

Status of ESA Earth Observation Programmes

ESSC Meeting

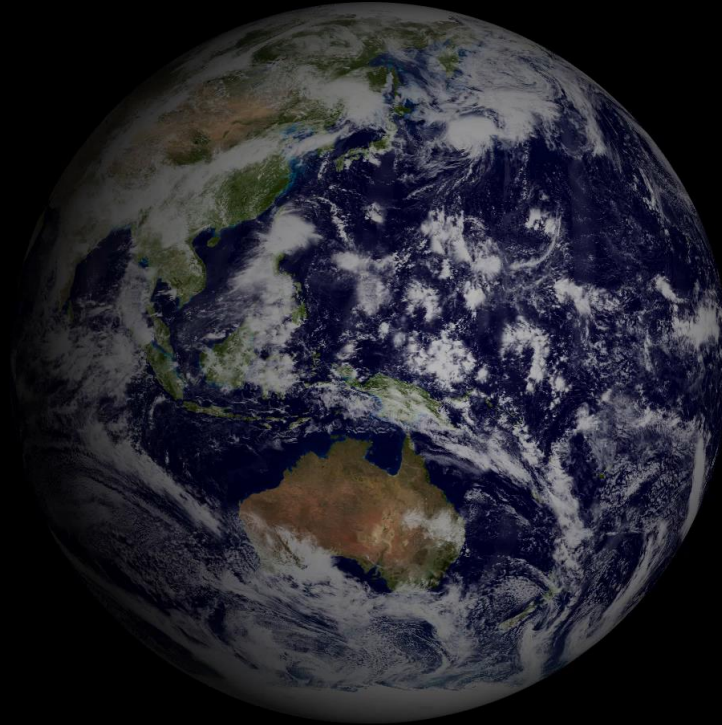
London, 27 November 2018

Maurice Borgeaud, ESA

Head of the ESA Earth Observation Department

"Science, Applications and Climate"

Feeling the Pulse of our Planet

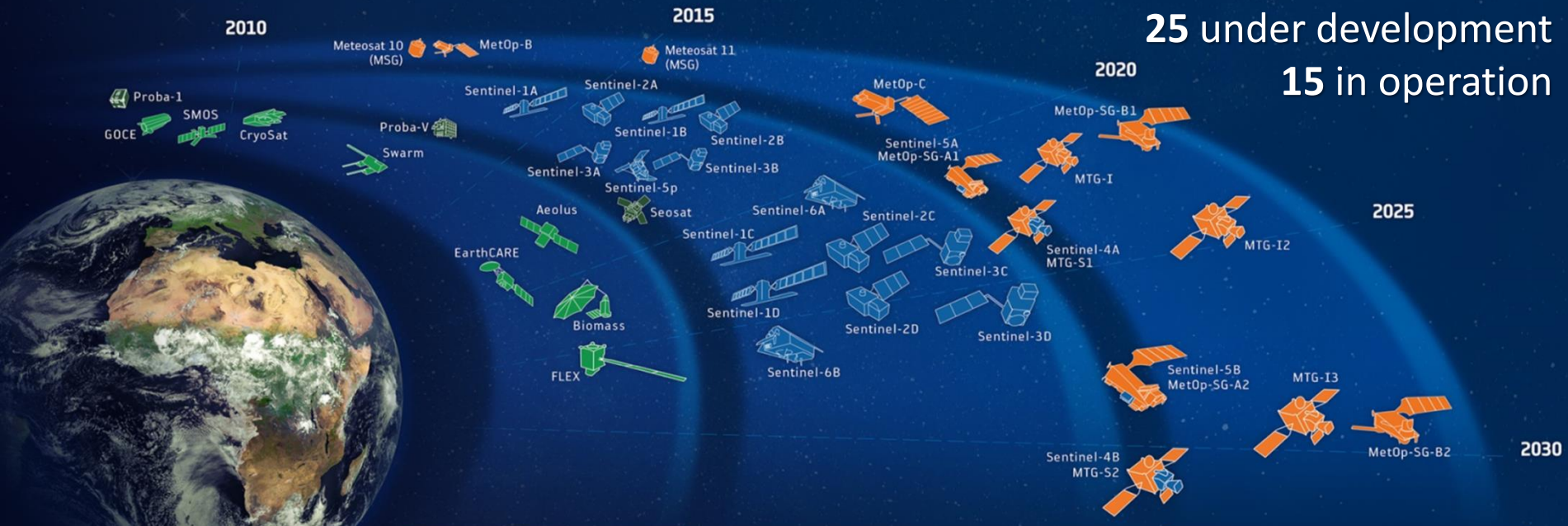


ESA-DEVELOPED EARTH OBSERVATION MISSIONS



Satellites

25 under development
15 in operation



Science

Copernicus

Meteorology

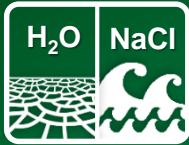


Flying Missions

GOCE
2009-2013



SMOS
2009



Cryosat
2010



Swarm
2013



Aeolus
2018



Science & Innovation



4.700+
Reg. Users

Future Missions

EarthCare
2021



Biomass
2022



FLEX
2022



EE-9
2025

2
Cand.

EE-10
2027

3
Cand.

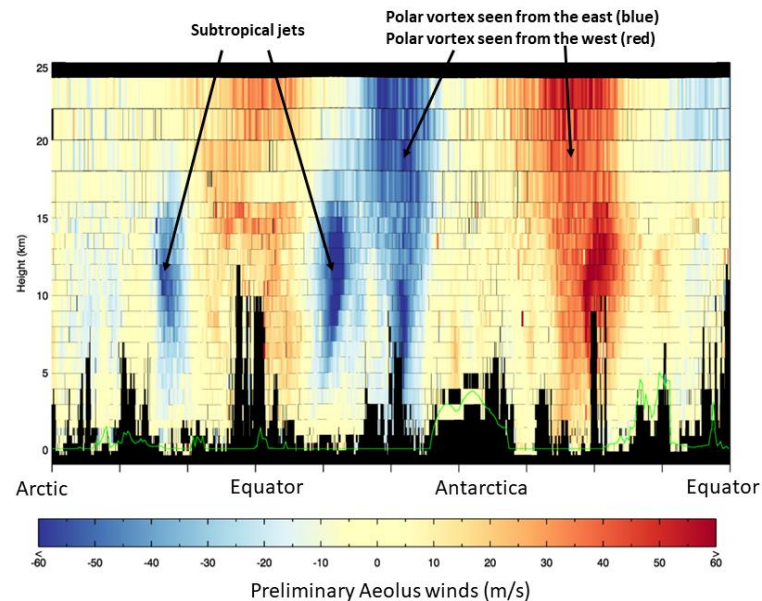
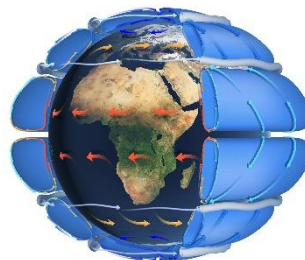
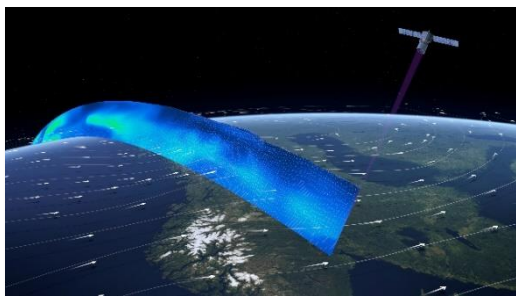


300+ Publ.
per Year

**High Risk for
Great Rewards**

AEOLUS – The Wind Mission

- Launched on 22 August 2018
- Aeolus will advance our understanding of atmospheric dynamics
- First wind **UV Doppler LIDAR** in space
- Probes lowermost 30 km of the atmosphere to provide profiles of **wind**, **aerosols** and **clouds**
- Can provide information to improve **numerical weather** and **climate prediction**



Upcoming Earth Explorers



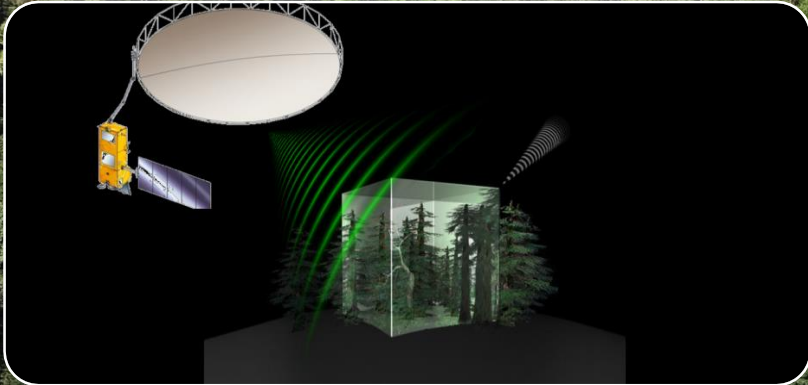
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EarthCARE

- Clouds, aerosols & radiation
- High performance lidar tech.
- Partnership JAXA
- Launch planned 2021



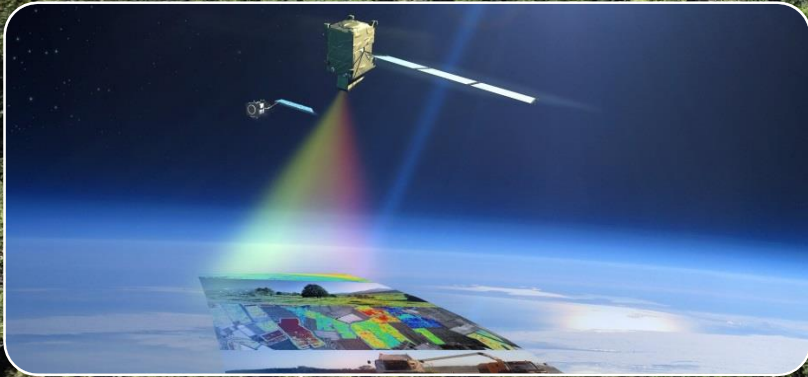
Further Earth Explorers



7

Biomass

- Biomass estimates
- First P-band SAR in space
- Launch planned 2022



8

FLEX

- Vegetation fluorescence, indicator of photosynthesis
- Launch planned 2022



Status Future Earth Explorers

9

2 Candidates

- FORUM or SKIM
- Mission selection in Sept. 2019
- Launch around 2025

10

- Three candidates for Phase 0
 - STEREOID
 - Daedalus
 - G-CLASS:H2O
- Launch around 2027/28



Earth Explorer 9 Candidates

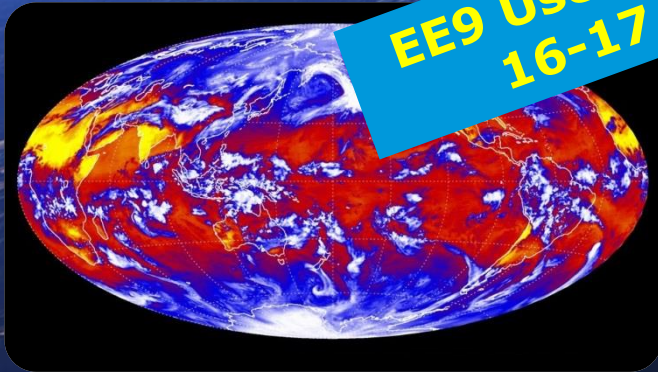


- Candidates undergoing competitive feasibility assessment (Ph. A/B1)
- End Phase A selection recommendation by ACEO Prioritisation Panel 19
- EE9 implementation financed via EOEP-Next Programme proposal
- Launch around 2025

**EE9 Users Consultation Meeting (UCM),
16-17 July 2019, Cambridge, UK**

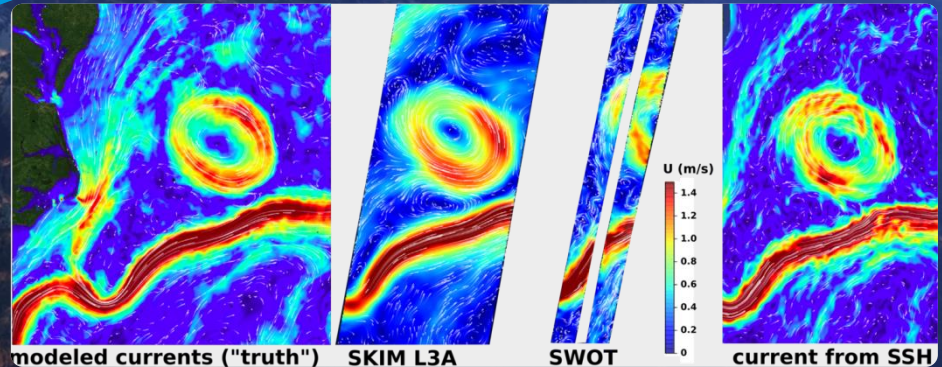
FORUM

Far-infrared Outgoing Radiation



SKIM

Ocean Surface Currents



Science dashboard



More than **40**
Workshop
and conferences



More than **9,000** workshop participants



More than **250**
scientific institutions involved



More than **400**
peer-reviewed
scientific papers



More than **260,000**
SNAP Toolbox downloads



More than **500,000**
users of
SNAP Platform



More than **1,000**
young scientists
trained

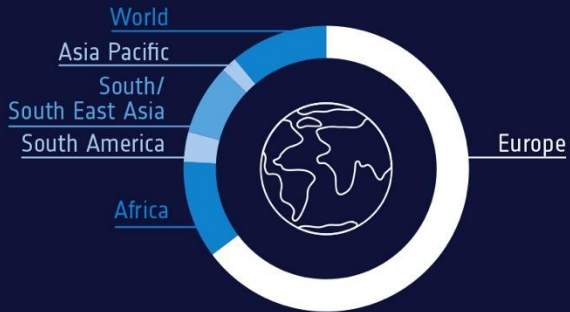
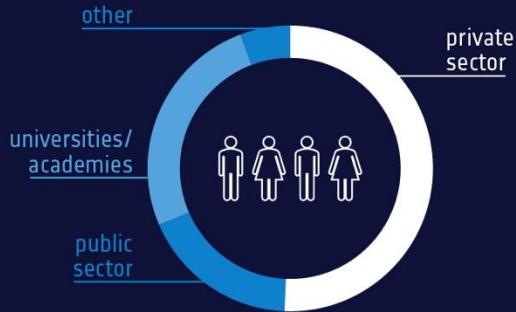


More than **20,000**
participants to on-line courses

EOEP Block 4 dashboard



WHO WE WORK WITH



WHERE WE WORK

INNOVATION



43%

of EOEP contract address innovative new developments



OPEN CALL

36 industry led innovative projects per year

FOCUS ON SMES



40% of industrial contractors are SMEs

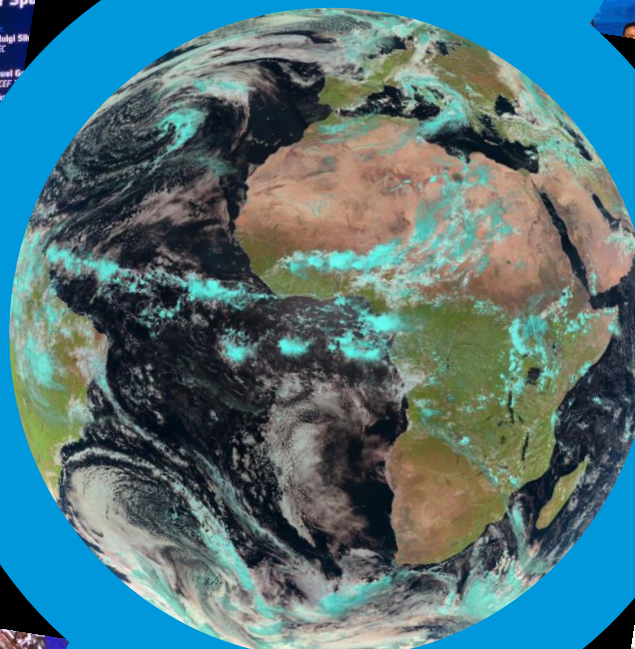
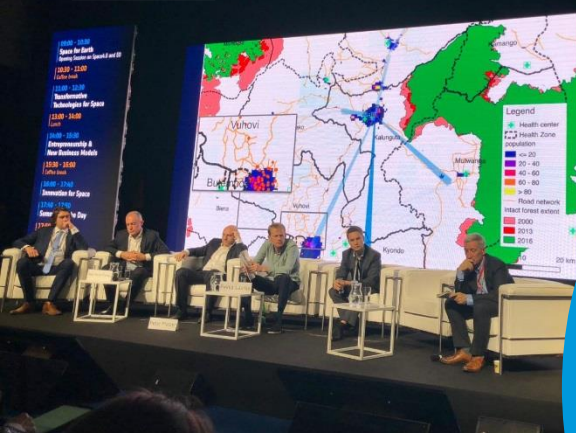
64% of all industrial spend with SMEs

PARTNERSHIPS



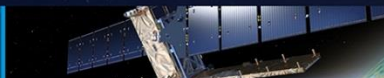
On average, each contract involves and **3.4** countries partners and **4.7**

<http://phiweek.esa.int/>
11-16 Nov 2018



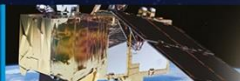
European Space Agency

Copernicus: Sentinels



sentinel-1

→ RADAR VISION



sentinel-2

→ COLOUR VISION



sentinel-3

→ A BIGGER PICTURE



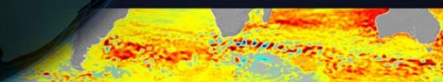
sentinel-4

→ EUROPEAN AIR MONITORING



sentinel-5p | sentinel-5

→ GLOBAL AIR MONITORING



sentinel-6

→ SURFING THE SEAS



> 175.000

registered users
= tip of the iceberg



Land



Atmosphere



Ocean



Climate



Disaster



Security

6 operational services



150 TB satellite data
distributed per day



full, free & open
data policy

7 satellites flying

S1



S2



S3



S4



S5P



S5



S6



preparing Copernicus 2.0

Copernicus Services

Land

Atmosphere

Marine Environment

Climate Change

Emergency Management

Security

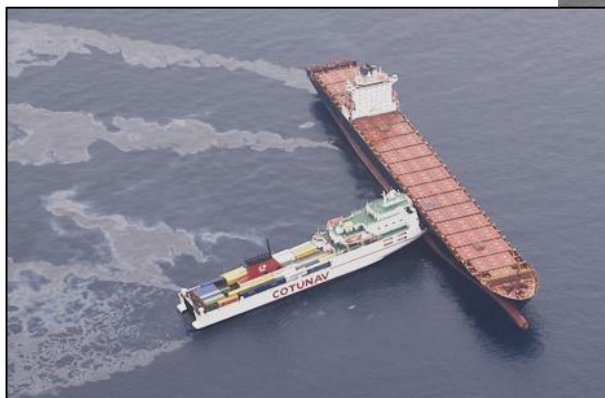


Security
Refugee Camp Monitoring

Sentinel-1 mission status



*Oil Spill North of Corsica,
8 September 2018*

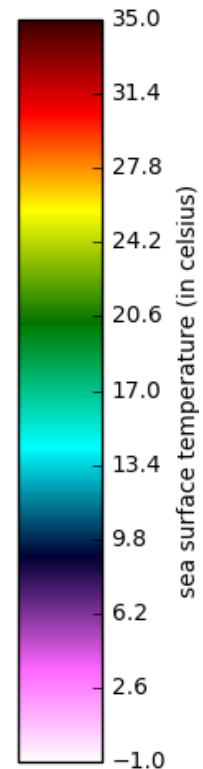
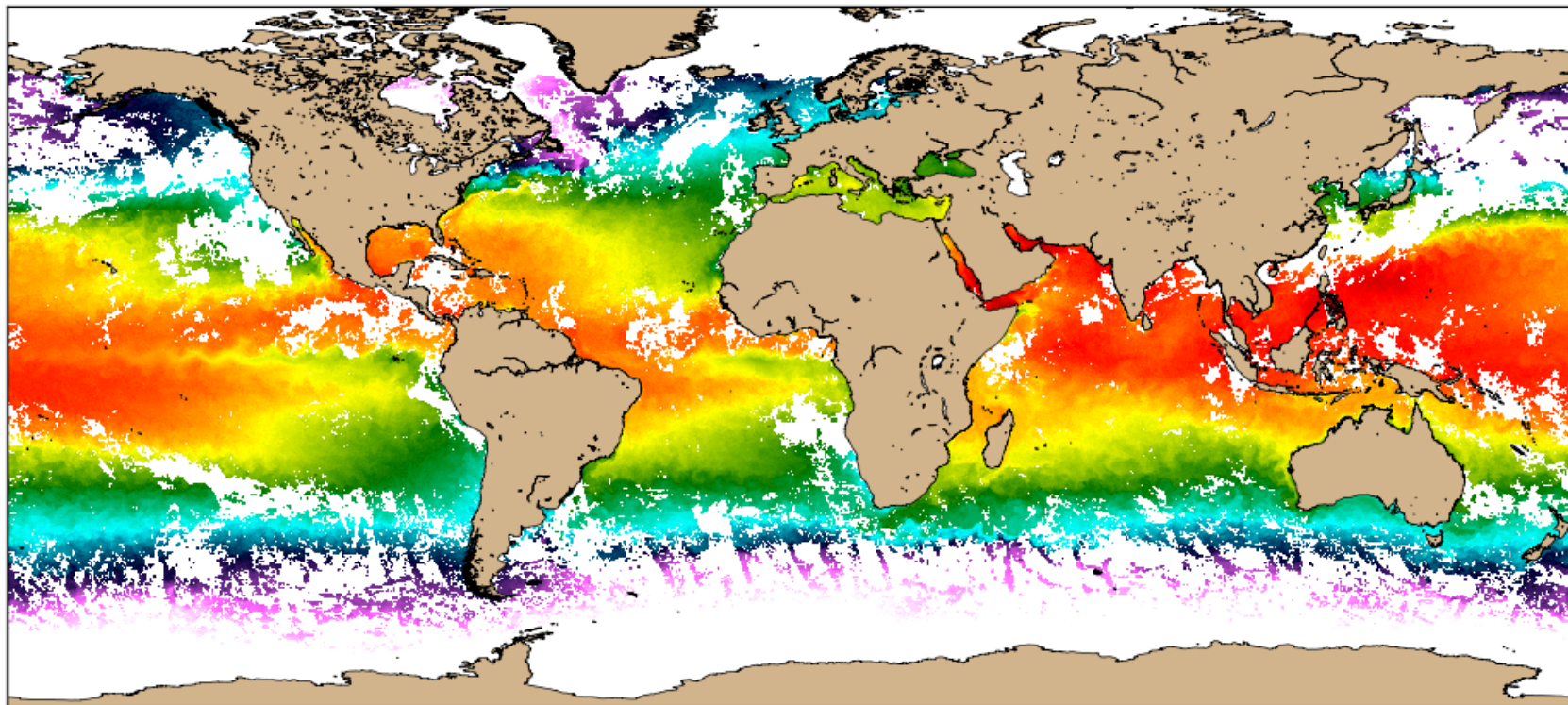


Copyright: Contains modified Copernicus Sentinel data (2018) / processed by ESA

Sea Surface Temperature

sea surface skin temperature
15-19 Jun 2017 composite - Sentinel-3A / SLSTR WST NR [PB2.16]-
N = 1427346, min = -1.99 C, max = 36.71 C

Sentinel-3

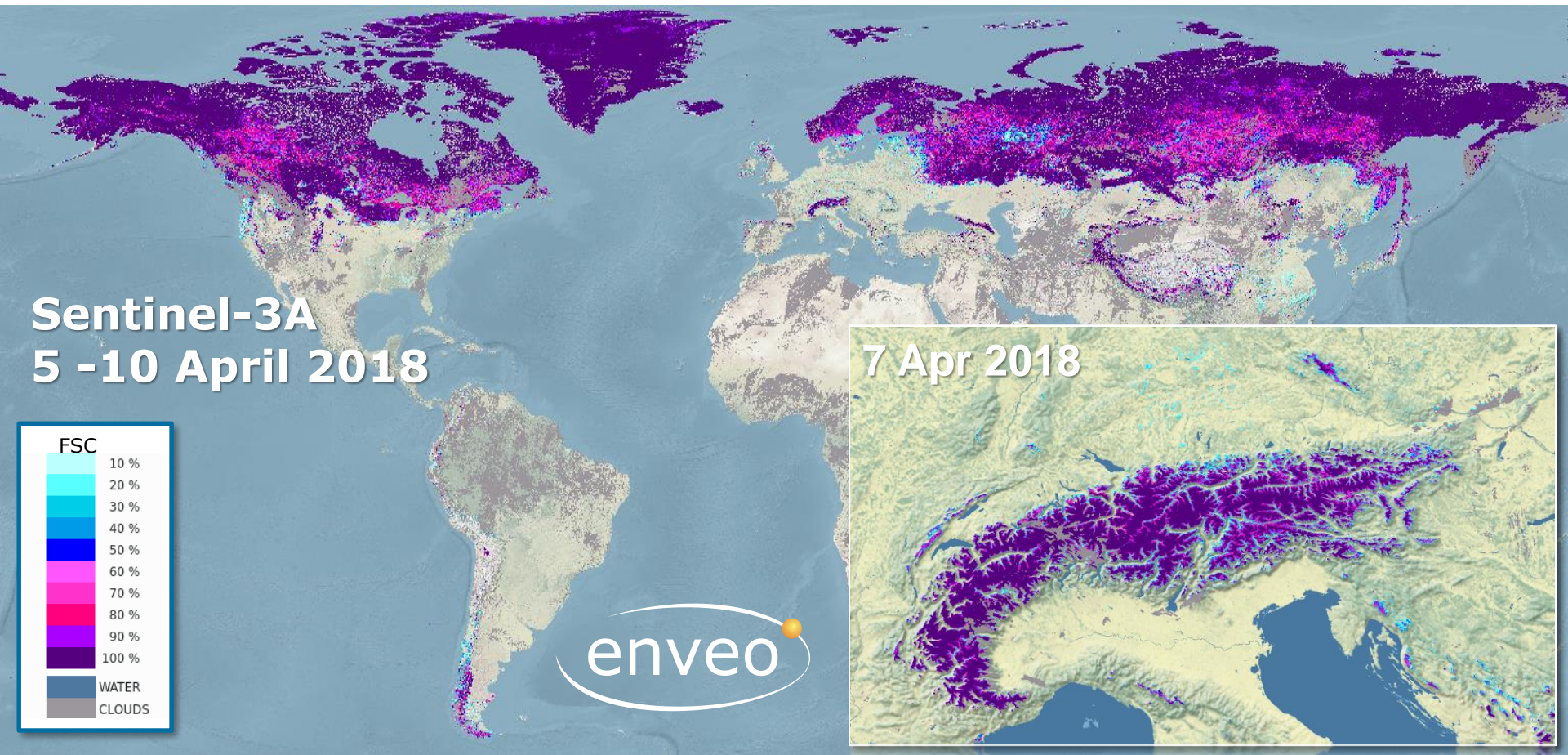
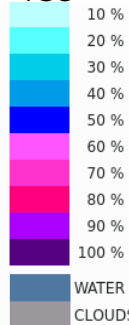


Snow Extent

Sentinel-3A
5 - 10 April 2018

7 Apr 2018

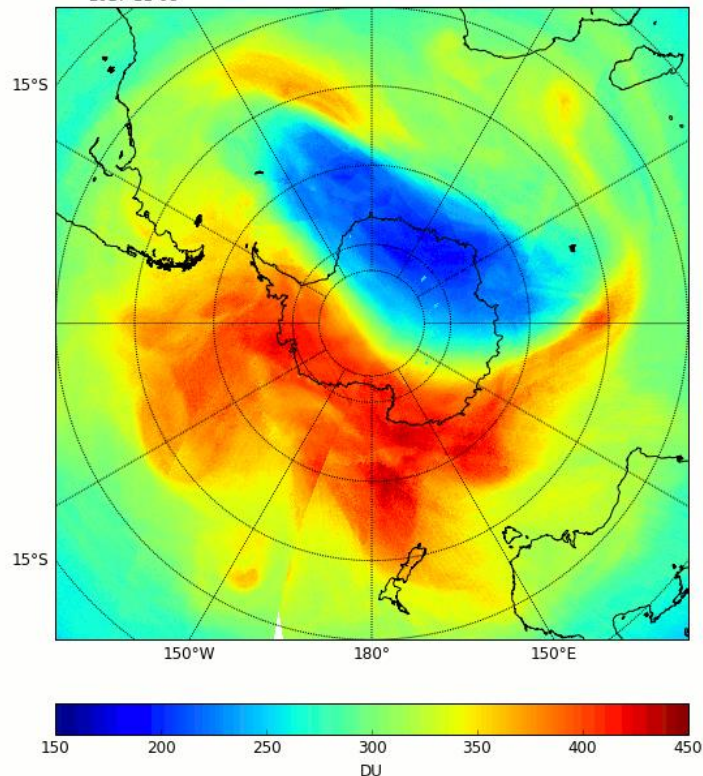
FSC



Closing of the Ozone Hole

Sentinel 5 Precursor, total ozone, DLR-BIRA

2017-11-08

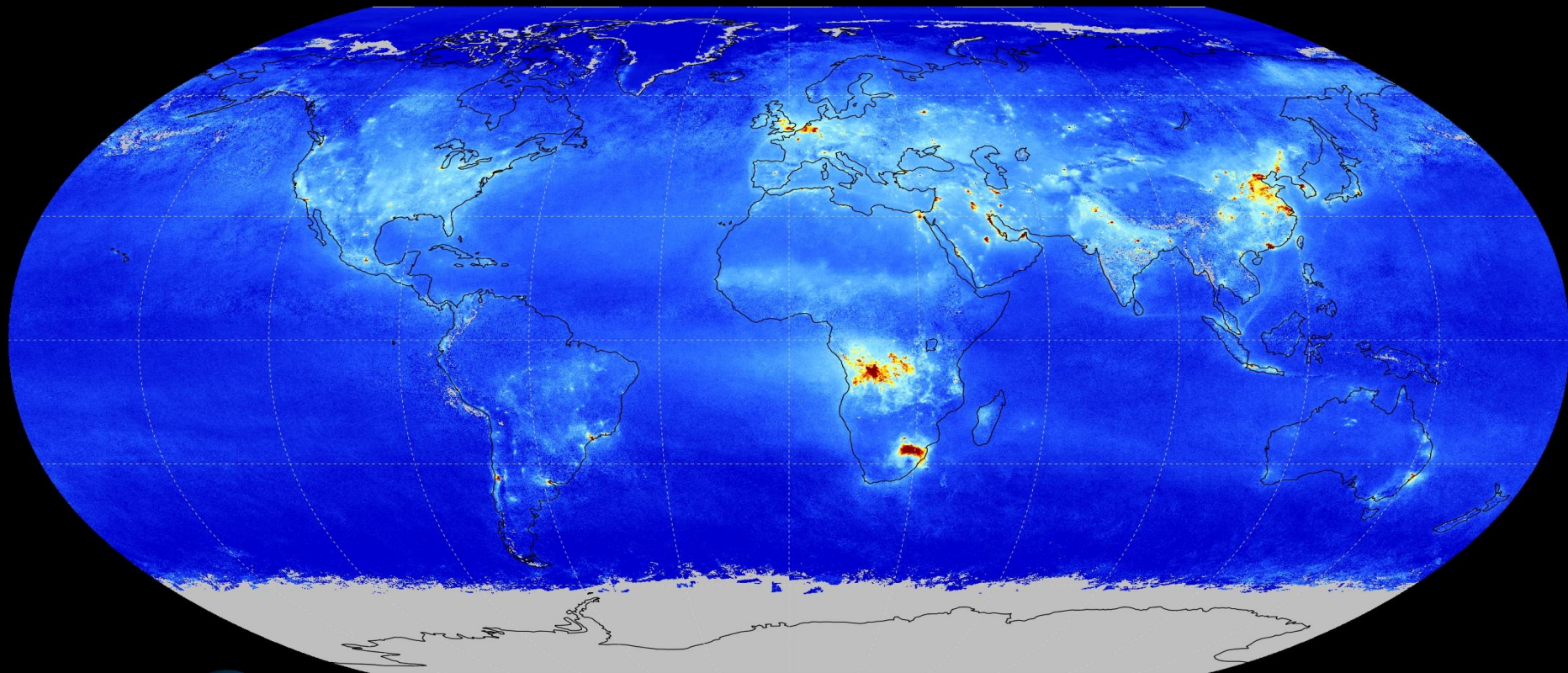


Released 11 July 2018

November 2017 data
Sentinel-5P

© DLR

S5P/TROPOMI NO₂ tropospheric column, July 2018

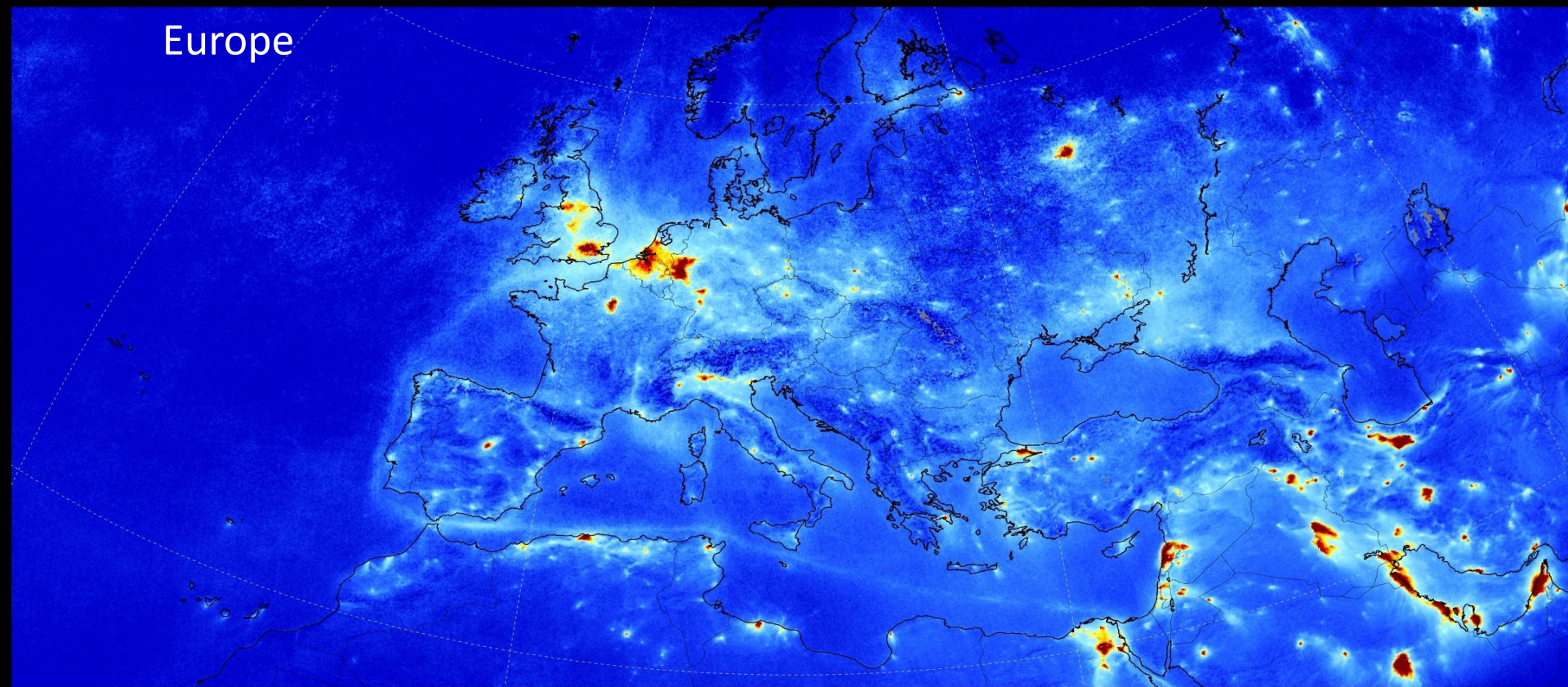


NO₂ tropospheric column [$\mu\text{mol m}^{-2}$]

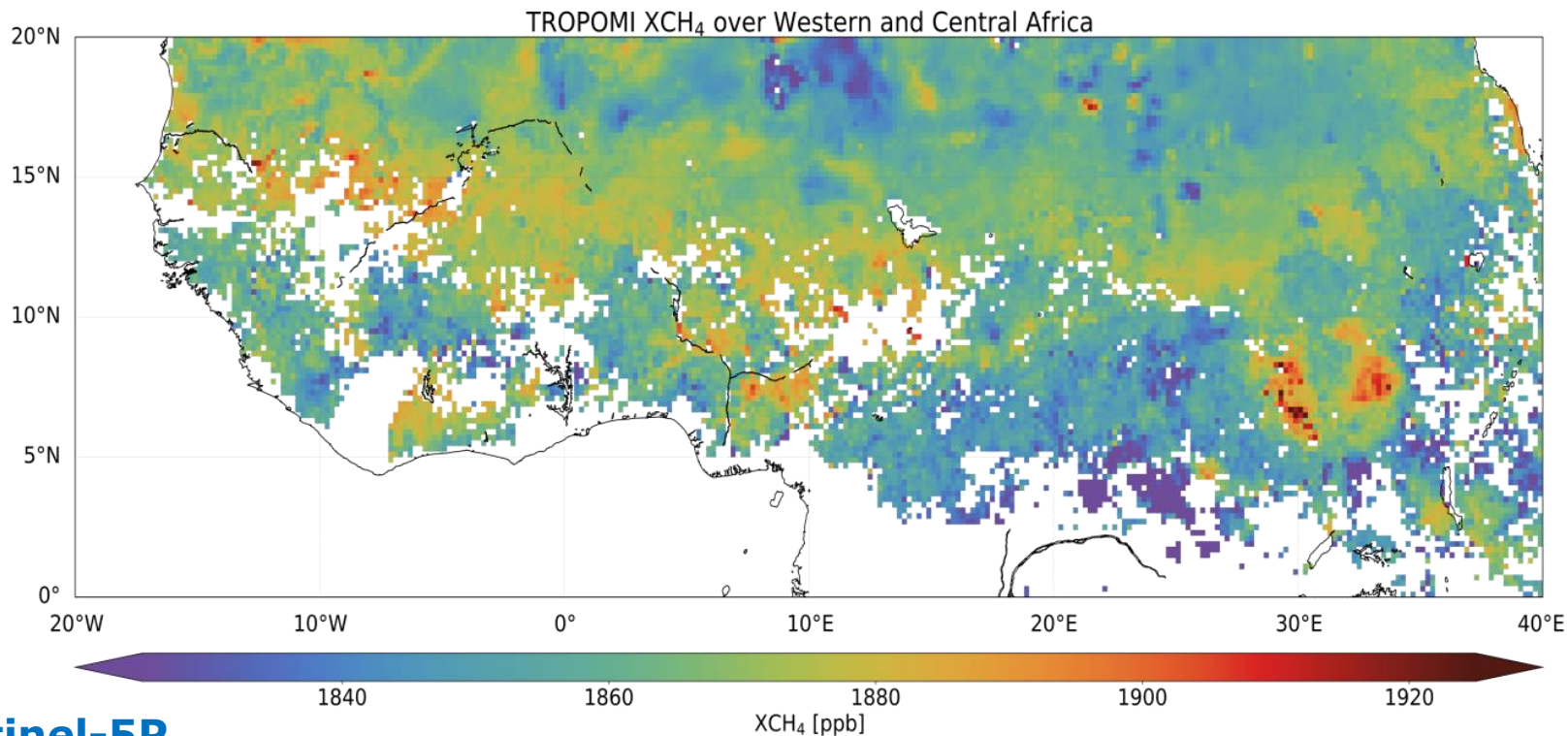


S5P/TROPOMI NO₂ tropospheric column, July 2018

Europe



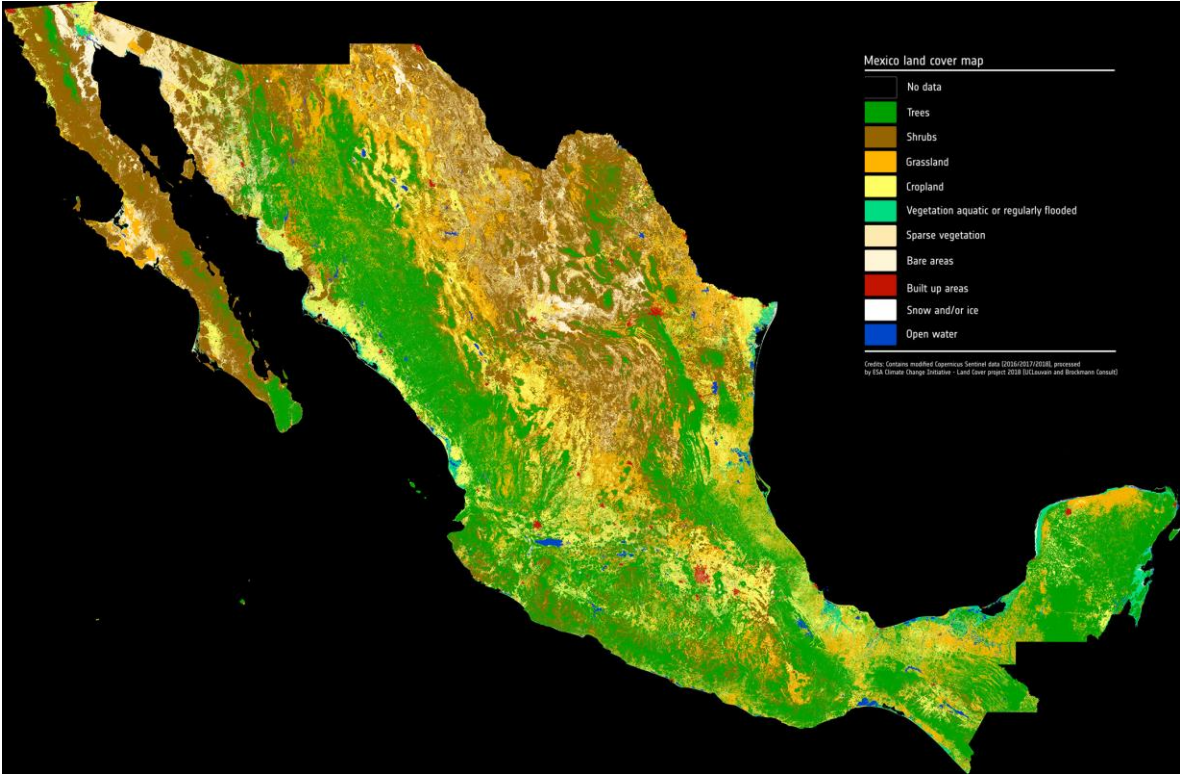
Methane – Regional Scale XCH₄



Sentinel-5P Western and Central Africa, 2018

© Hu et al., GRL

Mapping Mexico's land cover



22 Oct 2018

Combined images from the Copernicus Sentinel-2 mission to produce a detailed view of the different types of vegetation growing across the entire country.

The high-resolution land-cover map combines images captured by Copernicus Sentinel-2 between 2016 and 2018.

Climate Change Initiative Extension – CCI+

New CCI subscriptions at CM-16

83M€ for 2017-2024 period

Knowledge

ITTs for CMUG, new R&D on existing ECVs and Knowledge Exchange released in Q1 2018

CH4, Ozone, SST, Ocean Colour, Sea Level, Sea Ice, Glaciers, Ice Sheets, Land Cover, Fire, Soil Moisture

Ground Biomass, Permafrost, Land Surface Temperature, Water Vapour

CROSS-ECV Scientific Exploitation



EO in a World of Disruption

3 Megatrends



Our Changing Planet



Tech & EO Revolution



Data-Driven Economy

EOP Key Objectives at Space19+



- **Pioneer groundbreaking observing systems**
 - answer key science questions
 - address global societal challenges & SDGs
- **Strengthen Europe's leadership:** Copernicus 2.0 with EU
- **Harness NewSpace entrepreneurs' creativity**
 - forge dynamic European EO architecture
 - deliver world-leading public & commercial services
- **Seize non-space tech:** to accelerate EO innovation, effectiveness, incentivise private space investments
- **Capitalise on MS' excellence:** synergise EO in Europe



FutureEO

- New name for EOEP, envelope structure & legal basis remain

Operational EO

- In partnership with European Commission and EUMETSAT

Customised EO

InCubed+

Int. Development Assistance

Altius Phase E

Safety and Security

- EO contribution to ESA pillar on Safety & Security

Earthnet and Heritage Data Programme

(Basic Activities)

**Future
Flagships
& Systems**

1.

**Foundations
& Concepts**

2.

**Research
Missions**

FORUM or SKIM

**Operation &
Exploitation**

3.

**Mission
Management**

4.

**Earth Science
for Society**



→ End-to-end Approach for World-class Earth Science!

Customised EO: 3 Programme Elements

InCubed+

Continuation of
InCubed until 2026



2020-2023

InCubed Earth Watch
Element format

Int. Development Assistance

Bring operational EO
solutions in ODA



2020-2025

New Earth Watch
element
(ODA compatible)

Altius PhE

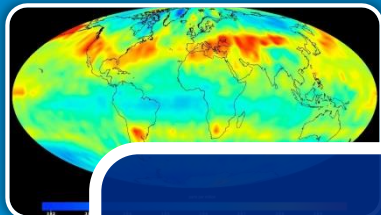
Operational ozone
monitoring



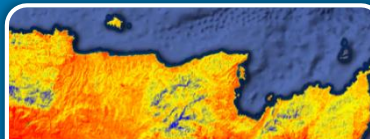
2020-2024

Extend existing Earth
Watch element

6 High Priority Candidate Missions



Anthropogenic CO₂
Monitor causes of
Imaging
Climate Change



High Resolution
Agriculture & Water
Surface Temp.

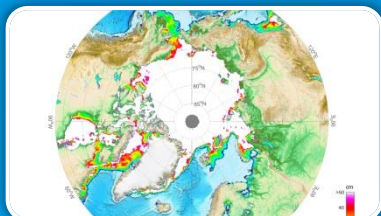
Phase A/B1 for new Sentinels ongoing



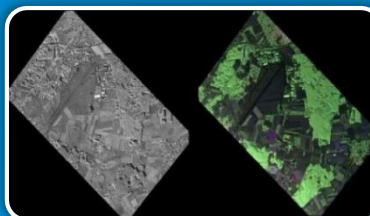
(CO₂ emissions)
Climate Change
Topography
& Cryosphere
volume)



Soil
& Mangroves, Forestry,
Biodiversity



Passive Microwave
(Arctic monitoring
situational awareness)
& SST



Soil Moisture,
Vegetation &
Ground Motion

Sustainable Development

UN SDGs



Develop & implement EO SDG monitoring in MS

Environmental Threats to Society

Sendai Framework



Strengthen European Resilience through novelty

Official Development Assistance



Facilitating Development Worldwide

1 NO POVERTY

2 NO HUNGER

3 GOOD HEALTH

4 QUALITY EDUCATION

5 GENDER EQUALITY

6 CLEAN WATER AND SANITATION

7 RENEWABLE ENERGY

8 GOOD JOBS AND ECONOMIC GROWTH

9 INNOVATION AND INFRASTRUCTURE

10 REDUCED INEQUALITIES

11 SUSTAINABLE CITIES AND COMMUNITIES

12 RESPONSIBLE CONSUMPTION

13 CLIMATE ACTION

14 LIFE BELOW WATER

15 LIFE ON LAND

16 PEACE AND JUSTICE

17 PARTNERSHIPS FOR THE GOALS

THE GLOBAL GOALS
For Sustainable Development

LPS 2019



- More than 3000 abstracts received
- Preliminary programme: March 2019
- Registration closes: 30 April 2019
- <https://lps19.esa.int>

Links to European Space Sciences Committee

ToR's of ESA EOP Earth Science Committee (ESAC) reformulated end 2017 =>

- Setup of the Advisory Committee for Earth Observation (ACEO)
- Advises directly D/EOP
- Athena Coustenis appointed as (Ad Personam) Ex-officio member
- 3 meetings in 2018
- 2019: UCM and EE-9 recommendation
- ESSC recommendation on ESA programmes for Space19+

Thank you for your attention!

www.esa.int