



SUSTAINABLE DEVELOPMENT IN DEVELOPING COUNTRIES: THE AFRICAN, CARIBBEAN AND PACIFIC OBSERVATORY

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Abstract. Freshwater, aquaculture, fisheries, biodiversity, forests, and agricultural land have high economic and social value throughout the Africa, Caribbean and Pacific (ACP) region; but they can also be over-exploited, with damaging consequences for local economies, long term stability and for the Earth system as a whole – especially the climate system. The ACP's fast growing population puts growing pressure on the environment to provide food, water and fibre, on the regions' urban centres and transport networks, and on energy sources. Information on the location, condition and evolution of resources is an important step towards sustainability, but unfortunately such information can be hard to get. Earth observing satellite technology combined with geographical information management can help fill the information gap. In this objective, and because of its unique position to support the implementation of advanced interoperable geospatial technologies, the Joint Research Centre (JRC) of the European Commission (EC) is setting-up of an “*Observatory for sustainable development*” as single portal to support decision-making for development in the fields of natural resource and food security. The African Union and European Union recognise the importance of this service and are beginning to develop this capacity as part of the AU EU joint strategic partnership. This paper describes the needs, and presents the first steps taken by the JRC and by the joint partnership in harnessing space technologies to help meet Millennium Development Goals, in particular eradication of poverty, and environmental sustainability.

Keywords: natural resource management, remote sensing, space, Earth Observation, geographic information management, sustainable development, Africa, ACP.

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1. Introduction

Water, forests, agricultural/grazing land, resources such as fish stocks and the biological diversity encompassed by such domains have high economic and social value, yet they are being over-exploited in many parts of the ACP, thus increasing poverty and vulnerability of a large proportion of the population. The declining productivity of the natural resourcebase further exacerbates poverty and vulnerability as it leads to greater and more widespread food insecurity. And of course resource availability – and lack of – is a persistent and growing driver of conflict and of population migrations. Also, Climate Change is inextricably linked with the sustainable development process (EC 2003). The peoples of developing countries are among the most vulnerable and they have limited adaptive capacity.

The 2005 European Consensus on Development (OJEU 2006) recognises the role of good environmental management in poverty reduction. However many of the current development-aid initiatives concentrate on ‘environment and resources’ in terms of production, trade and economic growth. Beyond this, objective and comparable information on the status and the evolution of the “natural resources capital” of given countries is not available. Furthermore, quantification is difficult to be provided and agreed standardized methodologies are not yet in place. As a consequence, the policies tend to neglect the less-obvious functional services provided by environment and natural resources, such as the fundamental role land cover type has in determining local water cycles, and even the climate system.

Environmental considerations must be integrated at an early stage of decision making, i.e. upstream at the policy making, programming and project formulation stage. The increase of monitoring efforts, as well as the development of appropriate data bases and thematic cartography to support the improvement of analytical capacities, will allow better planning, better design of policies, programmes and, projects and, more generally, will result in better quality development aid.

2. Decision-making: context, constraints and needs

Links between development and environment encompass a wide range of issues. This paper concentrates on illustrating ways in which Earth Observing satellites plus computer processing and statistical analysis can support decision-making on sustainable management of natural resources and on agriculture and food security.

These aspects are relevant worldwide. The characteristics of Earth Observing satellite technologies too have global applicability. Furthermore, they provide multi-thematic information feeding different research areas. Better Policy Coherence for Development (PCD) (EC 2007) can best be provided if various thematic issues are addressed in a combined fashion.

In this objective and given the strategic importance of the Africa, Caribbean and Pacific (ACP) region for Community development co-operation, the Joint Research Centre (JRC) of the European Commission (EC) has set-up an ACP Observatory for Sustainable Development, aiming at supporting development policies of the EC and of the beneficiary countries and regions, through the provision of sound scientific information tailored on partner needs and formatted to allow further exploitation by users (databases, sector indicators, visualiza-

tion tools, assessments, prioritization tools, detection of anomalies, alerts, etc.). Within the ACP the initial focus is on Africa, as a result of the consolidated experience of the JRC in that continent and of the recently launched European Union and African Union Joint Strategic Partnership (AU-EU 2007), identifying 8 thematic partnerships, including one (n° 8) on “Science, Information Society and Space”.

The current deployment of the Observatory focuses on collection, access to and visualization of the information at different scales with a focus on the national level, i.e. national main figures and trends in different thematic areas. This essential information is simply not available yet in structured and comparable formats and compiling archives allows identifying gaps for complementary monitoring. This compilation will provide the necessary base for implementing integrated assessments. Trend simulation and design of management models/scenari for sustainable management of natural resources are not among the objectives of this first phase of deployment of the Observatory. This is planned to be addressed in a subsequent step.

Decision-makers – EC services, the donor community & the beneficiary countries and regions – need scientific information and they need technological (IT) support to access and use such information. This information flow aims to underpin decision-making, to improve the relevance and the quality of development aid to support the political dialogue with the beneficiaries and to facilitate interaction among different EC services and external partners. Donors/EC staff involved in development cooperation in general lacks specialized IT knowledge. This results in difficulties in accessing information and/or in identifying the right sources, as well as in increased externalization of the analysis, with little control over input or quality of results. Accessing and analyzing available information is indeed a challenge. Available data are often scattered, not always reliable and can be difficult to compare at different scales. In most cases, the outputs of scientific/research studies remain too theoretical and cannot even be used as starting points for the needs and the purposes of development cooperation. Further tailoring is necessary to respond to donors/EC needs.

Despite the fact that the role of natural resources and of ecosystems services is increasingly recognised as critical in addressing poverty alleviation and sustainable development, the mobilization of financial resources remains insufficient and natural resource management is still rarely considered as a priority in developing countries. The lack of baseline reference data, of environmental indicators duly recognized and of particular relevance for meaningful country assessments and the insufficient capacity to systematically monitor changes of situations (permanent observation systems) is a major shortcut in addressing natural resources management and climate change challenges in the frame of development cooperation. From the operational point of view, the main needs of the donor community and of their partner countries, in terms of environmental assessment and management include:

- To objectively assess and possibly quantify status and trends of Natural Resources in given countries and regions, assess – the actual deterioration of the situation, identify critical situations and highlight concrete risks;
- To rely on scientific information and on updated and comparable figures in a format that can be further exploited, respondent to the needs and in the different scales of work, in view of supporting – the different phases of the cycle of the operations, from programming to monitoring;

- To contribute with factual and reliable information to the sensitive debate on the importance and priority of investing funds in natural resources or in another sector.

The current insufficiency of reliable figures undermines advocacy capacity for ensuring appropriate consideration to natural resources issues in National and Regional financial allocation of Overseas Development Assistance (ODA).

Evidences on how decision-makers use information produced by the ACP Observatory to realize their needs and on how the Observatory contributes to improved quality of policy formulation and of development aid are provided in section 4.

3. The JRC response: the information portal ACP Observatory

The EU is the world's largest donor of official development assistance, with the European Commission playing an important role in both development policy formulation and the practical aspects of development and aid programme implementation. The Joint Africa-EU Strategy provides an overarching long-term framework for Africa-EU relations, while its first action plan specifies concrete proposals for 2008–2010, structured along eight Africa-EU strategic partnerships. Research at JRC addresses many areas where the EC is actively delivering. In this context the JRC has established the *Africa*, *Caribbean* and *Pacific Observatory*.

The ACP Observatory brings together JRC's work on Information and Communication Technologies and geospatial sciences to optimise its input to the Africa-EU Action Plan and advance sustainable development in ACP countries. Thematic domains covered by JRC in ACP countries are diverse and comprise among others: soil, land-cover, biodiversity, forests, food security and rural development, rangelands, marine and coastal ecosystems, water management, land degradation and desertification, natural hazards (floods, fires), civil security and spatial data infrastructure. The broad spectrum of activities includes the production of reference scientific material, the delivery of warning systems and added-value information to decision-makers, technical advice to development projects, capacity-building and networking in Europe and in Africa (Willemen, Roggeri and Mayaux 2010).

The overarching objective of the work is the establishment of a Reference Centre for scientific and technical information. This library of information will benefit European Commission services and ACP stakeholders in their decision-making processes related to development policies and programmes, in the areas of sustainable management of natural resources, food security, crisis prevention and management and renewable energies. Three major activities contribute to this overall objective:

1. A forward looking analysis of emerging complex development issues and inter-related scientific topics, based on the identification of integrated multi-thematic solutions to be developed together with EC services in charge of policies and key ACP stakeholders. Emerging issues, such as the link between climate change and international security, the future of tropical forests after the economic crisis and the demand for biofuels are examples of such complex matters which need to be tackled. These, together with the necessity of coherence between different EC policies, all require a multi-thematic and multi-technique approach combining different skills. Current work is focusing on the development of a first concept of integrated assessment models to address the sensitive topic of "Competition for Land" in the Congo Basin: the interaction between the

drivers of the competition for land (agriculture, charcoal, biofuels, mining, logging, land grabbing, pastures,...) and the different ecosystem services (livelihood, food, fibre, carbon, biodiversity, grazing,...) are evaluated taking into account biophysical limitations (soil suitability, climate change) and socio-economic constraints (land tenure, population growth).

2. Information portal for EC services and ACP countries (ACP Observatory 2010) to provide access to the information (data, products and models) collected, produced and validated by the JRC and thus provide a *reference centre* for environmental and human-security datasets for ACP countries, with a special focus on geospatial information.
3. Permanent exchange between JRC and ACP stakeholders as a basis for long-term and stable cooperation: (i) joint production of added-value information on natural resources, agriculture, hazards and conflicts; (ii) improvement of geo-spatial information by building on existing human capacities within the ACP countries; (iii) reinforcement of the scientific networks and (iv) building capacities of ACP stakeholders through exchange of experts, 'on-the-job' learning and *ad hoc* trainings.

4. Examples on how the system can improve decision-making

One single interactive portal: the ACP Observatory web-site

In order to respond to the needs of the staff of the EC, of National and Regional services of beneficiary countries and more generally of the Development community, the JRC is developing a single portal giving access to the available relevant scientific information supporting decision-making in different areas of active EC delivering. The information is tailored according to the needs of the users and the portal intends to offer the possibility to visualize and produce customized thematic maps at different scales. Composite information for each country is centralised in the portal but will not substitute portals dedicated to specific applications. For each theme (soil, forest, drylands, agriculture, biodiversity, rangelands, disasters...), the information includes reference maps, indicators, and specific analyses, where relevant. Particular attention is be paid to the presentation of the indicators adapted to the needs of the partner-DGs. The system is developed in order to comply with the recently adopted INSPIRE Directive (EC2007) which aims to create a European Spatial Data Infrastructure and which may become legally binding for EU Institutions. On the other hand, an image portal gives access to the satellite imagery of the African continent archived at JRC. Links with more specialized studies or thematic web-sites developed by the JRC or by other Organizations are also provided. An advanced version of the web-site is accessible at the following address: <<http://acpobservatory.jrc.ec.europa.eu/>>. A more complete version of the web-site is expected to be launched by early 2011.

Prioritization, policy design and program formulation: the Digital Observatory for Protected Areas (DOPA)

Africa is home to some of the most valuable natural ecosystems and species on the planet. These ecosystems cover large areas, making field monitoring methods very difficult for a

large scale assessment. Environmental organisations and international donors such as the EC consider the remote monitoring of Protected Areas (PAs) in Africa as a priority. To provide decision makers with indicators allowing prioritizing these PAs according to biodiversity values and threats, information needs to be regularly collected on a large scale, processed and often validated with ground truth data. It is the purpose of the Digital Observatory for Protected Areas (DOPA) to automatically monitor and assess the state and pressure of PAs and to prioritize them accordingly, in order to support decision making and fund allocation processes (Hartley *et al.* 2007; Dubois *et al.* 2009, 2010). The DOPA is thus a biodiversity information system currently developed as an interoperable web service at the Joint Research Centre of the European Commission in collaboration with other international organizations, including GBIF, UNEP-WCMC, Birdlife International and RSPB. The African component of the DOPA (Available from Internet: <<http://bioval.jrc.ec.europa.eu/PA/>>) has been used to characterize 741 PAs (see Fig. 1) according to their biodiversity value and the anthropogenic

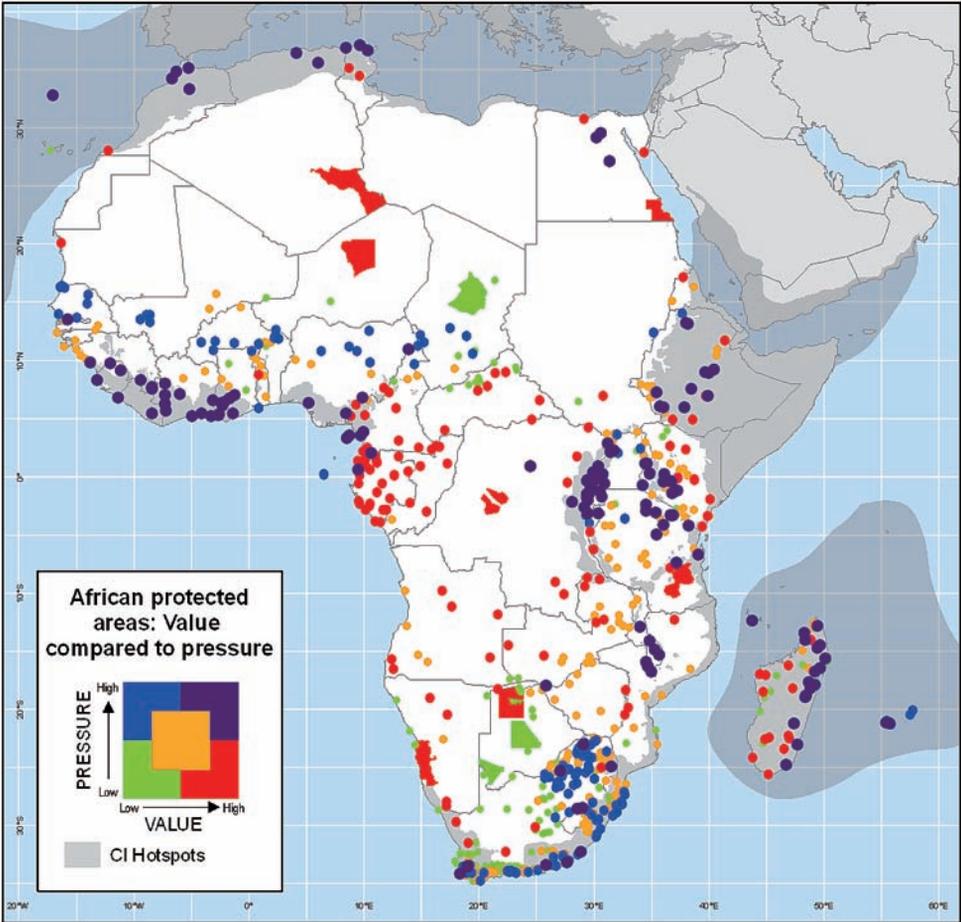


Fig. 1. Map of the Protected Areas analysed and comparison of the value and pressure on these areas against the biodiversity hotspots regions (in grey) defined by Conservation International

pressure that they are exposed to (Nelson, Hartley, Mayaux *et al.* 2009; Buchanan, Fishpool *et al.* 2009). The information produced has been recently used by the EU Delegation in the Democratic Republic of Congo (DRC) to identify priority areas of intervention in the formulation of a project on Conservation of Biodiversity (30 M EUR).

Assessments & prospective analysis: Land availability

Earth observing satellites have been employed for monitoring land cover and its changes since the mid 1970s (MacDonald and Hall 1980). A recent study presented by Brink and Eva (2009) uses high resolution Landsat images from the mid 1970s and the year 2000 to assess land cover changes over sub-Saharan Africa. Results show that over the 25 year time period around 5 million hectares of Africa's natural vegetation were converted to agriculture each year whilst less than 2% of the existing agricultural land reverted – i.e., was abandoned, see Figure 2. But, despite this expansion, the agricultural domain is more densely populated than 25 years ago. This is due to the fact that the percentage increase in sub-Saharan Africa's population is greater than that of the expansion of agricultural lands. Agricultural lands have increased by 57% over the last 25 years, which gives an annual rate of 2.3%. On the other hand, the annual average rural population increase has been 2.7% over the period. This indi-

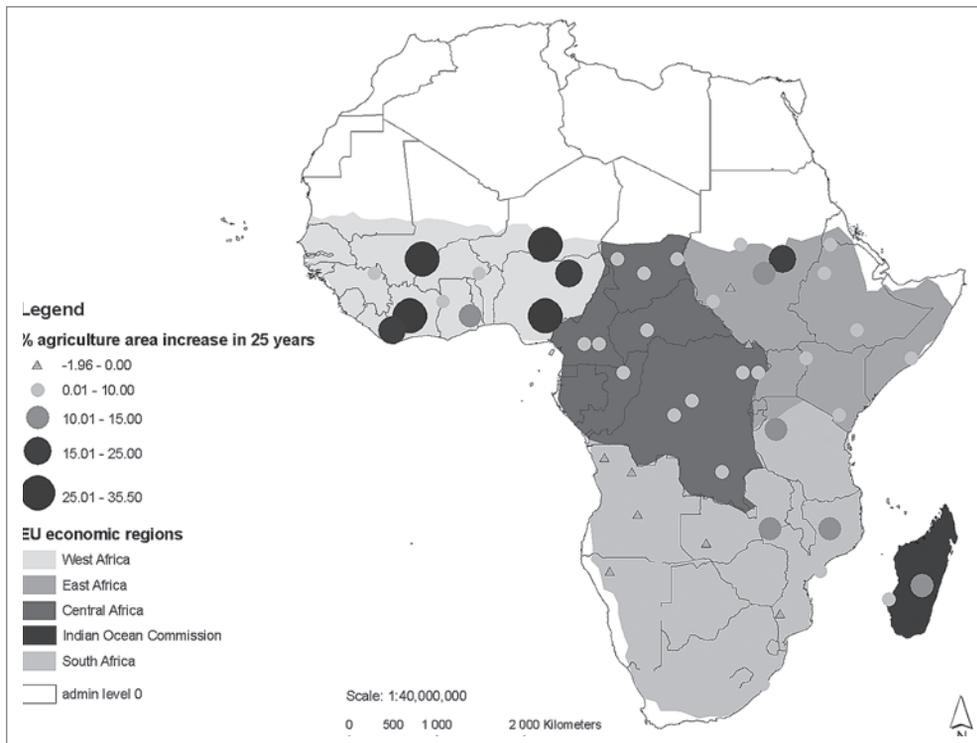


Fig. 2. Rates at which natural land is converted to agriculture at various sample sites across Africa. Rates calculated by measuring land cover conversions between 1975 and 2000 from Landsat imagery

cates that the rural domain is 20% more crowded than it was 25 years ago. Furthermore, by converting natural vegetation into agriculture also the natural pastures have been reduced in extent while, together with the population increase also livestock levels have risen (FAOSTAT 2006). From a socio-economic point of view the reduction of natural vegetation combined with the increases in human and livestock populations means more competition for less and for poorer quality lands. This raises the risk of potential conflict, especially in periods of environmental stress, such as drought (Jacobson 1988). There is a growing body of literature on environmental scarcity and conflict (Raleigh and Urdal 2005; Urdal 2005) which reflects not only current concerns but that of future scenarios based on climate change prediction and its subsequent impact on water resources, land degradation and food production. Studying the dynamics of land availability and its implications provides decision-makers critical information, frequently hidden or neglected, to understand situations and identify/design appropriate responses. The results of the study allowed to ensure increased focus on land availability and related aspects in the formulation of Country Strategy Papers, the “joint EC/partner country” reference document for programming aid allocation

Observatory service for political bodies: the Observatory of the Forests of Central Africa (OFAC)

The same technology is also being used to measure deforestation and forest degradation in the Congo Basin. As part of a joint operation between the Ministerial Commission for the Forests of Central Africa (COMIFAC) and the EC, a regional monitoring centre, the Observatory of the Forests of Central Africa (OFAC, see Figure 3), has been established in Kinshasa in 2007 to further develop monitoring systems in support to decision-making in several thematic domains: forest cover change, forest carbon stock and flux, forest management and biodiversity conservation. OFAC is run and coordinated by the beneficiary countries. Monitoring systems include a combination of indicators collected in and models derived from the field and by remote sensing at two scales: national level and in selected territorial units (logging concessions, protected areas, hunting zones, community forests, landscapes...). Results recently published (“The forests of the Congo Basin, State of the Forests of the Congo Basin 2006 and 2008”), show that the net deforestation rates being measured are lower than previously estimated. At just 0.16% per year they are around half the rate of deforestation in South America, and less than a quarter the rate in Asia (Duveiller *et al.* 2008). This information collected by OFAC was used by Central African countries during the recent negotiations in the Conference of Parties in Copenhagen in the frame of the REDD + (Reduction Emissions due to Deforestation and forest Degradation) mechanisms of the Framework Convention on Climate. But the demand for Africa’s timber is relentless and a monitoring programme must be maintained if accelerated, even illegal, deforestation is not to go undetected. The OFAC regional center is now using satellite imagery at very high spatial resolutions (2.5 m and finer) to monitor logging of individual trees. These patterns can then be cross-referenced with the terms of various timber concessions and form both an inventory and a method of control in the Voluntary Partnership Agreements (VPA) signed between the Congo Basin countries and EU in the frame of the FLEGT process (Forest Law Enforcement, Governance and Trade).

It is interesting to note the strong local involvement of national services in the regional Observatory: (i) the basic information is collected by the national services according to standard protocols agreed during regional workshops, (ii) information are synthetised and harmonized by OFAC, (iii) national services use the analysed data (long-term series, derived maps, control systems) in their national decisions or ask for specific studies to OFAC. For example, the COMIFAC council of Ministers recently asked to OFAC to produce a regional synthesis on the impact of the financial crisis on the forest logging companies.

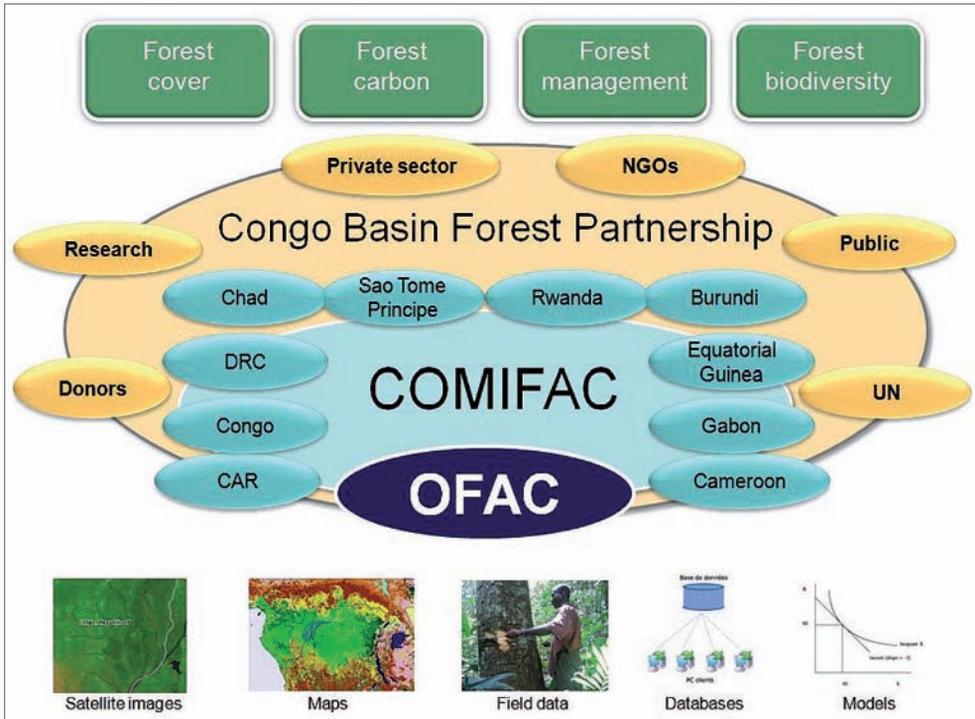


Fig. 3. Organisation of the information flow in the Observatory of the Forests of Central Africa (OFAC)

Monitoring and Early Warning systems: Food Security

The Observatory’s crop monitoring and forecasting system uses Low resolution satellite derived indicators, Meteorological information from circulation models (ECMWF) and satellite estimates (Rainfall), agro-meteorological models to monitor agricultural and pasture land conditions in around 10 countries vulnerable to crises and food shortages. The system, based on 20 years research for crop yield monitoring in Europe by the Monitoring Agriculture with Remote Sensing (MARS) project, provides, during the campaign, monthly reports describing current crop condition, yield prospects and, identifying hot spots and the likelihood of food shortages (MARS 2009). Priority attention was paid to the Horn of Africa due to the recurrence of food

crisis in this region but global capacities are available and a work program is under development to extend monitoring and capacity building activities in Sub Saharan Africa in coordination with UN FAO, FEWSNET, National and Regional Food security information systems (FAO 2005 – EC 2006). Specific project was initiated in 2008, to assess the impact of CC on cropping systems in West Africa (Cotton in Burkina Faso and Rice in Mali – BECRA Project) and thereby provide to the concerned countries and to the EC (HQs and Delegations), relevant information for the formulation of sector policies and of sector budget support programmes.

5. Data engineering

The above mentioned systems heavily rely on databases, usually distributed between various actors. The shared use of these databases requires interoperability of the systems providing and exchanging this information as well as significant efforts in documenting this information. Active research for the establishment of the ACP Observatory includes development and tailoring of databases documenting physical, environmental and socio-economic variables, complemented by modelling, dedicated Geographic Information Systems and near real-time information from Earth Observation satellites. Together with GMES Africa, the Observatory is an early deliverable of the “Space component” under AU-EU Partnership number 8, “Science, Information Society and Space”. Discussions are currently taking place with the AUC to explore the possibility to set-up a mirror of the Observatory currently (“African Observatory mirror”) in an African Research Centre with the specific objective to serve AUC needs for policy making at the continental level. Technical development within the Observatory is underpinned by a suite of international initiatives which aim at improving the availability and exchange of geospatial information. These in turn rely on implementation of fundamental infrastructure (ICT) and capacity building, permitting for example direct satellite communications and data transfer links with all AU countries, with African Regional Economic Communities (REC’s) and with AUC headquarters, also through the Africa Monitoring of Environment for Sustainable Development (AMESD) programme. The first AMESD forum, held in December 2009, was entitled “Towards a Pan African Partnership and Networking for the monitoring of the Environment by Satellite in Africa” (AMESD 2009). AMESD has a budget of 21M euro 2007–12, and is regarded as the key African contribution to the objectives of the Group on Earth Observation (GEO).

GEO implementation is firmly founded on the principle of a “systems of systems approach”, implying strong needs for technical interoperability between diverse systems. This results in an architecture that is distributed, or “federated”, and GEO is working actively to gather, pilot and implement existing standards and protocols, specifically in the geospatial domain, to act as a catalyst to realize this vision. The Observatory itself will be an early adopter of many of these “interoperability arrangements”, many of which reference existing standards and specifications (ISO, Open Geospatial Consortium etc) in the areas of metadata catalogues, service registries and map/data access services. JRC is in a unique position to support the implementation of advanced interoperable geospatial technologies, being directly involved in the work of the GEO Architecture and Data Committee (ADC) and being the technical coordinator of the recently adopted INSPIRE Directive (EC 2007). Whilst

the current priorities of building Spatial Data Infrastructures are to “unlock” existing data repositories through better mechanisms to discover and access data, attention is now shifting to making data more interoperable through common data specifications and automated data transformation techniques. This is a necessary precursor for building distributed processing architectures, where the need to collect, transform and model geospatial data at a single location will become less important. In this respect, JRC work on the DOPA will provide a detailed testbed for many technologies which support distributed geoprocessing (Figure 4). This extends interoperability beyond simple data exchange.

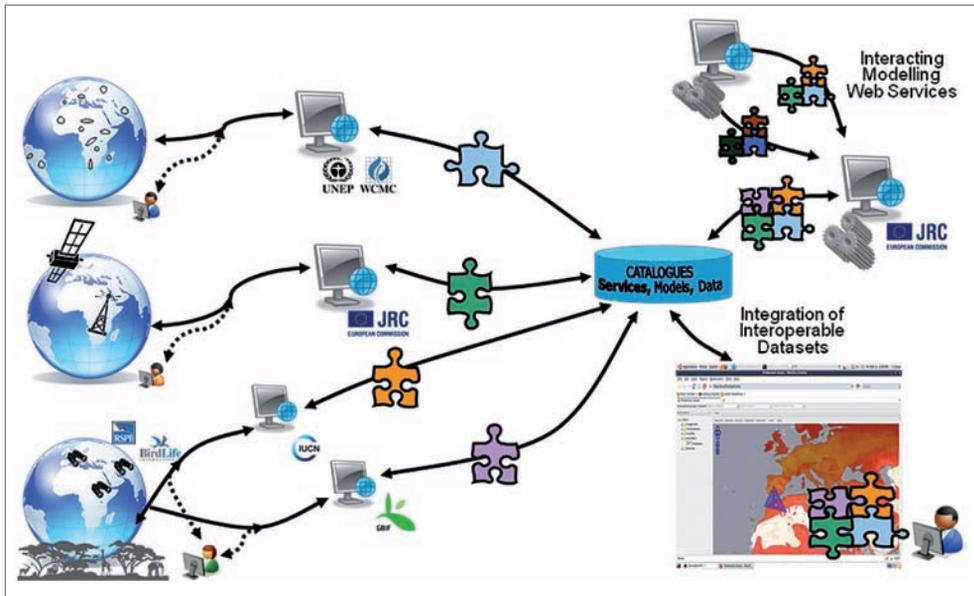


Fig. 4. Information flow between main actors involved in the Digital Observatory for Protected Areas(DOPA). Interoperable data are exchanged between web services and web modelling services for ecological monitoring and forecasting

The e-Habitat model, a component of DOPA, is a case in point. Using the delineation of Protected Areas in Africa, we have identified and ranked PAs based on their habitat similarity, and we have created an indicator of the habitat irreplaceability (HI) of the PA (Hartley *et al.* 2007). The HI quantifies the extent to which the dominant habitat of a PA occurs elsewhere. If a relatively small area of similar habitat occurs elsewhere, then the habitat of the PA is considered highly irreplaceable, and thus of higher conservation priority. In e-Habitat, we assume that a protected area contains a single habitat that can be characterised by a number of geophysical variables.

While e-Habitat will allow end-users to define the variables to be considered when modelling habitats in the future, the current system is still based on a default set of 9 variables derived from earth observation methods: 1) Percentage tree cover; 2) Percentage herbaceous cover; 3) Percentage barren cover; 4) Elevation in metres; 5) Slope in degrees; 6) Aridity index;

7) Percentage small water body presence (SWB); 8) Normalized Difference Vegetation Index (NDVI); 9) Normalized Difference Water Index (NDWI).

Mixed together using Mahalanobis distance metric, one can compute a covariance matrix of these thematic layers and generate a map of probability values ranging from 0.0, representing cells with no similarity with the investigated areas, through to 1.0, for areas which are identical. An example of the use of the HI is shown in Figure 5.

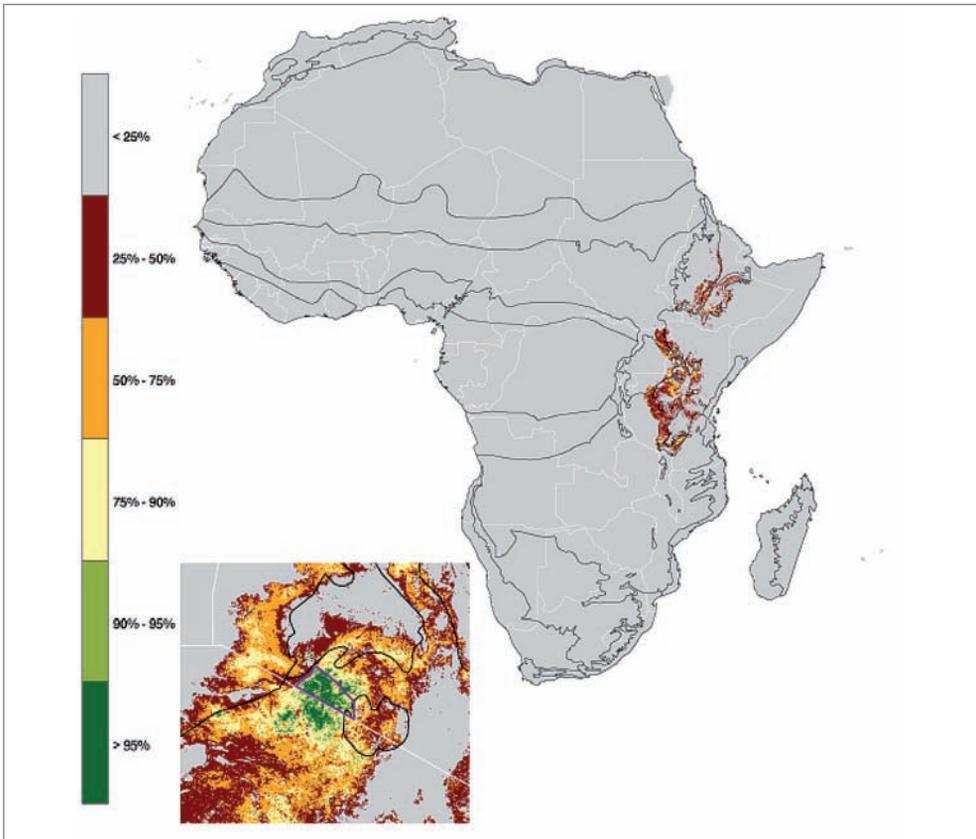


Fig. 5. Map of habitats that are similar in the Somalia-Masai ecoregion to the Masai Mara protected area in Kenya, and associated scale of similarity

This computation has been done using analytical functions within standard commercial-off-the-shelf desktop GIS, with considerable effort in data gathering, compilation, and analysis. The results, whilst of significant value to decision makers, are static and extremely time-consuming to reproduce. Consequently, we are re-engineering the model to benefit from the various interoperability arrangements available. This entails automatic, machine-driven harvesting of input data from the providers via web services (OGC Web Feature Service

and Web Coverage Service), data preparation and storage in spatially-enabled databases (PostgreSQL with PostGIS extension) and algorithm implementation in an open-source statistical computing environment, “R”. This is an ongoing development which, as it evolves, raises increasingly challenging issues of performance optimisation and service orchestration, but which is already delivering the following tangible benefits:

- Input data comes directly from the provider, and therefore maintained as up-to-date and authoritative;
- Updates by the provider trigger automatic updates to the calculation via web services;
- Standardised web services allow data to be decoupled from applications and therefore multi-use, providing a basis for developers to independently conceive their own applications;
- Users can perform interactive analyses, for example defining their own “Virtual Park” and assessing impact on habitat protection, and selecting alternative data sources;
- Development on an open source framework allows any organisation or other interested party to implement these components free of licensing dependencies.

At European level, work is beginning to define commonly agreed data specifications for a number of key environmental themes as part of INSPIRE – by 2012 these should address themes including orthoimagery, land cover, soils, species distribution, habitats, agriculture, land use, population distribution – in Africa the recognition and definition of “fundamental geospatial datasets” is being promoted by the UN Economic Commission for Africa – through GEO these could be a major contribution to turning existing and future geospatial data into relevant and usable information for sustainable development, that the Observatory will provide a gateway to.

6. Conclusions

The permanent dialogue with Africa, Caribbean and Pacific countries, particularly via National services, Regional Economic Communities and the ACP Secretariat, as well as the AU-EU Strategic Partnership set up the general framework of collaboration between Africa and Europe and contributes to foster the role of the AUC as continental organization with an overall responsibility of African development, poverty alleviation and general improvement towards the attainment of the MDGs. To fulfill its mandate Africa needs to develop the necessary architecture to cope with continental issues and therefore to produce relevant policies and guidelines. In parallel the EU, as world’s largest donor of Official Development Assistance, needs to empower its capacity to understand situations and trends, to develop prospective and multi-thematic analysis and to prepare appropriate responses to the challenges. These crucial activities imply the definition of a long-term strategy and the set-up of appropriate observing and “knowledge-management” capacities:

1. With reference to the strategy, the main priority and “early deliverable” of the Space part of the AU-EU partnership n° 8 (“Science, Information Society and Space”), is the formulation of a “*Global Monitoring of Environment and Security (GMES) & Africa Action Plan*” detailing infrastructure needs, thematic priorities and financial require-

ments. A Baseline study for the Action Plan has been drafted under the coordination of AUC/HRST and JRC and will be the reference for the finalization of the GMES&Africa Action Plan, within the overall framework formally endorsed by African and European Heads of State, in the 3rd Africa-EU Summit (Lybia, November 2010). GMES & Africa will reinforce Africa's use of and contribution to remote sensing science, especially building operational services for sustainable development.

2. On the set-up of observing and “knowledge-management” capacities, JRC staff is working in close collaboration with relevant EC services to further improving and customizing *ACP Observatory* capacities. Also, EC staff is closely co-operating with AUC – including staff secondment – in identifying modalities for implementing a mirror of the Observatory at AUC (AU-EU, College to college meeting 2008). This will allow increasing the use of geospatial science in support of sustainable development and ensuring the necessary scientific and reliable back-up for sound decision-making. JRC staff is seconded at AUC premises to explore alternatives and constraints.

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DARNUS VYSTYMASIS BESIVYSTANČIOSE ŠALYSE: AFRIKOS, KARIBŲ IR RAMIOJO VANDENYNŲ VALSTYBIŲ APŽVALGA

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Santrauka. Gėlasis vanduo, akvakultūra, žuvininkystė, biologinė įvairovė, miškų ir žemės ūkio paskirties žemė turi didelę ekonominę ir socialinę vertę visoje Afrikoje, Karibų ir Ramiojo vandenyno (AKR) valstybių regione, bet šie veiksniai gali būti per daug eksploatuojami ir turėti žalingų padarinių vietinei ekonomikai, ilgalaikiam stabilumui ir visai Žemės sistemai, ypač klimato sistemai. Dėl greitai augančio AKR gyventojų skaičiaus regionų miestų centruose transporto tinklų ir energijos šaltinių vietose didėja aplinkos naudojimo mastas, siekiant gyventojus aprūpinti maistu, vandeniu ir ląsteliena. Informacija apie

vietovės išteklius, išteklių būklę ir raidą yra svarbus žingsnis siekiant darnos, bet, deja, tokią informaciją sunku surinkti. Žemės stebėjimo palydovais technologija, sujungta su geografinės informacijos valdymu, gali padėti užpildyti šios informacijos spragą. Dėl šio tikslo ir dėl unikalios padėties, siekiant diegti pažangias tarpusavyje sąveikaujančias geoerdvines technologijas, Europos Komisijos (EK) jungtinis tyrimų centras (JTC) yra įkūręs Darnaus vystymosi observatorijas kaip vieną portalą, kad palaikytų sprendimų priėmimo plėtotę gamtinių išteklių ir maisto saugumo srityse. Afrikos Sąjunga (AS) ir Europos Sąjunga (ES) pripažįsta šios paslaugos svarbą ir pradėjo plėtoti šiuos pajėgumus kaip dalį strateginės AS ir ES partnerystės. Straipsnyje pristatomi pirmieji žingsniai, žengti AKR valstybių, plėtojant jungtinę partnerystę kosminių technologijų srityje, siekiant spręsti tūkstantmečio tikslus – mažinti skurdą ir tobulinti darnų aplinkos vystymą.

Reikšminiai žodžiai: gamtos išteklių valdymas, nuotolinis stebėjimas, kosminis, stebėjimas, žemės stebėjimas, geografinės informacijos valdymas, darnus vystymasis, Afrika, AKR.

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