GMES and Africa
Summary of the Baseline Action Plan

Disclaimer:

This document does not represent the views of the African or European Union Commissions, the African Regional Economic Communities, neither those of African and European Member States. It simply attempts to summarise the baseline Action Plan prepared late 2009 along the *Lisbon Process on GMES and Africa* launched at the AU-EU Summit in Lisbon 2007, with the exclusive objective of facilitating subsequent discussions.

V01.0 September 2011
Based on the GMES and Africa baseline Action Plan (2009)

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Rationale and scope of the document

Significant time has elapsed since the drafting of the GMES and Africa baseline Action Plan late 2009. A consultation on the baseline plan was scheduled for 2010, which took place partially through an electronic consultation[1] from April to June 2010. However, the regional consultation workshops foreseen for 2010 along the Lisbon process did not take place.

Nevertheless, progress is to be reported: Both in the definition of the Monitoring for Environment and Security in Africa (MESA) project[2], as well as in some thematic areas where projects[3] to support the GMES and Africa initiative started in 2010, co-financed by the EU R&D budget (FP7-GMES), a strong effort was made to steer the contents and objectives along African needs and the preliminary discussions held. Moreover, after the request from the national representatives at the *'GMES and Africa Extended Coordination Team'*, an action[4] aiming at supporting mainly African representatives, as well as awareness actions in Africa, should start early 2012.

In July 2011, at the informal *'Space Troika'* meeting between the two Commissions[5] it was clear that concrete steps had be taken to bring things forward for 2012. Also the cross-cutting nature of space-related files was underlined and reflection given on how to bring together all the interested stakeholders. The lack of a secretariat to coordinate related activities was identified as one reason for the delay. The baseline document drafted late 2009 was considered too extensive for consultation, and so it was suggested to shorten it to facilitate communication and catalyse discussions. **This document is the result of this exercise, and the different sections of the baseline Acton Plan were summarised by the original authors in two pages and harmonised in format.**

Discussions are now ongoing under the Joint Africa-EU Strategy (JAES) regarding governance of the partnerships and the possible setting up of a joint secretariat. In addition to the Introductory section, as in the original Action Plan the document in divided into two main sections: the first addresses **cross-cutting issues**; the second the **eight thematic areas**.

[1] http://www.aquaknow.net/gmes-africa
[2] MESA will build end expand on the results of AMESD
[3] EAMNET (Marine) and GARNET-E (Emergency Response) - started 2010
[4] BRAGMA – Bridging Actions for GMES and Africa – expected to start Jan 2012
[5] Between AUC (HRST) and EC (ENTR, DEVCO - JRC will participate in subsequent meetings)

Introduction

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 organisations[1], 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 and it is framed in the Space component of the "Africa-EU Partnership n° 8 on Science, Information Society and Space". The strategic objectives are as follows:

- 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);
- to identify thematic priorities and priorities to enhance the use of EO in Africa;
- 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.
- 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;
- 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/MESA, 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
- an approach to the governance and data access policy issues;
- the setting of a timetable for long term future actions

SECTION 1 – CROSS CUTTING ISSUES

Policy and Institutional framework

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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. African ownership, leadership and management are essential.

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 – both in general terms and among thematic communities - 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.

The following recommendations can drive the reflection:

- Understanding requirements and prioritizing actions is key before in depth analysis on governance, finance and implementation issues takes place.
- All relevant Institutions need to be closely involved.
- 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.
- Africa is home of numerous projects, institutions and networks relying on 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.

- Resources should be made available to invest in building infrastructures for earth observations and in-situ data collection, packaging, archiving and dissemination to users, as well as to build capacity in order to ensure that GMES and Africa is operated by qualified resources across the various thematic areas.
- 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.

Infrastructure framework

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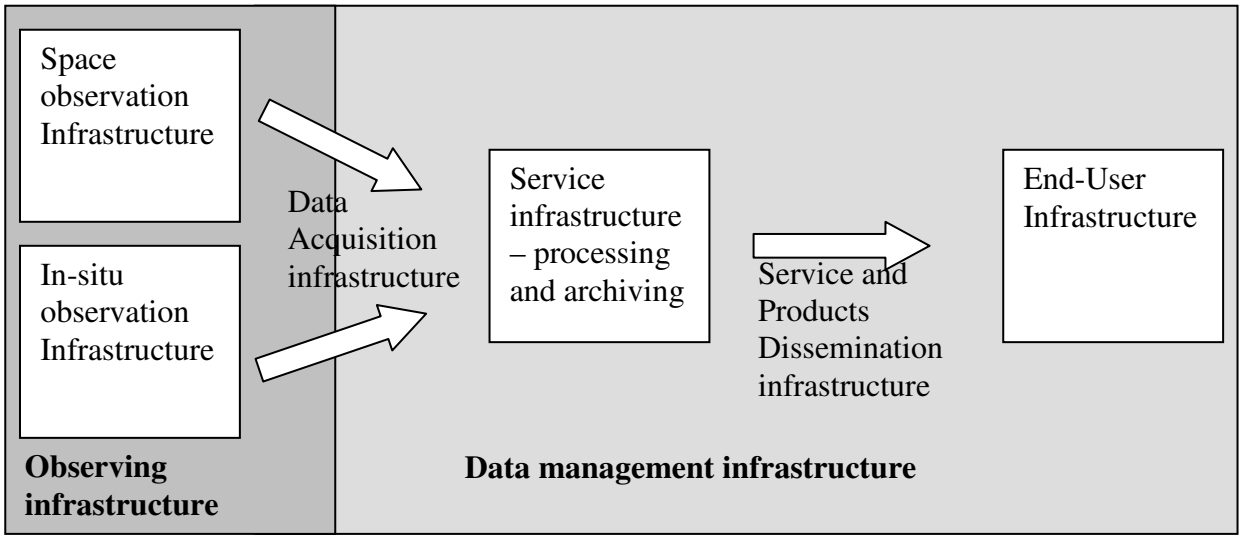
The GMES Africa "infrastructure" is composed of two main building blocks:

- The **observing infrastructure**, with two main components:
  - The satellites and their on-board instruments and the ground segment to operate these satellites;
  - The in-situ equipments that measure physical parameters locally (meteorological station, hydrologic stations, sounder, buoys, airplane, etc…).
- The "**data management" infrastructure**, which is there to access, process and disseminate the information derived from the observing infrastructure. This infrastructure is closely linked to the advent of ICT infrastructure in Africa.

Each of these building blocks has its own life-cycle, decision processes and policy frameworks, which can developed independently from GMES Africa. The challenge of GMES Africa is certainly to be able to put together all these block to ensure performing and operational end-to-end services.



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 should therefore focus 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.

When looking at the "GMES Africa Infrastructure need" components by component, the following recommendation are proposed

- **Observation infrastructure** (satellite and in-situ): GMES Africa shall maximise the use of existing and operational satellites missions from Europe, Africa and worldwide. This includes obviously the GMES Sentinel mission and African Remote Sensing missions (e.g. ARMC initiative), but also EUMETSAT, ESA, NASA, NOAA missions. CEOS should be the reference when looking at available and foreseen satellite mission..
- **Data acquisition infrastructure**. Due to the various data policy scheme applied by satellite operators, Africa should develop a data acquisition strategy at continental level through projects such as MESA. Africa needs well developed and maintained data acquisition and access infrastructure which include; adequate hardware and software, skilled human resource, supportive access policies and legislation, coordination framework. Africa should also maximise the use of data acquisition infrastructure deployed recently as part of the AMESD programme, which has equipped each country with two GEONETCast acquisition systems. This infrastructure shall be maintained and shared within each country.
- **Service infrastructure** (Data storage and processing); there is a clear need to develop Data storage facilities such as servers and data processing capacity (software, skills and hardware) and to provide mechanism and adequate policy framework to share these data within the continent. GMES Africa shall build on existing national and regional centres, that have developed capacities on Earth Observation (e.g. AMESD Regional Implementation Centre and their networks)
- **Data dissemination**; A clearinghouse at African level should be developed, as well as Data dissemination polices and strategies. For this affordable high speed bandwidth for internet access are needed. Experience gained in AMESD for disseminating data at regional level shall be taken into account in GMES and Africa.
- **Data Utilization or end user infrastructure:** definition of core datasets at continental, regional, national and local levels, encourage the use of compatible and interoperable systems at users level, so that experience can be shared within the continent.

In **conclusion**, the availability of an adequate infrastructure is key for all the themes of the GMES Africa initiative. An overall approach for the GMES Africa Infrastructure shall be developed at continental level and for all GMES Africa applications. This shall be based on existing infrastructure, notably those deployed recently as part of EU-funded development projects, implemented by the African Union Commission (AMESD). Focus should be on the maintenance of this infrastructure and deployment of new infrastructure where gaps have been identified.

The deployment and maintenance of an adequate infrastructure will require an appropriate governance scheme and the capacity to define standards and methodologies across the various applications domains. It will also require appropriate capacities in terms of human resources. The GMES Africa related infrastructure requires skilled personnel.

Regarding the Space observation, it is recommended to make maximum use of existing space missions. GMES Africa shall focus on Space applications, not on space technologies, as this is already covered by other initiative such as the African Pan-Universities or the African Space Agency.

Finally, GMES Africa infrastructure shall also relied on the advance made in the ICT sectors, with the development of broadband internet access and of affordable satellite communication systems.

Capacity building

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GMES and Africa strategy provides a unique opportunity to mobilize, coordinate and leverage the efficient use of Earth Observation (EO) data and applications with relevance for Africa, strengthening cooperation between European and African communities concerned with environmental monitoring based on geo-information (GI). Capacity Building as a cross-cutting activity is a key issue for the implementation and the sustainability of each service identified as pertinent for the process, through the corresponding programs, but also comprises global initiatives and policies to face generic challenges. The development of a GMES and Africa Capacity Building coherent plan is crucial to guarantee that available information and technology are fully balanced by readily available skilled Individuals, a supporting Institutional framework and updated Infrastructures, covering the usually summarized as the I^3 of Capacity Building (Individual, Institutional and Infrastructure):

- **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 resources 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 between European and African institutions. At the forefront of the training backbone is an efficient enhancement of capacities of trainers.

- **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 to strengthen technical and industrial capacity in Africa to take full ownership of GMES and Africa in due course. Institutional capacity can be seen through the lenses of collaboration development (including south-south) that gives higher strength and skills of involved incumbents. Therefore, creating a complementary enabling working environment among centres of excellence is an important added value to face the challenges of building the GMES in Africa.

- **Infrastructure Capacity** is related to technological and research infrastructures and platforms to access, use and develop EO data and products for decision-making. 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 the GMES and Africa initiative, should result into a more "democratic" access to EO data. Cheap and reliable Internet access is a requirement, not only for successful human Capacity Building and collaboration but to provide a mean to retrieve and disseminate data and information, as well as for the future GMES related services for Africa.

The foundations for effective Capacity Building future actions rely 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.

GMES and Africa framework should be used as an assertive approach to accomplish sound results, taking into account present circumstances and searching solutions involving four main overarching areas, to support and be sustained, by Capacity Building 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 (e.g. GEONETCast, the data dissemination backbone of the Group on Earth Observation (GEO));
- Expand and extend data and information portals;
- Promote interoperability: standard setting, accreditation and certification;
- Improve infrastructure for data access, analysis, 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 topics related 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 to promote continuous updated Capacity Building

- 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 Capacity Building to support proficiency in the development of EO applications and awareness of new applications.

The success of GMES and Africa Capacity Building requires commitment of numerous stakeholders at different levels (including grassroots) and from various thematic programs, to develop a robust consensus, necessary to contribute towards an integrated policy for environment and security in the context of climate change. The new strategic partnership between Africa and Europe is expected to provide a novel framework of cooperation, addressing African priorities, where GI Capacity Building plays an unquestionable role.

SECTION 2 - THEMATIC AREAS

Long-term management of natural resources

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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.

Service definition and provision. The generation of standard products can be envisaged in function of the 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.

(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: (a) the regular land-cover characterisation at coarse resolution (300m) updated every 3 years locating the main land-cover types, (b) 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.

(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: (a) national estimates based on a sampling design, with an intensity depending on the country size, analysing extracts of medium resolution images every 5 years (b) 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…

Capacity-building. 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 from technicians to managers, including scientists and local communities. According to the category, the reinforcement of capacities should take place in existing schools or in specific schools with a focus on Space-based technologies.

Prioritisation of 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.

Organisational scheme. For the management of GMES Africa, a clear political vision is a pre-requesite. 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.

Marine and Coastal Areas

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This summary includes 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 (EO) 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 within legislative and governance frameworks 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 enterprises specifically addressing African marine and coastal waters such as the EC funded Europe Africa Marine EO Network (EAMNet) and global initiatives with application around Africa (e.g. ChloroGIN Network) 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 provides 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 GMES Sentinel satellites.
- **A Network of Coastal 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.
- **An African Capacity Building Network of Higher Education Institutions** linked to the Network of Coastal Stations and to the Network of Marine Remote Sensing and Dissemination Centers.

In each case 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 utilize marine and coastal products of value.

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 EAMNet.

The successful implementation of the GMES Africa Service for the Marine and Coastal Areas will bring progress on sustainable development and on-going 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
- Providing a **stable level of financial** support into the future.

Water Resource Management

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Water, one of the Millennium Development Goals 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, EO technology represents a unique tool to support African water authorities to overcome the water geo-information gap in Africa. In particular, the increasing observational capacity available in the near future through the coming GMES Space component, with special attention to Sentinel 1, Sentinel 2 and Sentinel 3, will provide an unprecedented potential to enhance inventory, monitoring and assessment of water resources at continental, regional and local levels. Therefore, *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 bases of several initiatives (AMESD, TIGER, UNESCO IHP, WHYCOS and HYCOS, SERVIR Africa). 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.

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 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 bodies mapping, soil moisture estimation, water levels estimation, catchments characterization, water quality, ground water exploration, water Infrastructure monitoring among others.

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

Ownership

- African ownership of the service definition and development of decision-support tools for (African) users is a key element for *GMES and Africa* service model. African institutions shall drive and own the development and implementation process of improving local Integrated Water Resource Management (IWRM) strategies. AMCOW, as African interlocutor in support of the AU, shall play a key role in coordination and governance.

Operational scale

- It is recommended that the basin authorities from sub-national to trans-boundary scales and national water authorities will be the main users of the services and hence the main end-beneficiaries of *GMES and Africa*. Consolidated and validated information services shall be implemented in dedicated technical centres taking into account the conditions and requirements of the respective institutions and regions. Long-term free and straightforward access to GMES observation data is considered to be essential.

Capacity building

- It is recommended that a dedicated Capacity Building Program at continental scale is created to develop a critical mass of human expertise, African technical centers and value adding companies with the capacity to develop and operate EO-based water information services and IWRM information systems. At the same time, a strong capacity building component shall be dedicated to empower users (water authorities) to maximize the utility of the geo-information into practical day-by-day management and planning practices.

Partnerships

- A long-term dialogue between the different actors involved in the end-to-end service chains shall be established and maintained. It is recommended that a mechanism will created to interface the data providers, the technical centres in Africa that may serve as service providers and the basin and national water authorities. That dialog shall allow to establish suitable service level agreements and data access and sharing protocols to sustain the service provision and utilisation in the long-term.

EO Data Access:

- Suitable mechanisms shall be put in place to ensure an efficient and open access to EO data in Africa, with special attention to the GMES Sentinel missions. This implies both the establishment of a free and open data policy for the Sentinel missions and the implementation of suitable technological solutions to ensure the physical access to the large amounts of EO data expected from the Sentinel missions, hence overcoming the African digital divide.

Impacts of Climate Variability and Change

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Introduction. Africa is endowed with immense renewable national resources but has also been identified as a continent particularly vulnerable to the consequences of climate variability and change (Odada et. al 2008), the effects of which are becoming evident 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 suffer from high rainfall variability in many parts of the continent. Climate variability and change is likely to affect food security as well. 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). The multiple impacts of climate variability and change in Africa that will need to be addressed by adapted and knowledge based policies are widely accepted and include: decreased food production, water availability, loss of habitats and biodiversity, worsening land degradation and threats to human health such as increased malaria outbreaks (IPCC, 2007), all of which might trigger human conflicts over scarce resources.

Policy Drivers and Need Analysis. A major factor influencing the constant urgent decisions national policy makers need to take 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. Africa needs to build effective partnership systems linking stakeholders, users and decision-making sector with climate information providers. Synergies with sister conventions, UNFCCC, CBD can therefore be consolidated optimizing use of resources, obtained information and reporting obligations. 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; as well as to compile assessment of their impacts and vulnerability; and for the development of appropriate mitigation and response policies.

Specific activities are already undertaken conform to regional issues highlighted by the Global Climate Observing System (GCOS). These experiences confirm a lack of standardized procedures and methods to perform this at operational scales. Building required capacity 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 focused and continent wide programmes that include all key stakeholders. GMES is an excellent basis for such contraction.

Governance. Capacity building for GMES constructs 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 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.

The GMES and Africa Action Plan lists the African and European communities and stakeholders that could be engaged in the GMES initiative and lists also the existing capacities and programmes in Africa on which to further build upon. These include institutions such as the Africa Union, NEPAD, IGAD SADC, ECOWAS, European Commission Institutions and International institutions, such as UN organizations; as well organisms of the GEO group of programmes, initial GMES processes, drought monitoring centres and Africa wide programmes such as AfricanNESS.

Implementation and prioritization. Increasing the acceptance of the continuing need for monitoring and assessment and its flow into the policy making process is a basis for the GMES capacity building starting with adapted knowledge management. It further needs a transparent, collaboration and coordination of activities at regional and national scales. Once knowledge improves, this catalyzes needs and use of information. Such 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. Services will need to deal with a certain initial inertia of product take-up and focus on knowledge management and transfer than product generation itself during the initial phase.

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. Prioritization is listed below:

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

Building GMES and Africa Service. Besides the requirement of reliable space and in-situ data collection systems, the successful implementation of the services will depend on a robust information baseline, built on common principles of data collection, data handling and reliable methodologies for the integration of archived data and monitoring data, in view of deriving biophysical and socio-economic trends; concepts for streamlining 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;

Earth Observation is complementary, not alternative, to in-situ observations, but provides a good basis for spatio-temporal integration of both data types. The GMES initiative aims at closing identified thematic, data, methodological and knowledge gaps to contribute to effective monitoring of natural resources in support of stakeholder needs, especially at local policy level. African data collection methods and storage are mostly dispersed and not harmonized. Data gathering in-situ at national level is not fully coordinated and if data is collected for one purpose it might not be available to other stakeholders. In many cases institutional capacity or motivation is missing to cover less common, but needed, data needs. 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.

Basic and advance services, including space borne solutions and focused products, responding to these needs are listed in detail in the Action Plan. GMES plans to provide integrated services based on the many science approaches available. Still a research question in many cases, but building on experiences from IPCCC and the recent science integration process of the UNCCD, it is a 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.

Natural and Human Induced Disasters

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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 Centres 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.

Food Security and Rural Development

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Food Security and Agriculture are key element to consider for eradicating poverty and to ensure sustainable development in Africa and especially in Sub Saharan Africa. In this region, Agriculture accounts for more than 50% of the Gross Domestic Product and employs more than 60% of the population.

Sub Saharan Africa did not benefit 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 Official Development Assistance 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 agriculture development is also challenged by demographic growth and climate change as well as the recent "Land grabbing" issue.

In line with the Comprehensive Africa Agriculture Development Program (CAADP) ratified in 2003, this is now a unique opportunity for the Sub Saharan African countries to develop comprehensive Agricultural information systems (Early warning systems, Agricultural statistics, Large scale mapping on rural areas and Land tenure information system) required to support rural development policies, to provide information to farmers (including adaptation to Climate Change) and market organisations, and more generally to contribute to a sustainable management of the natural resources.

The Information Systems will be implemented in the short and in the long term at different scales, from local to continental levels. To be effective, the activities must be based on existing communities of users, according to the different policies, institutional and technical levels. The 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.

- In terms of priorities, the **Food Security Early Warning System** should be first implement at regional level, taking advantage of the capacity and quality of the existing regional centers like AGHRYMET in Niamey, RCMRD in Nairobi and SADC Center in Gaborone, and the support of the current EU funded AMESD-MESA programs. These centers could share their experience leading to best practices and common and accepted approaches. The development of the system can count also on international activities already carried out in Africa : FEWS Net, FAO GIEWS, EU JRC MARS, ESA GMFS … The first requirement will be to secure Low and Mid resolution EO data reception and the definition of common standard products. Processing facilities should also be installed at regional 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 mirroring regional outputs, offering a continental vision and supporting an African Food Security strategy. Regional centers will serve as coordinator of the national actions in the EWS topic. The activity will be based on the production of regular biophysical remote sensing parameters calibrated and validated with field information.

- Link to their nature and the political decision level, **agriculture statistics and land planning** activities must be implemented at national level. The priority will be to develop for each country a

national land cover – land use database and maps with a specific focus on an accurate representation of the agriculture domain. The product should follow a multipurpose and standard classification approach. The activity could be in line and seen as a continuation of the FAO AFRICOVER initiative. Building the activity through an institutional network approach and involving the National Mapping Agencies should facilitate the success of the operation. The product developed on High resolution EO data will answer to the needs of agriculture statistics providing a basis for land stratification and the requirements of national land use planning.

- In the **land administration** context, key advanced countries will be selected for a first implementation of pilot activities. This should support existing initiatives, national or supervised by FAO or the World Bank. The activity should be based on very high resolution products (less than 1 m resolution) acquired on an ad hoc request and for a specific area. The activity needs a well defined socio-political context to be efficient.

National activities should be supported by regional centers. These regional centers could play a key role of technical support, training infrastructure, ensuring compliance with product standards, production validation then providing a platform for product and best practices dissemination. Dialogue and coordination between regional centers is also essential, involving technical exchanges and the sharing of experiences.

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. For the technical implementation, partnerships with existing international initiatives like USAID FEWS net, EU JRC MARS, ESA GMFS, AMESD … must be considered. Duplication of efforts must be avoided through an open dialogue with the existing projects; if relevant, consolidation of activities should be the objective for a long term sustainability of the developments.

It is recommended for the success of the development that the activities will be supported by an open and strong data access policy. The implementation of the activities should also respect institution mandates and should be built preferably upon a Network of institutions to reinforce and to guarantee the sustainability of the activities.

Infrastructure for territorial development

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The term infrastructure refers to the physical and organization of structures needed by societies to operate. Societal technical infrastructures include roads, water supply, sewers as well as electrical grids and telecommunications networks. Their quality and extent within a country is correlated with social and economic development. Other physical infrastructure is equally important. For example, societal development is expressed by the relative distribution of population in urban and rural areas and by the spatial arrangements and connectivity of its villages, towns and cities. Within this built environment the presence of school, hospitals and public services relate to a high human development index. Finally, it is the societal production sector and its spatial arrangements of industries, commercial, energy generation plants that contribute to the wealth of a nation. The availability of all of these physical infrastructures and the service they provide are directly related to economic and social development.

Africa is growing rapidly and so are its physical assets and infrastructure. This fast growth of population, urban centers, cities, transport networks, needs to be planned and managed for a sustainable economic and environmental growth. The complex and interconnected societies we live in needs management that is based on the collection and availability of precise, updated and timely information on its infrastructure. Some of this important information can be generated by GMES services.

Infrastructure information is needed at different scales because infrastructure projects are carried out with different geographical extent. The spatial information required for planning and modeling the projected outcomes are different whether the project is local – i.e. Disaster risk mitigation plans within an urban center; or reconstruction plan on a disaster affected area; it is interstate – i.e. roads or rails connecting cities or countries, it is regional – i.e. building a hydroelectric power plan; it is continental – development of telecommunication infrastructure. Satellite imaging technology such as that provided by GMES with its range of multi-scale satellite sensors are best suited to rapidly and effectively collect information.

Information is essential to evaluate, plan, size and build infrastructure projects. These may be funded by donors of the high income economies (USA, European Union) and increasingly by the new emerging economies including China, Arab states, India, Turkey, South Korea. Project implementation may be supervised by UN agencies or other Non-Governmental organization. Information can thus benefit donors and international organization. However, information is created for managing the infrastructure and it is thus for Africans and African institutions.

Infrastructure management occurs at different levels and with different players. At continental level it is the Commission of African Union, the secretariat of NEPAD, the Economic Commission for Africa, the African Development Bank, and of specialized institutions. At national level there are at least two types of institutions that are related to territorial development: those that operate at strategic level and those that operate at technical level. The institutions operating at strategic level require and use the information on infrastructure for strategic plans; for example, for prioritizing funding to be used to supply and the distribution of freshwater, the road-network, the regional industrial infrastructure. The technical bodies typically manage and often generate the information that are grouped within three types of ministerial institutions: first, the ministry of public works that among many tasks also supervises the development of the built environment and the urban environment; second, the ministry of energy and mineral resources that addressed the resources other than agriculture; finally the ministry of agriculture that supervises rural development. In all of these

technical bodies including the ministry of agriculture, the infrastructure – whether irrigation plans, or road networks play a very important development role.

At local level it is the municipalities that require infrastructure information the most. Especially the municipalities of large metropolitan areas and those of the rapidly expanding cities face some grand challenges that include for example, absorbing a continuous flux of people resulting from both city population growth and from rural urban migration. The resulting processes are unplanned urban areas, urban sprawl, deficit in lifelines and in services, and lack of pollution reduction strategies. GMES can help to generate some of the required information to tackle these issues. For example, GMES can help to generate information on settlement extent, its growth, the quality of the urban areas and its building stock, the location of disaster prone areas as well as the unhealthy and the less resilient areas of the municipality. When information is collected then plans and proposals can be put forward, evaluated, and sized. Plans are used to request funding – possibly also through donors - and eventually used for financing and start to implement rejuvenation of urban landscape, up-scaling lifelines planning and preparing for expansion of cities.

Gaps in technology, training and data within African institutions need to be closed. GMES will generate data that can be used by the different African actors. That data needs to be processed by trained professional and training and capacity buildings will be required. There are several recommendations on how to achieve this. There seem to be a consensus on strengthening the current scientific and technical facilities already available in Africa. Also, new scientific technical institutions could be envisioned as follows:

- **Euro-African Agency of Geomatic** that will be responsible for managing and establishing a geo-portal on Africa. The agency will address data standardization of geographical data at the continental level and train technical and managers for cartographic production and for managing land parcel systems (Cadastres).
- **Territorial development agency** that will focus on produce disseminate land use management datasets related to urban, rural industrial, as well as those of transport and telecommunication.
- **Environmental and territorial development observatory** will have the focus on managing environmental indicators to be used also within international conventions.

The timeline for implementing GMES will be dependent on the resources and the objectives. Some such as capacity building and training should receive highest priority. Some development processes such as the rapid and unplanned growth of cities require rapid intervention for which current cartography and spatial datasets are indispensible. The priorities will be inevitably listed with the stakeholders.

GMES may not address all territorial information needs for Africa but it may provide solid backbone continental information “infrastructure” to guide and manage the future development of Africa.

Conflicts and political crises

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In the 1990s several African countries were affected by violent conflicts and political crises that caused considerable losses of human lives and destruction of socio-economic infrastructures. Their consequences are still felt in those countries but also in entire regions like the Central Africa (civil wars in the Democratic Republic of the Congo, in Burundi and in Congo, genocide in Rwanda, etc.) or the Western Africa (civil wars in Liberia, Sierra Leone, Côte d'Ivoire). They make the effort of poverty reduction and promotion of sustainable development more difficult in a context where international cooperation resources are shrinking. There's nowadays a general consensus on the close links between sustainable development, poverty reduction and conflict management. Contrary to a dominant design before the 1990s, development and security matters are considered today closely dependent either at the national level or at the regional and continental levels.

In that context, conflict prevention and identification of the effective approaches of management of political crises and their consequences have become priorities for all development actors. In practice however, few advances in terms of methodological and operational approaches were recorded because of complexities surrounding those issues. The causes of the conflicts and political crises are multiple and form part of the specific history of each country. They involve not only the colonization-inherited problems such as the imposed national borders, but also the poor management of the country natural resources, political exploitation of ethnical identity, weakness of public institutions, increasing inequalities and corruption.

The search of innovative approaches for conflict prevention and management of the conflicts should take into account the development of the new technologies that have proved to be efficient for data collection and processing. This action plan aims at making it possible to benefit from the development of space technologies in the prevention, management and resolution of conflicts and political crises in Africa. In this continent, peace and security matters have become central on the agenda of development policies, in particular since the establishment of the African Union in 2002. A consensus now exists on the importance of ensuring peace and security which are the necessary conditions for socio-economic development and for regional integration. Several African countries underwent violent conflicts and political crises which caused considerable human and material losses and destruction of socio-economic infrastructures. Consequences are still felt at the level of these countries, but also at the level of whole regions like the Central Africa or Western Africa. They handicap the efforts of poverty reduction and sustainable development in a context where the resources of international cooperation become rare and conditioned. Hence, there is a strong need to enlarge the strategies of conflict prevention and management. This action plan falls under this prospect.

The GMES services & Africa can contribute significantly to the implementation of African Peace and Security Architecture initiated by the AU as the coordination framework of the peace and security initiatives on the continent. The examination of its last and current projects shows that the urgent needs concern the equipment for acquisition and use of space technologies, financial resources, the strengthening of the user capacities at the level of the AUC's units and of the RECs in charge of implementing the program.

An action plan over 10 years is proposed to meet the urgent needs and to address the existing shortcomings through four main intervention lines:

- Support the implementation of the AU Border Program by the use of space technologies in the **inventory, the delimitation and the demarcation of boundaries**.

- Strengthen support to AU and RECs peace operations by the use of space technologies to provide **cartographic products and location services**.
- Increase the **analysis and forecast capacities** of the AUC and of the RECs using space technologies and field data collection tools.
- **Support to humanitarian operations** of the AU Member States and local NGOs.
- Complementary initiatives can be envisaged to adapt to the volatile and changing character of the security context.

In order to guarantee the success of this action plan, it is recommended to ensure an effective cooperation between the African and European institutions involved in the initiative. For that purpose, the cooperation structure should value the contribution of each partner, create synergies and facilitate the dialogue between the partners. The privileged dialogue should be strengthened between on the one hand the European and African institutions (in particular both Commissions), and between the African and European research communities, on the other. The African and European private sectors and the civil society organizations should also be involved in the various phases of the program.

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