Welcome to IVOS#30

28 March 2018

ESA-ESTEC

Michael Rast, ESA-ESRIN

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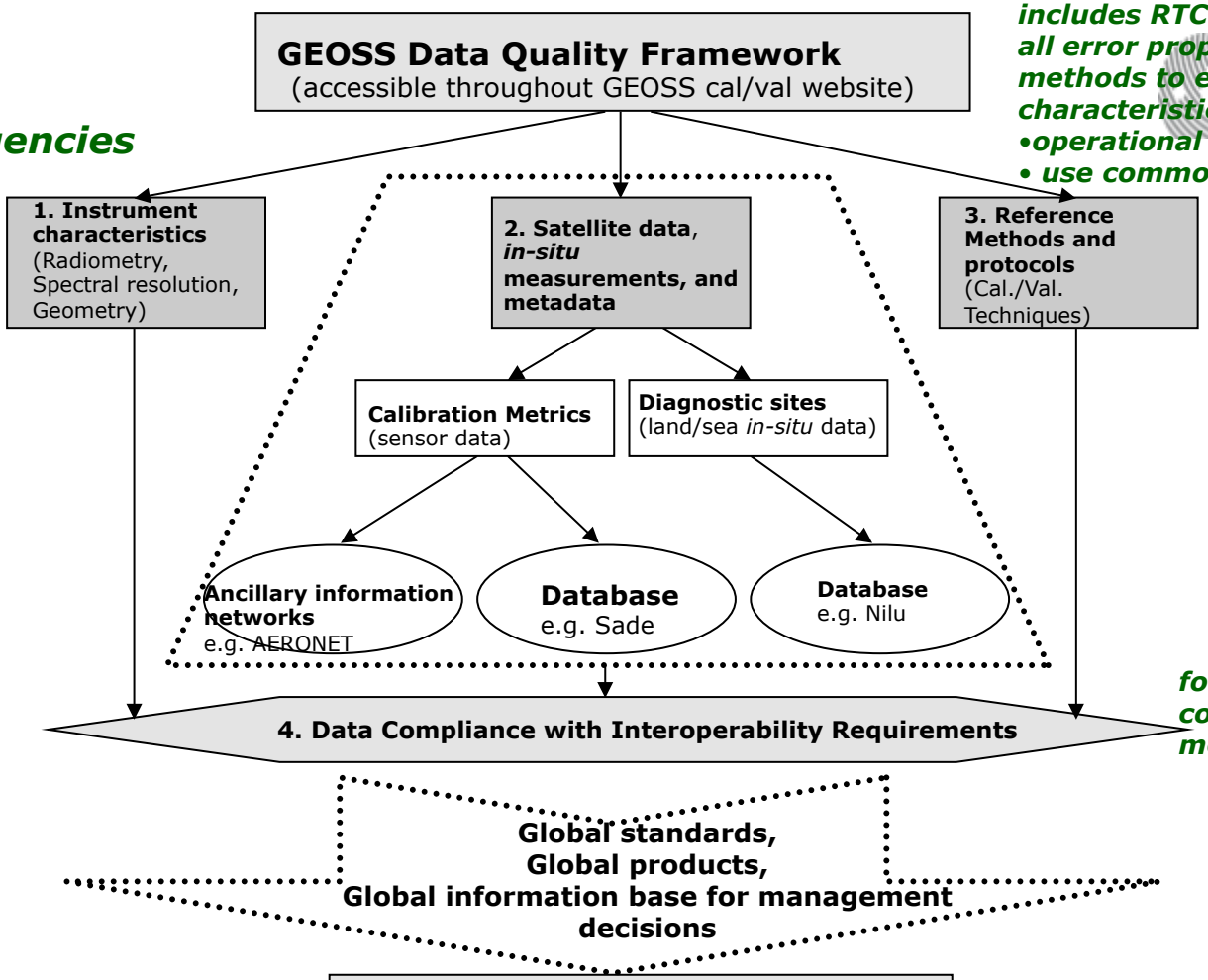
European Space Agency

Workshop on the Inter-Comparison of
Large Scale Optical and Infrared Sensors

Links to different Agencies

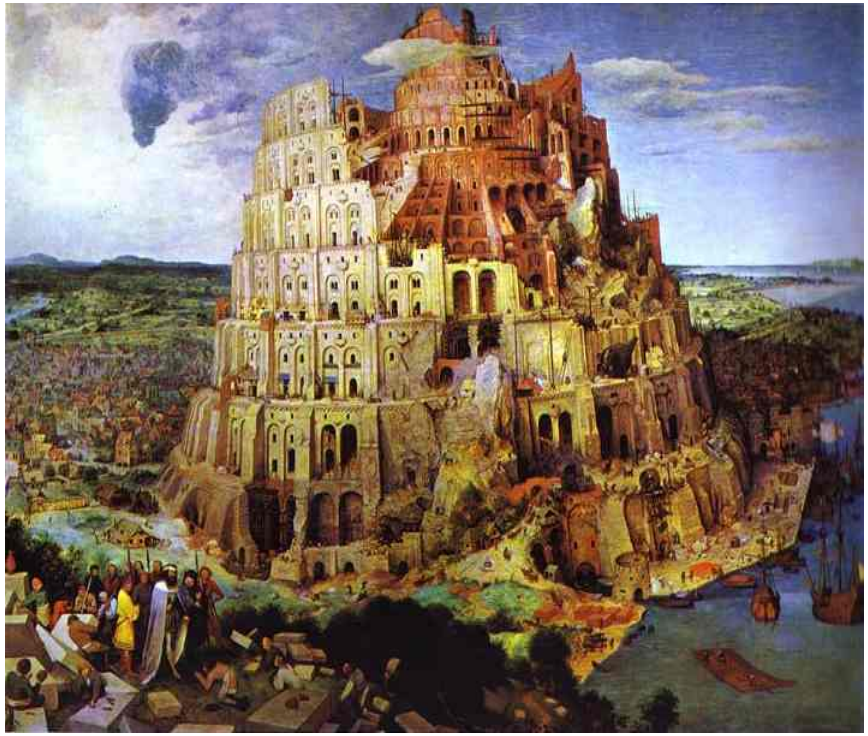
includes RTC procedures and all error propag. models and methods to establish QA characteristics. Use:
•operational processor(by al
• use common data format

Cal/Val and data quality assessment framework system elements for GEOSS



for data combination and merging

The Tower of Babel



Need for Standard Interoperable Formats to Benefit from all Earth Observation Systems

EO Supporting Global Policies

Sustainable Development

UN SDGs

Measuring Status & Progress

Climate Action

Paris Agreement

Monitoring & Understanding

Disaster Risk Reduction

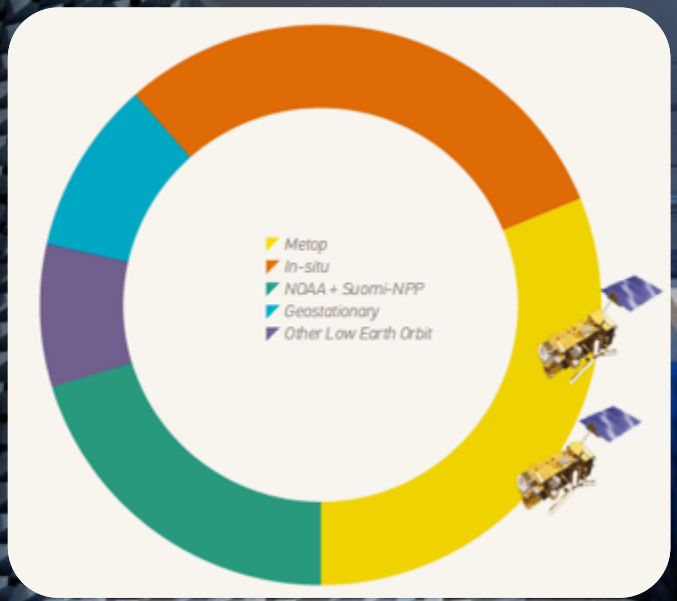
Sendai Framework

Supporting Resilient Infrastructure

European Space Agency

28 satellites in development, 13 in operations

Meteorology: Protecting Lives & Assets



NWP Forecasting Accuracy Contributions

MetOp A+B: 44%

NOAA+NPP: 29%

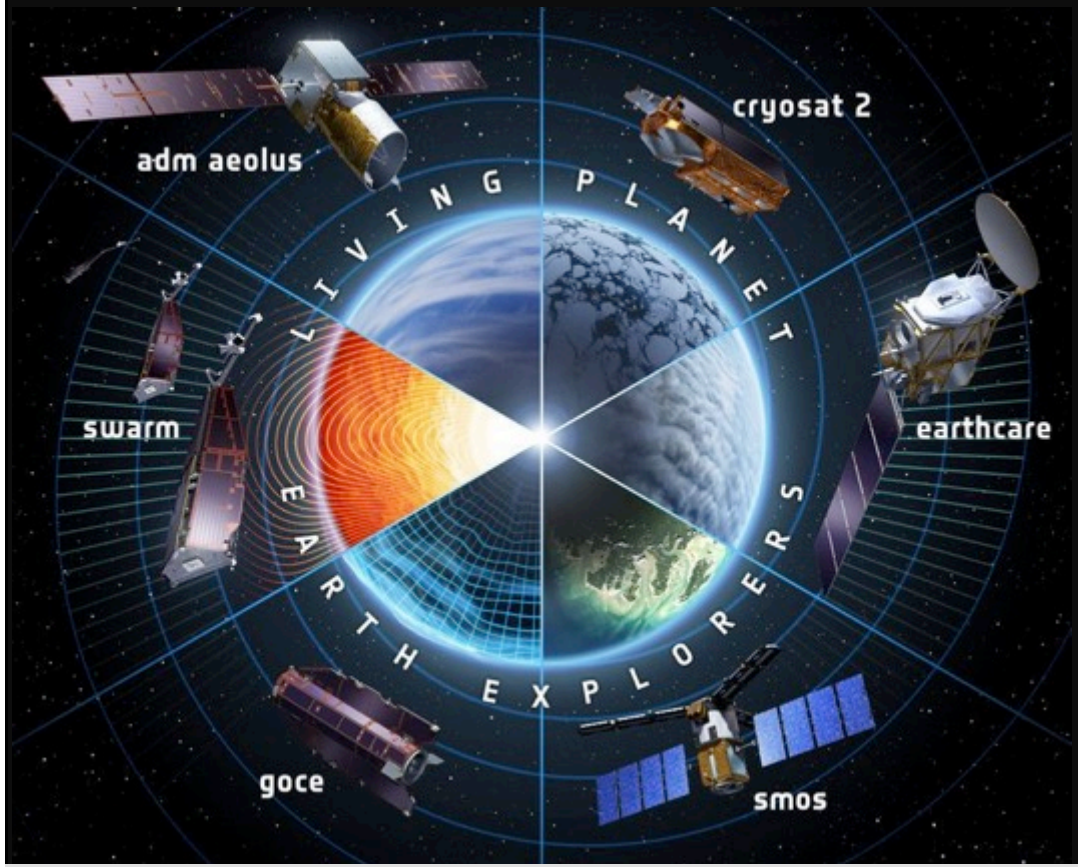
UK Met Office, 2015

New Meteorological Systems

< Current Systems

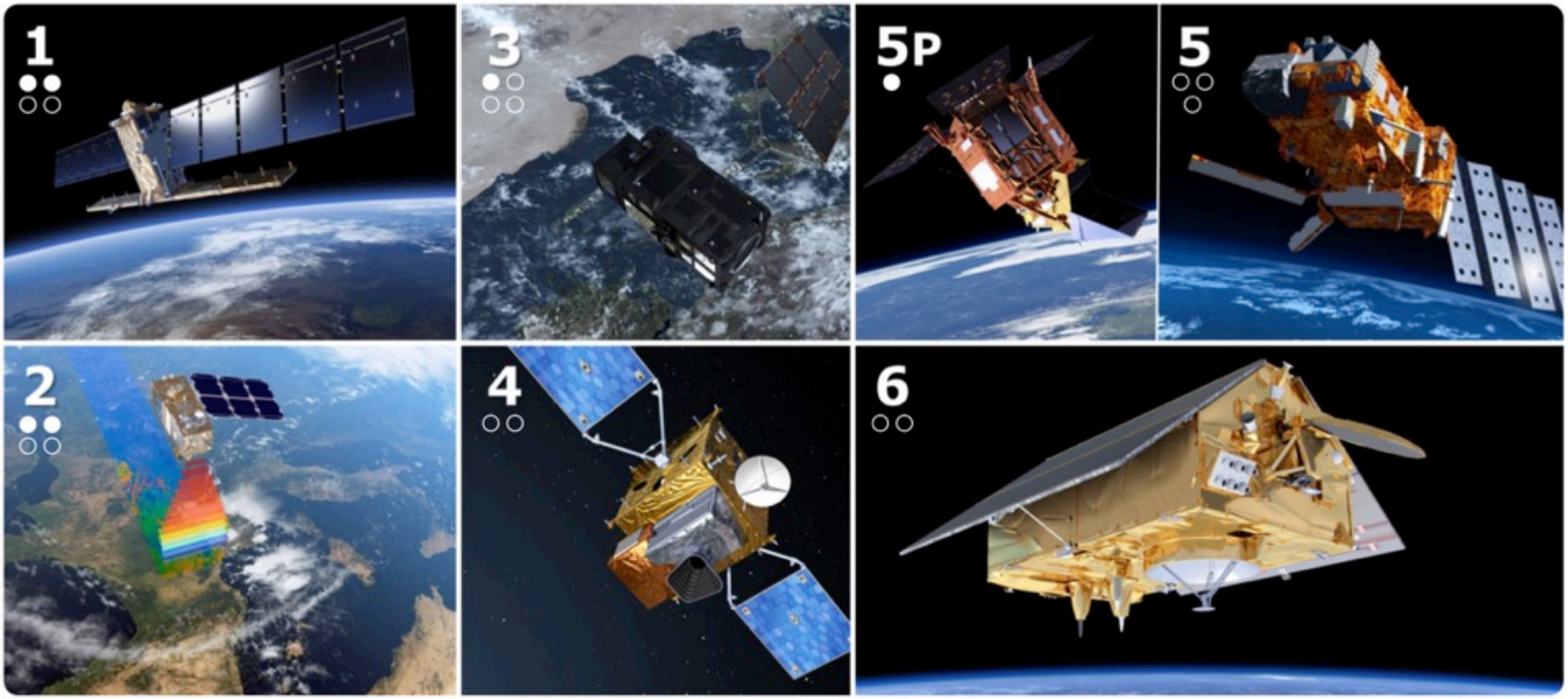
< Post-2020 Systems

Earth Explorers

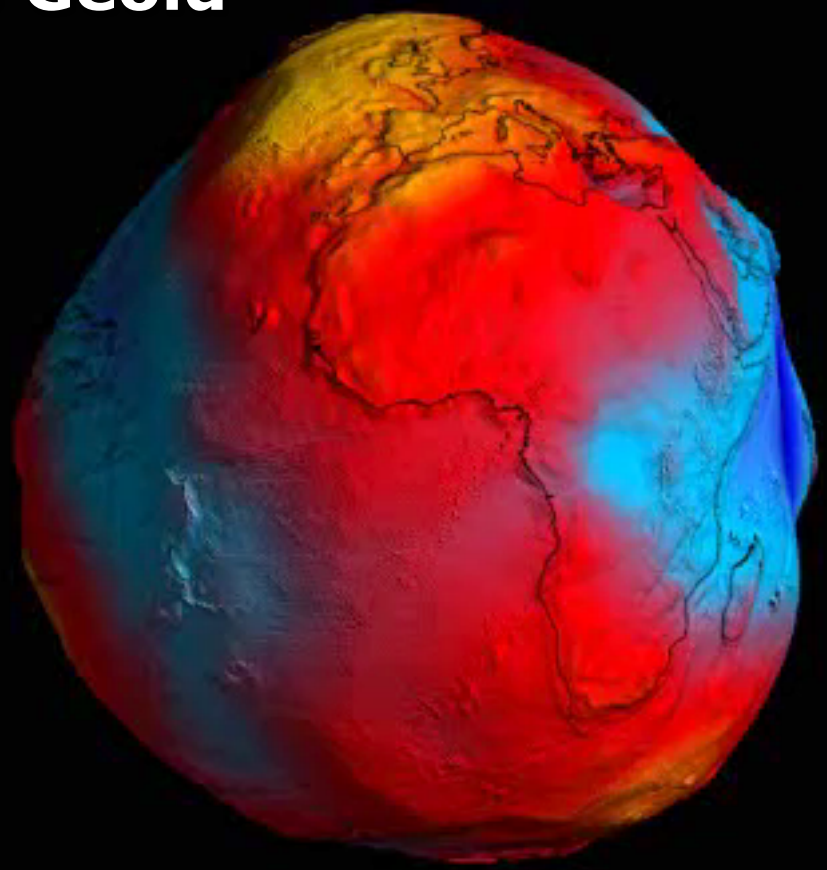


GOCE	2009 – 2013
SMOS	2009 – Present
Cryosat	2010 – Present
SWARM	2013 – Present
Aeolus	2018
EarthCARE	2020
Biomass	2021
FLEX	2022

Copernicus – European Leadership in EO



GOCE: Earth's Geoid



Most precise geoid ever produced

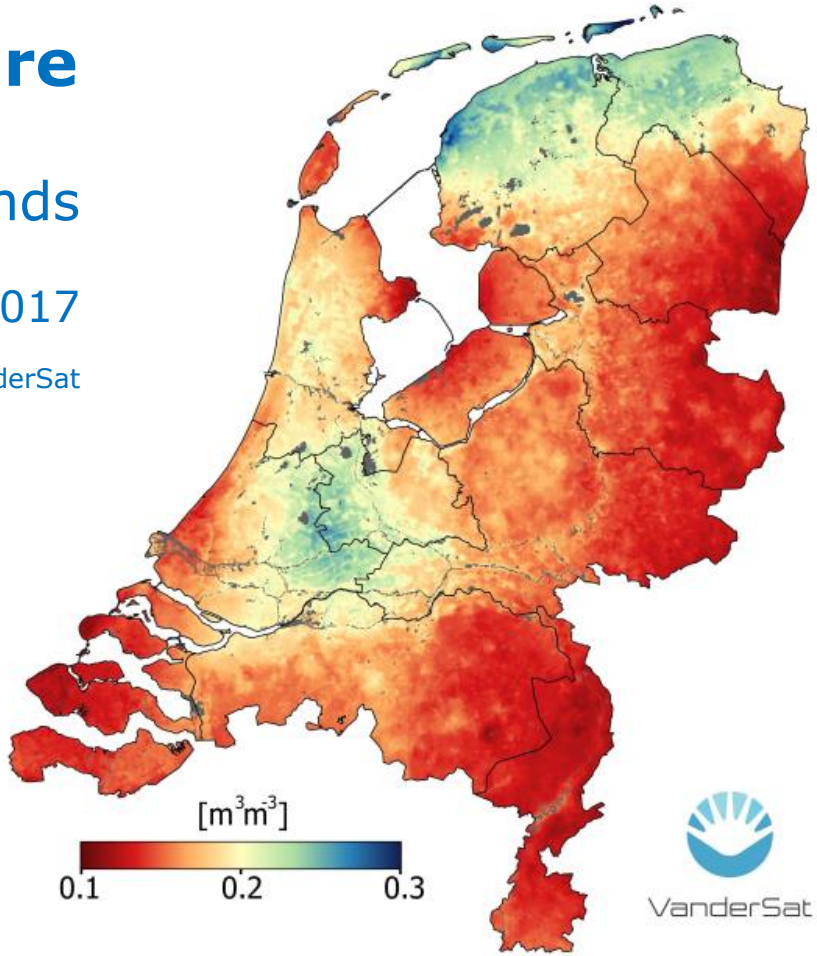
© ESA/HPF/DLR

SMOS: Soil Moisture

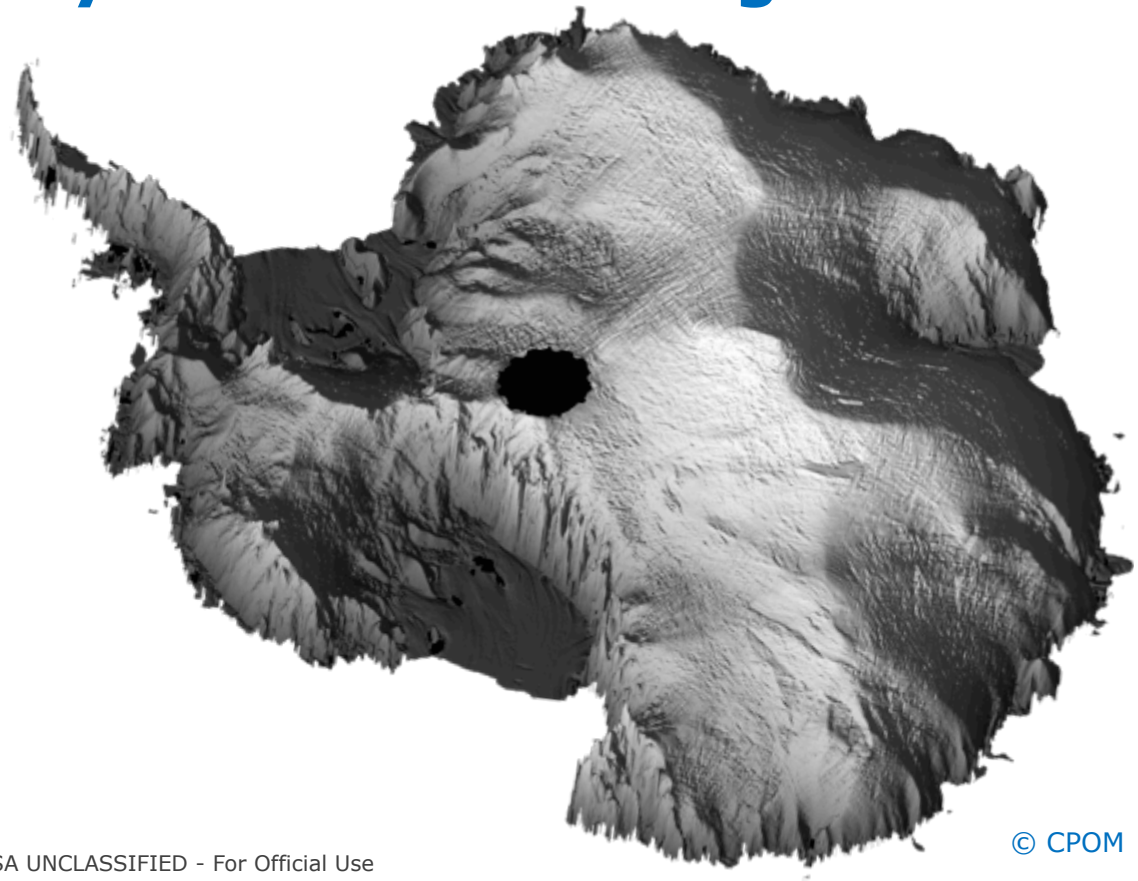
The Netherlands

June 2017

© VanderSat



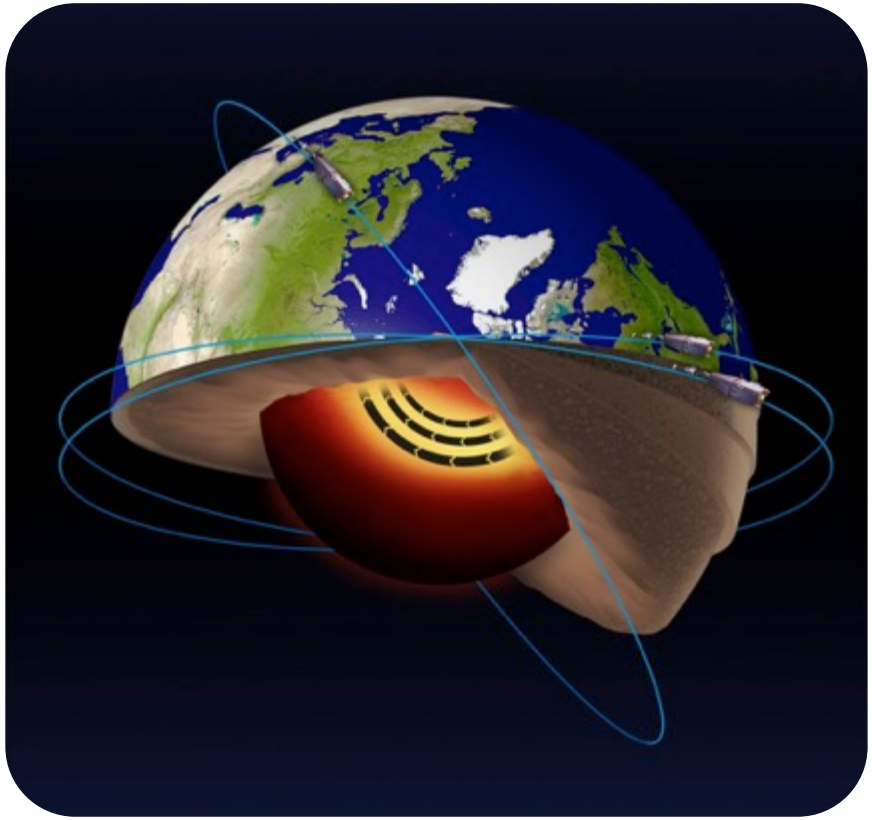
Cryosat: Antarctic Digital Elevation Model



© CPOM

- 2 km grid resolution
- 99% continent coverage
- Validated & accurate to within 25m on average

Swarm: Earth Core Discovery



Liquid Iron Jet Stream
3000 km beneath the surface

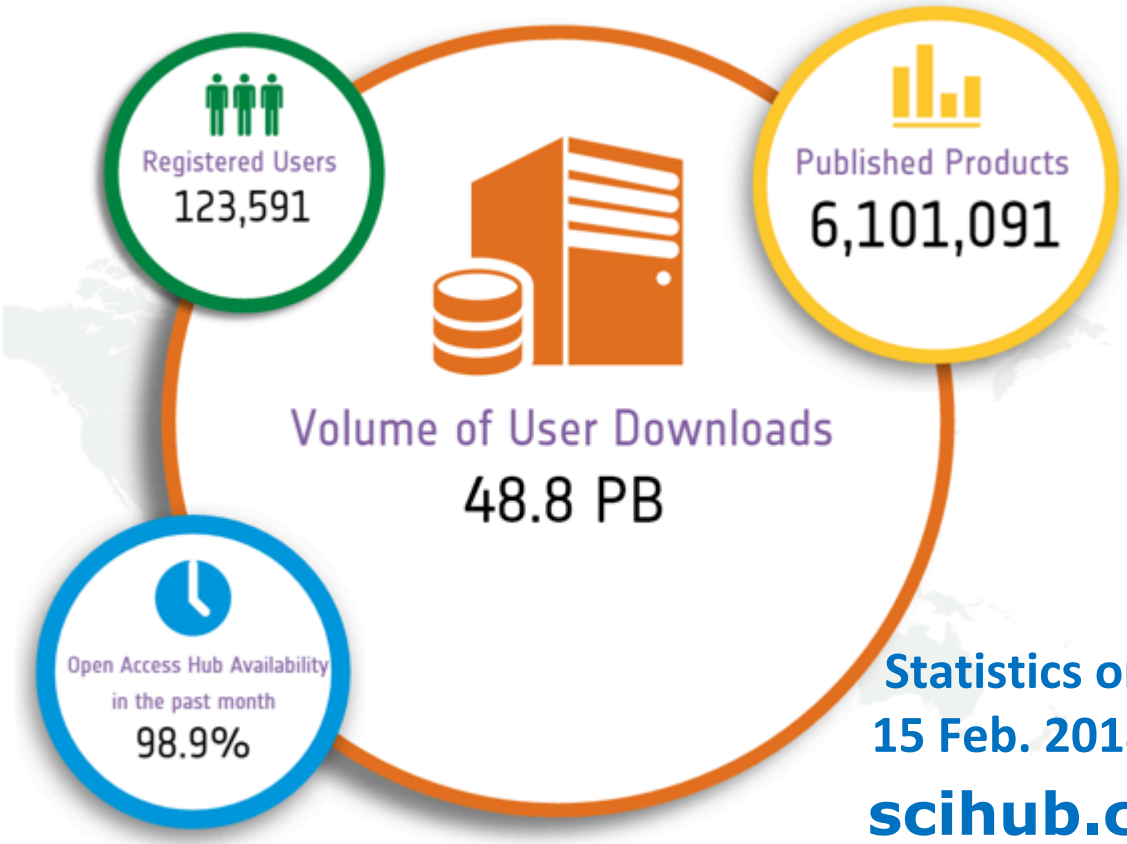
40 km / year

Jet stream is speeding up

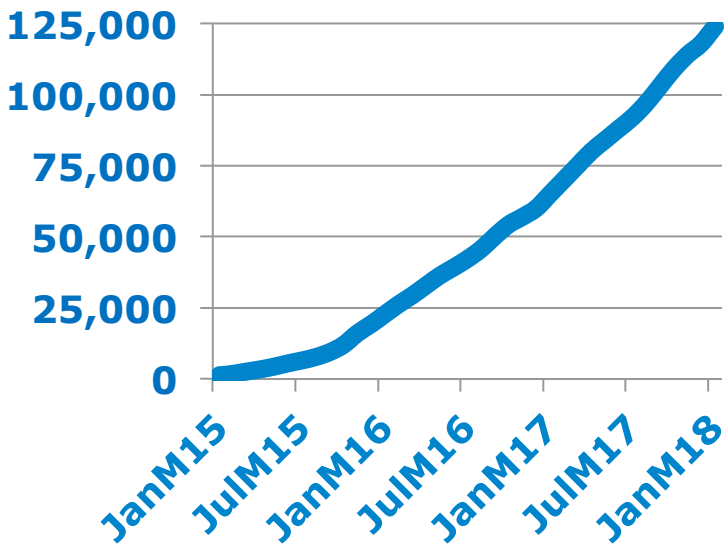
© ESA/ATG Medialab

Aeolus
esa
Launch Q3 2018
Wind Mission
First ever UV LIDAR in Space
European Space Agency

Sentinel Open Access Data Hub



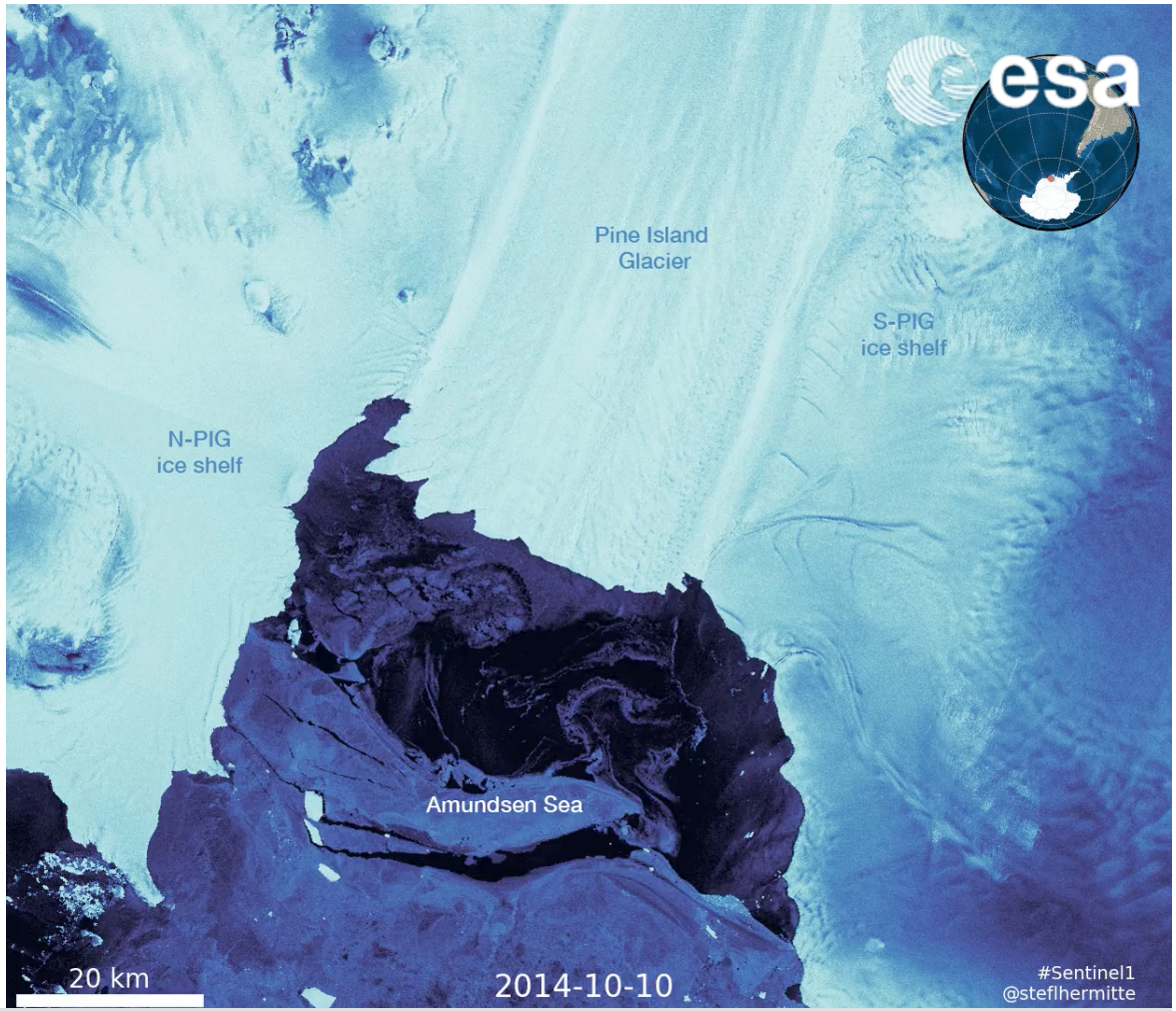
Copernicus User Uptake



Statistics on 15 Feb. 2018

scihub.copernicus.eu

Glacier Flow



Pine Island Glacier
Antarctica

Sentinel-1B
2014-2016

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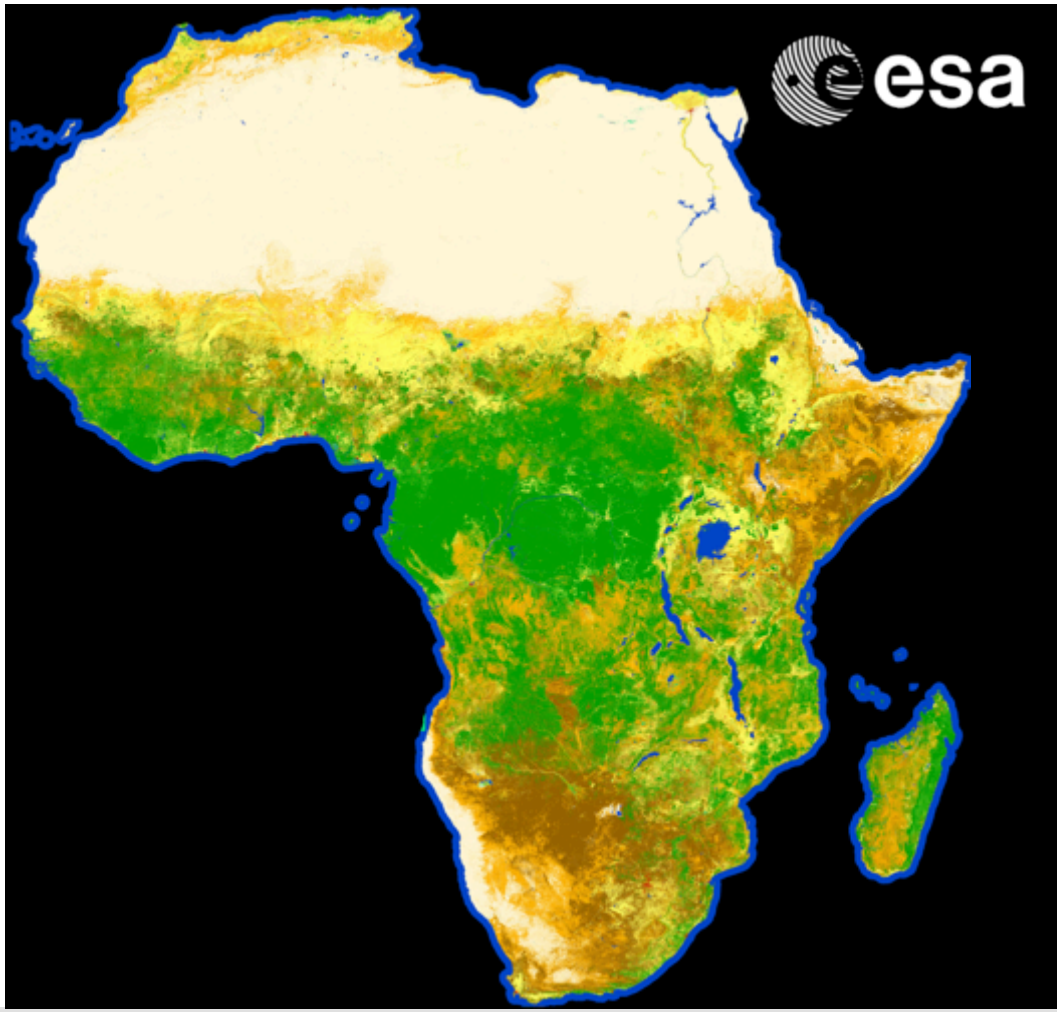
Changes on Land

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



- no data
- Trees cover areas
- Shrubs cover areas
- Grassland
- Cropland
- Vegetation aquatic or regularly flooded
- Lichen Mosses / Sparse vegetation
- Bare areas
- Built up areas
- Snow and/or Ice
- Open water

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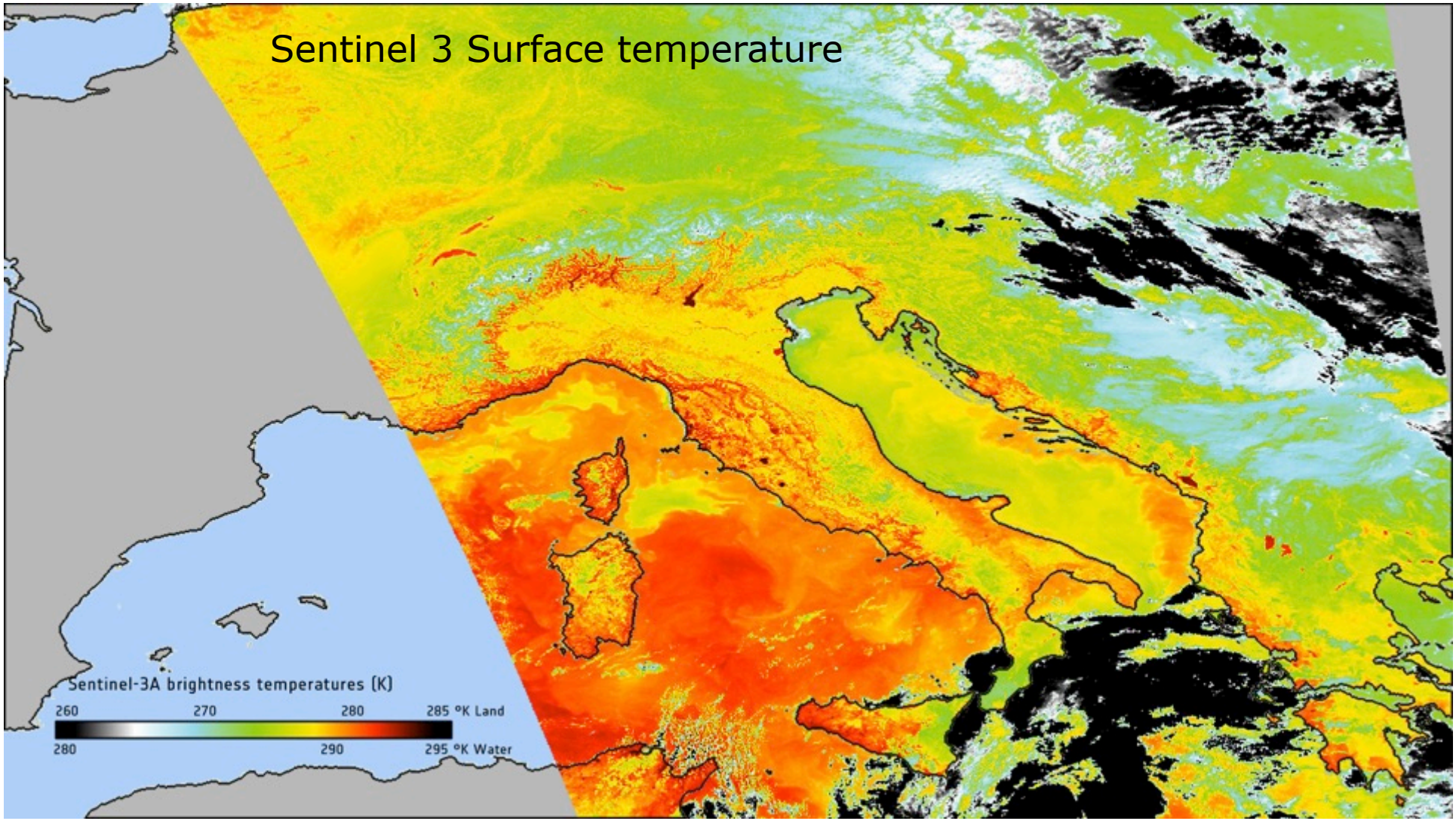
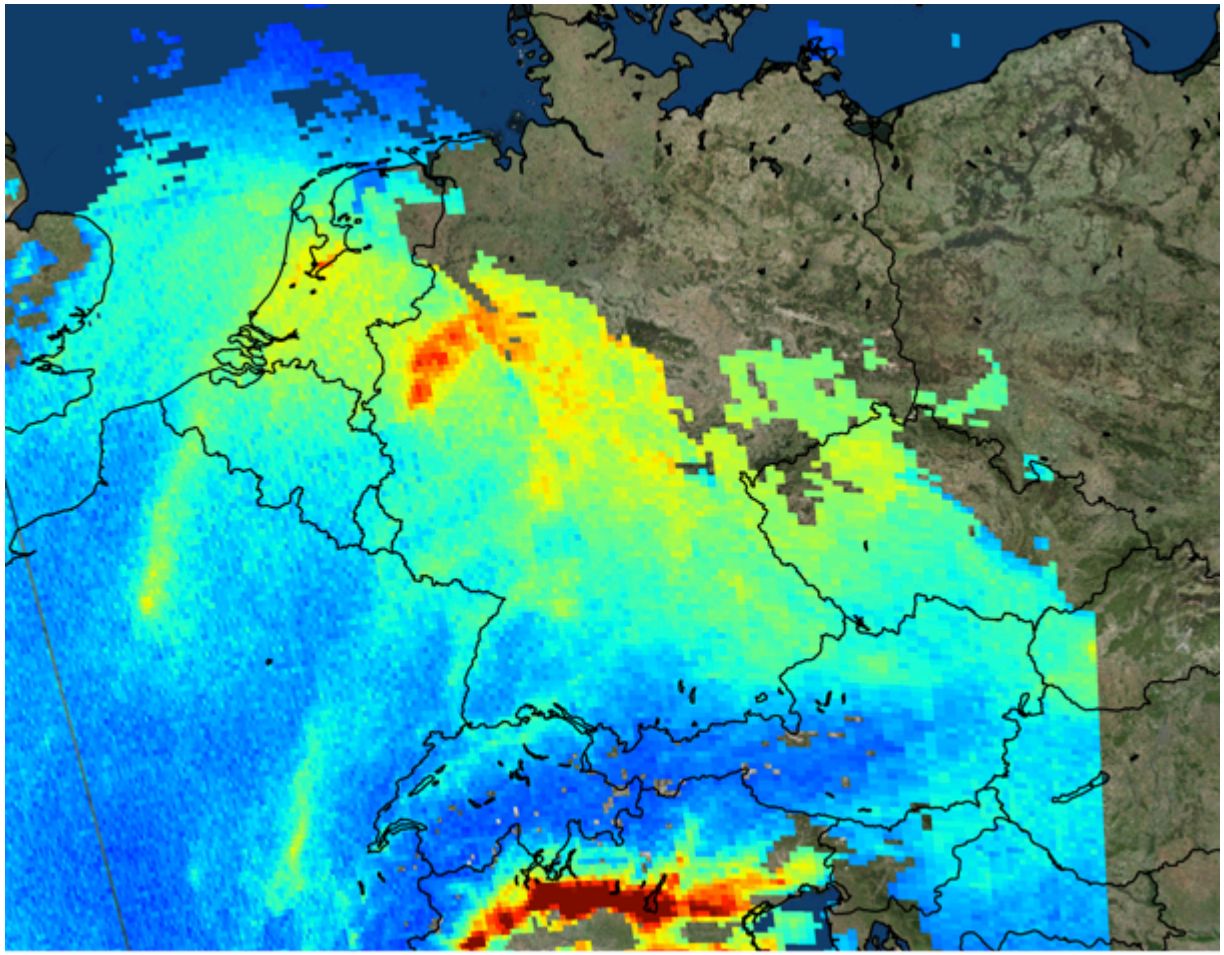

Sentinel 3 Surface temperature
Sentinel-3A brightness temperatures (K)
260
270
280
285 °K Land
280
290
295 °K Water

KNMI/NSO/ESA

NO_2 22-11-2017



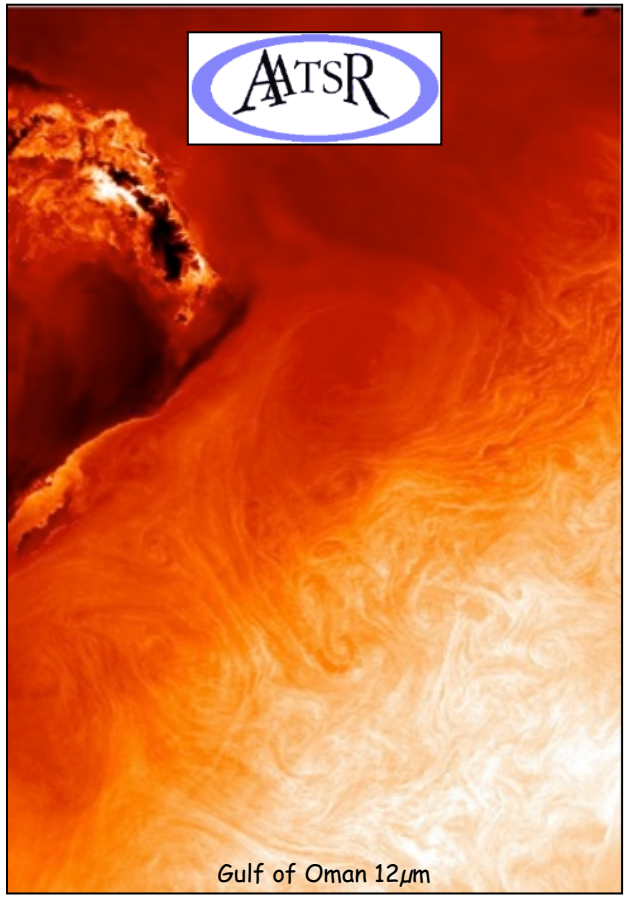
Sentinel 3-B Launch

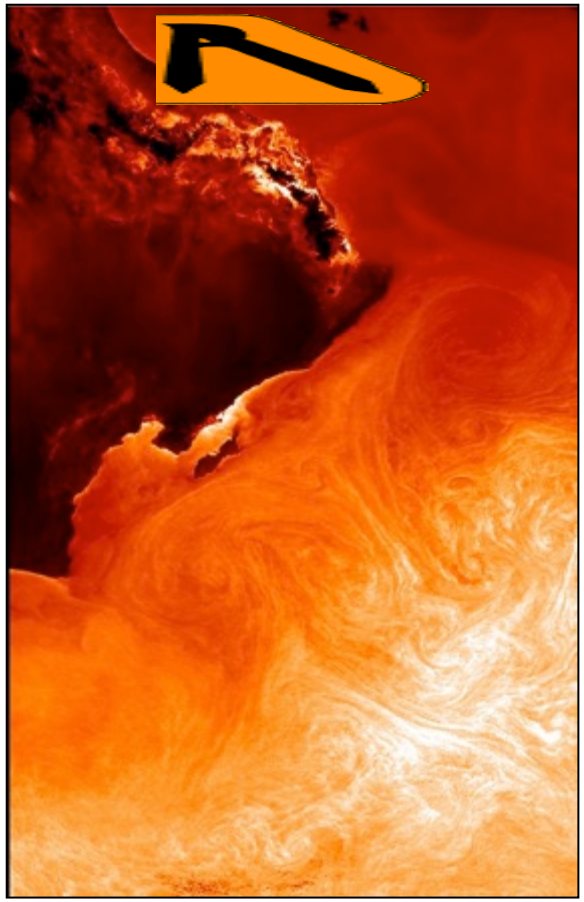
- Launch Team is in Plesetsk
- The satellite has arrived and been unpacked ready to be integrated with the Rockot launcher
- 'Countdown' has started for launch on the 25th of April
- Sentinel 3B will be in tandem formation with 3A for a duration of maximum 5 months

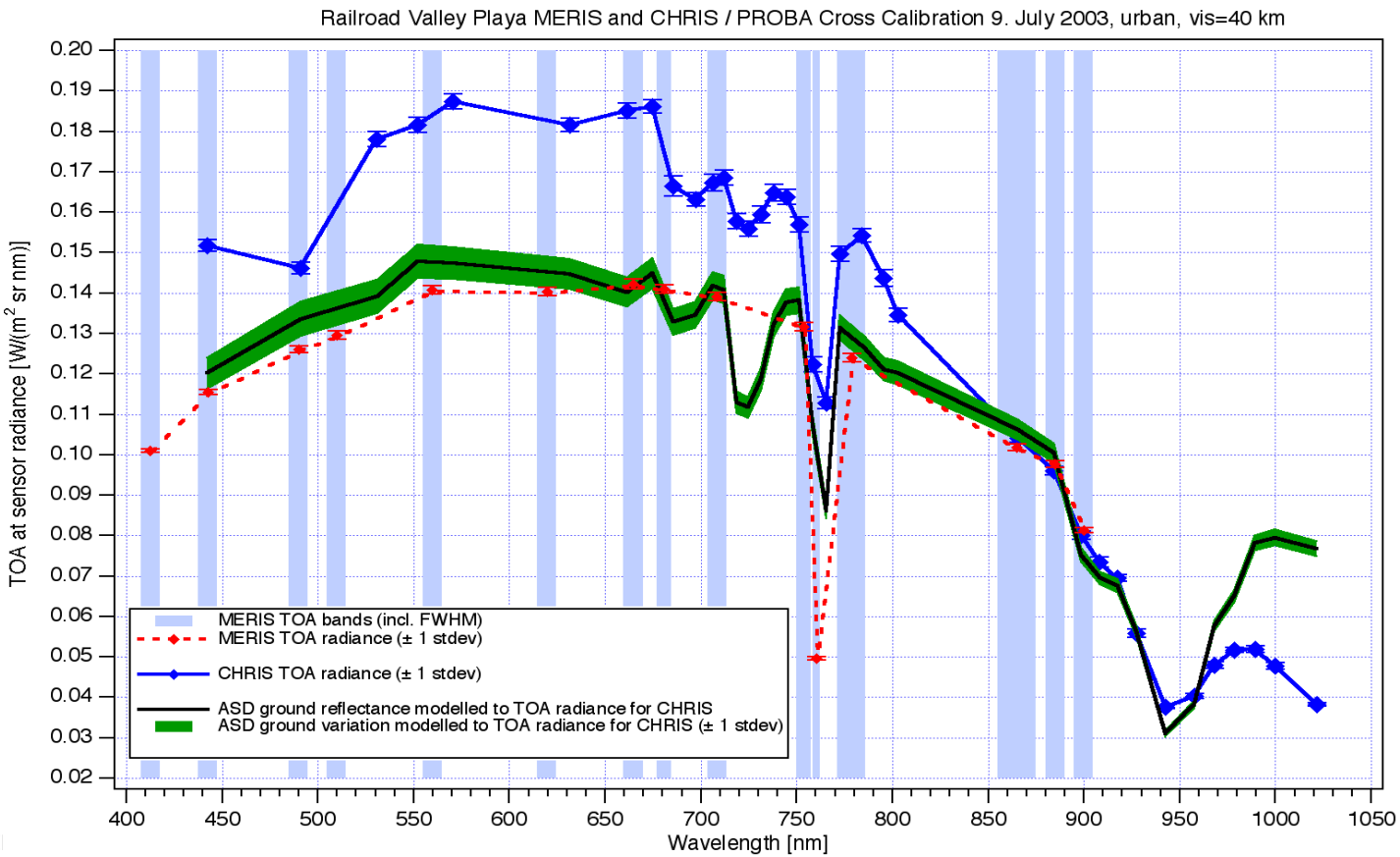
Sentinel 3 Tandem

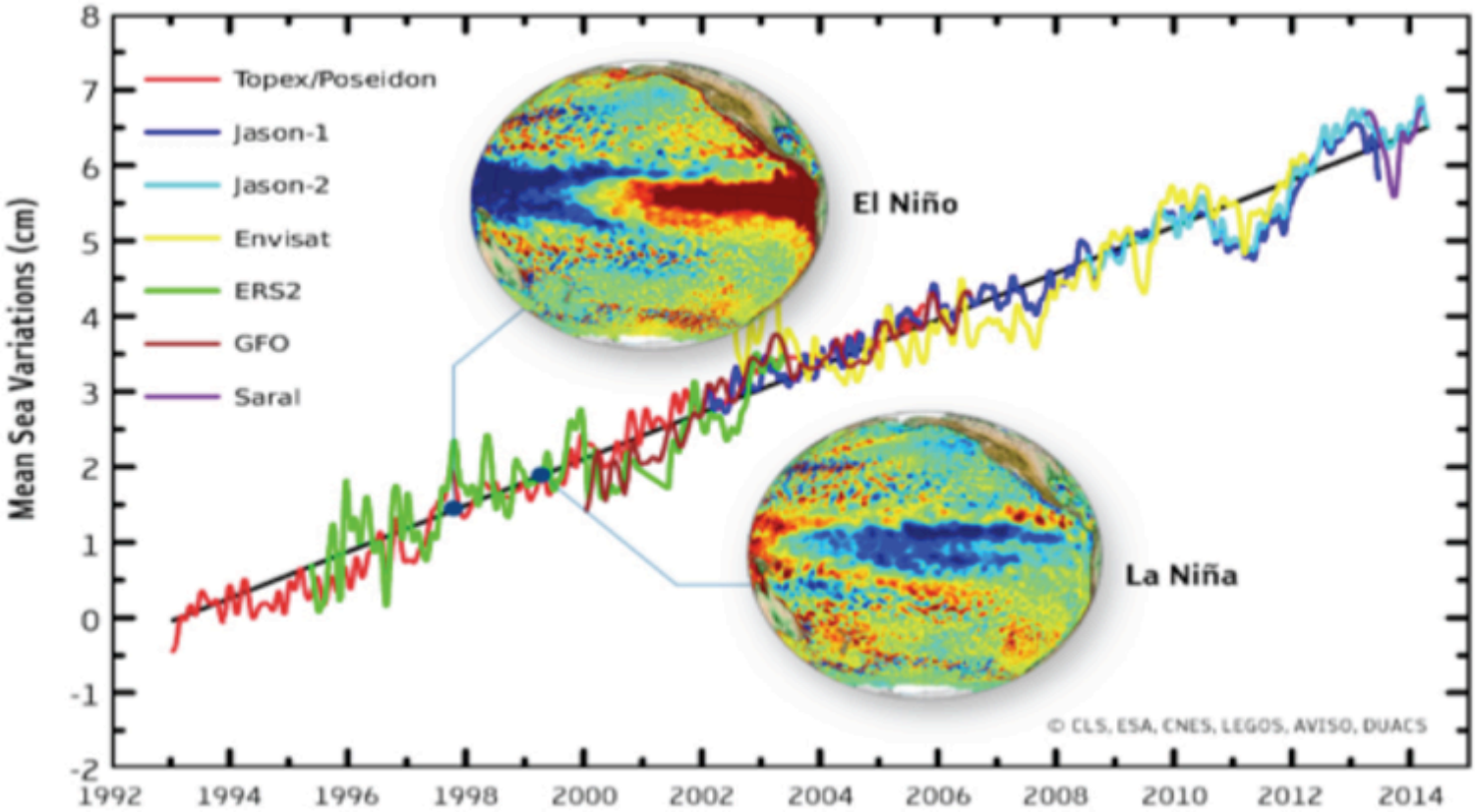
- Minimisation of uncertainties due to geophysical variability:
    - Uncertainty due to geophysical **ocean space and time variability** (especially in regions dominated by mesoscale structure, 1-10 days, <10-50 km)
    - Uncertainty due to **atmospheric space and time variability**

ENVISAT AATSR versus ERS-2 ATSR-2

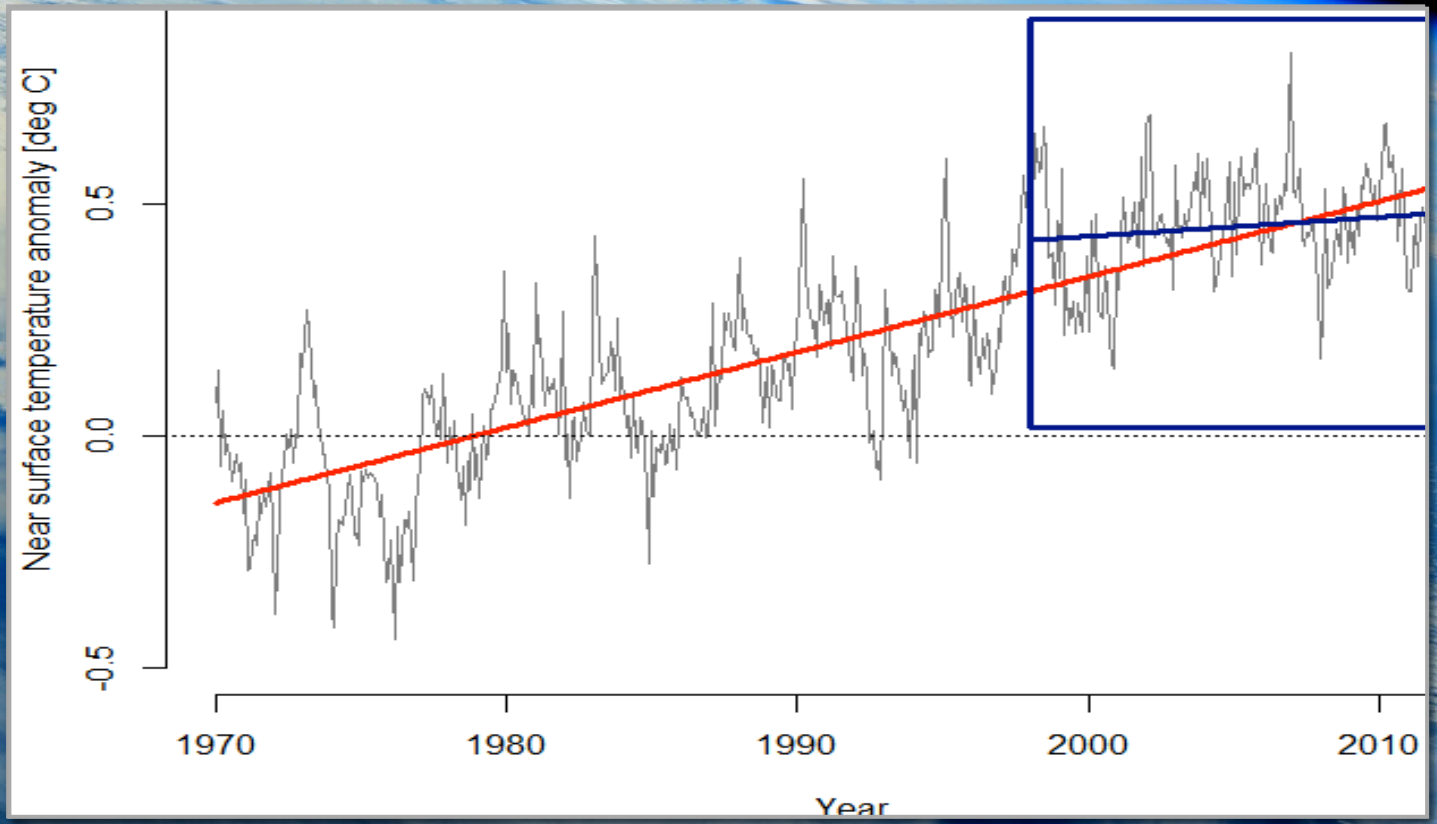





Railroad Valley Playa MERIS and CHRIS / PROBA Cross Calibration 9. July 2003, urban, vis=40 km
TOA at sensor radiance [W/(m2 sr nm)]
Wavelength [nm]
MERIS TOA bands (incl. FWHM)
MERIS TOA radiance (± 1 stdev)
CHRIS TOA radiance (± 1 stdev)
ASD ground reflectance modelled to TOA radiance for CHRIS
ASD ground variation modelled to TOA radiance for CHRIS (± 1 stdev)

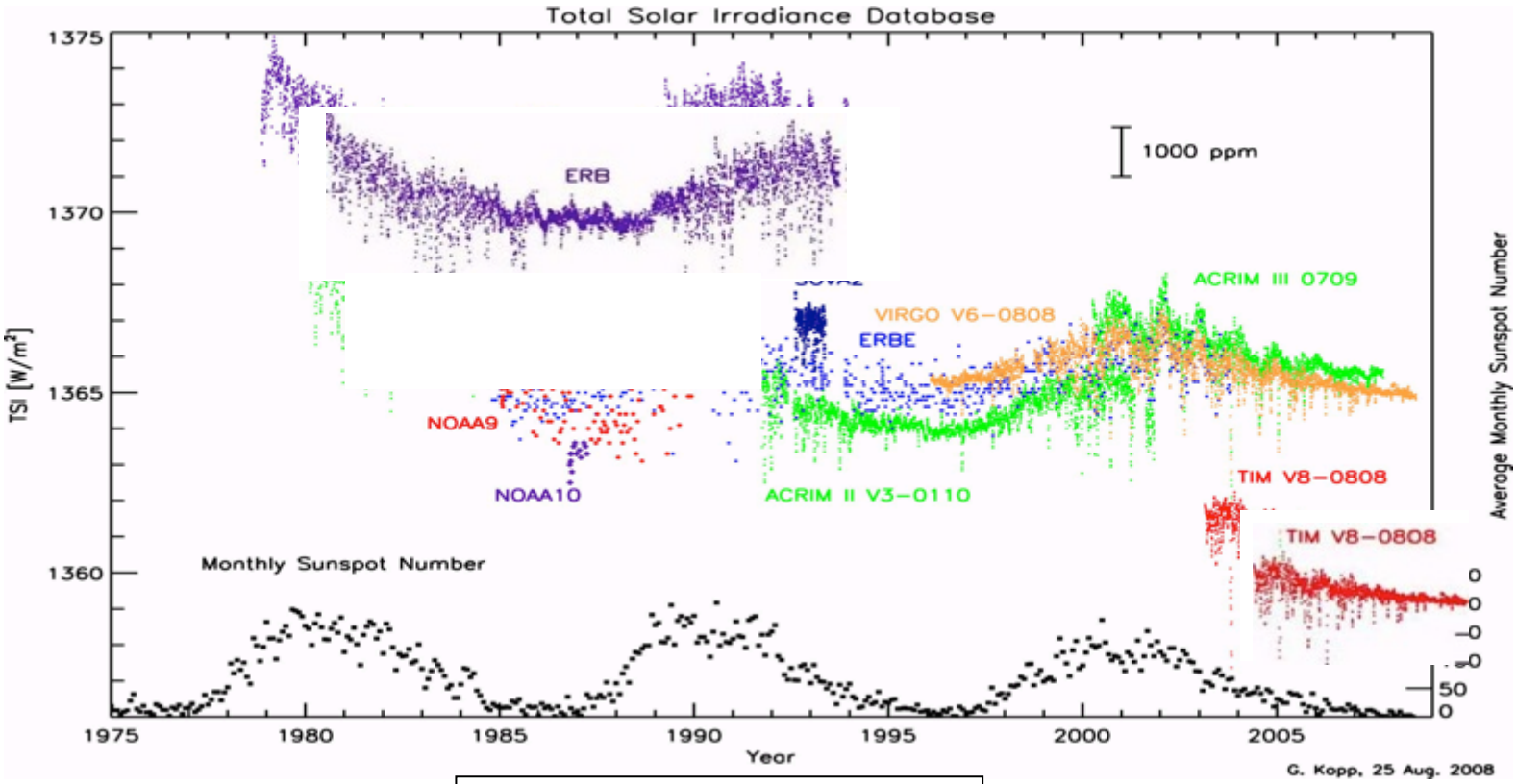

Topex/Poseidon
Jason-1
Jason-2
Envisat
ERS2
GFO
Saral
El Niño
La Niña
Mean Sea Variations (cm)
8
7
6
5
4
3
2
1
0
-1
-2
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
© CLS, ESA, CNES, LEGOS, AVISO, DUACS

Need for a long-term view – quantify trends



Data source: HasCRUT4 MetOffice (2014)

Need for Continuous re-processing

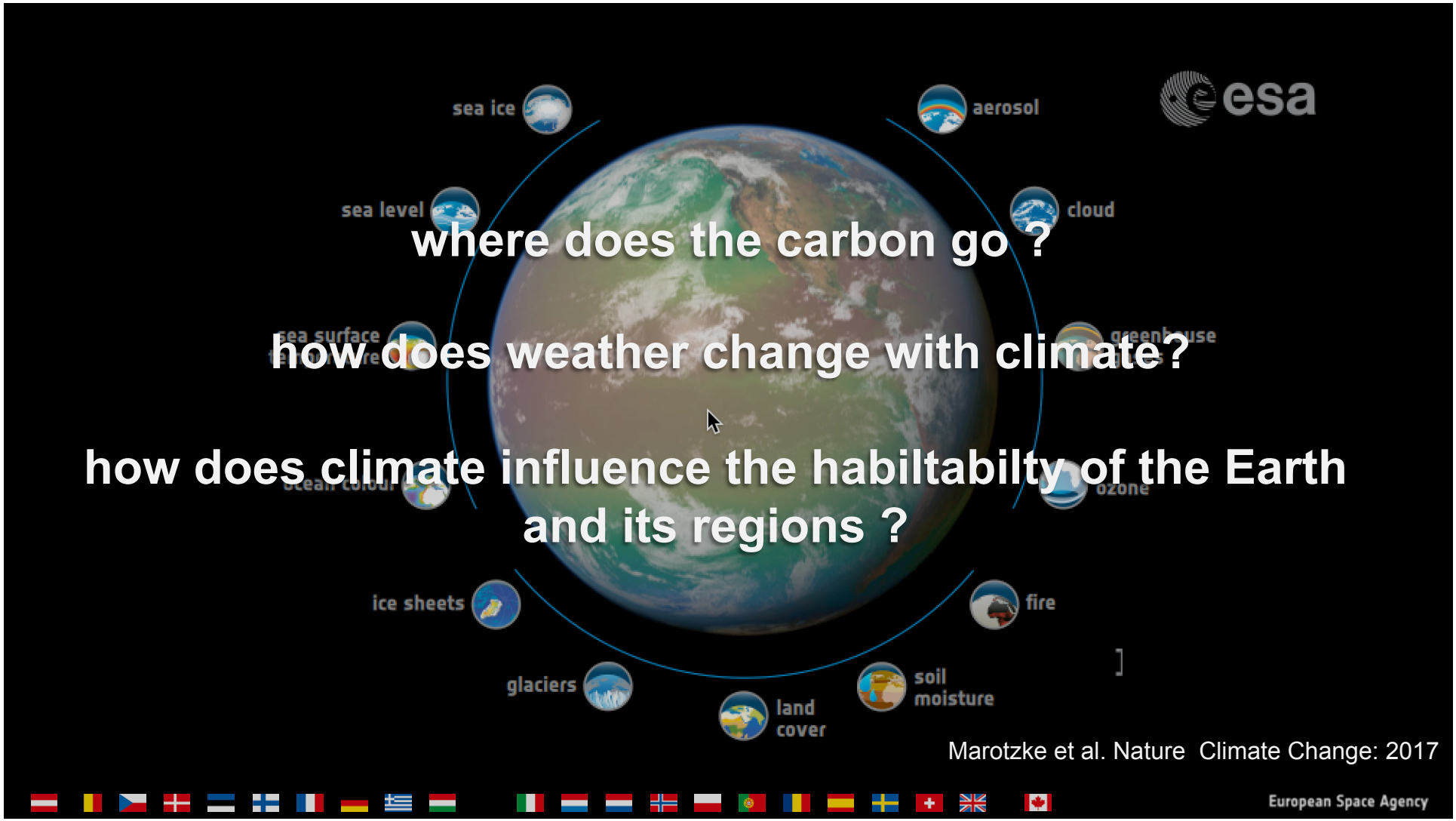


Need for homogeneous records

Required accuracy: 1 W/m2

Required decadal stability: 0.2 W/m2

(Satellite Supplement, GCOS-107, 2006)



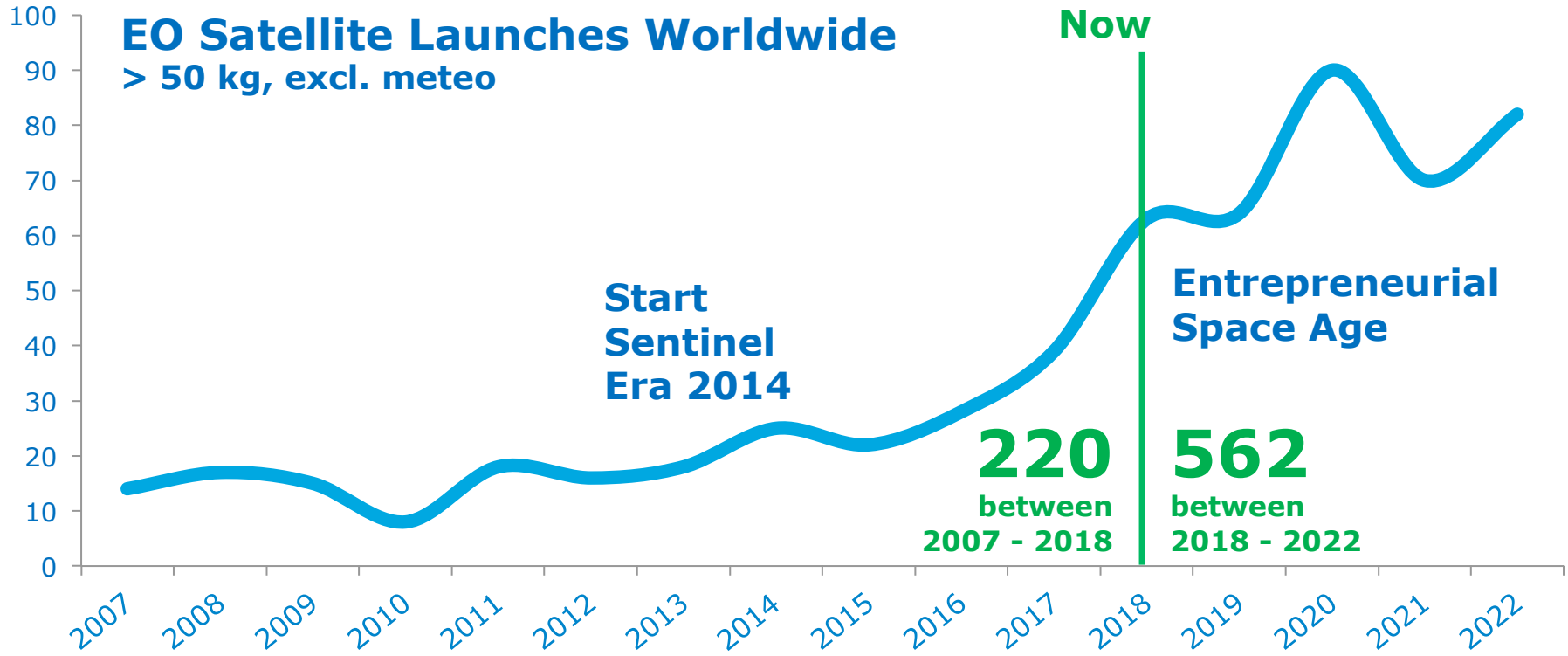
where does the carbon go ?

how does weather change with climate?

how does climate influence the habiltabilty of the Earth and its regions ?

Marotzke et al. Nature Climate Change: 2017

More Eyes in the Sky



Source: Euroconsult Database, 2017

The Space 4.0 Era

Space 1.0

Astronomy

Since millennia

Space 2.0

Space Race

Since 1958

Space 3.0

Int. Cooperation

Since Fall of the Wall

Space 4.0

Space for Society

Now

The Φ-lab

New ESA Initiative

Shaping the Future of EO

Leveraging the Data & Tech Revolutions

In one sentence

"Opening ESA to disruptive innovation in EO"

Φ-lab Action Lines

Explore

Non-EO Technologies

Artificial Intelligence

Future Architectures

Inspire

Open Work Space

Digital Education

Hackathons

Challenges

Connect

New Actors

Startups Innovators

Ecosystems

Internal/External

Invest

PPPs

New Joint Ventures

InCubed Programme

Why is CEOS/WGCV in general and IVOS in particular important for ESA?

- ESA is operating and developing a large number of EO mission that require pre-flight characterisation and in-flight calibration/performance assessment.
- WGCV and IVOS can help ESA (and other agencies) by being the place where:
  - Methodologies for in-flight performance assessment and pre-flight characterisation are discussed and agreed (e.g.: WG4 on PICS, MTF working group)
  - Results of in-flight performance assessment of past/ongoing missions are shared
  - Resources are shared by working together and sharing data, e.g.: RadCalNet, PICSCAR.
  - Standards are discussed and recommended (e.g.: Thuillier extraterrestrial solar spectrum)

Thank you for your attention!

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