TIGER-NET
Satellite Observations
Supporting Integrated Water
Resources Management in Africa

Funded by the European Space Agency

Enabling Water Observation Centres

THE WATER OBSERVATION INFORMATION SYSTEM

Dr. Christian Hoffmann, GeoVille Information Systms

TIGER NET

TIGER AFRICA

esa

A European team of industrial and academic partners led by GeoVille Gmbh

GeoVille Group | DHI GRAS | TU WIEN | DTU

implementing **WOIS** for

- Nile Basin Initiative
- Lake Chad Basin Commission
- Volta Basin Authority
- International Water Management Institute
- South African Space Agency
- Instituto Nacional de Meteorologia, Mozambique
- Department of Water Affairs, Namibia
- Department of Water Affairs, South Africa
- Department of Water Affairs, Zambia
- Zambezi Watercourse Commission (ZAMCOM)
- World Food Programme
- Action Against Hunger

THE WATER CHALLENGE

Every $1 invested in water and sanitation leads to an economic return of between $3 and $34
(World Health Organisation)

Health	• Over 300 million of Africans lack safe water supply and adequate sanitation
Hunger	• Irrigated areas are less than 10% of the potential
Poverty	• A major cause for poverty in Africa is the lack of access to clean water
Energy	• Only 6% of hydropower potential developed
Education	• Lack of Water = Lack of Equality

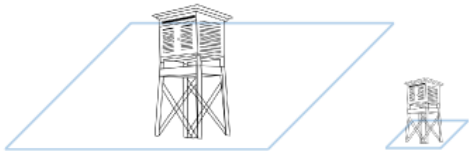
THE CASE FOR WOIS AND SATELLITES

- **Poor and crumbled infrastructures** lead to
- **Sparse and unreliable information,** posing a
- **Major limitation** for attaining the water-related Millennium Development Goals and Integrated Water Resource Management
- Satellites and WOIS are an excellent tool for **leap-froging**

http://www.economist.com/blogs/dailychart/2010/11/cartography

Africa
1 / 27.347 km²

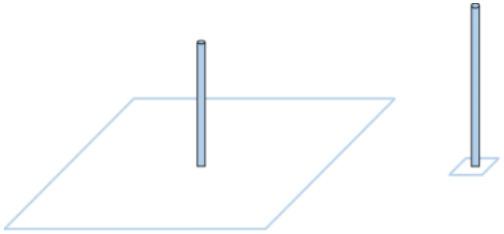
Germany
1 / 1.244 km²



WMO weather station

Africa
1 / 23.986 km² without Sahara

Germany
1 / 310 km²



Gauging stations

Source: Institute Water for Africa e.v.

THE WOIS BACKGROUND

- **THE MOTIVATION** - enable capacity & know-how of African water authorities to exploit the observations of current and future satellite systems

- WOIS developed and implemented through **TIGER-NET** project under the ESA TIGER initiative (existing since 12 years)
- Project volume: 2 Million €
- Project duration: 03.2012 – 5.2015
- Seed-funded by **European Space Agency**

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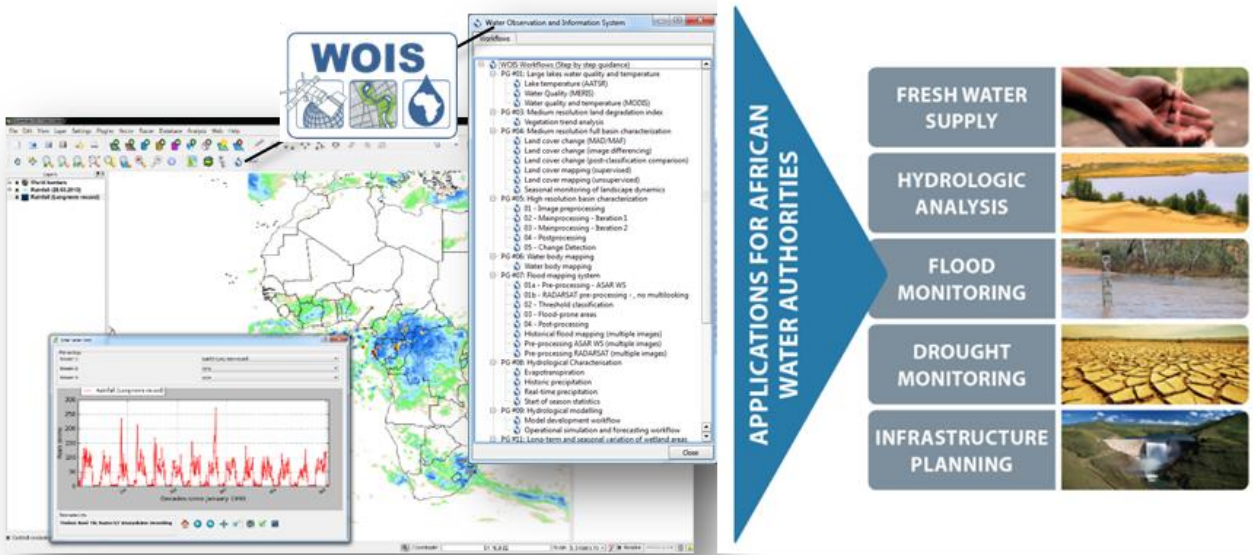
WOIS - A JOINT AFRICA-EUROPEAN DEVELOPMENT

- **Intensive user interaction – Design/Implementation/Testing/Validation**

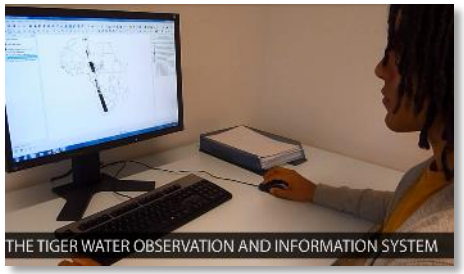
THE WOIS CAPACITY

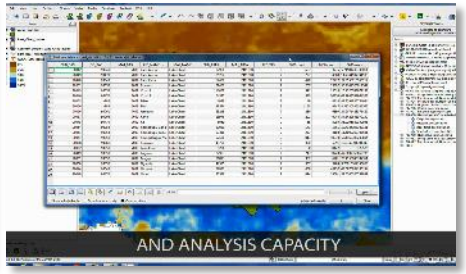
- Powerful **user-driven, open-source and free of charge** software
- Enables **monitoring, assessing and inventorying water resources**
- **Autonomous and cost-effective using satellite and terrestrial observations**



THE WOIS SOLUTION

- **Easily integratable** in existing IT infrastructures
- **Comprehensive analytical capacity** (> 80 water management questions)
- **Operational capacity** for information retrieval, summary reports and map productions for IWRM
- **Installed, tested and validated** in 8 African national & transboundary water authorities





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THE WOIS DATA SOURCES

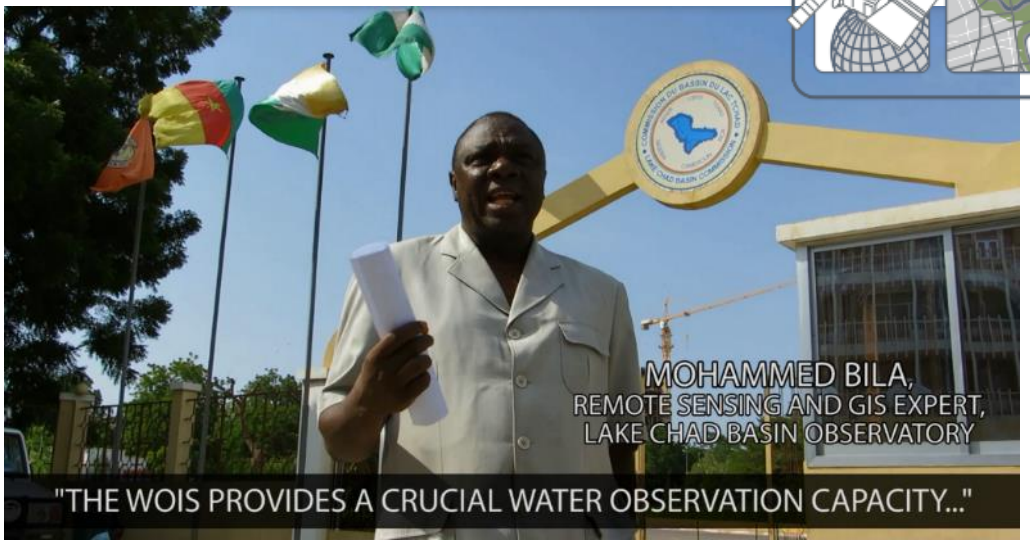
- WOIS can be by **powered by**
  - freely available satellite data through Copernicus Sentinel's
  - commercially available optical and radar satellite data
- WOIS can **integrate**
  - comprehensive suite of terrestrial in-situ data

TIGER NET

TIGER AFRICA

esa

WOIS



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*"The WOIS is essentially helping water managers in Africa to integrate and transition their existing in-situ monitoring systems to a more **cost-effective satellite based monitoring system**"*

Mohammed Bila, Remote Sensing and GIS Expert, Lake Chad Basin Commission

WATER DEMAND AND BALANCE MONITORING, SOUTH AFRICA

- **How much water is coming into basin, how much is being used and how much is left?**

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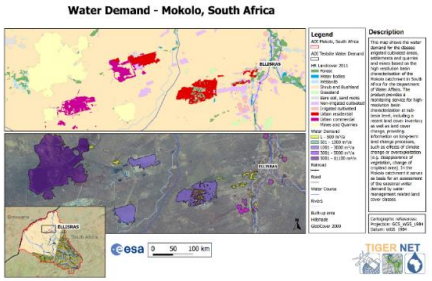

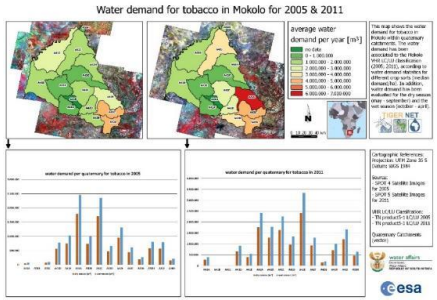

"The WOIS is used to complement, improve and fill information gaps needed in critical programmes *such as integrated planning, the National Integrated Water Information System and water use authorisation, monitoring and regulation. "*

Carey Rajah, Director of Spatial and Land Information Management at Department of Water Affairs

WATER SUPPLY AND SANITATION SUPPORT, CITY OF N'DJAMENA, CHAD

- **Which districts lack proper sanitation infrastructure, what is the water demand, where to place supply network ?**

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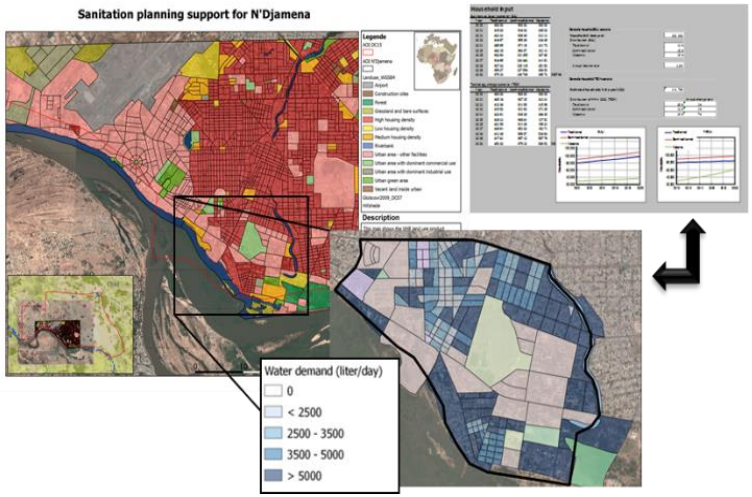
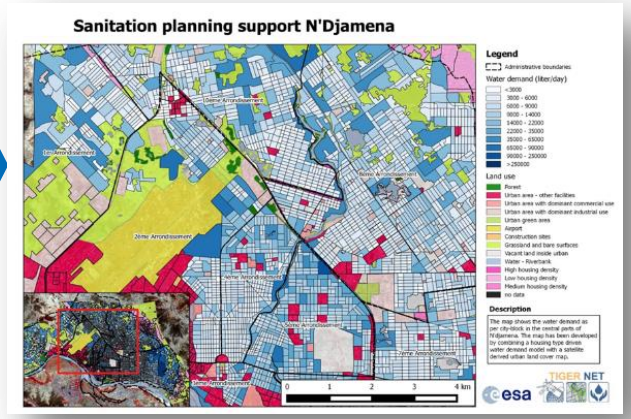
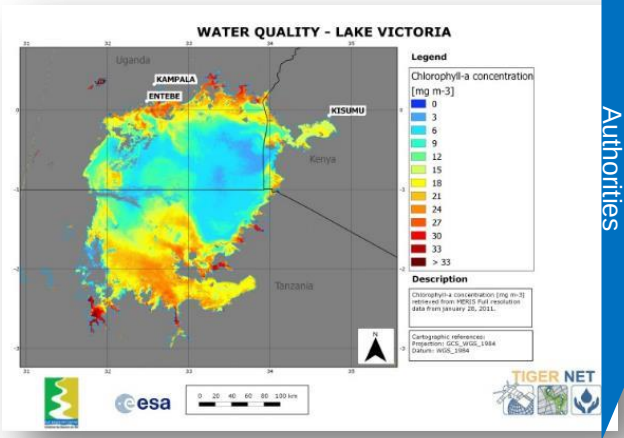


Applications for African Water Authorities

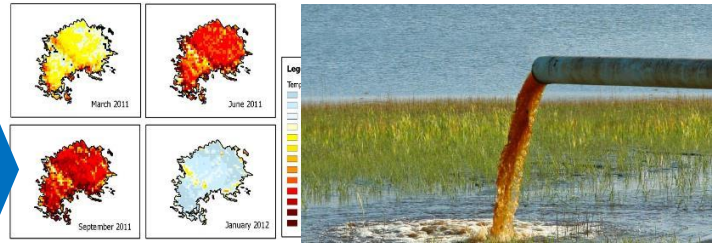


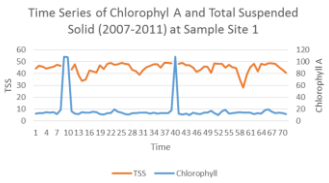
WATER QUALITY MONITORING, LAKE VICTORIA, CHAD, MALAWI, KARIBA…

- **Identification of point pollution sources, eutrophication mitigation planning, early warning of disease outbreaks**



Applications for African Water Authorities





	December-March		June-September	
	Mean	Std	mean	Std
2007	14,13	0,39	15,64	2,58
2008	12,96	0,68	14,67	2,90
2009	13,91	0,99	15,63	3,18
2010	13,37	0,75	14,18	1,90
2011	13,49	0,70	14,98	3,34
Mean	13,57	0,70	15,02	2,78

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LAKE CHAD BASIN ECOSYSTEM REPORT

- **How did the hydrological regime of Lake Chad change, what were the impacts for the land use and where are mitigation measures necessary?**

WOIS Analysis and Reporting

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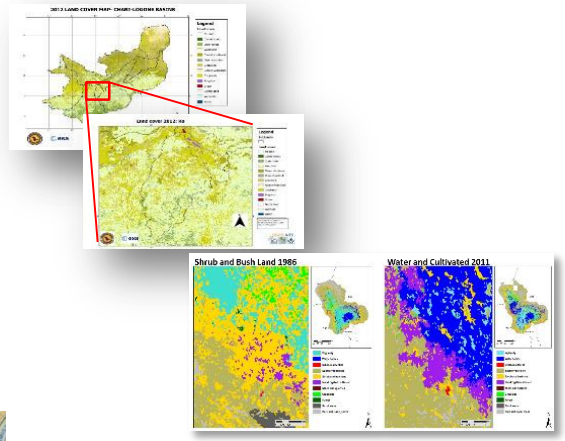
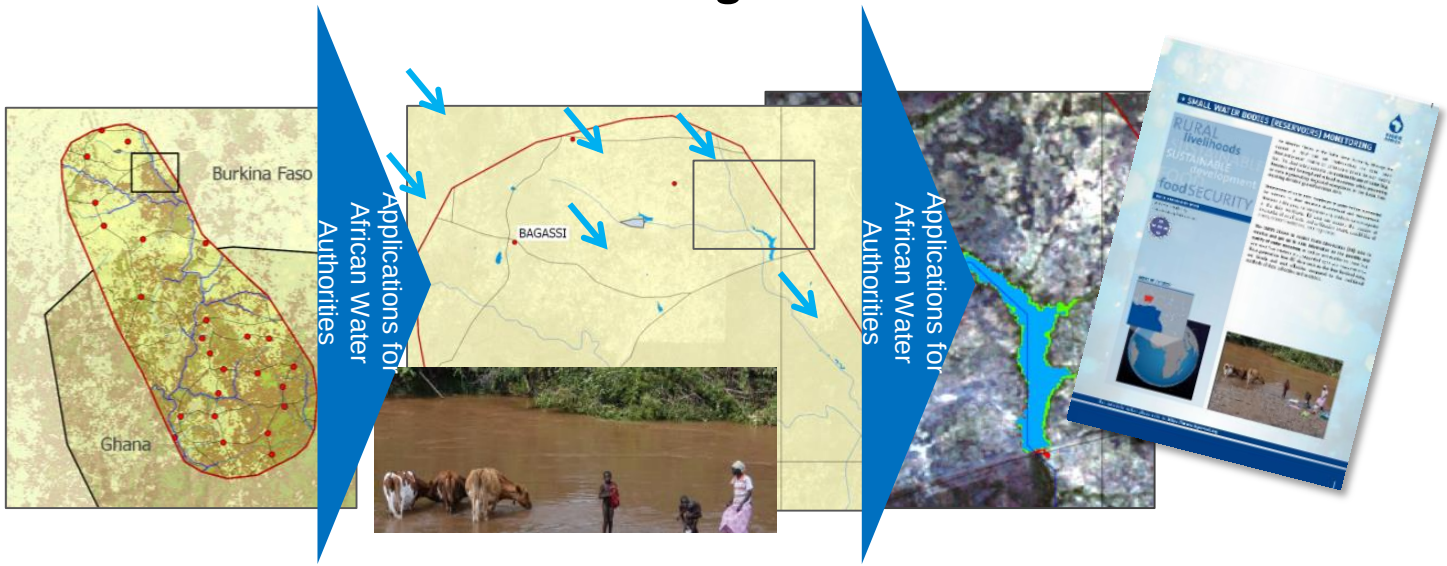


Applications for African Water Authorities

"The WOIS has provided the ***capacity to establish a basin-wide historical change inventory*** *and to identify challenges to be studied in detail for possible actions."* **Mohammed Bila, Remote Sensing and GIS Expert, Lake Chad Basin Observatory**

WATER BODY MANAGEMENT AND DAM PLANNING, GHANA & BURKINA FASO

- **Where are small water bodies, what is their seasonal state and where are dams needed for livestock watering?**



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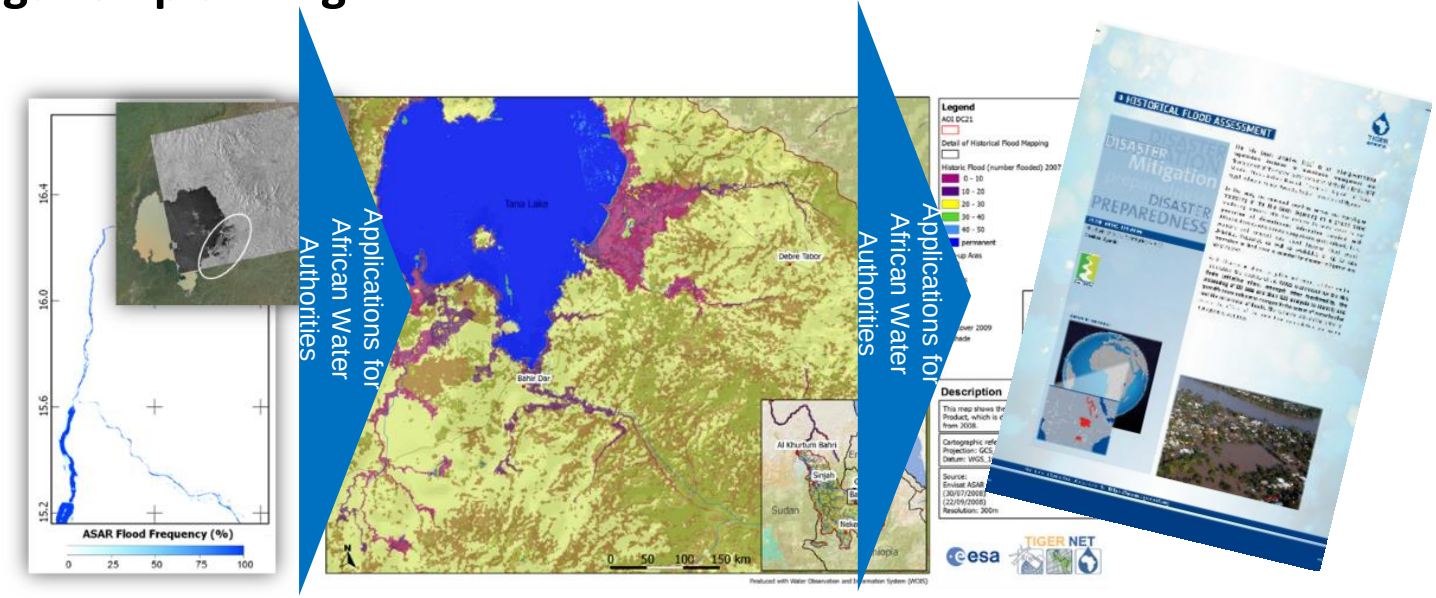
"The WOIS enabled small water body mapping capacity ***provides crucial information for livestock watering management in the Volta basin****."* **Dr. Jacob Tumbulto, Director Volta Basin Authority**

NEAR REAL TIME FLOOD & FREQUENCY, NILE BASIN

- **Which areas are flooded and what is the frequency of occurrence for mitigation planning?**



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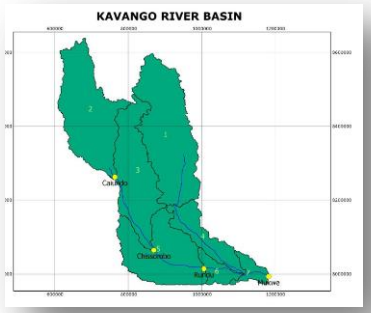
"WOIS enabled capability has created ***new dimension to flood inundation mapping*** *in eastern Nile seasonal flood monitoring."*

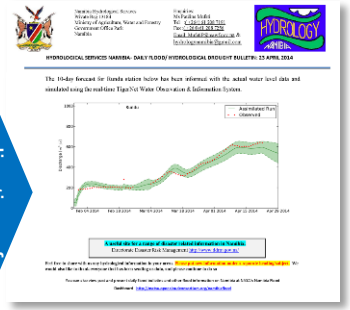
Ephrem Getahun Hailu, Nile Basin Initiative Secretariat

HYDROLOGICAL MODELLING AND FLOOD EXPOSURE ASSESSMENT, NAMIBIA

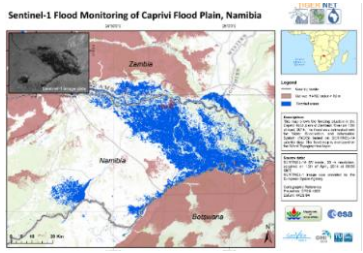
- **When will a flood occur, what are the affected infrastructures and how would this change with dam placements?**

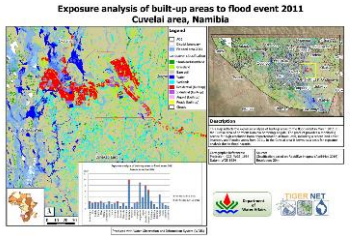


Applications for African Water Authorities



Applications for African Water Authorities





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"The WOIS provides the ***capacity for us to monitor vast areas with limited accessibility and of trans-boundary nature****."* **Pauline Mufeti, Head of Hydrological Services Namibia**

WOIS IWRM APPLICATION SOLUTIONS

- **WOIS covers > 80 different water related management questions**
- **Extension to cover further application solutions** through existing product portfolio and the flexible WOIS framework

WOIS PRODUCTS & CAPACITIES	INTEGRATED WATER RESOURCE MANAGEMENT APPLICATION SOLUTIONS											
	WATER BALANCE	FLOODS	LAND DEGRADATION INDICATOR	WATER SUPPLY	INFRASTRUCTURE PLANNING	RIVER BASIN	FORESTRY	AGRICULTURE	URBAN	SANITATION	ECOSYSTEM	CLIMATE IMPACT/ ADAPTION
Medium resolution land cover and change detection mapping			√			√	√					√
High resolution land cover and change detection mapping	√	√		√	√	√	√	√			√	√
Very high resolution land cover mapping					√				√			
Land degradation (via vegetation indices)						√	√	√			√	
Small water body mapping / monitoring	√			√	√	√						√
Lake shoreline mapping and change dedection	√			√								√
Wetland mapping and monitoring	√				√	√					√	√
Lake surface temperature, chlorophyll and sediment load										√	√	
Precipitation monitoring	√	√	√	√		√		√				√
Evapotranspiration monitoring	√			√	√	√		√				√

WOIS PRODUCTS & CAPACITIES	INTEGRATED WATER RESOURCE MANAGEMENT APPLICATION SOLUTIONS											
	WATER BALANCE	FLOODS	LAND DEGRADATION INDICATOR	WATER SUPPLY	INFRASTRUCTURE PLANNING	RIVER BASIN	FORESTRY	AGRICULTURE	URBAN	SANITATION	ECOSYSTEM	CLIMATE IMPACT/ ADAPTION
Soil Moisture and Soil Water Index monitoring	√	√	√	√		√		√				√
Drought/Wet Anomaly monitoring	√	√	√									√
Start of Soil Moisture Season monitoring								√				
Hydrological discharge model for scenario analysis				√	√	√					√	
Hydrological discharge model for operational forecasting	√	√										
Near-realtime flood mapping and monitoring		√										
Historical flood frequency and vulnerability assessment		√			√	√						
Soil Loss potential mapping						√	√	√		√		
Hot-spots of anthropogenic caused erosion						√	√	√		√		
Urban water demand model for sanitation planning support				√	√				√	√		

CAPACITY BUILDING AND TRAINING

- **Intensive Training Workshops at host institutions**
  - System Installations and Operations
  - Demonstration Productions and Validations
  - Operational Applications
  - Expert Training of Trainees

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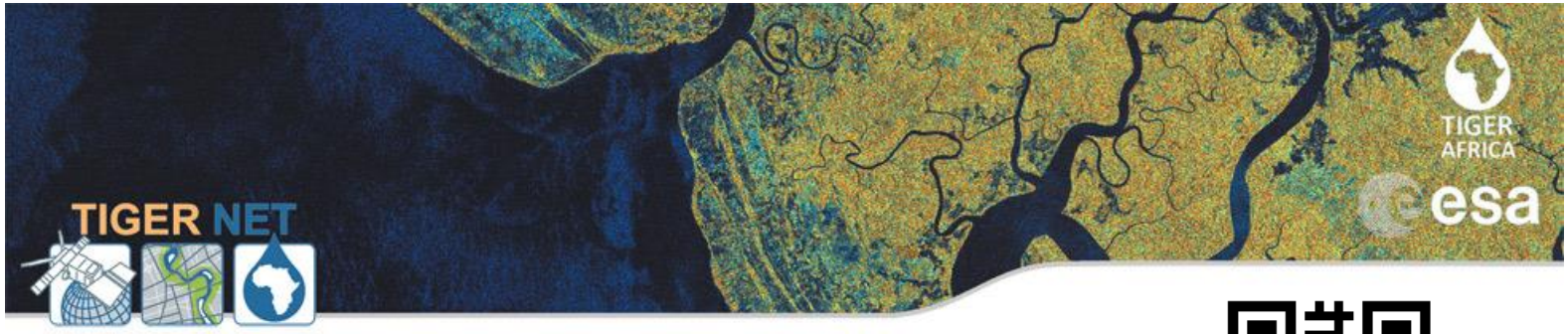
- **Training Effort**
  - **108 days in Africa** since 2012 (40 SITs, 68 DTs)
  - **>100 WOIS enabled operators** for supporting IWRM to date

REQUIREMENTS FOR CAPACITY DEVELOPMENT

- Extension to **national water authorities**
- **Populate with data & information**
- **Capacity retention** coupled with continuous training
- From scattered to basin-wide **inventories**
- **Data access** for operational monitoring
- Buildup of **operational monitoring and reporting systems**
- **Thematic information solution support**
- **Long-term data and financing commitments**

WOIS REGISTRATION AND DOWNLOAD



tiger-net.org

tiger.esa.int/page_eoservices_wois_form.php

WOIS

A solution for IWRM in Africa **funded by the European Space Agency's TIGER Initiative via TIGER-NET** and implemented by research institutions and commercial service providers under the lead of GeoVille GmbH.

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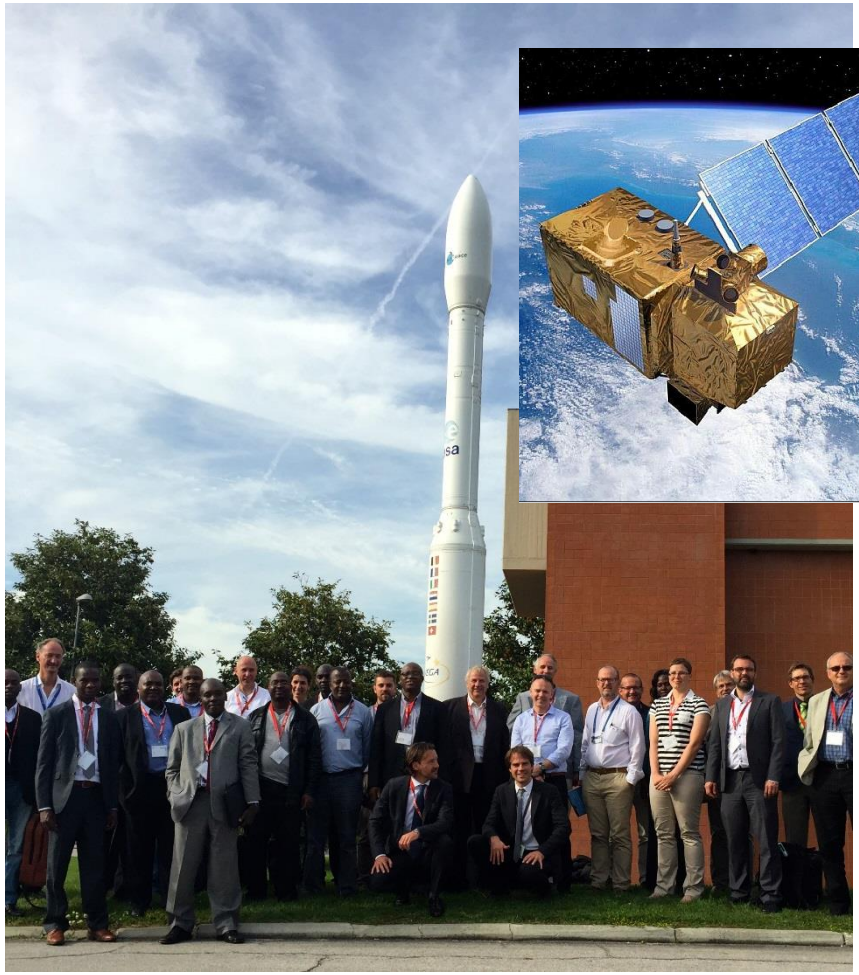
DHI Geographic Resource Analysis & Science A/S,
(Partner)

Institute of Photogrammetry & Remote Sensing,
Vienna University of Technology (TU Vienna) , Austria

Department of International Health (ISIM),
University of Copenhagen, Denmark

Dept. of Environmental Engineering, (DTU ENV)
Technical University of Denmark, Denmark



- COPERNICUS SENTINEL 2
  - Is ready 4 launch, and
  - ready 4 GMES in Africa