

# 6. “Marine and Coastal Areas”

## EXPERTS:

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## 1. INTRODUCTION

### 1.1 Thematic Content

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

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

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

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

### 1.2 Pressures/Constraints.

In spite of the great potential of satellite data to achieve unprecedented instant examination of the marine and coastal waters around Africa, several constraints have been identified by the community to use these data

operationally. These constraints are specifically a relatively poor access to data, limited frequency of measurements, lack of appropriate infrastructure, absence of local calibration/validation programmes (in situ measurements), as well as an inadequate analysis and information dissemination approaches to communities outside the research system. It is clear that there is still a wide gap between the potential user community for marine information in Africa and the means for delivering and analyzing that information from currently planned Earth Observing missions

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

## **2. POLICY DRIVERS AND NEEDS ANALYSIS:**

### **2.1 Policy Drivers**

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

#### **Global Conventions of Relevance to Africa:**

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

#### **Pan African Conventions and the National Legislative Framework**

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

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

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

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

Data and Information Network in Africa. This has also led to supporting initiatives from the African Commission of the African Union, the New Partnership for African Development through its Development Action Plan for the Marine and Coastal Environment, and the African Regional Economic Communities.

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

## 2.2 Need Analysis

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

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

## 3. IDENTIFICATION OF COMMUNITIES

### International:

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

### Pan African:

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

### Regional:

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

### National:

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

Provincial Bodies  
Municipalities

Coastal Planning and Environment  
Coastal Protection, Storm Water and Waste Water

### Key Academic and Research Institutions

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

## 4. MAPPING EXERCISE

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

### Programmes and Services.

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

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

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

### Capacity Building

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

	Capacity Development		
Coast-Map-IO	Improving Emergency Response to Ocean-based Extreme Events through Coastal Mapping Capacity Building in the Indian Ocean	IOC-UNESCO	<a href="http://www.ioc-cd.org">www.ioc-cd.org</a>
IOC-CD-WIO	Capacity Development Programme for the Western Indian Ocean	IOC-UNESCO	<a href="http://www.ioc-cd.org">www.ioc-cd.org</a>
Ocean Teacher	A training resource for Oceanography and Marine Meteorology	IOC-UNESCO	<a href="http://www.oceanteacher.org">www.oceanteacher.org</a>
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	<a href="http://www.rectas.org">www.rectas.org</a>
University of Abomey-Calavi (Benin)	International Chair of Mathematical Physics and Applications. University	IOC-UNESCO UPS (France) IRD (France)	
ACCESS	African Centre for Climate and Earth System Science	UCT, Princeton Univ., Third World Academy of Science (Trieste)	<a href="http://www.africaclimatescience.org">www.africaclimatescience.org</a>
CRTEAN	Centre Regional de Teledetection des Etats de l'Afrique du Nord (North African Centre for Remote Sensing)	Algeria, Egypt, Lybia, Morocco, Mauritania, Sudan, Tunisia	

### Funding instruments / potential donors

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

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

## 5. GAPS, SUITABLE PROGRAMMES and FUNDING INSTRUMENTS

### 5.1 Gaps

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

Elements that need strengthening include:

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

### 5.2 Existing or planned thematic funding programmes

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

Programmes that have been funded under these initiatives include:

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

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

## 6. BUILDING THE GMES AFRICA SERVICE

### 6.1 Service Definition and Provision:

Coastal and marine environments play a vital role in the economy and society of many African countries, contributing significantly to reducing the national balance of payments deficit, creating employment and meeting

the protein needs of the local population. The sustainable use of the coastal and marine environment in Africa requires the development at continental scale of an integrated coastal analysis and monitoring system. The subsequent application over large marine areas of integrating Earth Observations data and field surveys can then be embedded into a high quality, useful geographic information system on water quality and coastal resource exploitation, supported by a consistent user-driven management structure and continuous funding mechanism.

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

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

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

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

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

## **6.2 Capacity Building**

### **6.2a Necessary elements**

#### **Institutions, Human capacity and skills training**

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

### **6.2b Strategy to develop the necessary elements**

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

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

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

management staff will be needed to generate, disseminate and utilise marine and coastal products of value to the people of Africa.

### **6.3 Prioritisation of Requirements and Actions**

#### **The Proposed GMES-Africa Service for Marine and Coastal Areas**

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

##### **A GMES Africa Network of Regional Early Warning Centres**

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

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

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

##### **A GMES Africa Network of Marine Remote Sensing Centres**

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

##### **A GMES Africa Network of Coastal Sentinel Stations**

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

Supporting platforms will be needed to ensure that the GMES Africa Service can operate effectively. A Data Management Platform will be needed for the quality control of all observational data, for the archiving and retrieval of historic data, and for the generation of climatologies to place the products into a reliable context. A Marine and Coastal Modelling Platform will be needed to house the computing power and modelling software for



### **Build and Strengthen Flagship Programmes**

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

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

### **Extending the Benefits beyond the Marine and Coastal Theme**

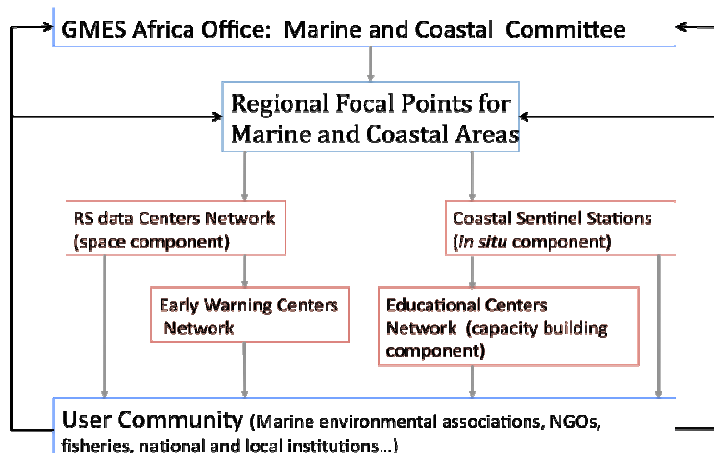
The Marine and Coastal Theme will seek to strengthen cooperation between African and European GMES stakeholders and user communities in other GMES Africa Themes, notably Natural Disasters and the Impacts of Climate Variability and Global Change. The joint use of new communication technologies such as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

## **6.4 Organisational Scheme**

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

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

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



### **Identification of candidates for future GMES Africa programmes:**

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

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

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

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

#### **Identification of the funding instruments to use**

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

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

## **7. RECOMMENDATION**

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

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

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

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

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

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

## **8. SUMMARY**

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

The people of Africa, in common with other less developed parts of the world, are increasingly migrating to the coast, realizing the advantages of living and working there, and reaping the benefits of coastal and marine resources in the fishing, mining and tourism sectors. A high proportion of the National Gross Domestic Product

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

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

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

- A Network of Regional Early Warning Centres, providing products of value to the public and private user communities around the coast of Africa, such as state of the marine environment reports, operational coastal sea level, circulation and sea state downscaled to localities at risk, ecosystem health reports and coastal vulnerability atlases.
- A Network of Marine Remote Sensing Centres, as the fully operational successors to existing pilot facilities, utilizing satellite observations and developing new capabilities linked to the new generation of sentinel satellites from Eumetsat.
- A Network of Coastal Sentinel Stations, gathering *in situ* observations from priority areas such as mega cities, ports and areas of offshore industrial activity, and localities at risk from natural disaster and the impacts of climate change.

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

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