

Az ESA földmegfigyelési programja – aktualitások és hosszabb távú tervek

Fény-Tér-Kép 2019
2019 november 14
Balatoni Limnológiai Intézet, Tihany

Bartalis Zoltán

Európai Űrügynökség (ESA ESRIN, Olaszország)
Földmegfigyelési Programok Igazgatósága
Tudományos, alkalmazási és éghajlatügyi osztály

Fény-Tér-Kép 2019
2019 November 14
Balaton Limnological Research Institute
Tihany, Hungary

Zoltan Bartalis

European Space Agency (ESA ESRIN, Italy)
Directorate of Earth Observation Programmes
Science, Applications and Climate Department

A large space shuttle is shown launching at night, with a massive plume of white smoke and fire at its base. The shuttle is illuminated by bright lights, and its ascent is supported by two tall service towers. A blue banner with white text is overlaid on the image.

The European Space Agency

ESA Activities



Exploration and use of space for exclusively peaceful purposes.

ESA is one of the few space agencies in the world to combine responsibility in nearly all areas of space activity.



ESA Participating States



22 ESA Member States:

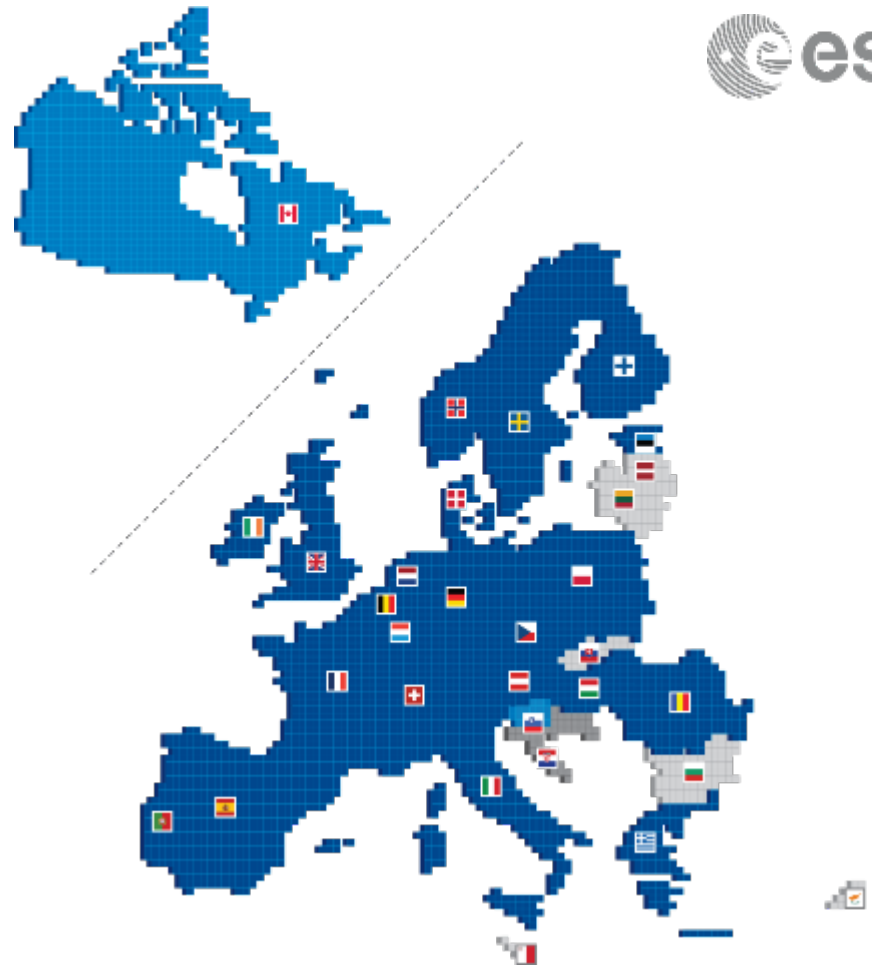
- 20 states of the EU (AT, BE, CZ, DE, DK, EE, ES, FI, FR, IT, GR, **HU**, IE, LU, NL, PT, PL, RO, SE, UK)
- Non-EU: **Norway** and **Switzerland**

Cooperation Agreements with ESA:

- **BG, CY, HR, LV, LT, MT** and **SK**

Slovenia is an Associate Member

Canada takes part in some programmes under a long-standing Cooperation Agreement

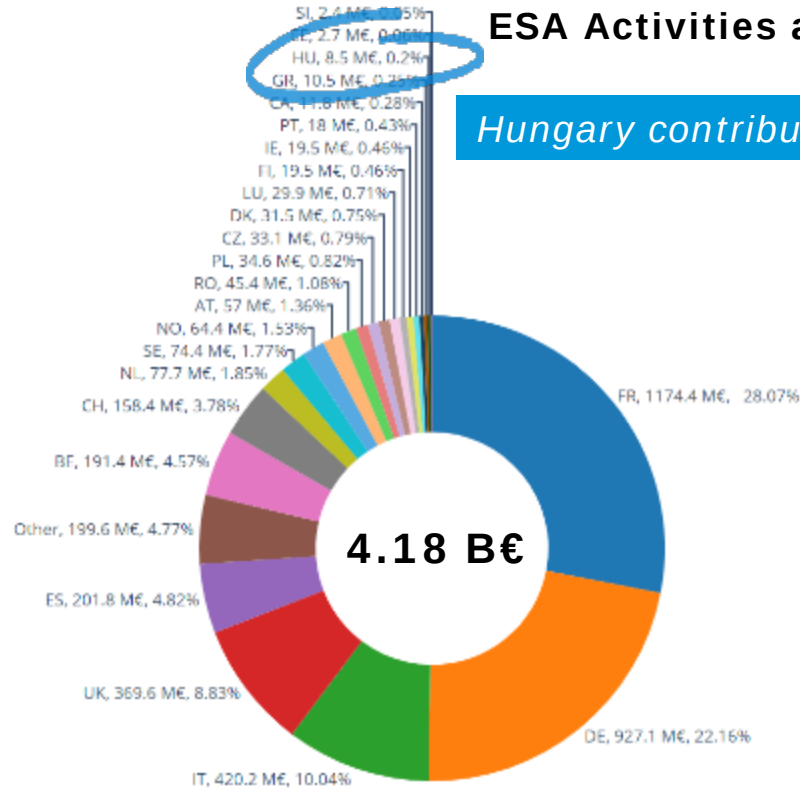


ESA Budget for 2019: 5.72 B€, 12€ per European Citizen

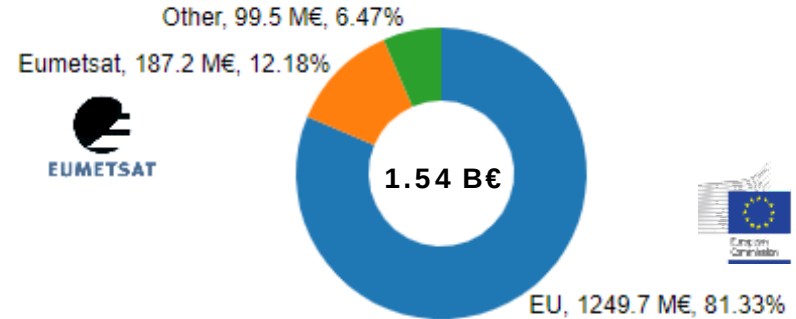


ESA Activities and Programmes

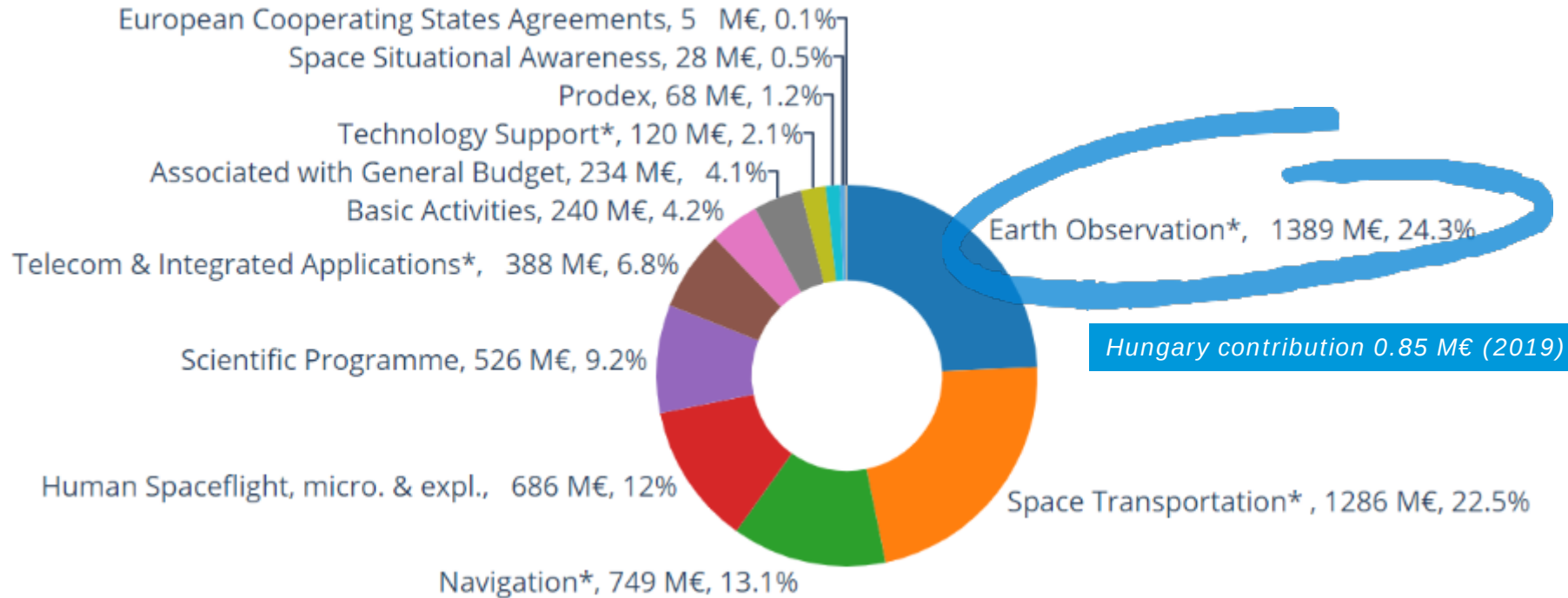
Hungary contribution 8.5 M€ (2019)



Programmes implemented for other institutional partners



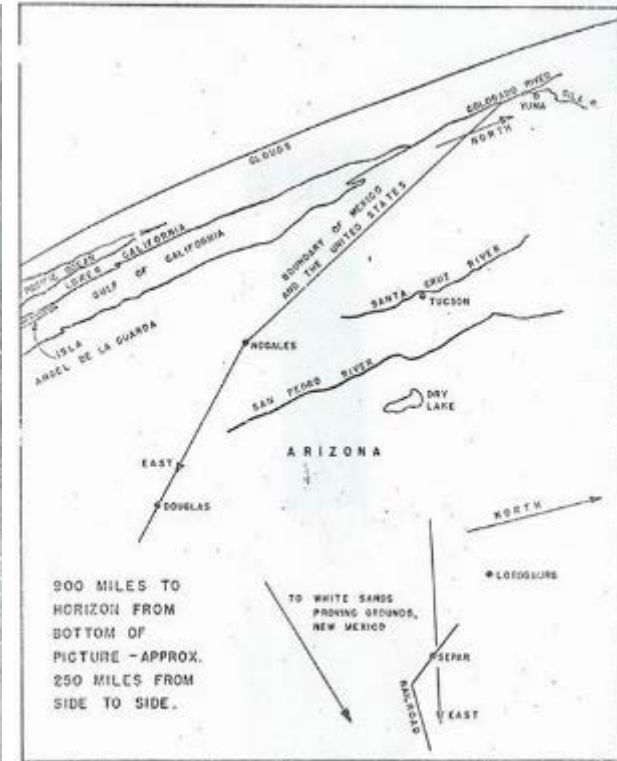
ESA Budget Allocation per Programme



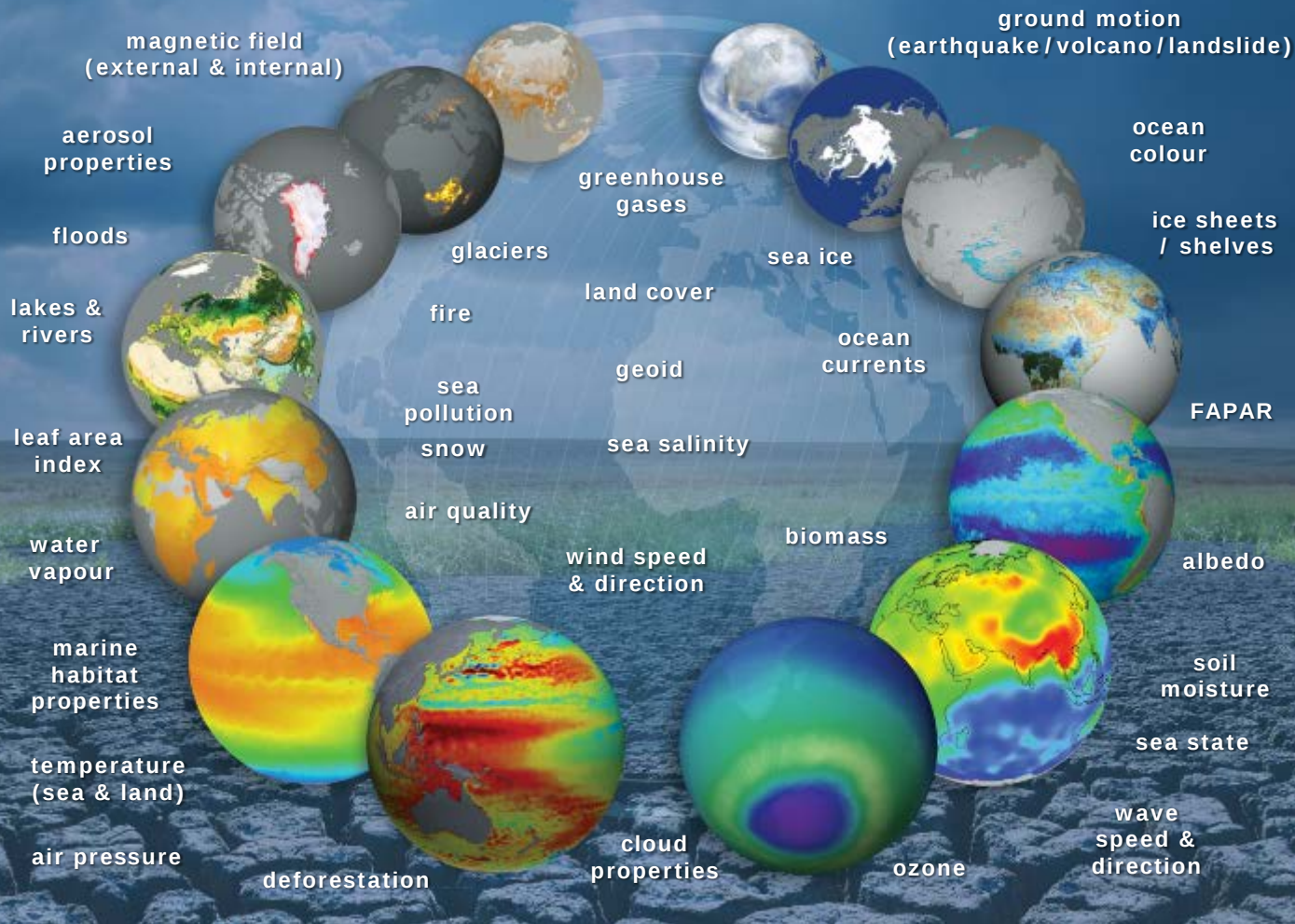
* = includes programmes implemented for other institutional partners

Earth Observation at ESA

-



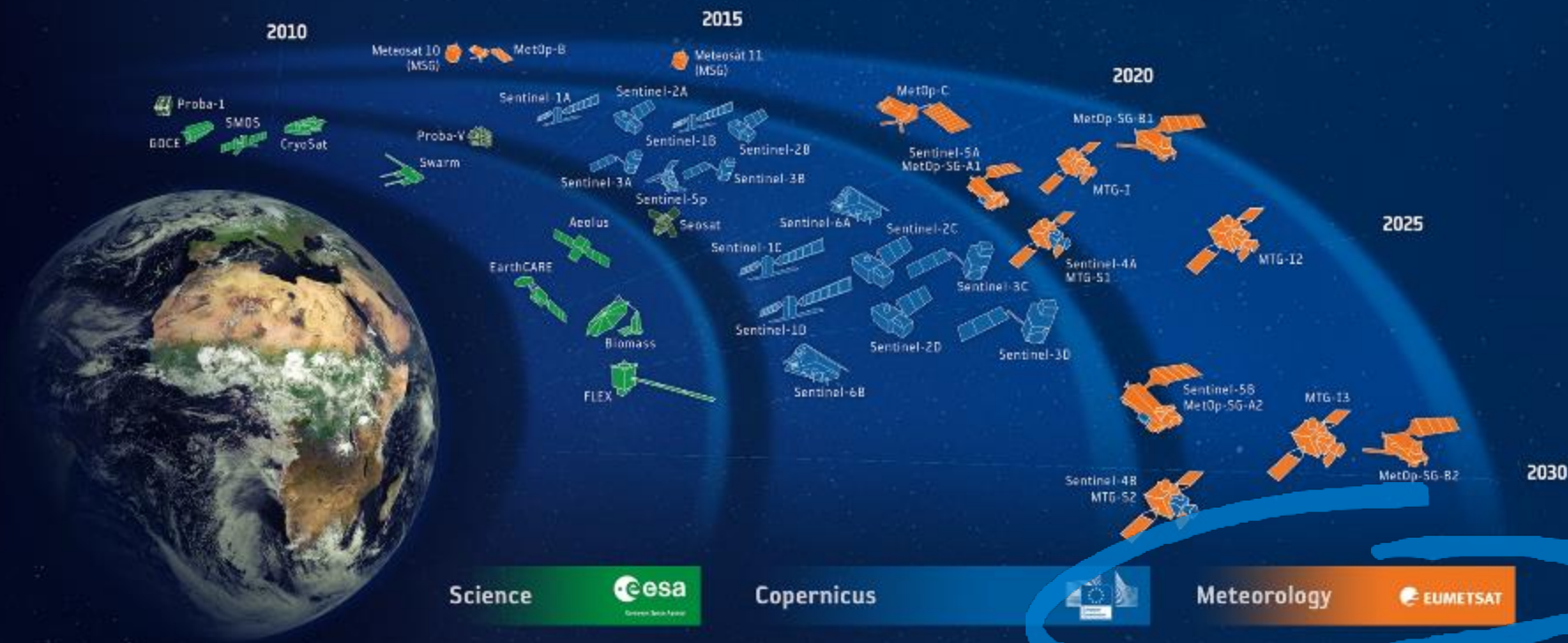
European Space Agency



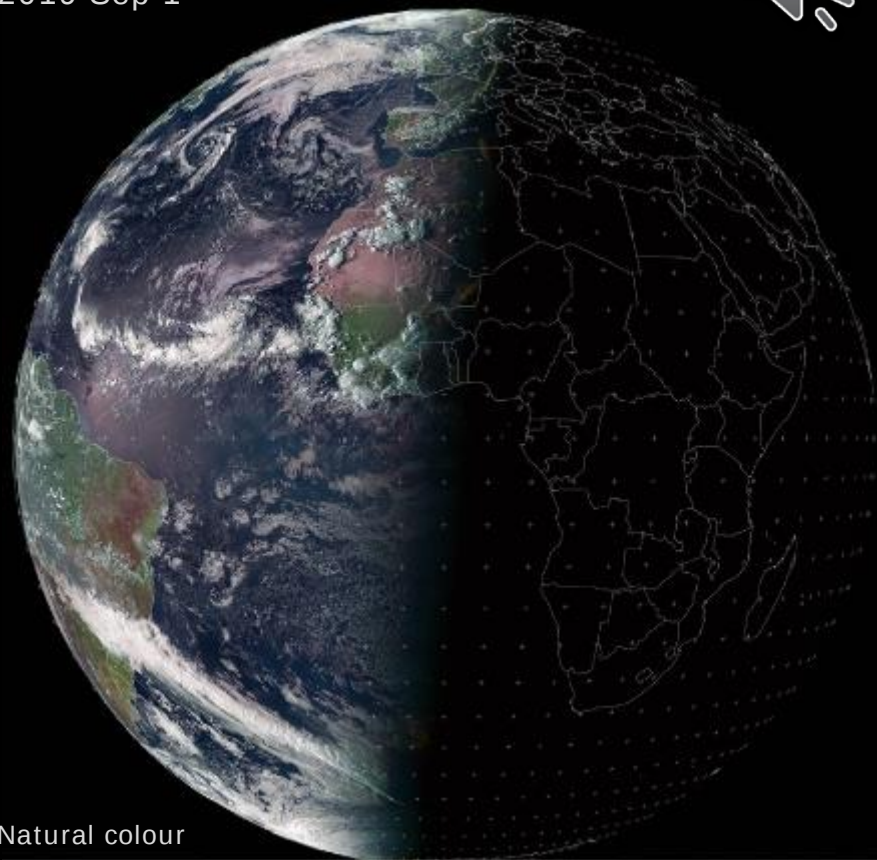
ESA provides
EO mission data
addressing
almost all
parameters
retrievable
by EO satellites

➔ Extreme user
diversity

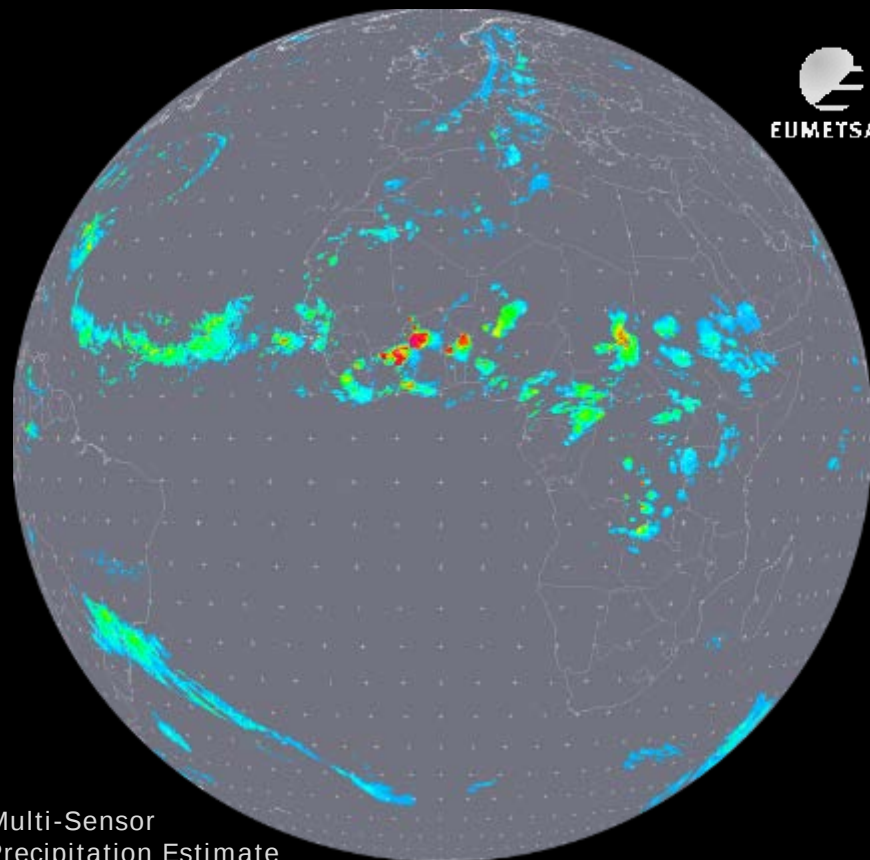
ESA-DEVELOPED EARTH OBSERVATION MISSIONS



Meteosat-11
2019 Sep 1



Natural colour



Multi-Sensor
Precipitation Estimate

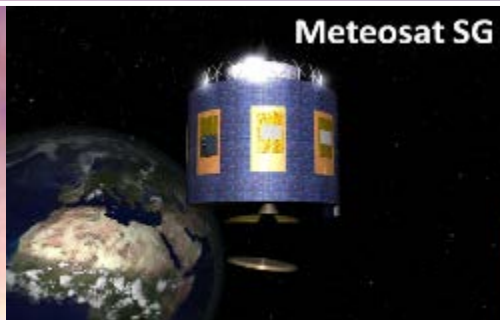
2019-09-01 17:00:00 UTC



European Space Agency

Meteorology

Current systems



Post-2020 Systems



Early 2020s begin preparation
for MFG and MetOpTG

ESA-DEVELOPED EARTH OBSERVATION MISSIONS



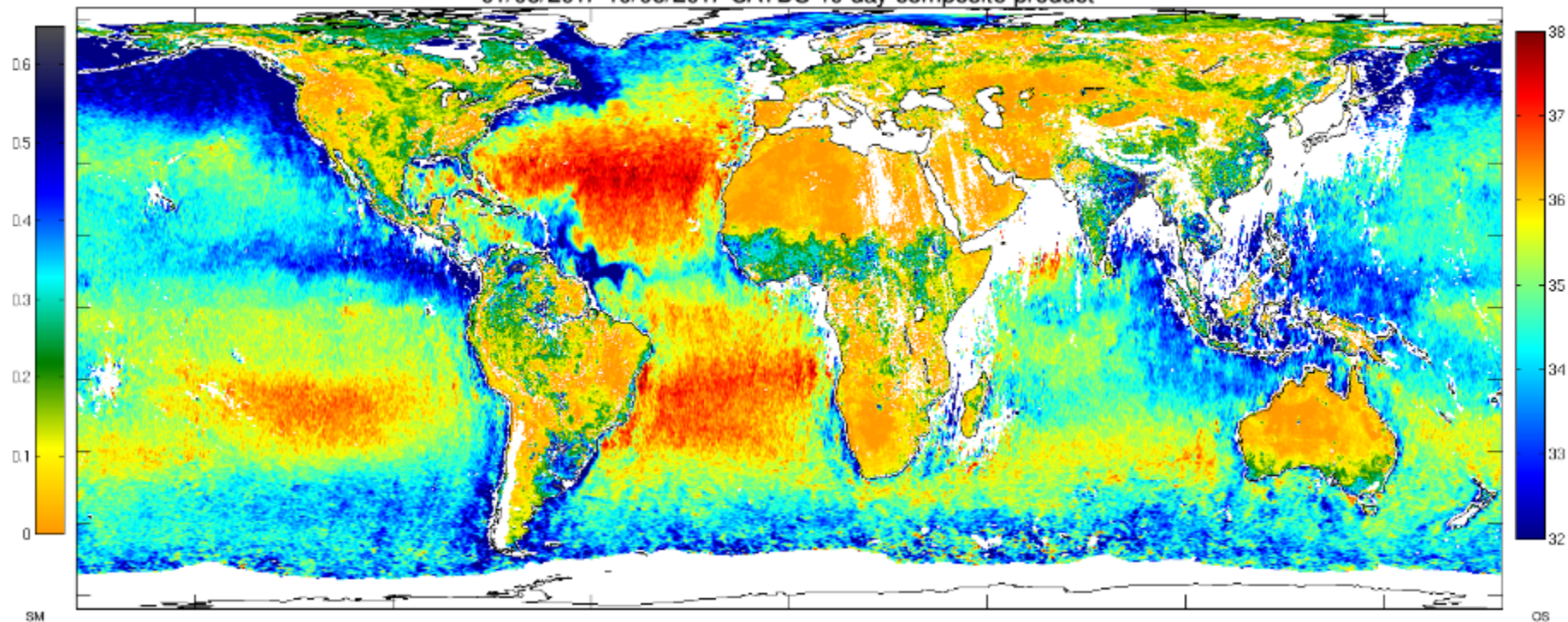
2013 – Present



SMOS Measurements

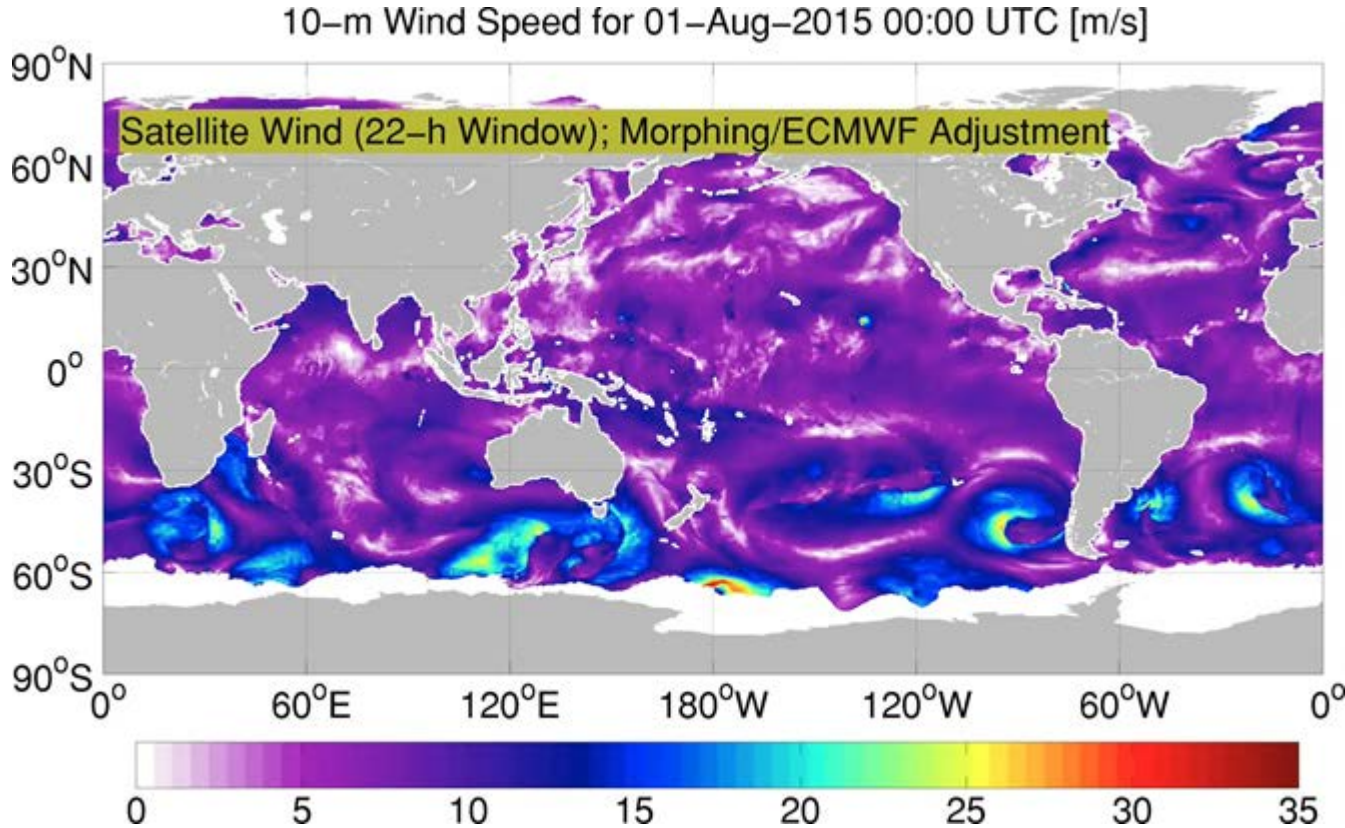


01/08/2017-10/08/2017 CATDS 10 day composite product



European Space Agency

SMOS Ocean Winds: Multi-Satellite Blended Product



SMOS data used to provide strong ocean wind speeds without saturation even over 35 m/s.

**Source: IFREMER,
OceanDataLab (FR)**

Science: Earth Explorers



flex

→ ESA'S FLUORESCENCE MISSION

2022

biomass

→ ESA'S FOREST MISSION

2022

earthcare

→ ESA'S CLOUD, AEROSOL
& RADIATION MISSION

2021

aeolus

→ ESA'S WIND MISSION

2018

goce

→ ESA'S GRAVITY MISSION

2009 – 2013

smos

→ ESA'S WATER MISSION

2009 – Present

cryosat

→ ESA'S ICE MISSION

2010 – Present

swarm

→ ESA'S MAGNETIC FIELD MISSION

2013 – Present



European Space Agency

Mission

Study of aerosols and high altitude clouds, Earth radiative budget (cooperation with JAXA)

Payload

ATLID: UV lidar, CPR: Cloud Profiling Radar (94 Ghz) from JAXA, MSI: Multi-spectral Imager, BBR Broad Band radiometer

Consortium

Prime: ADS-DE, ATLID: ADS-FR, CPR: NEC, MSI: ADS-UK, BBR: TAS-UK

Orbit SSO, alt: 393 km; LTDN: 14h00

Satellite 1950 Kg

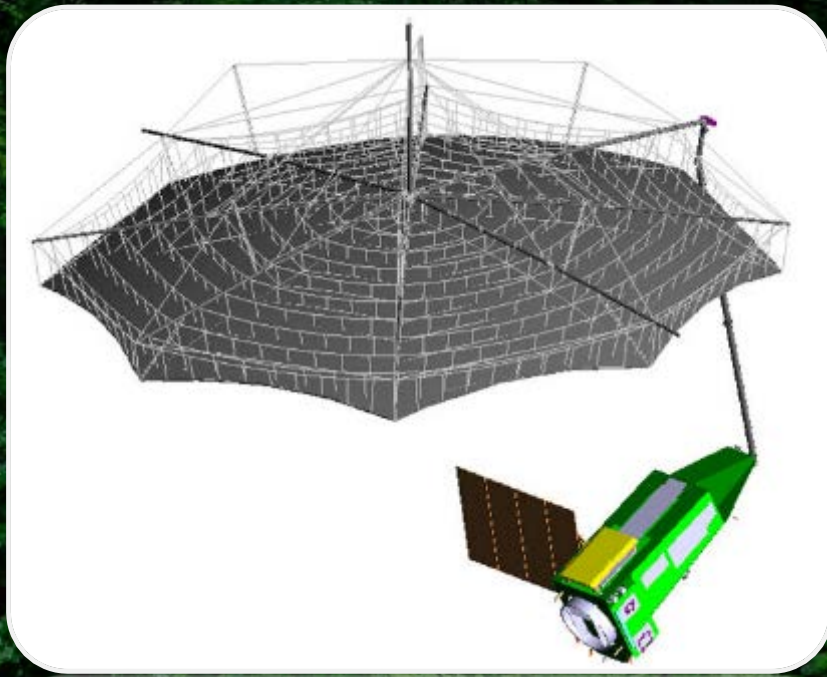
Launch date 2021



BIOMASS



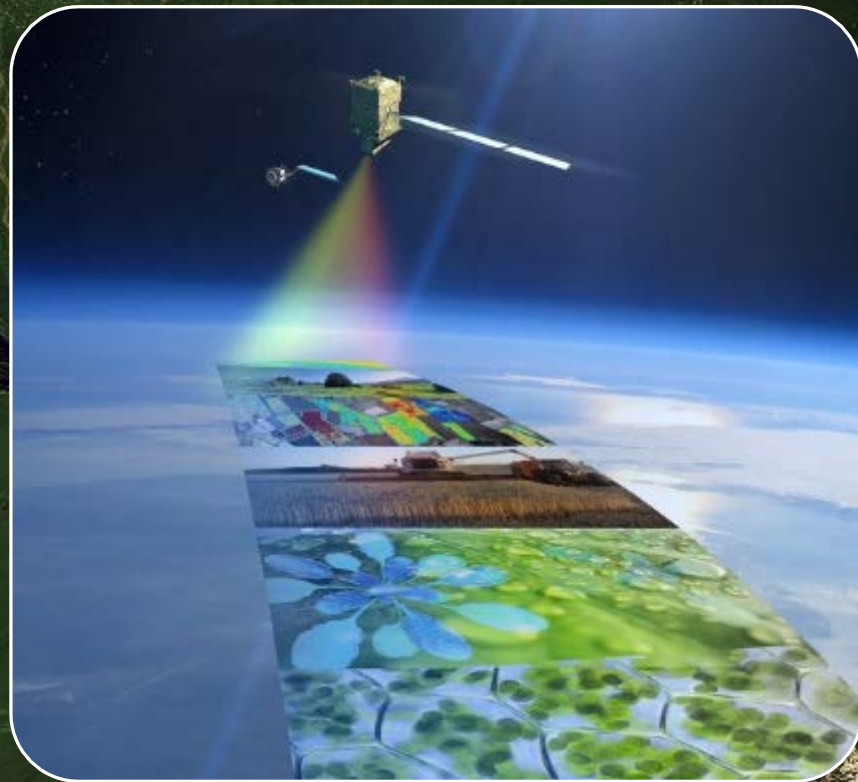
Mission	Measure of forest biomass and height (200 m. pixel resolution)
Payload	P-Band radar
Orbit	SSO, alt: 666 km; LTAN: 6h00
Satellite	1250 Kg
Consortium	Prime: ADS-UK, Instrument: ADS-DE
Launch date	2022
Lifetime	5.5 years



FLEX



Mission	Study & monitoring of fluorescence signal linked to vegetation stress; pixel 300m.
Swath	150 km
Payload	FLORIS, 2 channels spectrometers (O ₂ lines).
Orbit	SSO, alt: 814 km; LTDN: 10h00
Satellite	470 Kg
Consortium	Prime: TAS Instrument: Leonardo
Launch date	2024
Lifetime	3.5 years

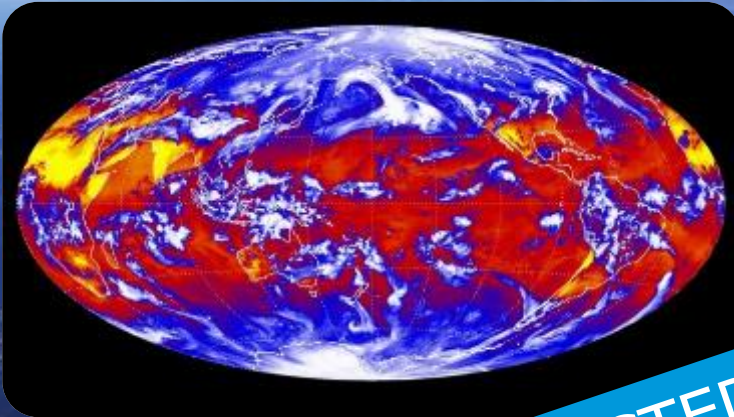


Earth Explorer 9 – Launch Around 2025



FORUM

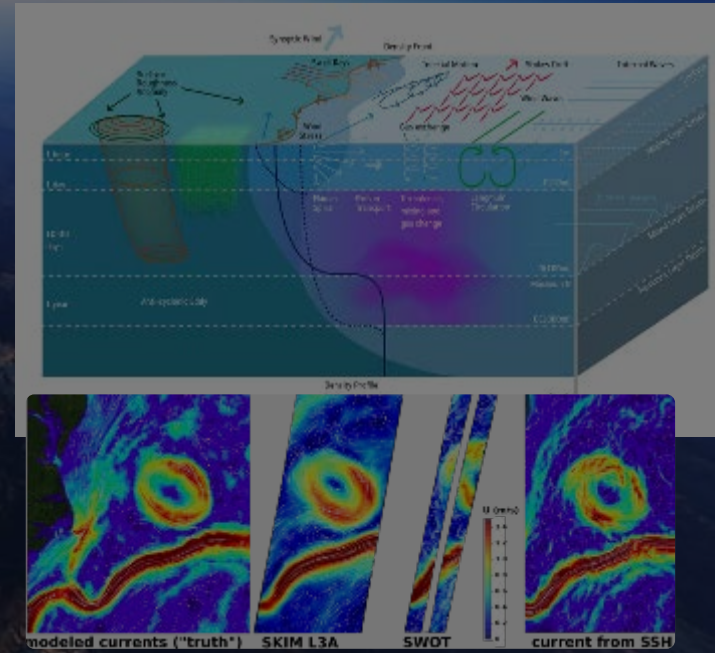
Greenhouse Effect / Climate Change



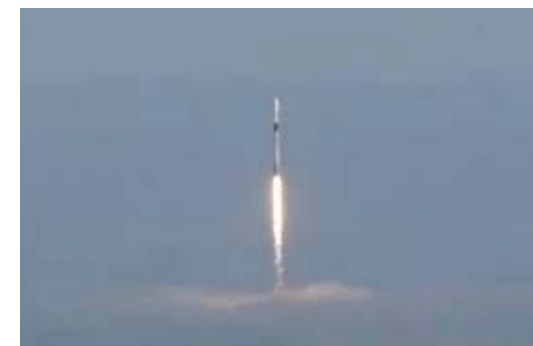
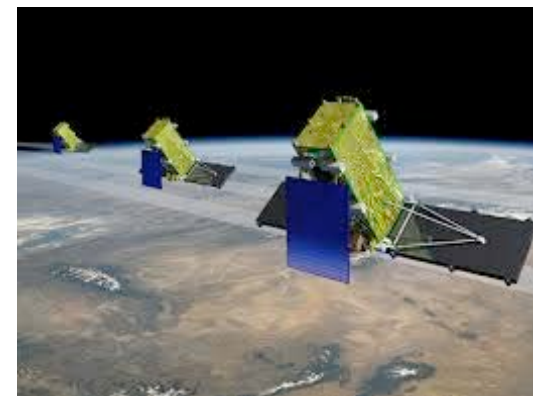
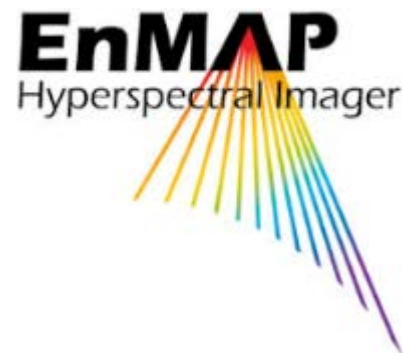
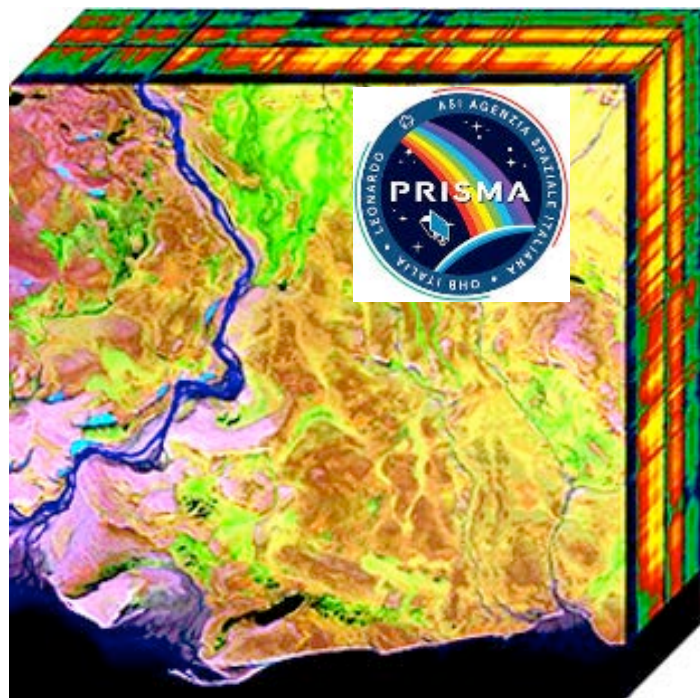
SELECTED

SKIM

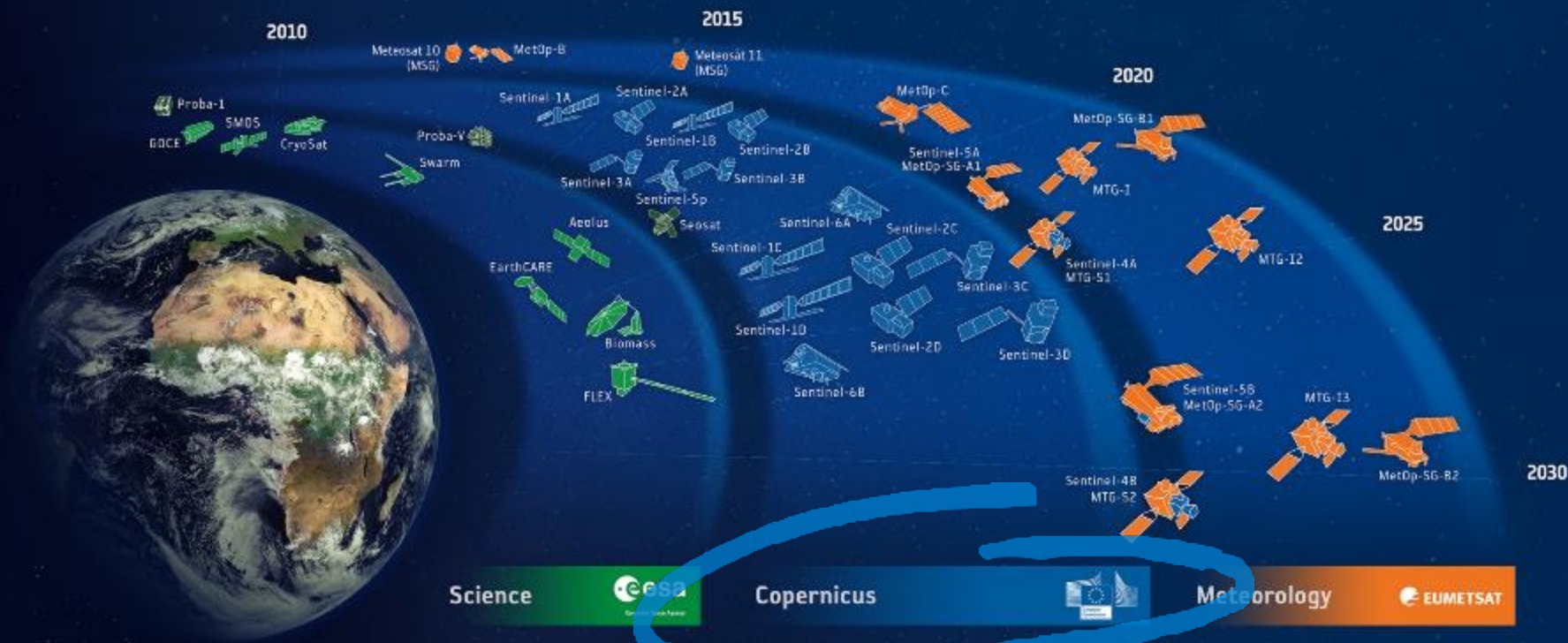
Ocean Surface Currents



National Missions



ESA-DEVELOPED EARTH OBSERVATION MISSIONS



Copernicus Sentinels Status



S-1



Radar

A

3 Apr. 2014

B

25 Apr. 2016

C

2022/23

D

> 2022/23

S-2



High Res.
Optical

A

23 Jun. 2015

B

6 Mar. 2017

C

2022/23

D

> 2022/23

S-3



Medium Res.
Optical &
Altimetry

A

16 Feb. 2016

B

25 Apr. 2018

C

2023

D

> 2023

S-4



Atmospheric
Chemistry
(GEO)

A

2022

B

2027

S-5P



Atmospheric
Chemistry
(LEO)

A

13 Oct. 2017

S-5



Atmospheric
Chemistry
(LEO)

A

2021

B

2027

C

> 2027

S-6



Altimetry

A

2020

B

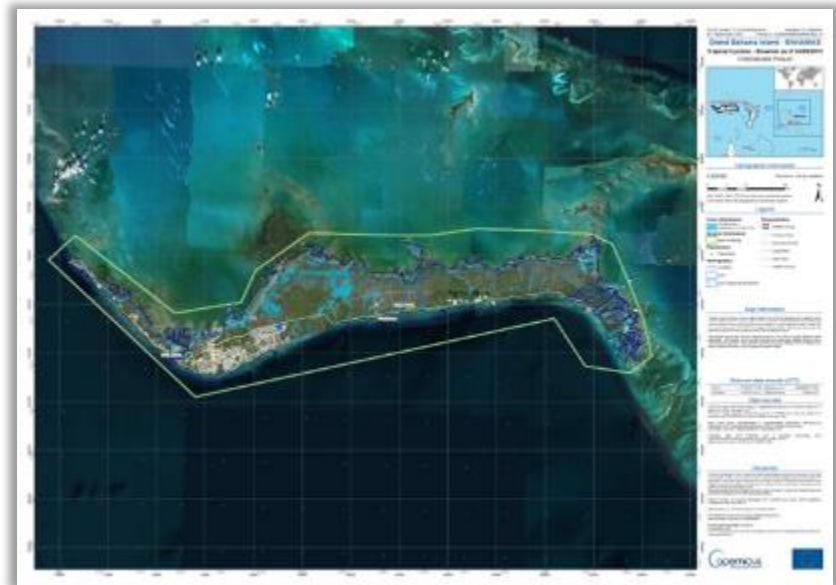
2025



Sentinel-1 Mission Status



- Sentinel-1A and Sentinel-1B mission operations → **nominal**
- **Routine provision** of Sentinel-1 data to **operational services**
- Sentinel-1 **contribution to emergency activations**, in particular from the Copernicus Emergency Management Service, continues to be very high, for flood monitoring in particular
- **Good health of both Sentinel-1A and Sentinel-1B satellites**
- Sentinel-1 is operated close to its **full mission capacity** i.e. difficulty to accommodate additional observations



Grand Bahamas Island, Tropical Cyclone Dorian

*Flood map based on Sentinel-1 imagery
acquired on 4 Sep 2019 at 11:09 UTC*

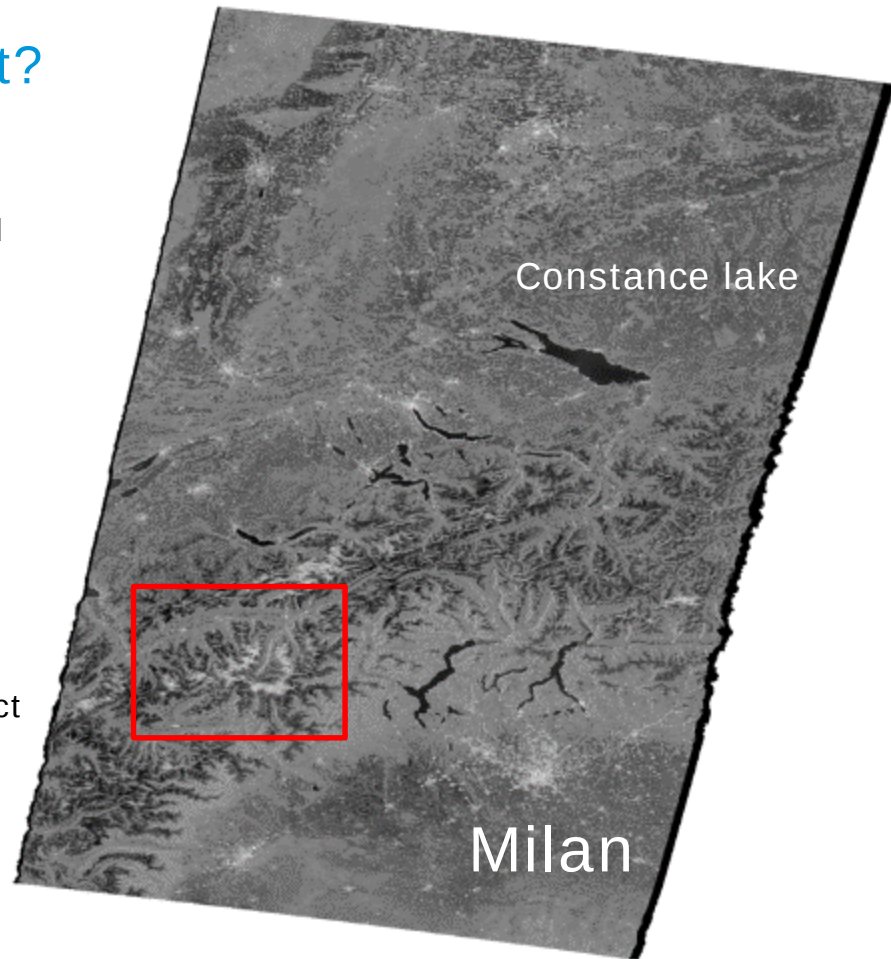
*Activation EMSR0385 from
Copernicus Emergency Management Service
processed by CEMS – GAF-AG released by e-geos*

Sentinel-1 Radiometry: What's Next?

S-1 radiometric calibration has reached an unprecedented accuracy and stability over time.

Major improvement can still be achieved using [terrain correction](#):

- Operationally possible since Copernicus DEM is a reality and algorithm is mature
- Would provide major improvements for different Copernicus services and for many users
- Decision to provide a new operational core product not taken yet, needs further discussion with the European Commission



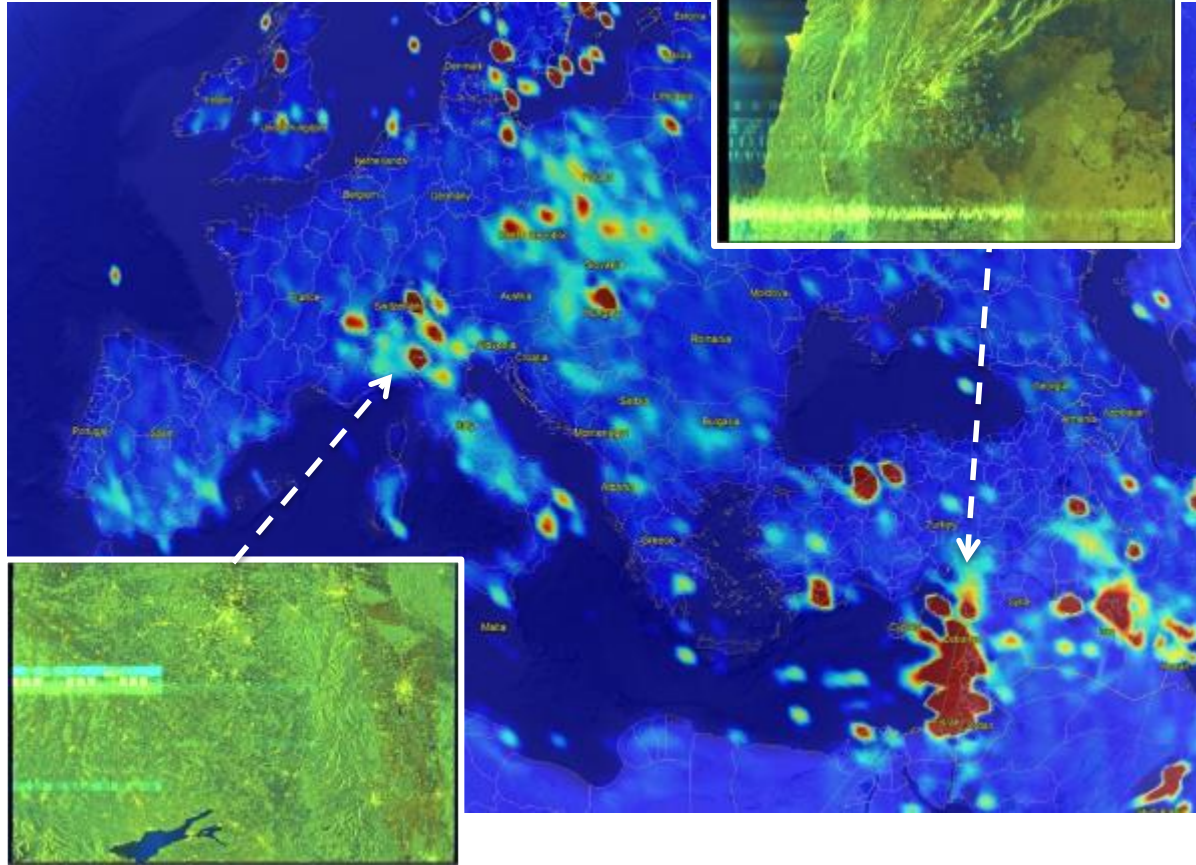
Sentinel-1 Radiometry: What's Next?

Radio Frequency Interferences (RFI) are severely impacting image quality

Represent major annoyance and limitation for users

Activity on-going for mapping and characterisation at global level (first time ever)

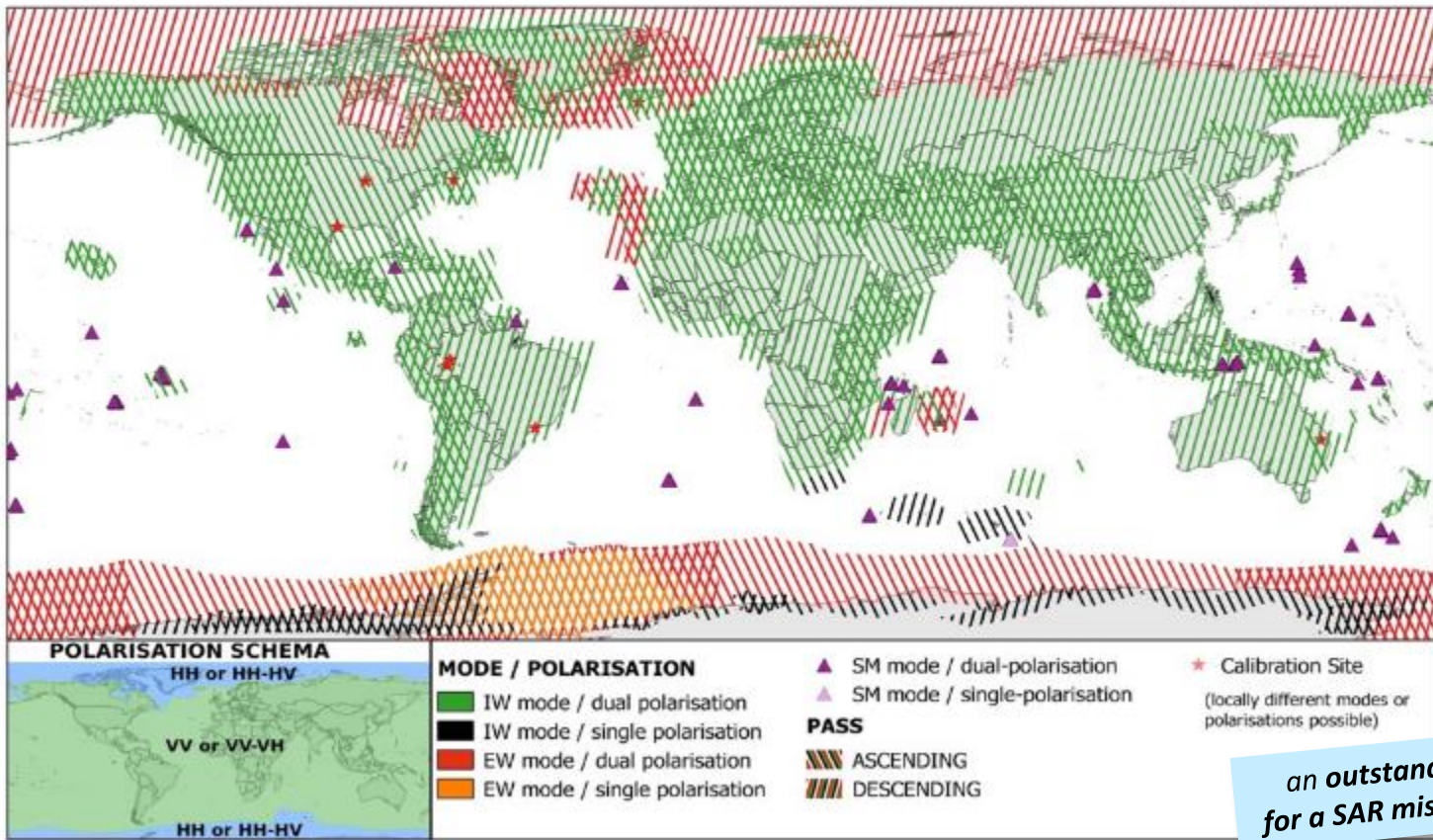
Planned processor evolution to filter RFI 2020+



Sentinel-1 Constellation Observation Scenario: Mode - Polarisation - Observation Geometry

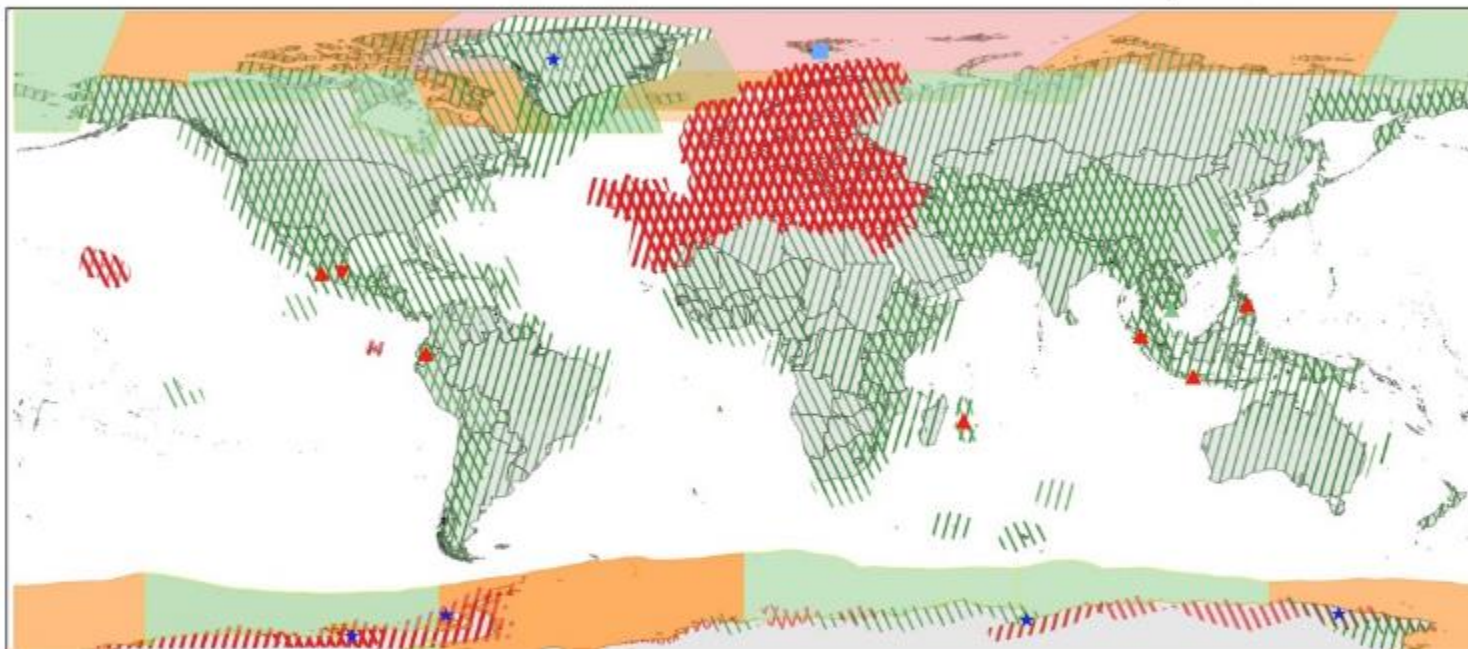
Updated
Baseline Map,
starting
May 2019

This map is
related to SAR
High Rate
modes only.
Wave mode
operated by
default over
open oceans
(not shown)



*an outstanding coverage achievement
for a SAR mission, predictable and reliable!*

Sentinel-1 Constellation Observation Scenario: Revisit & Coverage Frequency



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

* coverage ensured from same, repetitive relative orbits

** coverage not considering repetitiveness of relative orbits

an outst

for a SAR

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

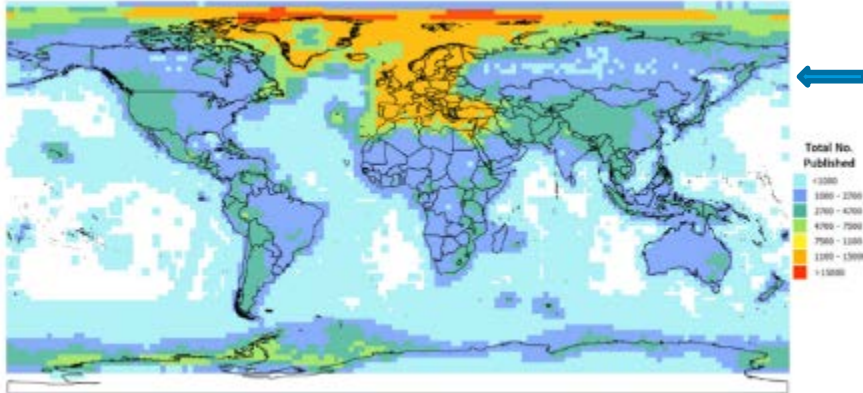
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Baseline Map,
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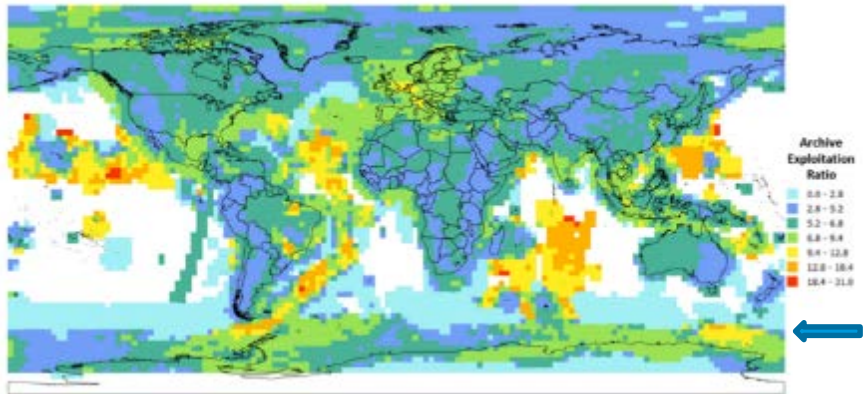
*an outstanding coverage achievement
for a SAR mission, predictable and reliable!*

Sentinel Data Access 2018 Report

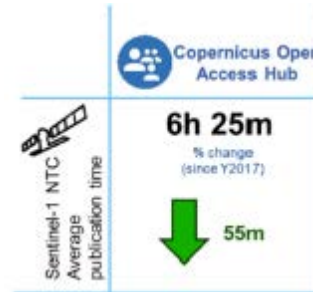
Examples of Sentinel-1 data product / user statistics



Heatmap of Sentinel-1 products (excluding OCN) published since the start of operations



Heatmap showing the archive exploitation ratio for Sentinel-1 L0 and L1 NTC products (excluding WV mode) during Y2018



Average publication timeliness on the Open Access Hub during Y2018



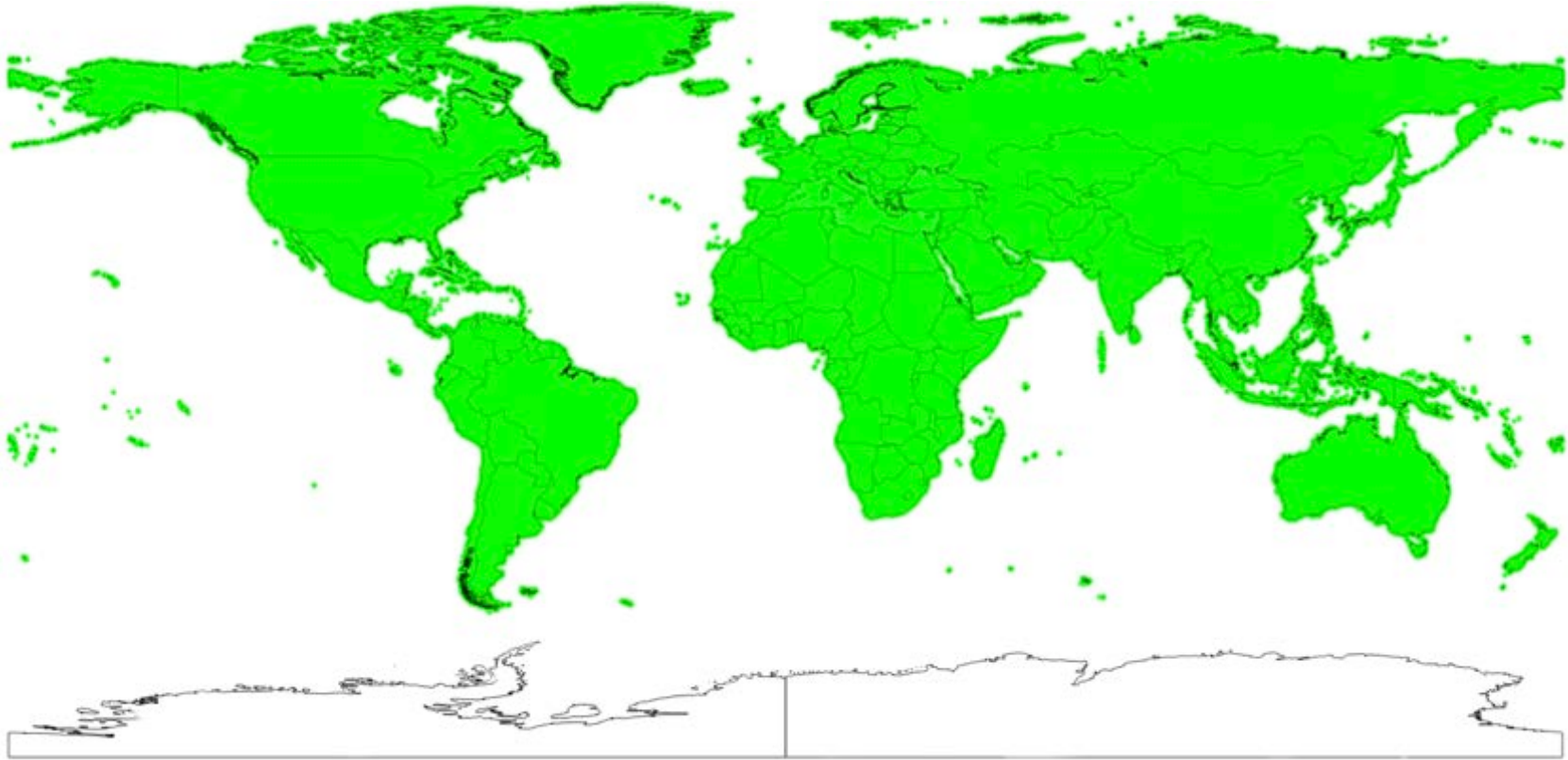
<https://scihub.copernicus.eu/reportsandstats>



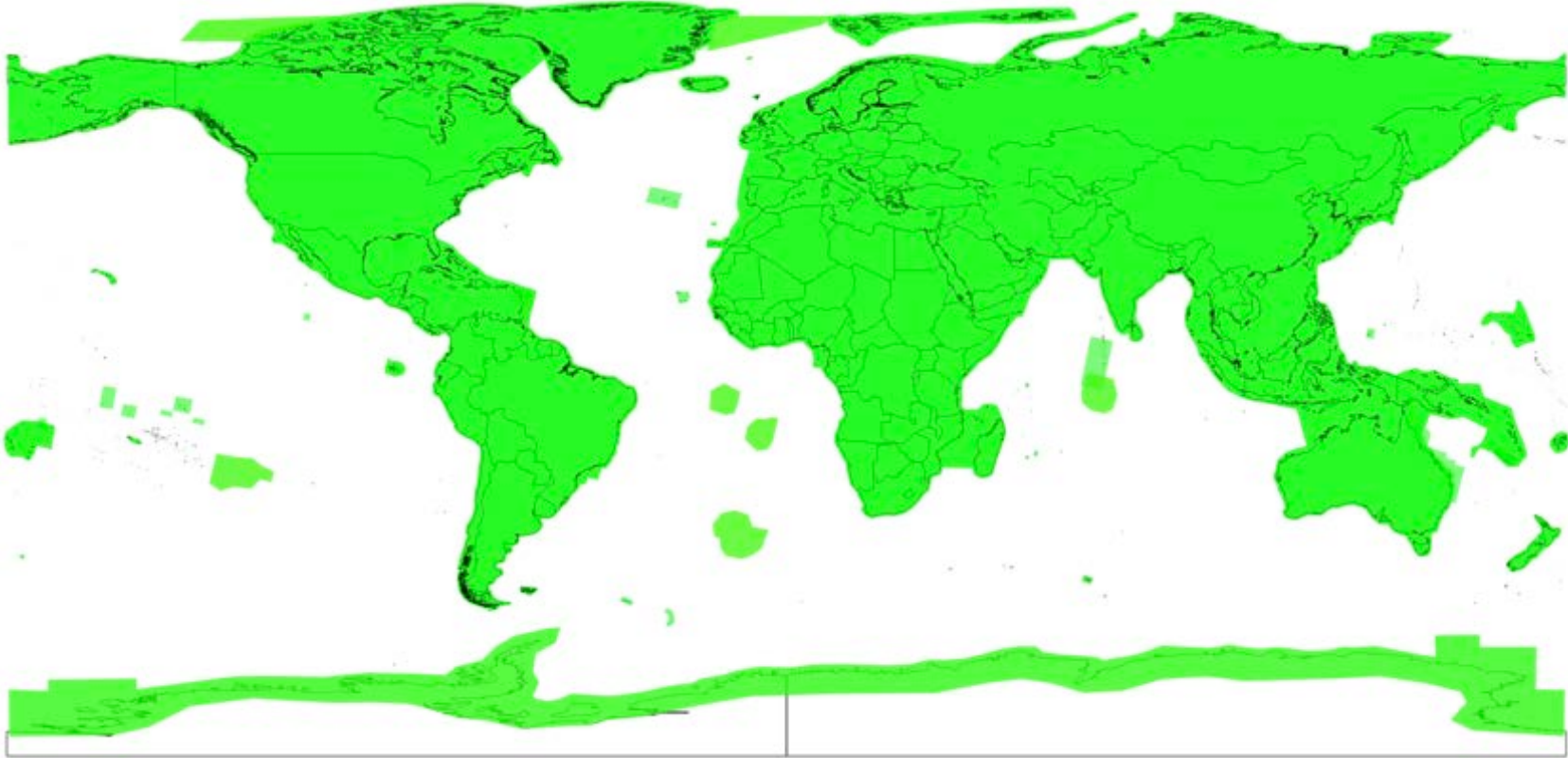


- Nominal Sentinel-2 constellation operations with Sentinel-2A and Sentinel-2B
- Routine provision of Sentinel-2 data to operational services
- Level-2A surface reflectance product generated worldwide systematically since 13 December 2018
- Good health of both Sentinel-2A and Sentinel-2B satellites
- Sentinel-2 is operated beyond the initially required observation scenario

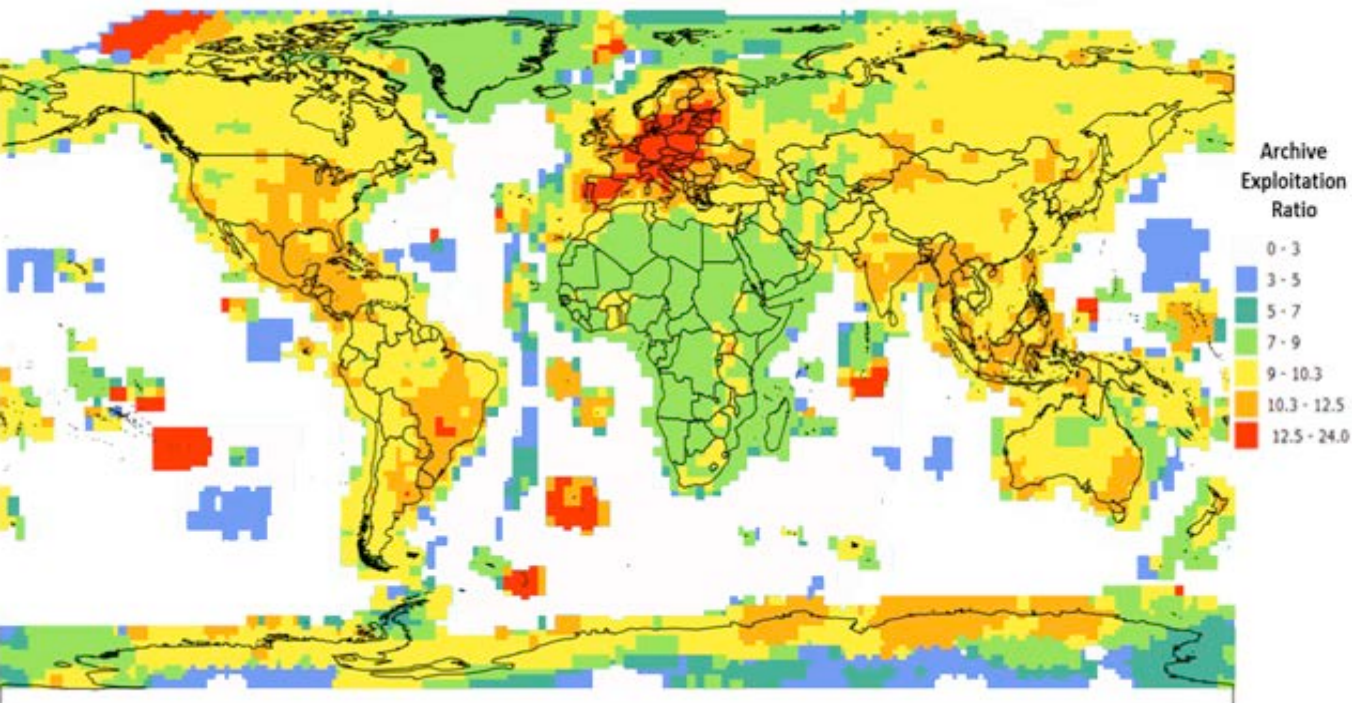
S-2 Observation Scenario (Mission Requirements)



S-2 Observation Scenario (Current)



S-2 Data Access / Archive Exploitation Ratio

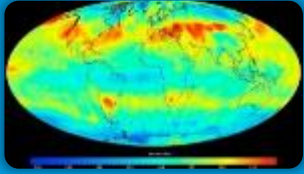


Available online

Copernicus 2.0 – New Monitoring Missions

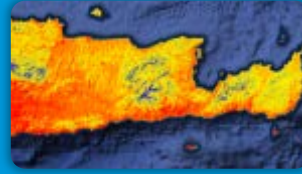


Anthropogenic CO₂ Monitoring Mission



Causes of
Climate Change

Land Surface Temperature Monitoring



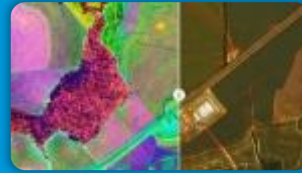
Agriculture,
Water Productivity

CRISTAL – Polar Ice/Snow Topography



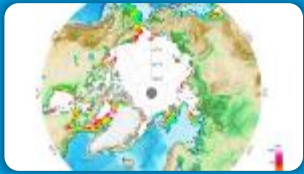
Effects of
Climate Change

CHIME – Hyperspectral Imaging Mission



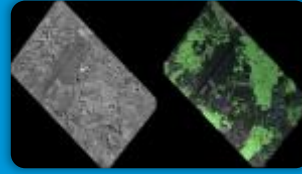
Food Security, Soil,
Biodiversity

CIMR – Passive Microwave Radiometer



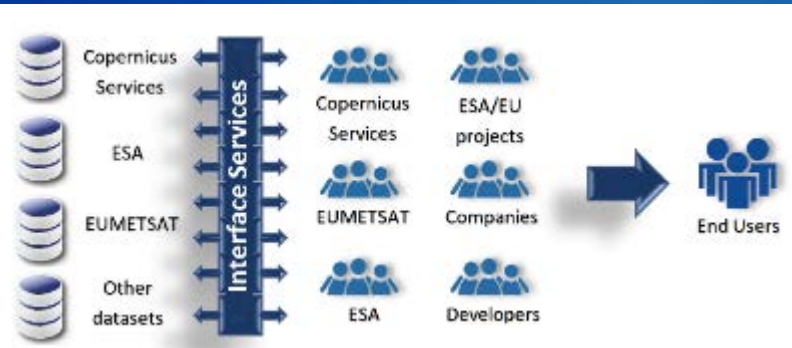
Sea Surface Temperature,
Ice Concentration

L-band SAR Mission

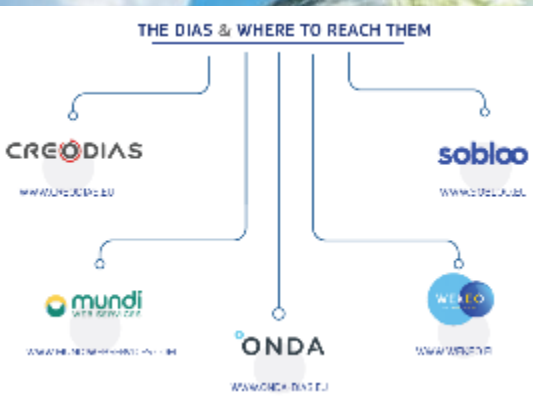


Vegetation, Ground
Motion, Soil Moisture

DIAS – Creating an EO Data Ecosystem



- Copernicus **Data and Information Access Services**
- Common DG-GROW-ESA approach to EO data exploitation with Copernicus at its core
- Create & enable European EO Data ecosystem for research & business
- Started June 2018



How Do We Work With EO at ESA?



Workshops & conferences



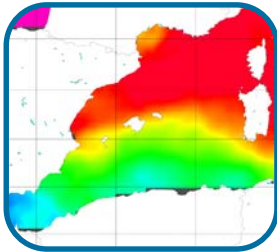
Training and Education



Toolboxes



Open Science



New methods & products



Earth system science



Driving future missions



Campaigns

A Strong European EO Service Portfolio



Imagery and Data



Information



Solutions



Decisions

Marine & Coastal

Polar & Sea Ice

Soil, Water & Urban

Food Security

Maritime Security

Forest Monitoring

Atmosphere

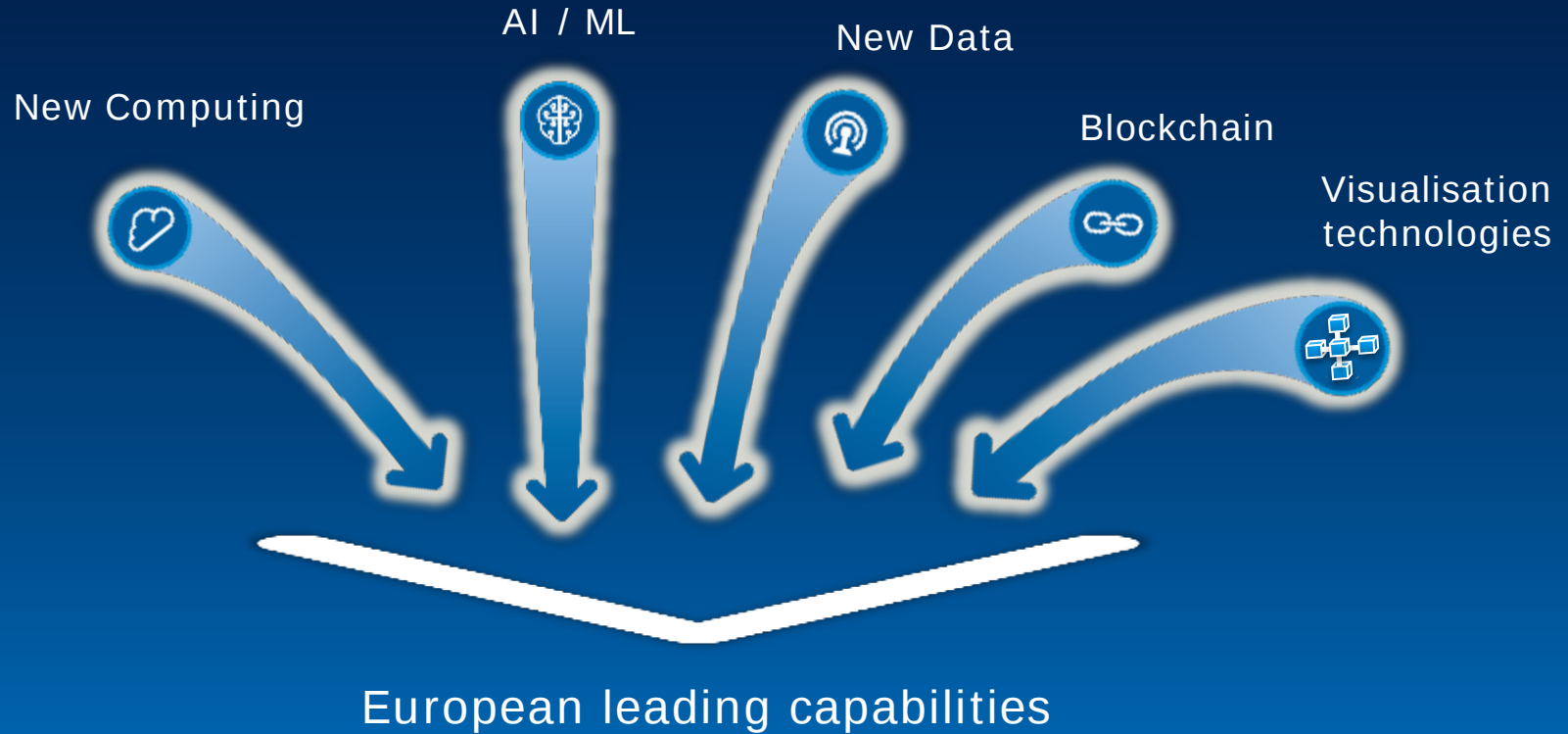
Flood & Fire Risk

Land Motion

Humanitarian Aid



Combining Parallel Developments



FutureEO Block 4 – Earth Science for Society



- Grand Science Challenges (with EC/RTD)
- Resilient Society bring EO Solutions for environmental threats, adaptation and SDG
- Regional Initiatives (Applications and Platforms)
- Pioneer Artificial Intelligence for EO (AI, Blockchain, Big Data)
- Exploit HAPS
- Develop Civilian Security Applications
- EO AFRICA (users engagement & uptake of EO solutions)
- **10% of budget via Open Call to foster innovative projects**

Grand Challenges



EO for Resilient Society



Regional Initiatives



EO4AI



EO for Africa



Security Applications



Earth Observation: A Necessity



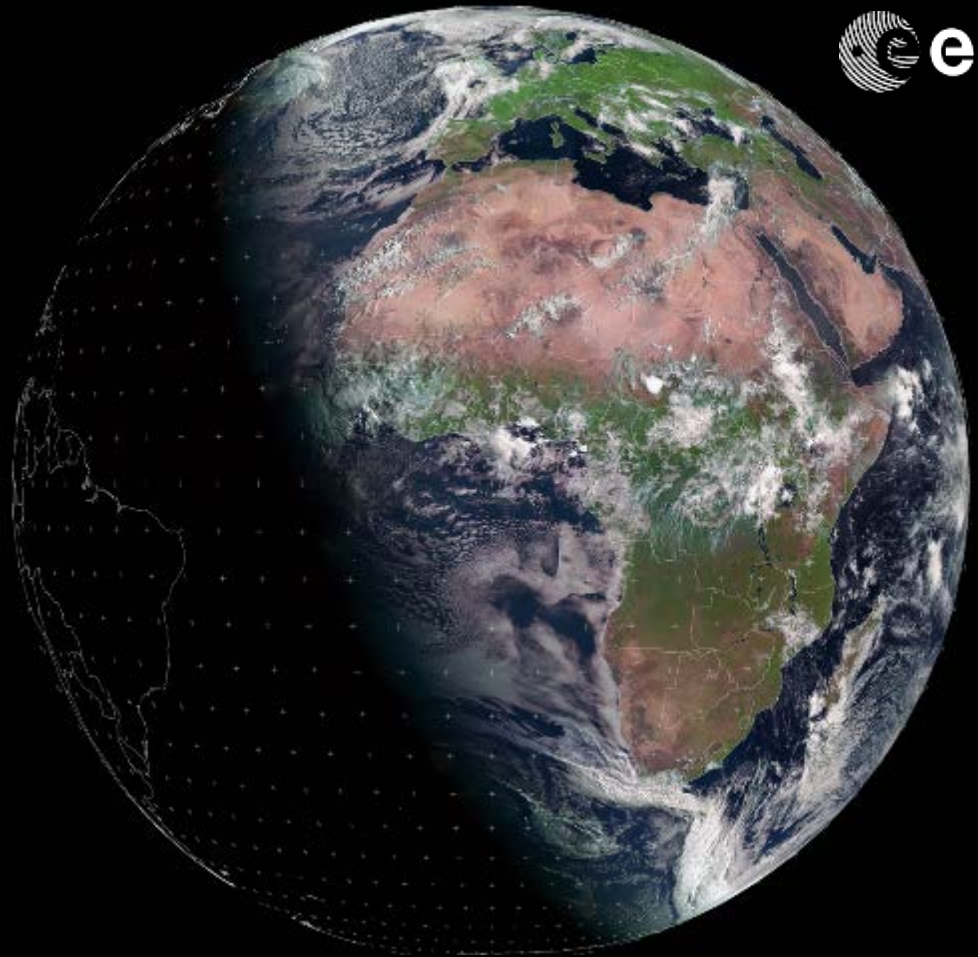
Thanks!

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European Space Agency