

# OPEN SOLUTIONS FOR SDG MONITORING: THE AFRICAN TIGER

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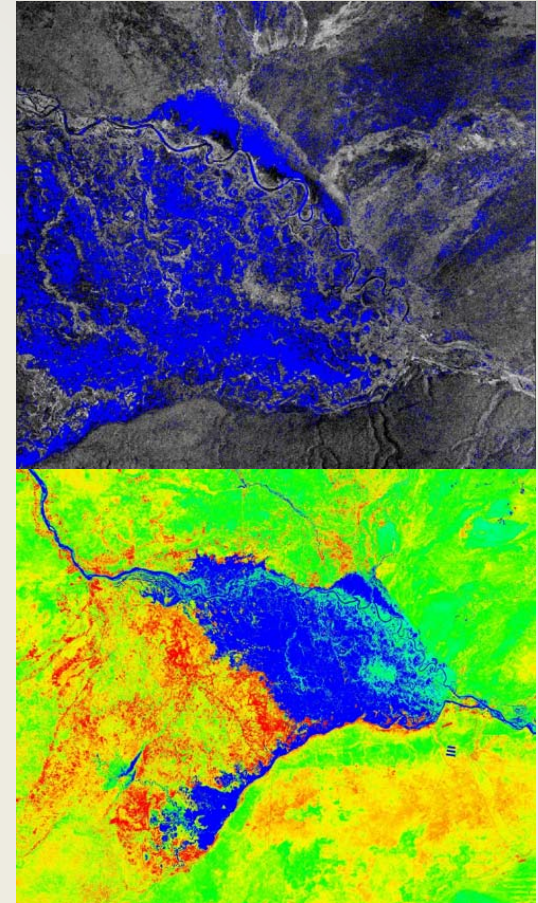
**Geospatial Technologies and Remote Sensing  
for Monitoring SDGs**  
4-8 July 2016, Budapest, CEU



# A quick overview of this talk

- TIGER Capacity Building Facility
  - Supporting research
- Research topics
  - Objectives
  - Methods
  - Expected outcomes
- Open research tool WOIS:
  - Workflow development

From the Alcantara research of Tsitsi Bangira



# History and objectives of the TIGER Capacity Building Facility

- **Long-term vision** about developing human, technical and institutional capacity in Africa
- Launched in **September 2006**
- Supporting the **scientific part of the TIGER Initiative**
  - Research projects with focus on Africa
    - Phase I – 15; Ph II – 20; Ph III – 10; **Ph IV – 10**
    - Alcantara: 6+3
- Objectives:
  - Recent topic: Water for agriculture
  - Developing a network of professionals
  - Strengthening centres of excellence
  - Finding key persons
  - Increasing knowledge base
  - Providing data access



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# History of TCBF actions

- Focus evolved by the time:
  - Selection of partners
  - Focus of actions (from researcher trainings to joint research and stakeholder trainings)
  - Key players supported throughout different phases
- Events
  - Training courses in Africa for project personnel (basic, advanced)
  - Training in EU (advanced)
  - Distance courses (basic and advanced)
  - TIGER Workshops



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## History of TCBF actions (2)

- Training Kit
  - 1<sup>st</sup> version in 2009
  - Latest is released in 2016
- Regional Centre activities
  - Hosting trainings
  - Receiving data, providing case studies
  - Receiving training in using the Training Kit
  - Receiving training in WOIS
  - Delivering training with third partners



## Recent phase: TIGER 2016

- TIGER Bridge or **TIGER 2016**: 2016 – Mid 2017
- Objectives:
  - **Continue** previous activities in strengthening EO capacity in African water community
    - Capacity building activities
    - WOIS support
    - Data provision
  - **Extend** cooperation between African and EU partners in research
    - 10 research projects of equal partners



# TIGER 2016: Research projects

- 10 Research projects
  - Ghana – Netherlands
  - Ghana – Netherlands
  - Kenya – Netherlands
  - Kenya – Netherlands
  - Kenya – Italy
  - Morocco – Netherlands
  - Morocco – Netherlands
  - Rwanda – Hungary
  - Tanzania – Belgium
  - South Africa - Germany
- Water for Agriculture
  - Water efficiency (SDG 6.4)
  - Water cycle - agriculture
- Workflow development for WOIS





# MONITORING SOIL WATER STORAGE FROM SPACE FOR IRRIGATION SCHEDULING IN THE UPPER EAST REGION OF GHANA

**KNUST, TU-Delft, VBA, TAHMO, Gmet, WRC Ghana, GAIP & MoFA**

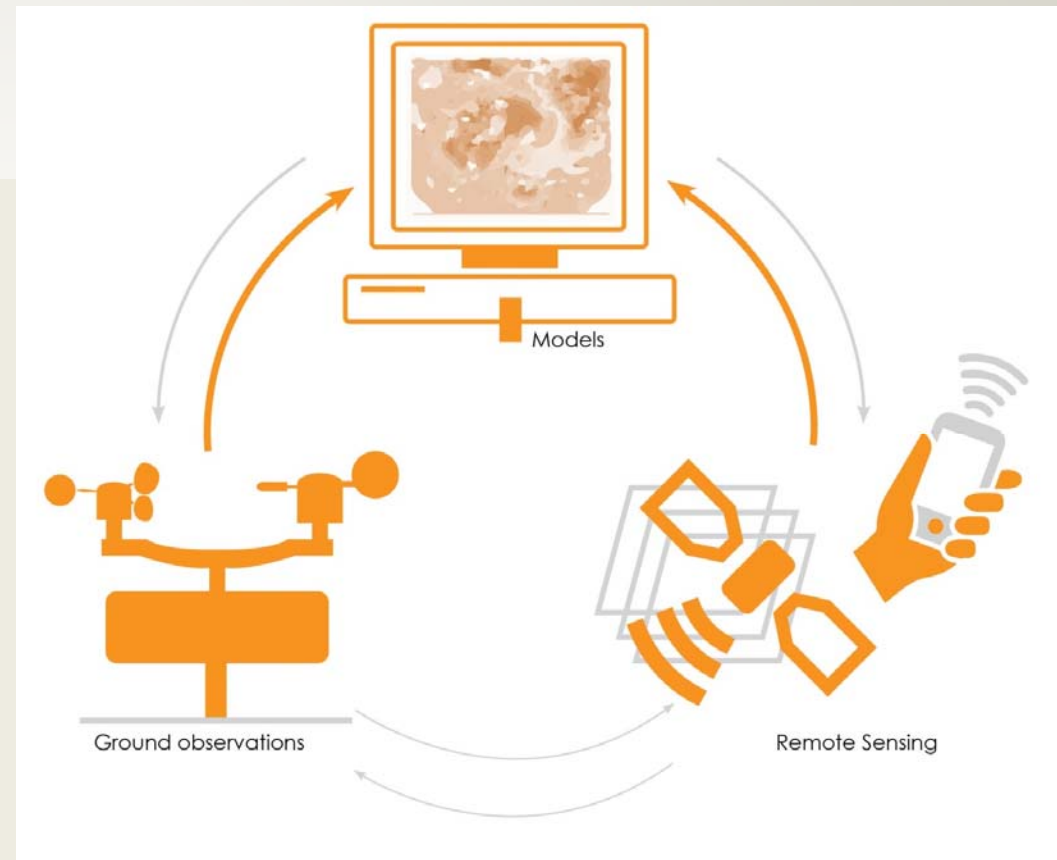
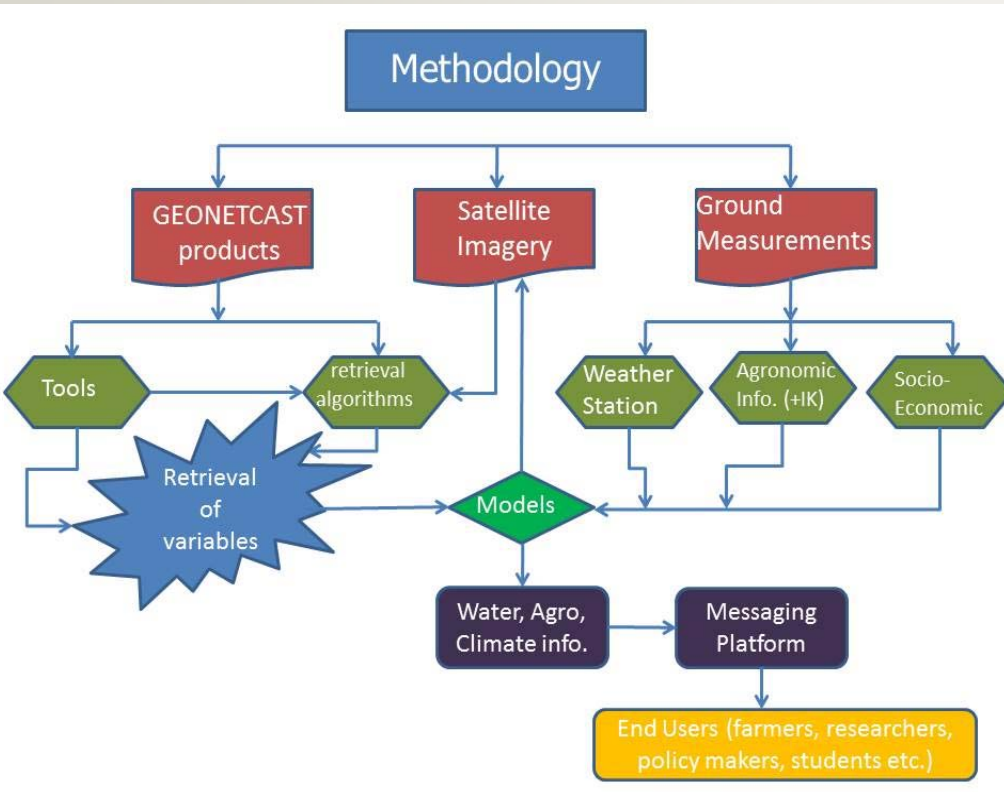
Presented by

**Frank Annor @UNECA, Addis Ababa 03-Feb-2016**

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# Metods

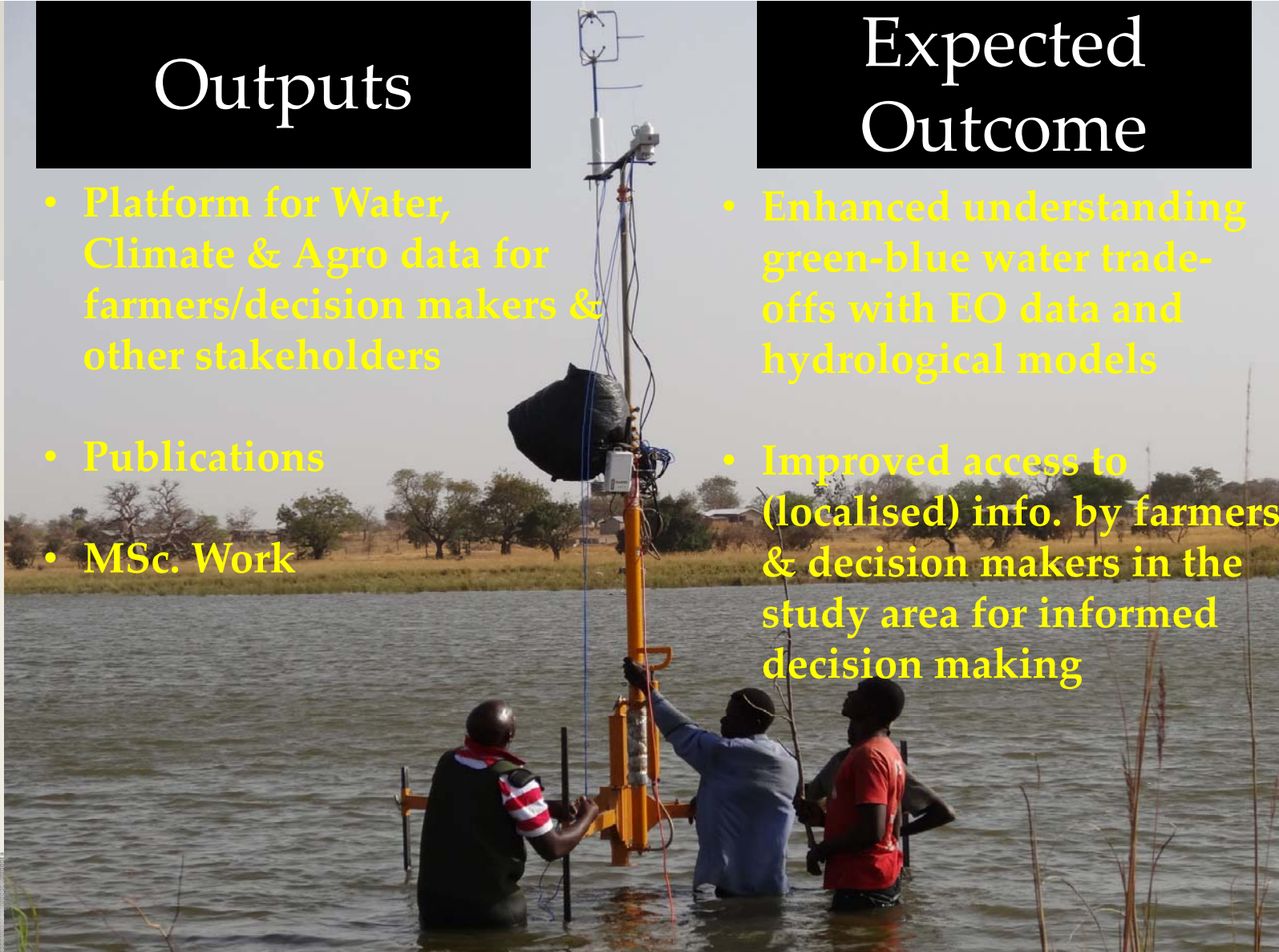


# Outputs

- Platform for Water, Climate & Agro data for farmers/decision makers & other stakeholders
- Publications
- MSc. Work

# Expected Outcome

- Enhanced understanding green-blue water trade-offs with EO data and hydrological models
- Improved access to (localised) info. by farmers & decision makers in the study area for informed decision making





Boniface P. Mbilinyi, Ann van Griensven, Boud Verbeiren, Imeshi Weerasinghe, Frederick C. Kahimba, Siza D. Tumbo

Tanzania - Belgium

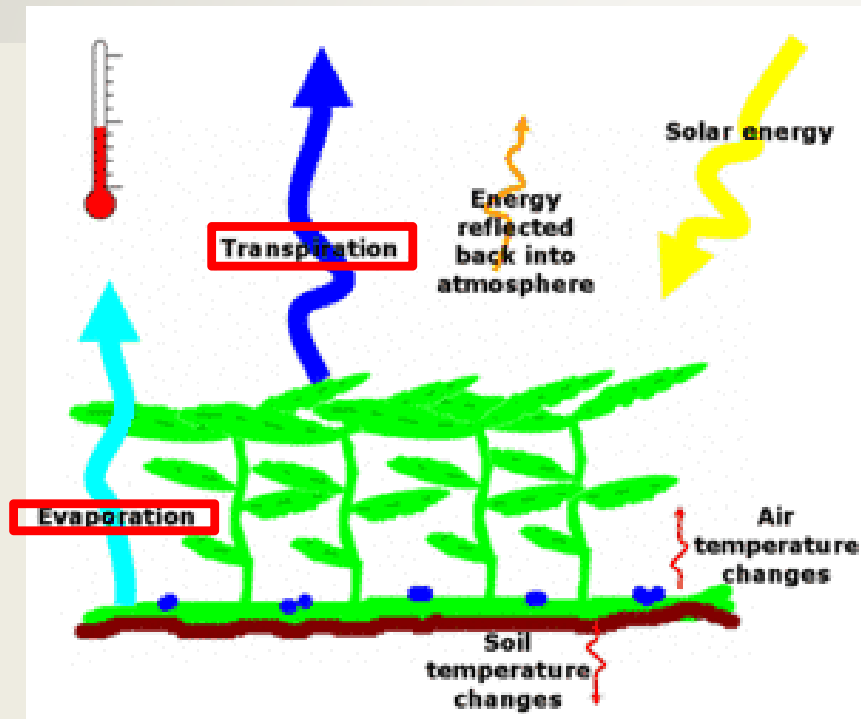
# **MANAGEMENT OF EVAPOTRANSPIRATION IN CULTIVATED CATCHMENTS IN TANZANIA USING EARTH OBSERVATION (EO) DATA**

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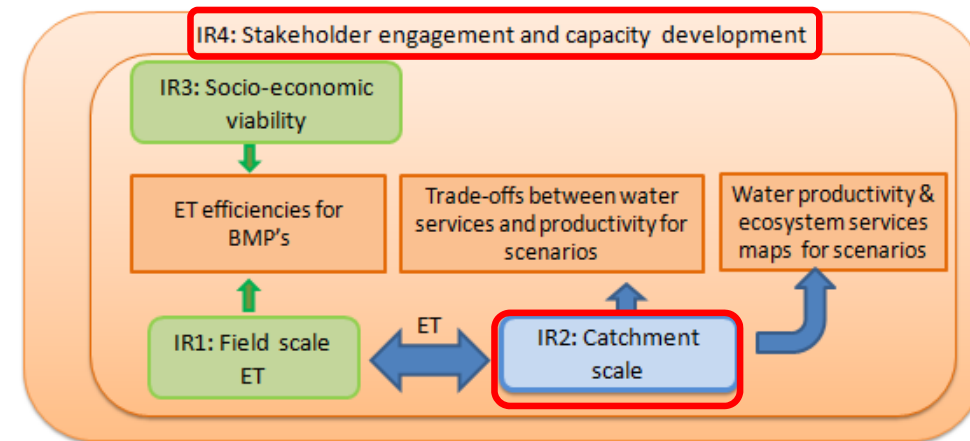
## Surface Energy Balance

**ET** calculated as the “residual” of the energy balance

TIR  
LST



## The Link Between VLIRUOS and Tiger





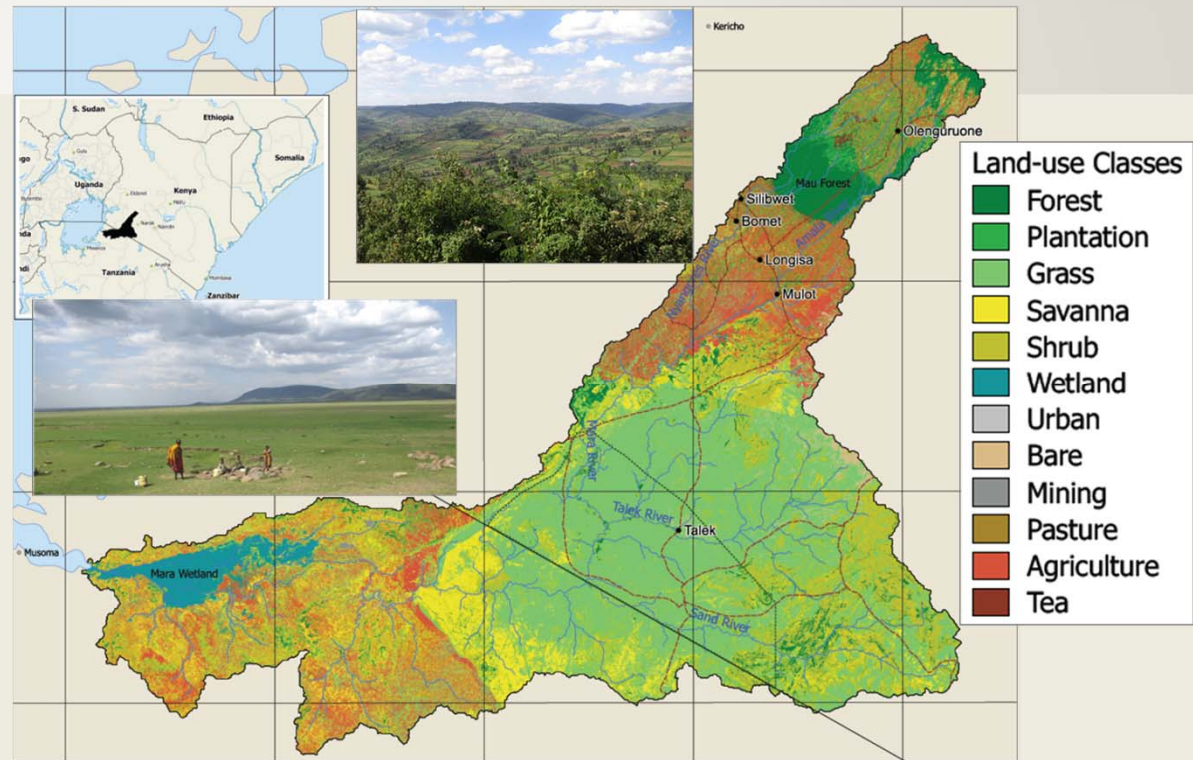
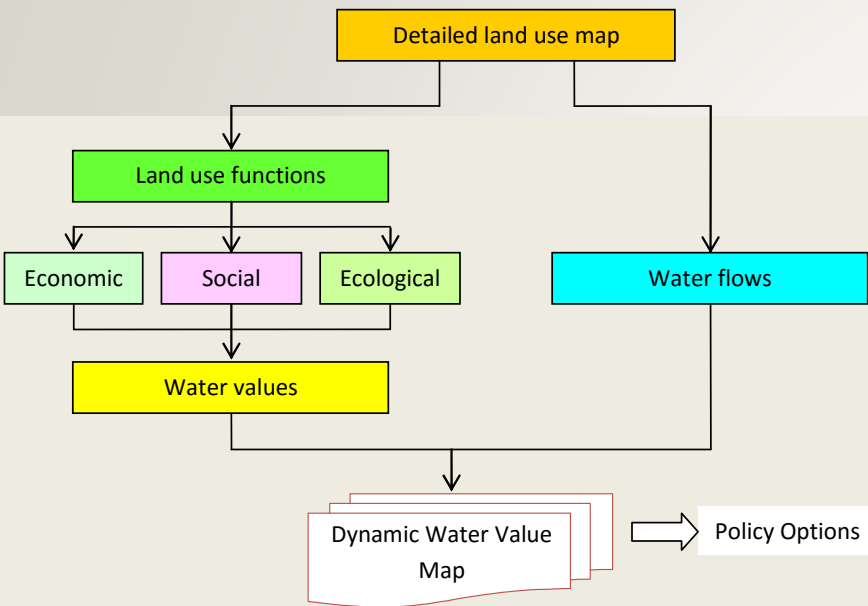
Jeremiah Kiptala – JKUAT, Kenya

Pieter van der Zaag – UNESCO-IHE, Netherlands

# DYNAMIC WATER VALUE MAP

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# Methodological approach



Source: MaMaSe, 2015; see: MaMaSe GeoNode:

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## Netherlands

Wim Bastiaanssen

Tim Hessels

## Morocco

Ahmed Er Raji

Mohamed Smiej

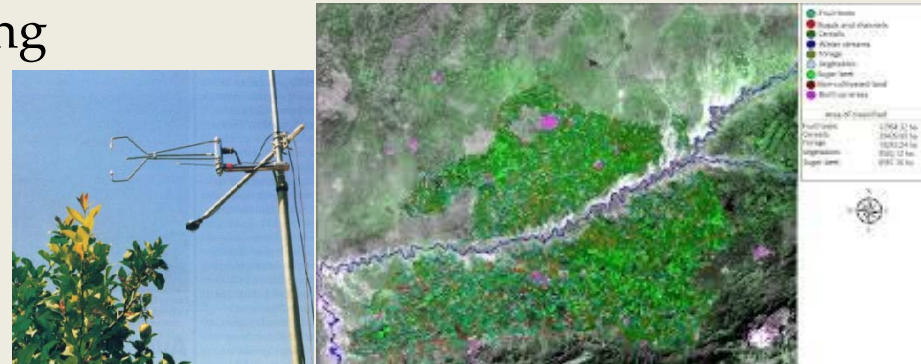
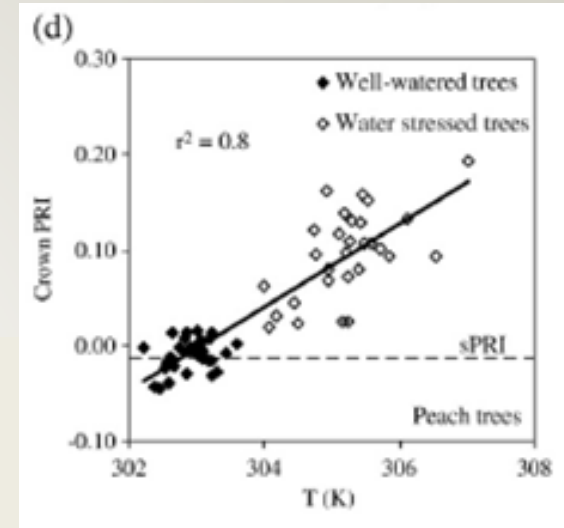
Mohamed Merdas

Driss El Hadani

# SENTINEL IMAGES FOR REAL TIME IRRIGATION WATER MANAGEMENT IN MOROCCO

## Methods

- Measure crop water stress for individual fields using Sentinel 2:
  - Photochemical Reflectance Index (PRI) is one candidate crop water stress indicators.
  - GVMi and LSWI and MSI will be tested as well
- **Sentinel-2 based spectral indices** for the determination of crop water stress will be compared against available **Landsat Thermal images**. The accuracy of energy balance computations using Sentinel-2 will be reported using a new Eddy Covariance system to be installed in Tadla Irrigation System





## Other topics

- Surface water resources for agriculture
  - Satellite based monitoring of intra-annual **reservoir storage volumes** and its implications for water and food security: a case study of Lake Bam in Burkina Faso (Ghana – Netherlands)
- Soil water
  - Earth Observation Based Identification of Suitable **Rainwater Retention Sites** (Kenya – Netherlands)
  - Synergy of multi-temporal Sentinel 1 and Sentinel 2 images for **soil water resource** monitoring in Africa (Kenya – Italy)
- Irrigation, agricultural water use
  - Assessment of climate effect on **crop water productivity** using earth observation data: case study of doukkala – western Morocco (Morocco – Netherlands)
  - Application of Remote Sensing Data to Improve the **Water Resource Management** of Rwanda

## Quick statistics of TCBF

- 10 years
- More than 600+100 participants on CB actions
- 42 African countries
- ESA; 3+3 European countries
- More than 200 publications
- 200< hours of training material in the TK



# Outreach: publications

Conferences (100+ presentations):

- Living Planet (Side events)
- AARSE (Special sessions)
- WaterNet Symposium (Special session)
- World Water Forum (Side event, exhibition)
- World Water Week (Side events)
- IGARSS, etc.

TIGER workshops (50+ scientific presentations)

ISI journals (15+):

- Remote Sensing (special issue + Book, incl. 7 TIGER articles)
- Remote Sensing of Environment
- Int. J. of Remote Sensing
- Etc.

MSc and PhD theses (5+)

Books (2)



# Outreach: training kit



6 topics:

- *Data acquisition*
- Crop monitoring and irrigation
- Land cover mapping
- Open water and flood mapping
- Vegetation monitoring and ET
- Water quality monitoring

- Five-day courses: **Lectures, exercises, showcases, background information** (7 GB with pdf files; ppt's and doc's are available separately on registration: [z.vekerdy@utwente.nl](mailto:z.vekerdy@utwente.nl); [a.m.vanlieshout@utwente.nl](mailto:a.m.vanlieshout@utwente.nl); [benjamin.koetz@esa.int](mailto:benjamin.koetz@esa.int))
- **Modular setup** – topics can be combined and/or further developed: own case studies, exercises, etc.
- Supporting material for **course design**.

# Outreach: cooperation with UNDP Cap-Net

Based on the Training Kit

Regional Offices receive trainings on using the TK

- TCBF action
- 4 training completed

RO delivers training(s) for trainers (ToT) on selected topics

- joint TCBF & Cap-Net action
- 3 trainings completed
- 200< applications for each course (max. 25-30 participants)
- more to come

Spin-off: Trainers to organize new trainings

- Cap-Net or third party action



# Outreach: UNESCO and World Bank



## UNESCO

UNESCO-ESA Regional training workshop on aquifer vulnerability mapping and spatial applications to groundwater management

	Training Course Topic	Date
1	Base-line mapping of small water bodies with optical and SAR data	April 2013
2	Flood risk and flood event mapping	Tbd
3	Small water body and flood event mapping with the latest EO techniques (Sentinel-1)	Tbd
4	Land cover and erosion mapping	T
5	Irrigation and crop water demand	T
6	Integrated Water Resources Management	T

## World Bank

Jointly organized training sessions for the key professionals of the Department of Water of Zambia



# Outreach: stakeholder involvement

- TIGER Workshops (3)
- Stakeholder trainings (3+1 trainings, 60+ participants):
  - Catchment authorities
  - Ministries of water, irrigation, energy, rural development
  - Universities, research institutions
  - Insurance companies
  - Environmental NGO's
  - Local water/environment/agric. Managers
  - Land managers, surveyors
  - Etc.



- WOIS users
  - Support
  - Feedback from users (new workflows)

# TCBF linkages to other TIGER activities

Supporting publications of other TIGER projects

TIGER-NET: WOIS

- Using in TIGER trainings as a tool
- Developing new workflows in research projects
- Giving trainings on the use of WOIS

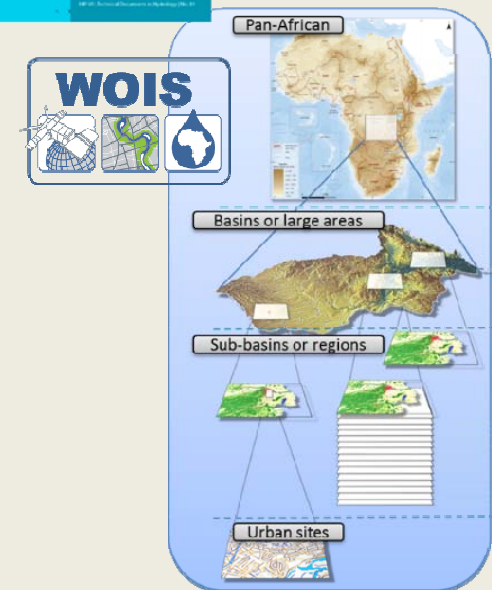
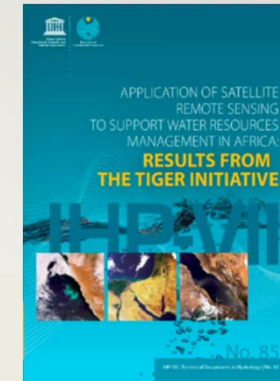


Schweizerische Eidgenossenschaft  
Confédération suisse  
Confederazione Svizzera  
Confederaziun svizra

Direktion für Entwicklung und Zusammenarbeit DEZA  
Direction du développement et de la coopération DDC  
Direzione dello sviluppo e della cooperazione DSC  
Direcziun da svilup e da cooperaziun DSC



GlobWetland





## TIGER 2016: WOIS and trainings

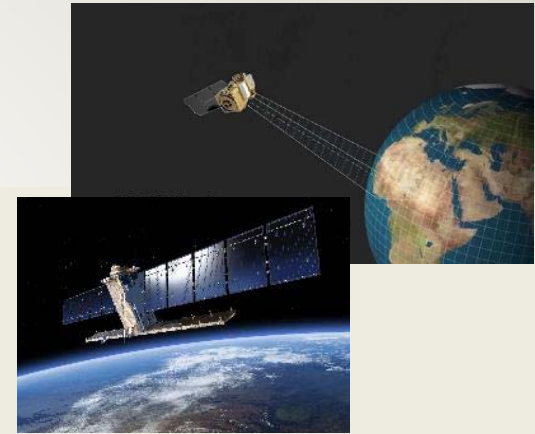
- WOIS maintenance and user support
  - To follow version changes in the software environment
  - To help research projects in workflow development



- Stakeholders training
  - Free access
  - 15-25 participants
  - Based on the Training Kit

# TIGER 2016: Data provision

- Sentinels: increased data volumes
  - Increased image sizes (imaging modes, band numbers, resolution, etc.)
  - Increased imaging frequency
- In many regions communication bandwidth is insufficient
- Data access for selected (max. 5) regional offices and major (basin level) data users
  - To overcome www-based data transfer difficulties
  - On demand (questionnaire)
  - Regular (monthly) shipping of physical data storage device





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



# WOIS

## – Water Observation and Information System

**System overview**

Steve Kass

Geospatial Technologies and Remote Sensing for Monitoring SDGs  
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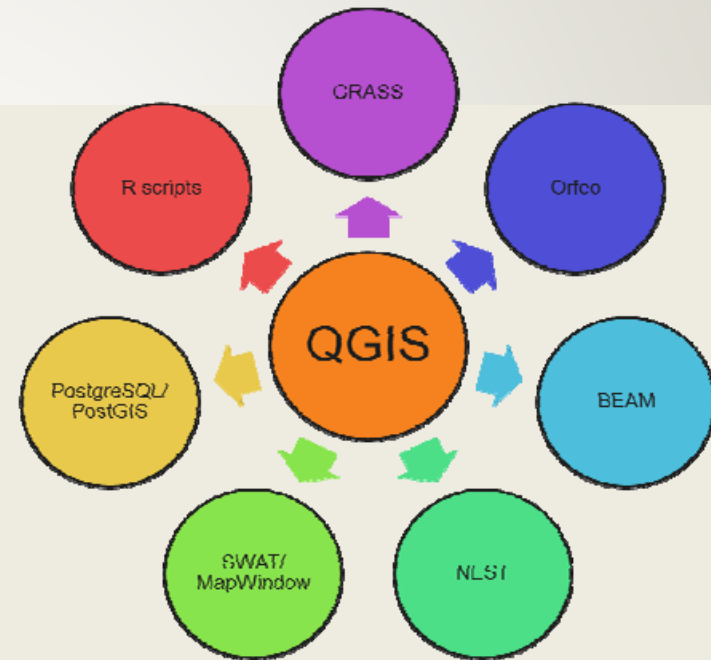


# Water Observation and Information System

- 💧 Powerful Geographic Information System (GIS) tool for water resource management
- 💧 Facilitates utilization of remotely sensed Earth Observation (EO) data
- 💧 Simple Graphical User Interface (GUI)
  - 💧 Ease of use for non-experts

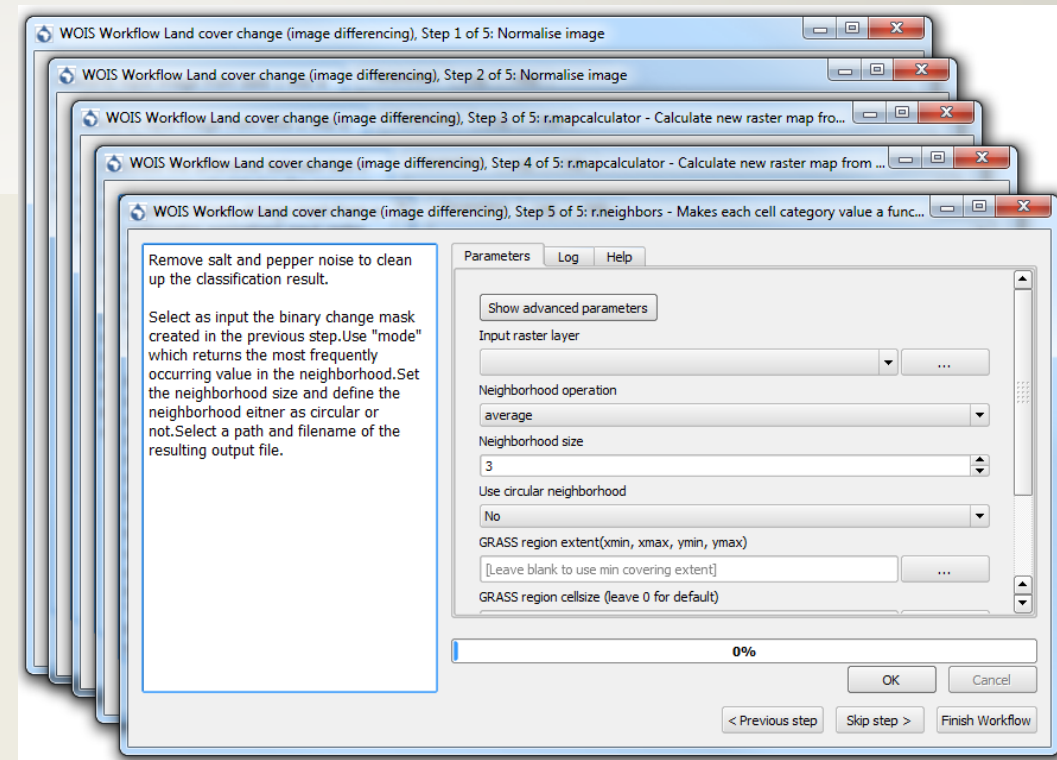
# WOIS components

- 🔹 Dedicated software for dedicated tasks
- 🔹 More functionality
- 🔹 Better performance
- 🔹 Open source
  - 🔹 Free distribution
  - 🔹 Easy to modify/extend



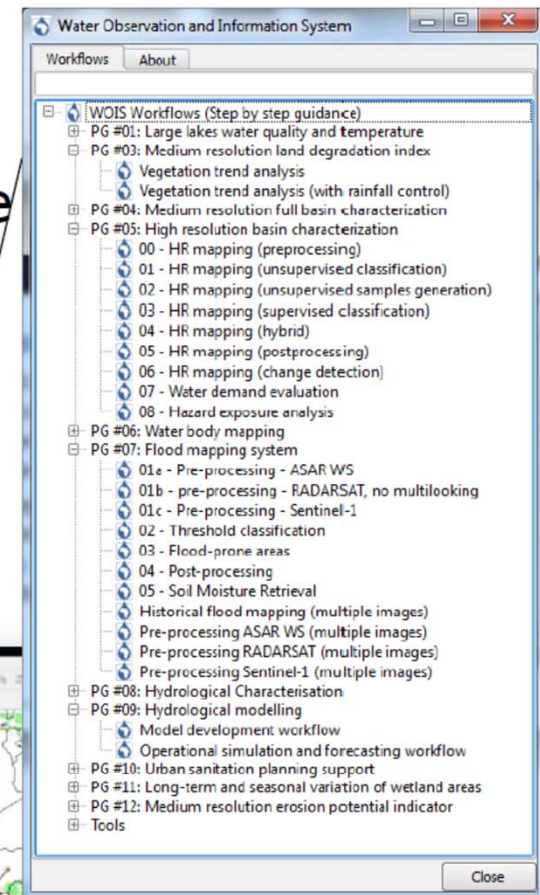
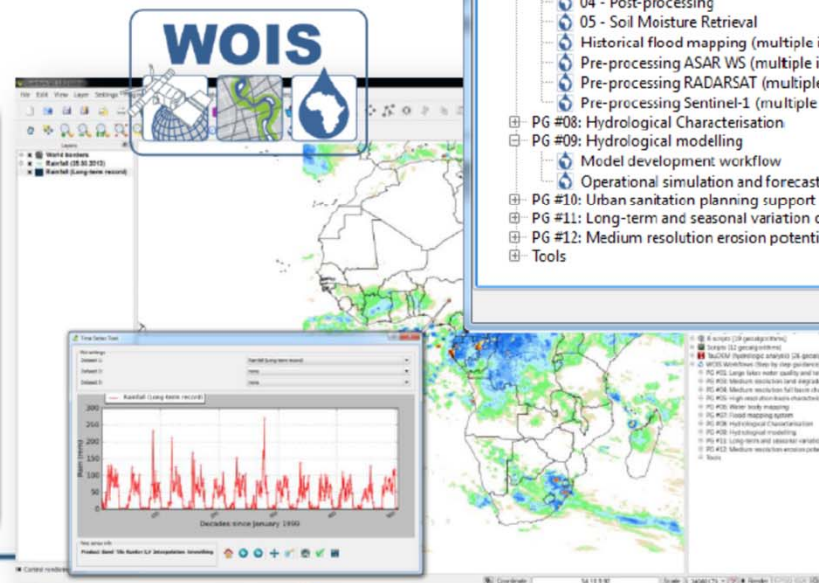
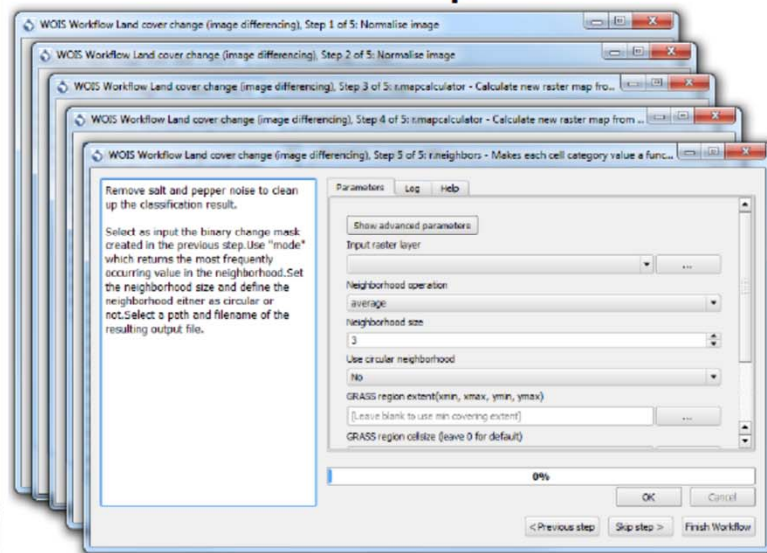
# Workflows

- 🔹 Simplify common tasks
- 🔹 Step-by-step instructions
- 🔹 Seamlessly combine WOIS components



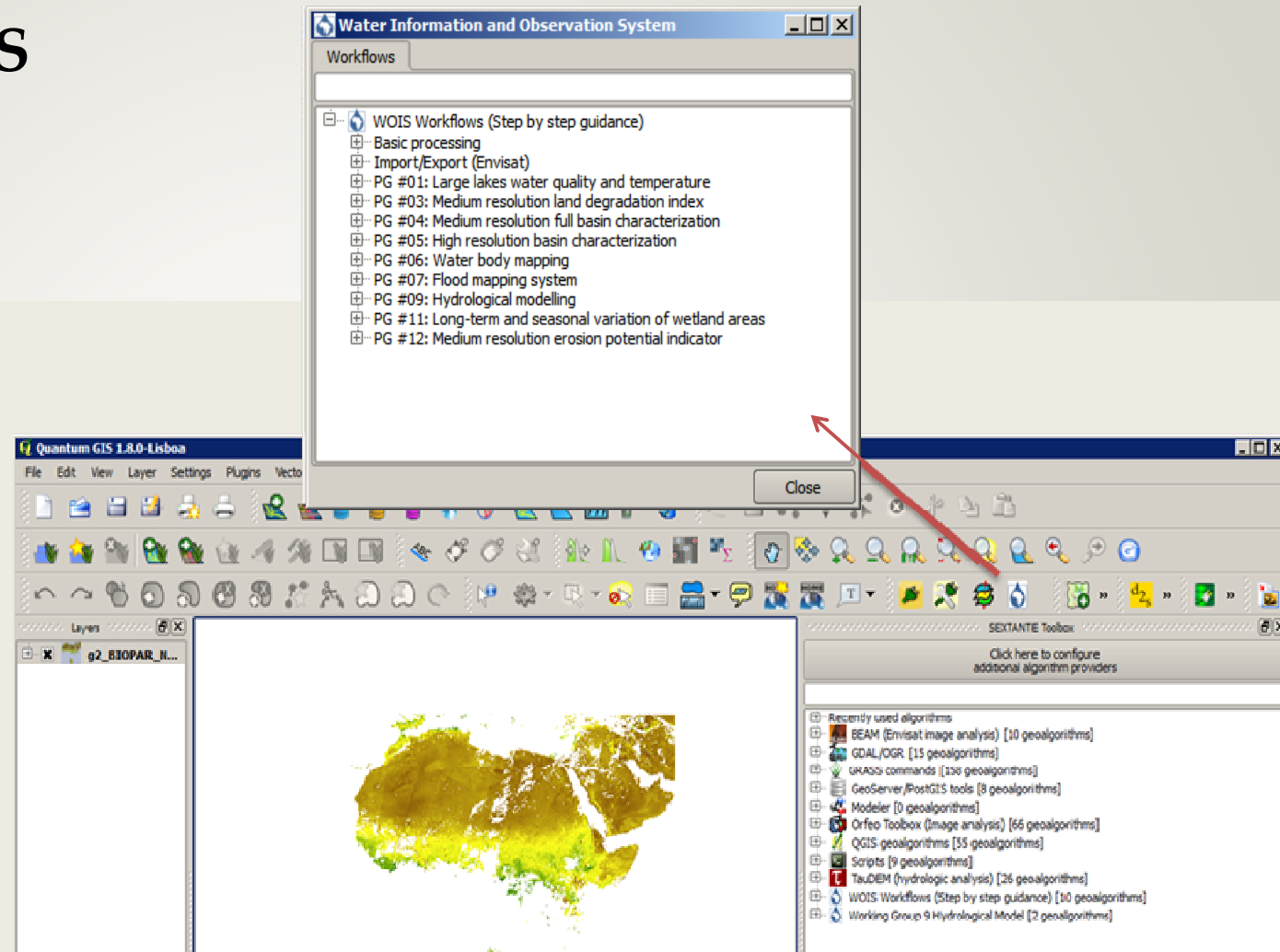
# WOIS Toolbox – workflow library

- 55 Workflows
- Providing step-by-step guidance for the processing of products and other relevant EO processing/GIS tasks
- through simplified common tasks
- with seamlessly combined WOIS



# WOIS button in QGIS

- Workflow library
- Provide step-by-step guidance for the processing of the TIGER-NET products and other relevant EO processing/GIS tasks





## Design strength

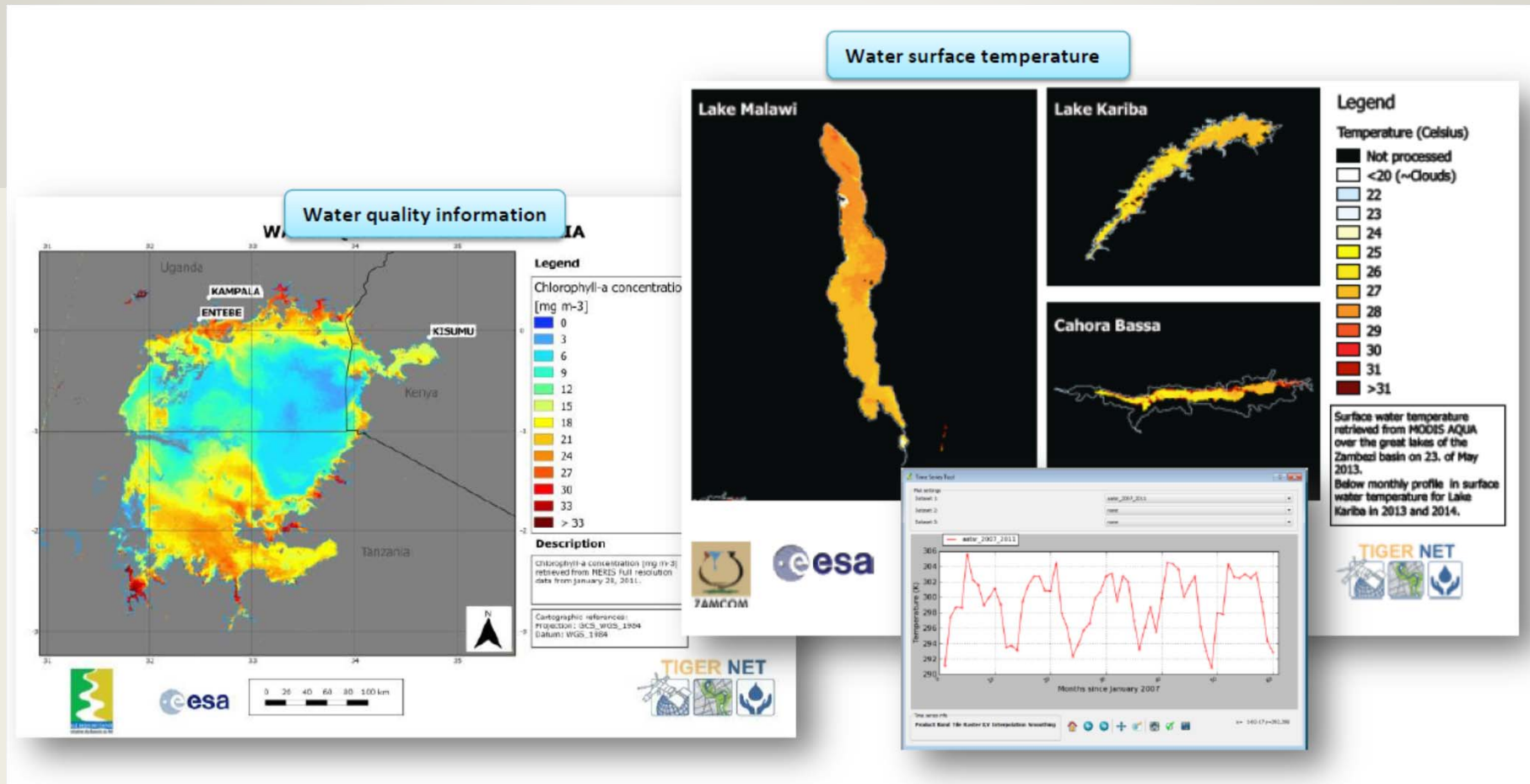
- 💧 One stop resource for integrated EO processing and GIS analysis
- 💧 The diversity of EO processing and GIS tools provided within a single GUI is unique
- 💧 The ability to sequentially combine algorithms from different providers into workflows



- 💧 Developed and tested for a number of product prototypes

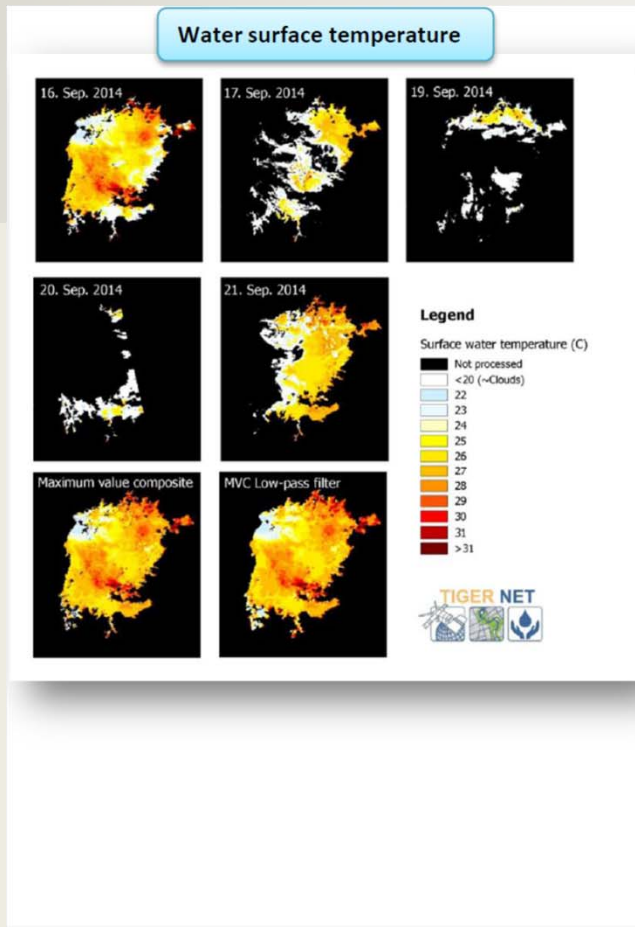
➤ **WOIS 2.0**

# Water quality and water surface temperature (PG 1)



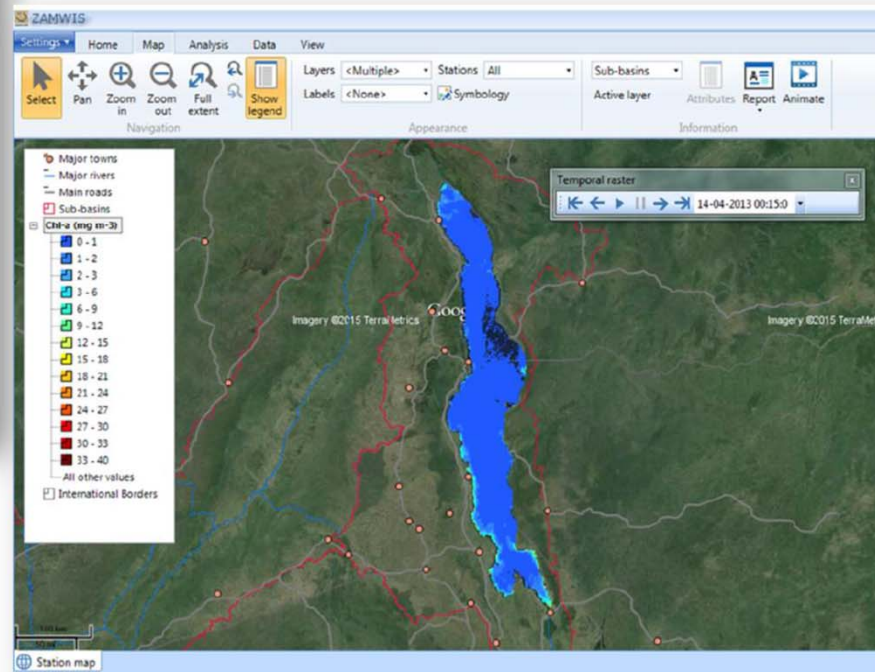
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# Water quality and water surface temperature (PG1)

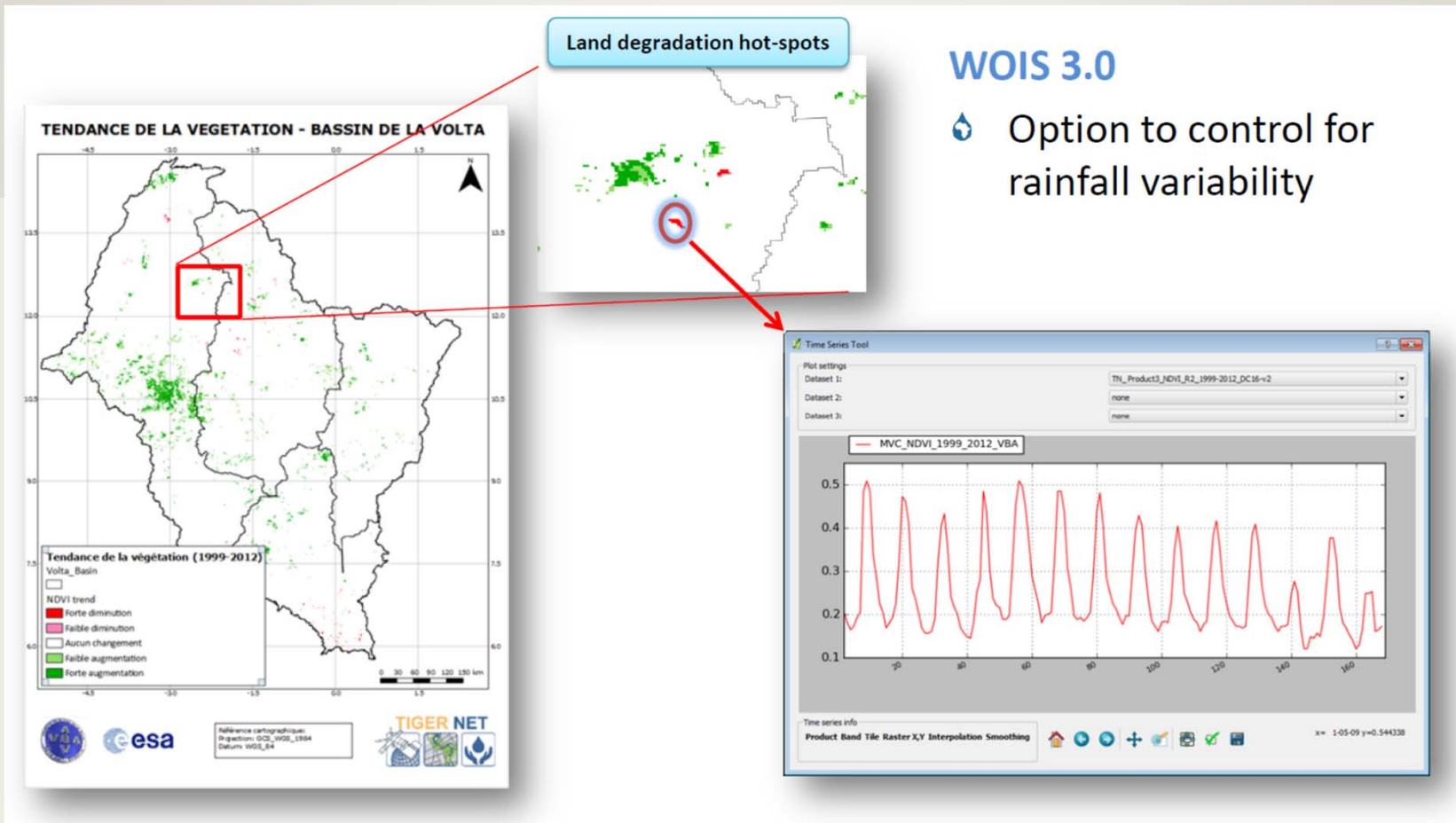


## WOIS 3.0

- Multi-date composition
- ftp plugin for direct and scheduled download

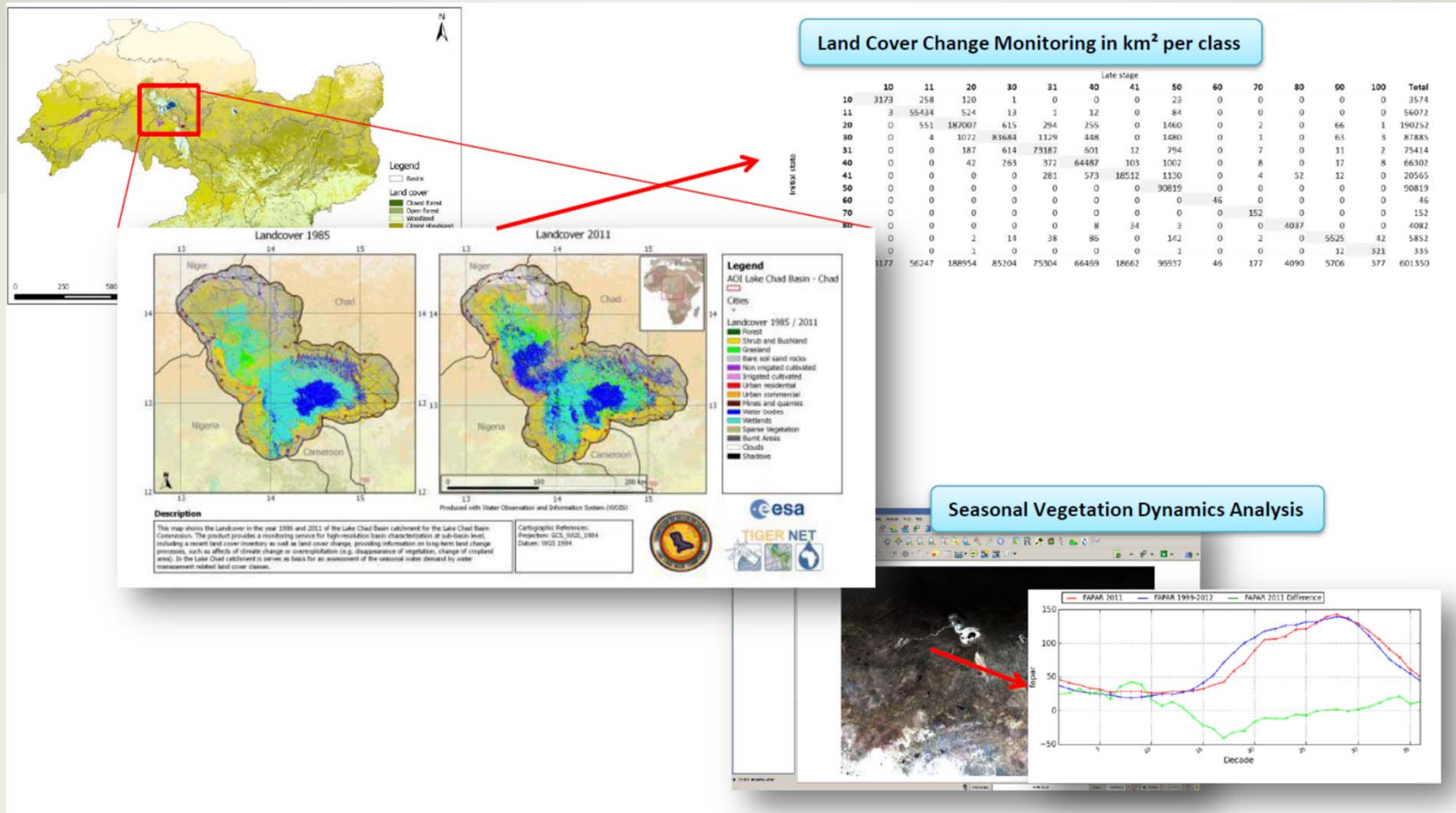


# Assessment of land degradation processes



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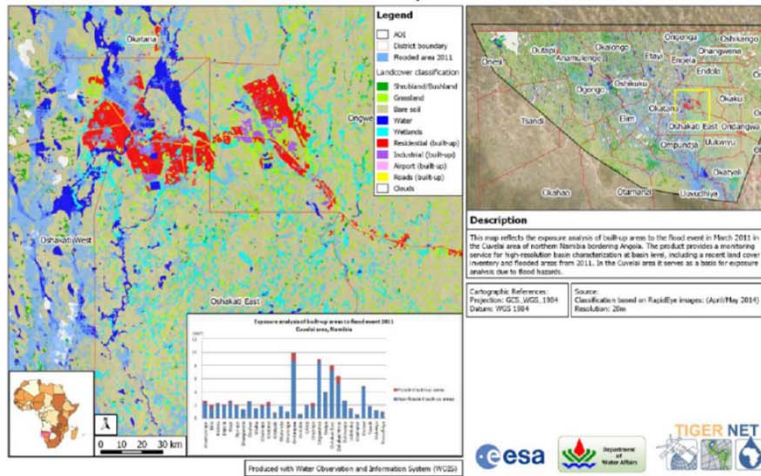
# State and change in LC/LU (PG4)



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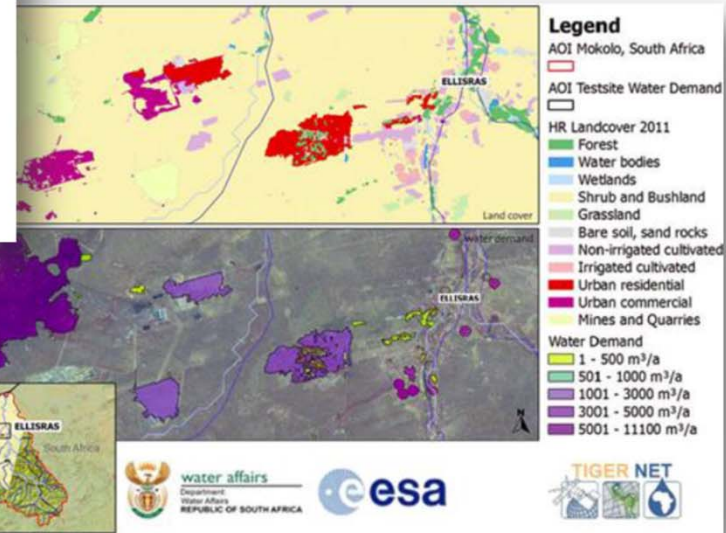
# Exposure analysis and water demand evaluation (PG5)

**Exposure analysis of built-up areas to flood event 2011  
Cuvelai area, Namibia**



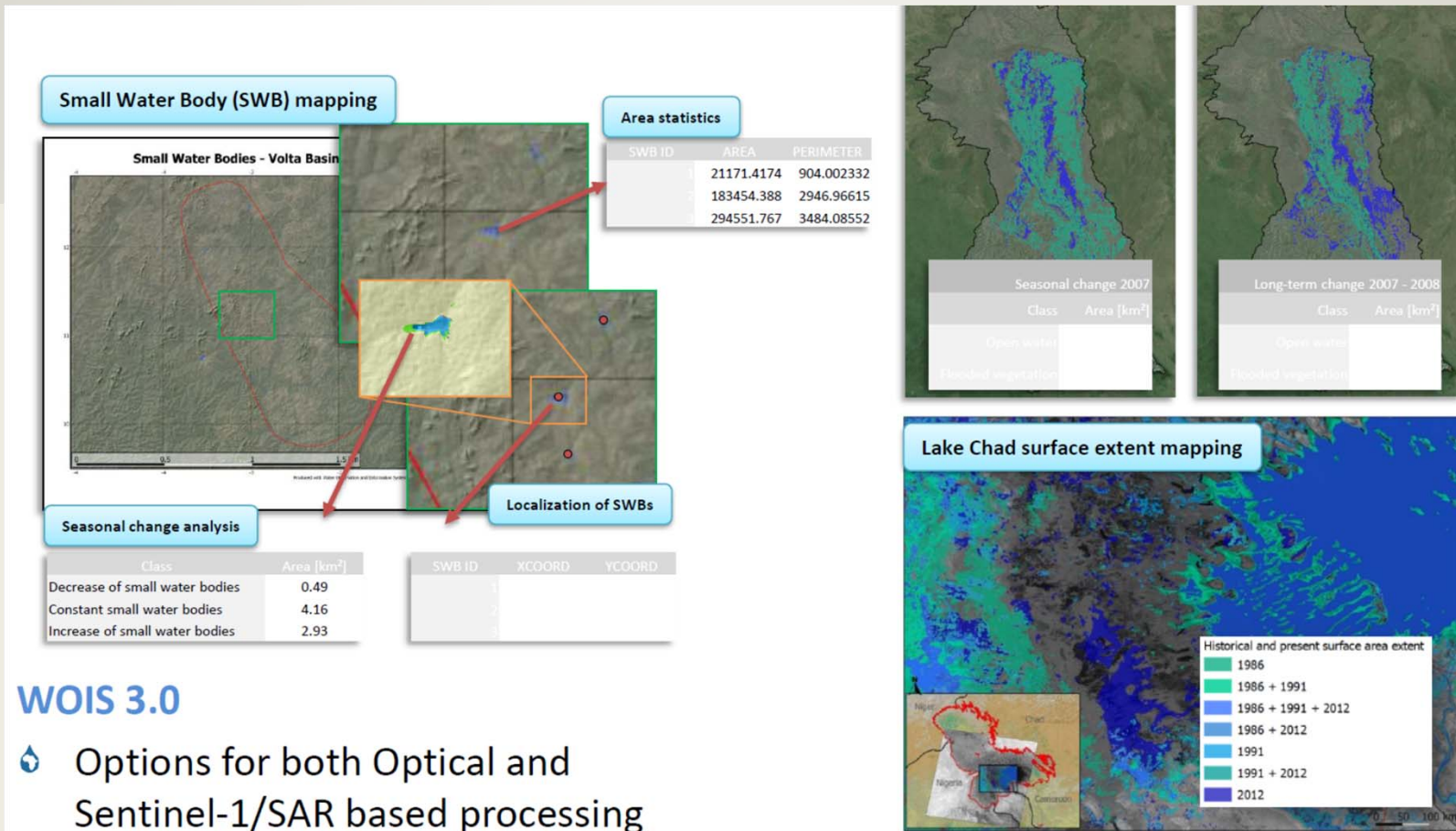
## WOIS 3.0

- Water demand evaluation and hazard exposure analysis
- SPOT VGT import support



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# Water body mapping (PG6)



WOIS 3.0

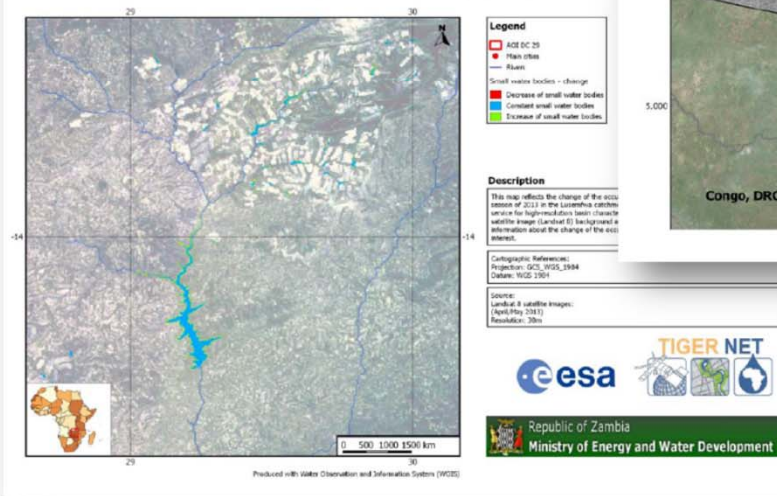
Options for both Optical and Sentinel-1/SAR based processing

# Water body mapping (PG6)

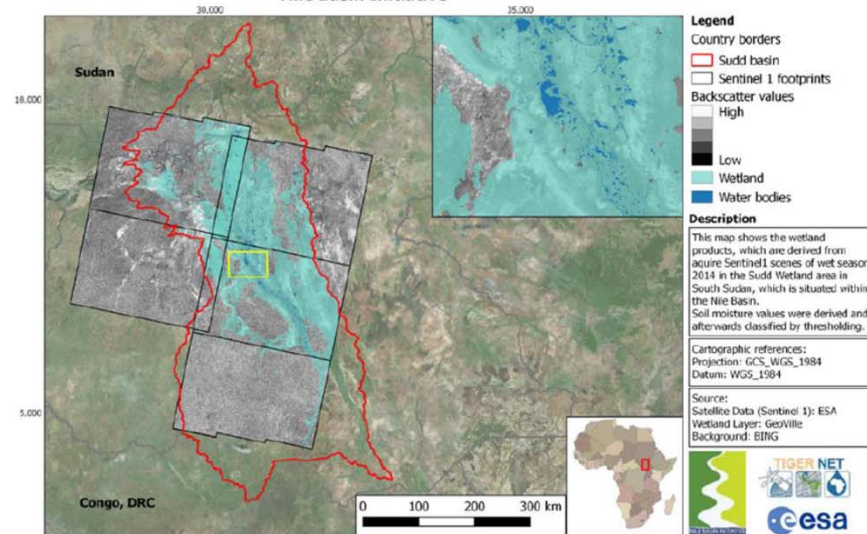
## WOIS 3.0

- Options for both Optical and Sentinel-1/SAR based processing

### Small water bodies - change dry/wet season Lusemwa catchment



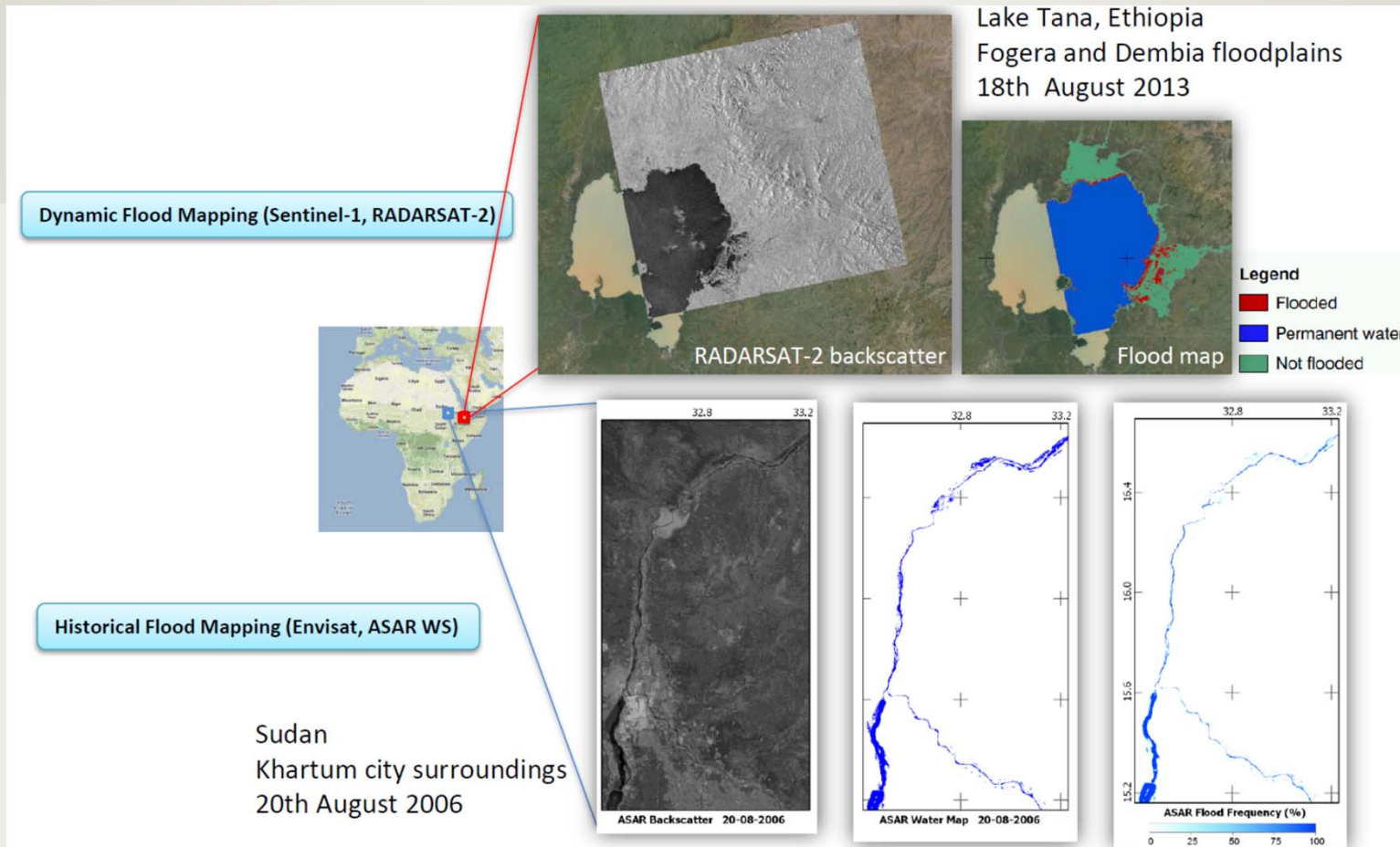
### Wetlands and permanent water bodies during October 2014 Nile Basin Initiative



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# Flood monitoring (PG7)

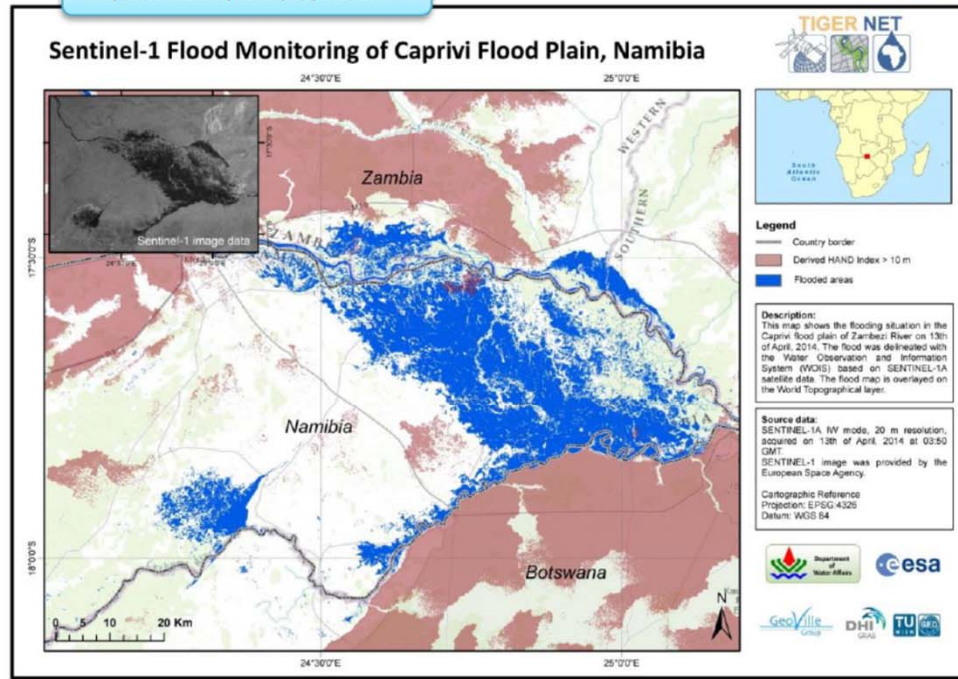


# Flood monitoring (PG7)

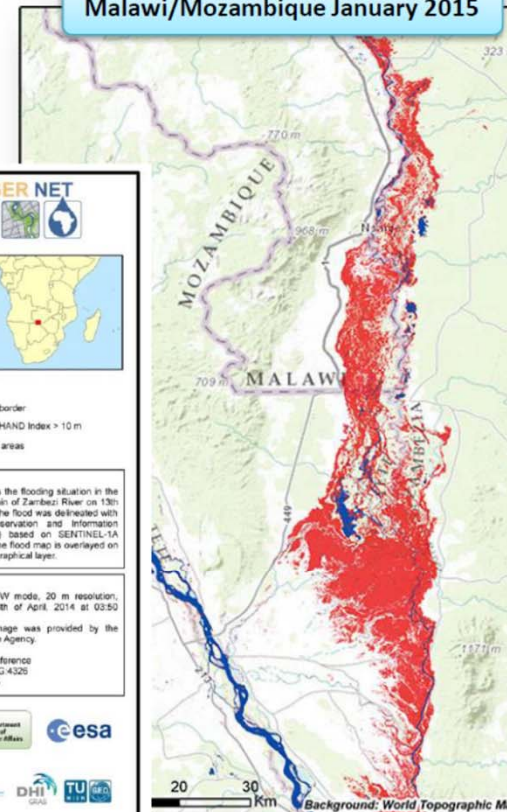
## WOIS 3.0

### Support for Sentinel-1

Caprivi floodplain, April 2014



Malawi/Mozambique January 2015



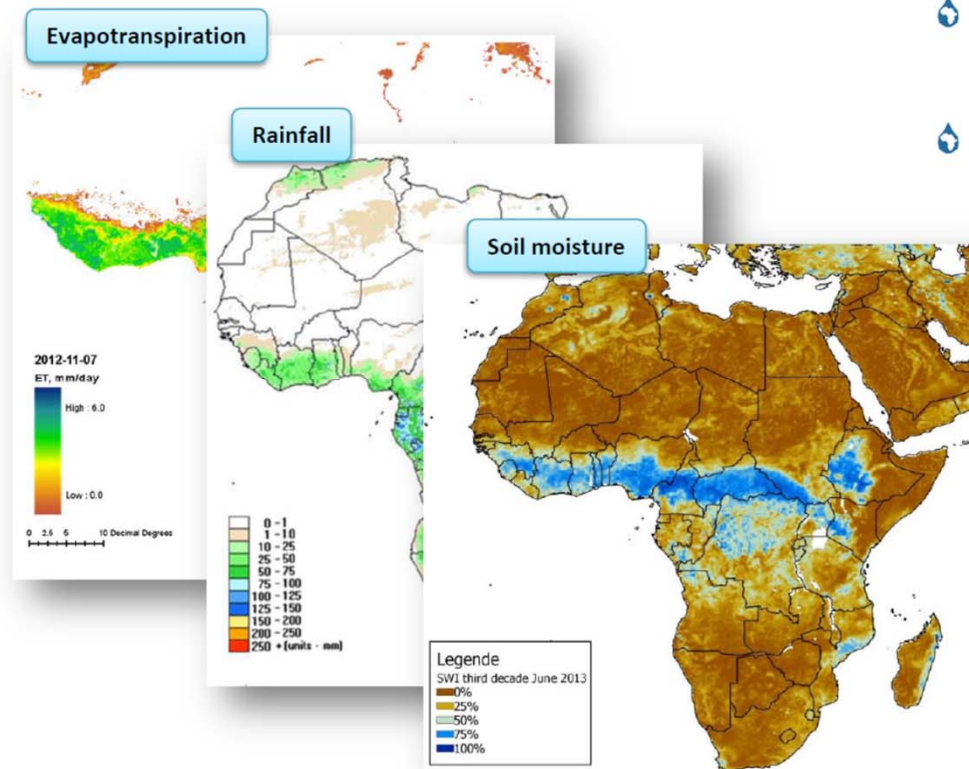
- Legend**
- International borders
  - Pre-flood waters (4th Jan 2015)
  - Flooded areas (22nd Jan 2015)

This map shows the flooding situation in the Lower Shire Basin on the 22nd of January 2015. The flooded areas was delineated with the Water Observation and Information System (WOIS) and based on Sentinel-1A satellite data.



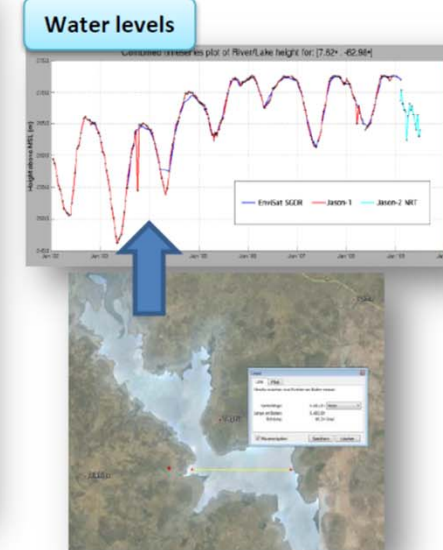
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# Hydrological characterization (PG8)

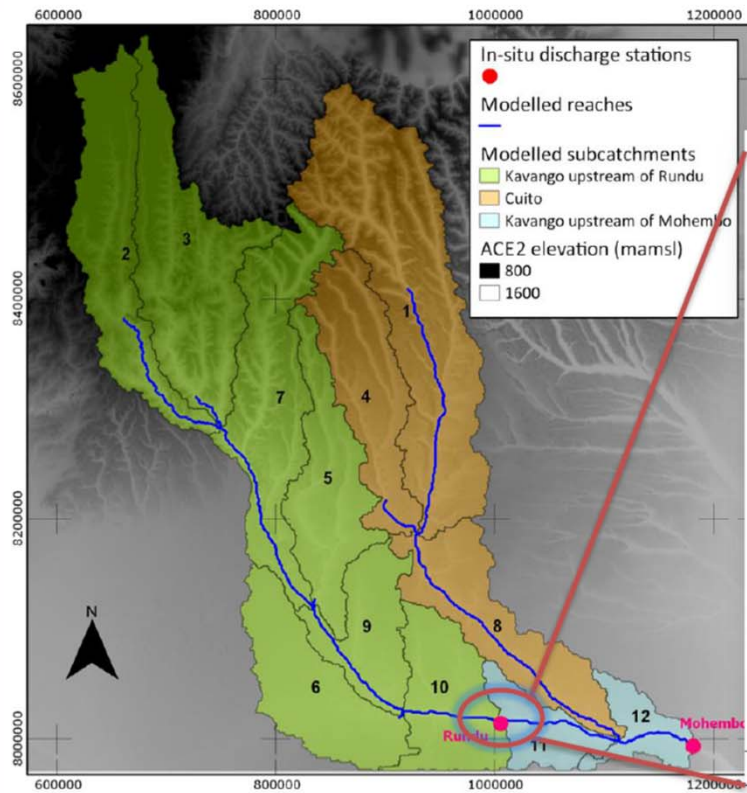


## WOIS 3.0

- 💧 ftp plugin for direct and scheduled download
- 💧 New soil moisture retrieval workflow

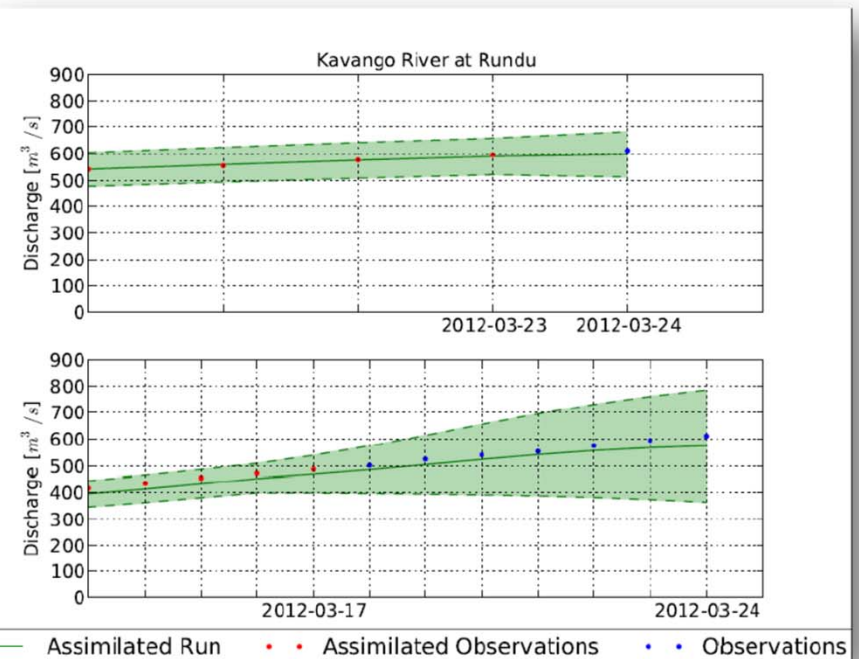


# Hydrological modelling (PG9)

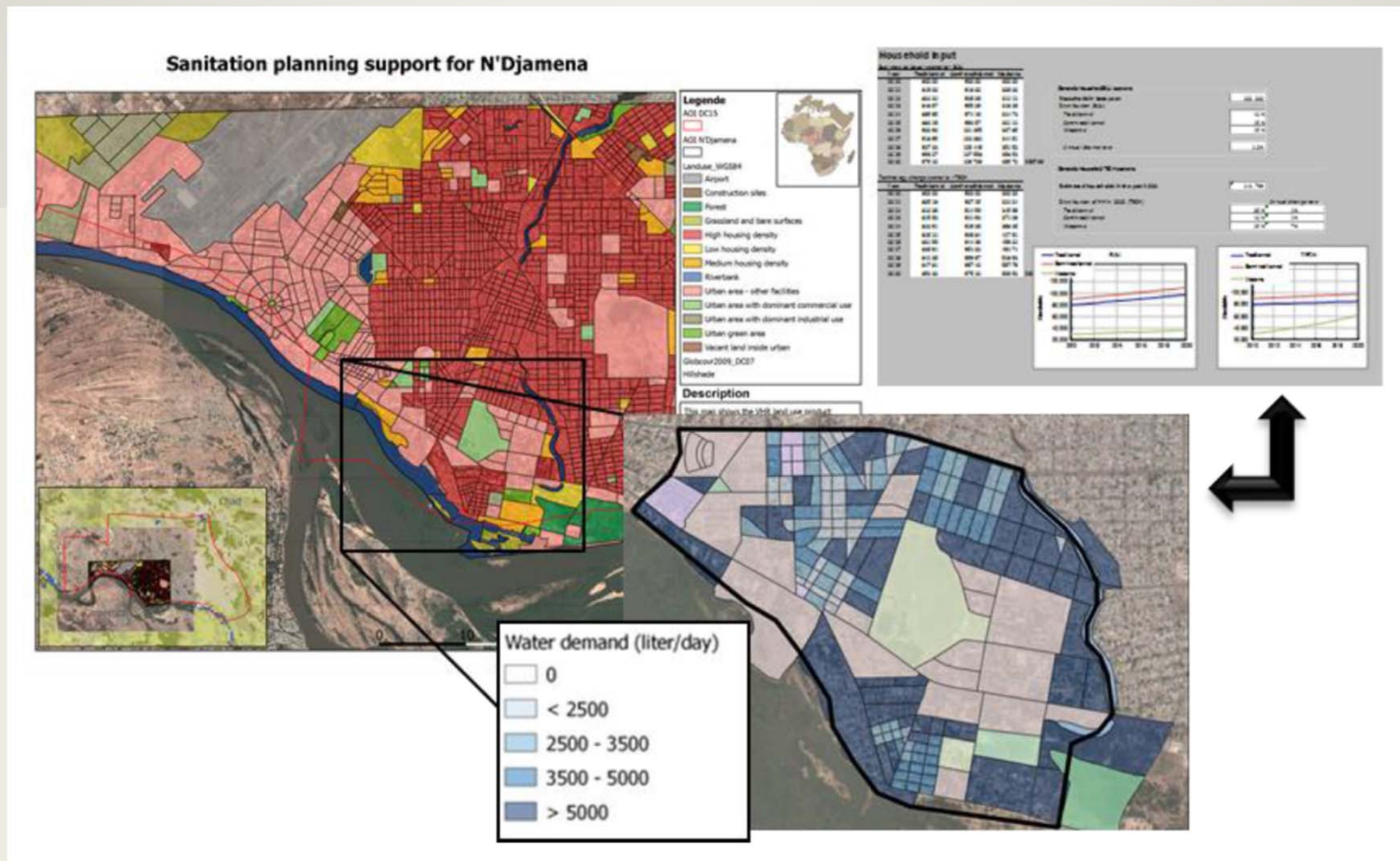


## WOIS 3.0

### Model and operational development framework



# Water supply and sanitation support (PG10)

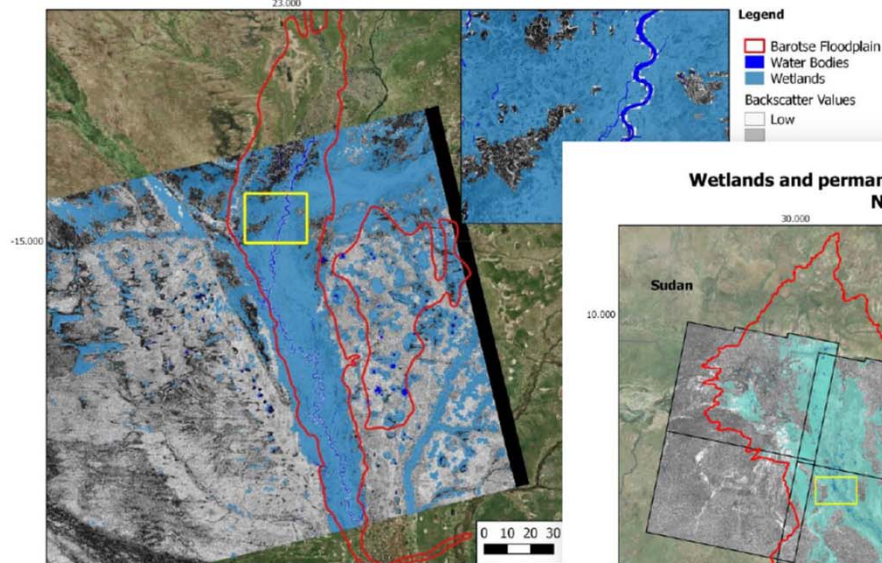


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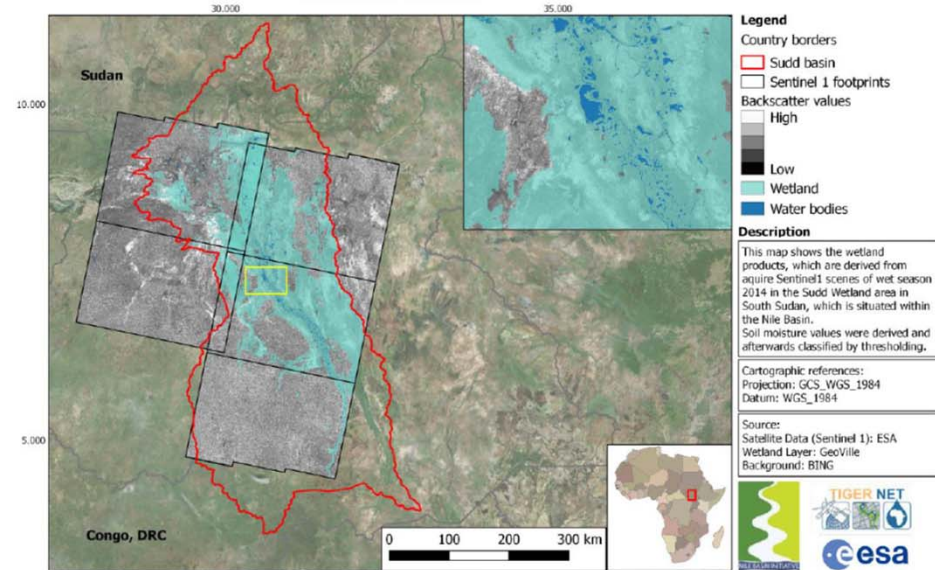
# Wetland mapping (PG11)

productGroup11\ZAMCOM\04\_Ba  
Wetlands\_SWB.jpeg

Wetlands and permanent water bodies during April 2015  
Barotse Floodplain, Zambia

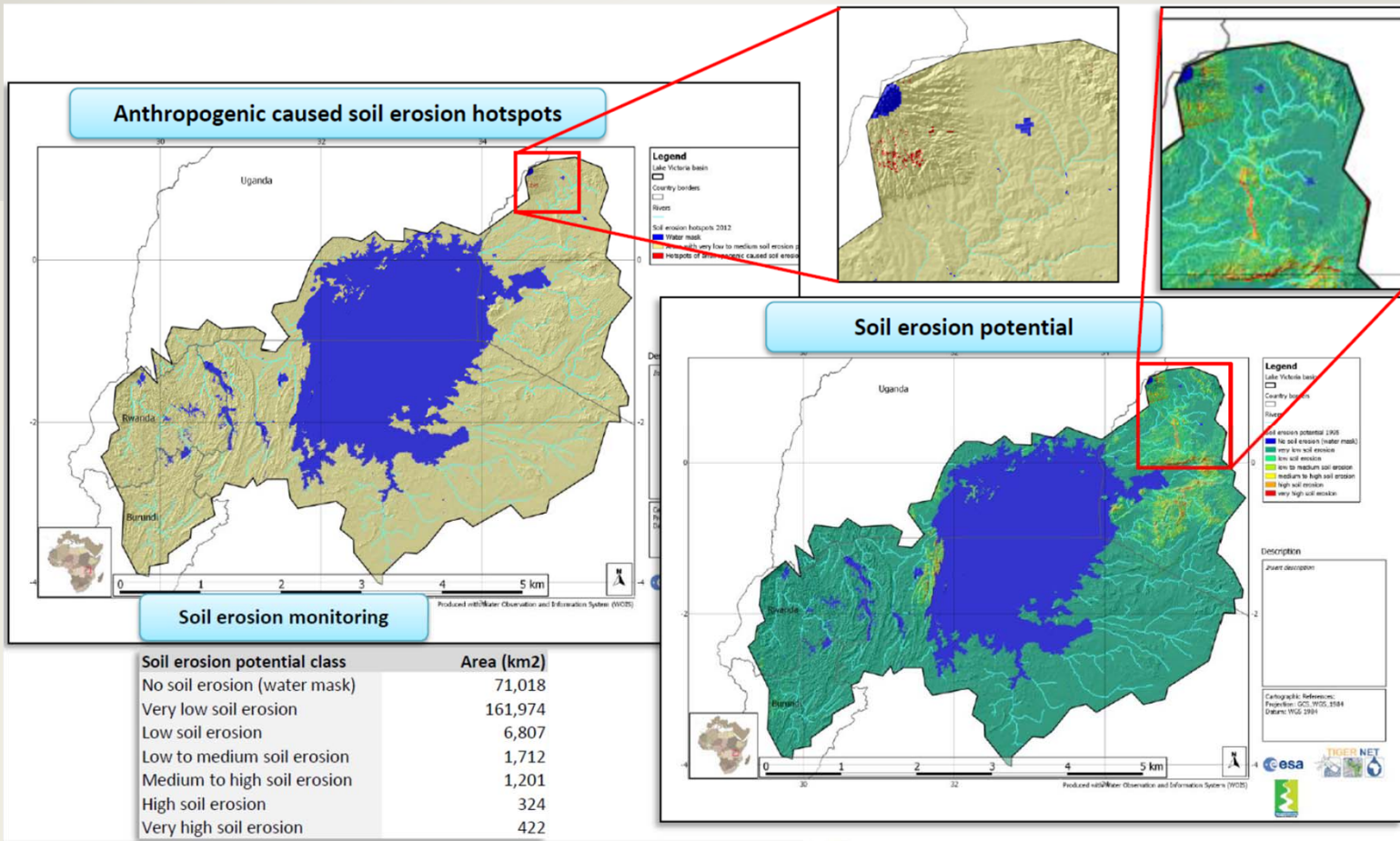


Wetlands and permanent water bodies during October 2014  
Nile Basin Initiative



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# Erosion potential indicator (PG12)



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## Downloadable

- [www.tiger-net.org](http://www.tiger-net.org)
- Registration is required – but no more
- Installation: it is advisable to remove all existing versions of components (R, Grass, Orpheo, SNAP, SWAT, PostgreSQL)

But...

- A **new version** is in beta testing phase, will be available soon. Keep an eye on the website!



A satellite-style map of Europe and the surrounding regions, showing landmasses in shades of brown and green, and oceans in various shades of blue. The text 'THANK YOU' is overlaid in a large, white, serif font in the center of the map.

# THANK YOU

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