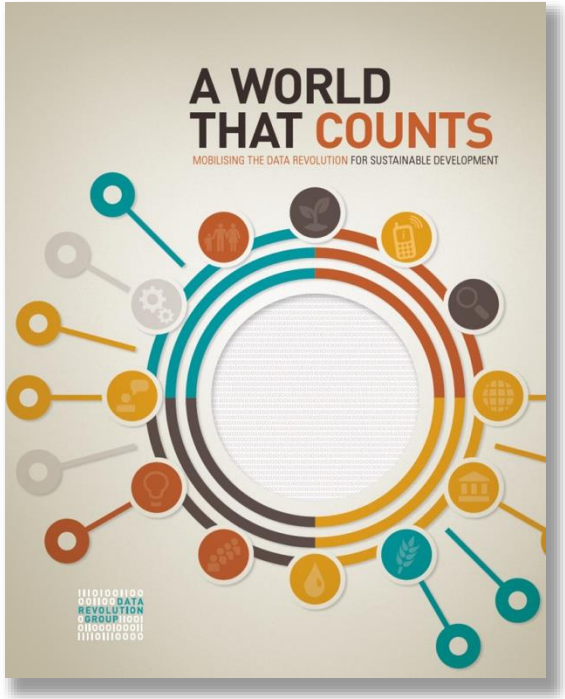
Earth Observation and Copernicus, a game changer for countries to implement the SDGs and MEAs

Copernicus for SDGs, International Agreements and Conventions
24 January 2019, Brussels

Session III: Land and Water

Marc Paganini
European Space Agency, Directorate of Earth Observation Programmes
CEOS Ad-Hoc Team on SDGs (AHT SDG)
GEO Initiative on SDGs (EO4SDG)

Mobilizing the Data Revolution for Sustainable Development



UN SG Independent Expert Advisory Group, Nov 2014

*"**Data** and **evidence** are the foundation of development policies and effective program implementation"*

Mahmoud Mohieldin, SVP, World Bank

Big Data Era

Advent of steady satellite data streams

Sentinels Fleet

>15 TB per day

Mobilise the data revolution

for the benefits of all

leaving no one behind

High Performance Computing Infrastructures

Building on ICT advances

EO contribution to the SDG's

Earth Observations potential contribution to the SDG Targets and Indicators

SDGs on land and water with most opportunities for EO data

Analysis performed by the GEO EO4SDG initiative

Target *Contribute to progress on the Target yet not the Indicator per se*									Goal	Indicator *Direct measure or indirect support*				
							1.4	1.5	1	1.4.2				
						2.3	2.4	2.c	2	2.4.1				
					3.3	3.4	3.9	3.d	3	3.9.1				
									4					
								5.a	5	5.a.1				
		6.1	6.3	6.4	6.5	6.6	6.a	6.b	6	6.3.1	6.3.2	6.4.2	6.5.1	6.6.1
					7.2	7.3	7.a	7.b	7	7.1.1				
								8.4	8					
					9.1	9.4	9.5	9.a	9	9.1.1	9.4.1			
						10.6	10.7	10.a	10					
	11.1	11.3	11.4	11.5	11.6	11.7	11.b	11.c	11	11.1.1	11.2.1	11.3.1	11.6.2	11.7.1
				12.2	12.4	12.8	12.a	12.b	12	12.a.1				
					13.1	13.2	13.3	13.b	13	13.1.1				
		14.1	14.2	14.3	14.4	14.6	14.7	14.a	14	14.3.1	14.4.1	14.5.1		
	15.1	15.2	15.3	15.4	15.5	15.7	15.8	15.9	15	15.1.1	15.2.1	15.3.1	15.4.1	15.4.2
								16.8	16					
17.2	17.3	17.6	17.7	17.8	17.9	17.16	17.17	17.18	17	17.6.1	17.18.1			

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 standardisation of EO data processing methodologies
- Lack of analysis ready data
- Difficulties to discover and access EO data
- Lack of clear and solid user-oriented methods and guidelines
- Capacity building and training
- Insufficient solid track records of successful case studies

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

GEO Initiative on SDGs (EO4SDG) ⇔ CEOS Ad-hoc team on SDGs (AHT SDGs)

UN Statistical Division

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

- Global Datasets
- Good Practices Guidance
- Mainstream in national systems & processes
- Capacity Building
- EO enabling infrastructure
- Tools & Platforms
- EO Knowledge Sharing Hub

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

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Custodian Agencies

Global Datasets

Good Practices Guidance

Mainstream in national systems & processes

Capacity Building

EO enabling infrastructure

Tools & Platforms

EO Knowledge Sharing Hub

CLMS / Global

CLMS / Pan European and Local

Copernicus Data and Information Access Services (DIAS)

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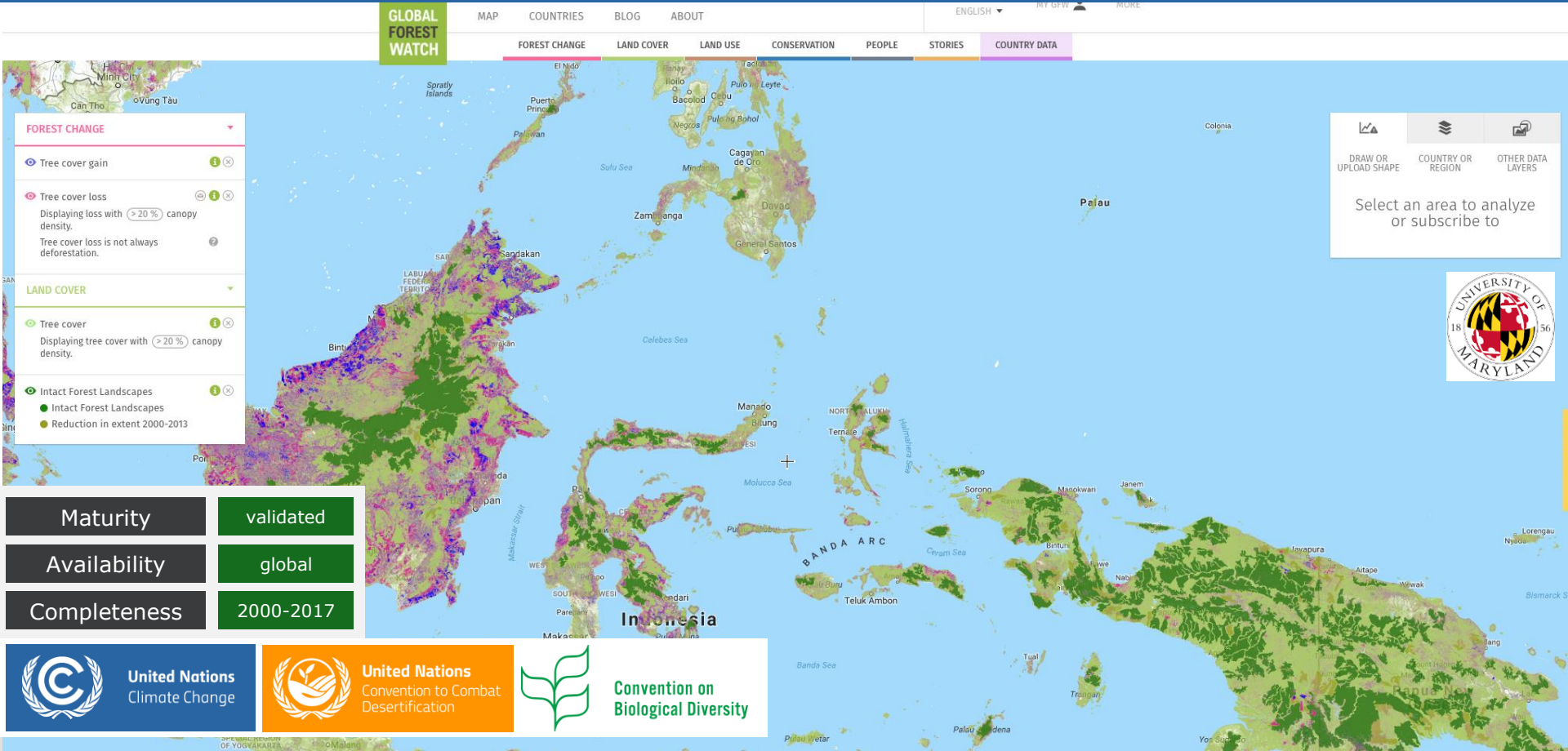
Tier I

Global EO products in support of SDG indicators
Global Forest Change for SDG 15.1.1 (forests)



Maturity	validated
Availability	global
Completeness	2000-2017

United Nations Climate Change

United Nations Convention to Combat Desertification

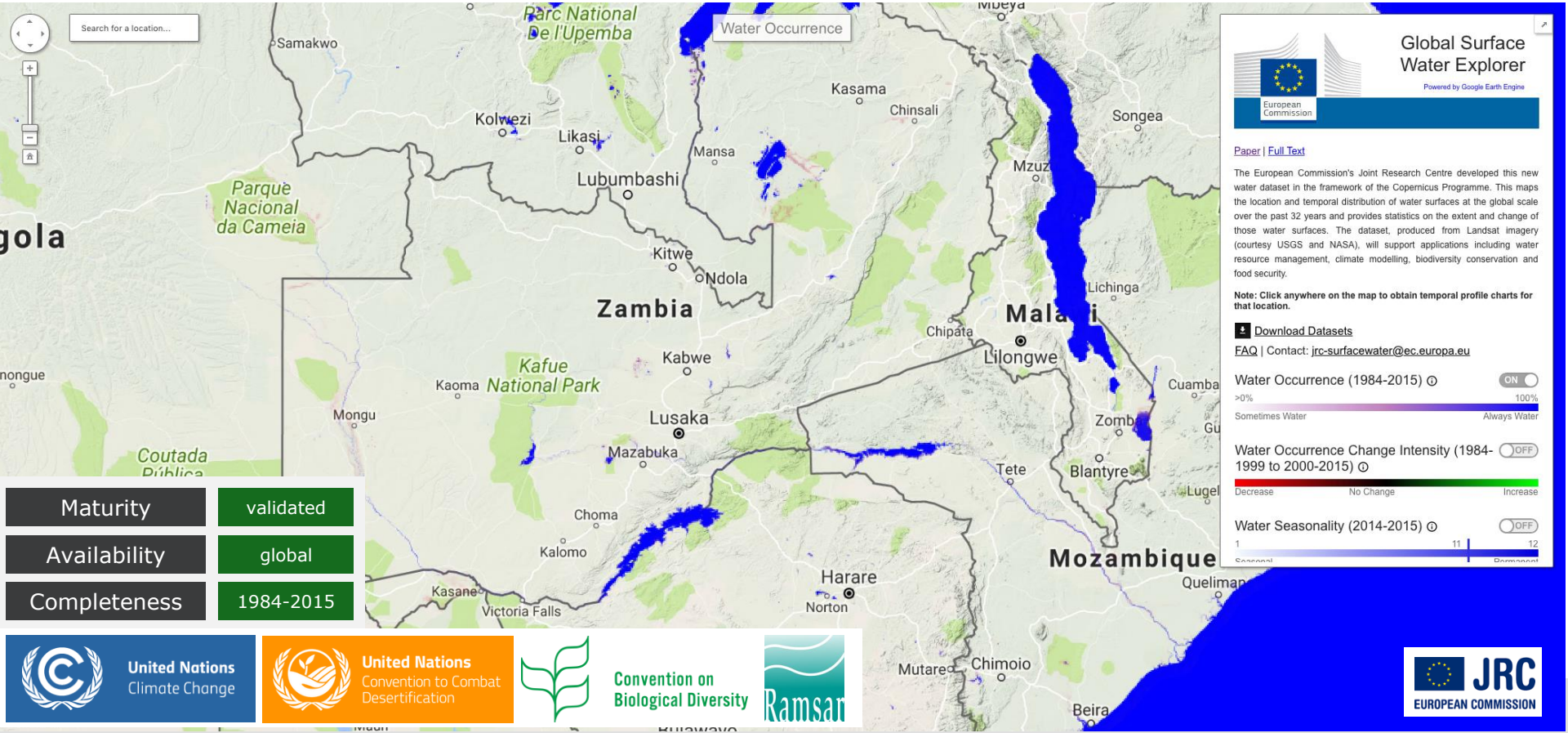
Convention on Biological Diversity

Tier I

Global EO products in support of SDG indicators

Global Surface Water Extent for SDG 6.6.1 (water-related ecosystems)

6 CLEAN WATER AND SANITATION



Maturity	validated
Availability	global
Completeness	1984-2015

United Nations Climate Change

United Nations Convention to Combat Desertification

Convention on Biological Diversity

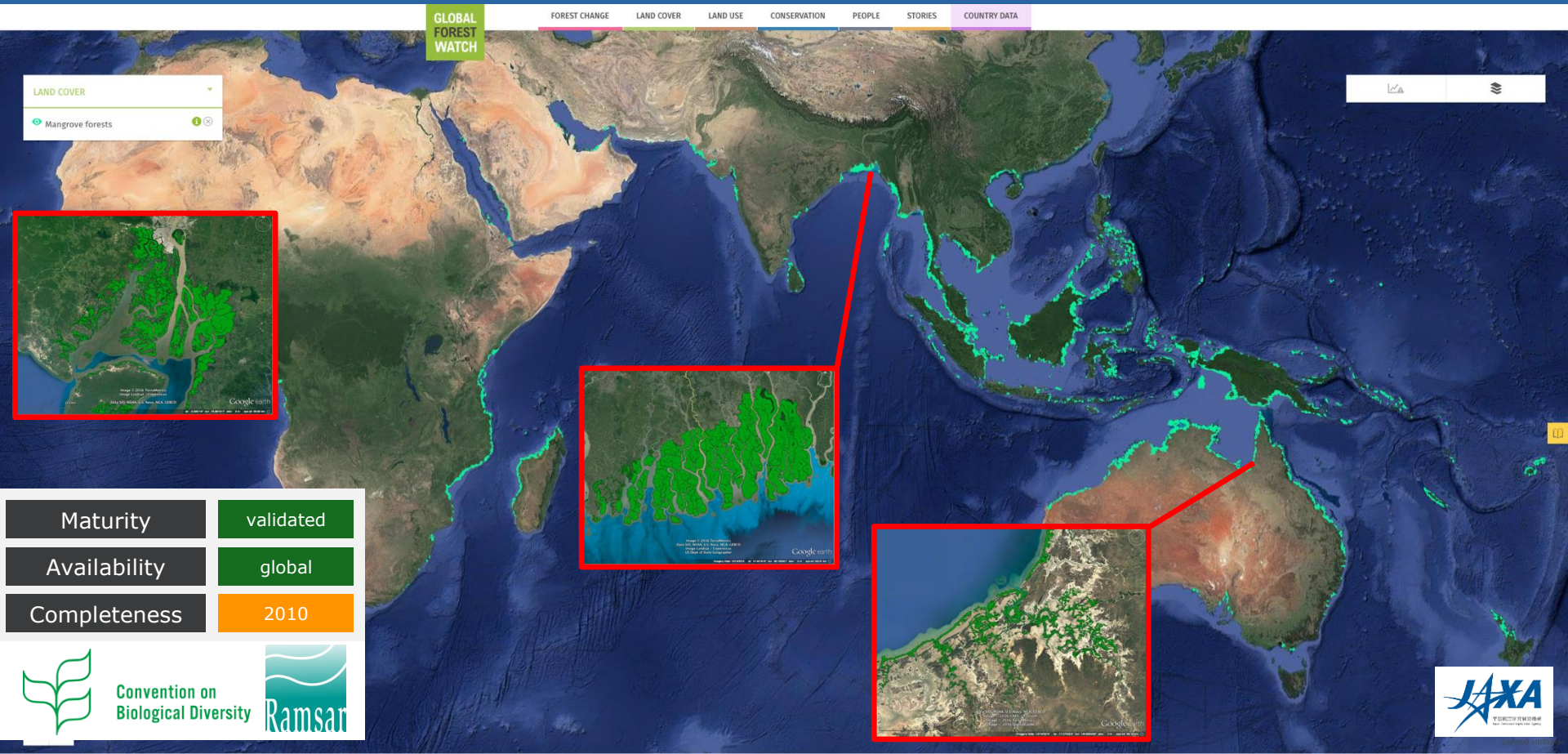
Ramsar

JRC EUROPEAN COMMISSION

Tier I

Global EO products in support of SDG indicators
Global Mangrove Watch for SDG 6.6.1 (water-related ecosystems)

6 CLEAN WATER AND SANITATION



Maturity	validated
Availability	global
Completeness	2010

Convention on Biological Diversity

Ramsar

JAXA

Tier I

Global EO products in support of SDG indicators
Vegetated Wetlands Inventories for SDG 6.6.1 (water-related ecosystems)

Target 6.6
Water-related ecosystems

Target 6.6 "By 2020, protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes"

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

Custodians: UN Environment and Ramsar

Table 1 Water-related Ecosystem Categories and their Applicable Extent Components

		Water-related Ecosystem Categories				
		Lakes	Rivers and Estuaries	Vegetated Wetlands	Aquifers	Artificial Waterbodies
Extent Components	Spatial Extent				N/A	
	Quality					
	Quantity	N/A		N/A		N/A

N/A = No requirement to monitor for Indicator 6.6.1

Ramsar Convention on Wetlands

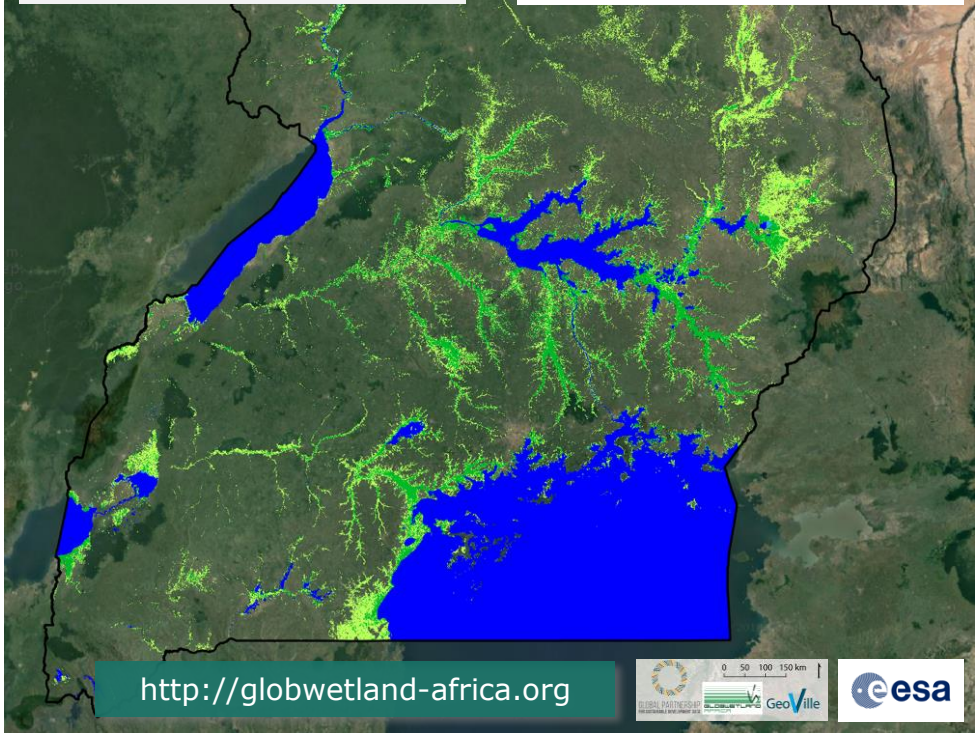
- **Ramsar Framework for Wetlands Inventories:** collection of core information for wetland management (including wetland assessment and monitoring)
- **Global Wetland Outlook 2018 :** Integrate wetlands into planning and implementation of the post-2015 development agenda | Improve national wetland inventories and track wetlands' extent (include remote sensing)

Ramsar 4th strategic plan (2016-2024)

Strategic Goal 3: Ensure the **wise use of all wetlands**

Target 8: **National wetland inventories** have been initiated, completed or updated and disseminated

Maturity	Under validation
Availability	national cases
Completeness	2017/18

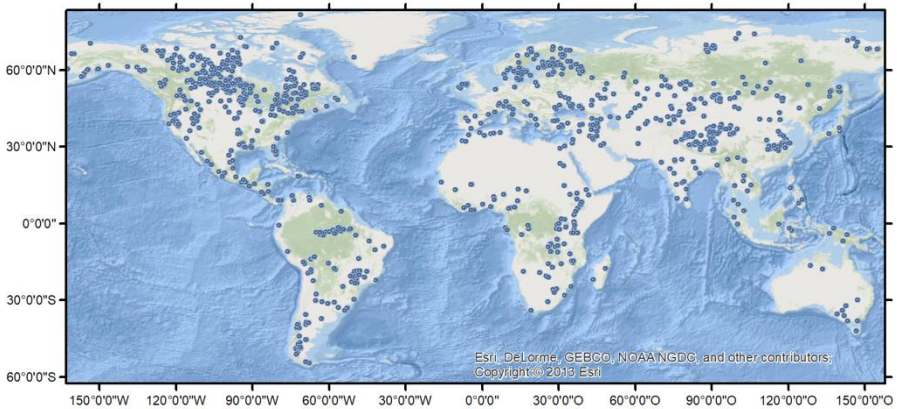


2017/18 Wetlands Inventory, Uganda, based on Sentinel 1 and Sentinel 2

Tier II

Global EO products in support of SDG indicators
Water Quality for SDG 6.3.2 and 6.6.1

- Water Bodies
- Lake and river water level
- Lake surface water temperature
- Lake surface reflectance
- Lake turbidity
- Lake trophic state
- Water Level



Maturity	needs tailoring
Availability	1,000 lakes
Completeness	2002-2012

Copernicus Global Land Service

Water Bodies

Lake Water Quality

Lake Surface Water Temperature

Water Levels (Rivers & Lakes)

Spatial resolution
- 300m, 1km
- 100m (in evolution)

Coverage
- 1,000 selected lakes

Temporal
- 10days averages
- 2002 – 2012; 2016 - ongoing

Evolution
- Evolution towards a seamless global product covering all water bodies at 100m resolution

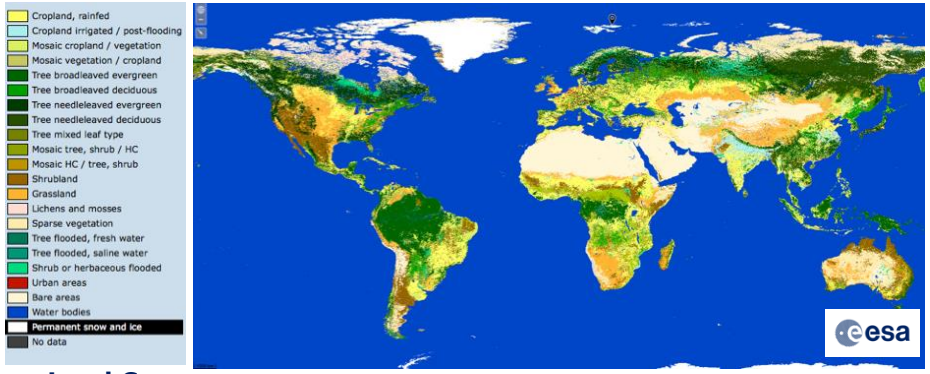
Convention on Biological Diversity

Ramsar

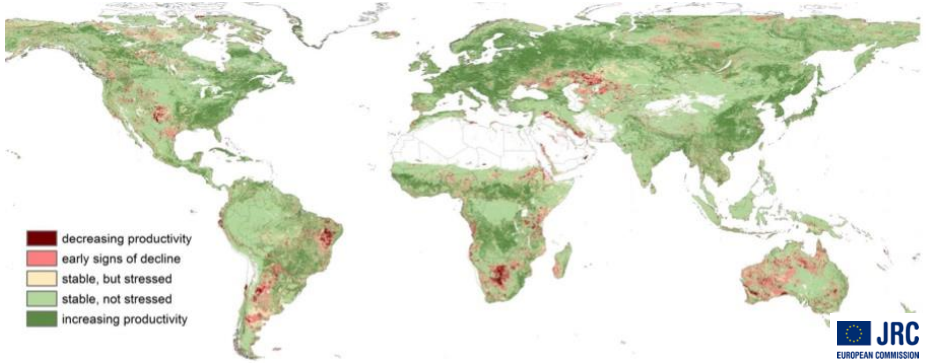
Tier II

Global EO products in support of SDG indicators

Global land cover and land productivity dynamics for SDG 15.3.1 (LDN)



Land Cover
Global land Cover Maps,1992-2015, Annual maps
ESA Land Cover CCI



Land Productivity Dynamics
LPD derived from 1999-2013 NDVI phenological analyses
JRC World Atlas of Desertification (WAD)

Maturity	coarse resolution
Availability	global
Completeness	2000-2015

United Nations Convention to Combat Desertification

Convention on Biological Diversity

SDG 15.3: By 2030, combat desertification, restore degraded land and soil … and strive to achieve a land degradation-neutral world

Indicator 15.3.1: Proportion of land that is degraded over total area

- Land Cover and Land Cover Changes
- Land Productivity
- Carbon Stock

UNCCD 2018–2030 Strategic Framework

Strategic objective 1: To improve the condition of affected ecosystems

UNCCD Progress indicators:

SO 1-1 Trends in land cover

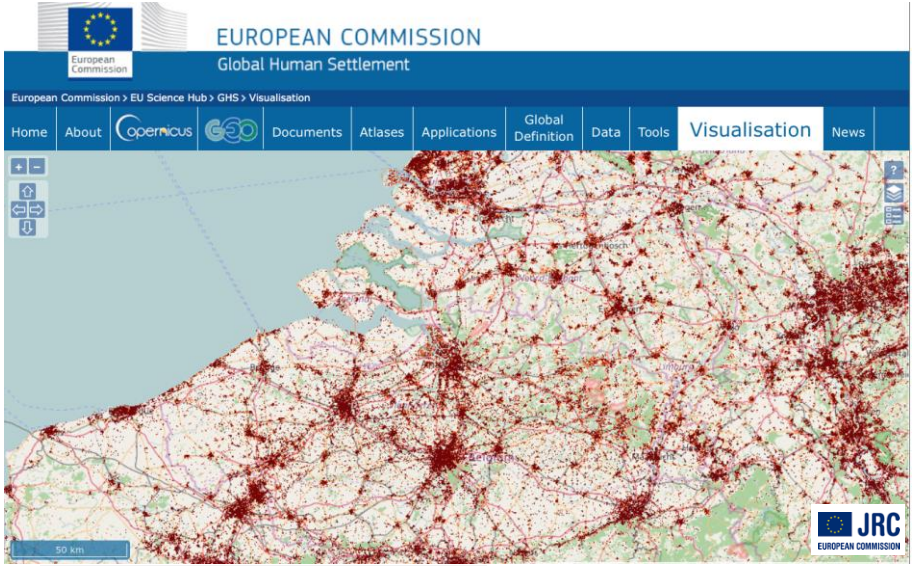
SO 1-2 Trends in land productivity or functioning of the land

SO 1-3 Trends in carbon stocks above and below ground

LDN scientific conceptual framework: one out all out

Tier II

Global EO products in support of SDG indicators
Global Human Settlements for SDG 11.3.1 (sustainable urbanization)



Maturity	validated
Availability	global
Completeness	2012, 2015

Global Urban Footprint (GUF 2012) *TS-X, TD-X*
World Settlement Footprint (WSF 2015) *L8, S1*

Maturity	validated
Availability	global
Completeness	75-90-00-15

Global Human Settlement Layer (GHSL)
Landsat series

+ population density
+ degree of urbanisation

United Nations Climate Change

United Nations Convention to Combat Desertification

Convention on Biological Diversity

New Urban Agenda

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

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Collaborative "big data" exploitation platforms

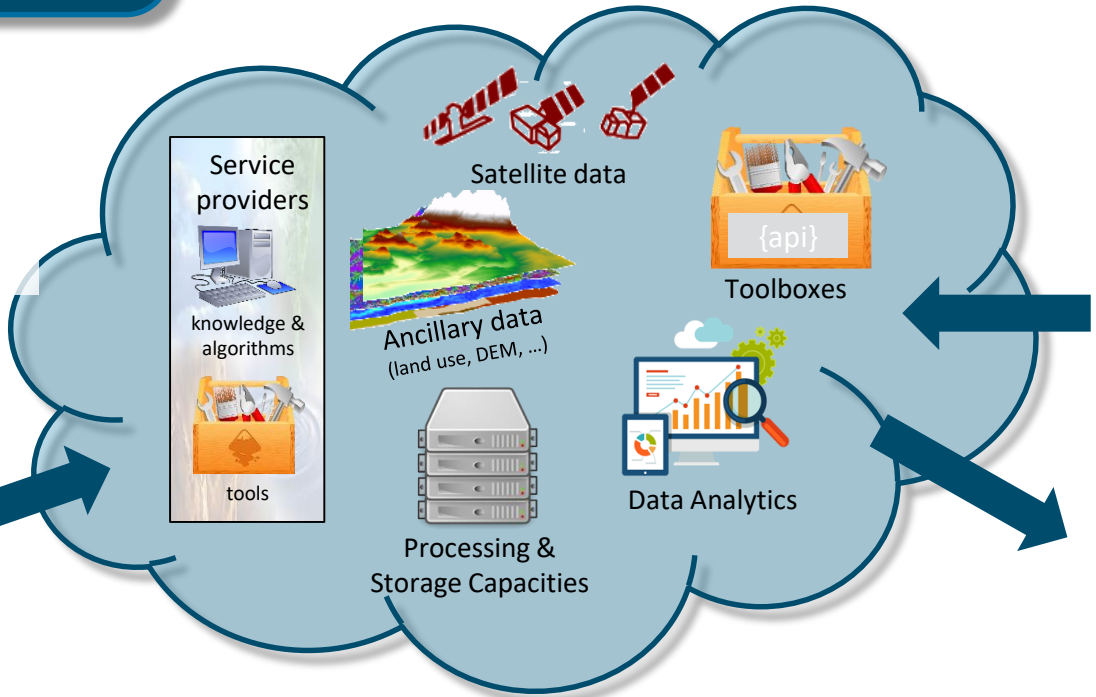
The power of the Cloud
The power of Partnerships

"Bringing the users to the data"

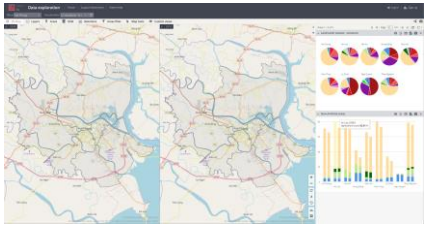
Simplify the extraction of information from EO data
Enable large scale exploitation of EO data
Stimulate innovation with EO data

Platforms as enabling technology

Mobile data
Crowdsourcing
citizen science



Remote access for users



User generated results

Collaborative "big data" exploitation platforms

tep
thematic exploitation platform

hydrology tep

urban tep

coastal tep

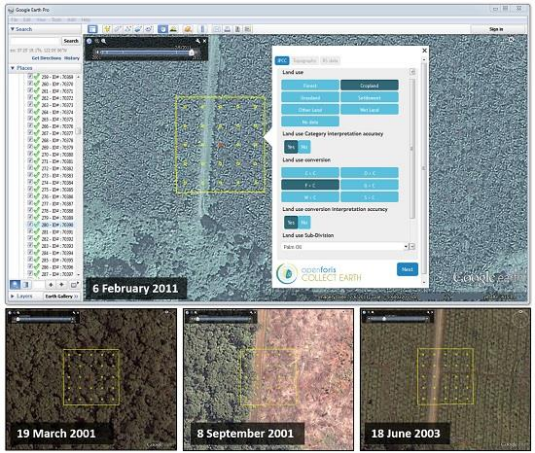
polar tep

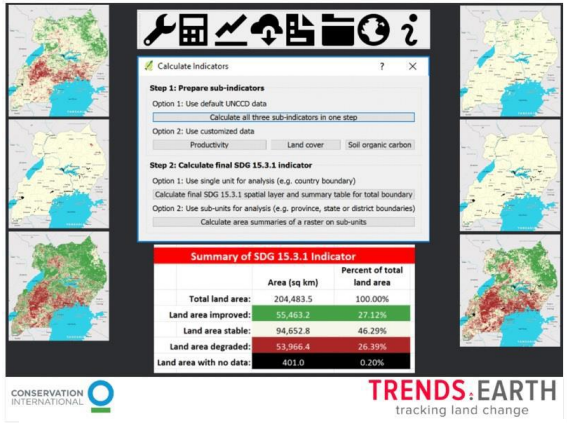
geohazards tep

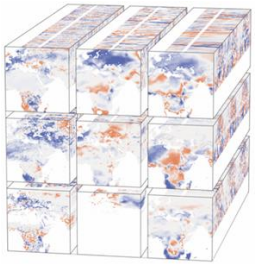
forestry tep

food security tep

openforis COLLECT EARTH







OPEN DATA CUBE

amazon web services

CREODIAS WWW.CREODIAS.EU

mundi WEB SERVICES WWW.MUNDIWEBSERVICES.COM

ONDA WWW.ONDA-DIAS.EU

sobloo WWW.SOBLOO.EU

WEKEO WWW.WEKEO.EU

https://urban-tep.eu/

urban tep

Background | Use Scenarios | Quick Start | Demos & Tutorials | Publications & Media | Partners

Data & Products Showroom

Visualisation & Analytics Center

Earth Observation Processing Services

Communication Hub

Processing clusters with standardised interfaces (OGC, WCS, WPS, WMS)

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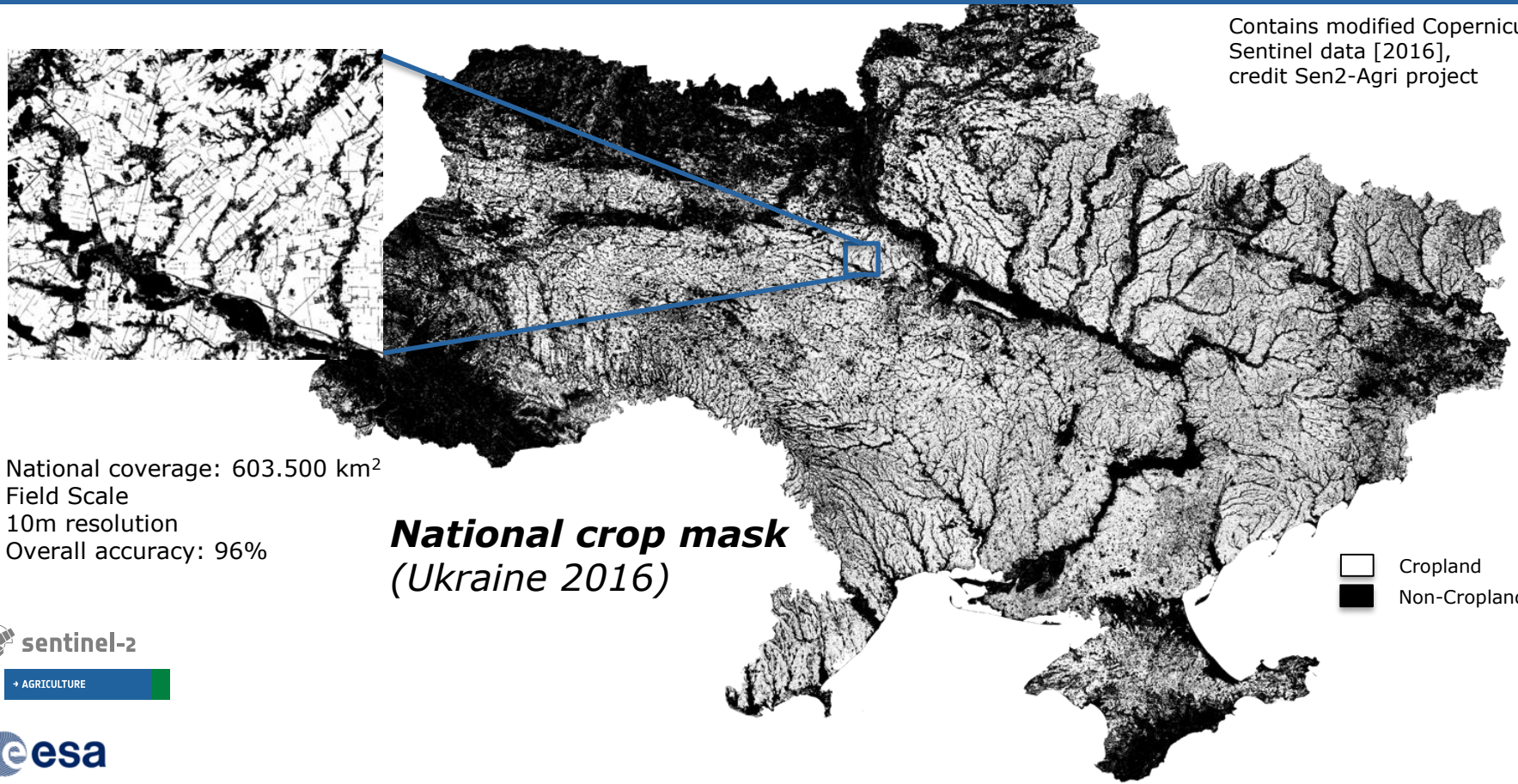
Tier II

EO products in support of SDG indicators
Crop masks and crop types for SDG 2.4.1 (sustainable agriculture)



Contains modified Copernicus Sentinel data [2016], credit Sen2-Agri project

National coverage: 603.500 km^2
Field Scale
10m resolution
Overall accuracy: 96%

National crop mask
(Ukraine 2016)

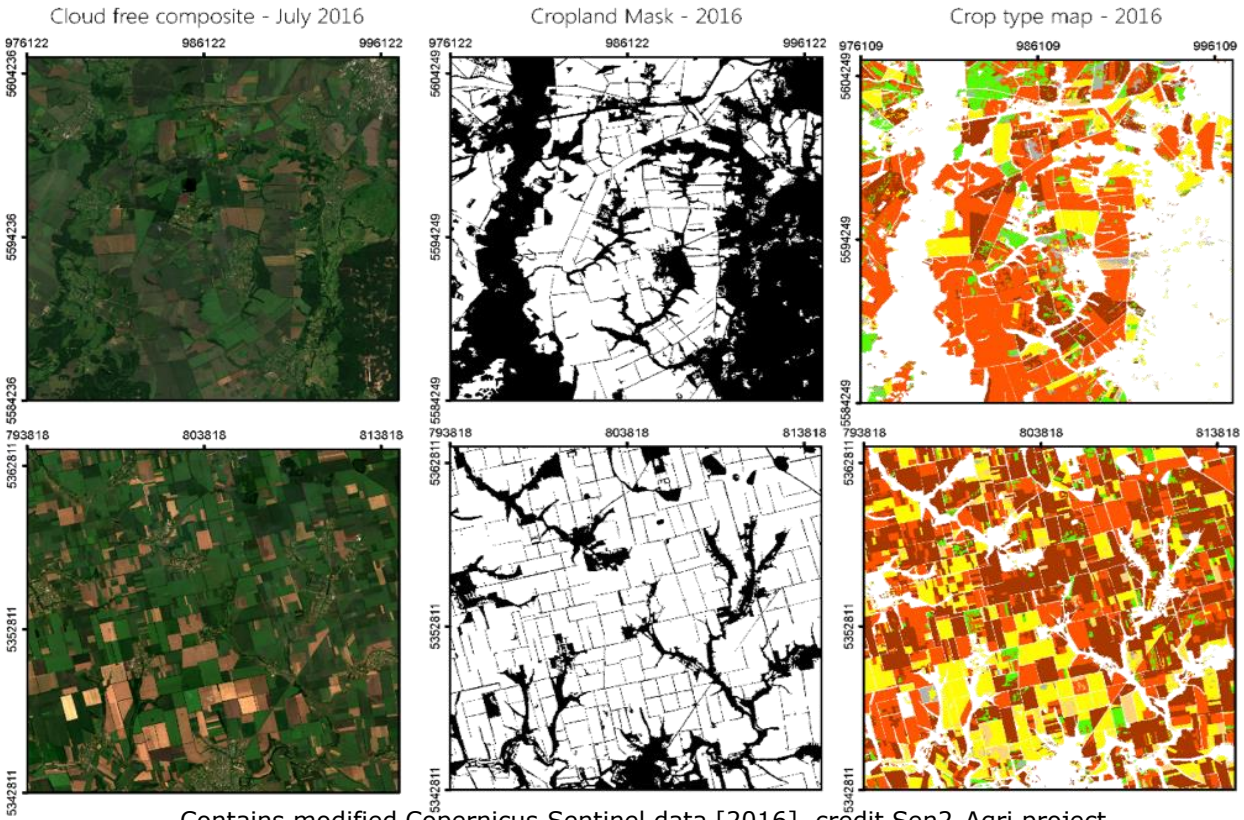
sentinel-2
→ AGRICULTURE

esa

Tier II

EO products in support of SDG indicators

Crop type mapping at field scale for SDG 2.4.1 (sustainable agriculture)



Contains modified Copernicus Sentinel data [2016], credit Sen2-Agri project

sentinel-2

→ AGRICULTURE

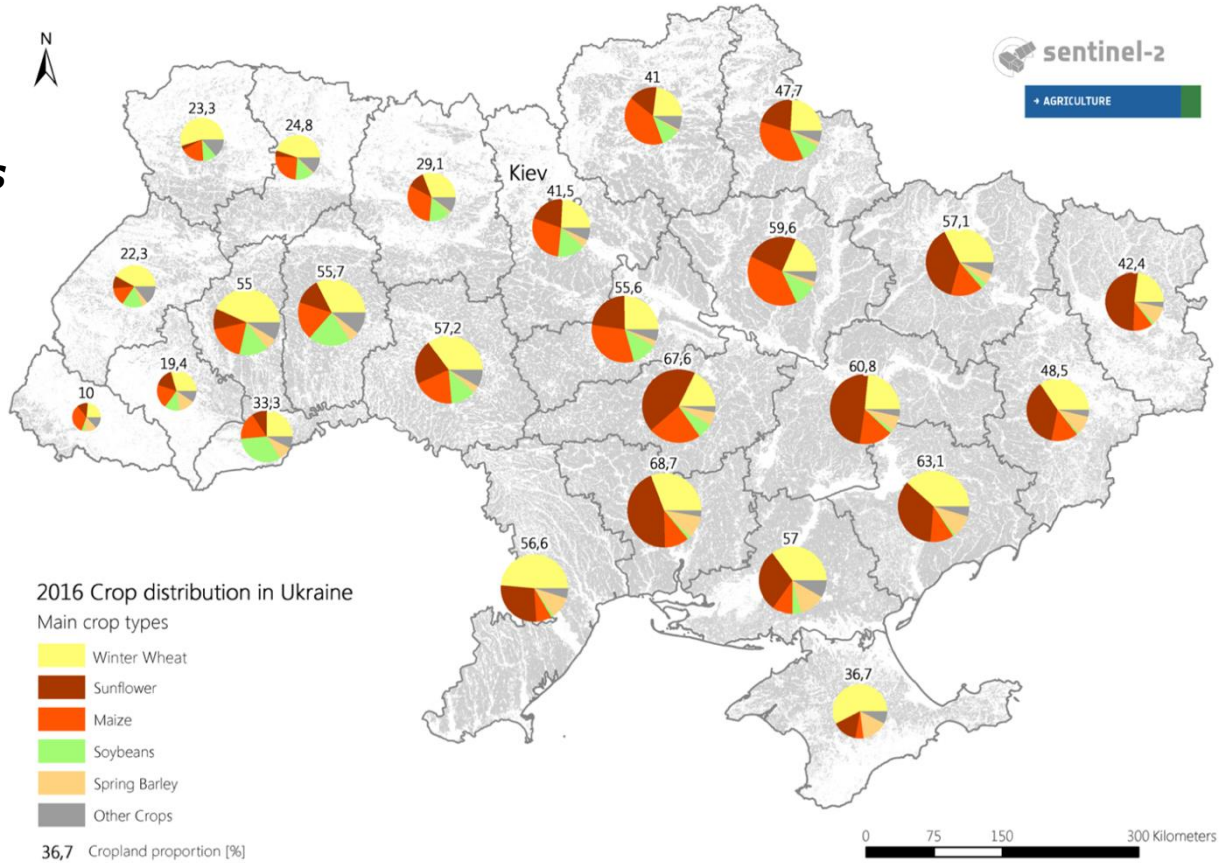
esa

Tier II

EO products in support of SDG indicators
Crop statistics for SDG 2.4.1 (sustainable agriculture)

2 ZERO HUNGER

National crop statistics by admin. units
(Ukraine 2016)



sentinel-2
AGRICULTURE

esa

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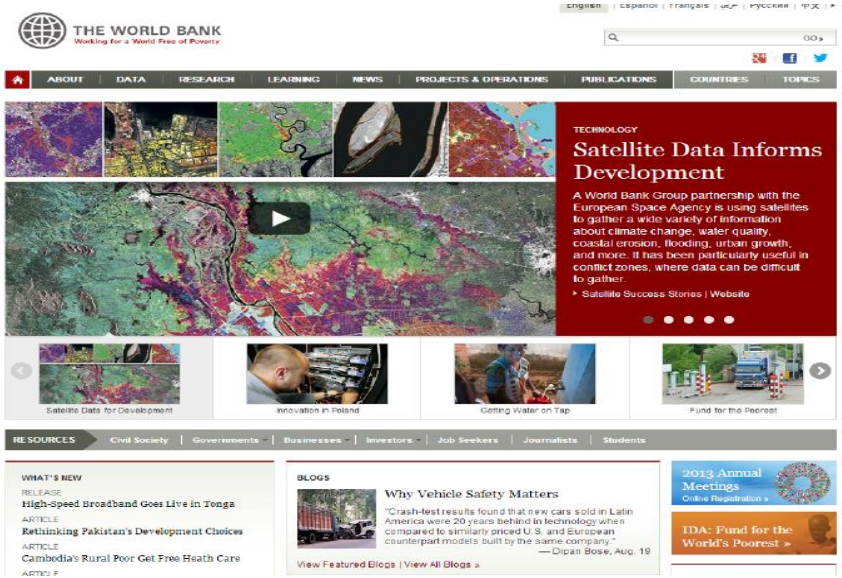
Earth Observation for Sustainable Development

In partnership with International Financing Institutions

eo4sd
earth observation for sustainable development

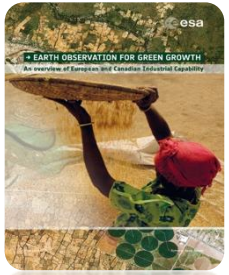
WORLD BANK GROUP | IFAD | European Investment Bank | ADB | European Bank for Reconstruction and Development

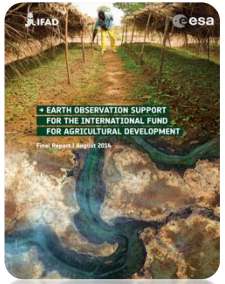
http://eo4sd.esa.int



From demonstrations to mainstreaming:

Transferring EO into operational working processes & development financing as 'best-practice' source of geo-information





Take Home Messages

- **Global Agendas** are calling for **cost-effective EO solutions** that can help countries worldwide addressing efficiently their development challenges.
- **Free and open data policies** of Copernicus program (with **long term continuity** and **frequent revisiting)** bring **unprecedented observations** for environment monitoring.
- **Copernicus can deliver** **ental information** that can help countries implementing the SDGs a ally in developing countries (**data poor countries**).
- **R&D activities** are still n **xploit the Sentinels capabilities** and mai n EO information into **national systems and processes** (e.g. national statisti
- **Advances in ICT** (e.g. cloud computing, Machine Learning) allows the gener **data sets** from **Sentinels** at affordable prices.
- **EO data** combined with **socio-economic and other informatio** allows to improve understanding of development patterns and environment **a analytics**)
- Availability of **on-line platforms** (such as the TEPs and D **-one" systems** (EO/nonEO data, tools & ICT resources) facilitates adopti s to EO solutions.

Joint European Research Agenda on SDGs/MEAs

Opportunities for SDGs/MEAs related components in CLMS Global Land Monitoring Service

Opportunities to stimulate DIAS offerings to SDGs & MEAs (including big data analytics)

The Future is Now

Copernicus, an essential tool for achieving the Sustainable Development Goals