Information Requirements for Decision-Making in African IWRM: the CEOS TIGER Initiative: An *Exploration* of the role of space data

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Abstract

What is the TIGER Initiative? *The European Space Agency (ESA) assisted by UNESCO developed the TIGER Initiative to assist with sustainable water management in Africa, as a sequel to the World Summit on Sustainable Development.*
Progress to Date: *TIGER has held stakeholder workshops in Rabat (2003) and Pretoria (2004) to help define its way forward. It also made two 'calls for proposals' for water related projects in Africa that require free satellite data. TIGER has several 'demonstrator' projects related to water and health, food security, disasters, wetland and transboundary aquifer management. Space partners in Canada, Europe, Japan and USA currently support TIGER.*
Next Steps: *At the 2004 workshop, national departments of water made it clear that good access to satellite products was essential for effective decision making in the IWRM process, at all scales from micro-watershed to transboundary basins. The workshop adopted a strategy based on IWRM in accordance with the Africa Water Vision, involving 10-year commitment to TIGER by the space agencies. TIGER is currently consulting stakeholders towards formulation a 10-year plan while assisting the network of projects to evolve into a coherent support base for IWRM in Africa.*

Key Words: IWRM, Information system, Decision support, Satellite observations, Earth Observation, Modelling, TIGER initiative.

What is the TIGER Initiative?

As a follow-up to requests made at WSSD, the Committee on Earth Observing Systems (CEOS) proposed that member agencies make coordinated efforts to use their assets and expertise to assist sustainable water management. The European Space Agency (ESA) assisted by UNESCO subsequently developed the TIGER Initiative to help address this goal in Africa. And although it started life as a technology-led initiative, motivated by the desire to see powerful space assets directed towards beneficial ends, the promoters immediately consulted potential stakeholders to see how the latent goodwill might best be fashioned to meet real needs.

Progress to Date

TIGER has:

- Held stakeholder workshops in Rabat (2003) & Pretoria (2004) to define priority needs, develop partnerships & encourage buy-in from stakeholders in Africa, and so help define its way forward.
- Made two 'calls for proposals' for water related projects in Africa that require free satellite data. These were issued by both. ESA and the Canadian Space Agency (CSA). ESA received approximately ten times the number of proposals expected.
- Established several 'demonstrator' projects related to water and health (EPIDEMIO), food security (GMFS) , wetland management (GlobWetlands) and transboundary aquifer management (AQUIFER)
- Initiated the radar altimeter 'river and lake' level validation process in Africa towards major refinement
- Been assisted by CEOS space partners in Canada, Europe, Japan and USA

Workshop Outcome

At the 2004 workshop, national water authorities and other stakeholders made it clear that good access to satellite products (in combination with many other sources of information) was absolutely essential for effective implementation of IWRM. Not only was spatial data required for a range of effective decision-making, but also to promote good governance through better stakeholder access to pertinent information. This applies at all scales from micro-watershed to transboundary basins.
The workshop of 140 persons adopted a strategy for TIGER based on IWRM in accordance with the Africa Water Vision, involving 10-year commitment to TIGER by the space agencies, and in coordination with UN Water-Africa.
While it had become clear that TIGER could contribute to informing the IWRM process in Africa, it was also speculated that TIGER techniques could enable development of a sustainable Africa-wide IWRM information system.

Next Steps

- TIGER is currently formulating a 10-year plan and proceeding towards the first stages of implementation (needs assessment).
- In order to complement existing activities, and to make sure that any developments are likely to be sustainable, TIGER is continuing with extensive consultation of stakeholders, while assisting the network of AO projects evolve into a coherent support base for IWRM in Africa.
- TIGER is developing a position paper on IWRM information needs
- Key Question: How best to integrate space data with surface observations to provide cost effective and sustainable observation network and a useful decision support (information) system?

Macro-Technical Context: Towards development of a sustainable Africa-wide IWRM information system

If we consider

1. the Policy Context of IWRM in Africa
2. the comparative advantages of satellite remote sensing for IWRM
3. GEOSS: Integration of Africans into the global observing system
4. the future of hydrological modelling, then
5. the conclusion is that the route being pursued by TIGER has merit.

Policy Context of IWRM

IWRM has evolved as a practical approach towards meeting MDG 7, Target 9 (Integrate the principles of sustainable development into country policies and programmes and reverse the losses of environmental resources) and Target 10 (Halve by 2015 the proportion of people without sustainable access to safe drinking water and basic sanitation). In addition, the 2002 World Summit on Sustainable Development called for all countries to develop integrated water resources management and water efficiency strategies by the end of 2005[i]

Development of improved information systems for IWRM is highly relevant to political priorities in Africa. The African Ministerial Conference on Water (AMCOW) and Heads of State of the African Union endorsed the "**Africa Water Vision for 2025**", produced by UN Water/Africa, which identifies **the paucity of information on water resources as a key limitation.**

Continental priorities for action under the New Partnership for African Development (NEPAD)[ii] include:

- Enabling Environment for Regional Co-operation (i.e. trans-boundary);

- Development of National Integrated Water Resources Management Policies;
- Improving Water Wisdom

Priorities at **sub-regional** level, as from the Southern African Development Community, for example, emphasise[iii]:

- Planning, development and management of water resources in the region should be **based on the principles of IWRM;**
- Member states shall establish water resources data and information systems in their territories **in an integrated manner** at regional, river basin and national levels to meet all water resource management needs.

Priorities at **national** level are to develop IWRM strategies, and then implement them at all scales from local to trans-boundary basins.

2. Comparative Advantages of Satellite Observations.

- Space-based data and maps have major comparative advantages for extensive resource management, such as water in Africa, in that they:
- Provide a homogeneous overview of **the whole area**, facilitating integration of information from local to national to transboundary scale
- Enable intelligent **interpolation** between traditional point measurements
- Can provide information on water **quantity, quality, and consumption**
- Enable conditions in **remote or insecure areas** to be monitored easily
- Provide timely information on **rainfall** for management of droughts and floods
- Enable **changes of hydrological variables** to be detected easily through repeat coverage (vegetation, erosion, river bed conditions, urbanisation, etc)
- Provide **neutral information** for integrated management of Africa's trans-boundary surface and ground water systems allowing the generation of common databases, inter-country comparable information and shared water management information systems
- Provide information in cloudy areas using satellite radar
- Are particularly **useful in data sparse areas** and also add considerable value when used in conjunction with surface observation networks.

In addition

- **Models**: satellite data is used more and more in regional (and global) hydrological models for real-time water resource management (as flood prediction/control)
- **Water levels**: new techniques are being developed that enable water levels in rivers, lakes and dams to be monitored routinely by satellite radar altimeters
- **Communication**: satellite communication techniques now enable remote communities to access data directly, such as the RANET system that uses satellite digital radio for (e.g.) weather map dissemination to rural communities
- **Sustainability**: Satellite based data is now essential for environmental management in developed countries: data sources will be sustained and techniques further developed through the Global GEOSS programme, with common access to free data for national development purposes.
- **Customizable**: Satellite techniques offer sustainable data sources essential for many different stakeholders in IWRM in Africa, as elsewhere.
- **Multipliers**: Because satellites provide global coverage, there are major multiplier effects from investing in this approach: innovation and best practice developed in one area can easily be transferred and/or adapted for wherever required.

GEOSS[iv]: Integration of Africans into the global observing system

Satellites make most sense when managed at global scale for helping to integrate many local actions into one global environmental management system. It would seem that sense has

prevailed and the powers that be have finally understood that satellite systems have an essential role to play in managing global environmental change.

Satellites now provide the single most important means of obtaining observations of the climate system from a near-global perspective and comparing the behaviour of different parts of the globe. A global climate record for the future critically depends upon a major satellite component, but for satellite data to contribute fully and effectively to the determination of long-term records the system must be implemented and operated in an appropriate manner to ensure that these data are accurate and homogenous[v].

On July 31, 2003, thirty-three nations plus the European Commission adopted a Declaration that signifies political commitment to move toward development of a comprehensive, coordinated, and sustained Earth observation system(s). The Earth Observation Summit attracted a distinguished group of government dignitaries from around the world who are committed to significantly advancing our collective ability to gather Earth observation data.

The Summit participants affirmed the need for timely, quality, long-term, global information as a basis for sound decision making. In order to monitor continuously the state of the Earth, to increase understanding of dynamic Earth processes, to enhance prediction of the Earth system, and to further implement environmental treaty obligations, participants recognized the need to support the creation of a comprehensive, coordinated, and sustained Earth observing system or systems.

Ministers met for Earth Observation Summit II in Tokyo, Japan, on 25 April 2004, where they adopted the Framework Document for a 10-Year Implementation Plan for this initiative. The plan itself will be presented at Earth Observation Summit III in February 2005.

The most important implication for IWRM in Africa is that we are approaching an era of long-term sustainable satellite systems with reliable and free access to data. This will change the whole science of Earth observation from a set of attractive but unsustainably expensive tools, to a very powerful set of practical and cheap tools for meeting a number of the many IWRM stakeholder needs for information. The important step now is to make sure as many people in Africa are aware of the potential and participating in development of these tools, so as to be able to negotiate African needs at the GEOSS table.

(Global) Hydrological Modeling

The primary focus of NASA's Global Hydrology and Climate Centre[vi] is to understand and predict the Earth's global water cycle, its connections to climate variability and weather, and to assess the interactions between human society and the dynamic Earth system in which we live. From there, inroads can be made toward educating our society on the global hydrological process and its impact on society's day-to-day activities.

NASA is already experimenting with global hydrological modelling linked to numerical weather models. The outputs are not particularly useful at the moment though there are indications that the modelling has identified certain areas where rainfall development is particularly sensitive to conditions on the ground.

Other groups are working on limited area hydrological models whose boundary conditions are driven by global models (an exact parallel to limited area weather models driven by global models) and controlled with surface and/or satellite observations. Some of these techniques are already functional on PCs and several groups within TIGER are exploring modelling options.

As IWRM gets more integrated, the only way to manage floodwaters effectively will be through the use of models with early warning alert systems. The route towards participation

for African countries probably lies in working initially with modelling teams to validate and improve larger area models before embarking on management of their own local area models.

Macro-Technical Conclusion
Considering a) the political requirement for implementing IWRM with compatible information systems in order to address transboundary issues together, b) the comparative advantages of satellite data for water resource management, c) the major steps towards sustainable global observing systems in GEOSS, and d) the development of hydrological modelling and other new techniques, there does appear to be scope for TIGER partners to move towards development of a sustainable Africa-wide IWRM information system.

Overall Conclusion
The TIGER Initiative shows promise for making a significant contribution to modelling and decision making in African IWRM. While it is still early days yet, if TIGER can identify sufficient stakeholder groups with information needs that can be assisted with space data, and then meet these needs through improved access to affordable data, then real progress will have been made. The prospects for sustainability alos appear promising.

If time permits, examples from ongoing projects will be shown

- Aquifer
- Globwetlands
- Epidemio
- River and Lake
- India Watershed Management Programme

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[i] Global Water Partnership, Policy Brief: Unlocking the door to social development and economic growth: how a more integrated approach to water can help: Technical Committee, 2004.
[ii] NEPAD Strategic Plan 2004-2007: The Roadmap to the Future, March 2004 Draft
[iii] Draft Regional Water Policy for SADC region: May 2004
[iv] http://earthobservations.org/
[v] Technical Supplement to the Second Report on the Adequacy of the Global observing systems for Climate (GCOS-82), version 2.7, 10 September 2003, http://www.wmo.ch/web/gcos/gcoshome.html
[vi] http://wwwghcc.msstc.nasa.gov/ghcc_more.html