Importance of Earth Observation for effective SEEA implementation

Joint OECD/UNECE Seminar on Implementation of SEEA | Geneva | 13-15 March 2023

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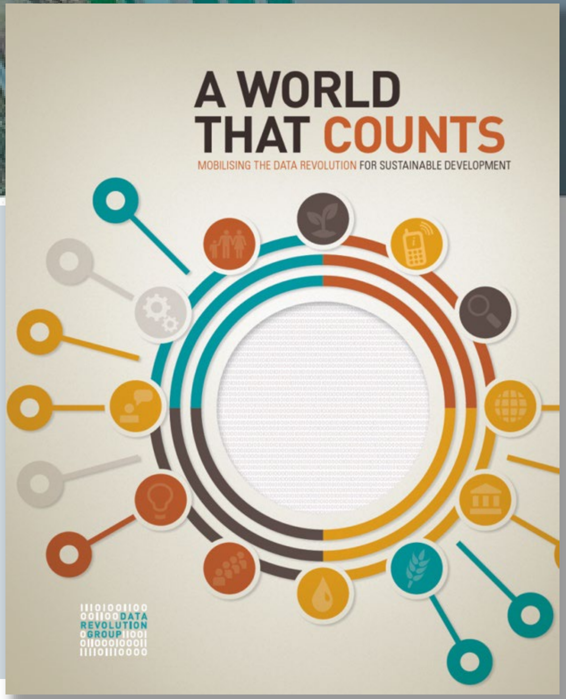
European Space Agency, Directorate of Earth Observation Programmes
Science, Applications and Climate Department

Mobilising the data revolution
Sustained data for sustainable development



- The monitoring of the MDGs taught us that **data are indispensable elements of the development agenda**.
- Despite improvement, **critical data** for informed policy making on development **are still lacking**.
- **New technology** is changing the **way data are collected** and disseminated.
- Data should be **open**, **easily accessible** and **effective for decision--making.**

A World That Counts: **Mobilising the Data Revolution for Sustainable Development**, Nov. 2014

UN SG Independent Expert Advisory Group on data revolution for sustainable development

- **Global Action Plan for Sustainable Development Data** launched at UN WDF in Jan 2017 and adopted at UNSC-48 in March 2017.
- **modernizing NSOs** is essential to achieving the 2030 SDGs.
- **Integrating geospatial and statistical data** is a necessity.

First UN World Data Forum on Sustainable Development Data
15-18 January 2017
Cape Town, South Africa.

United Nations WORLD DATA FORUM

The European Copernicus Programme

State-of-the-art observations with unprecedented coverage

Systematic data availability

Full, free and open data policy

Long-term availability

➔ *Know more: https://copernicus.eu and https://sentinels.copernicus.eu*

PROGRAMME OF THE EUROPEAN UNION
Copernicus
Europe's eyes on Earth
co-funded with
esa
CHIME
Copernicus Hyperspectral Imaging Mission for the Environment
soil properties
crop health
biodiversity
water quality
ROSE-L
L-band Radar Observing System
geohazards
polar ice
forest management
food security
maritime surveillance
LSTM
Land Surface Temperature Monitoring
sustainable agriculture
water resources management
drought
urban heat islands
CIMR
Copernicus Imaging Microwave Radiometer
sea-ice concentration/extent
global ocean and cryosphere
soil moisture and vegetation
CO2M
Copernicus Anthropogenic Carbon Dioxide Monitoring
carbon dioxide and methane from human activity
CRISTAL
Copernicus Polar Ice and Snow Topography Altimeter
coastal and inland waters
polar oceanography
snow
ice sheets and glaciers
sea-ice thickness
Food Security and Water Management
Monitoring Land and Natural Resources
Combatting Climate Change
Safeguarding the Arctic
Copernicus Sentinel Expansion Missions
→ THE EUROPEAN SPACE AGENCY

Commonly stated obstacles to the scaling-up and operational use of EO in the global sustainable development agendas

- Restrictive data access policies (including cost)
- Not enough “fit for purpose” products
- Frequency of observations insufficient to track changes at appropriate scales
- Needs for continuity of observations and long-term EO programs
- Lack of analysis ready data
- Capacity building and training
- Lack of standardisation of EO data processing methodologies
- Lack of clear and solid user-oriented methods and guidelines
- Difficulties to discover and access EO data
- Insufficient solid track records of successful case studies

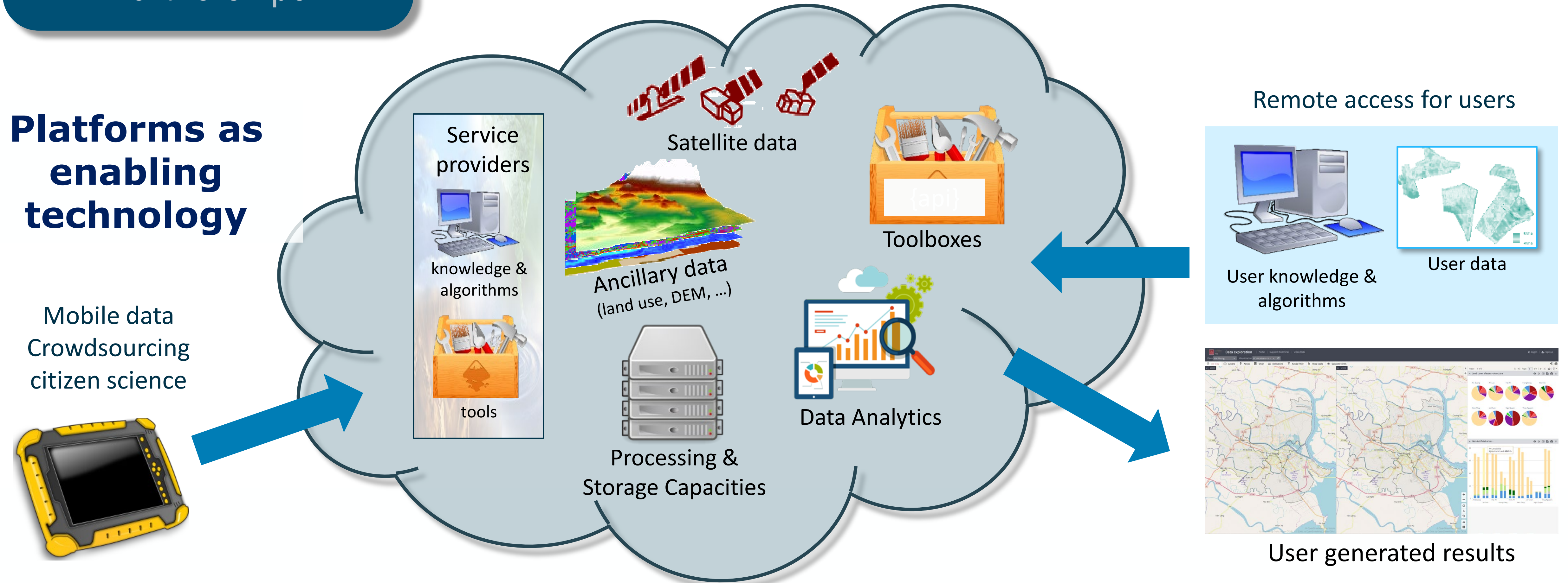
The emergence of EO exploitation platforms

The power of the Cloud
The power of Partnerships

"Bringing the users to the data"

Simplify the extraction of information
Enable large scale exploitation
Stimulate innovation

Platforms as enabling technology



International collaboration to scale up EO innovation for the full achievements of the 2030 Agenda on Sustainable Development

GEO GROUP ON EARTH OBSERVATIONS

CEOS
The Committee on Earth Observation Satellites

UN Statistical Division

Statistical Commission

UN-GGIM
UNITED NATIONS COMMITTEE OF EXPERTS ON GLOBAL GEOSPATIAL INFORMATION MANAGEMENT

@UNStats

WG on Geo-spatial Information (WGGI)

IAEG-SDGs
Inter-agency Expert Group on SDG Indicators

UN Habitat | UNCCD | UNEP
UN ISDR | WHO | FAO

UN Specialized Agencies

National Statistical Offices

Line Ministries

WBG | GPSDD
UN OOSA | GEE

SDG Stakeholders

UN Agencies

- Global and Regional *fit for purpose* Datasets
- Good Practices Guidance

Countries

- Mainstreaming in National Systems & Processes
- Skills Transfer & Capacity Building

EO Community

- EO Enabling Infrastructures Tools & Platforms
- EO Knowledge Sharing

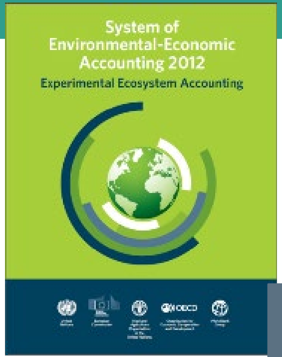
The UN System of Environmental-Economic Accounting (SEEA)

System of Environmental Economic Accounting

European Natural Capital Accounting

2012 | SEEA Central Framework (SEEA-CF) adopted by UN Statistical Commission

2013 | SEEA Experimental Ecosystem Accounting (SEEA-EEA)



2014

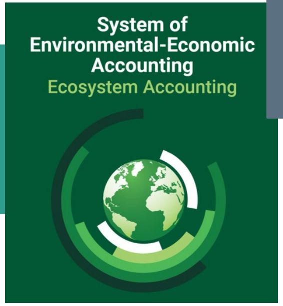
2015

2016

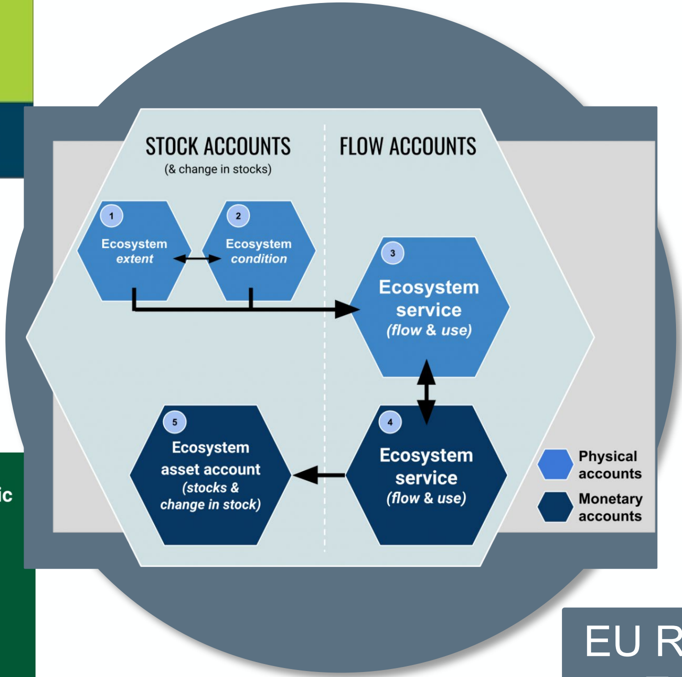
2017

2018–2020 | SEEA Experimental Ecosystem Accounting (SEEA-EEA) Global Revision

2021 | SEEA Ecosystem Accounting (SEEA-EA) Adopted by the UNSC



2022



2011 | EU Regulation N 691/2011 on European environmental Economic Accounts

REGULATION (EU) No 691/2011 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL

of 6 July 2011

on European environmental economic accounts

(Text with EEA relevance)

2012

2013

2014

2015

2016

2017

2018

2019

2020

2021

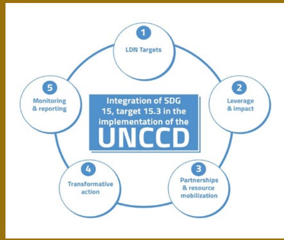
2022 | EU Regulation N 691/2011 amendment on Ecosystem Accounting

Ecosystem Accounting underpins the Multilateral Environmental Agreements

UN Convention to Combat Desertification (UNCCD)

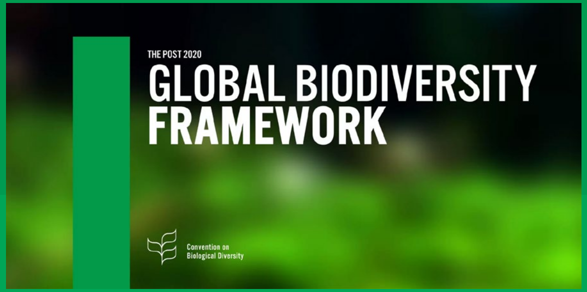
UNCCD 2018-2030 Strategic Framework

Strategic Objective 1: to improve the conditions of ecosystems



Convention on Biological Diversity (CBD)

Post 2020 Global Biodiversity Framework (GBF) and its monitoring framework



UN Framework Convention on Climate Change (UNFCCC)

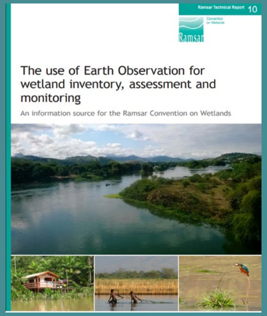
UNFCCC Paris Agreement

Glasgow Climate Pact

Ramsar Convention on Wetlands

Ramsar Strategic Plan (2016 – 2024)

Conservation and wise use of all wetlands



UN SEEA Ecosystem Accounting

International standard on Ecosystem Accounting that regulates the production of statistical accounts on ecosystem extent, condition and services, underpinning the development of monitoring frameworks of other MEAs.

Sustainable Development Goals (SDGs)

6 CLEAN WATER AND SANITATION

SDG Target 6.6
Protect and restore water-related ecosystems

14 LIFE BELOW WATER

SDG Target 14.2
Sustainably manage and protect marine and coastal ecosystems

15 LIFE ON LAND

SDG Target 15.1
Ensure conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems.

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EARTH OBSERVATIONS FOR
ECOSYSTEM ACCOUNTING

United Nations

System of
Environmental
Economic
Accounting

Programme of the workshop

Bring together experts in Earth Observation and in Ecosystem Accounting to discuss the key challenges that need to be addressed in order to mainstream the use of EO in the production of national ecosystem accounts.

3 panels

- Importance of EO for SEEA Ecosystem Accounting
- MEA monitoring programmes that SEEA EA can support
- National implementation of SEEA EA and EO opportunities/challenges in national accounts

8 Sessions

- Ecosystem Extent, Condition and Services
- Thematic Accounts: Urban ecosystems, Forests, Marine/Coastal ecosystems, Agroecosystems
- Operationalisation of EO data flows in the compilation of national ecosystem accounts.

12 panellists

15 session chairs

7 guided discussions

50 oral presentations

800+ participants

EO opportunities & challenges in SEEA-compliant Ecosystem Accounting

Ecosystem Accounts are inherently spatial accounts
that strongly depend on the **availability of spatially explicit datasets**, including **Earth Observations**.

The emergence of **EO data streams at appropriate scales** combined with **advances in digital technologies** offer **unprecedented opportunities for countries** to efficiently monitor the **extent** and **conditions** of their ecosystems, determine **ecosystem services** and implement their **national ecosystem accounting**.

EO in Statistical Accounts

- Requires a **change of mindset in NSOs** to use Earth Observation and Big Data more widely.
- Requires **integration of many strands of expertise** including statisticians, ecologists, national mapping agencies, geo-spatial and EO experts.
- Needs to have spatially explicit accounts **consistent in space and in time.**
- Importance to have a **precise estimation of the uncertainties** for officially statistics.
- Need to have **regularly updated accounts** that allows to track the “intrinsic” variations of the subject accounts.

EO Enabling Elements

- Need to adopt a **data flow strategy** similar to the SDGs.
- Request from the statistical community to have **“Accounts Ready Data”** which can simplify their integration into official statistics.
- Need for **practical methodological guidelines** (datasets, tools and models) **with operational examples** to help countries integrating EO within their national systems on ecosystem accounting.
- The importance to have **adequate infrastructures (data factory following FAIR principles)** to enable country appropriation of EO technology in ecosystem accounting.

EO opportunies & challenges in SEEA-compliant Ecosystem Accounting

Ecosystem Extent Account

- Classification is the **backbone of ecosystem accounts.**
- Need **reliable and comprehensive mapping of ecosystem types** (EO need to go beyond LC/LCC and support IUCN GET/ EUNIS typology classification).
- How to exploit the large quantity and variety of **in-situ data collections available in MS** on ecosystem types?
- Monitoring **changes in extent of ecosystem types** bring another level of complexity.
- Strong need to **automate the production** of ecosystem extents and their changes.

Ecosystem Condition Account

- derivation of **reliable EO-based metrics on ecosystem conditions** and of their **distance from a reference condition.**
- Need for condition indicators in terms of **biotic and abiotic characteristics** and for **ecosystem structure, function and composition**.
- Importance to monitor the conditions of ecosystems **outside of protected areas** (less reference information).
- Needs to find a **compromise between simple and rapid assessment** based on remote sensing products wrt **accuracy needed for statistical accounting.**

Ecosystem Services Account

- Ecosystem Service is a **priority for most countries** (needed in multiple policy frameworks such as UNFCCC)
- Conceptual Framework for Ecosystem services (provisioning, regulating and cultural services) well established but **use of EO is still marginal**.
- Need to **integrate EO data with other spatial datasets in spatial ES modelling** to derive flows of ecosystem services .
- **How to leverage the use of modelling tools and platforms** (e.g. ARIES for SEEA) to estimate reliable ecosystem services accounts.

EO integration in SEEA EA workflows

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Stock Accounts and Changes in Stocks
(in physical terms)

Ecosystem Extent

Ecosystem Condition

Flow Accounts
(in physical terms)

Ecosystem Services *(flow and use)*

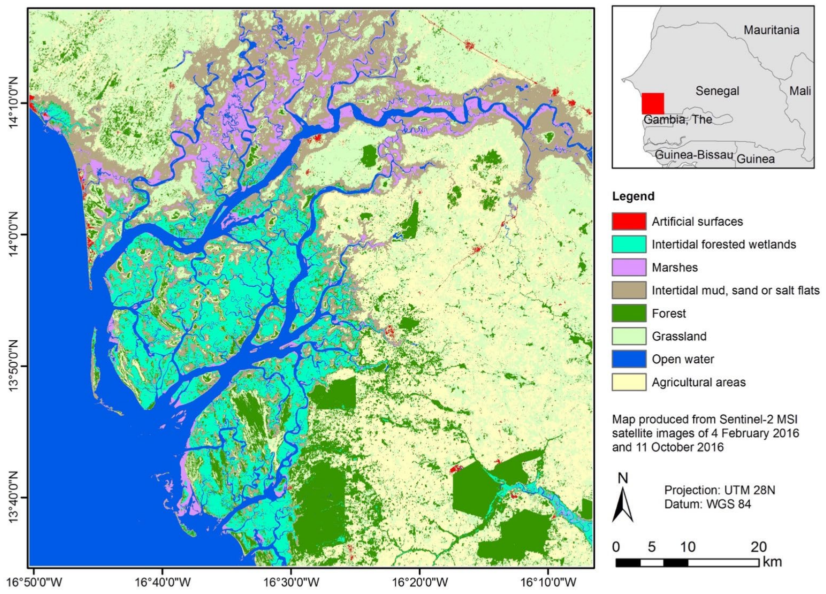
Natural Capital Valuation
(in monetary terms)

Ecosystem Asset Account

Ecosystem Services Account

Wetland Ecosystem **Extent**
e.g., Habitats Mapping

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

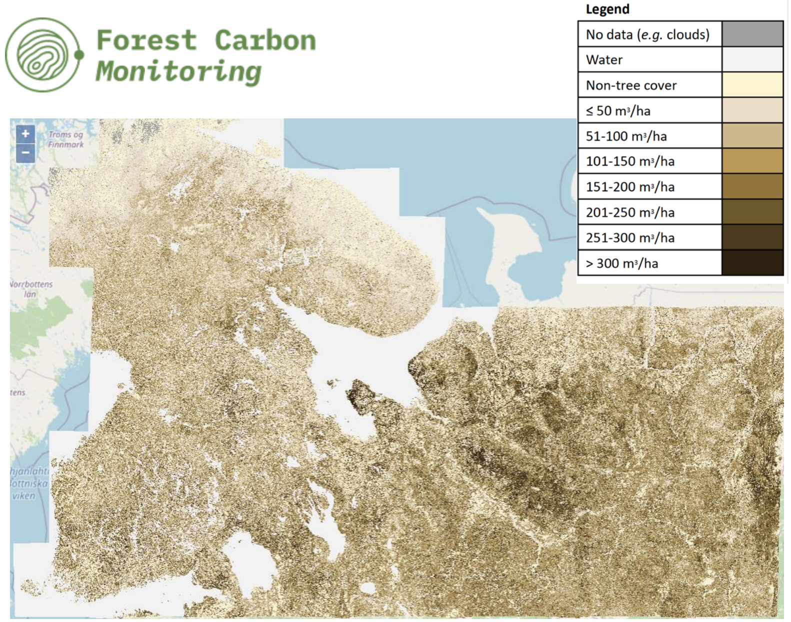


Forest Ecosystem **Condition**
e.g., Bark Beetle Infestation

1 medium probability
2 medium - high probability
3 high probability
4 very high probability

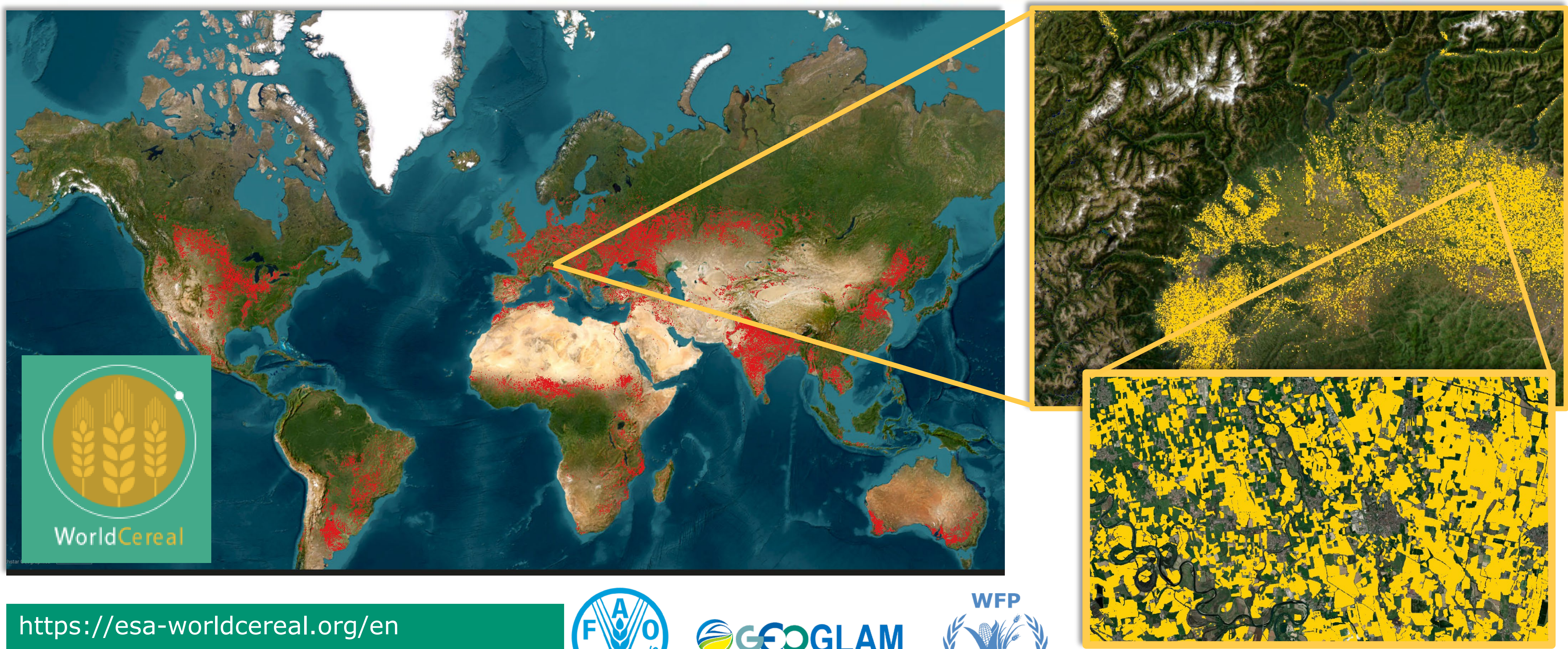
Bark beetle infestation progression (14-day) and infestation probability over the beetle season 2018

Forest Ecosystem **Services**
e.g., Carbon Stock Volume



→ THE EUROPEAN SPACE AGENCY

Ecosystem Accounting in agroecosystems



Seasonal maize, 2021, Northern Italy

https://esa-worldcereal.org/en

GEOGLAM Global Agricultural Monitoring

WFP

Ecosystem Accounting in terrestrial ecosystems

https://eo4society.esa.int

Classification of in-situ vegetation relevés to EUNIS habitat types

Training data European Vegetation Archive (EVA) & environmental data layers

RS-enabled EBV's, e.g. HR-VPP

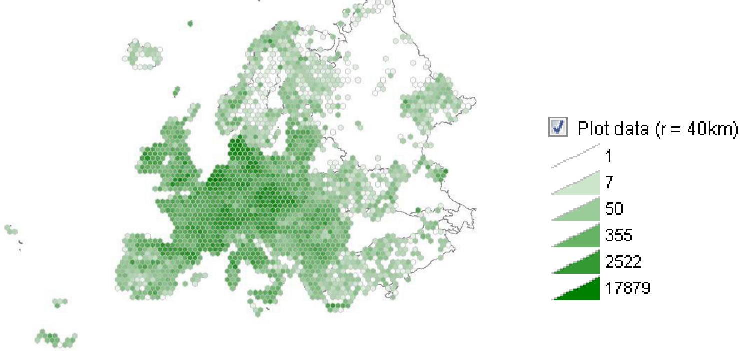
Modelling with MAXENT

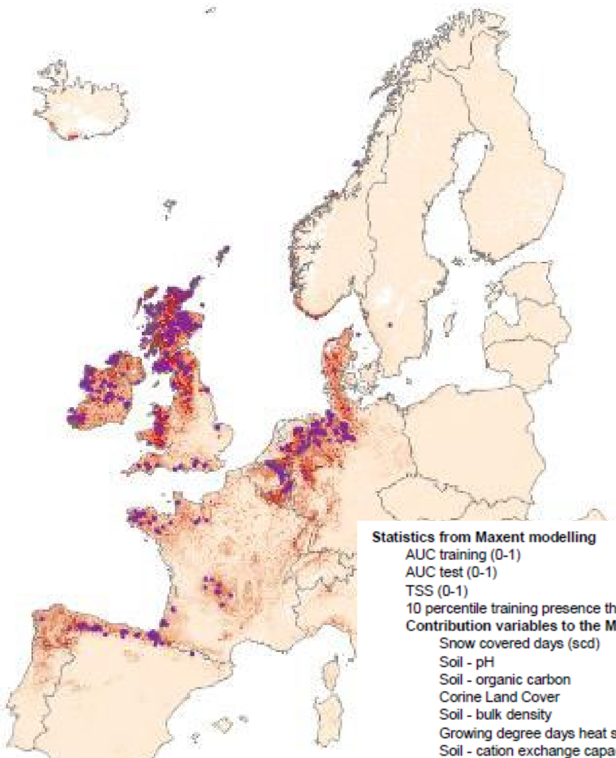
Habitat Suitability Maps (100m)

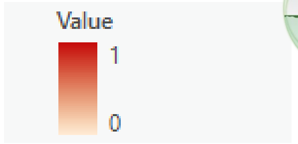
Actual Copernicus Land Cover

Habitat Probability Maps (20m or 100 m)

European Vegetation Archive (EVA)





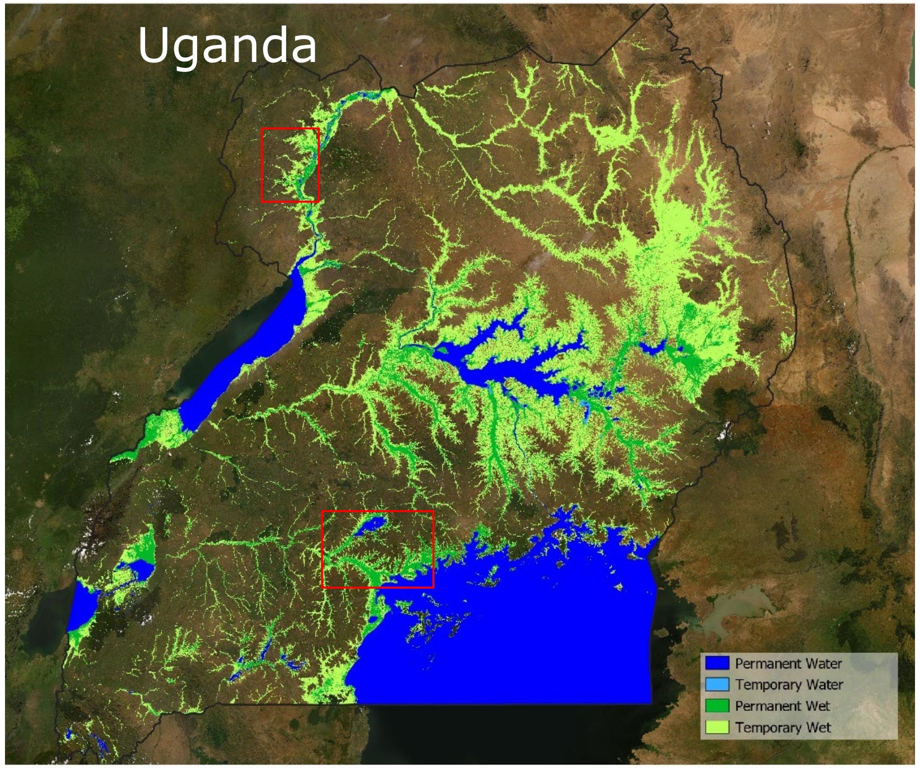


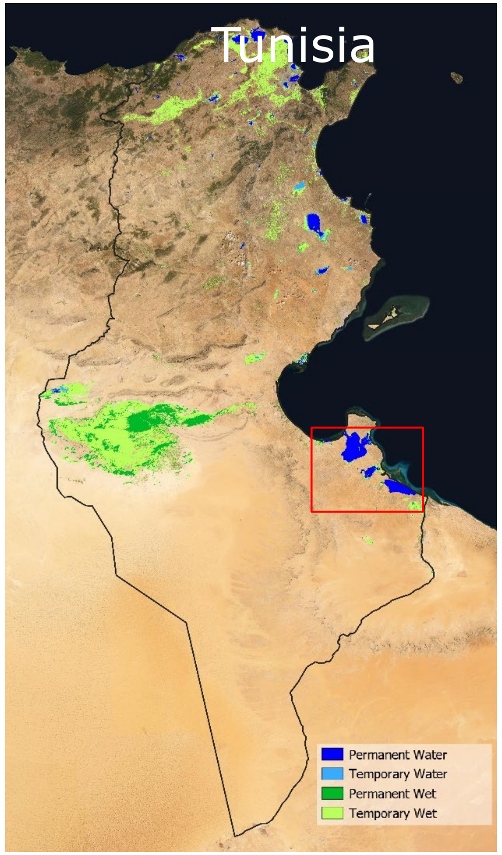
Suitability map S41: wet heaths

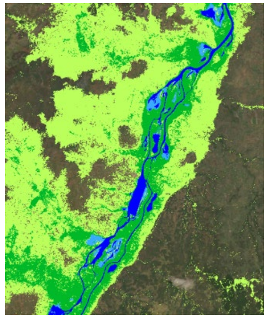
Statistics from Maxent modelling	
AUC training (0-1)	0.9018
AUC test (0-1)	0.9006
TSS (0-1)	0.8455
10 percentile training presence threshold (0-1)	0.3927
Contribution variables to the Maxent model (%)	
Snow covered days (scd)	39.0162
Soil - pH	27.9856
Soil - organic carbon	15.1298
Corine Land Cover	5.6031
Soil - bulk density	3.5019
Growing degree days heat sum above 5°C (gdd5)	2.2464
Soil - cation exchange capacity	1.7273
Accumulated precipitation amount on growing season days TREELIM (g	1.7192
HR-VPP - Length of season (number of days between start and end)	0.6452
Annual precipitation (mm yr-1)	0.5998
EU DEM Slope	0.5858
EU DEM	0.445
Soil - clay fraction	0.2858
Soil - sand fraction	0.1996
Population density	0.1179
HR-VPP - Slope of the greenup season (PP I × day-1)	0.0682
Soil - course fractions	0.0491
Mean temperature of the growing season TREELIM (gst)	0.0258
Distance to inland water	0.0182
HR-VPP - Season amplitude given by MAXV-MINV	0.017
HR-VPP - PPI at the day of maximum-of-season	0.013
Inundation - occurrrence	0

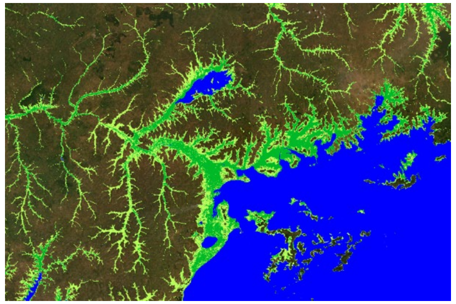
Ecosystem Accounting in wetland ecosystems

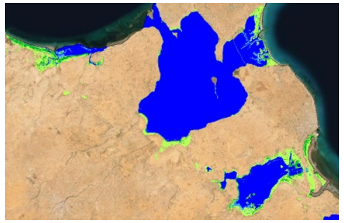
http://globwetland-africa.org



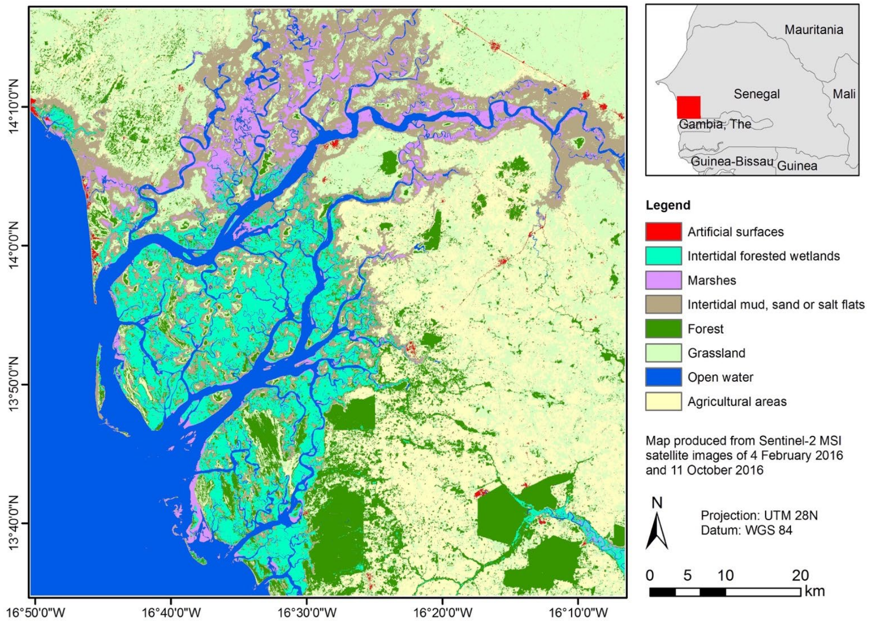


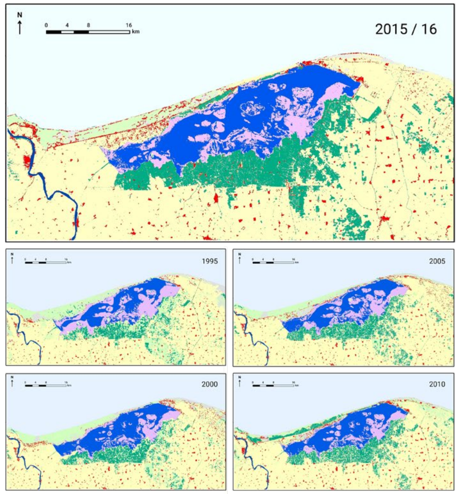




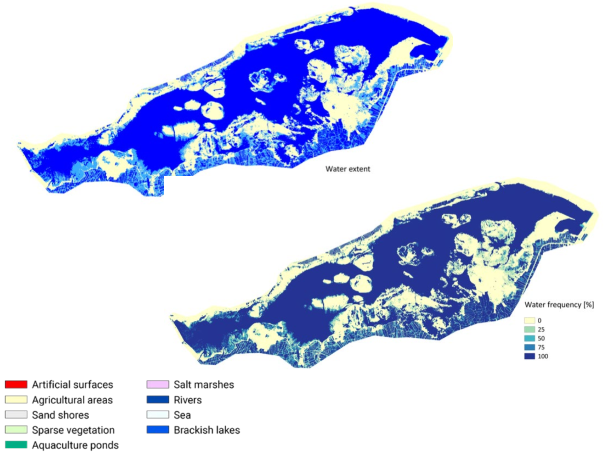


Wetland Habitat Mapping - Delta du Saloum (Senegal) (Site 98) - 2015/16

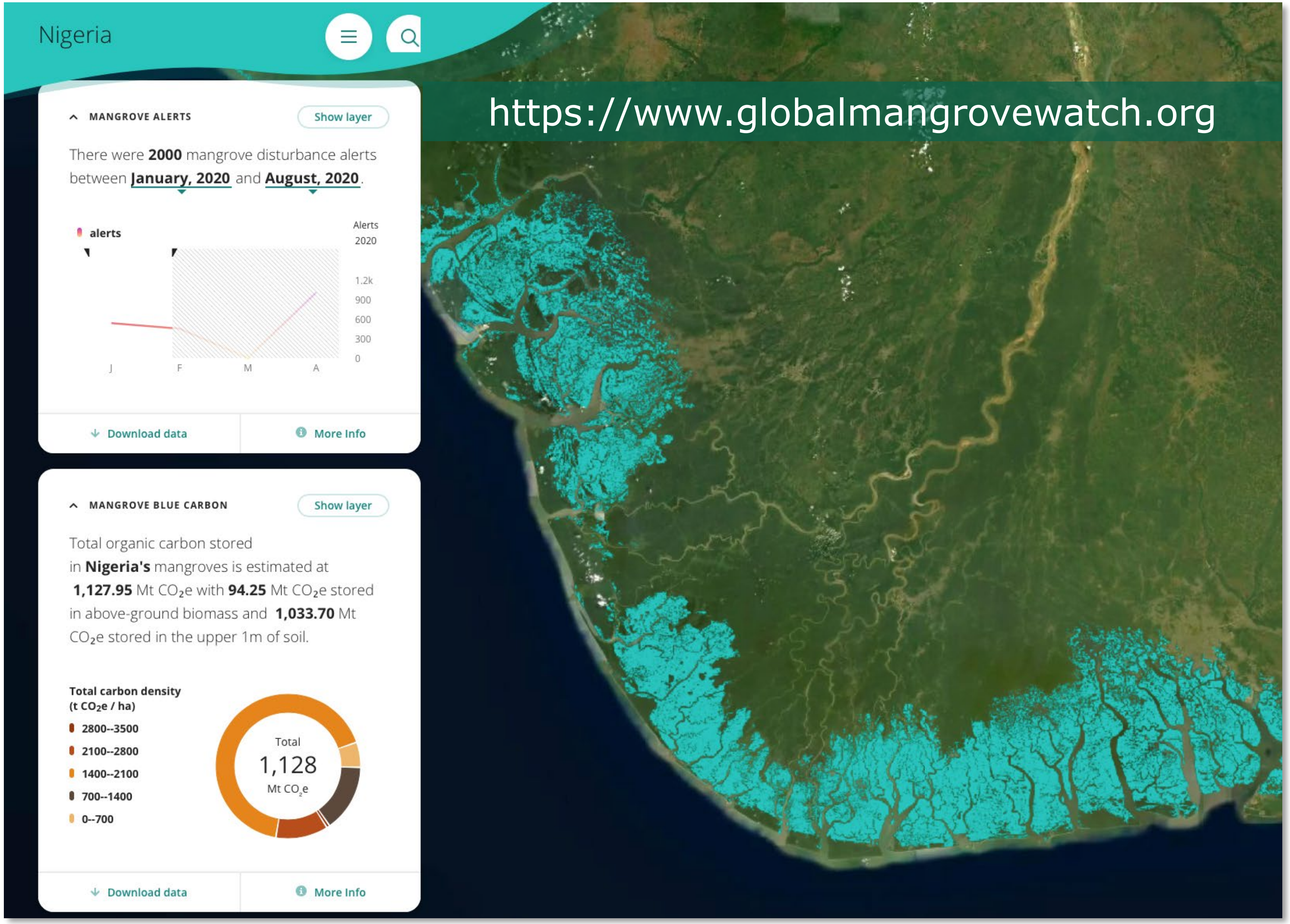




Lake Burullus, Egypt



Ecosystem Accounting in mangrove ecosystems



GEO WETLANDS

GLOBAL MANGROVE ALLIANCE

Prifysgol Aberystwyth University

soloEO

The Nature Conservancy

Wetlands International

University of Cambridge

IUCN

Griffith University

WWF

Conservation International

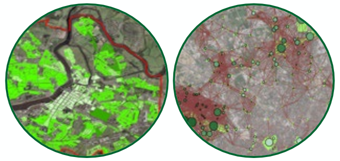
JAXA

NASA

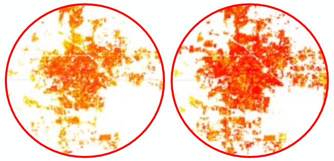
Scripps Institution of Oceanography

Ecosystem Accounting in urban ecosystems

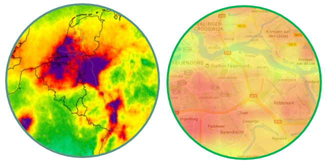
Green Areas



Urbanisation

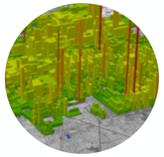


Urban Climate



Building Footprint

Population Density



UN HABITAT
FOR A BETTER URBAN FUTURE

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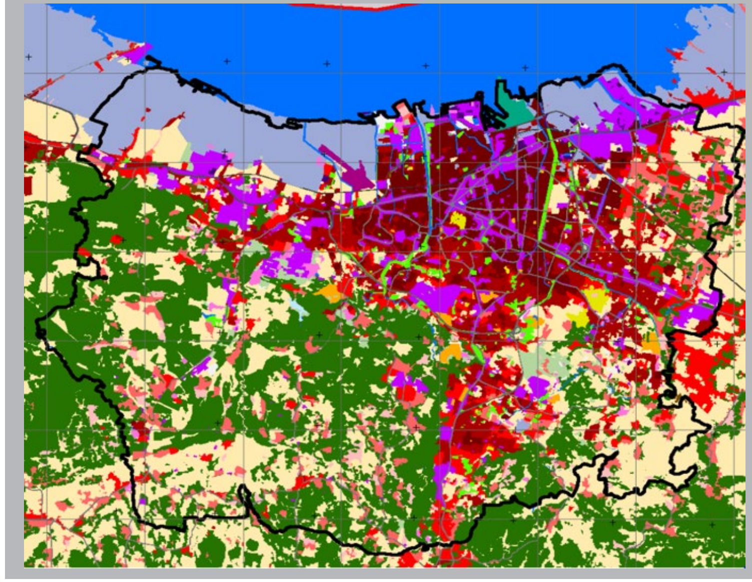
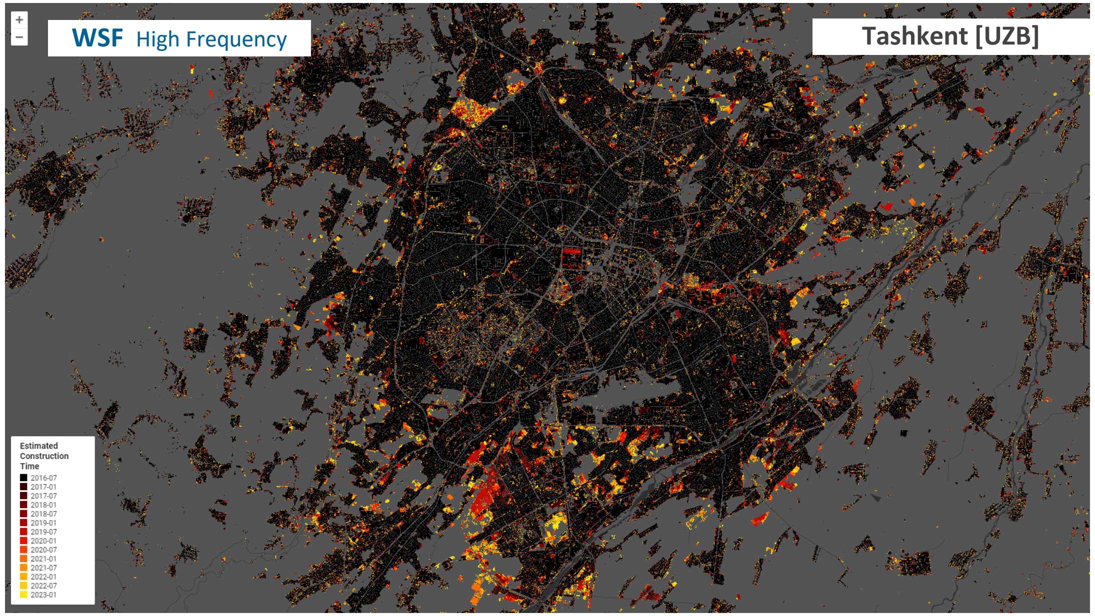
Baseline Products: Urban and Peri-Urban LU /LC



Detailed

Changes

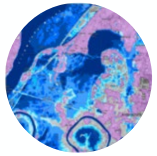


Transport Infrastructure

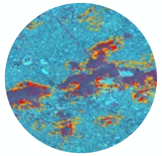
Informal Settlements

Waste Sites

Flood Risk



Landslide Risk



Terrain Motion

World Settlement Footprint (WSF) and its dynamic evolution in time, with Landsat and Copernicus Sentinel-1 and Sentinel-2.

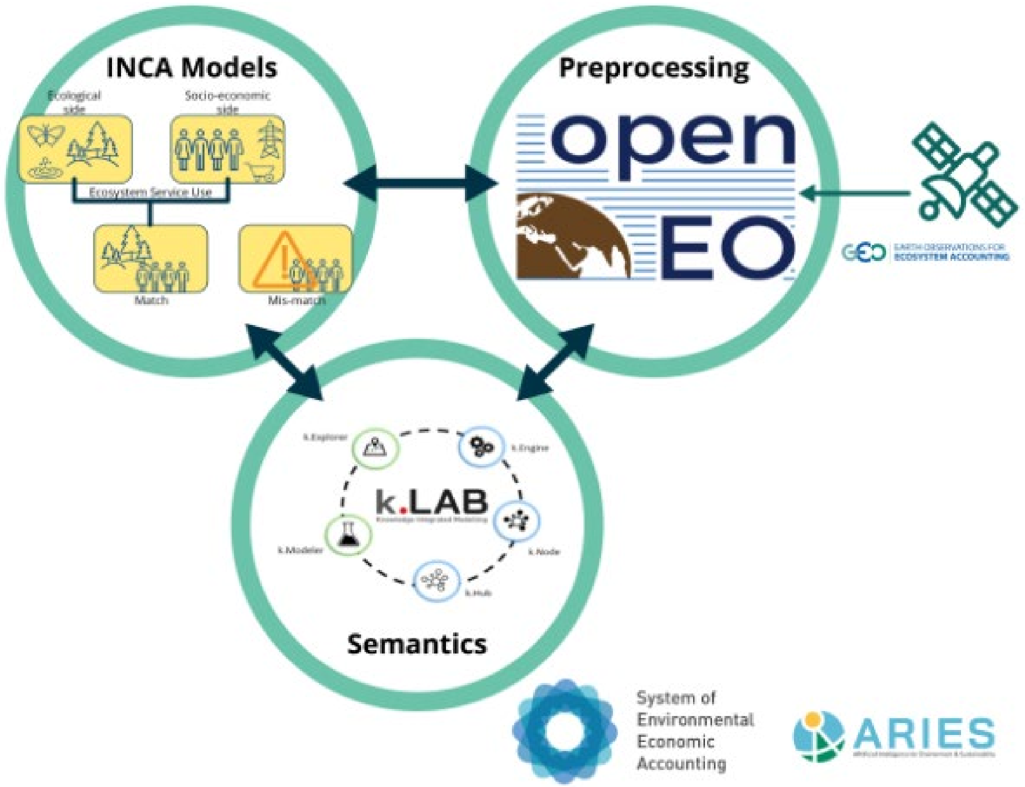
Understanding of urbanization at planetary scales.

DLR urban tep

Integrating EO workflows in SEEA-EA processes

- Review the **opportunities and challenges of integrating EO data in ecosystem accounting** for terrestrial and freshwater ecosystems.
- Co-develop high-quality **EO-based ecosystem account models** with countries.
- Showcase and validate **pilot demonstrators** to prove the value.
- Contribute to the international collaborative efforts to **advance the use of EO in ecosystem accounting** and support countries developing their national ecosystem accounts.
- Prepare a **R&D roadmap** to scale-up the use of EO in ecosystem accounting

https://esa-people-ea.org/



EO4EA Data Platform Architecture Blueprint

Take home messages

- The uptake of Earth Observation in SEEA (CF and EA) can benefit from the availability of a **steadily increasing flow of satellite data of suitable characteristics** from the **emergence of affordable digital solutions** to address the size and complexity of such large data sets of satellite observations.
- Within many national governments, there is a **recognition of the need to link statistical information and geospatial information** (**including Earth Observation**) to improve national data on SEEA, its disaggregation, and the evidence on which decisions are made.
- Despite the growing awareness among NSOs that traditional statistical techniques must be complemented with geospatial information to meet the ambition of the SEEA, **the uptake of Earth Observation in SEEA has been slow and unevenly adopted by countries.**
- **A number of challenges still need to be adequately tackled by countries to fully embrace the EO potential in national statistics on SEEA (including Ecosystem Accounting).** The challenge of synthesising multiple and heterogeneous data sources, and designing adequate methodologies that harmonise EO with statistical data according to the rigorous standards of official statistics, is key for the NSOs.
- There is a need for a **stronger collaboration between NSOs and EO experts, to enable the potential of EO to be fully realised within the SEEA**, in particular if EO data is to be merged with other statistical data and big data collections

I wish all participants an inspiring and constructive seminar