→ GLOBWETLAND AFRICA TOOLBOX

Towards Earth Observation based Wetland Monitoring

Ramsar

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The GlobWetland Africa Toolbox is an open source and free-of-charge software toolbox for inventorying, mapping, monitoring and assessing wetlands.
The toolbox comes with end-to-end processing workflows for wetland delineation, wetland habitat mapping, monitoring of inundation regimes, extraction of water quality and modelling of river basin hydrology.

Development team

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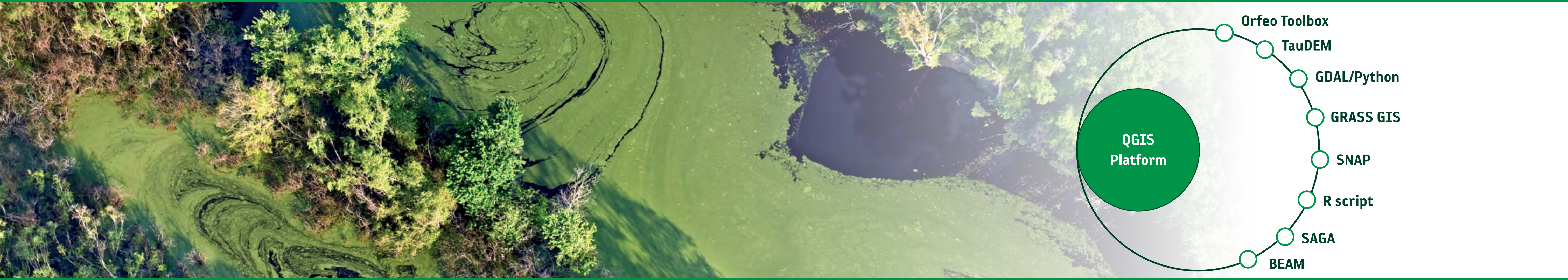
See also:

www.globwetland-africa.org

GLOBWETLAND AFRICA

→ TOOLBOX BASED ON OPEN SOURCE SOFTWARE

The GlobWetland Africa Toolboxis an an open source and free-of-charge software platform that provides users with all the necessary processing and analytics tools to make the best use of satellite-based information for measuring the ecological state of wetlands and their capacity to support biodiversity and provide ecosystem services.



GlobWetland Africa Toolbox advantages

- Cost and license free
- Open source i.e. easy to transfer, modify and integrate with existing user systems
- Extensive geoprocessing framework with +500 algorithms for raster and vector processing
- Drag and drop modeler and python scripting for complex computations and automated processing
- Wizard based processing workflows for non-experts
- Scaling up for future applications and demands

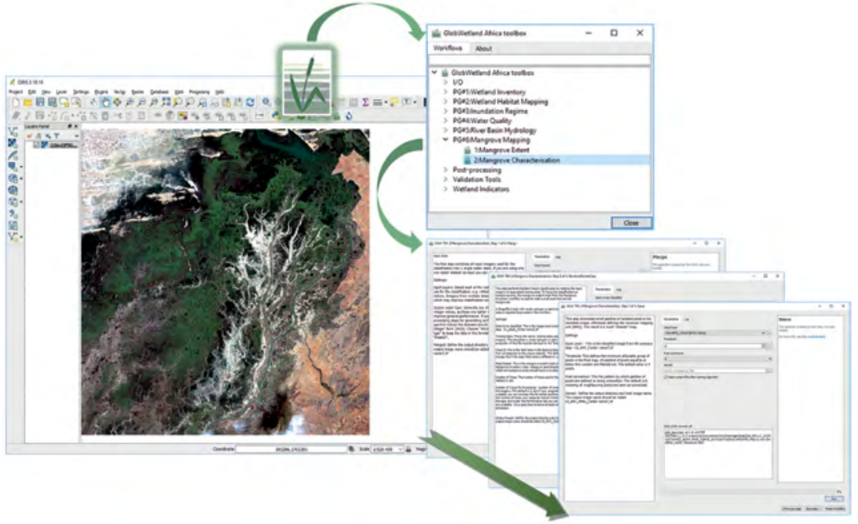
The GlobWetland Africa Toolbox is a unified software platform built on the free and open source QGIS Geographic Information System, integrated with a complete suite of proven and stable open source software packages (ORFEO, GRASS, GDAL, TauDEM, SAGA, SNAP/BEAM, R script).

The platform incorporates all necessary software tools to exploit the increasing capabilities of new and freely available satellite observations from the Sentinel missions of the European Copernicus initiative and other third party missions (e.g. Landsat).

The individual software packages are unified into a single QGIS graphical user interface with tools for the discovery and retrieval of satellite data, for EO data processing and analysis, and for building models, maps and applications.

➔ SIMPLE AND EASY TO USE GRAPHICAL USER INTERFACE

The GlobWetland Africa toolbox provides users with end-to-end processing functionality to monitor, assess and inventory wetlands and their surrounding areas, starting with the ingestion of the satellite data up to the production of the final geo-information maps and indicators.



Toolbox: *Library of customized workflows for importing, processing and analyzing optical and radar EO data in support of wetland management.*

Key capabilities

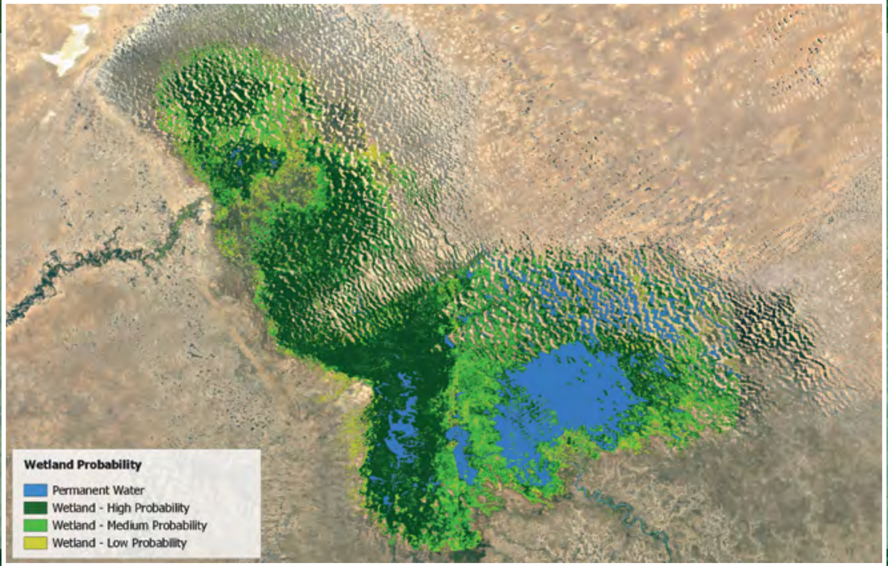
- Retrieve, manage and process EO data as well as integrate in-situ data
- Produce wetland information products and indicators
- Integration of hydrological modelling functions
- Supporting decisions based on full GIS framework with extensive mapping and reporting functionality
- Tested on Cloud platform for operational large-scale processing and application

The GlobWetland Africa Toolbox provides end-to-end processing workflows for

- wetland inventory (automatic identification and delineation of wetland areas over large river catchments)
- wetland habitat mapping (detailed classification of land cover/use types inside and around a wetland site)
- wetland inundation regimes (seasonality of the surface water extent)
- water quality (monitoring of aquatic eutrophication and physical disturbance)
- river basin hydrology (modelling of the water balance and underlying hydrological processes)
- mangrove mapping (mangrove delineation and characterisation)

→ WETLAND INVENTORY

Wetland inventory to identify and delineate wetland areas and serving the needs of national/regional agencies interested in exploring the possibilities to reduce costs associated with large wetland inventorying exercises.



Lake Chad Wetlands

EO input data: Sentinel-2, Sentinel-1 (optional), Landsat 8

Other input data: Digital Elevation Model (<30m resolution)

Method: The creation of the wetland inventory is based on a multi-temporal classification approach using optical and radar data (if available in sufficient quantity). The optical approach relies on a dynamical thresholding approach to identify areas which contain surface water or wet soils. The radar based method builds on the interpretation of geophysical parameters derived from dense SAR time series to detect water and wetness. Finally, both products are merged at decision-level into the final information products.

Output indicators: Change in Wetland area over time, Fragmentation statistics

Map legend: Water and Wetness Probability Index [%], probabilistic wetland classification

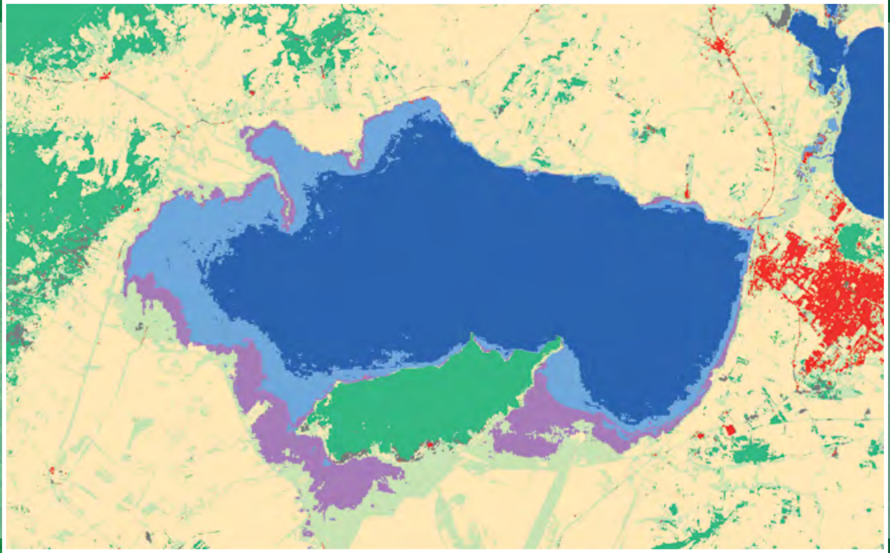
Spatial resolution: 20 m pixel resolution. MMU = 0.1ha = 3 pixels

Temporal resolution: Status mapping

Delivery format: GeoTiff, QGIS style file, additional information or other data formats upon request

→ WETLAND HABITAT MAPPING

Wetland habitat mapping provides a detailed classification of the land cover and land use of wetlands. Historical analysis allows obtaining a synoptic view of the main changes occurring in the wetland areas, whether they are of natural or anthropogenic origin.



Lake Ichkeul, Tunesia

EO input data: Sentinel-2, Landsat (TM, ETM, OLI)

Other input data: Digital Elevation Model (<30m resolution)

Method: The wetland habitat map is derived using a Random Forest (RF) classification of multi-spectral satellite imagery. The RF classifier is a supervised algorithm that takes a set of training data to establish the relationship between the response variable (i.e. the land cover/use classes) and the explanatory variables (cf. the satellite imagery).

Output indicators: Areal distribution of land cover/use classes; annual rate of change; Landscape fragmentation

Map legend: Land cover/use classes based on Corine land cover nomenclature adapted to incorporate the Ramsar wetland typologies

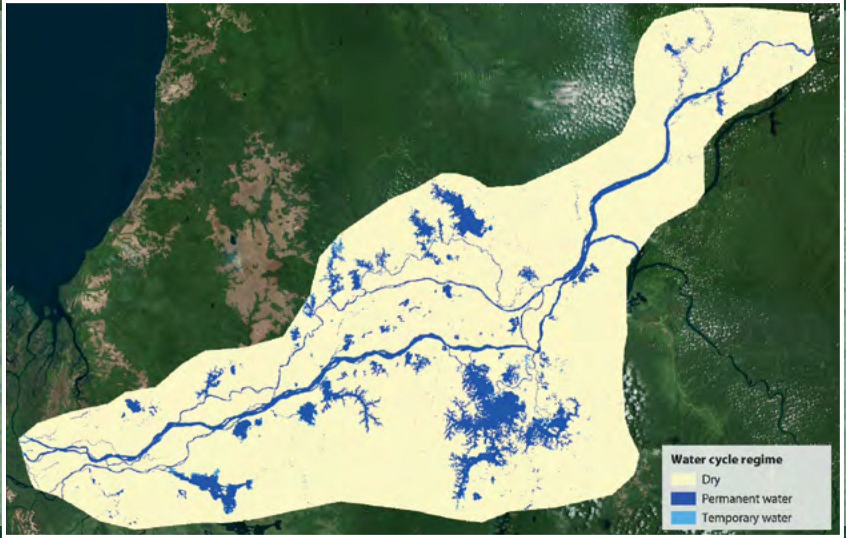
Spatial resolution: 10 m pixel resolution for Sentinel-2 derived products, MMU = 0.1ha = 10 pixels; 30 m pixel resolution for Landsat derived products, MMU = 1ha = 11 pixels

Temporal resolution: Annual, every 5 years (1990, 1995, 2000, 2005, 2010, and current status)

Delivery format: GeoTiff, QGIS style file, additional information or other data formats upon request

→ INUNDATION REGIME

The inundation regime provides an overview of the surface water extent within wetland sites and the surrounding area. Inter- and intra- annual variations of the water tables allow users to monitor the dynamics of water retention and flow and to assess how these changes of water regimes affect the overall wetland ecosystem.



Bas-Ogooué, Gabon

EO input data: Sentinel-2, Sentinel-1 (optional, if available), Landsat (TM, ETM, OLI)

Other input data: Digital Elevation Model (<30 m resolution)

Method: The derivation of the inundation regime is based on a multi-temporal classification approach using optical and radar data (optional, if available in sufficient quantity). Water frequency parameters are derived separately for both datasets and fused in the end to give a comprehensive representation of the surface water variations throughout one year.

Output indicators: Minimum and maximum water extent

Map legend: Categorical classification (dry, permanent and temporary water), Water frequency [%]

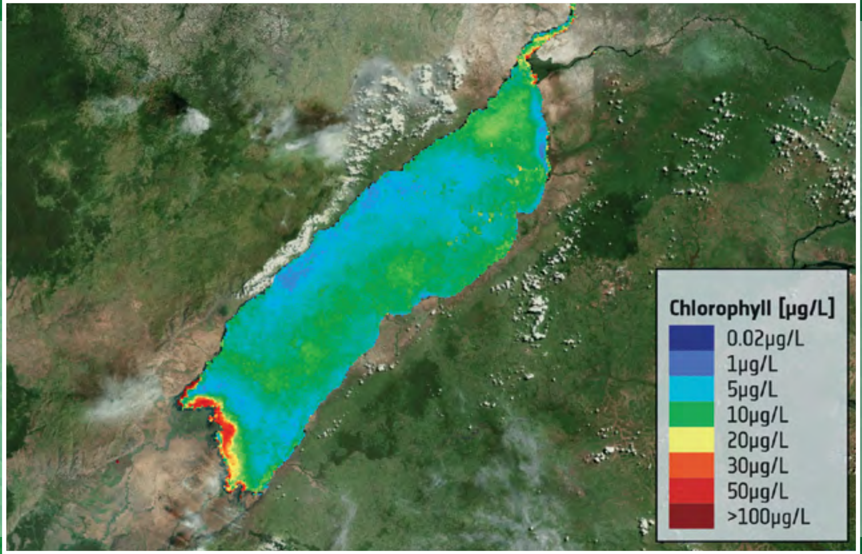
Spatial resolution: 20-30 m pixel resolution. MMU = 0.1ha = 3 pixels

Temporal resolution: Annual, every 5 years (1990, 1995, 2000, 2005, 2010, and current status)

Delivery format: GeoTiff, QGIS style file, additional information or other data formats upon request

→ WATER QUALITY

Water quality parameters allow to monitor wetland ecosystem changes from high sediment discharge (e.g by deforestation and erosion) or increasing contamination by nutrients causing algal blooms (eutrophication).



Lake Albert, Uganda

EO input data: MERIS FR, Sentinel-3 OLCI FR

Other input data: User supplied in-situ data

Method: The water quality parameters are derived from optical data by a coupled system of atmospheric correction and in-water retrieval. Different algorithms are applied for the different parameters and water types. These methods comprise neuronal net approaches (FUB WeW and C2RCC algorithms) and the MPH algorithm based on band combination after an Rayleigh correction.

Output indicators: Time series of chlorophyll concentration, turbidity, suspended sediment concentration, indicators for floating vegetation.

Map legend: chlorophyll concentration in mg/m^3, turbidity in FNU, suspended sediment concentration in g/m^3

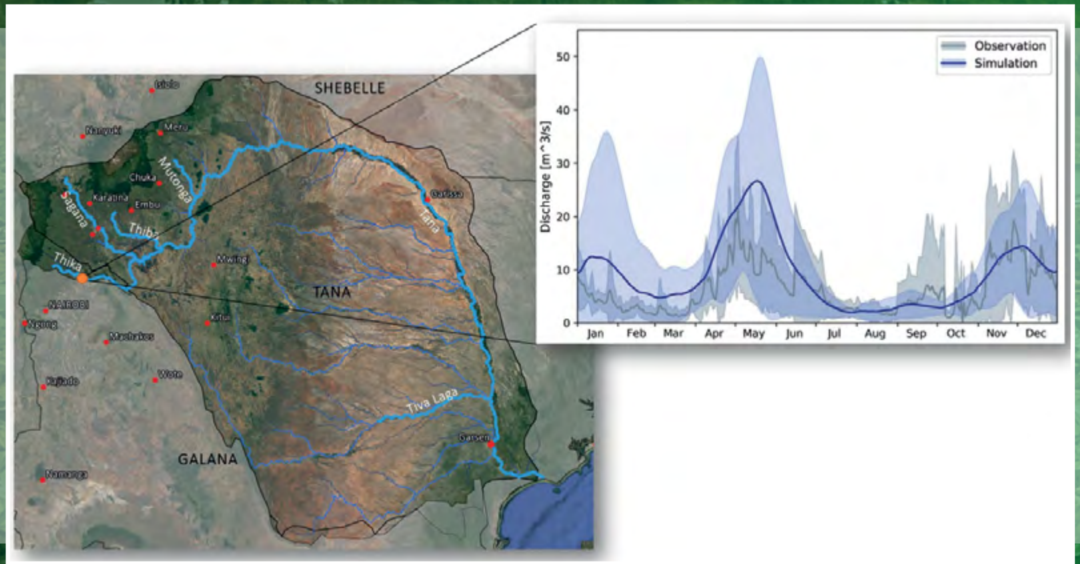
Spatial resolution: 300 m

Temporal resolution: daily, but averaged to e.g. 10-days or monthly composites

Delivery format: GeoTiff, QGIS style file, additional information or other data formats upon request

→ RIVER BASIN HYDROLOGY

Hydrological modelling of the water balance and of the underlying hydrological mechanisms for assessing the impact of climate change or human activity (e.g. water pumping for irrigation or urban settlements).



Tana river, Kenya

EO input data: SRTM and/or ACE2 digital elevation model; FEWS-RFE and/or TRMM precipitation estimates; Virtual station radar altimetry time series (Jason, AltiKa, Sentinel-3); Drifting-orbit radar altimetry data (CryoSat-2); GRACE total water storage time series

Other input data: In-situ discharge from users and/or Global Runoff Data Centre

Method: Hydrological modeling is conducted using an implementation of the Budyko framework i.e. a type of lumped rainfall-runoff model useful to investigate the interaction between climate, the hydrologic cycle, and catchment characteristics.

Output indicators: Time series of simulated discharge and/or water levels

Units: m^3/s

Spatial resolution: Sub-catchment level

Temporal resolution: 2000 to present (Daily time steps)

Delivery format: Ascii (.txt), Excel

→ MANGROVES MAPPING

Mangroves mapping to characterise the spatial distribution and structural arrangements of mangroves.

Zambezi delta

EO input data: Sentinel-2, Sentinel-1 (optional), Landsat (TM, ETM, OLI)

Other input data: Digital Elevation Model (<30m resolution)

Method: The Mangrove extent and characterization maps are derived using supervised machine learning algorithms (i.e. Random Forest and Support Vector Machine) that takes a set of training data to establish the relationship between the response variable (i.e. the mangrove classes) and the explanatory variables (cf. the satellite imagery).

Output indicators: Areal distribution of Mangroves; Fragmentation indices

Map legend: Mangrove map (mangrove / no mangrove); Mangrove characterization (3-4 structural classes e.g. density or height)

Spatial resolution: 20 m pixel resolution. MMU = 0.1ha = 3 pixels

Temporal resolution: Status mapping

Delivery format: GeoTiff, QGIS style file, additional information or other data formats upon request