

POLICIES FOR APPLYING EARTH OBSERVATION IN AFRICA: AN ISPRS PERSPECTIVE

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ABSTRACT:

This paper is prepared as a basis for discussion on what strategies ISPRS should be applying in order to promote the use of Earth Observation data in Africa. The paper will start with a brief review of current Earth Observation activities in Africa and the organisations and policies which underlie this activity. In particular the role of national agencies in Africa will be discussed. The role of international agencies such as the United Nations, ICSU and the Group on Earth Observations (GEO) and international societies such as ISPRS, will be examined. Valuable material to support this discussion has been obtained from workshops organised by ISPRS, IEEE and OGC under the umbrella of the Global Earth Observing System of Systems (GEOSS). These workshops have presented the role of GEOSS to African audiences and have included sessions in which the participants can give feedback on their requirements.

1. INTRODUCTION

Africa is a key region for ISPRS because of the urgent need for development, the shortage of resources in Africa, and the need for ISPRS to execute its mission of promoting photogrammetry, remote sensing and the spatial information sciences. There is a very strong interest on the part of many organisations, both within and outside Africa, in developing Earth observation in Africa and this paper seeks to discuss these, and the role which they are playing in the development of technology and applications; and the part which ISPRS can play in this.

2. INTERNATIONAL CONTEXT

2.1 Policies and funding agencies

Funding bodies such as USAid and JICA from Japan support development projects in Africa. These arise out of international agreements such as the UN Millennium Development Goals and on The New Partnership for Africa's Development (NEPAD). The International Council for Science (ICSU) has established a Regional Office for Africa and supports scientific project in Africa.

2.2 Group on Earth Observations

The application of Earth Observation in many areas has been given a boost by the Group on Earth Observations (GEO). 80 nations and 58 organisations are members of GEO, including 15 African countries and Organisations. GEO has established the Global Earth Observing System of Systems (GEOSS). 'The purpose of GEOSS is to achieve comprehensive, coordinated and sustained observations of the Earth system, in order to improve monitoring of the state of the Earth, increase understanding of Earth processes, and enhance prediction of the behavior of the Earth system. GEOSS will meet the need for

timely, quality long-term global information as a basis for sound decision making, and will enhance delivery of benefits to society'¹. Africa features in many of the GEOSS tasks, but of particular interest to ISPRS are the Capacity Building tasks. Some of these are very similar to ISPRS Commission VI tasks, Task CB-10-01: Building Capacity through Outreach and Awareness Raising is particularly important and ISPRS is working with IEEE and OGC to organise 'User Oriented Workshops for GEOSS Outreach and Feedback'.

GEOSS has already established GEONETCast which is a near real time, global network of satellite-based data dissemination systems designed to distribute space-based, air-borne and in situ data, metadata and products to diverse communities. GEONETCast is gradually being introduced in African organisations. Experiences gained on the use of GEONETCast in Africa are expected to be presented at the 8th Conference of the African Association of Remote Sensing of the Environment (AARSE) in October 2010²

2.3 Europe

Other initiatives, such as GMES, come from CEOS and the European Commission. GARNET-E (GMES and Africa: Regional Network for information Exchange and Training in Emergencies) aims at integrating African requirements in the operation of the GMES Emergency Response Service in Africa. GARNET-E will help strengthen regional and local capabilities in order to enable African users to access the information provided by the GMES Emergency Response Service. The overarching objective of GARNET-E is to contribute to the partial re-alignment of the "GMES Emergency Response in Africa" agenda, from technical activities focused purely on risk

¹ From GEOSS 10-year Implementation Plan.

² www.aarse2010.org

and poverty reduction and response using European capacities, to those more directed to building sustainable local capacities, leading to real wealth creation in Africa.

This main objective would be achieved through the two sub-objectives:

- (i) To enable the integration of African requirements in the definition of future operation of the Emergency Response Core Service in Africa; and
- (ii) To encourage the strengthening and building of regional and local capabilities, to allow African users and policy makers to access the EO-derived information provided by the Emergency Response Core Service.

Further technical sub-objectives emanating from the above are:

- (i) To exchange information, mainly through training exercises, on the operation of the GMES Emergency

Response Core Service and the International Charter Space and Major Disasters; and

- (ii) To improve the quality and efficacy of the GMES Emergency Response Core Service itself, through consideration of requirements gathering exercises and the ingestion of in situ data.

2.4 United Nations

The United Nations uses Earth observation in many of its agencies. Some of these are listed in table 1. According to Yepes (2010) The UN has so far pursued a highly decentralised approach to space amongst its agencies and organisations, but is now considering a United Nations Space policy which will include provisions for using space, including Earth observation, for the benefit of humankind.

Organisation	Brief	Use of EO
UNOOSA/UN COPUOS	Supports 2 Regional Centres for SST education (French and English); manages UN-SPIDER; Supports AFREF.	Capacity building and Development projects.
FAO	To help developing countries and countries in transition modernize and improve agriculture, forestry and fisheries.	Food security and early warning project; AFRICOVER Project.
UNOSAT	Applied research relating to satellite solutions.	UNOSAT delivers satellite solutions, geographic information to organizations within and outside the UN.
WMO	Supports African Centre of Meteorological Applications for Development (ACMAD)	Meteorological Activities
UNFPA	Population Census activities	Census enumeration
UNECA	Supports/coordinates: CODIST-Geo, SDI, AFREF, MAFA, African Water Information Clearinghouse, Regional Centres (RECTAS & RCMRD); etc.	National implementation of SDI & mapping, Human capacity building
USAID	Providing US economic and humanitarian assistance.	Capacity building in Sahelian region (AGRHYMET), Servir Africa, (RCMRD).
WHO	Directing and coordinating authority for health within the United Nations system.	Health information systems ; Second Level Admin Boundaries (SLAB) Mapping (with ECA).
UNEP	Caring for the environment by inspiring, informing, and enabling nations and peoples to improve their quality of life without compromising that of future generations.	EIS-Africa (initial support), Africa Atlas, SDI in East Africa.
UNIDO	Promotes industrial development for poverty reduction, inclusive globalization and environmental sustainability.	Gulf of Guinea Large Marine Ecosystem implementation.
UNDP	Advocating for change and connecting countries to knowledge, experience and resources to help people build a better life.	Contributing to projects in Climate Change and disaster management.
UNESCO	To create the conditions for dialogue among civilizations, cultures and peoples, based upon respect for commonly shared values.	GOOS-AFRICA (IOC); Application of RS in water resources management & ecosystems.

Table 1. United Nations Agencies involved in Earth Observation in Africa (see Appendix for explanation of acronyms)

3. AFRICAN ORGANISATIONS

3.1 National bodies

Many African countries are participating in a variety of notable space technology initiatives. Examples of these initiatives as updated from Abiodun (2005) and reported in Kufoniyi (2009b).

Many of the nations of Africa are involved in Earth observation, both as collectors and users of data. South Africa, Nigeria, Algeria and Egypt operate satellites with Earth observing sensors. Groups of African nations meet to develop EO capabilities in Africa and the African Resources Management (ARM) Satellite Constellation is a joint programme of South Africa, Nigeria, Kenya and Algeria and any other interested country in Africa. The project is one of the key flagship projects in the NEPAD Science and Technology Ministerial Programme areas. The ARM constellation has been described as fulfilling the need for regular high resolution data over Africa for resource management applications. The widespread use of high and medium resolution image data clearly demonstrates the urgent need for this kind of data in a timely manner over Africa. The user requirements of the ARM have evolved to include medium resolution imagery (<30m) and very high resolution imagery in addition to future needs identified in the form of SAR and thermal infrared image data sets. The countries involved would collaborate in building capacity to support space programmes in Africa.

The African Leadership Conference on Space Science and Technology for Sustainable Development is organized to sensitise African leaders on the importance of science and space technology for the sustainable socio-economic development of Africa. It provides a regular forum for the information exchange and promotes inter-African co-operation in the development and the application of space technology. The conference is supported by the United Nations Office for Outer Space Affairs.

The Nigerian government has a policy to ‘... develop a “critical mass” of Nigerians in the area space science and technology to enable the country realize its objectives for achieving technological, industrial, commercial and economic self reliance.’³ In other words Nigeria is using its space programme to build capacity in space science and technology. It also has the objectives of using EO as a tool for managing the natural resources of the country.

In addition African countries participate in international fora. For example five African countries - Algeria, Madagascar, Nigeria, Tunis and South Africa - are participating in the global Search and Rescue programme known as COSPAS-SARSAT which provides location-related space-based search and rescue services particularly for people and transportation systems in danger, e.g. air crashes, ship-wrecks and automobile accidents. African countries are members of the United Nations Committee on the Peaceful Uses of Outer Space (COPUOS). A majority of African countries participated in the three United Nations Conferences (UNISPACE-68 in 1968, UNISPACE-82 in 1982 and UNISPACE III in 1999). Virtually all African countries are members of the International Telecommunication Union (ITU) and INTELSAT, the two intergovernmental organisations respectively responsible for the regulation and provision of communication services. Today, these services are

provided by a large array of geo-stationary satellites as well as constellations of Earth orbiting satellites. Egypt has its own operating communication satellites (NileSat-1 and NileSat-2) that are located at the geostationary orbit.

Management and mitigation of disasters is a major concern in Africa. GARNET-E has already been discussed. African universities also collaborate to form the University Network for Disaster Risk Reduction in Africa (UNEDRA), which is a network dedicated to collaboration in this field and to running courses. Another aspect of disaster management is SERVIR, set up initially to serve Latin America and recently extended to Africa, SERVIR is developing an integrated platform for data and service discovery, acquisition, sharing, and use, and has concentrated on disaster management.

3.2 Other bodies

3.2.1 EIS Africa is a pan African membership based non-profit (section 21 company) organization that is governed by an elected Board of Directors. The day to day operations of EIS-AFRICA are carried out by a Secretariat based in Tshwane, South Africa. The Secretariat is headed by an Executive Director who is appointed by the Board. The organisation organises the biennial AFRICAGIS conference in collaboration with AARSE and AOCRS. The conference is aimed at focussing on geo-information technologies and applications in Africa (see www.eis-africa.org).

In addition to acting as a geo-information knowledge network, EIS-AFRICA is also involved in several pan African projects and initiatives which all have a common goal. EIS-AFRICA is a key regional collaborating centre supporting UNEP/DEWA’s African Environmental Information Network (AEIN) and African Environmental Outlook (AEO) programmes. The goal of AEIN, which is being co-ordinated by the UNEP Division of Early Warning and Assessment (DEWA), is to enhance accessibility to more reliable environmental data and information at national level for the environmental assessment and reporting in the region (www.unep.org/dewa/africa/aeoprocess/aein/aein.asp)

3.2.2 The African Association of Remote Sensing of the Environment (AARSE) was founded in 1992. It became a Regional Member of the International Society for Photogrammetry and Remote Sensing (ISPRS) in 1994. AARSE is a pan African membership based non-profit (section 21 Company) organization with registered secretariat in South Africa. The primary objective of the association is to increase the awareness of African governments and their institutions, the private sector and the society at large, about the empowering and enhancing benefits of developing, applying and utilizing responsibly, the products and services of Earth Observation Systems and Geo-information Technology.

To achieve its objectives, AARSE conducts biennial international conferences across Africa as well as other awareness and capacity building activities. Since 1996, AARSE, with the support of local and international organizations, has organized seven of such conferences in Harare (Zimbabwe) in 1996, Abidjan (Cote D’Ivoire) in 1998, Cape Town (South Africa) in 2000, Abuja (Nigeria) in 2002, Nairobi (Kenya) in 2004, Cairo (Egypt) in 2006 and Accra (Ghana) in 2008. The 8th edition will take place in Addis Ababa (Ethiopia) in October 2010 while the 2012 edition is scheduled to hold in Morocco in October 2012.

³ Nigerian national Space Policies and Programmes

AARSE has been involved in many regional developmental projects including the on-going GARNET-E project. It also represents Africa's interest in global and regional EO-related organisations and activities such as GEO and the GEOSS implementation

3.2.3 Other inter-governmental Organisations. There are other inter-governmental Regional Centres & Organisations that are also involved in EO activities: Regional Centre for Training in Aerospace Surveys in Nigeria, (RECTAS) runs bilingual (English & French) courses in geoinformatics and executes mapping projects, Regional Centre for Mapping of resources for Development in Kenya, (RCMRD) is involved in short-courses and project execution, AOCRS focuses on networking, ACMAD on weather-related courses/projects, African Regional Centre for Space Science and Technology Education – English in Nigeria (ARCSSTE-E) runs diploma course in SST in English, CRASTE-LF runs diploma course in SST in French, while AGRHYMET organises short-courses/project.

4. ISPRS CAPACITY BUILDING

In geospatial information (GI) production and management, advances in space and information technologies have impacted positively on human capacity globally through availability of geospatial information technology (GIT) tools. To be fully utilized however, the acquisition of GIT must be fully complemented by readily available skilled manpower and an enabling infrastructure. It is noted that there exists now some indigenous capacity in EO in Africa especially through the capacity building aspects of the satellite programmes of African countries that can and should be built upon. With plans to launch additional satellites by the countries that already have, and new ones by other countries as well as the proposed Geo-Africa satellite, building, on the existing capacity will rapidly enhance mastering space technology expertise, reinforcing science and technology education, and stimulating areas of high-tech spin offs.

Given that many organizations in African countries are unable to afford the costs to send their staff abroad for (re)training programmes except through external funding support from donor countries and agencies, and considering the number of persons to be trained before achieving capacity utilization, it is necessary to provide alternative solutions through educational networking of institutions in developed and African countries, i.e., through cross-border education and web based education/e-learning.

Moreover, it is necessary to strengthen institutions of higher learning and national and regional institutions to enable each country to have capacity for research and developmental efforts in its national institutions. Overall, the goal should be to build on the existing capacity to enable each country enhance its scientific and technical knowledge and experience in the applications of Photogrammetry, Remote Sensing and Spatial Information Sciences in addressing Africa's needs.

In recognition of these capacity development needs, ISPRS has an interest in Africa to serve the ISPRS members in Africa and to promote the use of photogrammetry and remote sensing on the continent. Technical Commissions have a remit to work in all parts of the world, but there are a number of constraints on what can be done in Africa. Funding is a major problem and this leads to the difficulty of African organisations and

individuals in fully participating in ISPRS. ISPRS has recently appointed one of the authors of this paper, Jide Kufoniya and Regional Representative for Africa with the following brief to assist Council to coordinate activities in regions not already represented on the Council.

- (a) Liaise with Members and potential members within their region and represent the views of those members on Council.
- (b) Make best efforts to ensure that at least one ISPRS meeting is held within the region during the inter-Congress period.
- (c) Encourage members and organisations within their region to support the aims of ISPRS and become Members of ISPRS.
- (d) Attend national and regional activities within their region and promote the aims and activities of ISPRS.
- (e) Attend meetings of the Council and Advisory Board when invited.

ISPRS encourages people from developing countries, especially students, to participate in ISPRS conference and scientific projects though the ISPRS travel awards and scientific initiatives.

The main vehicle for capacity building within ISPRS is Technical Commission VI which deals with Education and Outreach. The Working Groups within Commission VI illustrate the topics which are being addressed:

- WG VI/1 - Web Based Education
- WG VI/2 - E-Delivery of Education Services
- WG VI/3 - Frameworks for Cross-Border Education
- WG VI/4 - Joint Educational Programs
- WG VI/5 - Promotion of the Profession to Young People
- WG VI/6 - Special Interest Group "Technology Transfer Caravan"

Working Group VI/2 addresses the problem of developing software for e-learning and is responsible for CATCON which is a contest of newly developed computer assisted teaching software packages.

ISPRS has a Student Consortium, run by the students and we have programmes with other organisations. ISPRS established, first, the Youth Forum at the beginning of the millennium. The Youth Forum has evolved to the ISPRS Student Consortium. At the moment the Student Consortium does not have any activities in Africa

ISPRS works with the Joint Board of Geospatial Information Societies (JBGIS) www.fig.net/jbgis in order to coordinate activities, which includes FIG, ICA, IHO and AIG. JBGIS has an ad hoc committee on Capacity Building in Africa to coordinate the capacity building activities in Africa of the members of the Joint Board and to advise the Joint Board on policy issues relating to education in Africa. Projects such as African [Geodetic] Reference Frame (AfReF) and Mapping Africa For Africa (MAFA) need more resources and recognition by government

ISPRS is working with OGC and IEEE to organize 'GEOSS Workshops' organised with the objectives of focusing on broad range of users and regional issues, educating users about the Global Earth Observation System of Systems (GEOSS) and through interaction with users, get feedback on their needs – for

data, information and infrastructure. see <http://www.ieee-earth.org/Conferences/GEOSSWorkshops>

Technical Commissions of ISPRS are also encouraged to work with African regional Centres and associations to build on existing EO capacities in Africa. These include RECTAS, RCMRD, AGRHYMET and ACRSSTE-E/F. In addition, regional associations such as AARSE and EIS-Africa organize capacity building workshops and biennial conferences in their fields of operations.

5. BOTTLENECKS AND CHALLENGES

The GEOSS workshops referred to above have included small group discussion and the conclusions from these indicate some of the problems which face any organisation seeking to develop capacity building in Africa. There are basic requirements such as the need for more finance and better understanding of the problems, which involve first the identification and then the participation of user groups, and then better communication. There are particular technical problems for Africa which include:

- Poor infrastructure, particularly low bandwidth on the internet;
- Lack of basic technology equipment, (training is no use without equipment);
- Lack of spatial literacy and education on use of GI in schools;
- Lack of political will;
- Poor communications amongst African governments.

There is a crucial need for good communication: between scientists, between disciplines and to policy makers, and activities must be more regionally relevant. A key requirement is for more information on resources available, and how to access them. Steps which can be taken to overcome these obstacles could include:

- More opportunities created for users to interact through user groups and to obtain research reports;
- Promotion of open source software;
- Provision of Spatial Data Infrastructure nationally and on a continental scale;
- Provision of distance learning packages.

6. SUMMARY OF POLICIES

It is apparent from the above that many organisations have an interest in developing Earth observation (EO) in Africa. International Agencies such as the United Nations use EO and actively promote its development. Countries such as USA and Japan, and the European Union, provide funding for development projects which fit into the policies of The Millennium Development Goals and NEPAD. It is also clear that African nations recognise the importance of EO, both to serve national objectives such as management of resources and the environment, and as a weapon in the armoury of building science and technology in their countries. An important driver for this is the management of disasters and the introduction and expansion of SERVIR is a good indicator of that. African countries also recognise the importance of collaboration, shown by the South African involvement in GEO and the development of ARM.

To harmonise such activities as those highlighted above, commendable efforts are being made through different

initiatives and fora to evolve regional Space Science and Technology policy for Africa. The joint UNESCO/African Union high-level scientific workshop on the *Critical role of satellite remote sensing applications for Africa's sustainable development*, 30th May to 1st June 2007 recommended the establishment of an African Space Agency to coordinate regional space programmes in Africa. The declaration of the workshop was unanimously adopted by the Honourable African Commissioners to UNESCO for integration into the AU's science and technology programmes.

The adopted declaration also featured prominently as key aspect of Africa's position at the fourth plenary meeting of the Group on Earth Observations (GEO-IV) in Cape Town, South Africa from 28th to 30th November 2007 as well as in the declaration of the 7th conference of the African Association of Remote Sensing of the Environment (AARSE) in 2008. The EU-AU meeting of 7th December 2007 on GMES and Africa equally emphasised the need to utilize data from Earth Observation satellites for the global monitoring of environment and security.

In some countries, maps and map products are seen as highly sensitive and classified information, and sometimes controlled by the military. A national GI policy will facilitate necessary access and make the information available to commercial organisations, allowing government agencies such as the national surveying and mapping agency to share fundamental datasets with other public sector organisations and the industry. This will in turn enhance private sector opportunities to develop more innovative applications.

In addition to having a national GI policy, it is also necessary to put in place a national mapping policy to address in detail the activities of national topographic mapping, provision of geodetic framework as well as cadastral mapping including the funding modalities for them. These cannot be treated in depth within the national GI policy and its absence can deter production of these vital fundamental datasets.

7. ISPRS VISION FOR THE 21ST CENTURY

ISPRS announced a new strategic plan in July 2010, this will include the following strategies relating to capacity building:

- Use core disciplines in applications such as disaster management, health, cultural heritage and maintaining a sustainable environment;
- Develop interest in key international issues such as working towards the Millennium Development Goals and climate change;
- Engage with developing countries, especially in capacity building and student activities;
- Improve electronic and printed forms of communication.

In order to implement these strategies in Africa we recommend that ISPRS gives support towards the realization of the African Space Agency and also support the implementation of the recommendations of CODIST-1⁴ and Kufoniyi (2009a) for the enactment of (1) a national geospatial information (GI) policy

⁴ Report of the First Meeting of the Committee on Development Information, Science and Technology (CODIST-1), E/ECA/CODIST/1/L, United Nations Economic Commission for Africa, Addis Ababa, 1 May 2009

and (2) a national mapping policy to provide an enabling environment and legal backing for geo-information activities in Africa. It is noted that the establishment of SDI backed by a National Policy will certainly eliminate most of the problems being experienced by GI producers and users in African countries today. An efficient SDI and the associated National Policy should be regarded as vital requirements for sustainable National development.

8. CONCLUSIONS

We can conclude that there is an urgent need for capacity building to deal with many challenges in all countries. This must be based on an understanding of the issues of geomatics and on the development of sustainable institutions. A major requirement for the success of capacity building is international co-operation and a willingness to work together. Secondly there is a need for good communication and the provision of the technology. Thirdly funding is required. ISPRS is working to address fundamental problems of education, training and raising awareness so that geospatial information can be used to greater effect to benefit society.

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NEPAD	New Partnership for Africa’s Development
OGC	Open Geospatial Consortium
UN COPUOS	UN Committee of Peaceful Uses of Outer Space
UNDP	United Nations Development Programme
UNECA	UN Economic Commission for Africa
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFPA	United Nations Population Fund
UNIDO	United Nations Industrial Development Organization
UNOOSA	United Nations Office of Outer Space Affairs
UNOSAT	United Nations Institute for Training and Research’s Operational Satellite Applications Programme
USAID	United States Agency for International Development
WHO	World Health Organisation
WMO	World Meteorology Organisation

10. ACRONYMS

Acronym	Full name
AARSE	African Association of Remote Sensing of the Environment
AOCRS	African Organization of Cartography and Remote Sensing
ARM	African Resources Management (ARM) Satellite Constellation
EIS Africa	Environmental Information Systems Africa
FAO	Food and Agriculture Organisation
GEO	Group on Earth Observation
GMES	Global Monitoring for Environment and Security
IEEE	Institute of Electrical and Electronic Engineering
JICA	Japan International Cooperation Agency