

Big Data in Africa – an ESA perspective

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European Space Agency, Earth Observation Directorate

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Earth Observation in Africa – A Question of Scale

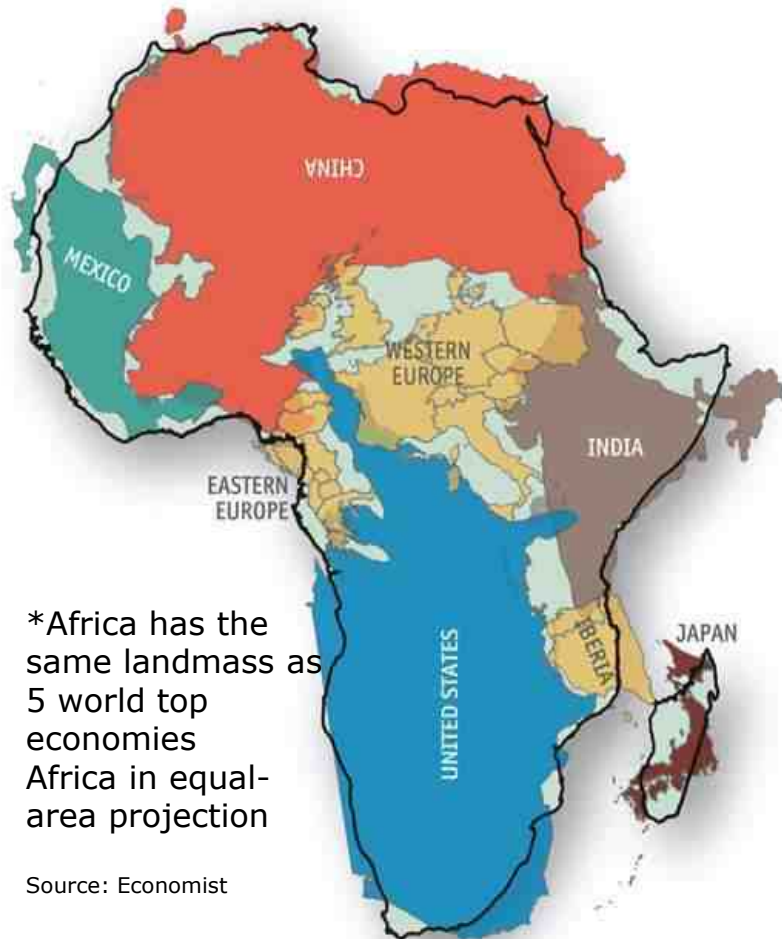


Earth 2nd largest continent

- 30.4 Million km² of vast natural resources
- Demography 1.2 billion (2050: 2.5 billion), 55 countries

EO = Opportunity for the Digital Economy in Africa

- Digitizing natural resources
- Monitoring economic activities
- Empowering data analytics
- Informing governments & citizens



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Source: Economist

Our Mission

**Develop world-class Earth
Observation systems
addressing scientific &
societal challenges
with European and global
partners**



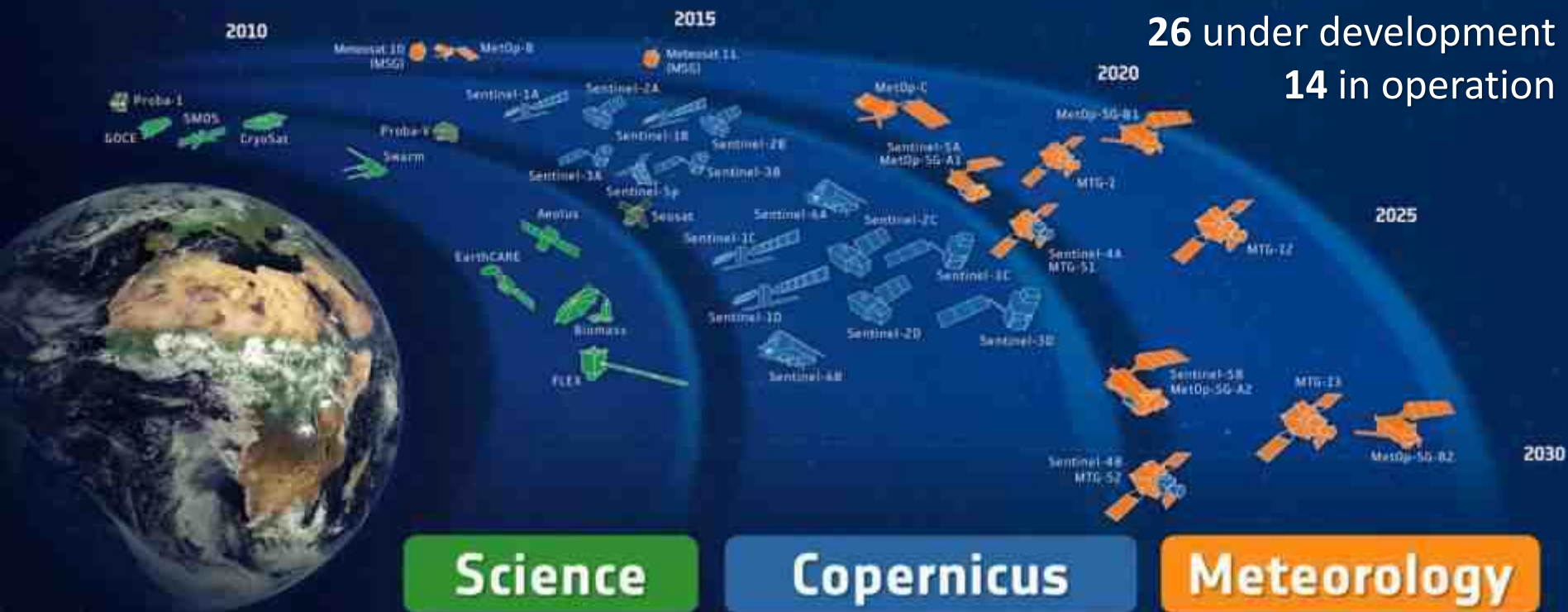
ESA-DEVELOPED EARTH OBSERVATION MISSIONS



Satellites

26 under development

14 in operation



Science

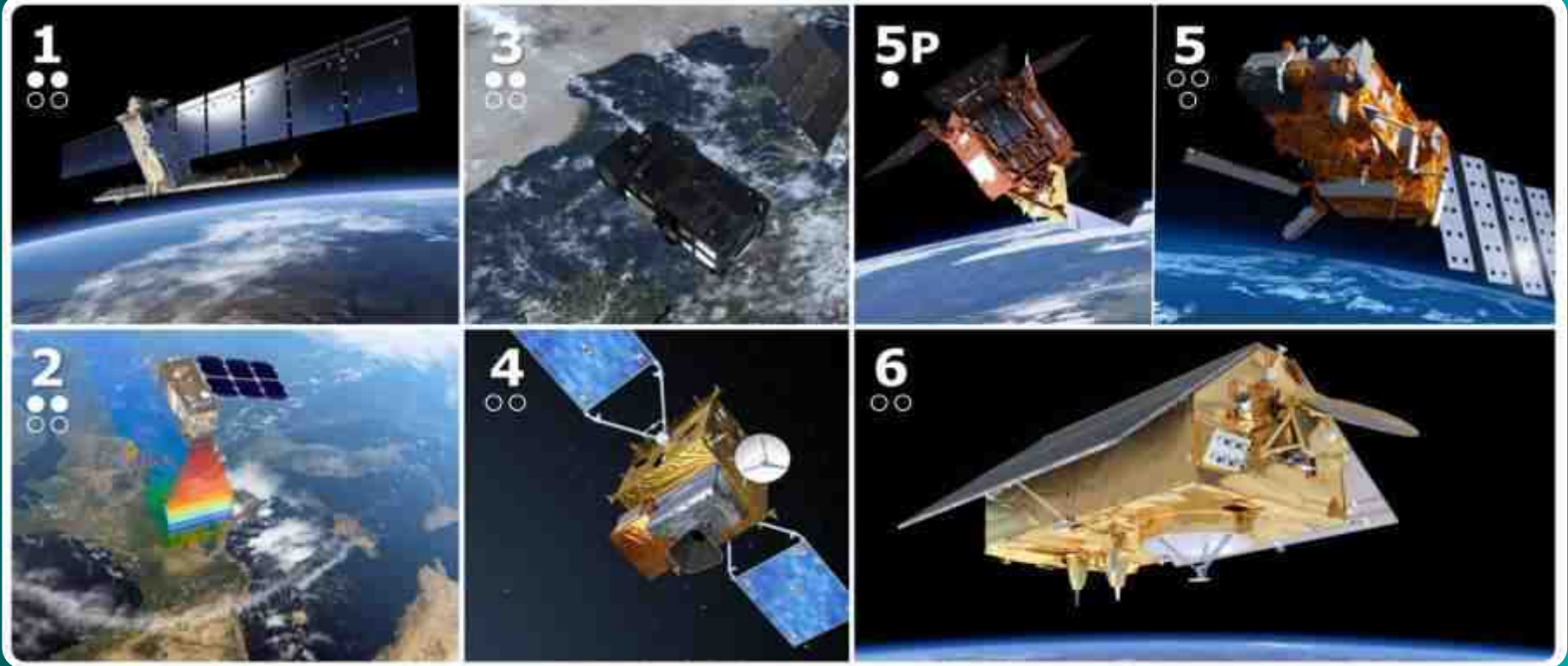
Copernicus

Meteorology



The Big Data Revolution

Copernicus is the largest producer of EO data in the world



Sentinels Looking after Africa



0 days 00 hours 00 minutes

Estimated Yearly Data Volumes for Africa (2018...)

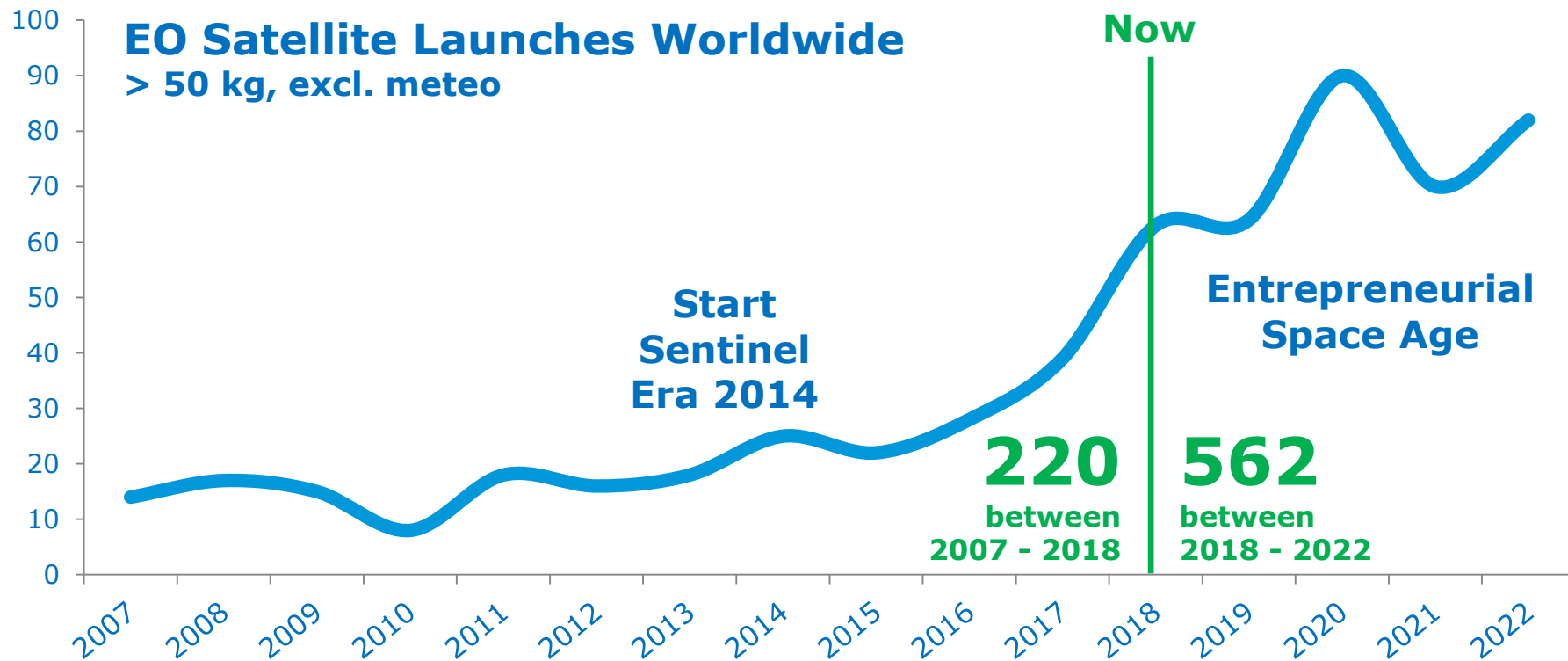


Product Level	Mission	Product Type	Annual Volume (TiB)	Totals - Continental (TiB)	Totals - Regional (TiB)
Level-0	Sentinel-1	RAW	77.81	77.81	15.56
Level-1	Sentinel-1	SLC	209.14	759.25	151.85
		GRD	44.55		
	Sentinel-2	L1C	286.24		
	Sentinel-3	OL_1_EFR__	22.10		
		SR_1_SRA_BS	23.80		
		OL_1_ERR__	4.26		
		SL_1_RBT__	34.76		
		SR_1_SRA__	1.01		
		SR_1_SRA_A_	33.39		
	Sentinel-5P	L1B	100.00		
Level-2	Sentinel-1	OCN	0.07	344.55	68.91
	Sentinel-2	L2A	333.35		
	Sentinel-3	OL_2_LRR__	0.53		
		SL_2_LST__	2.22		
		OL_2_LFR__	2.00		
		SR_2_LAN__	1.38		
	Sentinel-5P	L2 OFFL	5.00		
				1181.61	236.32

**Continental Africa:
>1.2 PB/year**

Totals are provided as Continental (39.1 km²) and Regional 1/5 of the Continental values.

More Eyes in the Sky



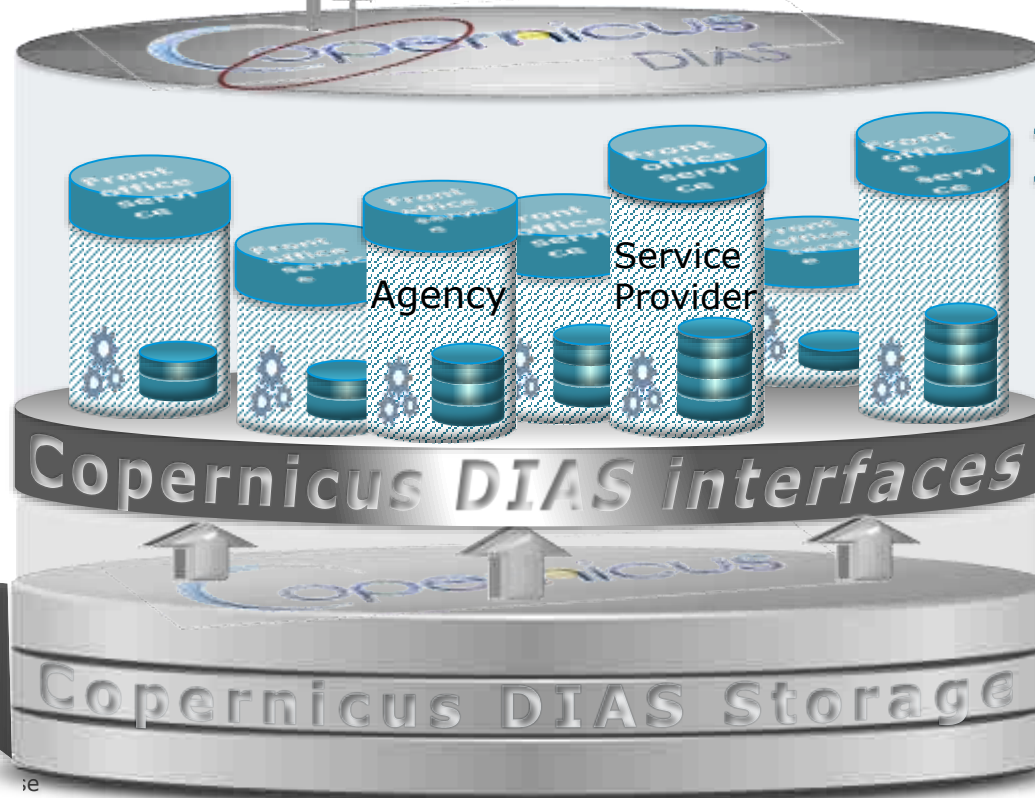
Source: Euroconsult Database, 2017

DIAS – Bringing the Applications to the Data



End user: User of the third-parties services

DIAS
Front-
office



Third-Party user
interface

Third-Party
resources



Third-Party



**DIAS
Provider**

Cloud Computing – Scalability & Reduced Bandwidth



The screenshot displays the EO Browser interface. On the left, a sidebar lists various visualization options:

- Band(s) bands 4,3,2
- False color
Based on bands 8,4,3
- False color (urban)
Based on bands 12,11,4
- NDVI
Based on combination of bands $(B8 - B4) / (B8 + B4)$
- Moisture Index
Based on combination of bands $(B8A - B11) / (B8A + B11)$
- SWIR
Based on bands 12,8A,4
- NDWI
Based on combination of bands $(B3 - B11) / (B3 + B11)$
- NDSI
Based on combination of bands $(B3 - B11) / (B3 + B11)$, values above 0.42 are regarded as snow

The main area shows a false-color satellite image of Alexandria, Egypt. A search bar at the top right contains the text 'Alexandria, Egypt'. A zoomed-in inset in the bottom right corner shows a detailed view of a city area. The bottom left corner of the interface indicates it is 'Powered by Sentinel Hub with contributions from the European Space Agency v2.16.3'.

S1: Alexandria, Egypt
12.10.2018

Changes on Land

180.000 Sentinel-2A images
Dec. 2015 – Dec. 2016



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Laco-Wiki: Online Validation & Crowd Sourcing



Mobile app



Web app



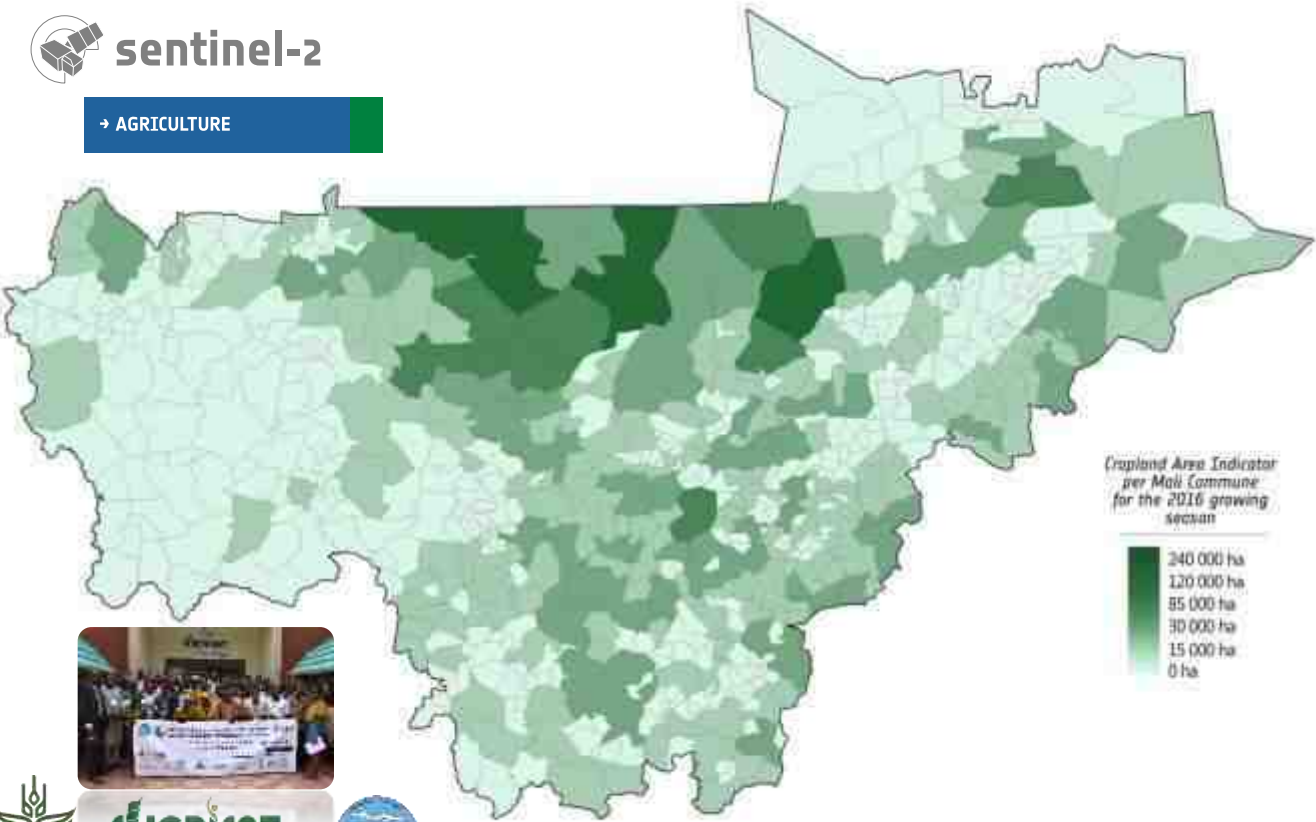
LACO-Wiki is a new web-based solution for validating land cover and land use maps. Using a variety of reference layers including satellite and aerial imagery from Google and Bing as well as OpenstreetMap, validation is a simple task. Users can validate the samples and create a report with the accuracy assessment.



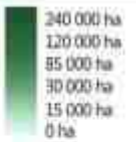
Mali: Food Insecure Country, National Statistics



→ AGRICULTURE



Cropland Area Indicator per Mali Commune for the 2016 growing season



November 2016

5/10/2016 - 25/11/2016




Growth Monitoring at Field Scale



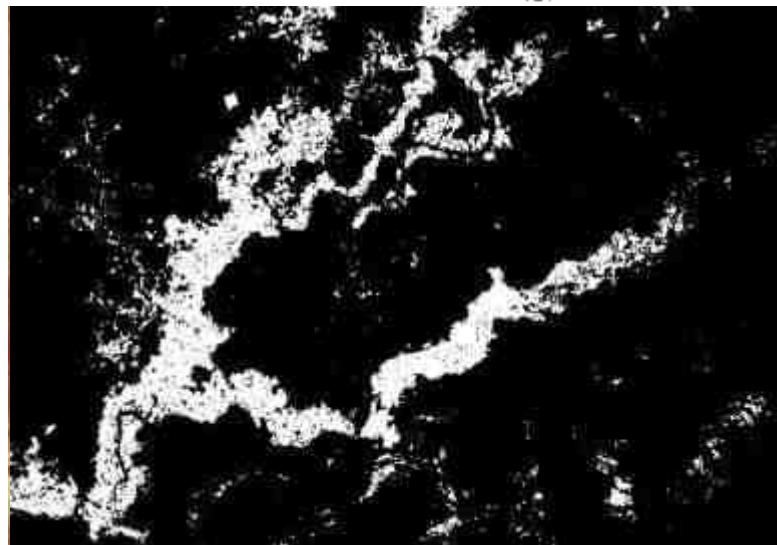
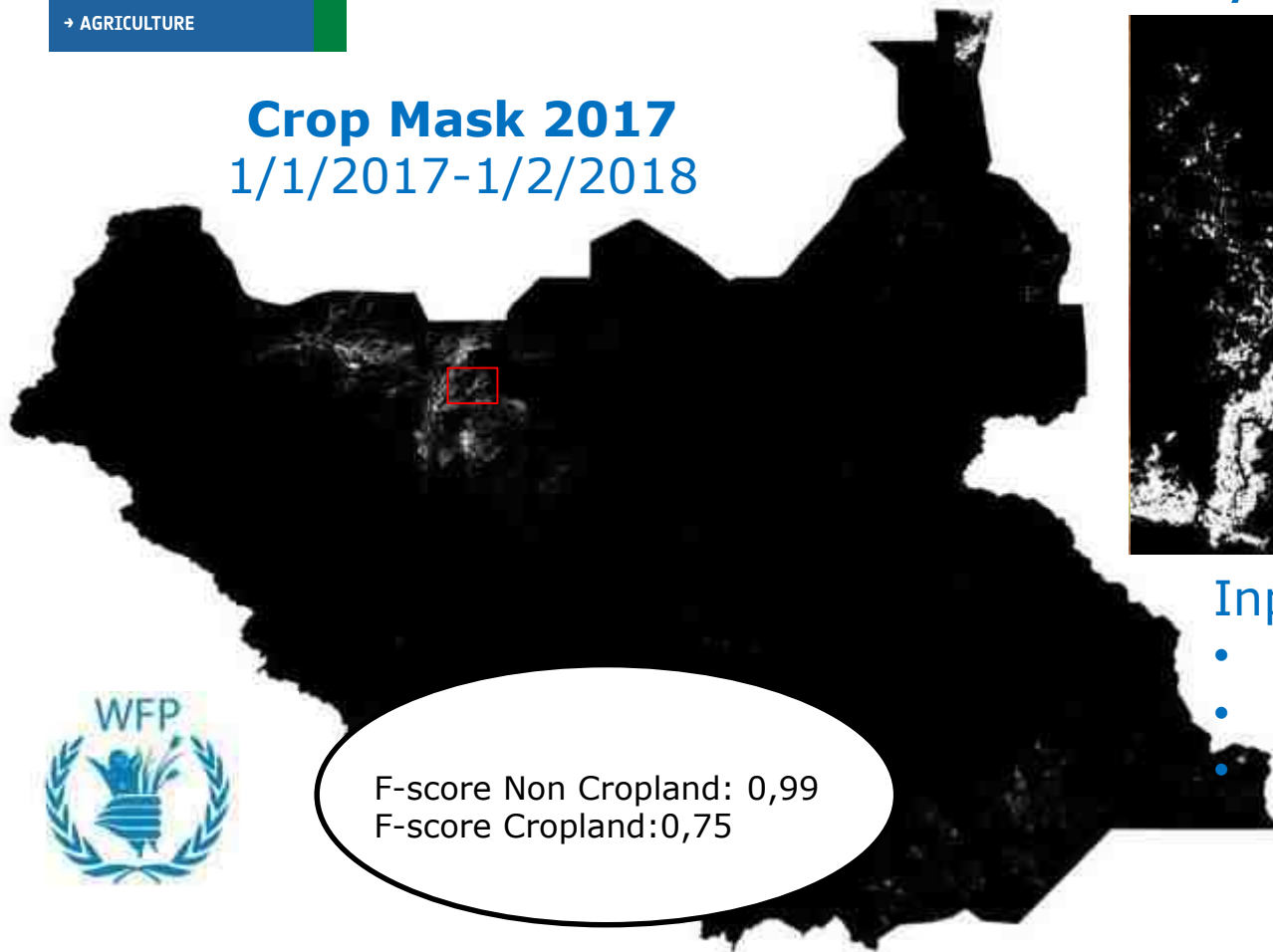
4
3
2
1
0

17/00570252016
26/087201570162016






Crop Mask 2017 1/1/2017-1/2/2018



Input:

- 3.1 TB (L1C), 14TB (L2A)
- 4406 S2A, 2472 S2B
- >4000 in-situ samples (Preliminary results)

F-score Non Cropland: 0,99
F-score Cropland:0,75



Open-source Sen2Agri in the Cloud

opernicus



sentinel-2

→ AGRICULTURE



Fully scalable

Close to the Data
(reduced bandwidth)

Continuous Monitoring

Operational context
(e.g. timeliness)

In-situ Data
GeoODK

**Cloud
Technology**
(AWS, IPT,
EODC & DIAS)



South Sudan
(Sept. 2017)



Hydro-TEP – Cloud Computing for Water



- 💧 Collaborative & open platform for large data volume processing & sharing for IWRM
- 💧 Hydrological modeling, flood mapping, small water bodies mapping, water quality & water level
- 💧 Supports algorithm development, sharing of data, tools & knowhow

[Sign in](#) [Register](#) [Contact](#)



hydrology
tep

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[Information Processing](#)

[Community](#)

[Partners](#)

WOIS



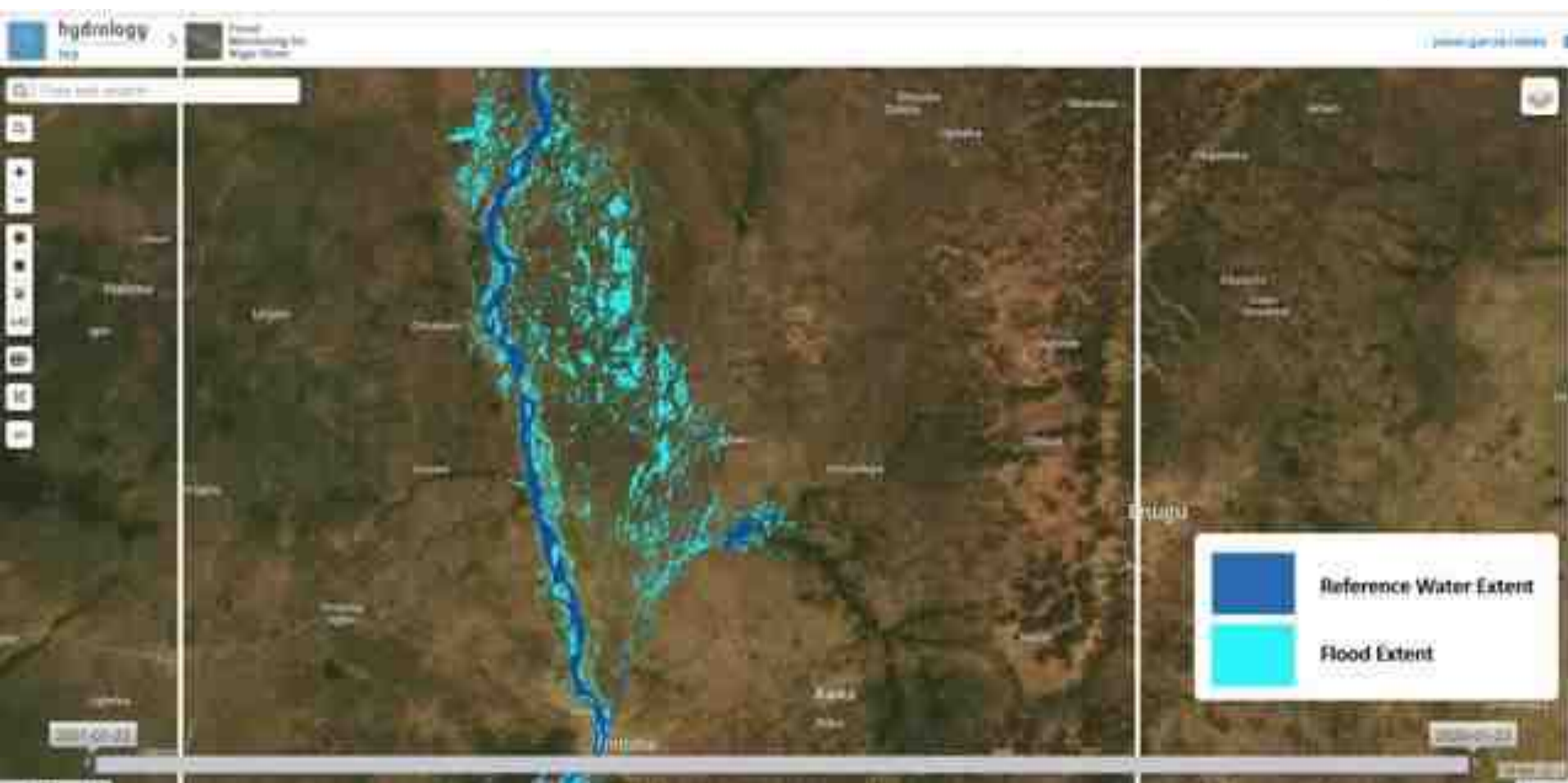
Our Community

The Thematic Exploitation Platform (TEP) for Hydrology is an heterogeneous community of scientific users, river basin organisations and service providers. The aim of this community is to exchange data, services and knowledge through a common collaboration framework.

[Become a Member](#)



Hydro-TEP: Recent Floods in Nigeria



New ESA Initiative

Shaping the Future of EO

Leveraging the Data &
Tech Revolutions



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In one sentence

“Opening ESA
to disruptive
innovation
in EO”

ESA | 12/11/2018 | Slide 19

New Technologies



Artificial Intelligence



Cloud



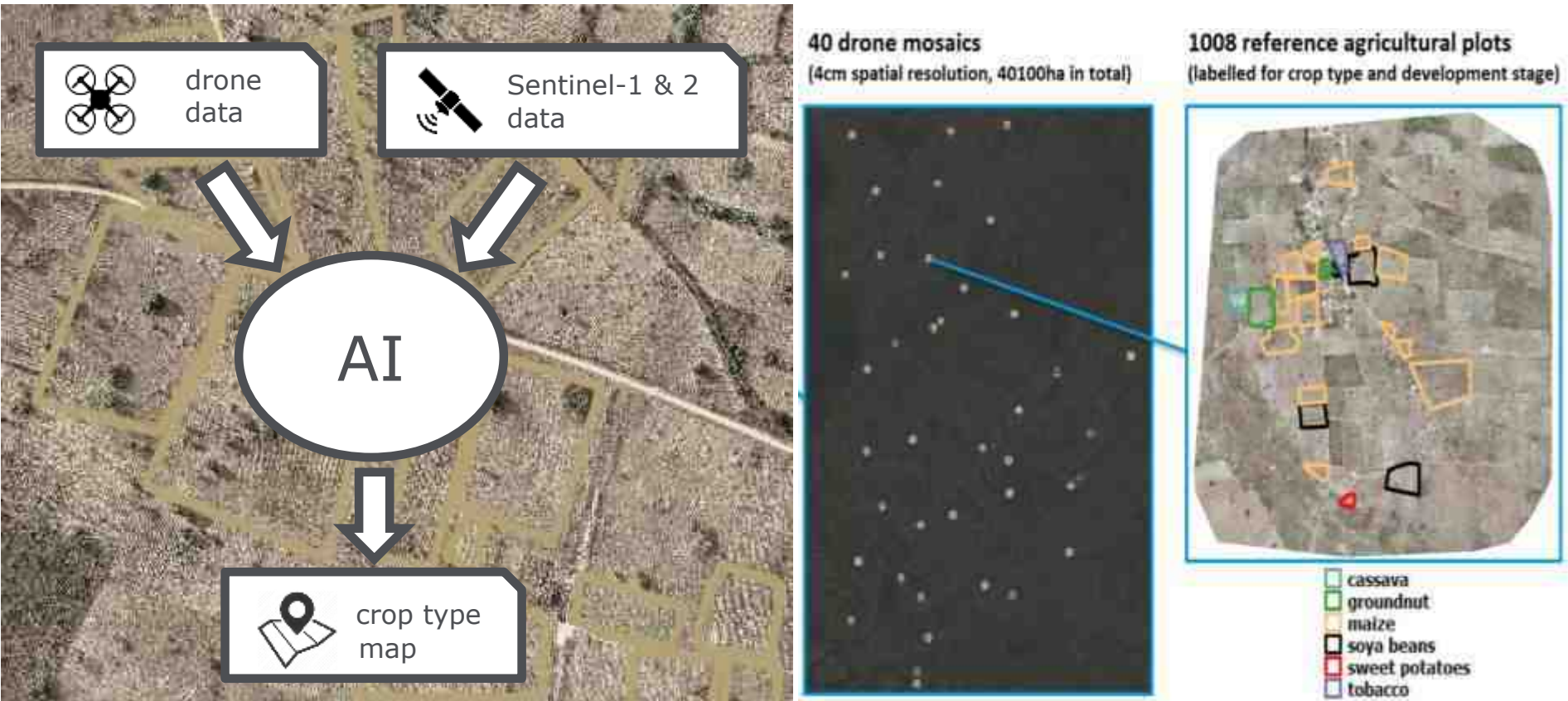
Internet of Things



Small Sat

New Data

Drones for crop type mapping in Malawi



Drone data classification challenges



From Information to Decisions

Elements for Capacity Development

Continuous & Reliable Observations
(EO & in-situ)

Sustainable (Free)
& Operational Data



Knowhow & Technical Expertise

Training and R&D



Technical Capacity for Data
Processing & Management

Software tools &
Infrastructure



Integration in Decision Making
Processes

Institutional
Capacity & User
Engagement





The TIGER Initiative: Looking After Water in Africa



- TIGER is based on a **user driven approach under African leadership**
- Endorsed by the African Ministers' Council On Water (AMCOW)
- Launched in 2002 responding to World Summit on Sustainable Development



- Assist African scientists, technical centres and water authorities to **develop the tools, the knowledge and the capacity** to exploit EO technology for the monitoring and management of water resources;
- African Community:** TIGER involves more than **150 African institutions in 42 countries** who participate in **development projects & capacity building actions**;



Official Use



European Space Agency

EO AFRICA: EO African Framework for Research, Innovation, Communities and Applications



Objective: Develop an African-European R&D partnership to facilitate the sustainable uptake of Earth Observation and related space technology in Africa

Partnership: AUC, EC, international & private sector

- African Union Commission (AUC)
 - New African Space Policy and Strategy (Feb. 2016)
- European Commission (DG-Devco, DG-Grow, DG-JRC)
- African, European and international organizations, research institutions and private sector

Focus on:

- **R&D, Capacity Development & Data Accessibility**



AUC visit to ESRIN, July 2017



"To us TIGER is the precursor for GMES & Africa, particular if we look at water resource management..."

Mahama Ouedraogo, African Union

EO AFRICA – Elements & Activities



Data Access(ibility)



Cloud
Technology
(DIAS & TEP)

Research & Development



Sustainable Development Goals



African Partnership



**GMES
AND AFRICA**

Capacity Development



EO Mainstreaming



living planet symposium

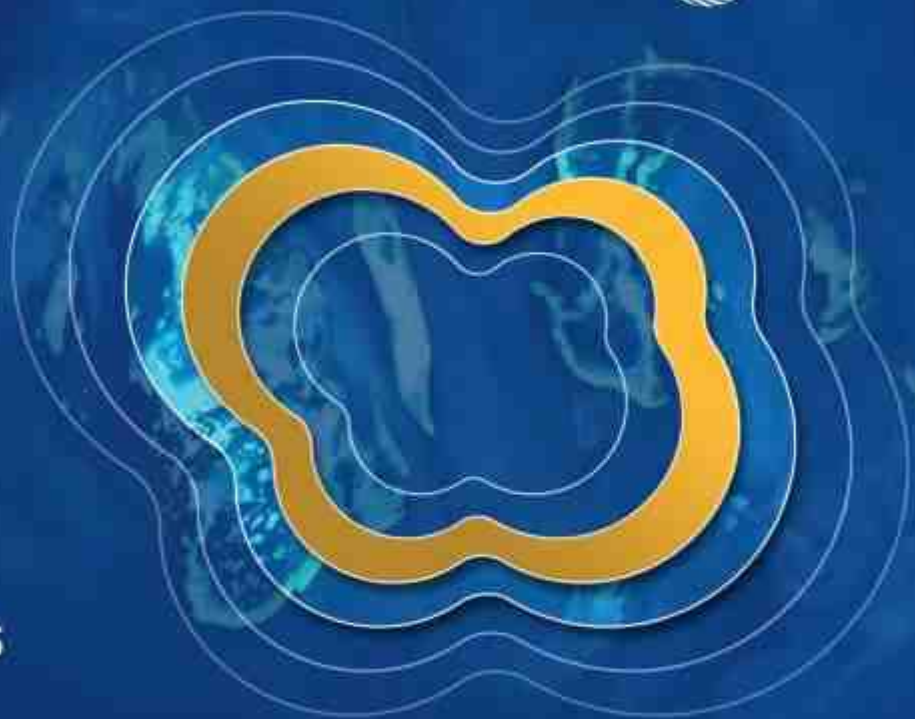
MILAN
13-17 May
2019

UNDERSTANDING THE EARTH SYSTEM

SPACE 4.0 AND EARTH OBSERVATION

BENEFITS FOR A RESILIENT SOCIETY

PUBLIC AND PRIVATE SECTOR INTERACTIONS



Deadlines

Session Proposals
17 June 2018

Abstracts
11 November 2018

Registration
April 2019

lps19.esa.int

Backup

Copernicus Space Component

Long term continuity space observations



2011

2015

2020

2030

Access to Contributing Missions

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 A/B

Open & Free Data Policy

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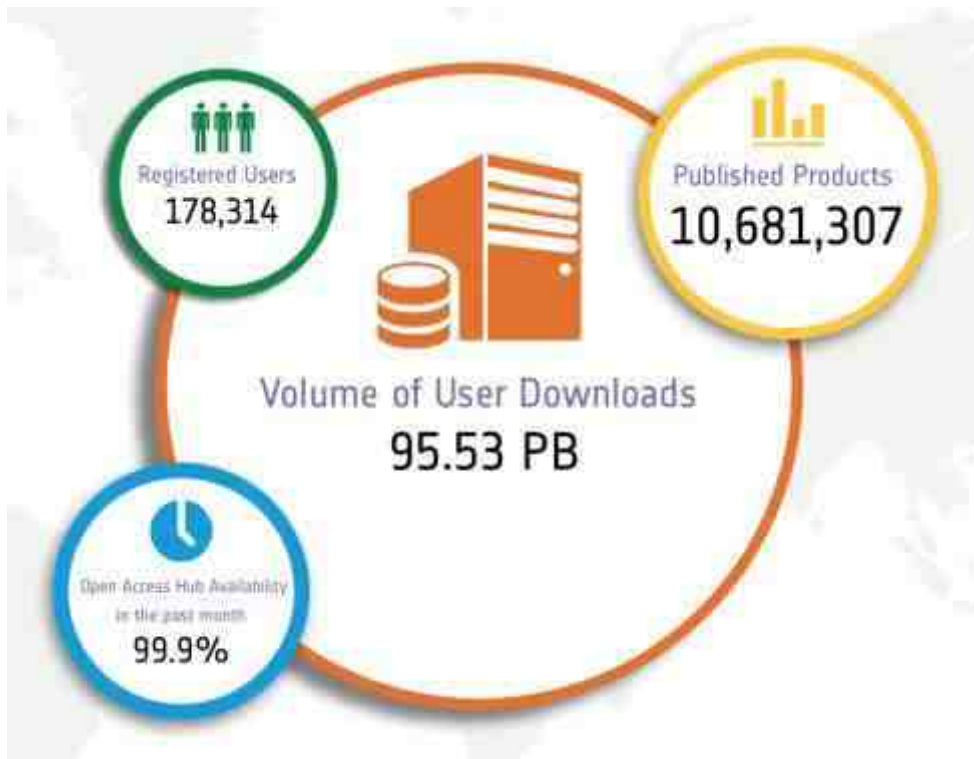


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European Space Agency

Sentinel Open Access Data Hub



Statistics on
25 Oct. 2018

scihub.copernicus.eu

DIAS: Data Information Access Service

The Copernicus Cloud



Back-office

DIAS operations

Interface for
storage access &
processing and
management
Scalable storage
hosted on cloud
environment



5 DIAS Provider: In charge of DIAS Back-Office Services & Interfaces operations

Data Sources:
Copernicus Data &
Information,
Sentinels Core
Products, ...



Opportunities to support SDGs in Africa

Global
Datasets

Methodological
Guidelines

Country
Support

Capacity
Building

EO Software
Toolboxes

Knowledge
Hub &
Platforms

Custodian Agencies

National Statistical Offices
Governments / Agencies

Key Stakeholders

- | | | | | | |
|--|---|---|---|--|--|
| <ul style="list-style-type: none"> ▪ Access to global / regional datasets. ▪ in the absence of or to complement and enhance, national data sources. ▪ countries which face major difficulties in collecting nat. data | <ul style="list-style-type: none"> ▪ Support method. guidelines for countries. ▪ EO Best Practices. ▪ Scientifically sound approaches. ▪ Product validation. ▪ Show Cases. | <ul style="list-style-type: none"> • Targeted activities to support NSOs and governmental ministries to report on SDG indicators. • Support country efforts to apply EO to track, monitor and achieve SDGs. | <ul style="list-style-type: none"> ▪ Build capacity to exploit EO ▪ Training courses ▪ Training material on EO best practices ▪ Mainly in developing and emerging economies | <ul style="list-style-type: none"> ▪ Free of charge ▪ Open source ▪ Easy to use ▪ EO Processing Toolboxes (SNAP) ▪ Thematic Toolboxes (WOIS, GWA, S2Agri) | <ul style="list-style-type: none"> ▪ Knowledge sharing ▪ Access to Sentinels ▪ Access to datasets ▪ EO best practices ▪ Method. guidelines ▪ Visual./ Analytics ▪ On-line processing ▪ Toolboxes |
|--|---|---|---|--|--|

support to SDGs in Africa
(Water, Food Security, Land degradation, Climate Action, Marine Resources, Sustainable cities)

EO for Sustainable Development

- EO informing Development activities & investments
 - planning, design, implementation & monitoring
- Collaboration with International Development Banks



THE WORLD BANK



World Bank, Dec 2015

Asian Development Bank, Nov 2016





Starting: Marine & Coastal,
Fragile & Conflict States, Climate
Resilience & Proofing, Forests