6. "Marine and Coastal Areas"

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EXPERTS

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1. INTRODUCTION

1.1 Thematic Context

With more than 35,000 km of coastline, coastal and marine environments play a vital role in the socio-economy of many African countries, contributing significantly to national Gross Domestic Products (GDPs), to food security, and supporting a wide range of coastal livelihoods. According to NEPAD (2005), the coastal and marine fishery sector provides vital contributions to the protein needs of 200 million people in Africa. In several African countries, marine products account for 60% of total protein intake. Biodiversity and natural assets of African coast are important attractors for tourism. In some countries, many of them Small Island Developing States (SIDS), tourism represents not only the largest employment sector but accounts for significant contribution to national GDPs, for example, up to 60% in the Seychelles (WTTC 2005).

In recent years, increasing coastal migration and urbanisation (50% of the population lives within 100 km of the coast) and industrial development, have driven negative environmental trends and has led to the unsustainable use of coastal and marine natural resources. The deterioration of coastal water quality is severe around many large African cities (Dakar, Abidjan, Conakry and Lagos, for example). Inappropriate zoning and coastal land use, as well as the lack of environmental management and the overexploitation of resources and services have also led to degradation of coastal water quality. Areas of high biodiversity such as mangrove forests and coral reefs have structurally been impacted severely 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, unregulated or regulated by unsustainable international agreements, has contributed to a massive decline in fish stocks, particularly off West Africa. By 2002, demersal fish stocks in northwest African coastal and shelf waters had been reduced to a quarter of its level in 1950 (OECD 2007), contributing to destabilising the economies of several regional countries that rely on fisheries to achieve up to 20% of their GDP.

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 has been linked to climate change, and in turn to rising sea levels. IPCC-projected sea level rise would increase coastal flooding, endangering even more the population and economy of continuously growing coastal megacities, causing further severe damage to the coastal and marine environments and the resources and services they provide.

1.2 Pressures and Constraints

In spite of the great potential of satellite data allowing for reliable and timely monitoring of the marine and coastal environment in Africa, several constraints have been identified by user groups regarding the operational use of acquirable data and metadata. Identified constraints are insufficient access to data, limited frequency of measurements, lack of appropriate infrastructure for data reception and analyses, absence of local in-situ calibration and validation programmes, as well as inadequate mechanisms of information dissemination to user groups and communities outside the scientific community. There is still a communication and participation gap between the scientific community and the

management/policy user community that would integrate Earth Observation (EO) data and information into coastal and marine planning and management in Africa.

The sustainable use of the natural resources and services of the coastal and marine environment in Africa requires the development of a continental-scale EO monitoring and data management and analysis system to understand long term environmental trends and to develop appropriate management responses. The embedding and integration of EO data and information on ecosystems at several scales (LME, regional, national, local) into high quality Geographic Information Systems (GIS) and related databases, would underpin this approach. Such an Africa-wide system would have to be supported by a consistent user-driven management structure and a sustainable funding mechanism. The GMES and Africa Service for Marine and Coastal Areas, proposed in this Chapter, describes such a system.

2. POLICY DRIVERS AND NEEDS ANALYSIS

2.1 Policy Drivers

Over recent decades, several Multilateral Environmental Agreements (MEA) have been enacted, all of which are particularly relevant to Africa's development needs. These MEAs at global scale were complemented by regional MEAs in Africa that were able to address local issues and priorities more specifically. GMES and Africa will be at the forefront of providing the means through which many of the objectives of these international and regional MEAs can be achieved and from which sustainable Africa-wide development will benefit.

International Conventions of Relevance to the Development of Africa's Coasts

- 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.
- The United Nations Conference on Sustainable Development – UNCSD (also known as Rio+20) held in Rio de Janeiro, Brazil, in June 2012 renewed the commitment of governments to sustainable development, and to ensuring the promotion of economically, socially and environmentally sustainable future for our planet and for the present and future generations.
- The UNCSD outcomes document - "Future We Want" recognised the importance of space-technology-based data, in situ monitoring, and reliable geospatial information for sustainable development policy making, programming and project operations. In this context, UNCSD noted the relevance of global mapping and recognized the efforts in developing global environmental observing systems, including by the Eye on Earth network and through the Global Earth Observation System of Systems. UNCSD recognized the need to support developing countries in their efforts to collect environmental data.
- The "Oceans Compact: Healthy Oceans for Prosperity", launched by the United Nations Secretary General in August 2012 sets out a strategic vision for the UN system to deliver on its ocean-related mandates, consistent with the Rio+20 outcome document "The Future we Want" in a more coherent and effective manner. It aims to provide a platform for all stakeholders to collaborate and accelerate progress in the achievement of the common goal of "Healthy Oceans for Prosperity. Three inter-related advance this goals: (i) Protecting people and improving the health of the oceans; (ii) Protecting, recovering and sustaining the oceans' environment and natural resources and restoring their full food production and livelihoods services; and (iii) Strengthening ocean knowledge and the management of ocean. These objectives must be underpinned by a robust global ocean observation and knowledge infrastructure and the successful operation of the UN General Assembly's Regular Process.

- Mauritius SIDS Declaration, Barbados, etc.
- Desertification
- CBD
- UNFCCC
  others

Pan African Conventions and the National Legislative Framework

A series of Regional Conventions and their Protocols are addressing specific priorities of the African coastal and marine environment:

- 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) set 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, all African coastal countries have enacted their own legislation to manage and protect their marine and coastal areas and resources. At the same time, each country recognises the value of regional and international cooperation to address common needs and priorities through national contributions to Regional Convention Funds as well as reinforced cooperation through the Regional Economic Commissions.

2.2 Needs Analysis

As the awareness of the importance of Africa's surrounding seas and oceans (to the climate, ecosystem health, and economy) has grown, so has the demand for data and information necessary for sustainable management. The need for unravelling and monitoring environmental functions in a changing climate, from continental to local scales, is increasing.

The implementation of international and regional coastal and marine conventions, but also of respective national legislation and policies in Africa, requires the reinforcement of existing research and operational infrastructure and the creation of further capacities. Given the prevailing shortage of financial means available in many African States, there is a growing need for national and regional networking, EO data acquisition and exchange, as well as the establishment of regional EO databases that would (cost-) efficiently support the implementation of national, regional and continental marine environmental programmes.

Needs analyses undertaken in the region:

- from the TDAs and SAPs that have been prepared by the African LME projects<
- relevant AU documentation that could be cited???

3. IDENTIFICATION OF COMMUNITIES ('Stakeholders and User Groups'?)

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, Global Environment Facility, 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, CBD, UNCCD, Agenda 21, UNECE, Johannesburg Declaration on Sustainable Development

Pan African

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

Regional

Regional conventions	Abidjan, Nairobi, Jeddah and Barcelona Conventions, Barcelona Convention ICZM Protocol
Economic communities	Economic Community of West African States, Southern African Development Community, Indian Ocean Commission, Economic Community of Central African States, IGAD, COMESA
Regional bodies	Benguela Current Commission, Interim Guinea Current Commission (?), Pan African Large Marine Ecosystems, South East Atlantic Fisheries Organisation, South Indian Ocean Fisheries Association, South West Indian Ocean Fisheries Commission, Indian Ocean Tuna Commission
Professional Associations	African Association for Remote Sensing of the Environment, Western Indian Ocean Marine Science Association, EIS Africa.

National

Government departments	Environment, Fisheries and Marine Resources, Tourism, Transport, Coastal Zone Planning, Minerals and Energy, Ports and Harbours, Marine Pollution, Maritime Surveillance, Armed Forces and Coast Guard
Offshore industry associations	Oil and Gas, Fisheries, mariculture, Mining, Coastal Transport and Shipping, Coastal Tourism

Local

	Local Government Units and National Line Agencies involved in Coastal and Marine Environmental Planning and Management

Key Academic and Research Institutions

There are a number of institutions along the coast of Africa that play important roles 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 delivered. National academic and research institutions are also managing a range of research and training facilities dedicated to marine and coastal development.

4. MAPPING EXERCISE

The development and implementation of a GMES and Africa programme in marine and coastal areas will build upon existing EO programmes, components and facilities, taking into account current developments specifically addressing African coasts and coastal waters.

Recent and current programmes and services

The emphasis here is on regional programmes and services in Africa that cut across national boundaries, arranged by application area. In most cases, countries have their own projects contributing to the programmes.

	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 (2007-2011)	COI/EU	www.progeco-oi.org
WIO-LaB	Addressing land-based activities in the Western Indian Ocean (2006-2009)	GEF/UNEP	www.wiolab.org
RCMP	Regional Coastal and Marine Conservation Programme for West Africa	WWF/IUCN	
ISLANDS (ISIDSMS)	Implementing the SIDS Mauritius Strategy (2011-2013)	COI/EU	
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	
more			
	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
WWF-EAME	East African Marine Ecoregion	WWF	
	[recent processes for the identification of World Heritage Sites, Vulnerable Marine Areas and EBSAs in the WIO]		
more			
	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 Ecosystems Project	GEF/UNDP	www.asclme.org
WIO-Lab	Addressing Land Based Sources of Pollution in the WIO	GEF/UNEP	
GCLME	Guinea Current Large Marine Ecosystem	GEF/UNDP	www.gclme.org
BCLME	Benguela Current Large Marine Ecosystem		www.bclme.org
CCLME	Canary Current Large Marine Ecosystem Project		

SPMLME	Strategic Partnership for the Mediterranean Large marine Ecosystem	GEF/UNEP	www.medsp.org
	Remote Sensing Servers		
GMIS	Global Marine Information System (specific focus on Africa, Caribbean and Pacific countries)	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
RCMRD	Regional Center for Mapping of Resources for Development	UNECA	
RECTAS	Regional Centre for training in Aerospace Surveys	UNECA	
MyOcean	EC FP7 MyOcean project	EC	www.myocean.eu.org
	Observation Networks		
NC-CHM	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 (2007-2012)	EU/COI/IGAD/AU (?)	www.amesd.org
MESA	Monitoring for Environment and Security in Africa (2013-2017)	EU/AUC; RECs & RICs	
ChloroGIN -Africa	Chlorophyll Global Integrated Network in Africa	GEO	www.chlorogin.org
DevCoCast	GEONETCAST for and by developing countries (2008 – 2011)	EU	www.itc.nl
EAMNet	Europe – Africa Marine EO Network (2010-2013)	EU	www.eamnet.eu
SAEON	South African Environmental Observation Network	SA- DST	www.saeon.ac.za
SIMORC	System of Industry Met-Ocean data for the Offshore and Research Communities	OGP	www.simorc.org

Capacity Building

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

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	www.africaclimatescience.org

		of Science (Trieste)	
CRTEAN	Centre Régional de Télédétection des Etats de l'Afrique du Nord (North African Centre for Remote Sensing)	Algeria, Egypt, Lybia, Morocco, Mauritania, Sudan, Tunisia	
EAMNet	Europe – Africa Marine EO Network (2010-2013)	EU	www.eamnet.eu

5. GAPS, SUITABLE PROGRAMMES and FUNDING INSTRUMENTS

5.1 Gaps

There are too few marine and coastal development programmes in some areas of Africa. There is a need for inter-connected programmes and projects, operating as an integrated operational Africa-wide framework. To support pan-African sustainable coastal and marine development, it will be crucial to establish new integrated initiatives, with coordinated regional and international technical and financial support involving the commitment of the entire international donor community. An example could be a pan-African network of coastal sentinel stations, gathering *in situ* observations of value to user communities at all geographic scales and management levels, forming an Africa-wide Integrated Coastal and Marine Zone Management Community.

Elements that would need strengthening include:

- *In situ* measurements in their own right, and for ground-truthing to support accurate EO interpretation.
- Effective dissemination of value added products, in near-real time, taking advantage of new and developing broadband links in Africa.
- A strong capacity building and maintenance programme, building on already existing capacities.

5.2 Existing or planned thematic funding programmes

The European Union CORDIS provides a Practical Guide to funding opportunities in research and innovation (http://cordis.europa.eu/eu-funding-guide/). Among others it identifies funding opportunities relevant to GMES and 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. Other opportunities are described in the context of initiatives under GEOSS, whilst regional funding opportunities may 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 (AMESD), funded through regional thematic actions for the development of coastal and marine management in the Western Indian Ocean. This programme will have its follow-up in the upcoming MESA Project (2013-2018) of AUC (EC funding).
2. The Guinea Current Large Marine System involving sixteen countries of West Africa.
3. The Europe-Africa Marine EO Network, funded through the Coordinating and Support Actions of European Union International Cooperation.
4. The DevCoCast programme of infrastructure support for satellite transmission of EO products, extending GEOSS GEONETCast across the countries of Africa.

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

6. Building the GMES and Africa Service

6.1 Service Definition and Provision:

Earth Observation can address socio-economic areas of critical importance to African coastal states through:

- Providing protection against natural and human-induced disasters,
- Understanding and managing environmental health issues,
- Managing coastal and marine energy resources,
- Development of climate change resiliencies ,

- Safeguarding and managing coastal freshwater resources,
- Improving weather forecasts,
- Managing coastal and marine ecosystems, their natural resources and environmental services,
- Conserving marine and coastal biodiversity.

It will be important to encourage the use of Best Practice and the creation of stakeholder networks in marine and coastal integrated management for the sustainable benefit of all groups of society. This can be accomplished by implementing operational, integrated services, built on existing programmes, and available throughout Africa. This GMES and Africa Service should be:

- Pan African: reaching to all the coastal countries of Africa;
- Operational: utilising Earth Observation from space agencies;
- Comprehensive: an end-to-end service from observations, through analysis and forecasts, to the dissemination of value-added products to user-communities;
- Built on existing research projects and pilot programmes;
- Maintained and operated by Africans, developing and utilizing African capacity in African Centres of Excellence;
- Designed to feed into local and national governance schemes that ensure effective consultation with all stakeholders;
- Equipped with a continuous funding processes and sustainable budgeting so as to maintain long-term sustainability of the Service.

6.2 Capacity Building and Maintenance

6.2a Necessary Elements

Institutions, Human Capacity and Skills Training

In Africa, considerable differences in the EO data application capacities for coastal and marine management prevail, with some countries already utilising EO-based systems, while most countries have very little or rudimentary capacities, some having being built with project support such as from the AMESD programme. Without addressing these gaps, the continent will fall further behind in its ability to respond to the challenges of establishing sustainable coastal and marine management. While supporting the development of necessary skills with the EO data user groups involved in coastal and marine management, it will be equally important to support investments into infrastructure specific to EO applications in coastal and marine management within relevant institutions across the continent.

6.2b Strategy to develop the necessary elements

Capacity building must take on an “operational” profile, enabling nations to manage the marine and coastal services required by society, maintaining vital links to science, technical infrastructure and international cooperation. It must be based on identified priorities as well as on utilising shared observations and data resources, and shared technical and scientific service tools. Not all of these conditions are adequately met today. However, from experience with already existing services, the availability of data and sophisticated numerical models and the expanding use of IT should be accelerating the implementation of marine and coastal EO systems.

Capacity building activities must find a balance between front-running high technology, and the realism needed for robust and sustained systems in the African context. The aim must be to make nations optimally self-sufficient in using marine and coastal observing systems. 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 institutions, and to the Regional Economic Commissions. Professionally trained and empowered scientific, technical and management staff, specifically involved in coastal and marine management will be needed to generate, disseminate and utilise marine and coastal EO products of value to the people of Africa.

6.3 Prioritisation of Requirements and Actions

The Proposed GMES Africa Service for Marine and Coastal Areas

The GMES and 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 will be founded on the following components:

A GMES and Africa Network of Regional Early Warning Centres

A major need exits for specific value-added EO products to support African coastal and marine user communities. Such products include:

- **Operational coastal sea level, coastal circulation and coastal sea state data, analyses, imagery and mapping**, downscaled to the particular coastal and marine management unit at hand. This product 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 example, for offshore oil and gas industry, ports, shipping and for safety at sea.
- **Operational biological productivity data, analyses, imagery and mapping**, low oxygen and harmful algal blooms as part of ecosystem health reporting from Long Term Ecosystem Research (LTER) observational networks, for coastal and marine resource managers.
- **Coastal sensitivity and vulnerability atlases** and **state of environment reporting** for coastal and marine managers, coastal land use planners, city managers, and the private sector (i.e. tourism industry, fishery, oil & gas, etc.), near-shore and off-shore.

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 tourism industry can make immediate use of many of the products generated for users in the public sector. The GMES and 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.

Early Warning Centres and the Remote Sensing Centres may possibly be institutionally combined.

A GMES and 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 ocean colour products for coastal, marine and ocean management 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 and Africa.

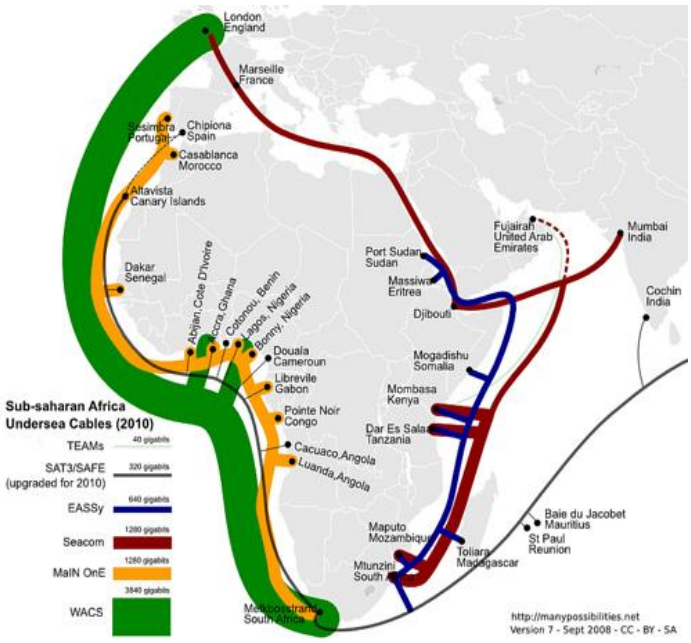
A GMES and Africa Network of Coastal Sentinel Stations

These coastal sentinel stations will be established at key locations along the coasts of Africa, and would be responsible for conducting and collecting in situ observations. Mega cities, ports and areas with offshore industrial activity are examples of priority locations. Measurements from these stations would be of value in their own right, and to provide ground truth data in support of the increased application and quality assurance of satellite observations in coastal and marine areas not only in Africa but at a global scale. 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, operating under 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 a GMES and Africa Service operating under the auspices of GMES and Africa.

Supporting technical platforms will be needed to ensure that the GMES and Africa Service can operate effectively. A Data Management Platform will be needed for quality control of all observational data, for archiving and retrieving historic

data, and for the generation of climatologies to add value to the data. 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.

A 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 speedy dissemination of value added products. A key example is making use of the various new fibre optics cables of the Africa Marine Information highway (reference and figure still up to date?).



The African component of the (recently ended) DevCoCast project and the on-going EAMNet project are important initiatives to help in the distribution of various marine remote sensing products across Africa. For example, chlorophyll products derived from ocean colour data are being used to demonstrate its effectiveness (through the Chlorophyll Global Integrated Network and in support of AMESD in the western Indian Ocean). Both these projects illustrate the value of cooperation between Europe and Africa. Within GMES and Africa, it will be important to prioritise the extension of DevCoCast and EAMNet into fully operational mode.

A GMES and Africa Capacity Development Network of Higher Education Institutions

This Network will be the final link in the chain of networks proposed for GMES and Africa. The priorities within this Capacity Development Network should not only be the building of new capacity in Africa, but also the effective utilisation and maintenance of existing capacity. 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 institutions, and to the Regional Economic Commissions.

How Can GMES and 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 and Africa Service to all the countries of the region. A suggestion would be to create these Centres in association with the African Large Marine Ecosystems.

- **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 and Somali Current Large Marine Ecosystem region is active in ensuring the long term sustainability of its marine resources. Coral and mangrove ecosystems and the coastal tourism industry are important in this region. Recurrent extreme weather (phenomena) leads to frequent additional perturbation of the coastal and 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 Canary Current Large Marine Ecosystem with coastal fisheries and offshore mining industries.
- **North Africa:** These countries from Morocco to Egypt are part of the Mediterranean Large Marine Ecosystem.

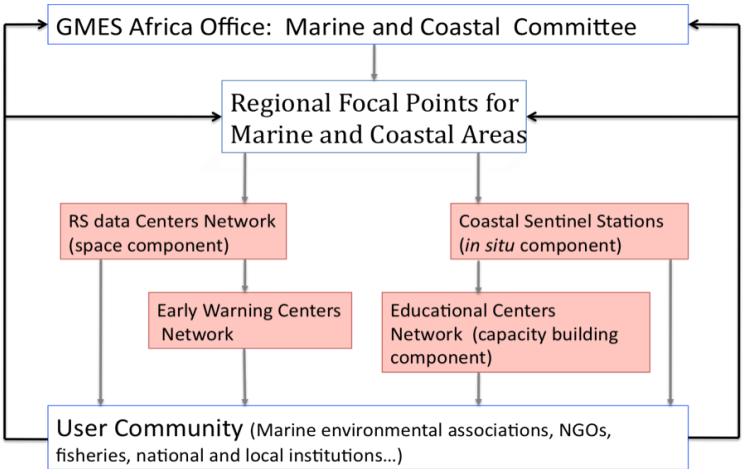
Build and Strengthen Flagship Programmes

Key programmes, covering specific segments of EO and a GMES and Africa Service should be established or consolidated from existing international network such as ChloroGIN and related projects (DevCoCast, EAMNet). These programmes could be conceptualised to support cross border and regional cooperation, which would further-on be developed into a full module/ segment of the GMES and Africa Service and Network.

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 (now completed) EC DevCoCast (GEONETCast applications for and by developing countries) and EAMNet projects, which use 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), South America (Brazil) and Asia (China). It will also improve the technical infrastructure by installing a number of GEONETCast receivers at marine science institutes. As these projects develop it is hoped that additional partners and countries will join in. It is also expected that additional products will be provided to the international user community.

6.4 Organisational Scheme

Effective and sustainable coastal and marine management in Africa can only exist under predictable, efficient, and accountable governance systems. The GMES and Africa Coastal and Marine Segment (theme) is no exception here. The GMES and Africa Service for Marine and Coastal Areas should be designed in such a way that continuous user uptake is possible following continued stakeholder consultations and integration of changing stakeholder needs in an iterative process.



Following the architecture of the GMES and Africa Service described above, 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 continued consultation with the coastal and marine user community, ensuring the updating of current issues leading to information needs for management. It would thus also determine priorities and distribute resources between all the service components accordingly.

Identification of candidates for future GMES and Africa programmes
(these four paragraphs will be moved up to the related tables and figures)

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 and 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 and 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 and 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 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.

Potential Funding Sources and Donors

COI	Indian Ocean Commission	Regional
COMESA	Common Market of Central African States	Regional
DST-SA	South African Department of Science and Technology	National
ECCAS	Economic Community of Central African States	Regional
ECOWAS	Economic Community of West African States	Regional
EC	European Commission	Europe
FUST	Flanders UNESCO Trust Fund	Regional
GEF	Global Environment Facility	Global
GEO	Group on Earth Observations	Global
IOC-UNESCO	Intergovernmental Oceanographic Commission of UNESCO	Global
IUCN	World Conservation Union	Global
NERC	Natural Environment Research Council of the United Kingdom	National
OGP	Association of Oil and Gas Producers	Global
SADC	Southern African Development Community	Regional
UMA	Union du Maghreb Arabe	Regional
UNDP	United Nations Development Programme	Global
UNEP	United Nations Environment Programme	Global
WB	World Bank	Global
WIOMSA	Western Indian Ocean Marine Science Association	Regional
WWF	World Wildlife Fund	Global
More?		

7. RECOMMENDATION

The GMES and Africa Action Plan is a joint initiative between the African Union and the European Union. The Vision/Aim for the GMES and 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: utilising Earth Observation 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, developing and utilizing African capacity in African Centres of Excellence;
- Feed into local and national governance schemes that ensure effective consultation with all stakeholders;
- Equipped with a continuous funding processes and sustainable budgeting so as to maintain long-term sustainability of the Service.

The recommended components of the GMES and 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 for 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 GEONETCast so as to ensure the speedy dissemination of value added products to the entire African user community.

The successful implementation of the GMES and Africa Service for Marine and Coastal Areas will be a valuable asset in supporting sustainable development along African coastal and will be a worthy endeavour by the European Union and the African Union.

8. SUMMARY

This summary will be finalised after the revision, re-editing and changes in the main text.

The European Union and the African Union wish to deepen the dialogue and cooperation between African coastal and marine policy makers and managers and the existing Global Monitoring for Environment and Security (GMES) Programme and European and African policy makers, so as to identify and integrate the requirements for GMES Services to the countries of Africa.

Africans, like people in other developing parts of the world, are increasingly migrating to the coast to find better living conditions, chances for personal development, and many times, to escape poverty. This migration is putting severe pressure on coastal and marine environmental and ecosystem services and resources. A high proportion of the GDP of Africa is produced along the coastlines and within the EEZ. Coastal cities are growing dramatically, raising issues of, among others, environmental health standards, adequate to ensure the well-being of their often poor inhabitants. The regional marine and coastal Conventions of Abidjan, Nairobi, Jeddah and Barcelona, in correlation to the United Nations Conference on Environment and Development, steering the implementation of the Declarations from the World Summits on Sustainable Development, are setting the stage for sustainable coastal and marine development around Africa. They also 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. The extension to Africa of the European GMES Programme, with its reliable information services, will greatly aid the countries of Africa in their quest for safe and sustainable coastal and marine development. Existing initiatives specifically addressing African coastal and marine zones as well as already existing global initiatives with applications around Africa will be used as the foundation for building a full GMES and Africa Service in Marine and Coastal Areas. Coastal and marine sectors which will benefit from such a GMES and Africa Service are among others as integrated coastal zone planning and general management, the coastal urban management, coastal and marine protected areas, fishery management, offshore industries such as oil, gas and mining, general coastal and marine environmental management and the management of the large African Marine Ecosystems (LME). The GMES and Africa Service will be associated with continued and intensified capacity building of all core stakeholder and user groups of its products, including institutional and organisational strengthening and support to the establishing of responsible institutions and organisations where necessary. Various international, regional and national funding instruments will be accessed and utilised.

From existing initiatives, it is possible to identify priorities, gaps and needs where capacity building and new investment are sorely needed. In a broader 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 and 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 and 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, high speed computing, and new communication technology and communication links associated to these. The quality of these platforms will derive from and be based on existing and newly established Centres of Excellence and the further development of Earth Observation Flagship Programmes such as ChloroGIN Africa and DevCoCast Africa.

The successful implementation of the GMES and Africa Service for Marine and Coastal Areas will be a key contributor to sustainable development for the people of Africa, and will be a worthy endeavour by the European Union and the African Union. One key to its long term viability will be the provision of adequate capacity in personnel and infrastructure within its institutions and programmes, addressing the real development priorities in the coastal and marine areas of Africa within a coordinated scientific and user framework of coastal and marine policy and decision makers and managers, The other key will be a stable level of financial support into the future.