qui seraient produits et leur valeur ajoutée par rapport aux analyses sociopolitiques des situations conflictuelles et de crises de différents pays.
- Accorder une priorité à la mise à disposition des services GMES & Afrique au Programme frontières de la CUA et ses démembrements au niveau des Communautés régionales, afin d'assurer son exécution et par là contribuer à diminuer significativement les conflits liés à la mauvaise démarcation des frontières.
- Mobiliser les centres de recherches et les opérateurs privés africains sur les opportunités d'investissement dans le développement des applications des services GMES.
- Sensibiliser les clients potentiels (opérations de paix et organisations humanitaires notamment) sur les opportunités d'obtenir les services qu'ils allaient chercher à l'extérieur du continent.
- Soutenir les projets de recherche et développement des centres de recherches et des universités africaines relatifs à l'utilisation civile des technologies spatiales dans le domaine de la sécurité.
- Mettre en œuvre le présent plan d'action de façon modulaire pour favoriser une appropriation progressive du processus et des techniques.

11. RÉSUMÉ

Les questions de paix et de sécurité sont devenues centrales dans l'agenda sur les politiques de développement en Afrique, en particulier depuis le lancement de l'UA en 2002. Un consensus existe maintenant sur l'importance d'assurer la paix et la sécurité comme des conditions nécessaires, voire des préalables, au développement socio-économique et à l'intégration régionale. En effet, plusieurs pays africains ont connu des conflits violents et des crises politiques qui ont causé des destructions et des pertes considérables sur le plan humain, matériel et des infrastructures socioéconomiques. Les conséquences se font encore sentir au niveau de ces pays mais aussi des régions entières comme l'Afrique centrale ou l'Afrique de l'Ouest. Elles handicapent les efforts de réduction de la pauvreté et de promotion du développement durable dans un contexte où les ressources de la coopération internationale deviennent rares et conditionnées. D'où la nécessité d'élargir les stratégies de gestion et prévention des conflits. Le présent plan d'action s'inscrit dans cette perspective.

Les services de GMES & Afrique peuvent contribuer significativement à la mise en œuvre de l'architecture africaine de paix et sécurité initiée par l'UA comme cadre de coordination des initiatives de paix et sécurité sur le continent. L'examen de ses actions passées et présentes montre que les besoins urgents concernent les équipements pour l'acquisition et l'utilisation des technologies spatiales, les ressources financières pour assurer leur fonctionnement, le renforcement des capacités des utilisateurs au niveau des unités de la CUA et des CER chargées de piloter le programme.

Un plan d'action sur 10 ans est proposé pour répondre aux besoins urgents et combler les lacunes existantes en suivant quatre axes principaux d'interventions :

- Appuyer la mise en œuvre du Programme frontières de l'UA par l'utilisation des technologies spatiales dans l'inventaire, la délimitation et la démarcation.
- Renforcer l'appui aux opérations de paix de l'UA et des CERs par l'utilisation des technologies spatiales pour la production de supports cartographiques.
- Renforcer les capacités d'analyse et de prévision de la CUA et des CERs grâce aux technologies spatiales et aux autres techniques d'observation de la terre.
- Soutien aux opérations humanitaires des Etats membres de l'UA et des ONGs locales.

Des initiatives complémentaires peuvent être envisagées pour s'adapter au caractère évolutif et changeant du contexte sécuritaire. Le coût global pour la mise en œuvre de ce plan d'action est estimé à 207 millions d'euros mobilisables dans différentes sources de financement existantes ou prévues.

Enfin, pour garantir le succès du présent plan d'action thématique, il conviendra de s'assurer de l'efficacité de la coopération entre les institutions et organisations européennes et africaines impliquées dans l'initiative. Pour ce faire, la structure de coopération devrait valoriser l'apport de chaque partenaire, créer des synergies et faciliter le dialogue entre les partenaires. Le dialogue privilégié devrait être renforcé entre d'une part les institutions européennes et africaines (notamment les deux Commissions), et d'autre part entre les chercheurs africains et européens. Le secteur privé africain et européen ainsi que les organisations de la société civile seraient aussi impliqués dans les différentes phases du programme.

12. ANNEXES

Annexe 1 : Principaux instruments panafricains et régionaux en matière de paix et de sécurité

Organisation	Instrument juridique	Date d'adoption	Entrée en vigueur
UA	Acte constitutif de l'Union africaine (UA)	11/07/2000	26/05/2001.
UA	Protocole relatif à la création du Conseil de paix et de sécurité de l'UA	9/07/2002	26/12/2003.
UA	Pacte de non agression et de défense commune de l'UA	31/01/2005	Non
UA	Nouveau partenariat pour le développement de l'Afrique (NEPAD)	Octobre 2001	Octobre 2001
UA	Charte africaine de la démocratie, des élections et de la gouvernance	30/01/2007	Non
UA	Convention africaine sur la conservation de la nature et des ressources naturelles.	11/07/2003	Non
CEDEAO	Cadre stratégique de prévention des conflits (ECPF) ⁴	Janvier 2008	Janvier 2008
CEDEAO	Protocole relatif au mécanisme de prévention, de gestion et de règlements des conflits dans la CEDEAO.	1999	oui
CEMAC	Pacte de non-agression, de solidarité et d'assistance mutuelle de la CEMAC	28/01/2004	oui
SADC	Protocole de coopération en matière de politique, défense et sécurité	2001	02/03/2004
SADC	Pacte de défense mutuelle (SADC)		oui
SADC	Traité de la SADC	1992	oui
CEEAC	Protocole relatif au COPAX (Conseil de Paix et de Sécurité d'Afrique centrale)	24/02/2000	oui
CEEAC	Pacte d'assistance mutuelle entre les États membres de la CEEAC	24/02/2000	oui
CEEAC	Pacte de non-agression entre les États de la CEEAC ⁵	08/07/1996	oui
CIRGL	Pacte sur la Sécurité, la Stabilité et le Développement dans la région des Grands Lacs	16/12/2006	Juin 2008.
ONU	Convention de l'ONU contre la criminalité transnationale organisée	15/11/2000	29/09/2003.

Annexe 2: Opérations de paix terminées

Acteurs	Initiatives	Dates de début et mandat
UA	MIAB (Mission Africaine au Burundi)	3 février 2003 - 1er juin 2004 : Superviser la mise en œuvre du cessez-le-feu des 7 octobre et 2 décembre 2002 en attendant la création de l'ONUB par l'ONU.
UA	MUAS (Mission de l'UA au Soudan (Darfour))	28 mai 2004 - 31 décembre 2007 : Surveiller l'application du cessez-le-feu signé en 2003 et assurer la protection des civils et des organisations humanitaires.
UA	MUASEC (Mission de l'UA pour la surveillance des élections aux Comores)	15 mars 2006 - 9 juin 2006 : Superviser le déroulement du processus électoral et de contribuer à créer un environnement stable avant, pendant et après la tenue des élections.
CEMAC	Force multinationale en Centrafrique (FOMUC)	octobre 2002 – juillet 2008. : Assurer la sécurité présidentielle, la restructuration de l'armée et surveiller le travail des patrouilles mixtes le long de la frontière avec le Tchad.
CEDEAO	ECOMOG Guinée-Bissau	Décembre 1998 - juin 1999 : Surveiller le retrait des soldats guinéens et sénégalais, et assurer le contrôle des élections

⁴ ECOWAS Conflict Prevention Framework (ECPF), ECOWAS, Abuja, janvier 2008.

⁵ Le Pacte de non-agression et celui d'assistance mutuelle des pays de la CEEAC ainsi que le Protocole relatif au COPAX forment un instrument unique.

CEDEAO	ECOMOG Libéria	août 1990 - octobre 1999 : Superviser l'application de l'accord de cessez-le-feu par les protagonistes.
CEDEAO	ECOMOG Sierra Leone	février 1998 - mars 2000 : Superviser l'embargo sur les armes et les produits pétroliers à destination de la Sierra Leone ainsi que la mise en œuvre de l'accord de cessez-le-feu du 23/12/1997, superviser le processus de DDR des combattants.
IGAD	IGASOM (Mission de soutien de la paix en Somalie)	avril 2005- février 2007 : Aider au retour du gouvernement fédéral transitoire et lui permettre d'exercer un contrôle sur l'ensemble du territoire, à l'exception du Somaliland.

Annexe 3: Opérations de paix en cours en Afrique

Acteurs	Initiatives	Dates de début et mandat
UA	AMISOM (Mission de l'Union Africaine en Somalie)	19 janvier 2007 : Appuyer le dialogue entre le gouvernement de transition et son opposition armée, assurer la protection des institutions de transition et leurs infrastructures.
UA	MAES (Mission d'assistance électorale et sécuritaire aux Comores)	13 mai 2007 : créer un environnement stable et sécuritaire pour la tenue des élections.
UA/ONU	MINUAD (Mission de l'ONU et de l'UA au Darfour), Soudan.	31 juillet 2007 : Mettre fin au conflit entre les mouvements rebelles du Darfour et les milices soutenues par le gouvernement soudanais.
CEEAC	MICOPAX (Mission de consolidation de la paix en Centrafrique)	12 juillet 2008 : Favoriser la paix, la stabilité, le processus politique et le respect des droits de l'homme et assister la RCA lors des prochaines échéances électorales.
ONU	MONUC (Mission de l'ONU en RD Congo)	Novembre 1999 : faciliter la mise en œuvre de l'accord de cessez-le-feu de Lusaka entre les protagonistes de la guerre en RDC, ensuite appuyer l'application de l'accord de paix inter-congolais et le rétablissement de l'autorité de l'Etat sur l'ensemble du territoire.
ONU	MINURCAT (Mission de l'ONU en Centrafrique et au Tchad)	25 septembre 2007 : protéger les réfugiés et personnes déplacées en Centrafrique et au Tchad.
ONU	ONUCI (Opération des de l'ONU en Côte d'Ivoire)	27 février 2004 : faciliter la mise en oeuvre par les parties ivoiriennes de l'accord de paix qu'elles ont signé en janvier 2003.
ONU	MINUL (Mission de l'ONU au Libéria) a	19 septembre 2003 : vérifier la mise en œuvre de l'accord de cessez- le-feu et le processus de paix.
UE	EUSEC-RDC (Mission de conseil et d'assistance de l'UE en RD Congo).	8 juin 2005 : appuyer la réforme du secteur de la sécurité en RD Congo.

Annexe 4 : Initiatives structurelles

Acteurs	Initiatives	Date et mandat
UA	Programme frontières	Adopte en juin 2007, il part d'un constat que moins d'un ¼ des frontières des pays africains possèdent des démarcations. Or cette absence donne lieu à des zones de non droit et constitue une source de tensions entre les pays. L'objectif global est la prévention des conflits et la promotion de l'intégration régionale. Trois de ses objectifs spécifiques peuvent bénéficier de l'appui du GMES & l'Afrique, à savoir la délimitation et la démarcation des frontières africaines qui ne l'ont pas encore été ; le développement, dans le cadre des CERs, de la coopération transfrontalière de proximité ; le renforcement des capacités en vue de la formation des décideurs dans le domaine de gestion des frontières et de la coopération transfrontalière. Un plan

		d'action pour la mise en œuvre du dit Programme et un programme de travail 2008 -2010 ont été adoptés.
CEEAC	Programmes frontière	Sous l'impulsion de l'UA, la CEEAC est en train d'élaborer son programme frontière pour aider ses pays membres à régler pacifiquement leurs problèmes transfrontaliers et à mener des actions de démarcations là où ce n'est pas fait pour éviter d'éventuels conflits.
Conférence internationale sur la région des Grands Lacs (CIRGL)	Programme paix et sécurité	Lancé en 2008 avec l'entrée en vigueur du Protocole de création de la CIRGL, il comprend 7 projets : la gestion conjointe de la sécurité aux frontières communes ; le désarmement et rapatriement des Groupes armés selon l'Accord de Lusaka ; la coordination des activités et renforcement des capacités de lutte contre la prolifération des armes légères et de petit calibre (ALPC) dans la région des Grands Lacs ; le projet sur le crime transfrontalier et le terrorisme qui sera mis en œuvre par le Centre kenyan de lutte contre le terrorisme ; le développement des zones frontalières et de la sécurité humaine ; le désarmement et promotion du développement en zone 3 (Kenya, Ouganda, Soudan) ; le déminage et action contre les mines dans la région des Grands Lacs.
Gouvernement de la RD Congo	Programme Amani à l'Est du pays.	Lancé en janvier 2008, il consiste à appuyer la reconstruction et la stabilisation de l'Est du pays ravagé par plusieurs années de guerres civiles et de rébellions.

Annexe 5 : Liste des acronymes

AARSE: African Association of Remote Sensing of the Environment
 ACP: Pays d'Afrique, Caraïbes et Pacifique
 AMISOM : Mission de l'Union Africaine en Somalie
 BAD: Banque africaine de Développement
 CE : Commission européenne
 CEDEAO : Communauté Économique des États de l'Afrique de l'Ouest
 CEEAC : Communauté économique des États de l'Afrique centrale
 CEMAC : Communauté Economique et Monétaire des Etats de l'Afrique Centrale
 CER: Communauté économique régionale
 CEWS: Continental Early Warning System
 CIRGL : Conférence internationale sur la région des Grands Lacs
 CPS: Conseil de Paix et de Sécurité
 CUA : Commission de l'Union africaine
 DG RELEX: Directorate General for External Relations
 DG AIDCO: Directorate General EuropeAid
 DPKO : Département des opérations de maintien de la paix de l'ONU
 ECHO: Service d'Aide Humanitaire de la Commission européenne (European Community Humanitarian aid Office)
 ECOMOG : Groupe d'observateurs militaires de la CEDEAO
 FAA : Force Africaine en Attente
 FED : Fonds européen de développement
 GMES: Global Monitoring for Environment and Security
 GRIP: Groupe de recherche et d'information sur la paix et la sécurité
 HCR : Haut commissariat de l'Onu pour les réfugiés
 IGAD : Autorité Intergouvernementale pour le Développement
 ISS: Institute for Security Studies
 KAIPTC: Kofi Annan International Peacekeeping Training Centre
 MINUAD : Mission de l'ONU et de l'UA au Darfour
 MINUL: Mission des Nations Unies au Liberia
 MINURCAT: Mission des Nations Unies en République Centrafricaine et au Tchad
 MONUC: Mission des Nations Unies en République démocratique du Congo
 MUAS: Mission de l'Union africaine au Soudan
 OMS : Organisation mondiale de la Santé
 ONU : Organisation des Nations Unies
 ONUCI: Opération des Nations Unies en Côte d'Ivoire

OUA : Organisation de l'Unité africaine (ancêtre de l'UA)
PAM : Programme alimentaire mondial
PNUD : Programme des Nations Unies pour le Développement
SADC : Communauté de Développement de l'Afrique Australe
UA : Union africaine
UE : Union européenne
UMA : Union du Maghreb Arabe
UNICEF: Fonds des Nations Unies pour l'enfance