ESA's Earth Observation Programmes

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Maurice Borgeaud

Head of the Science, Applications,
and Future Technologies Department

www.esa.int

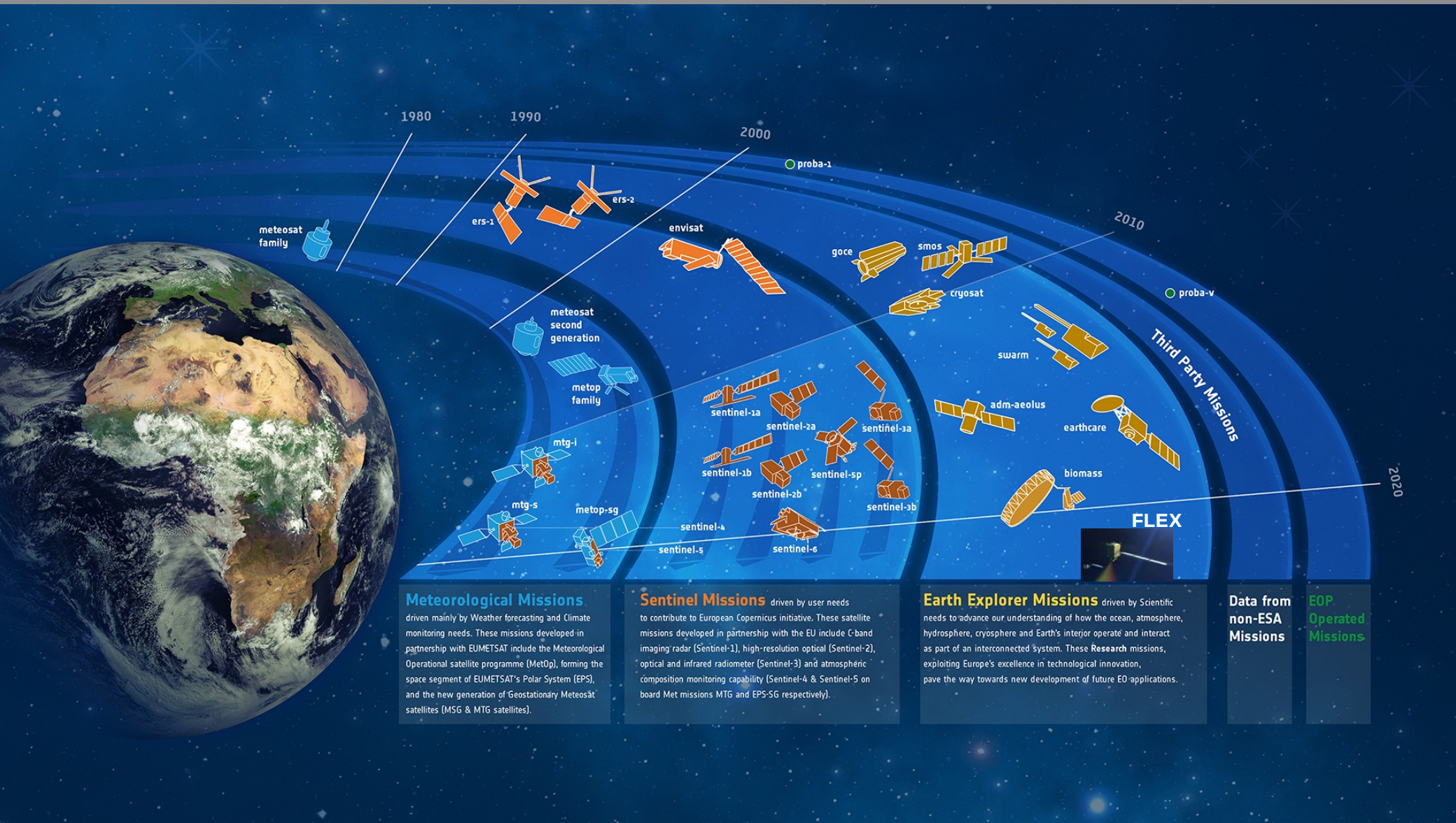
ESA Earth Observation Strategy

The prime objective of ESA Earth Observation Strategy is **to help society** to:

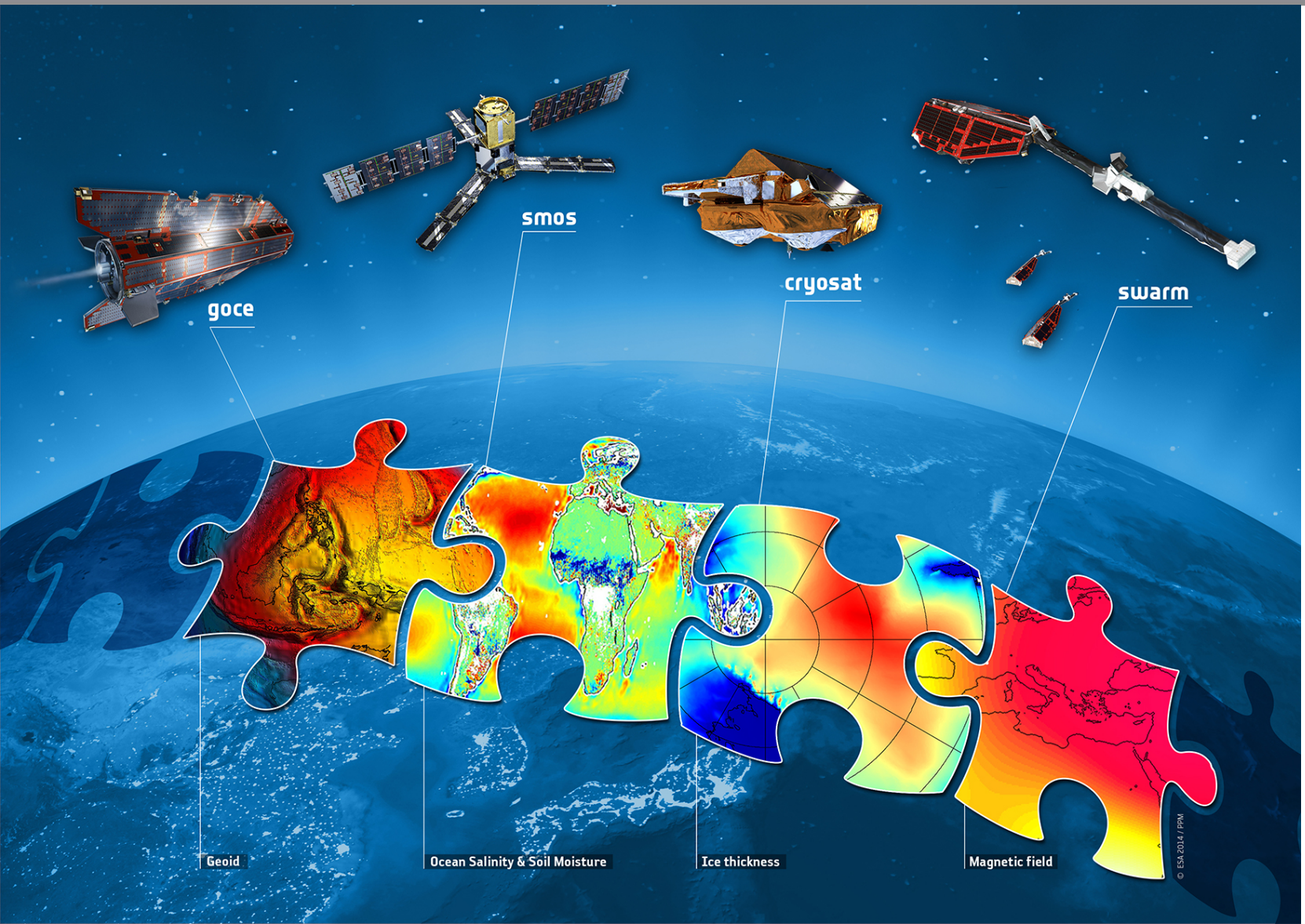
- **Observe**: develop and provide the observations to better understand the complexity of our planet and monitor its health;
- **Understand**: enable improved predictions of the physical interaction of society with the Earth system;
- **Decide**: inform decision makers and citizens on scenarios and consequences of political and economic decisions regarding our home planet.

The vision of ESA is to enable the maximum benefit of Earth observation for science, society and economic growth.

ESA Earth Observation Programmes



Science – the Earth Explorers



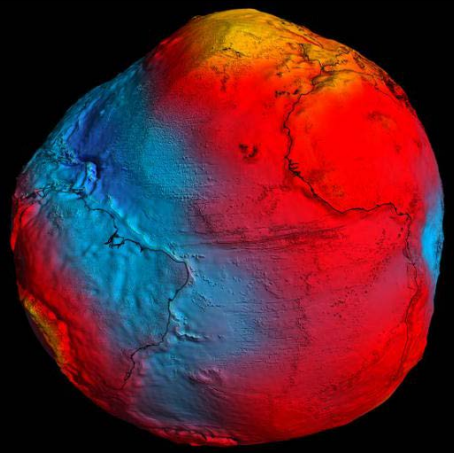
Earth Explorers Launched

Dedicated to specific aspects of our Earth environment whilst demonstrating new technology

Synergy between the missions

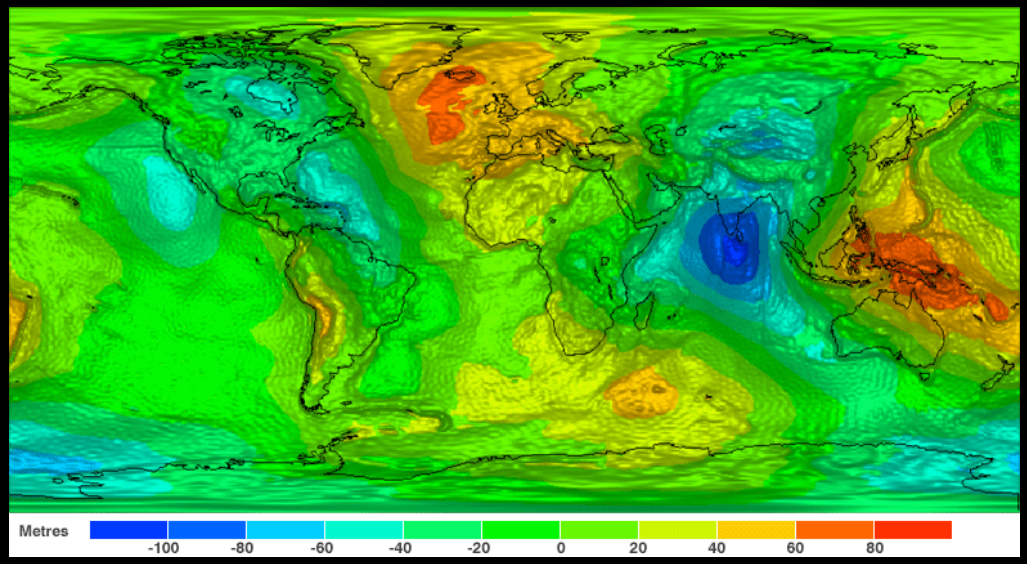
Gravity field and Ocean Circulation Explorer

goce



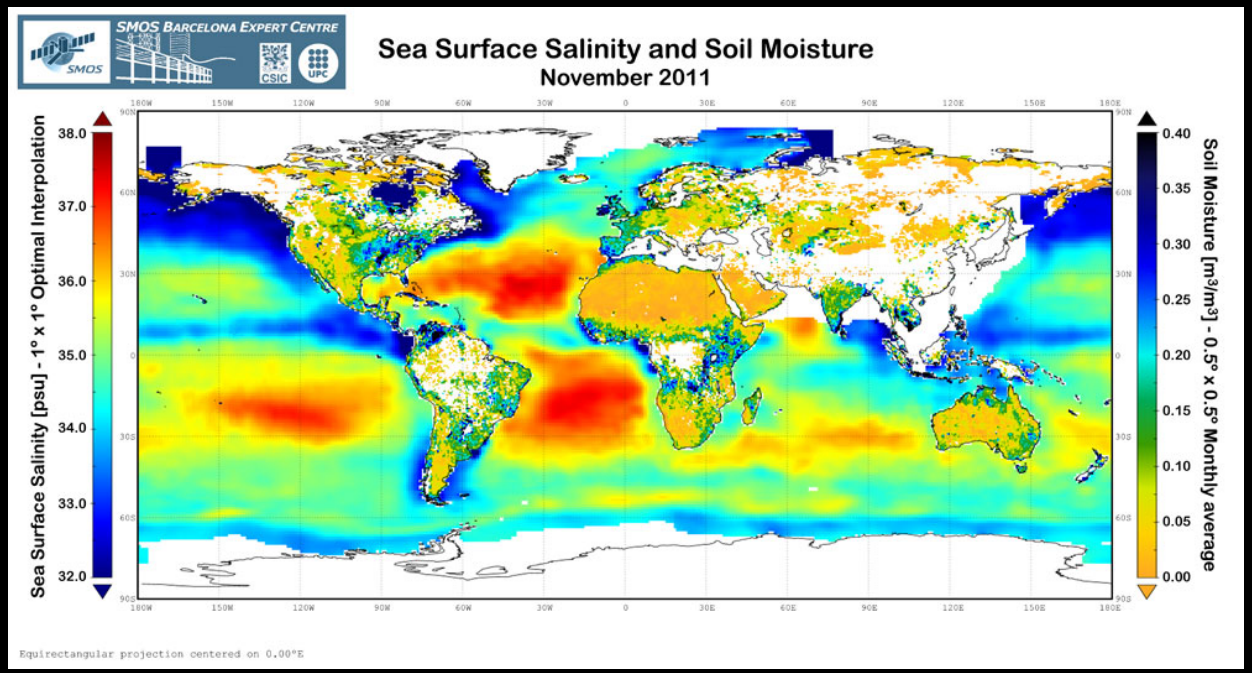
→ UNRIVALLED PRECISION

Technical success: 4.5 years of continuous mission operations at lowest flight altitude ever sustained by a civilian spacecraft.



Scientific success: exceeding all mission requirements/ objectives and addressing a vast number of of secondary objectives and opportunities

SMOS – Soil Moisture and Ocean Salinity



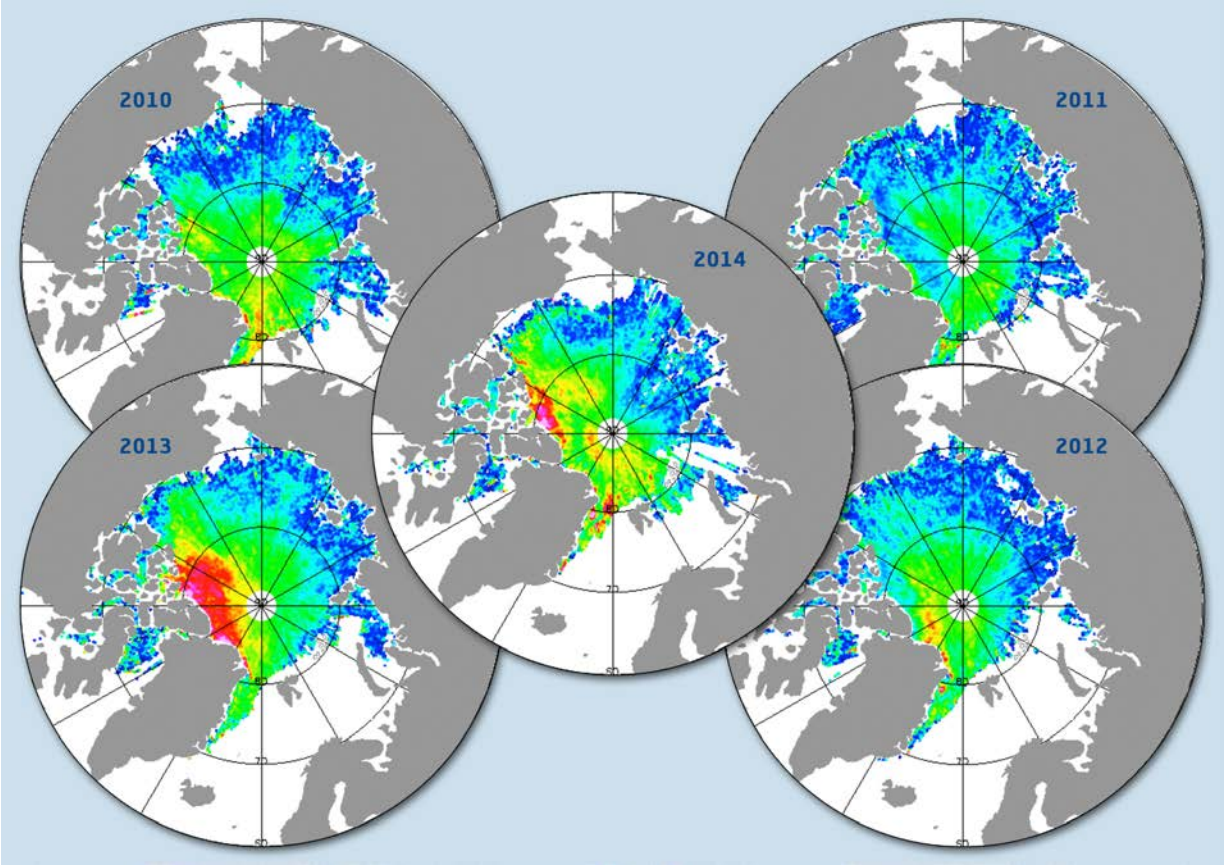
→ NOVEL CONCEPT

- L-band Microwave Imaging Radiometer with Aperture Synthesis
- Complete Earth coverage within three days
- ***Excellent status*** of space and ground segments
- No technical limitations to continue mission exploitation beyond 2017

CryoSat - the ice mission

cryosat

→ COOL TECHNOLOGY

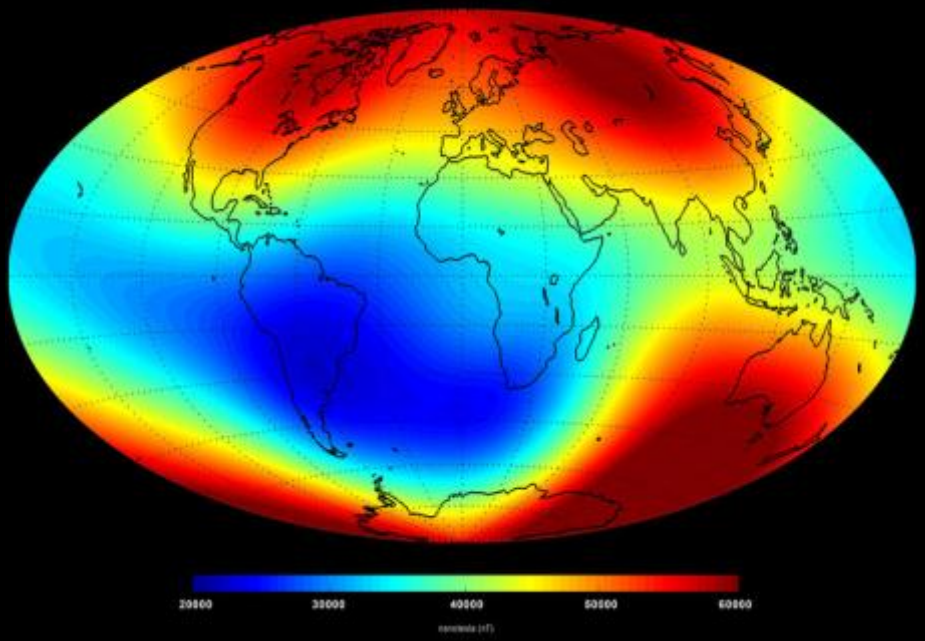


- Sophisticated radar altimeter
  (3 modes of operations)
- Reaching higher latitudes than any other missions
- ***Excellent status*** of space and ground segments
- No technical limitations to continue mission exploitation beyond 2017

Swarm - the geomagnetism mission

swarm

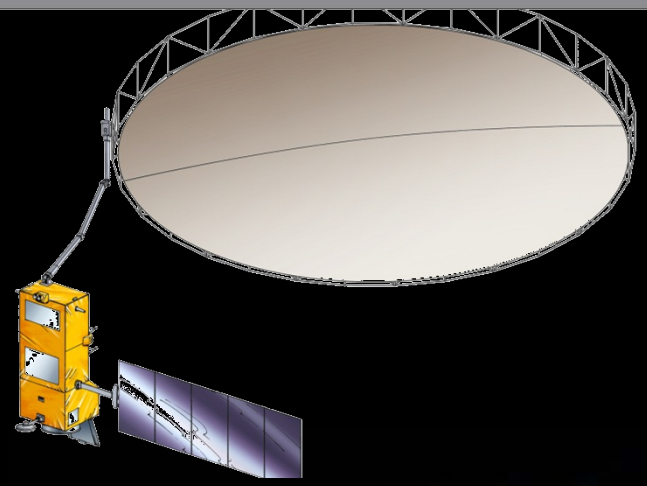
→ REVEALING THE EARTH COMPLEXITY

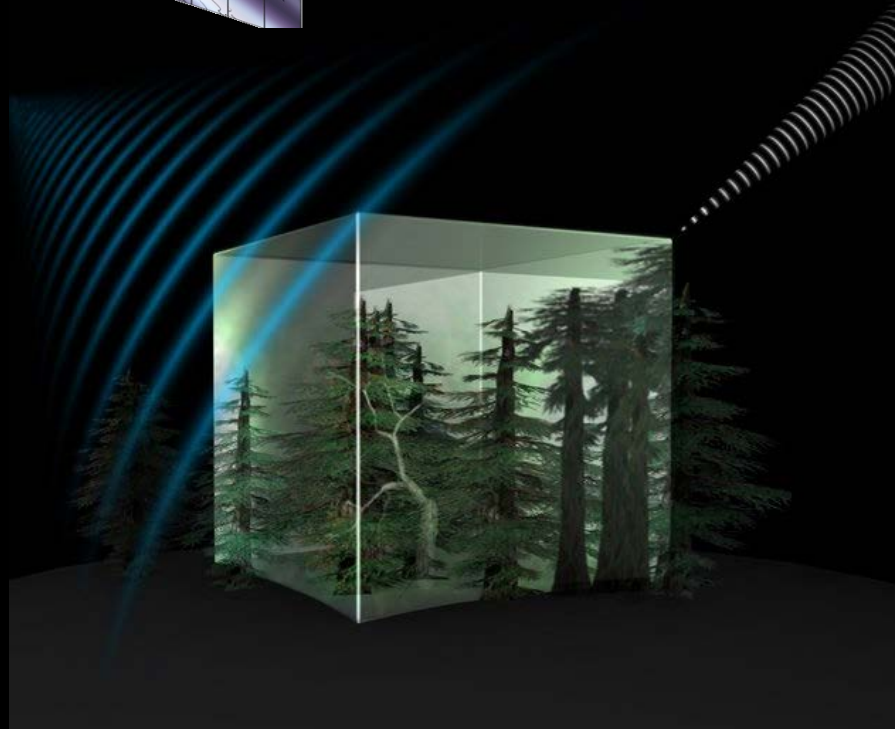


- Three identical satellites (Alpha, Bravo, Charlie) launched in 2013
- Constellation operating flawlessly, except for loss of Absolute Scalar Magnetometer on Charlie
- Magnetic measurement performance is brilliant; noise levels far below specification (1 nT)
- **First field models are all released and are of excellent quality**.

BIOMASS

- 7th Earth Explorer
  - Selected by ESA's Earth Observation Programme Board
  - Biomass estimates based on global interferometric and polarimetric P-Band Radar observations
  - Essential to understand the Earth's carbon cycle
  - To be launched in 2021

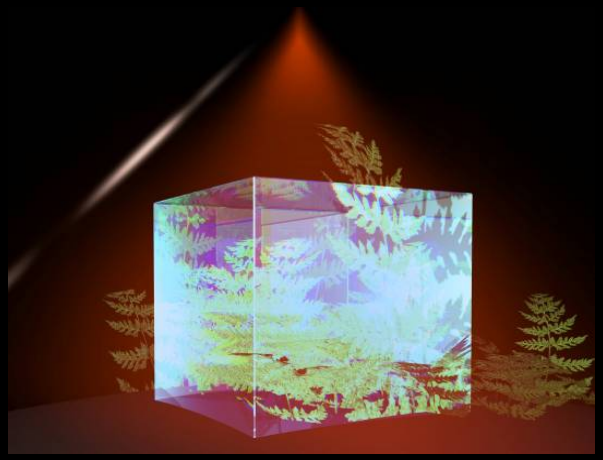


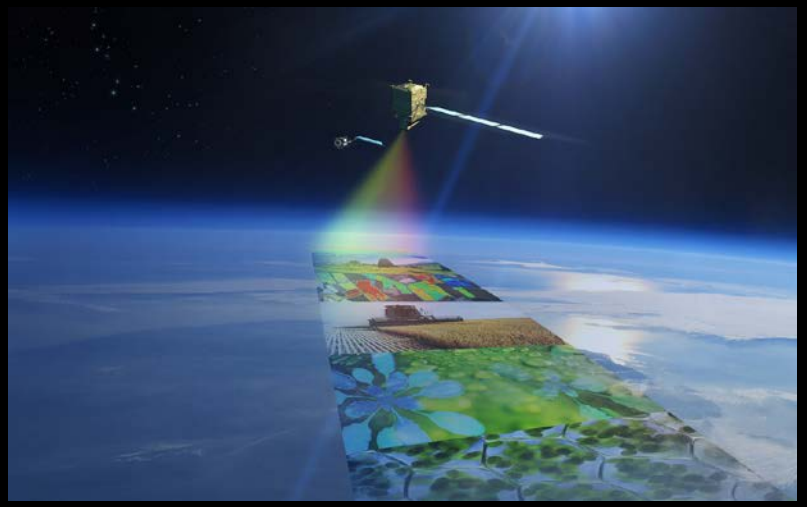


FLEX

8th Earth Explorer

- Mission approved in Nov 2015
- To provide global maps of vegetation fluorescence, which can be converted into an indicator of photosynthetic activity
- To improve our understanding of how much carbon is stored in plants and their role in the carbon and water cycles
- To be launched in 2022



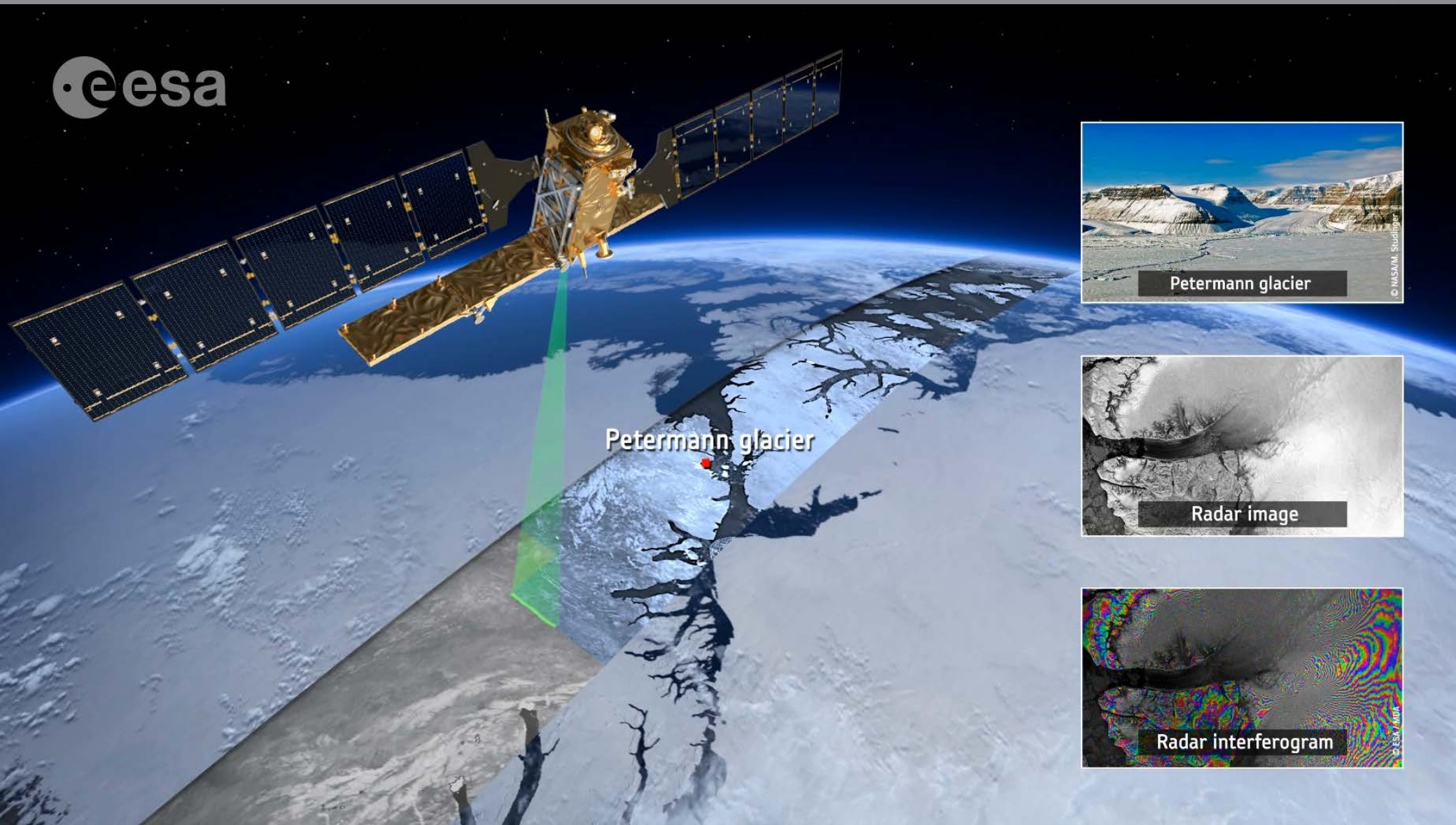


The Sentinel Family

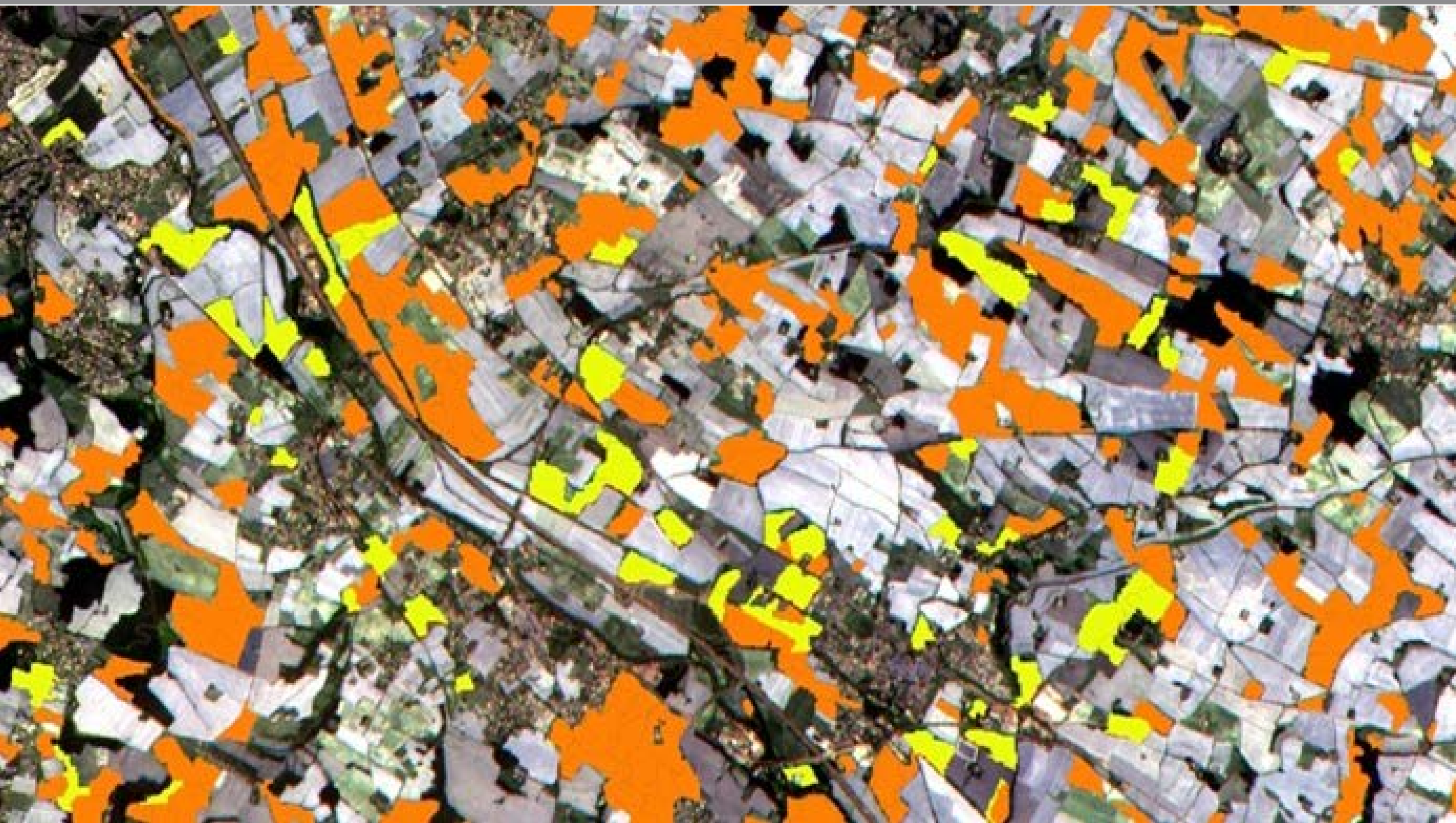
- S1: Radar Mission
- S2: High Resolution Optical Mission
- S3: Medium Resolution Imaging and Altimetry Mission
- S4: GEO Atmospheric Chemistry Mission
- S5P/S5: LEO Atmospheric Chemistry Missions
- S6/Jason-CS: Altimetry Mission

S1A, S2A, and S3A launched

Sentinel-1A: Glacier Motion



Sentinel-2A: Agricultural Monitoring

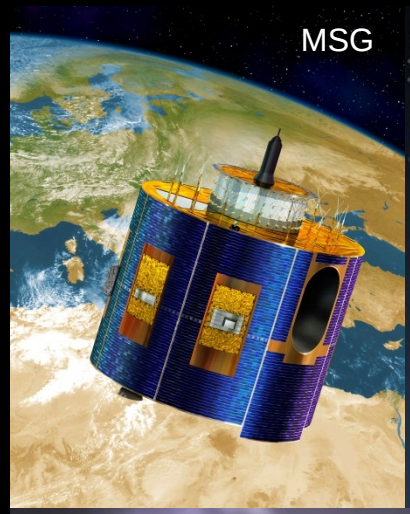


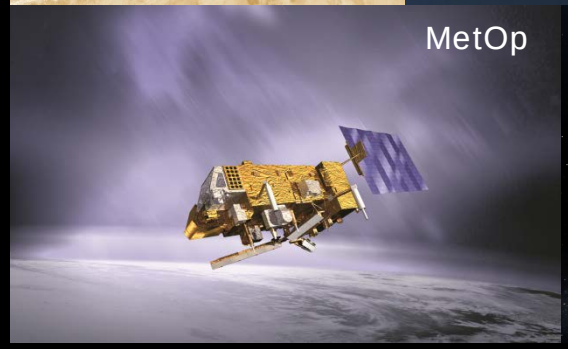
Sentinel-3A

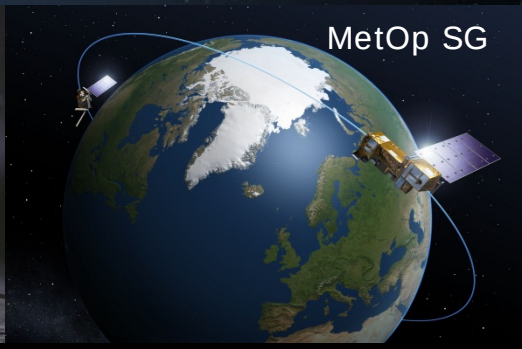
- Image acquired on 1 March 2016
- OLCI (Ocean and Land Colour Instrument
- Continuity with ENVISAT MERIS FR data at 300 m

Meteorological Missions

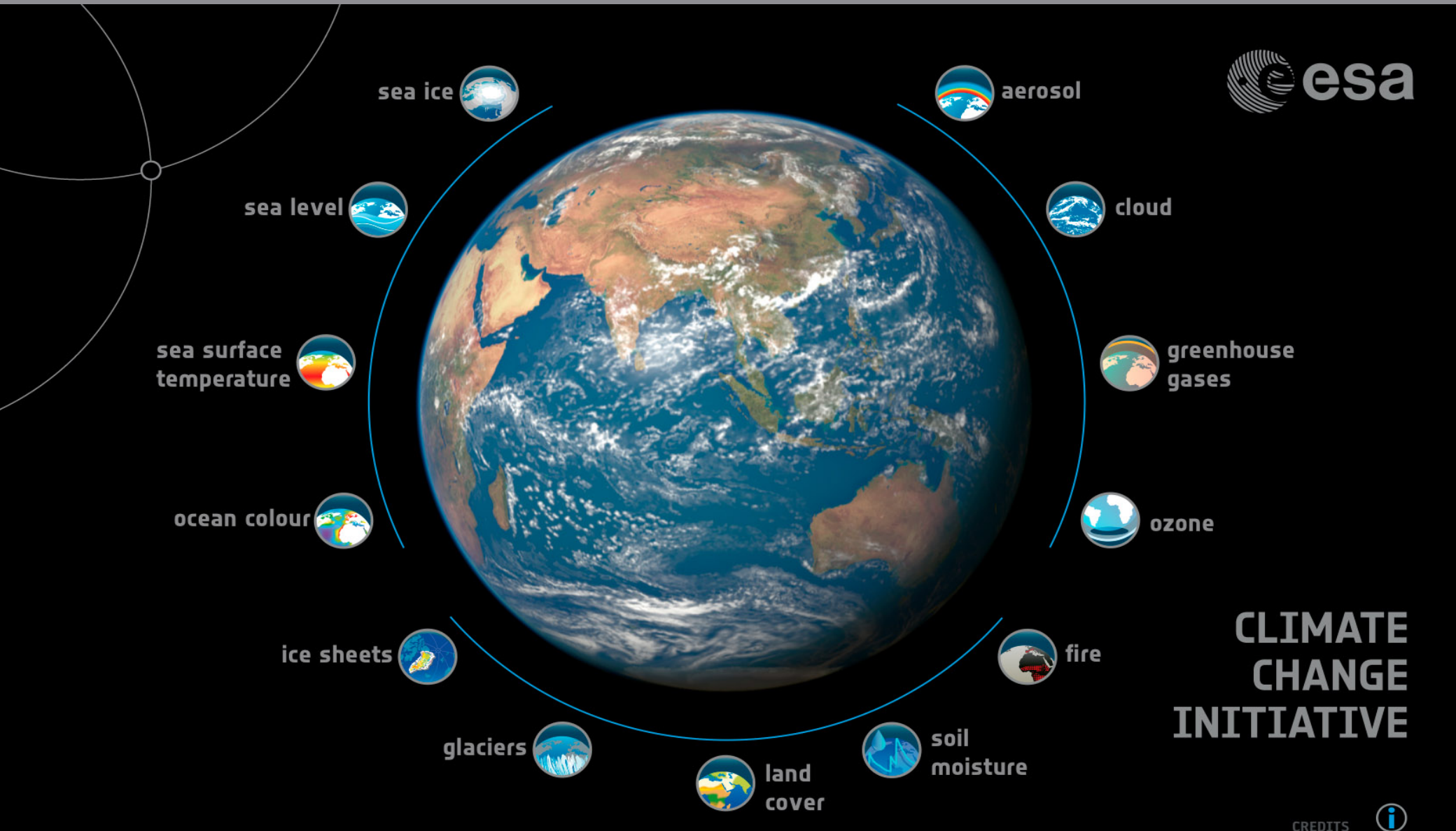
- ESA develops prototype satellites and, on behalf of EUMETSAT, procures recurrent satellites
- EUMETSAT operates the satellites
- Currently Meteosat Second Generation (MSG) missions in GEO and MetOp missions in LEO
- MeteoSat Third Generation (MTG) and MetOp Second Generation under development
- MSG-4 launched 15 July 2015







CCI: Essential Climate Variables



ESA's EO Science Strategy at a glance (2014)

Ground-breaking exploratory missions integrated into flexible observing systems for Earth system science

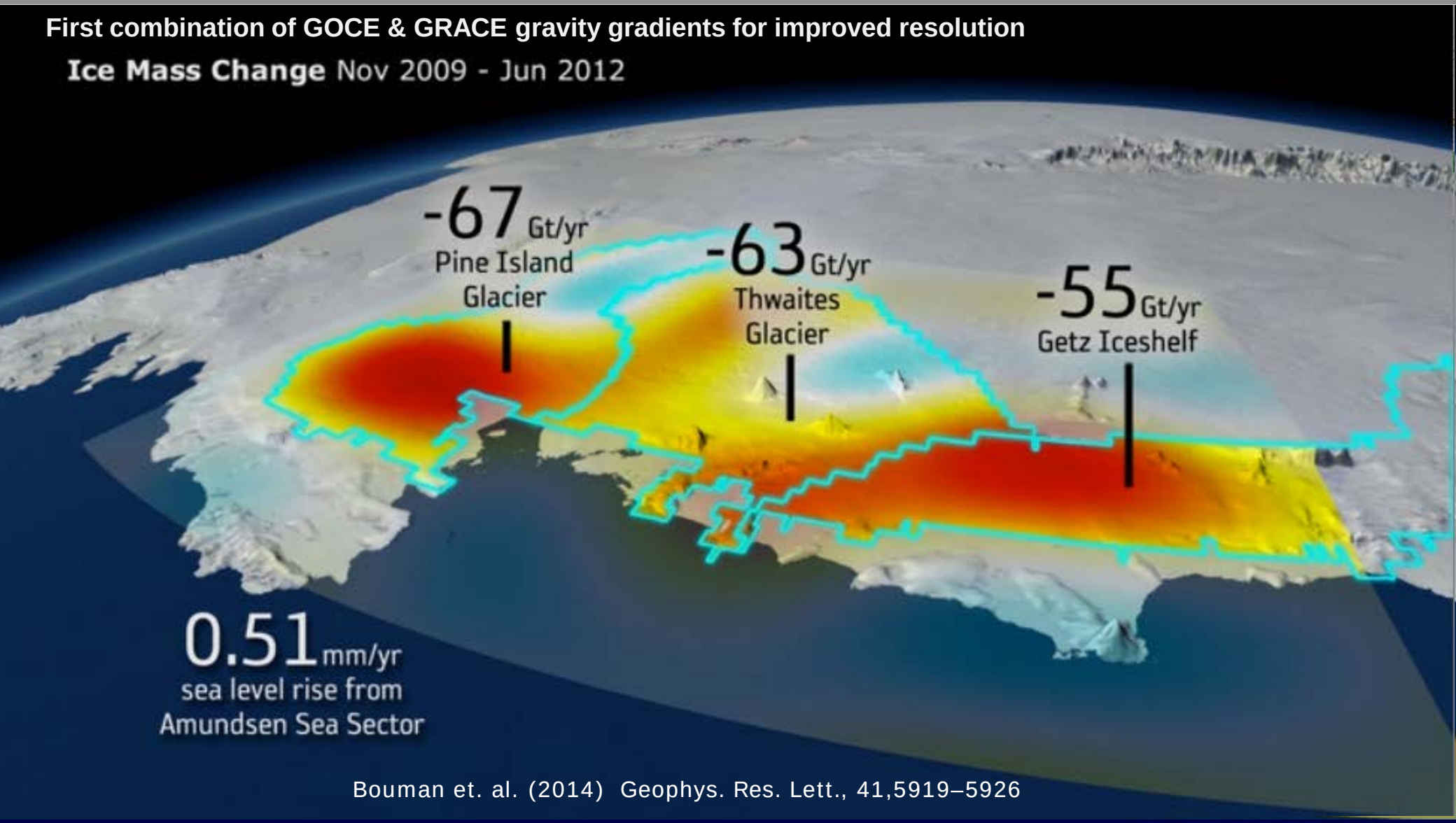
Sustained observations to understand and attribute trends beyond the expected variability

International co-operation to provide an integrated, optimised Earth observing system, which can grow in capability in a cost-effective manner

Translational science to synthesize and adapt the data streams from individual instruments and satellites into knowledge

Wider Communication and dialogue with people beyond the scientific sector to help explain the value, opportunities and inspiration provided by EO from space

International Cooperation (IMBIE)
Ice Sheet Mass Balance Exercise



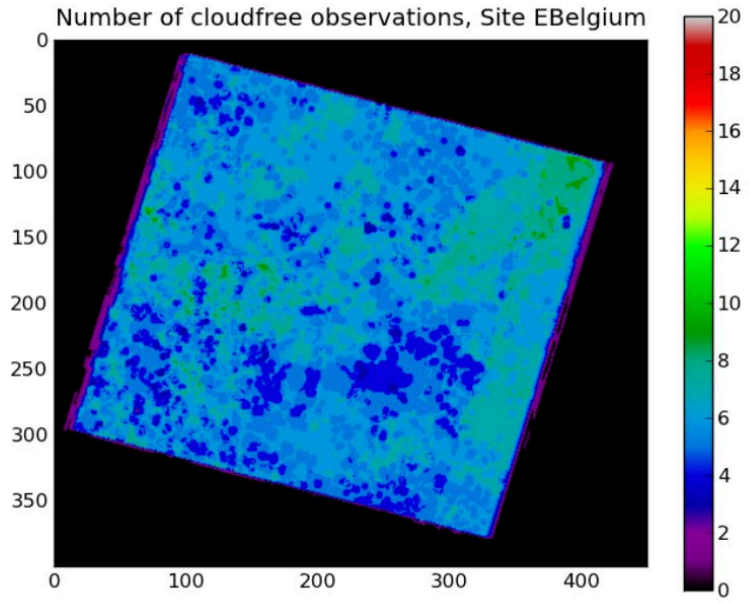
Bouman et. al. (2014) Geophys. Res. Lett., 41,5919–5926

S2 & Landsat long-term continuity

- Historic Landsat archives necessary for long-term monitoring
- Continuity improved with Sentinel-2
- Exchange of archives and cross-calibration required

S2 & Landsat coverage

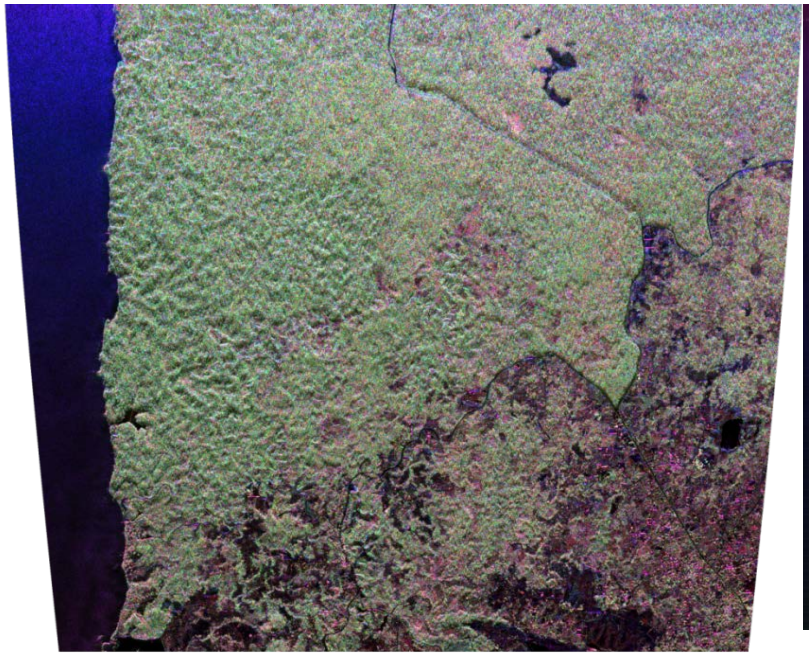
- S2 5 days revisit does not guarantee sufficient temporal coverage for services
- S2a/b + L7/8 missions increase revisit to 3.1 days



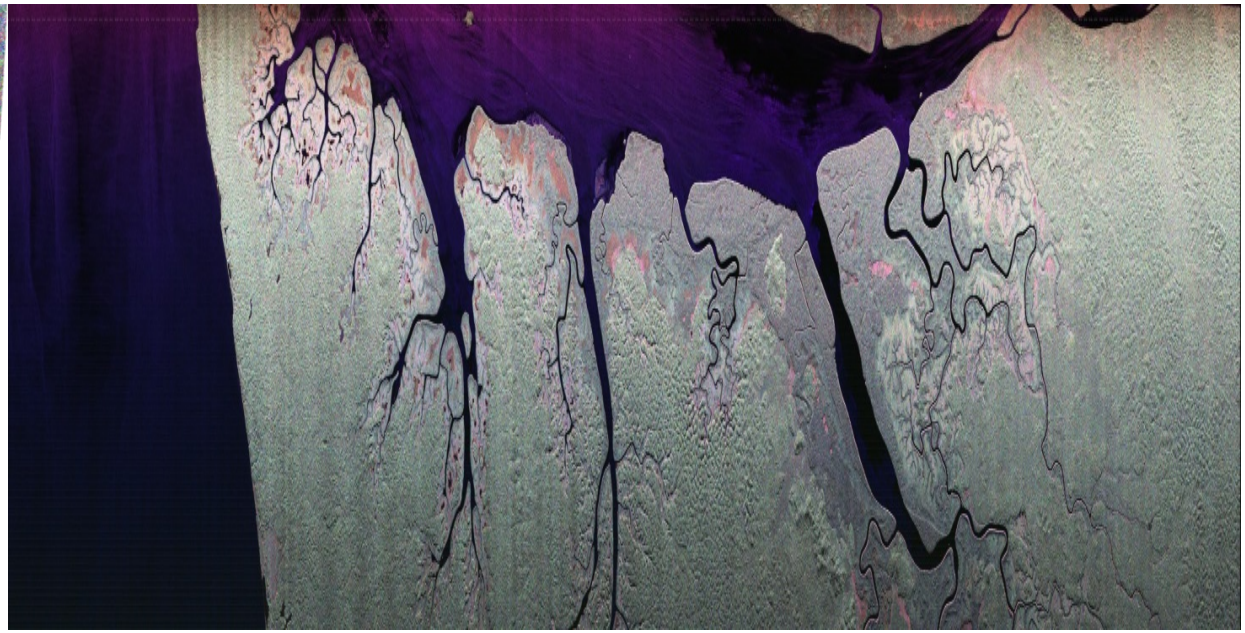
Spot4-Take5 Belgium: Cloud free pixels, with 5 days revisit in 4 months

AfriSAR first images – Airborne SAR at L- and P-band and lidar

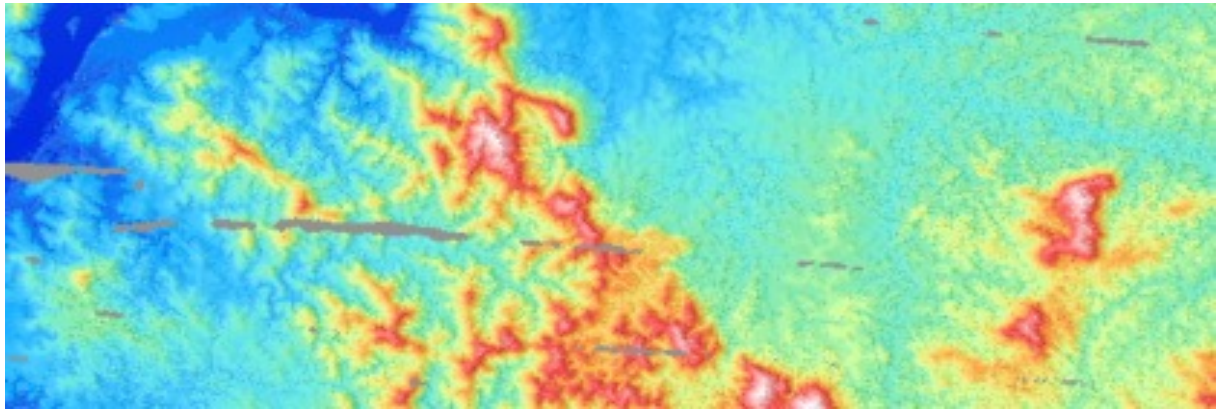
P-band SAR image (ESA/DLR)



L-band SAR image (UAVSAR NASA/JPL)



Lidar image (LVIS/NASA)



International Collaboration

- International cooperation is not only an opportunity but a "must"
  - Number of excellent and urgent proposals from science increases while the budgets stay constant
  - Cannot afford to double efforts anymore and need to work more than in the past together
  - Flying constellations (convoys) with international partners to reach a larger objective compared to a single mission

- Cooperation in Earth observation between ESA and NASA established but could be firmed up in the future

Conclusions

- ESA keen in a balanced and reliable cooperation with NASA in the frame of Earth observation
- Strong synergy between the priorities of the NASA Decadal Survey and ESA's future EO plans = > Obvious cooperation
- Concerns not only NASA and ESA but other Space Agencies

Thank you for your attention