Towards Integrated Water Management in Africa:
Space Technologies for Bridging the Water Information Gap

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Improving Water Governance

EO data

Integration: models

In-situ data

Better Information

Plans, decisions
The North-South Technology Transfer Model

DOT Approach:

- A consortium develops the System on the basis of the User requirements;
- The consortium operates and demonstrates the System (produces a number of final products);
- The system (and the database) is transferred to the user (Host Institution);
- The user (Host institution) operates the system;
**User Group:** International and National authorities and NGOs are main actors in the projects devoting resources in terms on manpower and data access.

- **User requirements consolidation**
- **Data access & ground truthing**
- **Support to products validation**
- **Assessment & operations**

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**Service Development**

**EO data**

**Products**

**Service**
The paucity and poor quality of information on water & land resources required for IWRM is considered a key limitation to achieve the WSSD goals;

In 2002, ESA launched TIGER as a CEOS contribution to implement the recommendations of the WSSD;

The goal of TIGER is to support African Water Authorities to improve Integrated Water Resource Management by exploiting the benefits of space technology to overcome the geo-information gap.
The TIGER Initiative: The history

- **2002**
  - TIGER Launch
  - WSSD Workshop Rabat

- **2003**
  - TIGER ESA AO
  - Workshop Paris
  - North-South Tech. Transfer Projects

- **2004**
  - TIGER 10-years Strategic Plan
  - Workshop Pretoria
  - 50 AO Proj. Kick-off
  - Implement. Plan 05-07

- **2005**
  - ESA ITT Innovators
  - Proposal for EC support submitted
  - Workshop Rome 3-4 October
The TIGER Partnership

- African component of TIGER:
  - More than 200 African experts in TIGER projects (from water authorities, technical centres and universities);
- Key collaborators: CSIR, ESRI, CRTS;
- Regional Technical centres (e.g., OSS, AGRHYMET);

- The CEOS partners (e.g., CSA have launched 5 new projects dedicated to TIGER in 2005);
- UNESCO provides access to the hydrology community through its IHP networks.
- Other Int. Organisations: UNOOSA, UN-ECA, FAO;
TIGER Lines of Action

Initial Stage

Pre-operational Stage

Operational Stage

Improving Access to EO Data

Capacity Building and Training

Support African teams to advance in the use of EO technology for IWRM

Support service development, demonstration and transfer of know-how.

Support access to donors to foster sustainability of successful services (Sub-regional)
**Initial Stage**

- **Start-up projects**: Set of pilot projects aimed at supporting African technical centres (i.e., potential service providers) to advance in the use of EO technology for IWRM.

- In 2004, **African institutions were invited to submit concrete proposals for Pilot Projects** (through an ESA Announcement of Opportunity).

- 95 project proposals submitted by more than 300 African experts dealing with water management issues;
- 50 projects based on specific user needs have been selected and launched in 2005;
- The **50 African teams** will be supported with:
  - *Free ESA data (2000 MERIS & ASAR)*;
  - *Training*;
Geographic composition of the AO teams

Composition of the AO teams

- Mixed team (African PI)
- Mixed team (non-African PI)
- African team

- Research
- RS
- Users
• During 2003/2004, ESA launched a number of TT Projects funded with more than 3.5 MEuro.

• These projects are carried out in close collaboration with almost 20 African Institutions (North-South partnerships) by using a User Driven Approach

• CSA has launched in 2004 3/5 new TT projects;

• Some info service under implementation:
  • Wetlands management;
  • Ground water and aquifer management;
  • Rivers and lakes water levels;
  • Sanitation and epidemiology.
The GlobWetland project

- Main Objectives:
  - Short-term: Develop user-oriented information system (based on EO-technology) to support the National and Local authorities in managing Ramsar sites;
  - Long-term: contribute to establish a solid basis for the operational use of EO technology in wetland management worldwide;

- Budget: 1MEuro;
- Duration: 24 months;
- Kick-off: November 2003;
- Geographical coverage: Around 50 Ramsar sites worldwide mainly in Europe and Africa;
- Implementation:
  - International Team: Atlantis (CND), Synoptics (NL), WI (Int.) and RRS (D);
The GlobWetland African Sites

- **User Group:**
  - 10 countries: Algeria, Egypt, Senegal, South Africa, Kenya and the Lake Chad Commission Members.

- **Wetlands:**
  - 15 wetlands sites;
What can EO do for wetland managers?

- Base mapping;
- Water cycle monitoring (seasonal and log-term):
  - Land cover/use and change:
  - Wetland identification (e.g., mires);
  - Wetlands typology mapping;
  - Peatlands fires mapping;
- Topography:
  - DEMs
  - Terrain dynamics (subsidence);
- Coastal dynamics monitoring;
- Biophysical parameters:
  - water quality (e.g., turbidity, colour,..);
  - Evapotranspiration;
  - Soil/water temperature;
The Aquifer project

Objective: Support the management of trans-boundary aquifers in Africa
Develop and demonstrate products and services
Support, develop and demonstrate local production

1 M€ - September 2004 to June 2007

• Carried out by an international consortium lead by the German company GAF;
• Users: Ministries in Algeria, Libya, Mali, Niger, Nigeria, Tunisia;
• User coordinator: OSS;
• 4 African service providers;
AQUIFER - Geographic Frame

Surface: Approx. 1 Mkm² each
What can EO do in Aquifer Management

Applications

Support in Aquifer Management

- Evaluation of land cover / land use and change
- Mapping of irrigated areas
- Estimation of ground water abstraction
- Monitoring of soil deterioration (salt crust extension)
- Improvement of existing SASS Model

- Support in hydrogeological modelling (groundwater flow/ recharge)
- Support in trilateral decision making and future treaty verification
- Generation of DTM for Planning

Services

EO Based Products

Water Abstraction Estimation Over Time

Land Use / Land Cover LU / LC Change

DTM

Refined Water Abstraction Estimation

Refined Land Use Map

Vegetation Monitoring Over Entire Aquifer

Subsidence Monitoring

OPERATIONAL maturity

high

SCIENCE maturity

low

European Space Agency
Agence spatiale européenne

The Living Planet
The TIGER Initiative: Key Issues

- Fostering the African Ownership (leadership of African Water Authorities):
  - TIGER Executive Bureau in Africa;
  - Sub-regional evolution of the programme implementation (led by African partners);

- Develop efficient mechanisms for technology and know-how transfer to African Service providers: from pre-operational to operational stage;

- Develop mechanisms for improving access to low-cost EO-data in Africa;

- Develop a strong capacity building component in TIGER: Human, technical and institutional capacity;

- Fostering partnership with development agencies and donor organisations;
• **Objective**: provide a near-real time information service to water authorities on rivers and lakes water levels;

• Satellite altimeters such as ERS-1/2, Topex, Jason-1 and Envisat were designed to retrieve ocean heights to an accuracy of a few cms.

• A system has now been developed which allows heights to be obtained over inland water, currently to an accuracy of 10-20cms. This accuracy is expected to improve.
River & Lakes: Lake Victoria

Time series of height differences

Water Levels
Future Possibilities

East African Lakes Volume Change

Rukwa
Mweru
Wantipa
Bangweulu
Mweru
Turkana
Pangani
Epidemio provides environmental information from Earth Observation to support epidemiologists in the study, monitoring and early warning of human disease.

**Services**
- DEM, water bodies, and land surface temperature for malaria early-warning
- Wind blown dust for meningococcal meningitis early warning
- Vegetation monitoring to target field work on the ebola reservoir
- Urban mapping and cartography to support WHO public health planning

**User Group**
- WHO
- Pasteur Madagascar
- CIRMF (Gabon)
- CERMES (Niger)
- Himal (Kenya, Uganda)
- London School of Hygiene and Tropical Medicine
- University of Oxford
Prototype Urban Map for Ouagadougou, Burkina Faso

Prototype classification of SPOT-5 image (early results)
Other EO Applications to Water Management

- Environmental and Natural Resources Management:
  - Soil contamination;
  - Water consumption;
  - Environmental indicators;
  - Food Security;
Locating well positions

Information provided:

- Drainage network, watershed
- Proposed locations for new well drilling
Agriculture Intensity: Soil contamination

Average Specific Nitrogen Leakage
Elbe Catchment 1985
(Total Emissions)
Irrigated surfaces
2002 / Neste system
(France).

Monthly and total
irrigation volumes.

© Astrium SAS
Irrigation Volumes.
Flumen Irrigation Unit (Spain)

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• Sustainable Development and Humanitarian Aid:
  • Support to agriculture management in developing countries;
  • Food security;
  • Support to humanitarian aid;
Food security: Production forecast

Information provided:

National scale resource base mapping & crop production forecasting:

- High resolution crop type/area + agrometeorological modelling;
- More accurate information for national ministries and international donors;

Legend

% cultivated area (Maize)

- 0 - 5
- 6 - 10
- 11 - 20
- 21 - 30
- 31 - 50

Legend

MODIS & AVG (1990-1999)

- Very Negative
- Negative
- Similar
- Positive
- Very Positive
Food security: Production forecast

Information provided: Accurate production assessment:

- Crop planting date monitoring;
- High resolution crop type/area;
- Agrometeorological modelling;
- Rapid service via SAR;
Rapid mapping & situation awareness

Information provided:

- Topographic maps
- Thematic maps
- Rapid damage assessment
Rapid mapping & situation awareness