Earth Observation for Water Management, a GEONETCab toolkit

Andiswa Mlisa

13th WaterNet Symposium, 31 October – 2 November 2012, Johannesburg, South Africa

The Group on Earth Observation Network for Capacity Building (GEONETCab) Project

General Info

- Duration 3 years: Nov 2009 – Oct 2012
- Budget: 1.2 million Euro
- Funding: European Commission + own contribution
- Regional focus
  - Southern Africa
  - French-speaking countries in Africa
  - Central & Eastern Europe
  - Spin-off to Latin America & Asia

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- ITC – NL (coordinator)
- CNES - FR
- IRD - FR
- SRC - PL
- CU – CZ
- CRASTE LF – MA
- SANSA – ZA
- UMVOTO – ZA

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Key Aspects

- Create conditions for improvement and increase of GEO capacity building
- Identification of CB needs
- Specifications for CB in EO
- Identification of resource providers
- Sustainable brokerage between stakeholders
- Mechanism to facilitate cooperation between stakeholders
- Global base of technical expertise for education & training in EO
- Monitoring & evaluation mechanisms for CB in GEO

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Workflow

- Inventory current situation (WP 1)
- Identify opportunities & bottlenecks (WP 2)
- Connecting & building (quick-win projects & capacity building web) (WP 3)
- Awareness & dissemination (general & targeted workshops) (WP 4)
- Evaluation & follow-up: continuous brokerage (WP 5)

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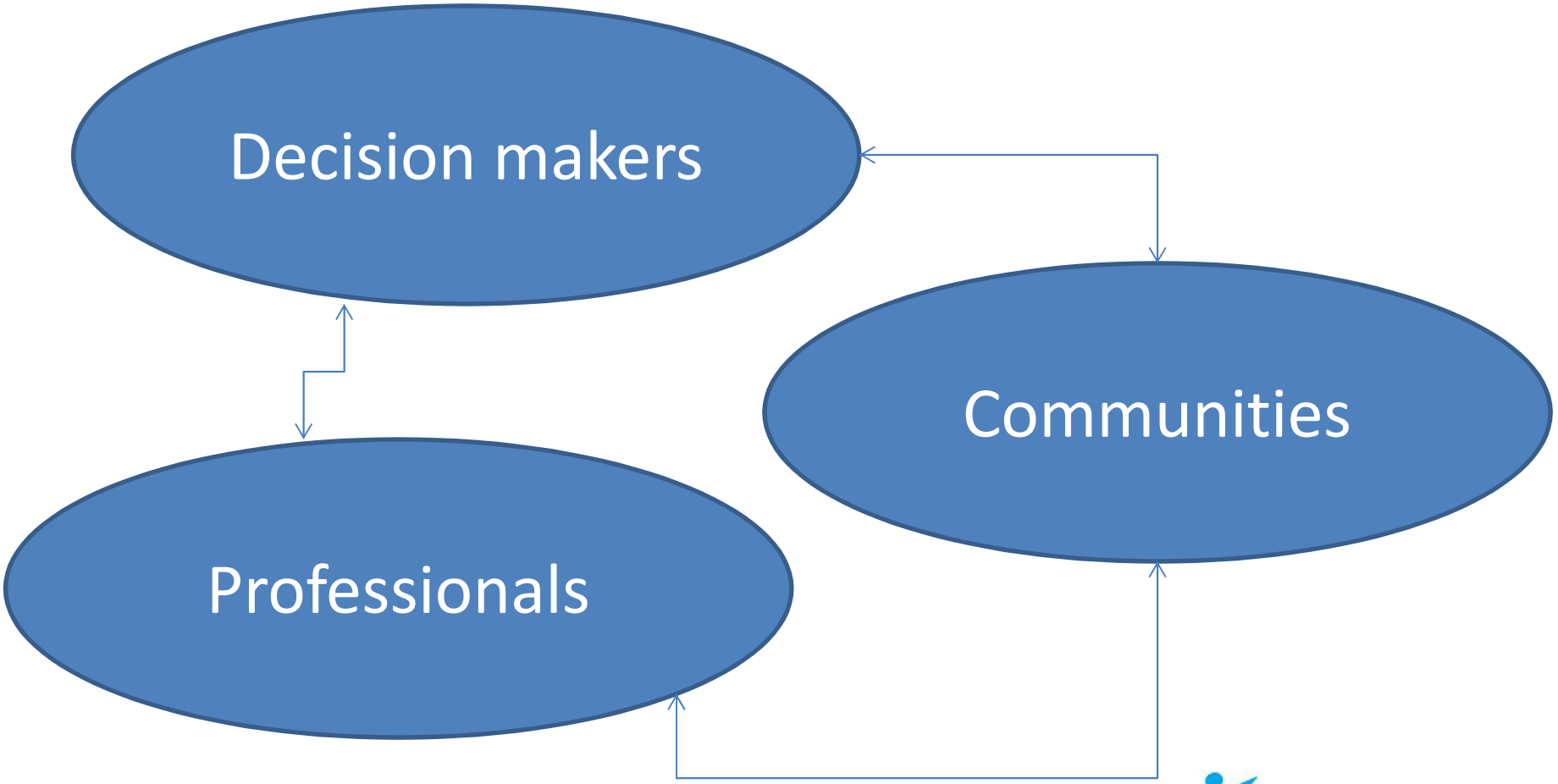
EARTH OBSERVATION

- Available to new groups of end-users
- Potential to involve (and empower) these users in Societal Benefit Areas
- To achieve this: build on strengths to address weakest links in the chain from provider to user
- GEOSS: (technical) platform for all users
- GEONetCab: facilitate capacity building & brokerage

Target Groups



Overview

Marketing of Earth Observation Products & Services (framework study)	Regional Studies (Poland, Czech Republic, French-speaking Africa, Southern Africa) + Synthesis
Capacity Building Strategy	Success Stories, Toolkits, Roadshow, Quick Win Projects, Workshops, Capacity Building Web

Marketing Toolkits

- International trends and developments in a GEO societal benefit area
- Promotion of earth observation applications
- How to get funding?
- Capacity building

- Disaster toolkit
- Crop modelling toolkit
- **Water toolkit**

Earth Observation for Water Management

International trends & developments

How to promote earth observation applications?

How to get funding?

Capacity building

Earth observation applications

On the verge of reaching new user communities
These new user communities need to be involved
Weakest link / last mile aspects are important
Marketing needed: promotion & capacity building

Life cycle of products & services

Initialization
System analysis & design
Rapid prototyping
System development
Implementation
Post-implementation

Assessment of business & funding opportunities

Categories of water management products & services

Life cycle phase of product or service

Regional context, level of technological & economic development

Optimum marketing mix

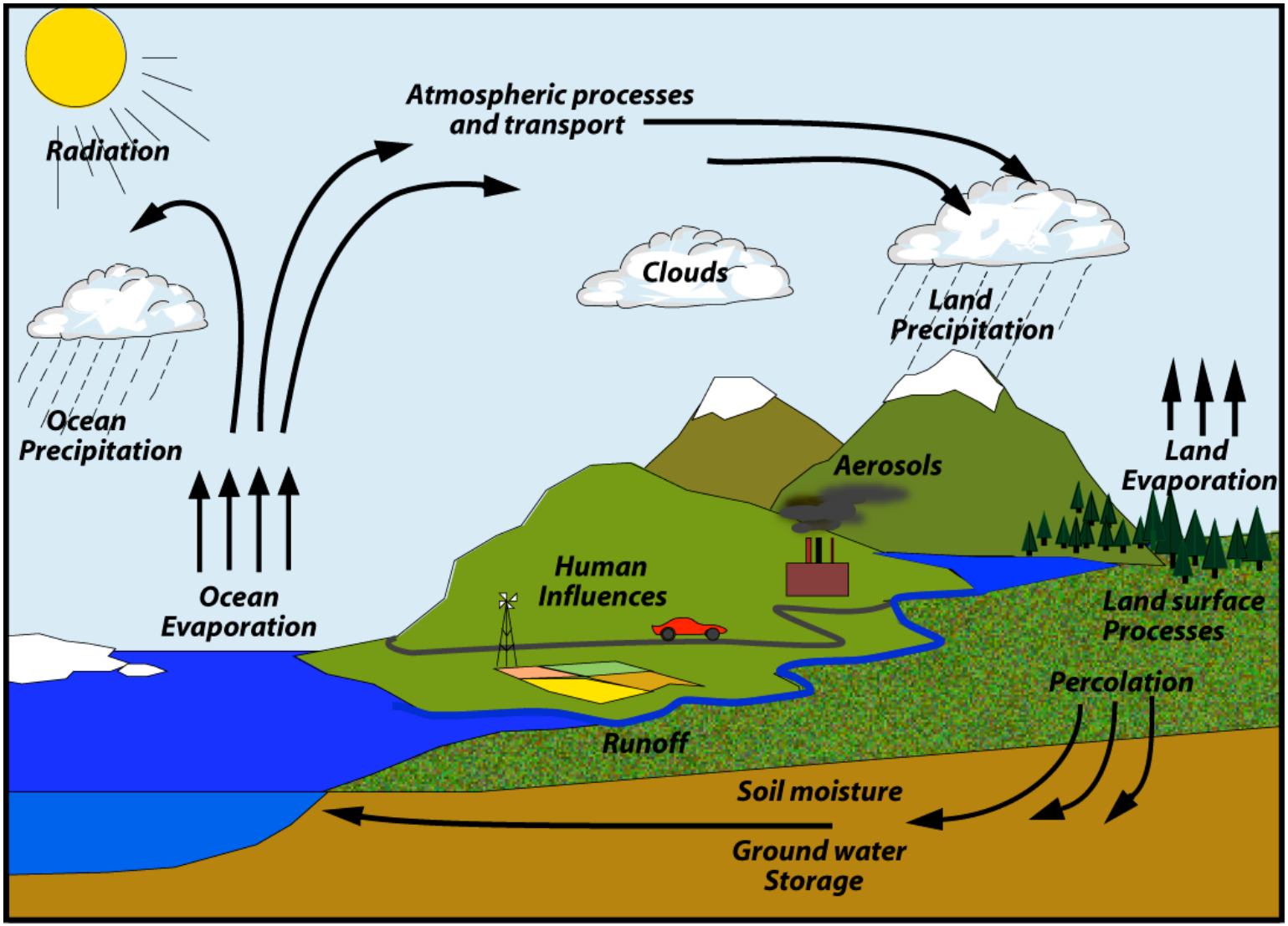
1. International trends & developments in earth observation for water management

Decision making

"We can only manage what we measure"

Water cycle: water resources availability and quality for

- Economic development
- Green economy
- Poverty reduction
- Community empowerment
- Risk management


Radiation
Atmospheric processes
and transport
Clouds
Land
Precipitation
Ocean
Precipitation
Aerosols
Land
Evaporation
Ocean
Evaporation
Human
Influences
Land surface
Processes
Percolation
Runoff
Soil moisture
Ground water
Storage

AFRICA WATER ATLAS

Modeling of Africa's surface water systems (water balance data), identifying:

- "hotspots": tenuous food security situation
- "hopespots": potential for rainwater harvesting
- "water towers": areas with upstream water surplus

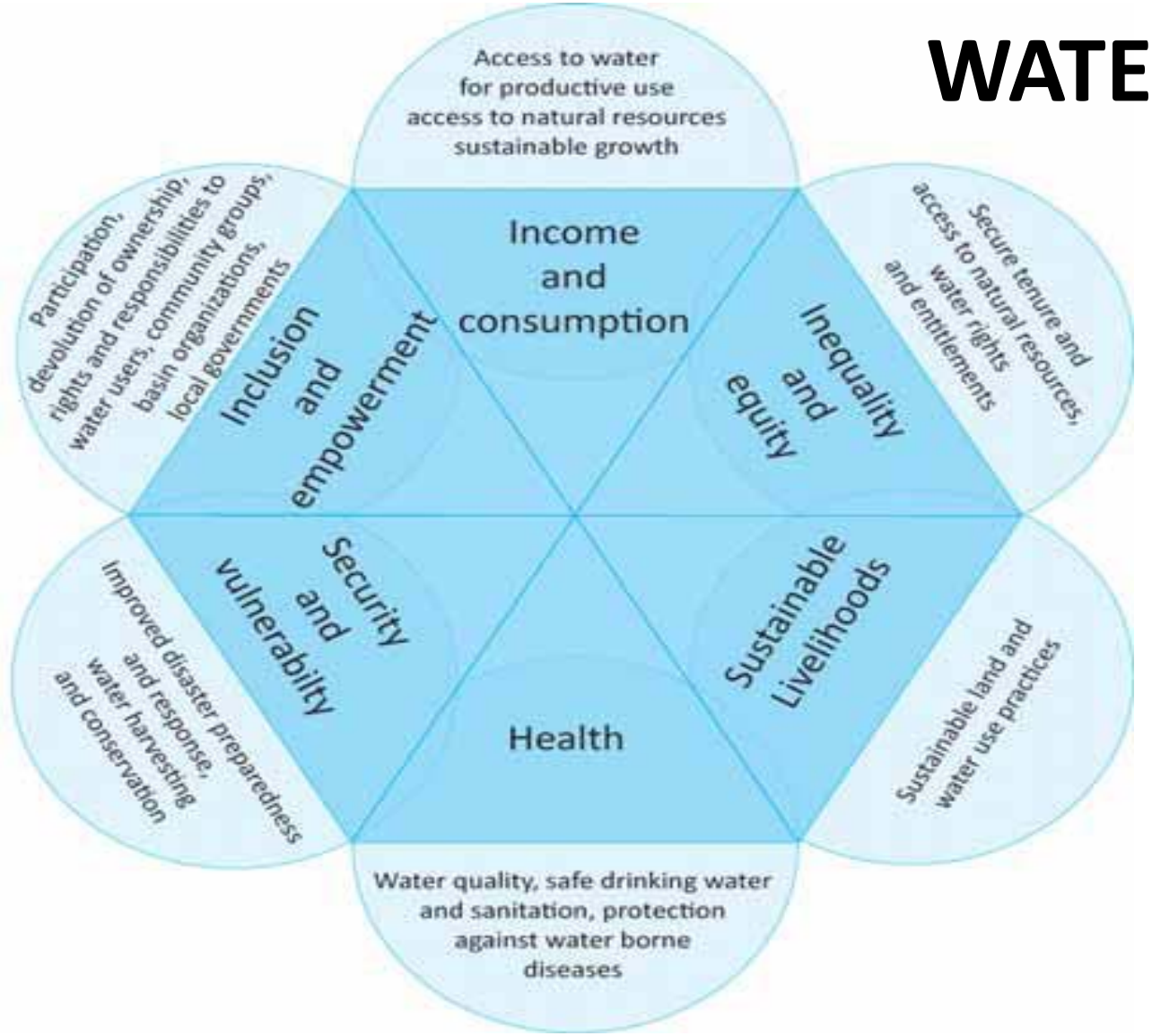
AFRICA WATER ATLAS

Key Facts:

- Millions of people in Africa suffer water shortages throughout the year
- Water scarcity is not simply due to geography: population growth, poor planning and poverty are significant factors
- Most urban population growth has taken place in peri-urban slum neighbourhoods, overwhelming municipal water services
- 64% of people in Africa use improved drinking water sources (2010)
- Only 38% of Africa's population has access to improved sanitation facilities (2010)
- Increases in access to improved drinking water sources and sanitation facilities are not keeping pace with population growth

Linkages between poverty water and the environment

AFRICA WATER ATLAS



AFRICA WATER ATLAS

Action:

- Provide safe drinking water + ensure access to adequate sanitation
- Foster cooperation in transboundary water basins
- Provide water for food security
- Develop hydropower to enhance energy security
- Meet growing water demand
- Prevent land degradation and water pollution
- Manage water under global climate change
- Enhance capacity to address water challenges

Earth observation contribution to action

- Increase insight in and visibility of available resources
- Analysis of historical and future use for planning and decision making
- Mapping of informal settlements, infrastructure and resources
- Analysis for more efficient use of water resources
- Hydropower: assessment of resources, planning & monitoring
- Instrument for community empowerment ->

example – Human sensor webs: challenges for monitoring

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CASE STUDY

Earth Observation Methodologies for Groundwater Exploration and Monitoring

Reference:

Managing Drought:

A Roadmap for Change in the United States

Back to decision making

"Make Information Relevant to Managers"

Main messages given to managers:

1. It is definitely getting warmer
2. Though we expect that the hydrological cycle, will be enhanced due to more energy in the atmosphere, we really don't know how precipitation patterns will be affected.

Managers are liable to respond with:

"I need more information before I will invest in adaptive activities – I don't know how to respond to this much uncertainty"

Reference:
Managing Drought:
A Roadmap for Change in the United States

Back to decision making (2)

"Make Information Relevant to Managers"

Reframe the information in terms of combining the effect of temperature and demand:

1. Increased human demands for water for human, agricultural and the environment, among other sectors
2. Impacts on supply (increased evaporation from reservoirs, increased consumption by plants, decreased snowpack, etc.)
3. If it does rain more in a warmer climate, it is likely to rain harder than more often

Reference:

Managing Drought:

A Roadmap for Change in the United States

Back to decision making (3)

"Make Information Relevant to Managers"

Then the message to managers becomes: "though we don't know much about whether total precipitation will increase or decrease, the implication of global warming for water management are likely a reduction in average supply availability and an increase in extreme events, including both droughts and floods"

Framed in terms of risk to managers' systems

Reference:

Managing Drought:

A Roadmap for Change in the United States

Back to decision making (4)

"Make Information Relevant to Managers"

Need for "integrated and adaptive decision support systems able to explicitly account for system uncertainty

Incorporate institutional, political, and economic considerations into translating physical science findings into relevant information for specific types of decisions within specific sectors

Communication should be perceived by the users as:

- Salient (answering the right questions)
- Credible (coming from a trusted source)
- Legitimate (accurate)

Other references related to extreme events:

References on flooding can be found in the GEONetCab disaster management toolkit

More references on drought:

Drought monitoring and early warning:
concepts, progress and future challenges

World Meteorological Organization
Weather • Climate • Water

NIDIS
NATIONAL INTEGRATED DROUGHT INFORMATION SYSTEM

The national drought information system implementation plan
a pathway for national resilience

Agriculture and Agri-Food Canada's Drought Monitoring and Information System

Agriculture and Agri-Food Canada
Agriculture et Agroalimentaire Canada

Measuring Water use in a Green Economy

Methodologies for:

"we can only manage what we measure"

Water registers (as key to fair distribution of access to water)

Water and ecosystem capital (water as natural capital, linked to economy and well-being (UN SEEAW 2007, NAMEA)

Water scarcity and vulnerability indices (per capita, renewal vs withdrawal, etc.)

Water footprint assessment (amount of water consumed per unit of product)

Life cycle assessment (benchmarking for industries)

Water stewardship (quantify corporate water monitoring)

Measuring Water use in a Green Economy

Key observations for:

"we can only manage what we measure"

- *Over the past 50 years global freshwater withdrawals have tripled*
- *A quarter of freshwater use exceeds accessible supplies*
- *By 2030 nearly 3.9 billion people will live under conditions of severe water stress (OECD)*
- *By 2030 global demand for water will be 40% higher than it is today*
- *Open data access and optimal data availability are of cardinal importance*

Measuring Water use in a Green Economy

Different levels for:

"we can only manage what we measure"

- **User level**: price and technology play a key role (creating awareness, charging prices based on full marginal costs, stimulating water saving technology
- **Catchment or river basin level**: choice on how to allocate the available water resources to the different sectors of the economy (depends on the value of water in its alternative uses)
- **International trade**: water as a global resource (overall efficiency)

Measuring Water use in a Green Economy

Economic calculations of:

"we can only manage what we measure"

Calculating the monetary value of externalities and ecosystem resources and services that are currently unpriced

Decoupling concepts:

- Resource decoupling: reducing resource use per unit of economic activity
- Relative decoupling: resource use still increases but at a lower rate of economic growth
- Impact decoupling: scale and character of resource use causes no negative environmental impact
- Absolute decoupling: resource use declines irrespective of the growth rate of the economic driver

2. Steps to promote earth observation for water management

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State-of-the-art

Earth observation is new technology. Learn technical skills, but when back in professional practice, it has to be put to good use. That involves ‘selling’ it. How to do that. To whom: could be your own boss, local authorities, communities, etc.

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Categories of products and services

Hydrologic information systems
Soil moisture modelling
Drought monitoring / early warning
Monsoon monitoring / forecasting

Different levels of intervention for earth observation products & services

Formalization axis (technical products, such as DEM, terrain analysis, land use / land cover & change detection)

Axis of use (processed information, for example for management of dams, water or hydro-erosion and flood risk zones)

Axis of facilitation (products and services that directly facilitate decision making)

From: Application of satellite remote sensing to support water resources management in Africa: results from the TIGER initiative

Steps for Earth observation supported water resource management

1. Land use and land cover mapping + change monitoring
2. Water abstraction estimate in respect of crop water demand estimates for irrigated areas
3. Refined land use / land cover mapping
4. Surface water bodies or water pools (location, extent, dynamics)
5. Digital elevation models and derived products
6. Estimates of basin-wide evapotranspiration and precipitation
7. Water and vegetation monitoring (entire aquifer)
8. Ground subsidence monitoring and its correlation with groundwater abstraction

From: Application of satellite remote sensing to support water resources management in Africa: results from the TIGER initiative

Where to get the data from?

Global energy and water experiment (GEWEX) -> now:

Global and regional energy and water exchanges – some considerations from “GEWEX Plans for 2013 and Beyond”

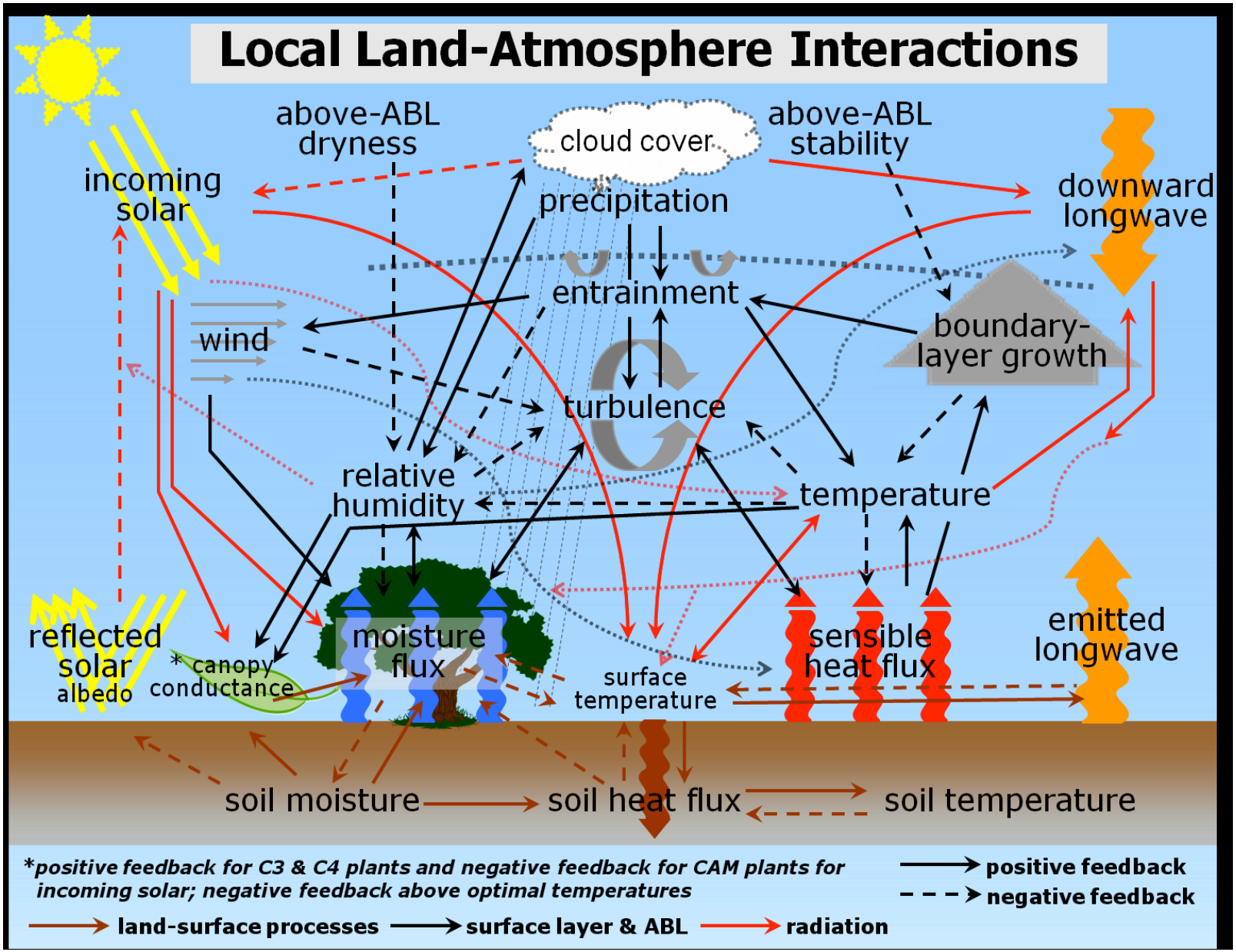
Prototype data management scheme for GEOSS

Development of land data assimilation systems

Decadal-long data records of land states for soil moisture

Systems require inputs from some combination of in-situ meteorological networks, satellite observations and forecast model outputs

Transfer research developments and demonstration applications to operational agencies and users


Local Land-Atmosphere Interactions
above-ABL dryness
cloud cover
above-ABL stability
incoming solar
precipitation
downward longwave
entrainment
wind
boundary-layer growth
turbulence
relative humidity
temperature
reflected solar
albedo
* canopy conductance
moisture flux
surface temperature
sensible heat flux
emitted longwave
soil moisture
soil heat flux
soil temperature
*positive feedback for C3 & C4 plants and negative feedback for CAM plants for incoming solar; negative feedback above optimal temperatures
positive feedback
negative feedback
land-surface processes
surface layer & ABL
radiation

More references:

GEO Task US-09-01a: Critical Earth Observations Priorities - *Water Societal Benefit Area*

Overview of available and needed observations, overview of application areas and user types

EUGENE Water Status Quo report (and final report)

Overview of state-of-the-art EO for water in Europe

WMO statement of guidance for hydrology

Overview of (international) organizations dealing with water

Overview of observation gaps: water use, evapotranspiration and soil moisture

WMO guide to hydrological practices

Part 1: from measurement to information

Part 2: management of water resources and application of hydrological practices

More references (2):

Remote sensing applications, National Remote Sensing Centre, India ***Chapter 6: water resources management & Chapter 8: groundwater***

Overview of remote sensing applications and case studies in India

Water management by satellites; the unavoidable way forward

Visionary presentation from a Dutch SME: assessing spatial water productivity & water footprint

Spatial dimensions of land administration and users rights over groundwater: case study of Kerala, India vs. Coca Cola

Case study on how geo-information visualizes groundwater rights, water use and associated problems

Impacts of agricultural intensification through upscaling of suitable rainwater harvesting technologies in the upper Ewaso Ngiro North basin, Kenya

Article describing remote sensing applications for rainwater harvesting

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More references (3):

Evaluating nitrogen removal by vegetation uptake using satellite image time series in riparian catchments

Article on a pilot study in China on improving water quality by making use of natural vegetation

Summary of the 2nd GEOSS Africa water cycle symposium

Overview of available data and models in Africa

GEO GROUP ON EARTH OBSERVATIONS

Update on the Integrated Global Water Cycle Observation (IGWCO) community of practice

Overview of activities of the GEO water community

HARIMAU Radar-Profiler Network over the Indonesian Maritime Continent: A GEOSS Early Achievement for Hydrological Cycle and Disaster Prevention

Article describing the establishment of a network for monsoon forecasting and monitoring

More references (4):

Global Runoff Data Centre report series

hydrologic information - metadata

UML model of available catalogues

The current status of global river discharge monitoring and potential new technologies complementing traditional discharge measurements

Article on options for discharge monitoring by remote sensing, especially in remote areas

Essential climate variable studies on: glacier, snow cover, groundwater, water level, river discharge

Description of available and needed information, including role of earth observation

References on drought: see slide above (on extreme events)

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More references (5):

SHARE: soil moisture for hydrological applications

Article on earth observation for soil moisture products

GEOWOW

Emerging technology analysis

Overview of application and possibilities of emerging technologies for earth observation related to water, weather and oceans

Space research – a European journey

Overview of space-related research projects, including projects dedicated to GMES downstream services

GMES
Observing our planet for a safer world

GLOWASIS
GLOBAL WATER SCARCITY INFORMATION SERVICE

GLOWASIS user requirement study

Report on user requirements for the GMES global water scarcity information system

Marketing of earth observation

Marketing of earth observation is difficult. New technology, few big companies, lots of small ones. Lots of reports describing the bottlenecks, like reliability, data access, data continuity, etc. Means that relatively a lot of effort is needed to promote EO.

Points to keep in mind:

- Look for opportunities, where can you have most success in a short time: quick-wins.
- Target the right audience to start with: who would be interested and listen to you? For crop modeling: see next slides.
- Identify the problem that they are trying to solve: is it the same as yours?
- Learn to speak the same language. Example ‘evapotranspiration’: this is a term most managers do not understand and do not care about. Use terms related to water use, supply and demand instead.
- Look for examples from elsewhere (success stories): solutions that work and are affordable.

Be patient:
introduction of new technology and / or applications takes time

3. How to get funding for your activities

Approach

- Share information on your subject (a thing you are doing) and think that is interesting for your contact, then look for the link. Could this solve a problem for your partner? Are adjustments necessary? Need other parties be involved? Take it from there.
- LEADS, LEADS, LEADS

How?

- Establish your network.
- Look for opportunities.
- Write a good proposal.
- Promise much, but not too much.

Proposal outline

(more detailed version in separate document, see also www.geonetcab.eu)

1. Introduction / relevance
2. Objective(s)
3. Activities
4. Output
5. Management & evaluation
6. Risk assessment
7. Time schedule
8. Budget

Annexes

Other references

- Civicus: writing a funding proposal
- Michigan State University: guide for writing a funding proposal
- ESRI: writing a competitive GRANT application
- REC: project proposal writing

THE REGIONAL ENVIRONMENTAL CENTER
for Central and Eastern Europe

Again:

- *SHARED PROBLEM*
- *SHARED LANGUAGE*
- *SHARED SOLUTION*

If all else fails, try to link with a more popular (and easy to understand topic.

4. Capacity Building

General

Marketing is promotion + capacity building.

Especially for the introduction of new technologies capacity building is important at all levels.

Capacity building is the instrument to increase self-sufficiency and make solutions work.

Think of:

Different instruments for different levels: workshops for decision makers and awareness raising, detailed technical training for professionals.

Provide follow-up. Getting funding for good capacity building is difficult: everybody agrees that it is important, but nobody has time.

Training is usually part of funding of big projects that are managed by big companies or ministries, as a consequence capacity building is forgotten (in the end).

Aim at small budgets that are available without having to tender.

Examples & references

White paper on GEO capacity building and water resources in Africa

Dedicated programs, such as TIGER and DRAGON

Tiger capacity building facility: growing from projects to professional community (article by Vekerdy, et al.)

GEONetCab capacity building web under construction: compilation of tutorials, references, open-source software, etc.

www.geonetcab.eu

GEO Portal: www.earthobservations.org

Focal points: general appraisal of water resources, specialist information (such as improving on curve number method), historical analysis (making use of free and open data): integration with other services

More references

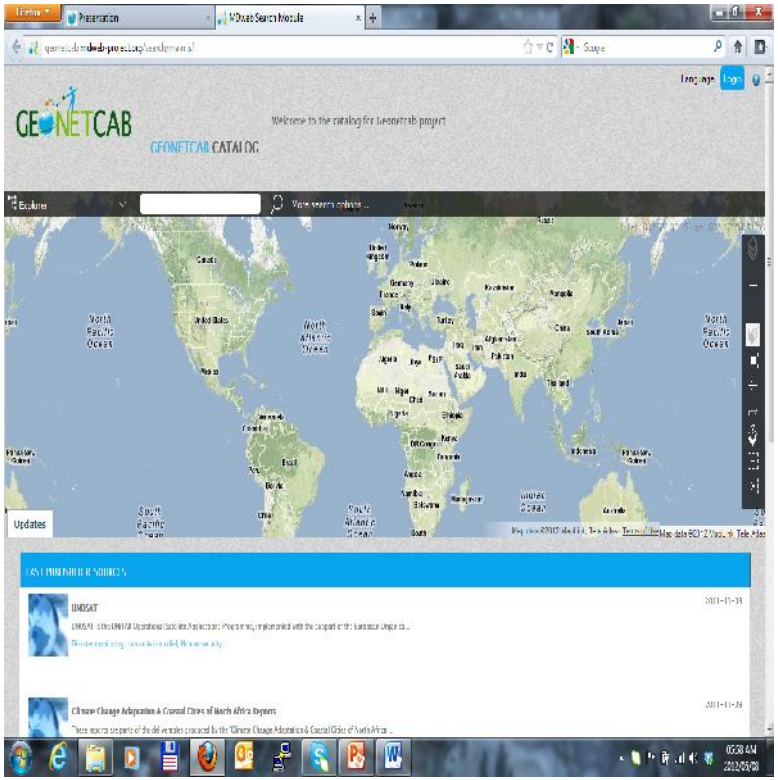
A Rough Google Earth Guide

MEASURE Evaluation Global Positioning System Toolkit (USAID)

Handbook of Research on Developments and Trends in Wireless Sensor Networks: From Principle to Practice

Capacity building web

- Guide to free and low-cost software
- Tutorials and references to training courses
- General information and references to earth observation applications and marketing toolkits



http://geonetcab.mdweb-project.org/search/main.jsf

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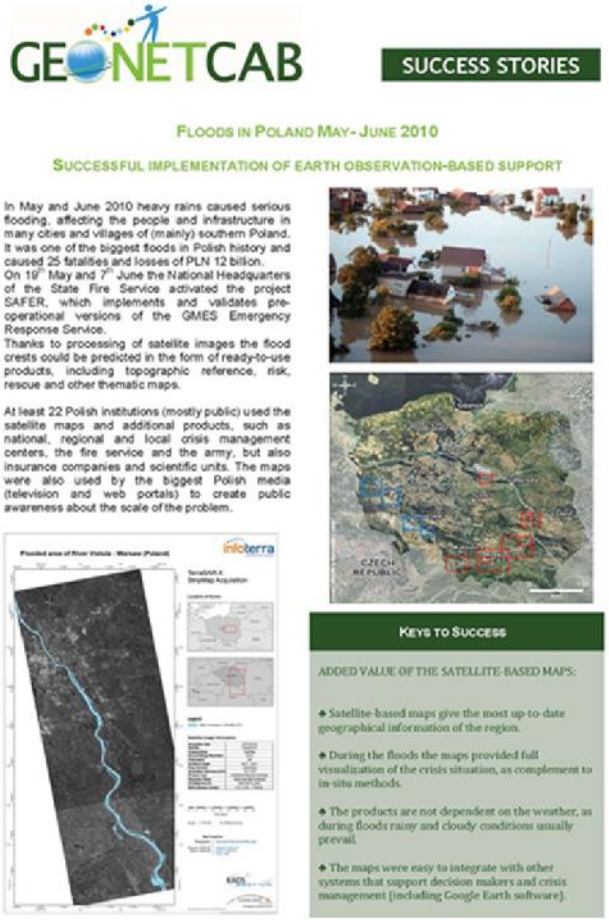
Success stories

Description of successful applications of earth observation in a language that potential clients understand



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SUCCESS STORIES

FLOODS IN POLAND MAY- JUNE 2010

SUCCESSFUL IMPLEMENTATION OF EARTH OBSERVATION-BASED SUPPORT

In May and June 2010 heavy rains caused serious flooding, affecting the people and infrastructure in many cities and villages of (mainly) southern Poland. It was one of the biggest floods in Polish history and caused 25 fatalities and losses of PLN 12 billion.
On 19th May and 7th June the National Headquarters of the State Fire Service activated the project SAFER, which implements and validates pre-operational versions of the GMES Emergency Response Service.
Thanks to processing of satellite images the flood crests could be predicted in the form of ready-to-use products, including topographic reference, risk, rescue and other thematic maps.

At least 22 Polish institutions (mostly public) used the satellite maps and additional products, such as national, regional and local crisis management centers, the fire service and the army, but also insurance companies and scientific units. The maps were also used by the biggest Polish media (television and web portals) to create public awareness about the scale of the problem.

infoterra

KEYS TO SUCCESS

ADDED VALUE OF THE SATELLITE-BASED MAPS:

- Satellite-based maps give the most up-to-date geographical information of the region.
- During the floods the maps provided full visualization of the crisis situation, as complement to in-situ methods.
- The products are not dependent on the weather, as during floods rainy and cloudy conditions usually prevail.
- The maps were easy to integrate with other systems that support decision makers and crisis management (including Google Earth software).

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Success Stories (WP3)
SPOT 5 Multi-User License

- Sustainability
- Feasibility
- Replication Potential
- Societal Benefit

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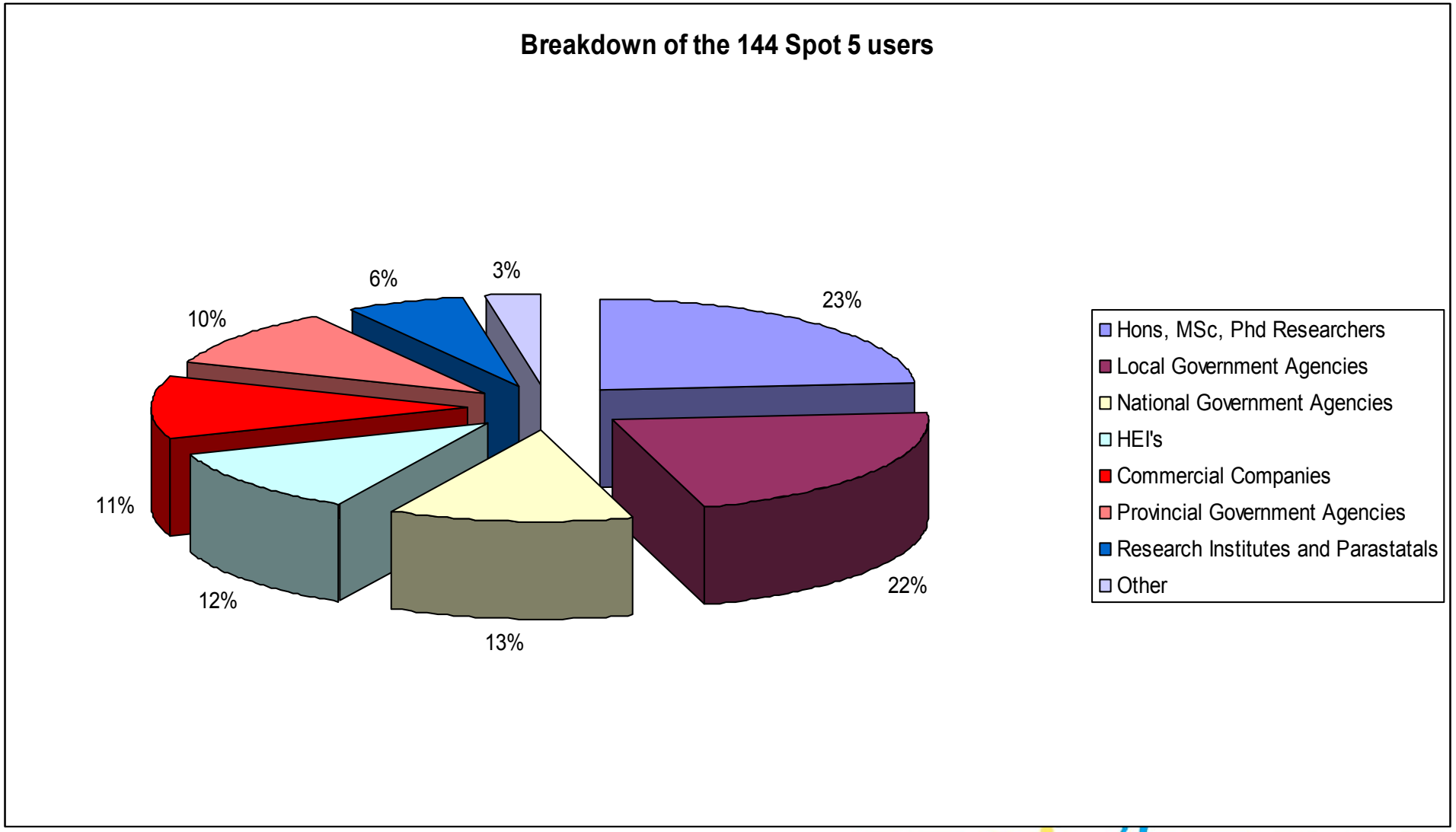
Breakdown of the 144 Spot 5 users
23%
22%
13%
12%
11%
10%
6%
3%
Hons, MSc, Phd Researchers
Local Government Agencies
National Government Agencies
HEI's
Commercial Companies
Provincial Government Agencies
Research Institutes and Parastatals
Other

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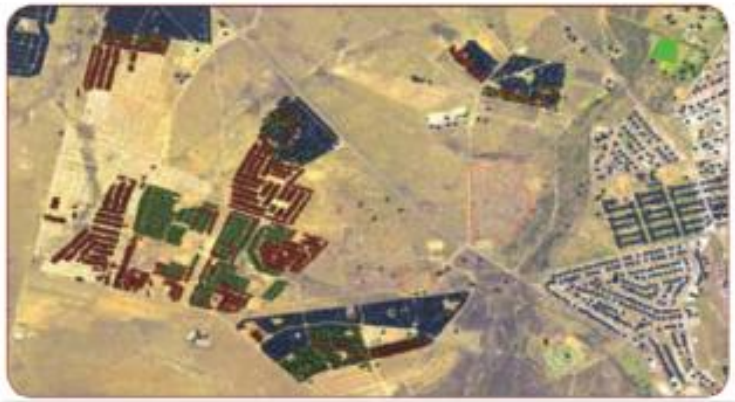
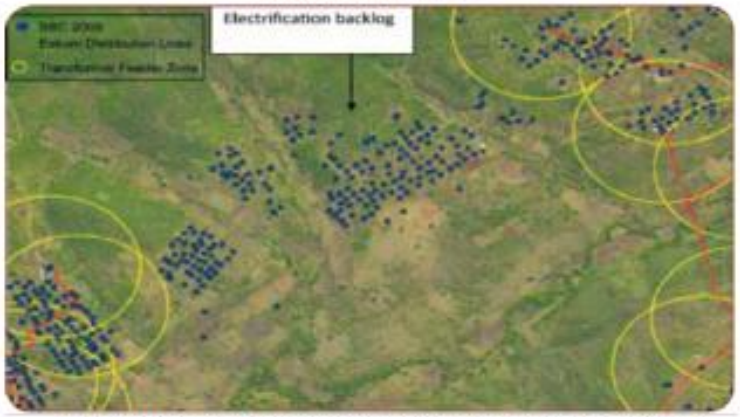
SPOT 5 Multi-User License

- Societal Benefit
  - SANBI: updated disturbed / transformed land on their NLC 2009
  - SKA study signal interference from communities
  - DWA water access project
  - Dept. of Human Settlement updated their RDP's and informal settlements database



Updated SBC base layer – 2006 (blue), 2007 (green) and 2008 (red).



SBC 2009 update showing buildings (blue points) outside the transformer feeder zone (yellow circles)

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Thank you

andiswa@umvoto.com

Visit GEONETCab Capacity Building Web

www.geonetcab.eu
and
http://geonetcab.mdweb-project.org/search/main.jsf