

EO opportunities and challenges for achieving SDG 6.6

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Sharing experiences on indicator 6.6.1 on freshwater related ecosystems, and exploring opportunities for better monitoring,

UN-GGIM HLF, INEGI, 27 November 2017

SDG Indicator 6.6.1: Change in the extent of water-related ecosystems over time

TIER III

Ecosystem types	Extent/Volume/Flow sub-indicators	Ecosystem Health sub-indicators
Vegetated Wetlands (water dominated ecosystems such as swamps, marshes and peatlands)	Spatial extent/area	Wetland health indices
Inland open waters (lakes and reservoirs)	Spatial extent/area Quantity (volume)	Lake health indices Water quality (6.3.2)
Rivers and estuaries	Quantity (streamflow)	River health indices Water quality (6.3.2)
Groundwater aquifers	Quantity (depth to groundwater table)	Groundwater interaction with surface water



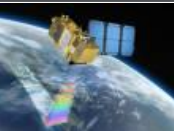











EO needs for monitoring water-related ecosystems globally

- ***Global and systematic observation scenarios with multi-sensor (radar/optical) approach***
to improve wetland inventories globally, which are still largely lacking.
- ***Multi-spectral bands with high radiometric performances***
to better distinguish the different wetland habitats, better delineate wetland areas, and better assess threats from agricultural practices, urbanisation and climate change.
- ***High spatial resolution***
to have more spatial details for capturing the variety of small habitats in wetlands and for detecting small water bodies.
- ***Short revisiting times***
to capture the seasonality of dynamic wetland ecosystems such as inundation regimes (permanent and seasonal waters) that are important indicators of healthy conditions of wetlands.

The European Copernicus program, Securing satellite data access on the long term



	Sentinel 1 – SAR imaging All weather, day/night applications, interferometry	2014 / 2016	
	Sentinel 2 – Multi-spectral imaging Land applications: urban, forest, agriculture,... Continuity of Landsat, SPOT	2015 / 2017	
	Sentinel 3 – Ocean and global land monitoring Wide-swath ocean color, vegetation, sea/land surface temperature, altimetry	2017 / 2018	
	Sentinel 4 – GEO Atmospheric Chemistry Atmospheric composition monitoring, trans- boundary pollution	2019	
	Sentinel 5 & Precursor – LEO Atmospheric Chemistry Atmospheric composition monitoring (S5 Precursor launch in 2016)	2017 / 2019	
	Sentinel 6 Jason-CS – Altimetry Mission High precision measurements of global sea-level (continuation of Jason ocean topography missions)	2020	

Long term
EO data
to better
monitor
our Planet



* Joint EU/ESA Data Policy Principles adopted by ESA Council and by EU Parliament and Council (Nov 2013)

The Sentinels of the European Copernicus Program

2014

2017

2021

2027

2030

S-1 A/B/C/D



S-1 A/B 2nd Generation

S-2 A/B/C/D



S-2 A/B 2nd Generation



S-3 A/B/C/D



S-3 A/B 2nd Generation



S-4 A/B (on MTG)



S-5 Precursor



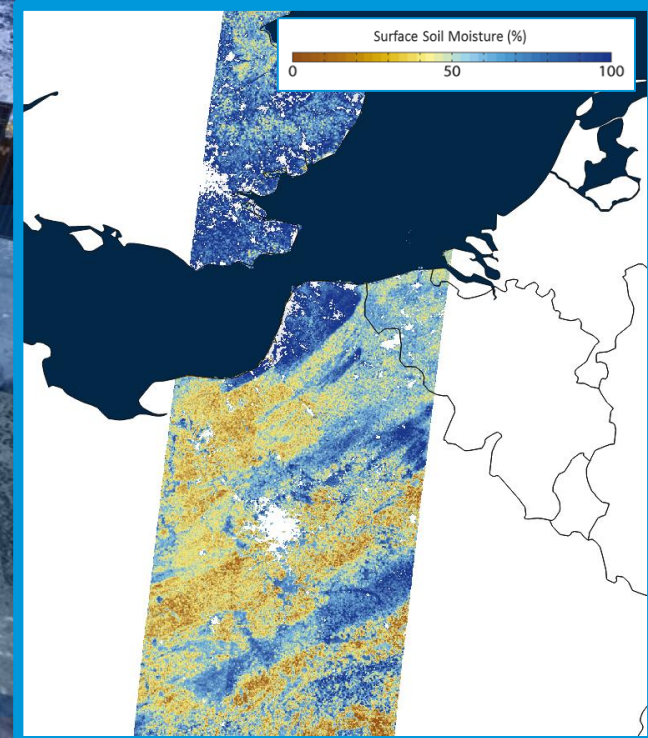
S-5 A/B/C (on MetOp-SG)



S-6 (J-CS) A/B



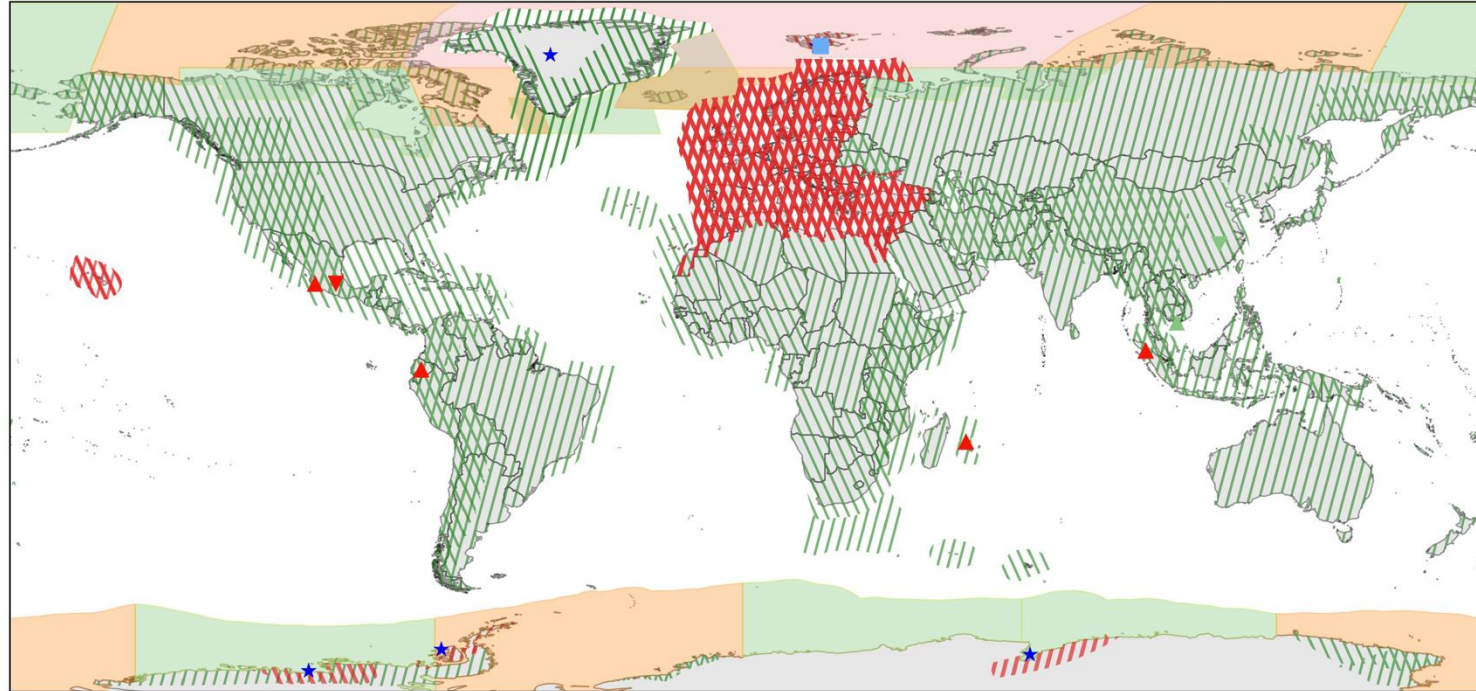
- C-Band Synthetic Aperture Radar
- Constellation of two satellites
- S1A launch on 3 April 2014, S1B on 25 April 2016
- 12-day repeat cycle at Equator (6 days with 2 satellites)
- Nominal lifetime of 7 years (max. 12 yrs)
- Default mode over land: IWS 20m dual pol. VV/VH,
- 250km swath width
- Global mapping today is every +/- 12 days (S1A+S1B)



Sentinel-1 Constellation Observation Scenario: Revisit & Coverage Frequency



validity start: 05/2017



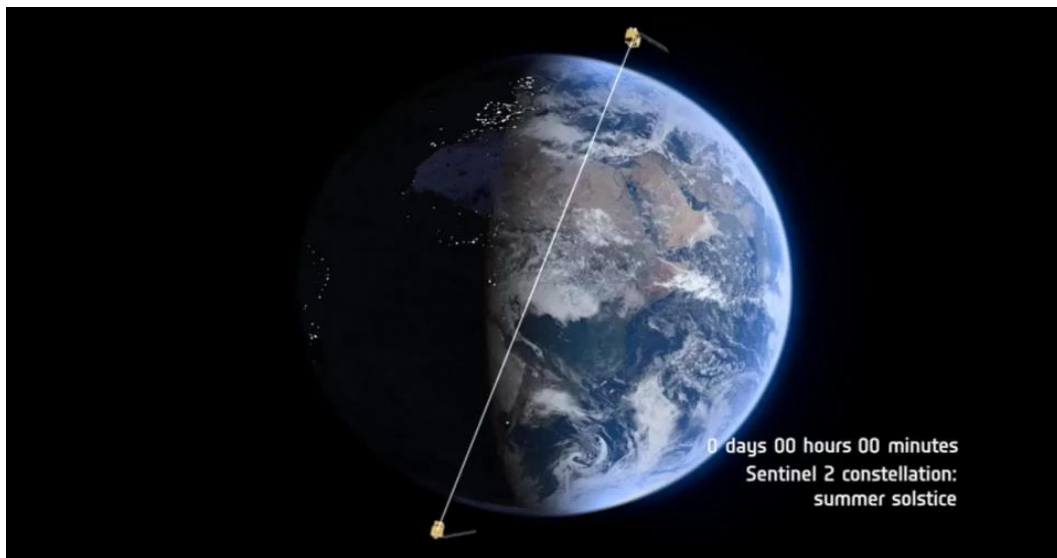
PASS	REVISIT	FREQUENCY *	COVERAGE	FREQUENCY **	REFERENCE DATA SITES (6d repeat)
<div> <div>ASCENDING</div> <div>DESCENDING</div> </div>	<div> <div>6 days</div> <div>12 days</div> </div>	<div> <div>12 days</div> <div>12 days</div> </div>	<div> <div>1 days</div> <div>1-3 days</div> <div>2-4 days</div> </div>	<div> <div>1 days</div> <div>1-3 days</div> <div>2-4 days</div> </div>	<div> <div>Highly active volcanism</div> <div>Fast subsidence</div> <div>Short growth cycle, intensive agriculture</div> <div>Fast changing wetlands</div> <div>Fast moving outlet glaciers</div> <div>Permafrost & glaciers</div> </div>

* coverage ensured from same, repetitive relative orbits
 ** coverage not considering repetitiveness of relative orbits

Baseline observation scenario in routine phase (S2A + S2B)

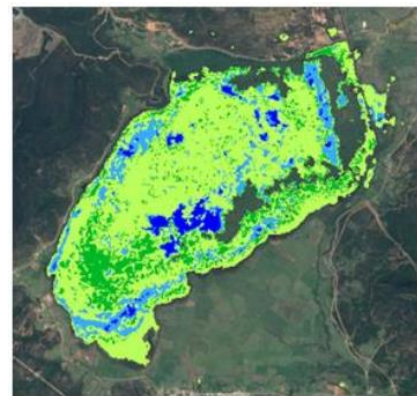
Systematically

- **All land surfaces** between 56° South latitude (Cape Horn in South America) and 84 North latitude (north of Greenland)
- **Major islands** (greater than 100 km² size),
- EU islands and all the other small islands located at less than **20 km from the coastline**
- The **whole Mediterranean Sea** as well as all inland water bodies and closed seas
- S2A launch on 23 June 2015,
S2B on 7 March 2017



EO for wetland inventories

- Identification and **delineation of wetlands areas** as a support to wetland inventories.
- Serve the needs of national/sub-national agencies interested in exploring possibilities to **reduce costs** of large-scale wetland inventorying campaigns.
- Exploit **long and dense time series of satellite imageries** to capture inter- and intra- annual variations.



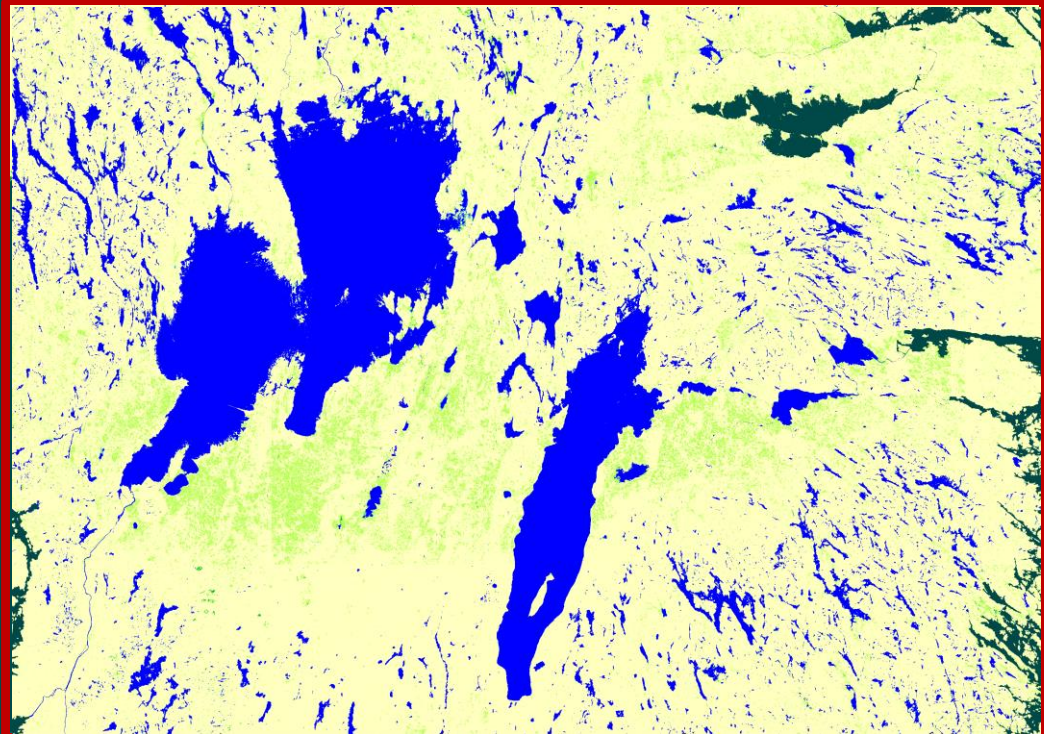
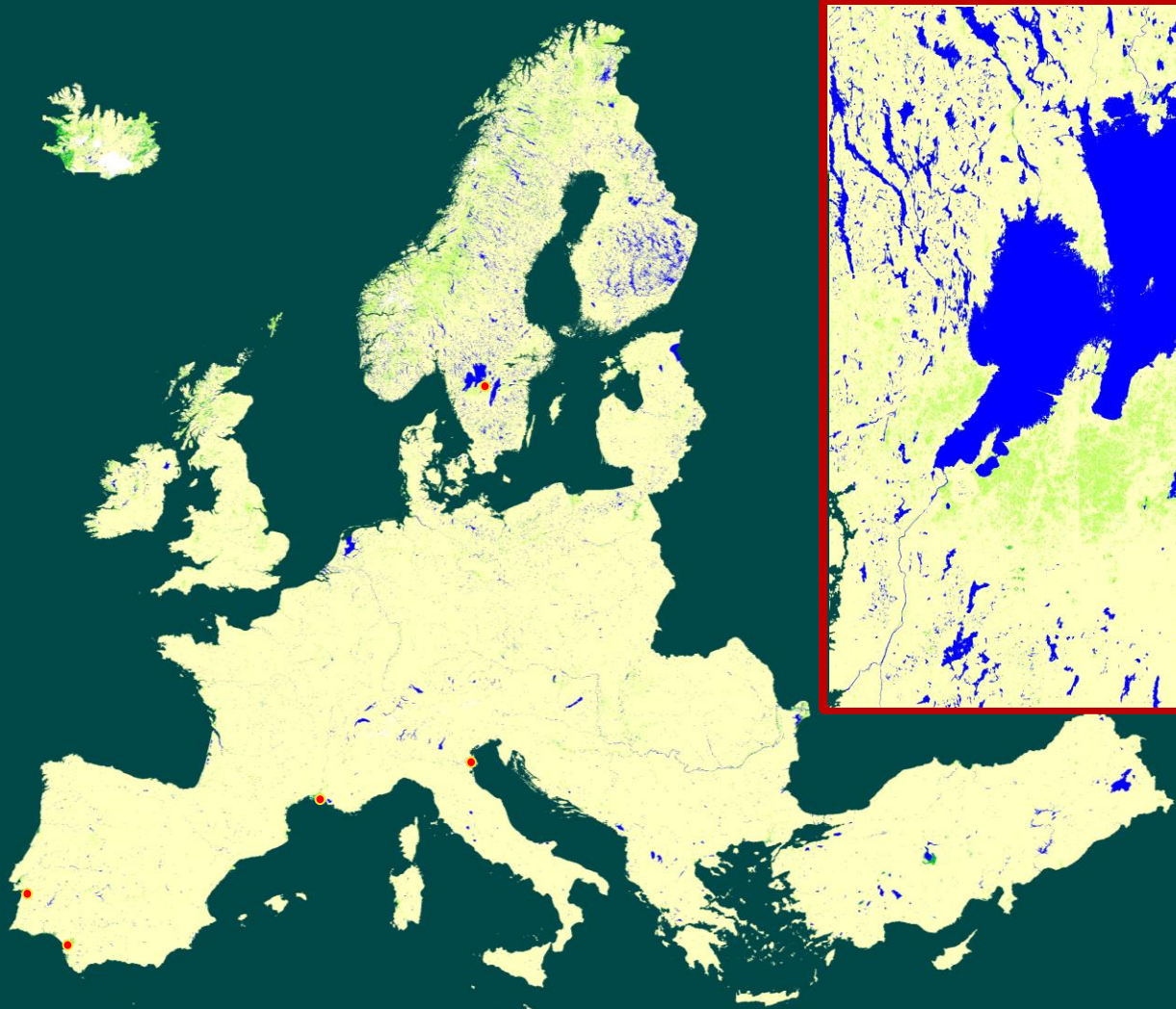
■ Permanent Water
■ Temporary Water
■ Permanent Wet
■ Temporary Wet



0% 100%

Lake Tonga, Algeria

Vegetated Wetlands		Inland Open Waters	
Spatial Extent	Health Indices	Spatial Extent	Water Quality
S1, S2, Landsat 8	S2, Landsat 8, (S1)	S1, S2, Landsat 8	S2, S3, Landsat 8, MODIS



- Dry
- Permanent Water
- Temporary Water
- Permanent Wet
- Temporary Wet
- Snow and Glacier
- Seawater

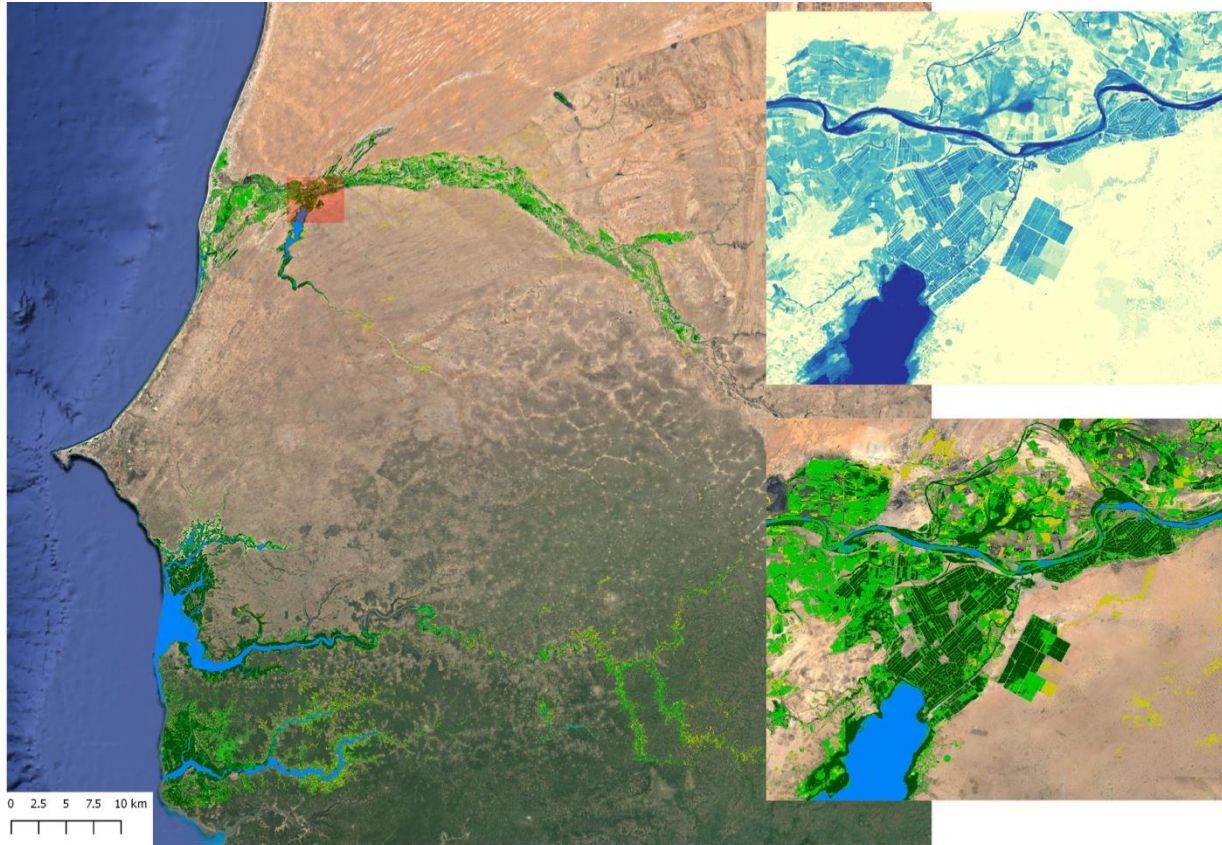
0 10 20 30 40 km

Copernicus

Land Monitoring Service

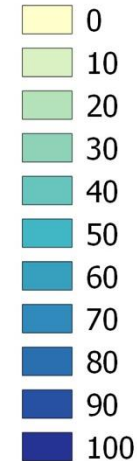
EO for wetland inventories

Senegal vegetated wetlands pre-inventory



Legend

WWPI [%]



Wetland classification

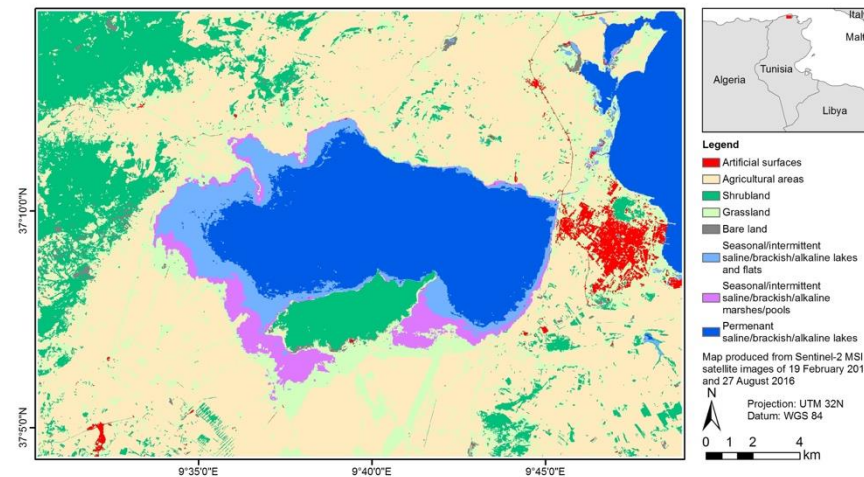


EO for wetland habitat mapping



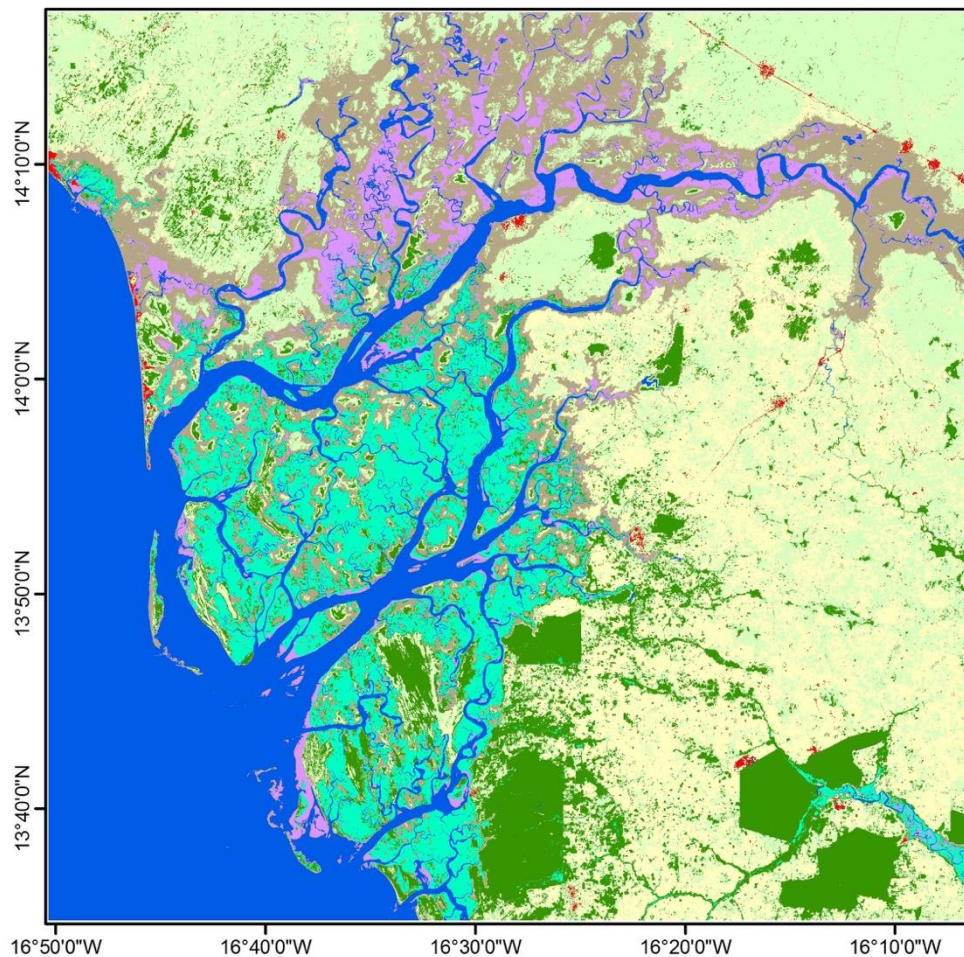
- Detailed **classification of the land cover and land use** inside and around the wetland site.
- Detect **changes in wetland habitats**, derive **trends of wetland status**, **assess threats** and **estimate impacts**.
- Exploit **time series of HR optical satellite images** to capture the variety of habitats in wetlands and detect threats.

Wetland Habitat Mapping - Ichkeul (Tunisia) (Site 113) - 2015/16



Vegetated Wetlands		Inland Open Waters	
Spatial Extent	Health Indices	Spatial Extent	Water Quality
S1, S2, Landsat 8	S2, Landsat 8, (S1)	S1, S2, Landsat 8	S2, S3, Landsat 8, MODIS

Wetland Habitat Mapping - Delta du Saloum (Senegal) (Site 98) - 2015/16



Legend

- Artificial surfaces
- Intertidal forested wetlands
- Marshes
- Intertidal mud, sand or salt flats
- Forest
- Grassland
- Open water
- Agricultural areas

Map produced from Sentinel-2 MSI satellite images of 4 February 2016 and 11 October 2016

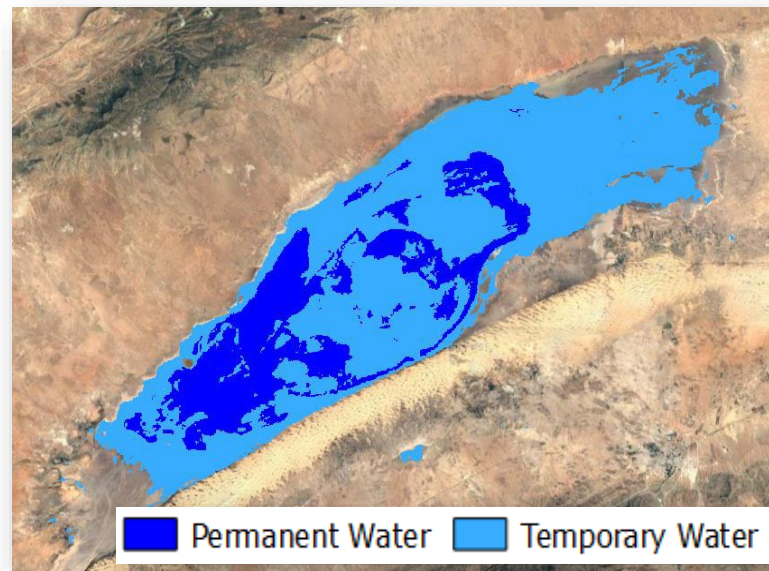


Projection: UTM 28N
Datum: WGS 84



EO for changes in open surface waters

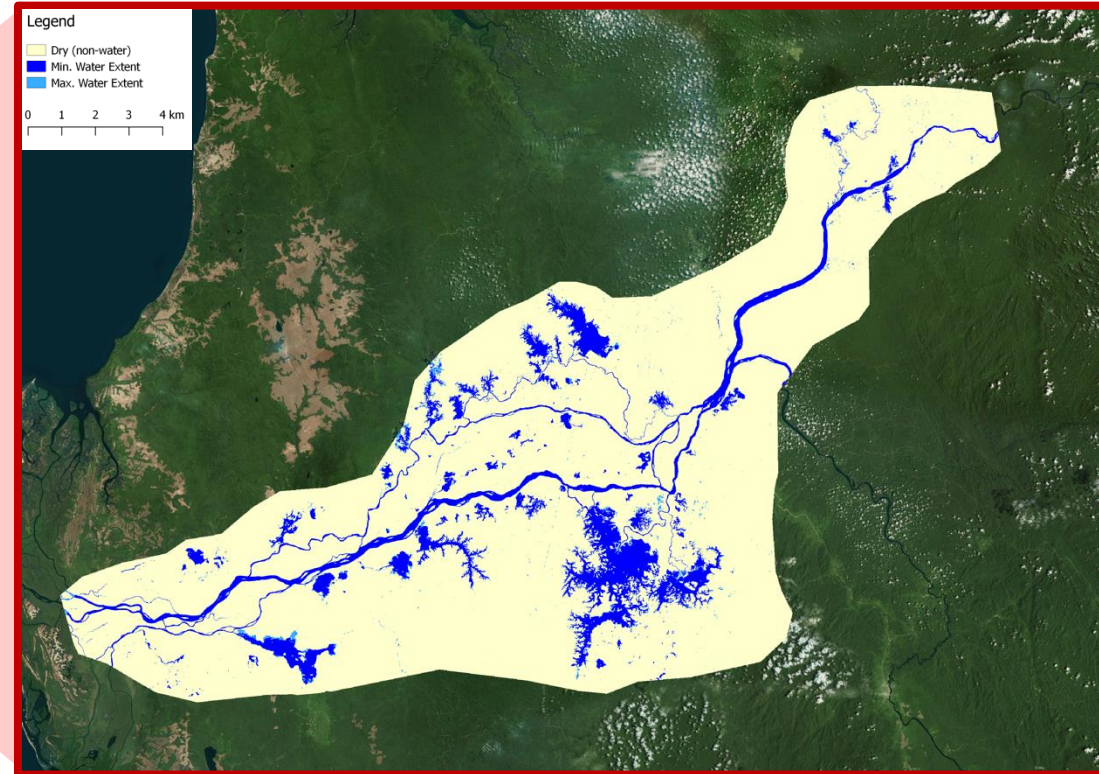
- Characterization of **inter- and intra-annual variations** of water bodies.
- Capture **minimum and maximum surface water extent** during each hydrological year and **frequency of inundation**.
- Exploit **yearly “dense time series” of satellite imagery** to capture the seasonality of inundation regimes.



Vegetated Wetlands		Inland Open Waters	
Spatial Extent	Health Indices	Spatial Extent	Water Quality
S1, S2, Landsat 8	S2, Landsat 8, (S1)	S1, S2, Landsat 8	S2, S3, Landsat 8, MODIS

Mapping open surface waters with the Sentinels

Bas Ogooué River, Gabon



Mapping open surface waters with the Sentinels

Bas Ogooué River, Gabon

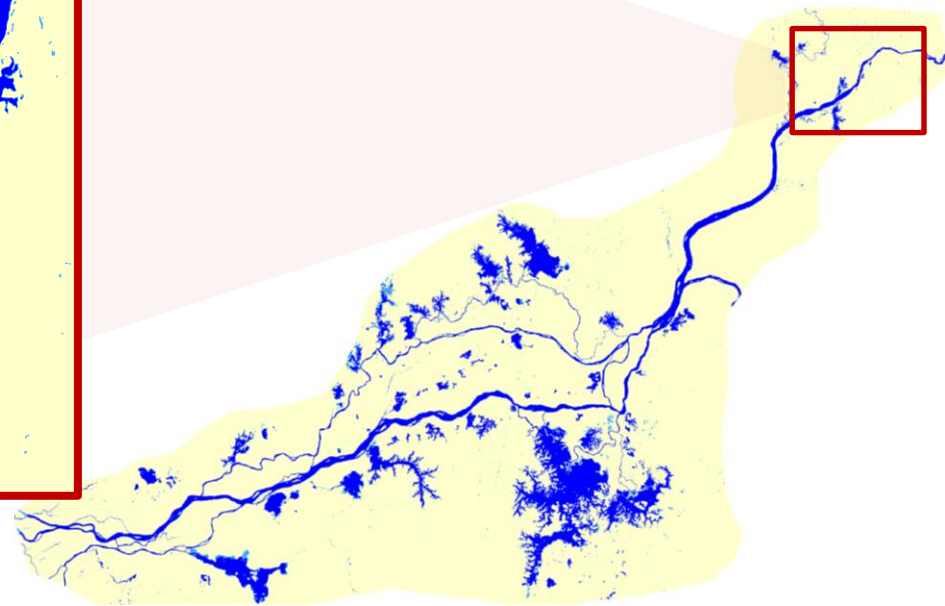


GlobWetland Africa,
Sentinels 1 and 2

Legend

- Dry (non-water)
- Min. Water Extent
- Max. Water Extent

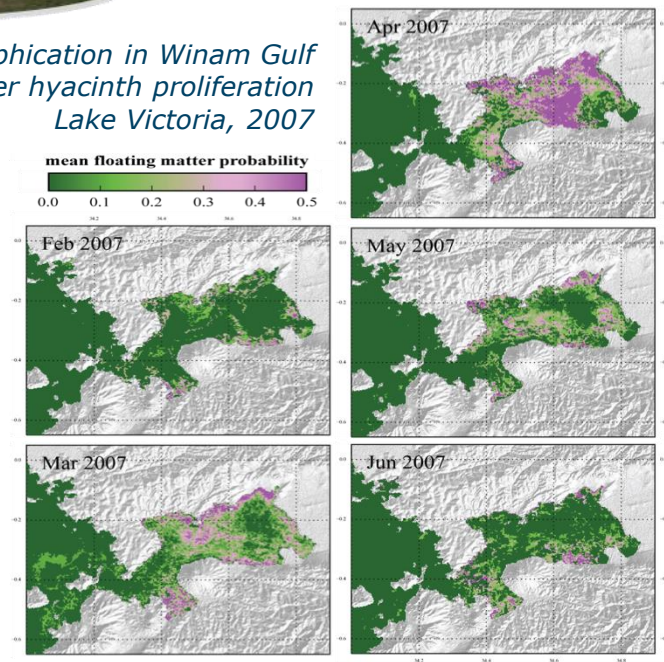
0 1 2 3 4 km



EO for Water Quality in open waters

- Retrievals of **suspended sediments**, **dissolved organic matters**, **chlorophyll concentration**, **cyanobacteria blooms** in absolute or relative terms
- Allow to monitor **wetland ecosystem contamination** (water body eutrophication due to excessive nutrients) and to estimate **physical disturbances**.
- **Spatial and temporal** assessment of Water Quality using multi/hyper spectral satellite data.

*Eutrophication in Winam Gulf
Water hyacinth proliferation
Lake Victoria, 2007*



Vegetated Wetlands		Inland Open Waters	
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EO integration into SDG implementation



Global
Datasets

Methodological
Guidelines

Country
Support

Capacity
Building

EO Software
Toolboxes

Knowledge
Hub &
Platforms

Custodian Agencies

- Access to global / regional datasets.
- in the absence of or to complement and enhance, national data sources.
- countries which face major difficulties in collecting national data

- Support custodian agencies to develop method. guidelines to countries.
- EO Best Practices.
- Scientifically sound approaches.
- Product validation.
- Show Cases.

National Statistical Offices
Governments / Agencies

- Targeted activities to support NSOs and line ministries to report on SDG indicators.
- Support country level efforts to apply EO to track, monitor and achieve SDGs.

- Build capacity to exploit EO
- Training courses
- Training material on EO best practices
- Mainly targeted to developing countries
- Critical mass of technical centers

Key Stakeholders

- Free of charge
- Open source
- Easy to use
- EO Processing Toolboxes
- Thematic Toolboxes

- Knowledge sharing
- Facilitate access to Sentinel data
- Access to global / regional datasets
- EO best practices
- Method. guidelines
- Visualisation and Analysis
- On-line processing
- Toolboxes



GlobWetland Africa, a free of charge and open-source EO toolbox for wetland inventory and monitoring



Wetland inventory

identification and delineation of wetland areas over large river catchments, in support to national wetland inventory campaigns;

Wetland habitats maps

for the assessment of the wetland status and for long-term change and trend analysis, inside and around Ramsar/wetland areas;

Water cycle regimes,

for the analysis of the intra- and inter-annual variations of the water tables, inside and around Ramsar/wetland areas;

Water quality parameters

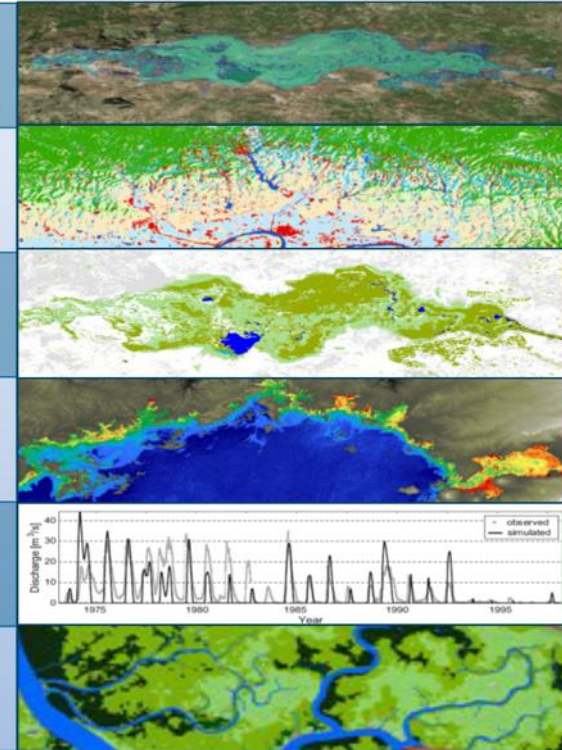
such as turbidity, suspended solids and chlorophyll concentration, for the monitoring of the aquatic contamination and physical disturbances of the wetland ecosystem;

River basin hydrology

for the modelling of the water balance and the impact of/on wetlands within river catchments;

Mangroves mapping

for the assessment of the status and trends of tropical mangroves.



*Inherits the **TIGER**
Water Observations
Information System*

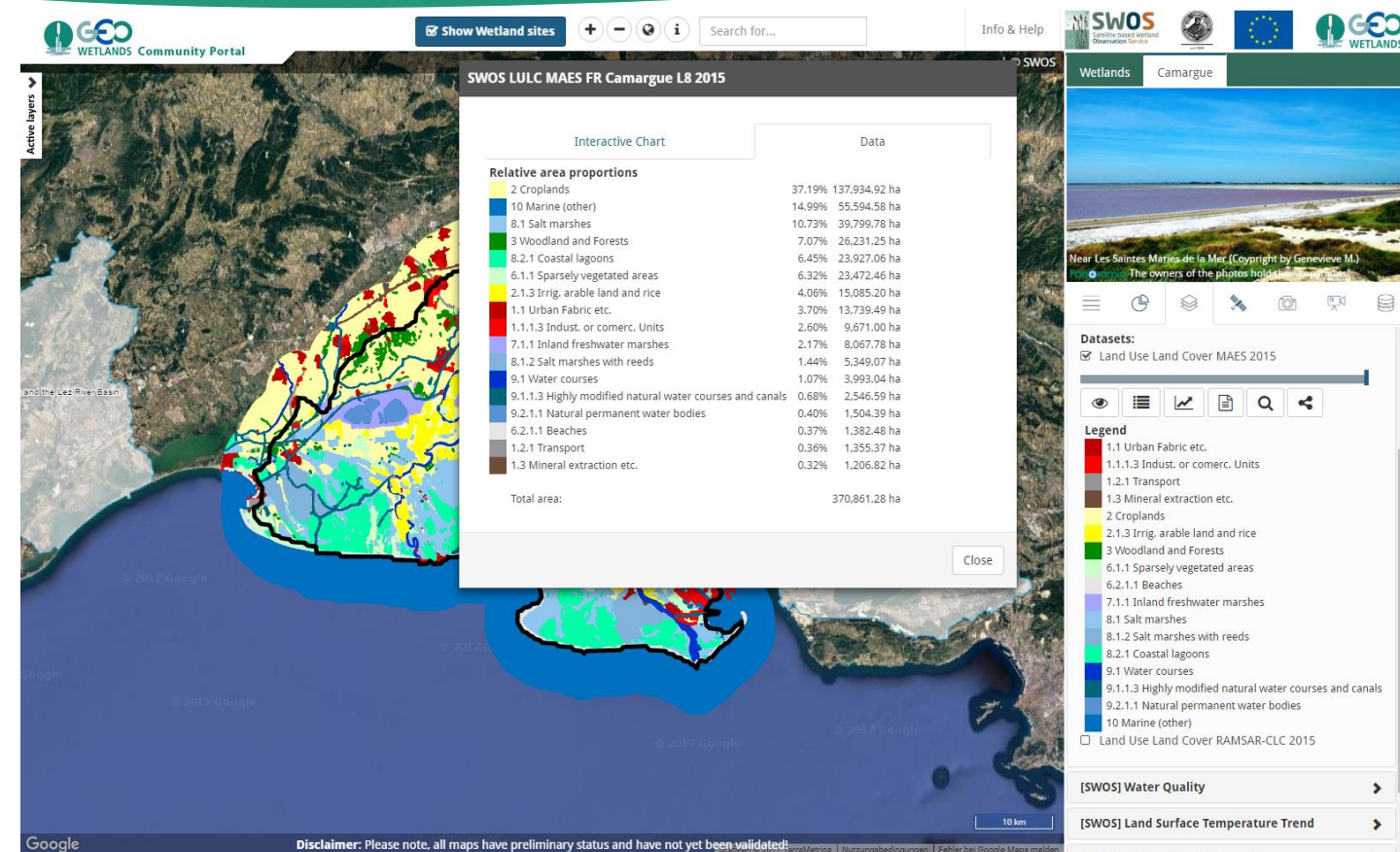


How is the EO community getting organised to support SDG 6.6?

***GEO-Wetlands mission:** Develop sustained & global approaches to wetland inventory, mapping, monitoring and assessment*

- A new GEO Initiative focusing on wetland ecosystem/habitat monitoring and on the specific needs of the wetlands community **(Policy & User Driven)**
- A **community and open platform of wetland observation practitioners** including academia, NGOs, national agencies, private companies, space agencies & international conventions **(International Collaborative Effort)**
- A framework for the **co-design of the Global Wetlands Observation System** (GWOS) **(GEO-Wetlands Community Portal & Knowledge-Hub)**

*A collaborative framework for **international cooperation**, co-design of **innovative solutions** and **community engagement***



- User-friendly satellite data discovery and access
- visualization tools to explore available wetland-related datasets (e.g. GSW)
- Continuous upload of thematic products
- Products download
- On-demand Map / Indicator production (*on-line processing in the future*)
- EO best practices
- Inter-operable with with other GEO portals (OGC compliant)
- Access to s/w toolboxes

EO for SDG 6.6 Water-related Ecosystems

Tier 3

Tier 2

Tier 1

Global & Regional Datasets

Methodological Guidelines

Country Support

Capacity Building

Software Toolboxes

Knowledge Hub & Platforms

6.6 Expert Workshop, Switzerland, Sept 2015

UN Environment Custodian Agency
SDG 6.6.1 Target Team

Ramsar, UN WATER, IWMI, CBD, WCMC,
UNEP DHI, ESA, IUCN

- Global Mangrove Watch (JAXA)
- Global Surface Waters Explorer (JRC)

Step-by-Step
Monitoring
Methodology
for SDG
indicator 6.6.1

GPSDD funded
"EO support for SDG
6.6. monitoring and
reporting on
wetlands", **Uganda**
GW Africa

- CEOS/NASA
datacube activities
(Columbia, Senegal,
Kenya)

- UN Environment
capacity building on
SDG 6
- GEO-Wetlands CB
Working Group
(TIGER, GW-A,
SWOS)
- NASA SERVIR
- GPSDD

UN Environment



- Knowledge sharing
Hub
- EO Best Practices
- Mapping Standards
- Monitor. Guidelines
- Benefit Showcases
- Toolboxes
- On-line processing





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