

ESA Earth Observation Programmes Status

ACEO Meeting, 24 May 2018

Mark Drinkwater

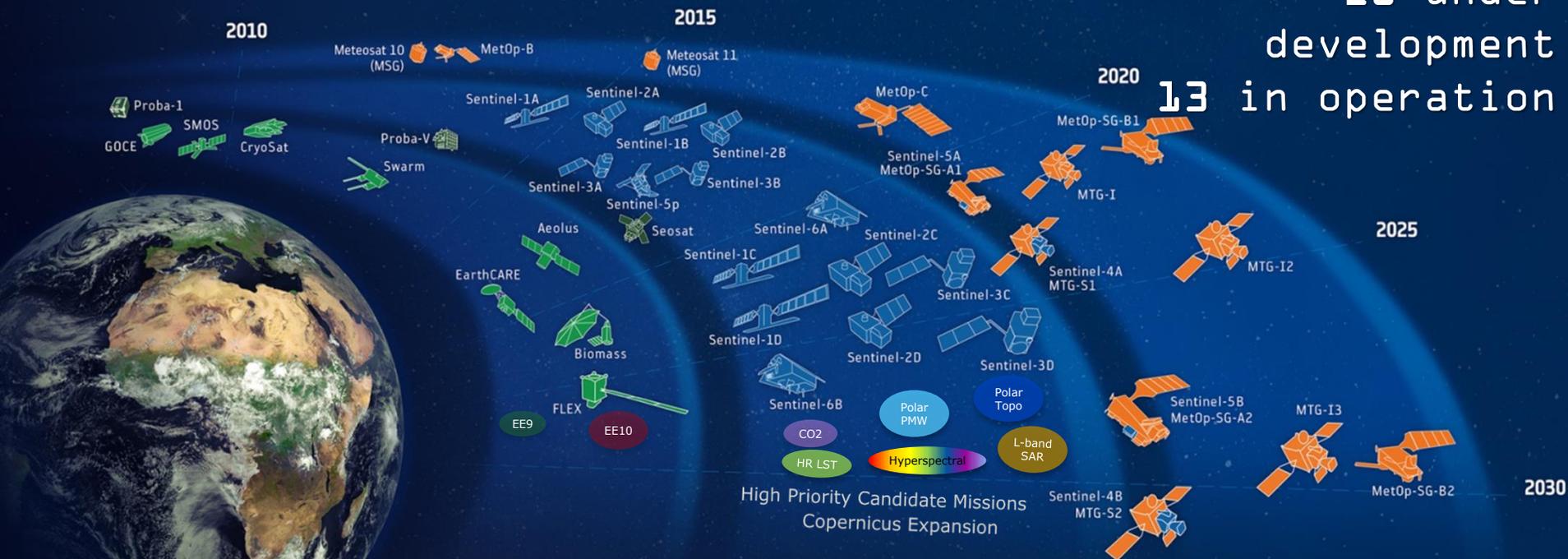
Earth and Mission Science Division

ESA Earth Observation Programmes

ESA-DEVELOPED EARTH OBSERVATION MISSIONS



Satellites
28 under
development
13 in operation



Science

Copernicus

Meteorology

Earth Observation Envelope Programme



**Scientific &
Societal
Challenges**

**Excellence &
Innovation**

**Industrial
Competitiveness**

Bringing Earth Observation to Society



Science Missions: Earth Explorers



GOCE	2009 – 2013
SMOS	2009 – Present
CryoSat	2010 – Present
Swarm	2013 – Present
Aeolus	August 2018
EarthCARE	2020/21
Biomass	2022
FLEX	2022
EE9 (SKIM/ FORUM)	2025
EE10	2028

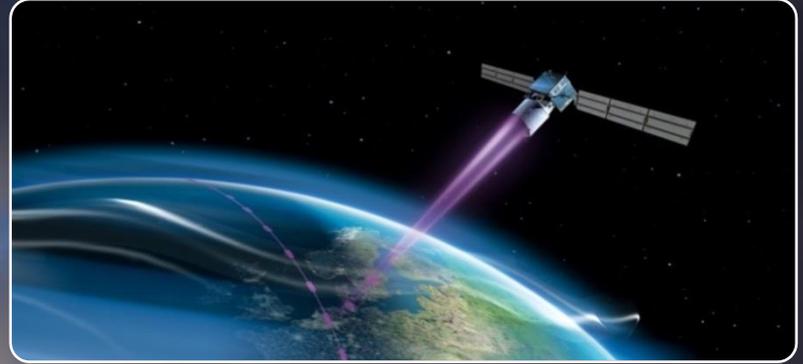


Upcoming Earth Explorers

5

Aeolus

- Global wind profiles
- Launch planned 2018



6

EarthCARE

- Clouds, aerosols & radiation
- Partnership JAXA
- Launch planned 2020



Aeolus: ESA's Wind Mission



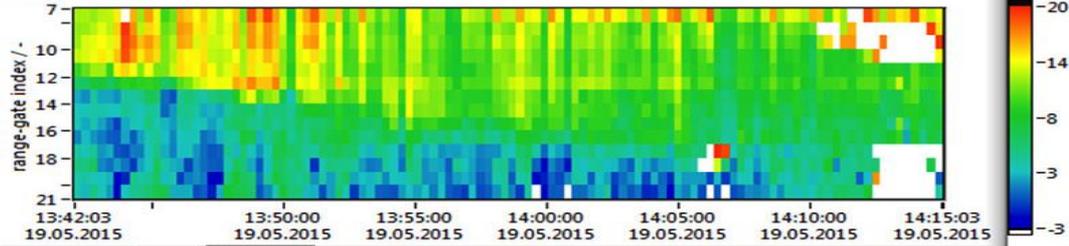
**Launch Scheduled Tuesday 21 August, 2018
23:20hrs European Central Time
(18:20 French Guyana time)**

First ever UV Doppler Wind Lidar in Space

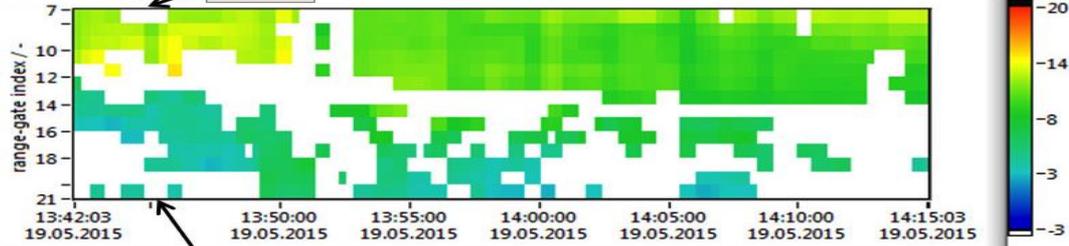


Aeolus: Airborne Cal/Val preparations

A2D winds (cut)

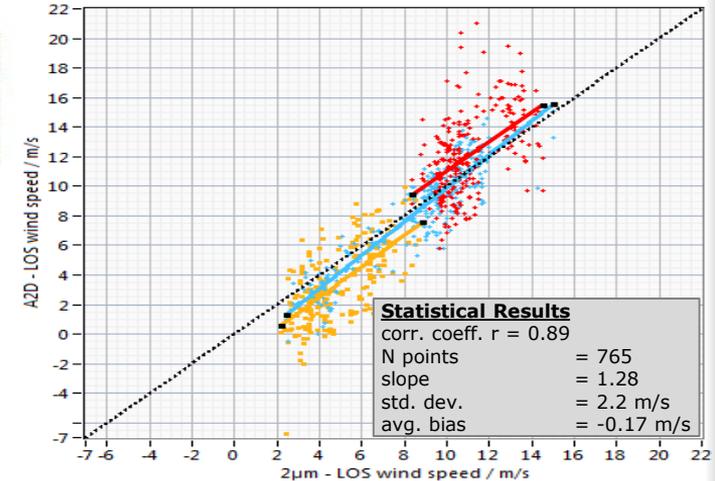
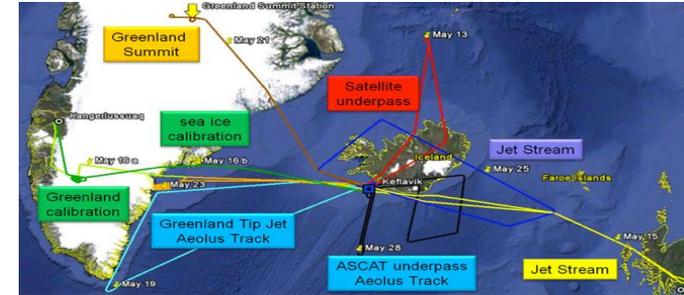


2µm winds (cut)

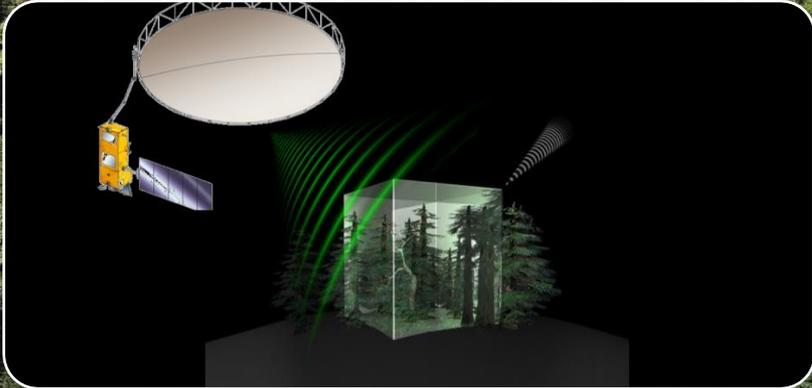


Credits U. Marksteiner, DLR

- DLR Payload: The ALADIN airborne demonstrator (A2D) and 2-µm reference wind lidar
- Jet Stream with wind speeds up to 70 m/s observed by 2-µm wind Lidar on May 15, 2015
- New algorithm for 2-µm wind lidar enhances vertical coverage dramatically in low-aerosol conditions



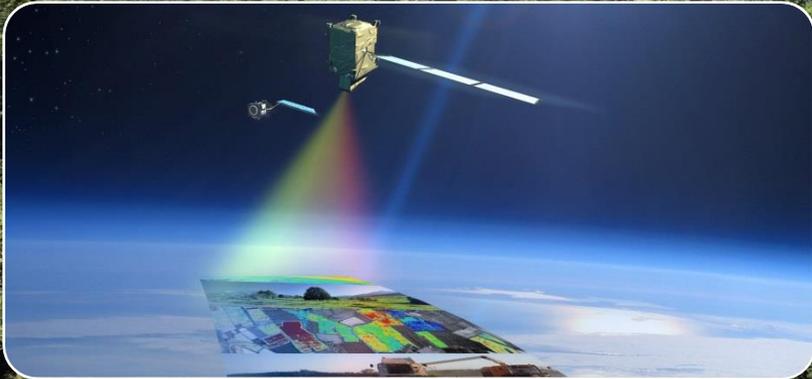
Further Earth Explorers



7

Biomass

- Biomass estimates
- Launch planned 2022



8

FLEX

- Vegetation fluorescence, indicator of photosynthesis
- Launch planned 2022



BIOMASS



Mission Measure forest biomass and height (200 m. pixel)

Payload P-Band radar

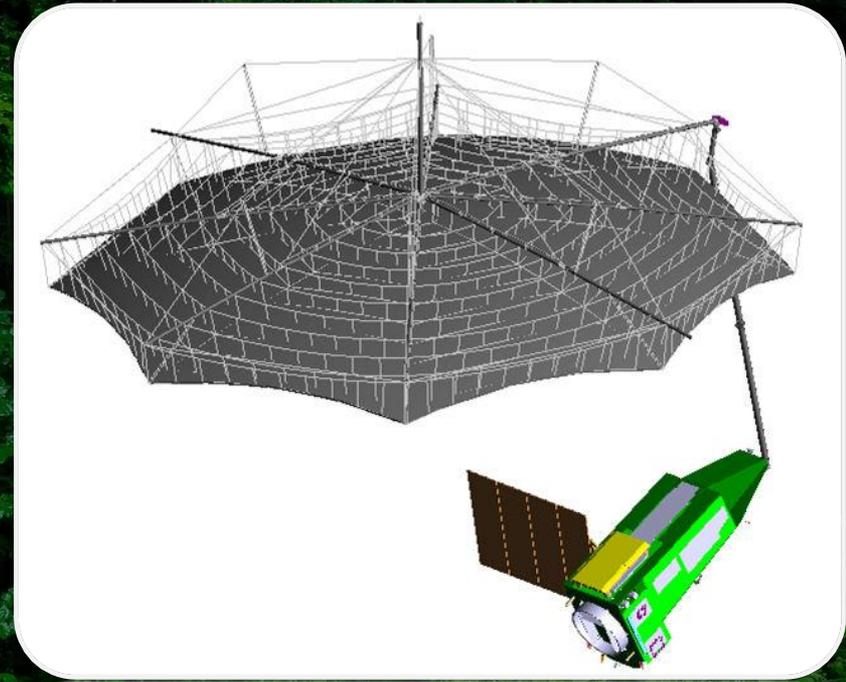
Orbit SSO, alt: 666 km;
LTAN: 06h00

Satellite 1250 Kg

Consortium Prime: ADS-UK,
Instrument: ADS-DE

Launch 2022

Lifetime 5.5 years



FLEX



Mission

Study & monitoring of fluorescence signal linked to vegetation stress; 300m pixel. In tandem with S-3

Swath

150 km

Payload

FLORIS spectrometer (500 nm – 780 nm); O₂ bands;

Orbit

SSO, alt: 814 km; LTDN: 10h00 (S-3 synergy)

Satellite

470 kg

Consortium

Prime: TAS
Instrument: Leonardo

Launch

end 2022

Lifetime

3.5 years



Later Earth Explorers

9

2 Candidates

- FORUM
- SKIM
- Launch around 2025

10

- Call for Ideas Phase
- 21 Proposed Mission ideas
- Launch around 2027/28



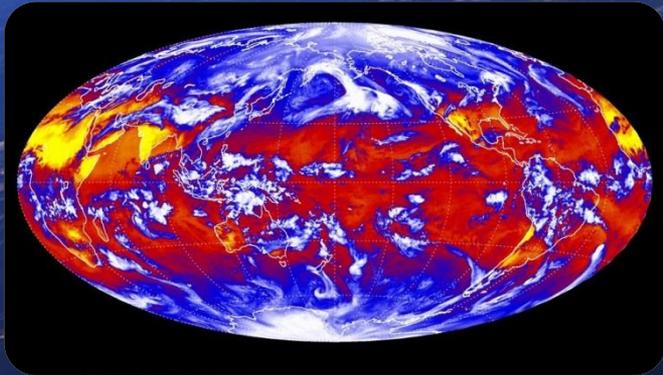
Earth Explorer 9 Candidates



- Candidates undergoing competitive feasibility assessment (Ph. A/B1)
- End Phase A selection recommendation by ACEO Prior to CM19
- EE9 implementation financed via EOEP-Next Programme Proposal
- Launch around 2025

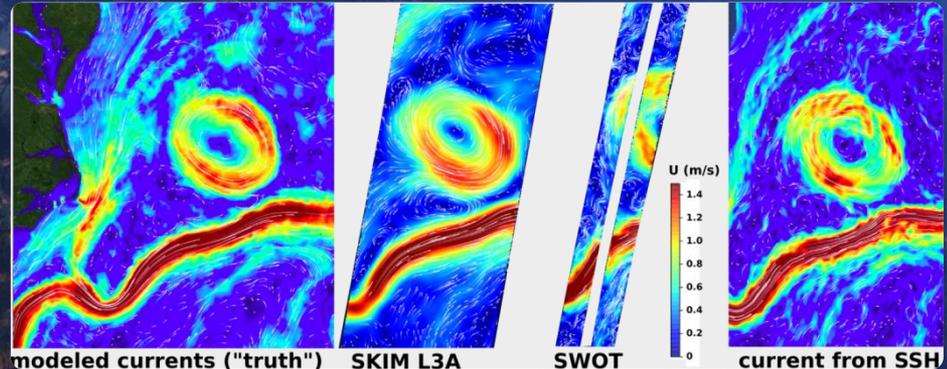
FORUM

Far-infrared Outgoing Radiation



SKIM

Ocean Surface Currents



Earth Explorer 10 – A flagship mission



Earth Explorer 10 call released on 25 September 2017

Scientific peer review by impartial experts to **engage the scientific community** in determining and advancing the content of the Earth Observation Envelope Programme

Earth Explorer 10 is a Core mission with a launch target in **2027/2028**

PB-EO in September 2018 to select up to 3 candidate mission ideas to enter Phase 0

Decision on implementation of the Earth Explorer 10 Core Explorer mission is scheduled to be taken **in 2022, prior to the CM-22**



Copernicus Status

Sentinel 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



S-5P



S-5



Atmospheric
Chemistry
(LEO)

A

2021

B

2027

C

> 2027

S-6



Altimetry

A

2020

B

2025

Sentinel-5P
Launched
13 October, 2017

Sentinel-3B
Launched
25 April, 2018



Sentinel-1 Status



- Sentinel-1A and Sentinel-1B mission operations → **nominal**
- Sentinel-1 **contribution to emergency activations** continues to be very high (~ weekly).
- During **SeaSAR 2018 workshop** (7-10 May 2018, ESRIN), strong emphasis was put on Sentinel-1 mission, with many talks on operational maritime applications and scientific advances, in the domain of oceanography, including sea-ice, target detection, sea state (wind, wave), etc.
- Sentinel-1 data acquisition plan stable:
 - a **new revision of the Sentinel High Level Operations Plan (HLOP)**, with main updates on Sentinel-1 and Sentinel-2, was released in March 2018 with specific presentations to Copernicus Committee and DOSTAG.
 - during 2019, the HLOP reflecting the completion of the full operational capacity (i.e. constellation of Sentinel-1, -2,-3 A and B-models as well as Sentinel-5P) will be submitted for approval to PB-EO and to the European Commission.

Oil spill detected by Sentinel-1B on 4th April 2018, Huelva, Spain



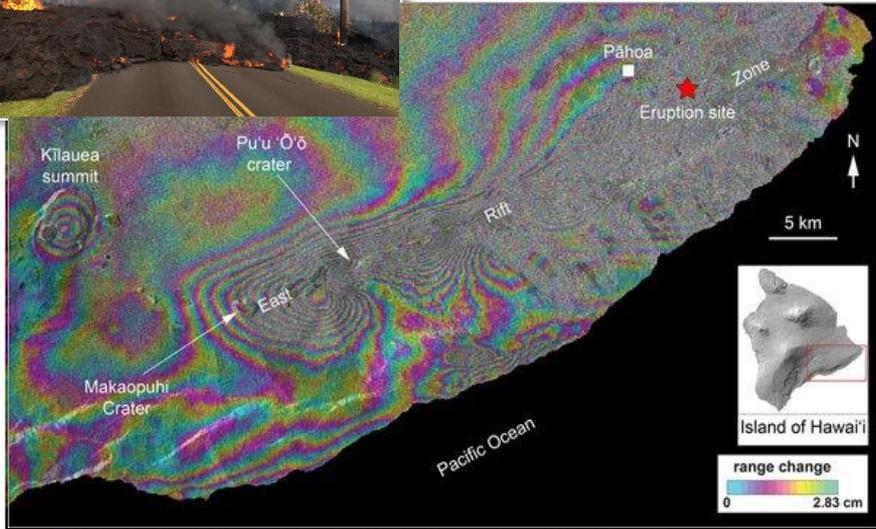
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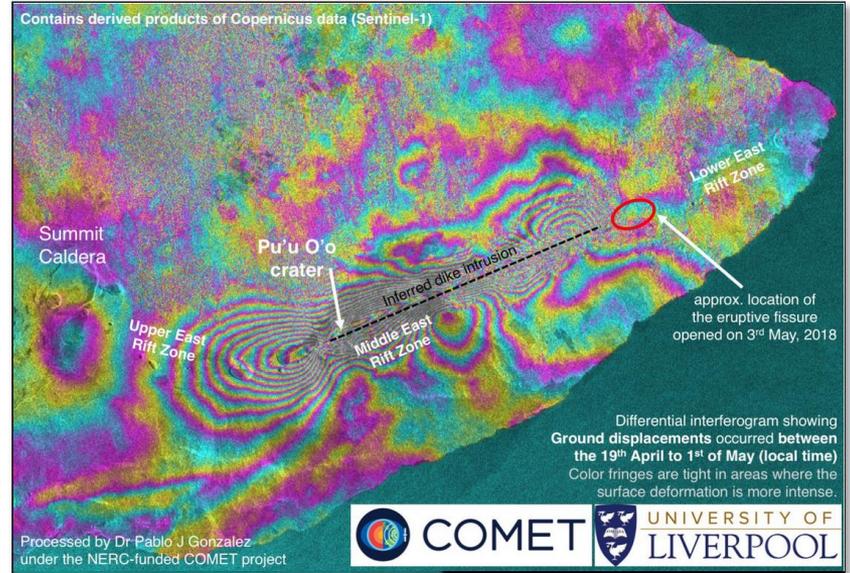
Sentinel-1 Recent Results



Eruption and earthquake near Kilauea volcano, Hawaii (3 May 2018)



Sentinel-1 interferogram (19 April – 1 May 2018)



Sentinel-1 interferogram (1 May – 7 May 2018)

Deformation due to magmatic intrusion → magma withdrawn from middle East Rift Zone and intruded beneath lower East Rift Zone.

**Sentinel-3B
Launched successfully
on Rockot on
25 April 2018**

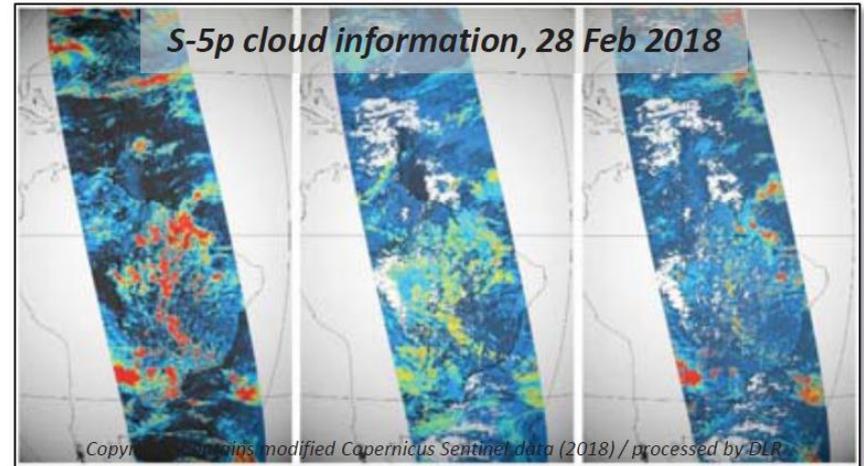


Sentinel-5 Precursor Status



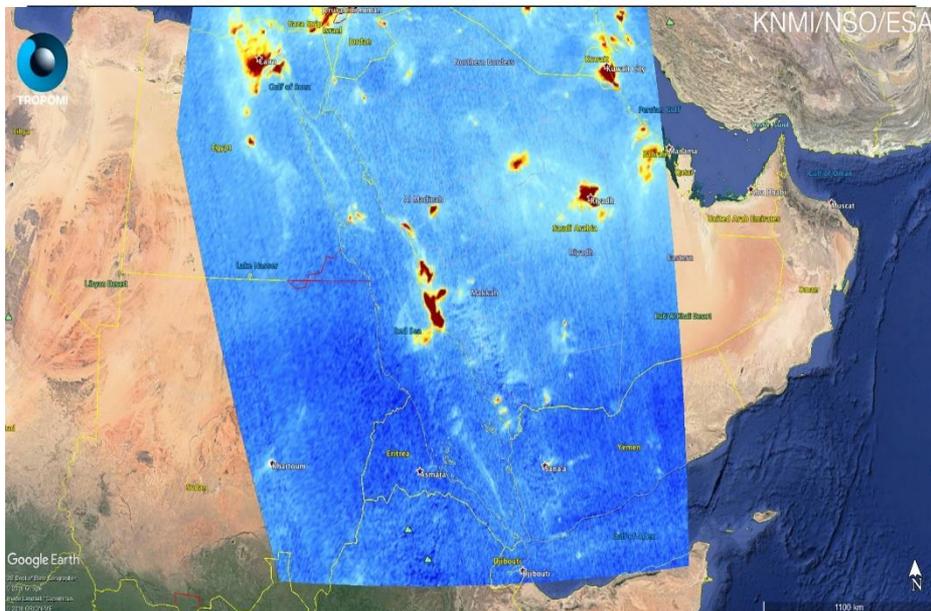
- **In Orbit Commissioning Review (IOCR)** on 24 April marking the end of the Commissioning Phase and the start of the Exploitation Phase. During the same day the mission authority was transferred from project manager to mission manager.
- The nominal operations baseline with a **360 orbit repeat cycle** has started with orbit 2818 on 30 April.

- Since March 2018, the **Cal/Val teams** have access to S-5p sample products via the S-5p Expert Data Hub.
- In **July 2018, first S-5p products will be released** to all users including Level-1B products and Level-2 CO products (NTC delivery time) and Level-2 O3, NO2, and cloud & aerosol information (NRT delivery time).
- By end 2018, all S-5p products should be available to users.



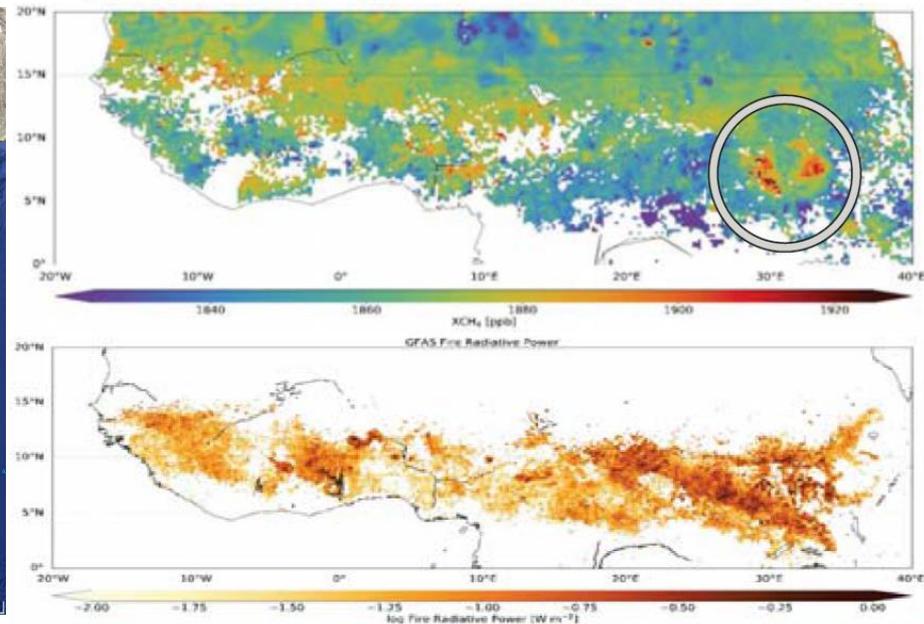
Sentinel-5 Precursor – early results

*Air Quality Monitoring:
Nitrogen Dioxide (NO₂) over Middle East*



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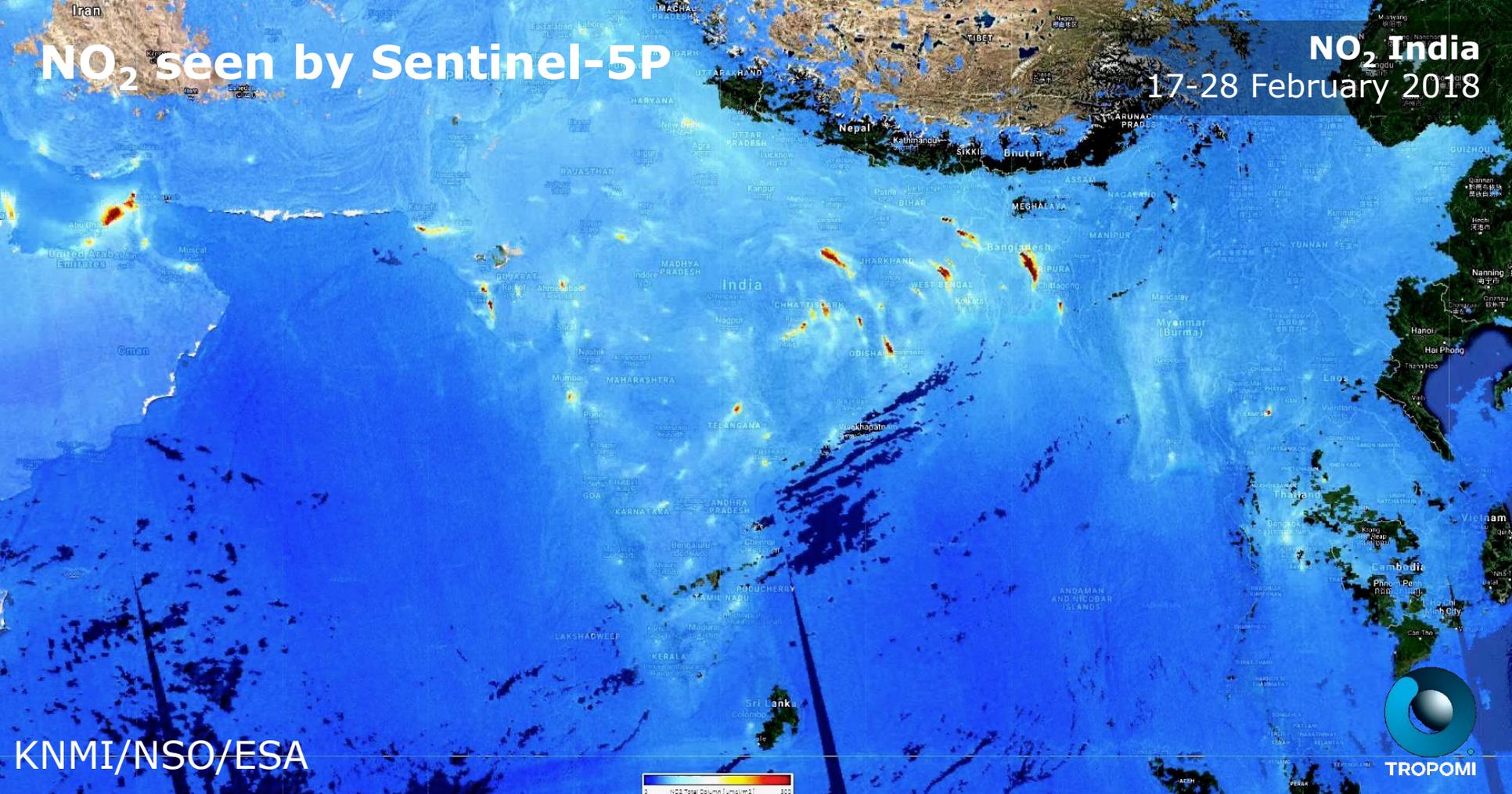
*Climate Monitoring:
Methane emissions by fires and wetlands (circle) over Africa*



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NO₂ seen by Sentinel-5P

NO₂ India
17-28 February 2018



KNMI/NSO/ESA



European Space Agency

Copernicus Space Component Evolution



2014



Next-Gen. missions will replace current & expansion missions



CSC Phase A/B1 Studies ITTs Published



High Priority Candidate Missions Applications

Anthropogenic CO₂

Monitoring Anthropogenic Emissions – Paris Agreement

Results of these Phase A/B1 studies will form the basis for CM19 and EU MFF proposals

Hyperspectral Imaging

Improved monitoring of forestry, raw materials, minerals and biodiversity

L-band SAR

Forestry, Natural Hazards, Crop type & Precision Farming, Sea ice type

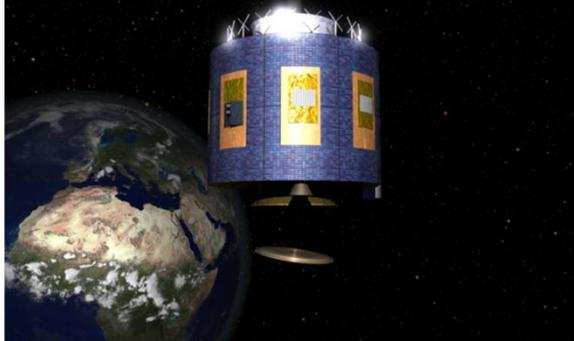
Mission Advisory Groups now established for each HPCM



New Meteorological Systems



Meteosat SG



MetOp



Meteosat TG



MetOp SG



< Current Systems

< Post-2020 Systems





**Launch
scheduled on
18 September
at 21:46:57
(Kourou time)**

**02:46:57
(CET) on 19
September.**

EO Science & Applications

GOCE

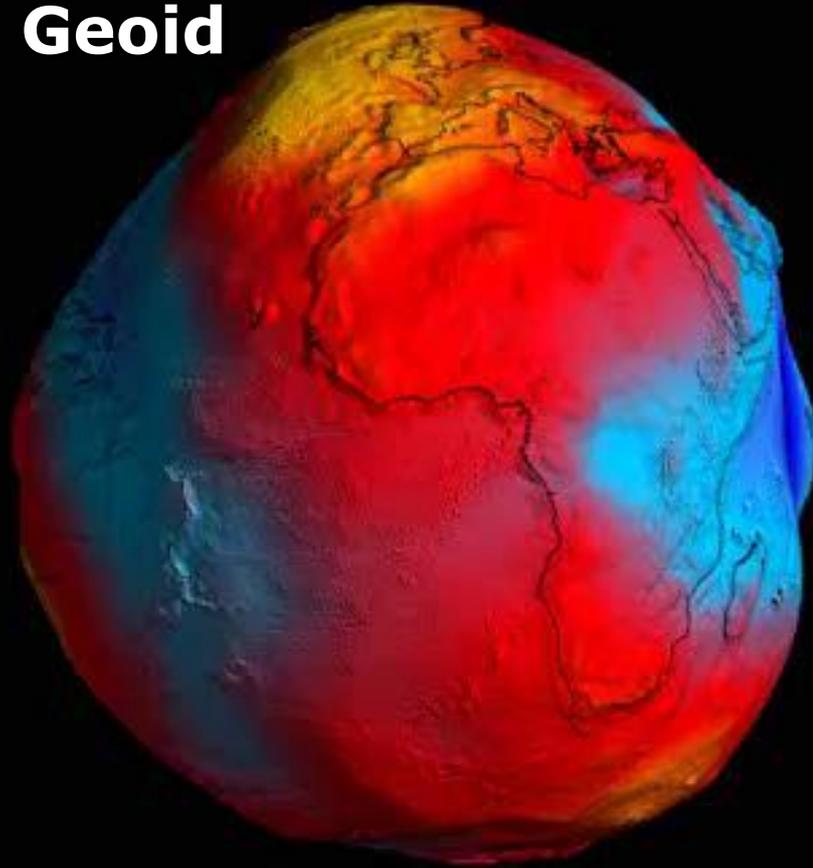


First Earth Explorer
Launched 17 March 2009



European Space Agency

GOCE: Earth's Geoid



Most precise geoid
ever produced.

Planned final 6th
data release with
significant
improvement of
cross-track gravity
gradients

© ESA/HPF/DLR

See; Siemes, C.- J Geod (2018) 92: 33.
<https://doi.org/10.1007/s00190-017-1042-x>



European Space Agency

SMOS



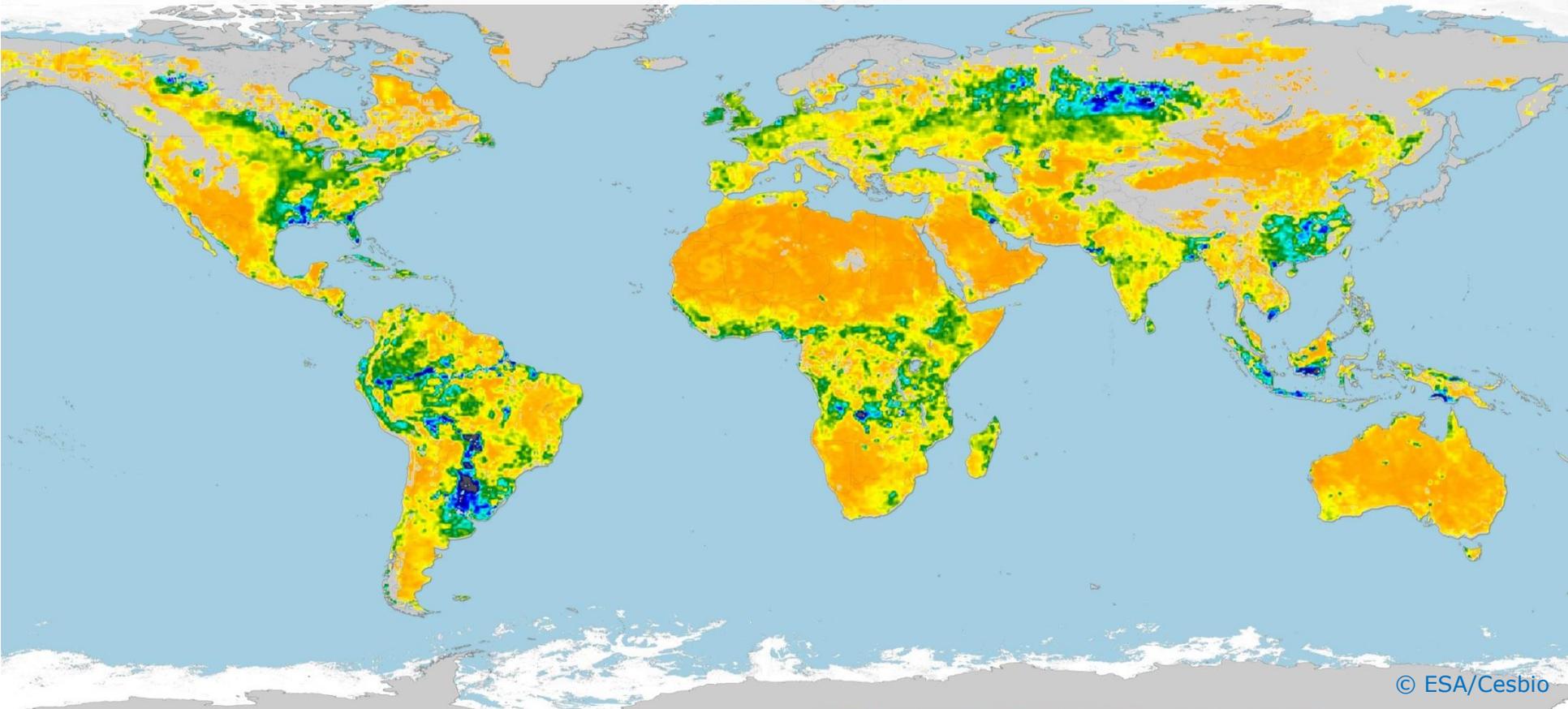
Second Earth Explorer
Launched 2 Nov. 2009

Two variables

- Soil Moisture
- Ocean Salinity



SMOS: Root zone Soil Moisture, May 2016

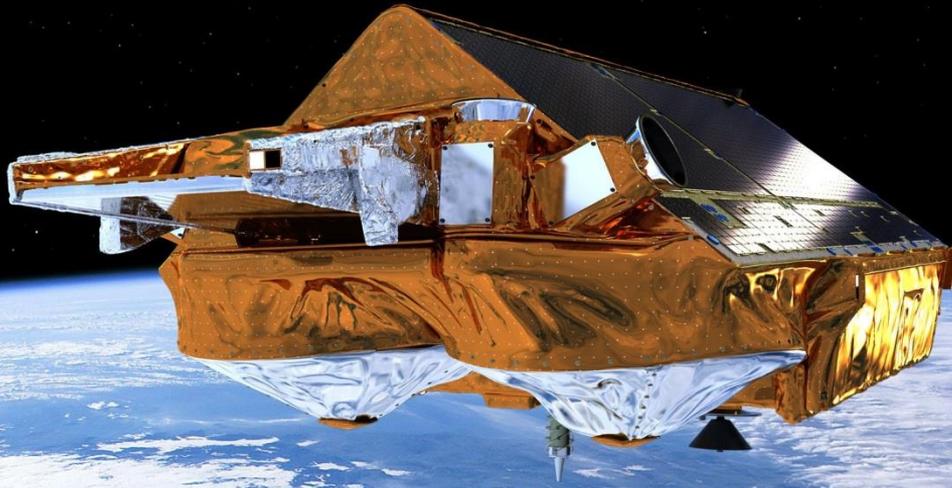


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European Space Agency

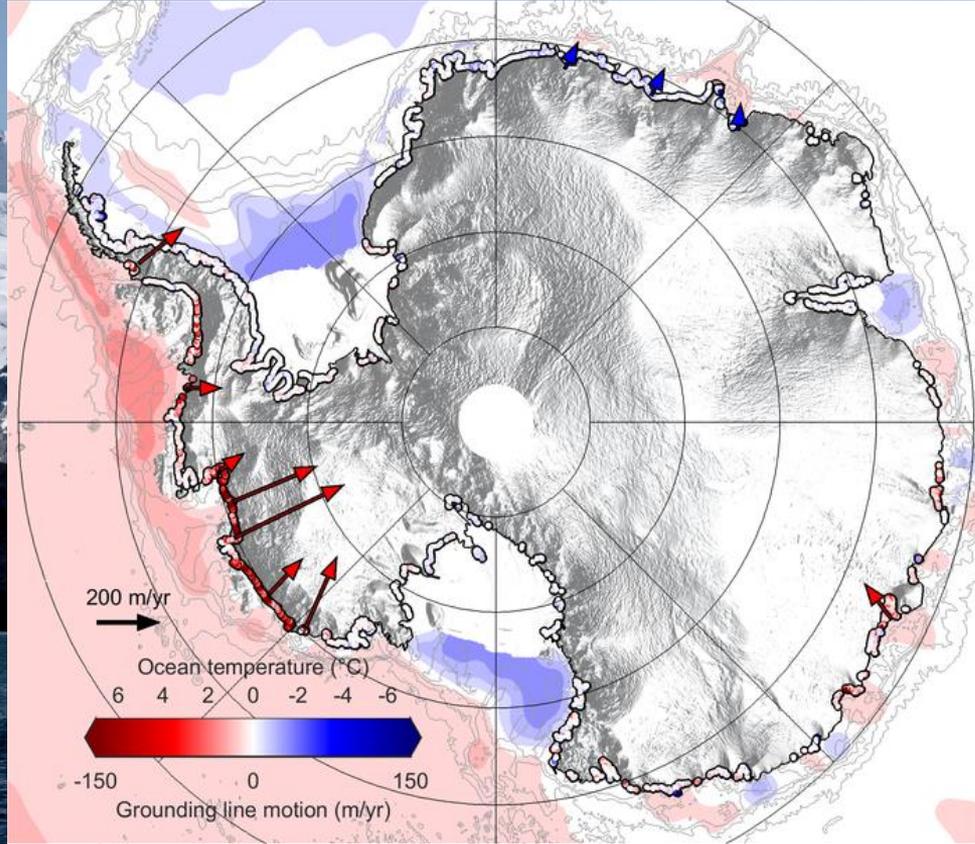
CryoSat



Third Earth Explorer
Launched 8 Nov. 2010
Ice Thickness (cm-level changes)



Land Ice Melting

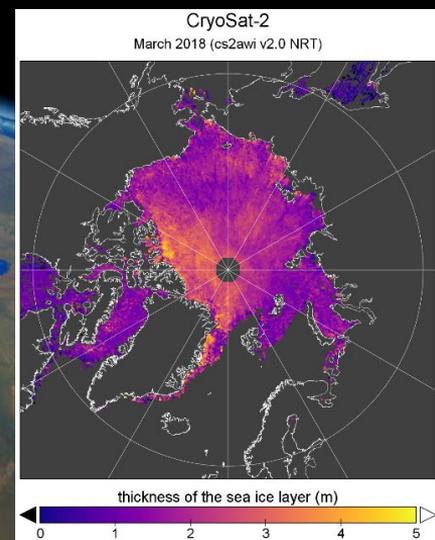
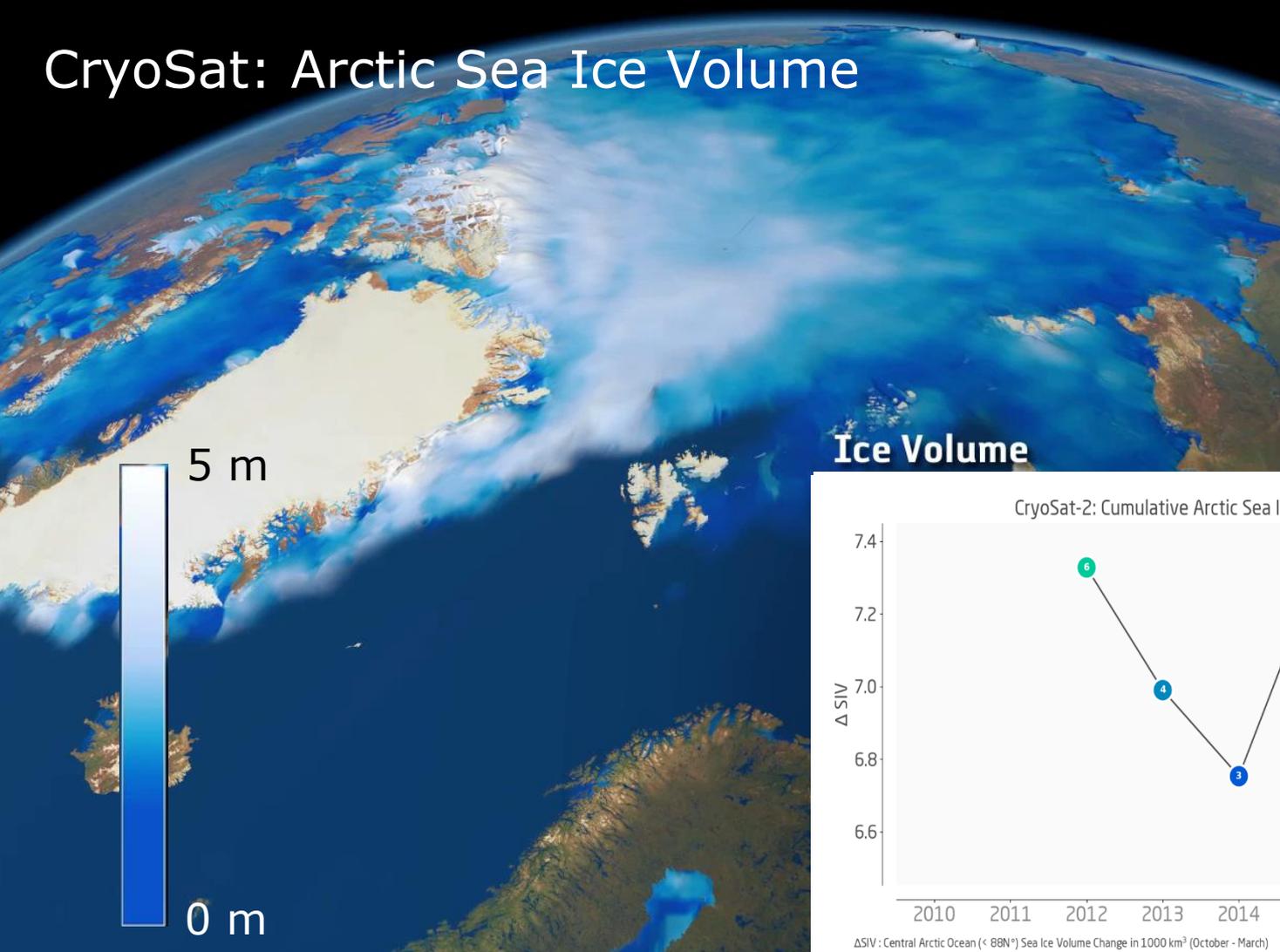


Antarctic Ice Sheet Monitoring

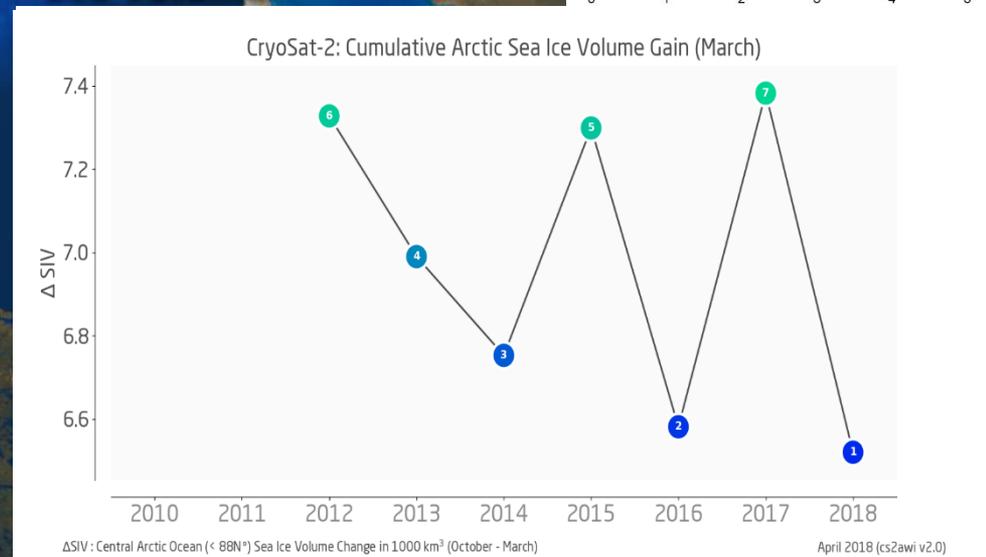
Based on CryoSat data

© CPOM/Leeds/ESA

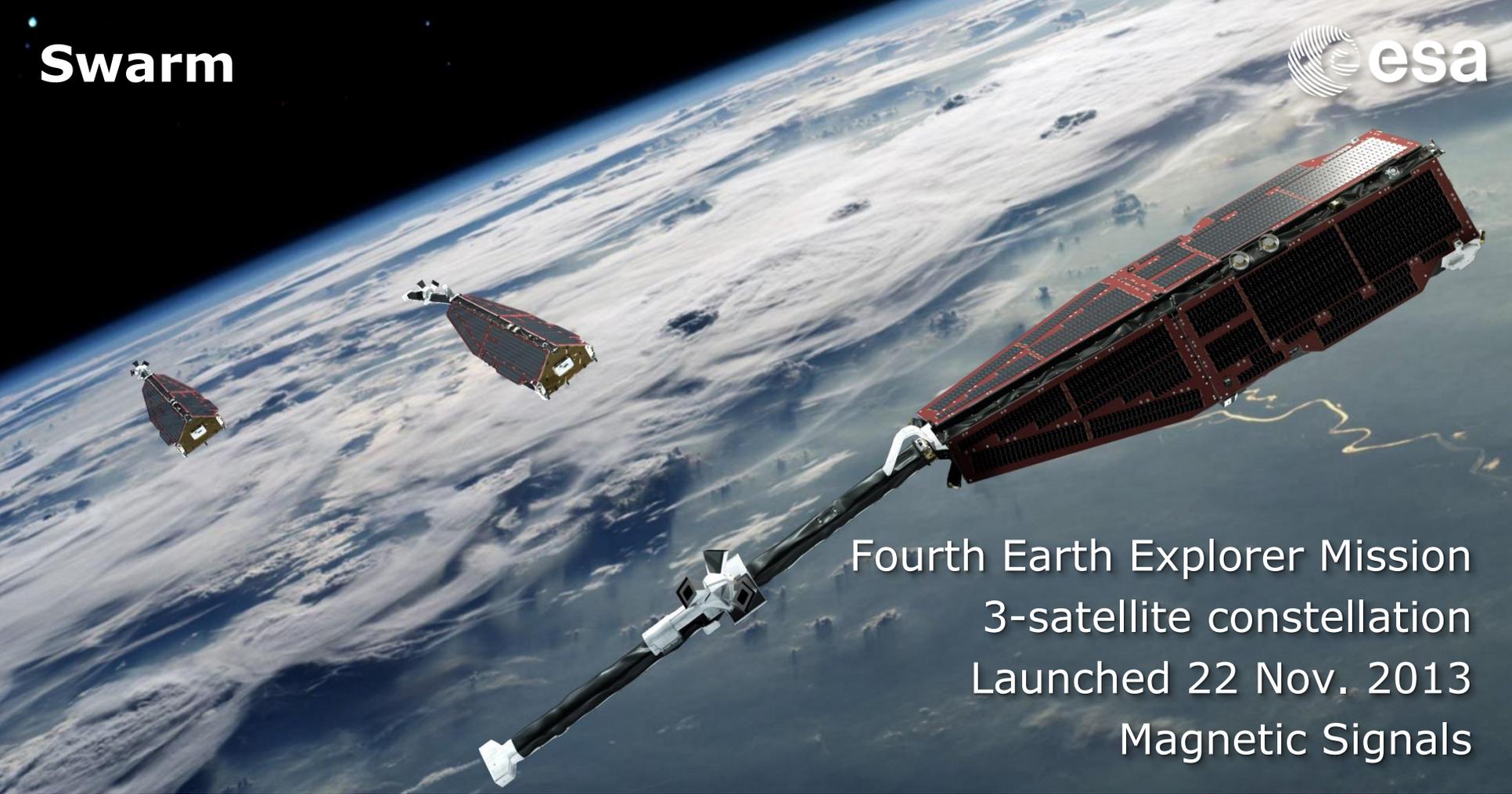
CryoSat: Arctic Sea Ice Volume



Ice Volume



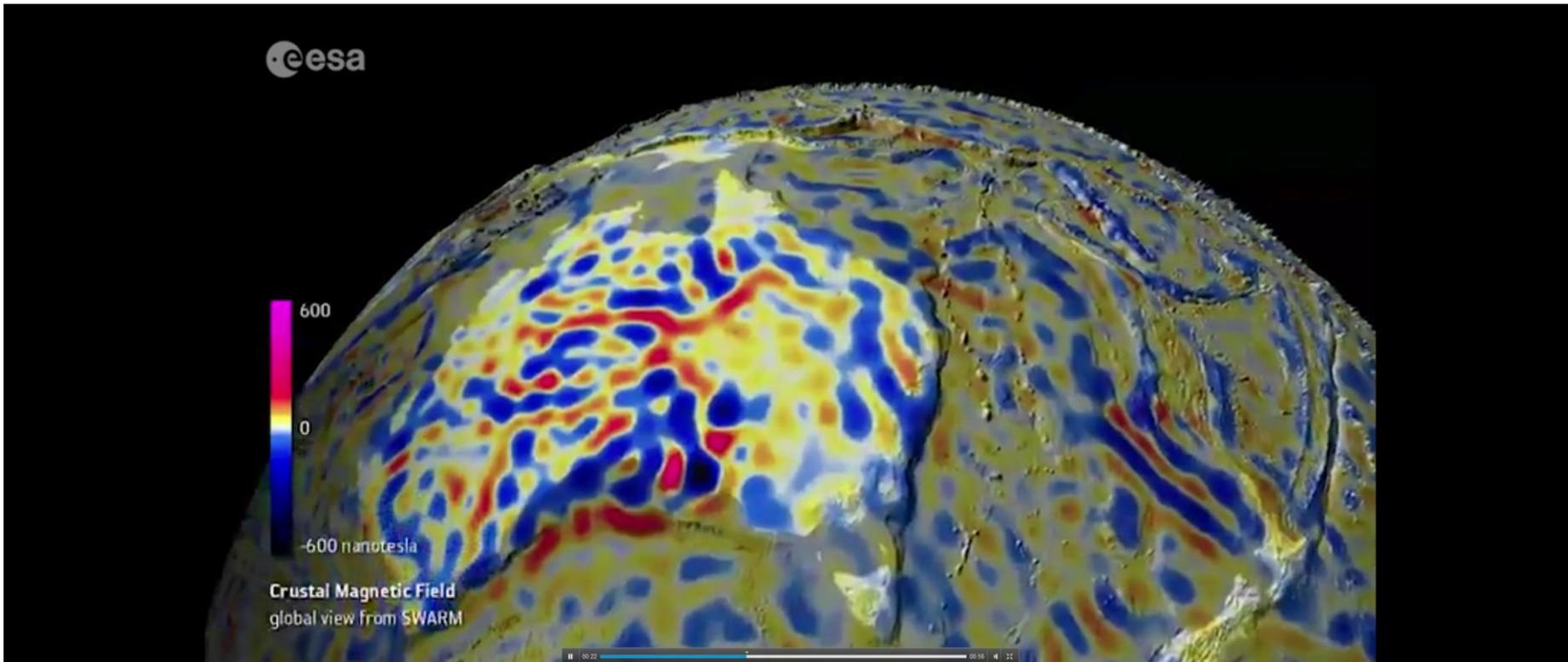
Swarm



Fourth Earth Explorer Mission
3-satellite constellation
Launched 22 Nov. 2013
Magnetic Signals

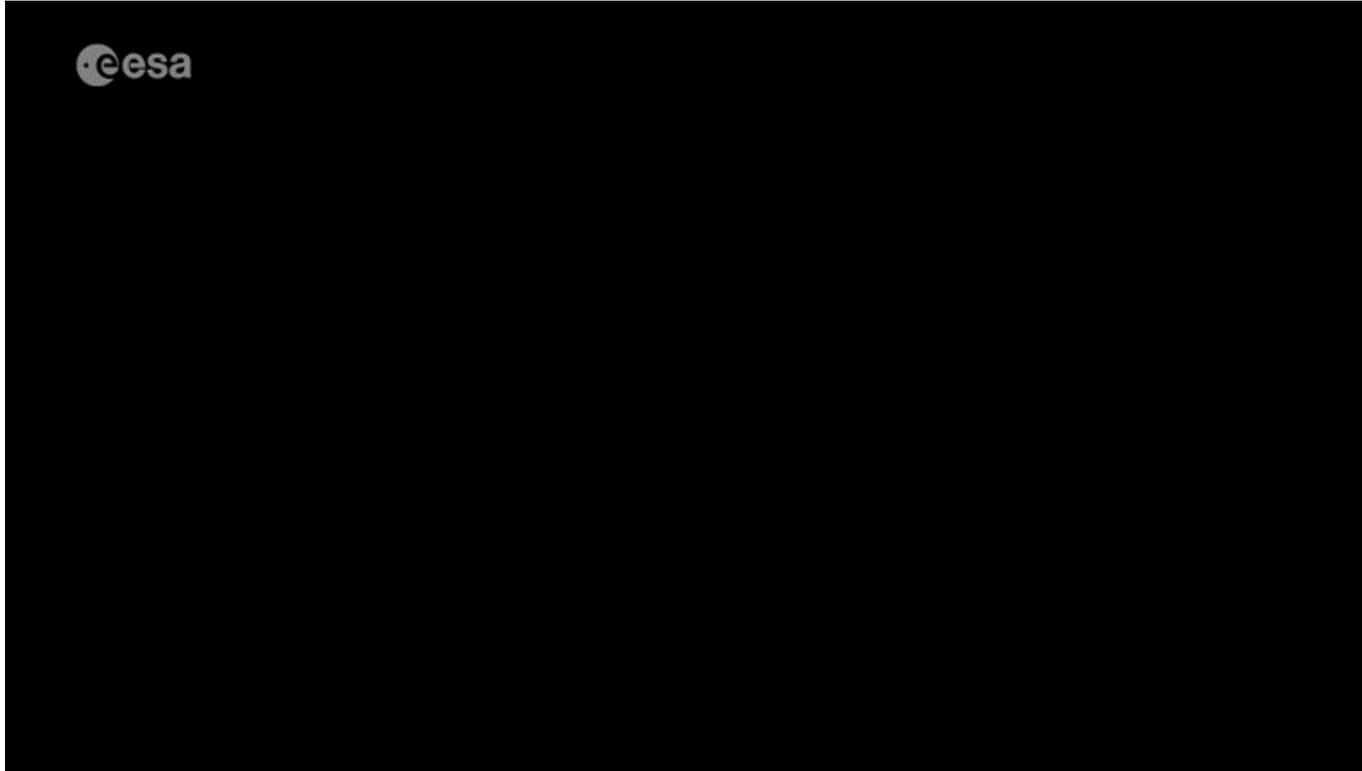


Swarm: Lithospheric Magnetic Field



Imprint of Earth's magnetic history and polar reversals visible at mid-oceanic ridge/plate-spreading zones in alternating stripes.

Swarm: Magnetic Tides



Principal semi-diurnal lunar M2 tidal constituent with a period of half a tidal lunar day (~12 hours and 25.2 minutes)

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

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Thank you for your attention!

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