



# ESA Earth Observation today and tomorrow

HGF 5<sup>th</sup> Alliance Week  
Garmisch - Partenkirchen  
27. June 2017

Michael Rast  
Directorate of Earth Observation Programmes  
European Space Agency



European Space Agency



**we develop world class Earth observing systems  
we do this with European and global partners  
with European and global partners**



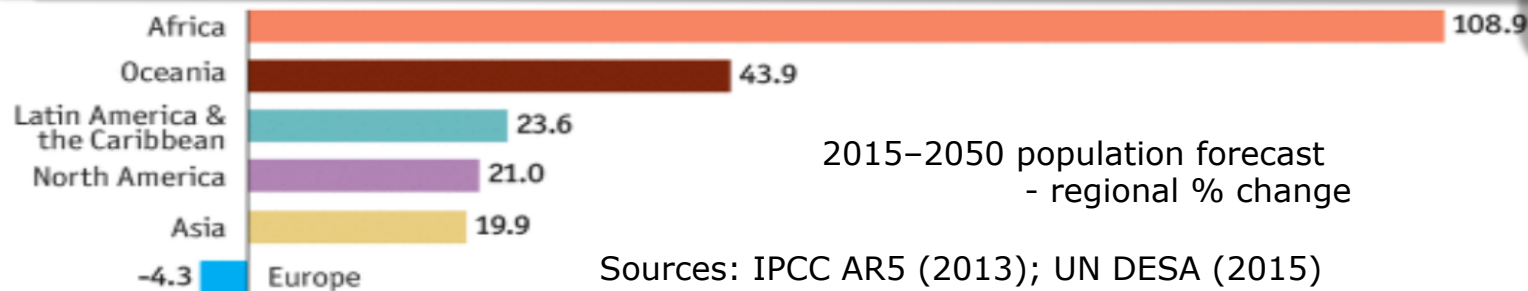
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# Global Trends 2000-2040



	2000	2020	2040
<b>Global CO2</b>	368ppm	412ppm	489ppm
<b>Global Surface Temperature</b>	-	+0.66C	+1.3C
<b>Global Mean Sea level</b>	-	+6cm	+17cm
<b>Arctic sea ice extent</b>		-11% per decade	
<b>Global population</b>	6.1B	7.6B	9.2B
<b>Urban population (% total)</b>	47%	56%	63%



Sources: IPCC AR5 (2013); UN DESA (2015)



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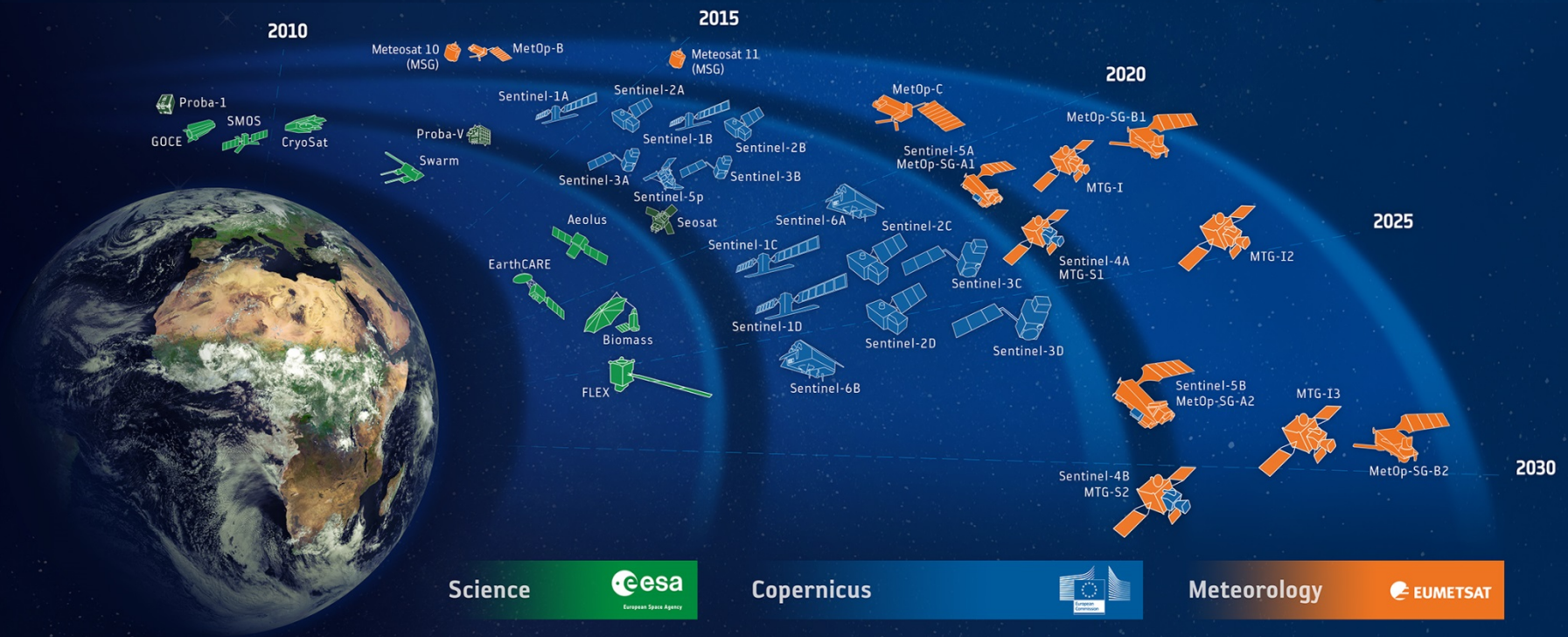




# ESA – developed Missions - Europe's public EO infrastructure



1977 → 2040



## Launch Sentinel-2B, 6 March 2017, Kourou



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# The Paris Agreement

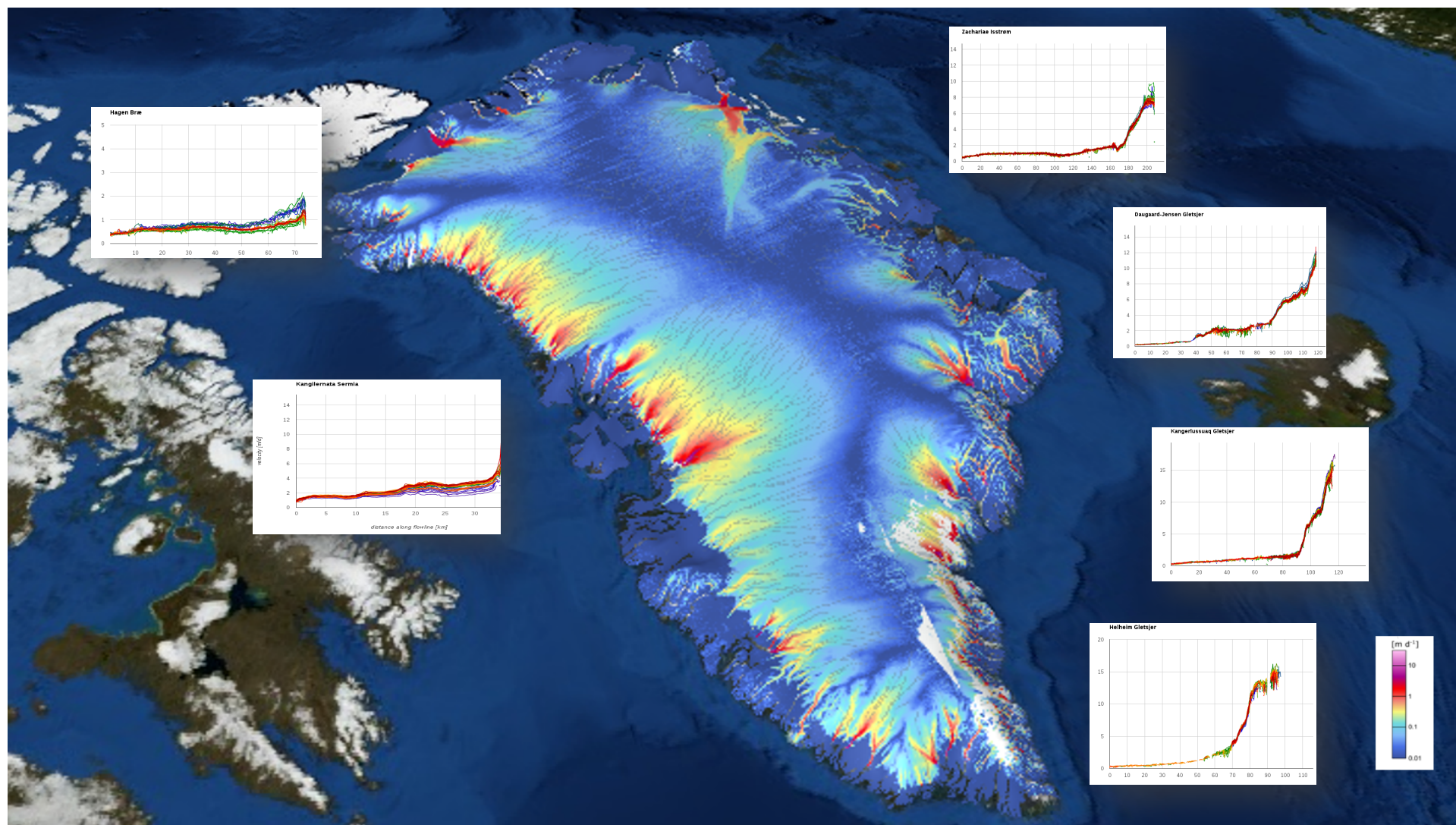


**Climate Mitigation  
Transparency  
Loss and Damage**

**Adaptation  
Global Stocktake  
Support**



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2014

1996

1978

Sentinel-1A

ERS-2

Seasat

→ **36 YEARS OF GLACIER RETREAT**  
southeast Greenland

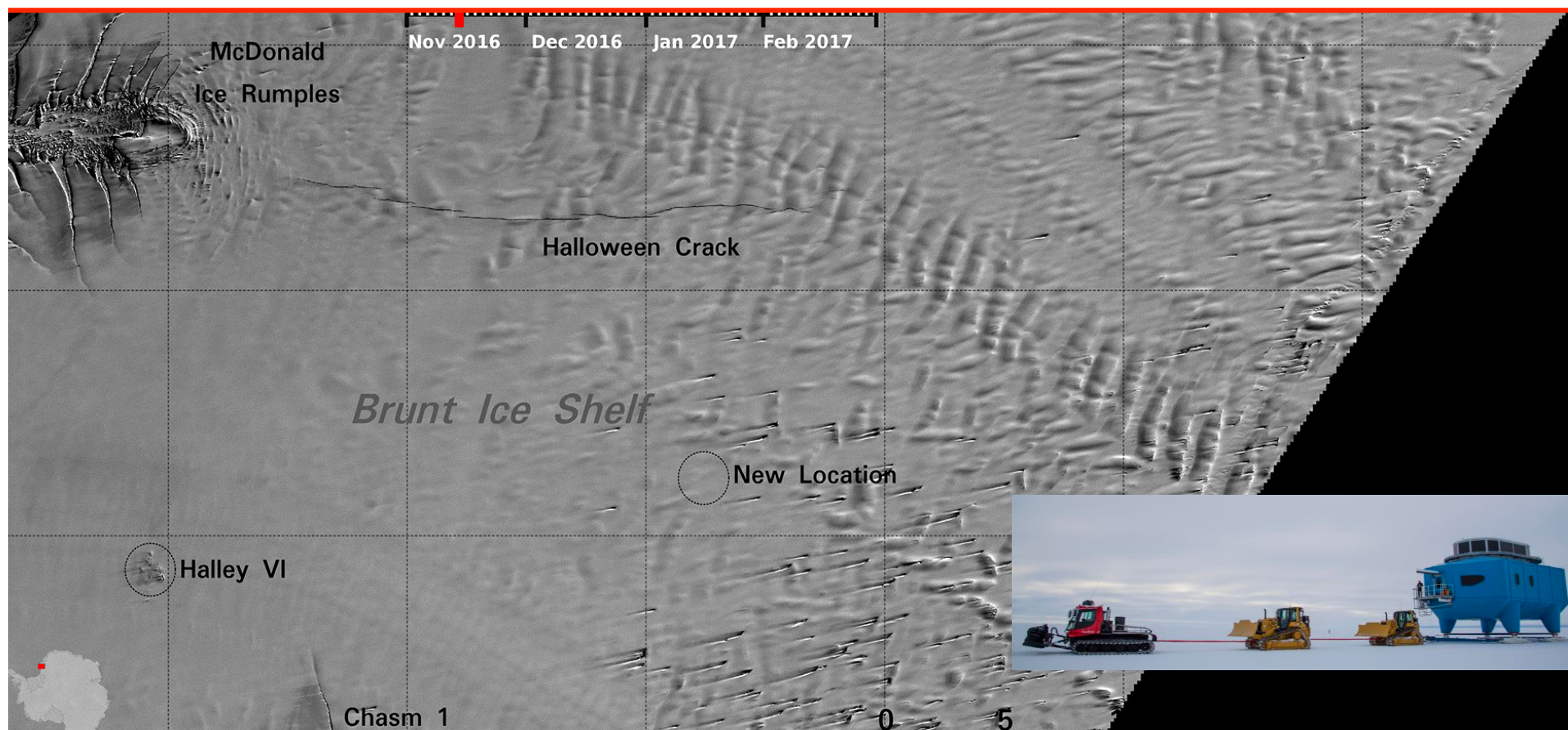
5 km

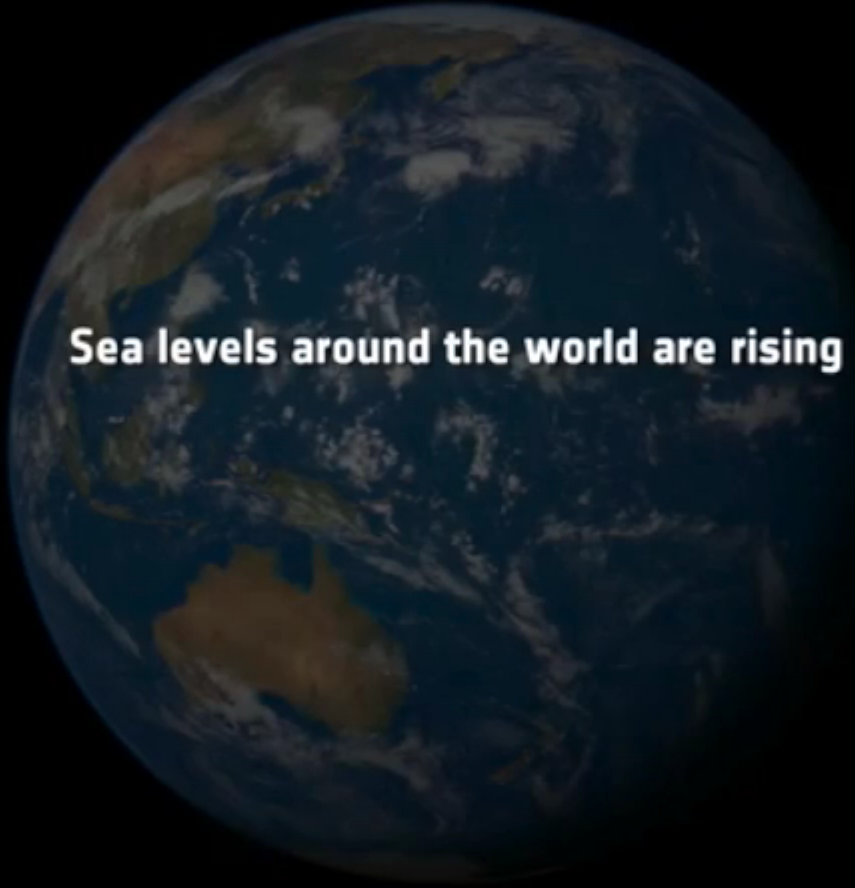


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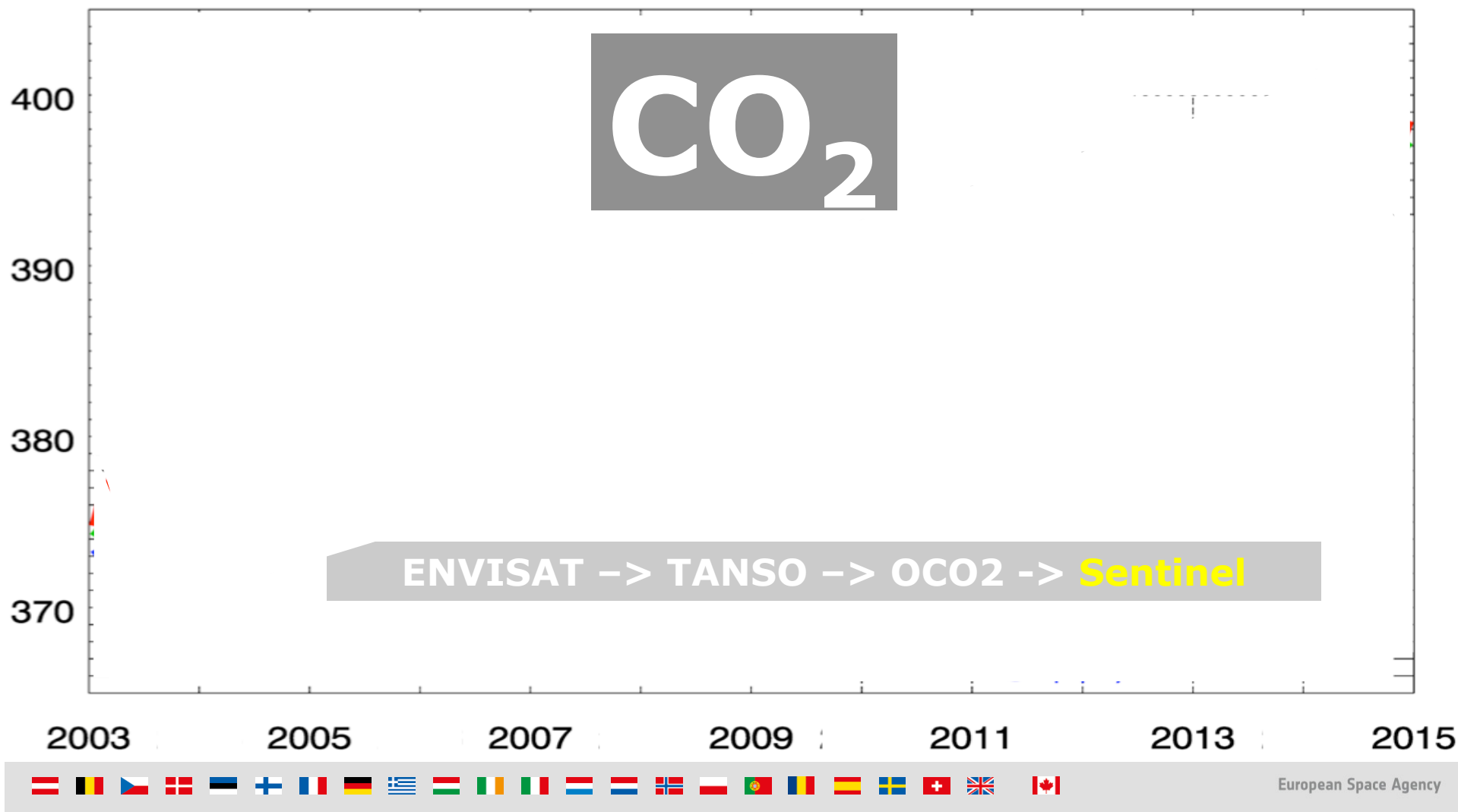


# Relocation of British Antarctic Station, opening of Ice crack seen by Sentinel-2: Nov 16 – Feb 17



A satellite image of the Earth from space, showing the Western Hemisphere. The Americas, including North and South America, are visible in brown and green, surrounded by blue oceans and white clouds. The image is centered on the Atlantic Ocean.

**Sea levels around the world are rising**



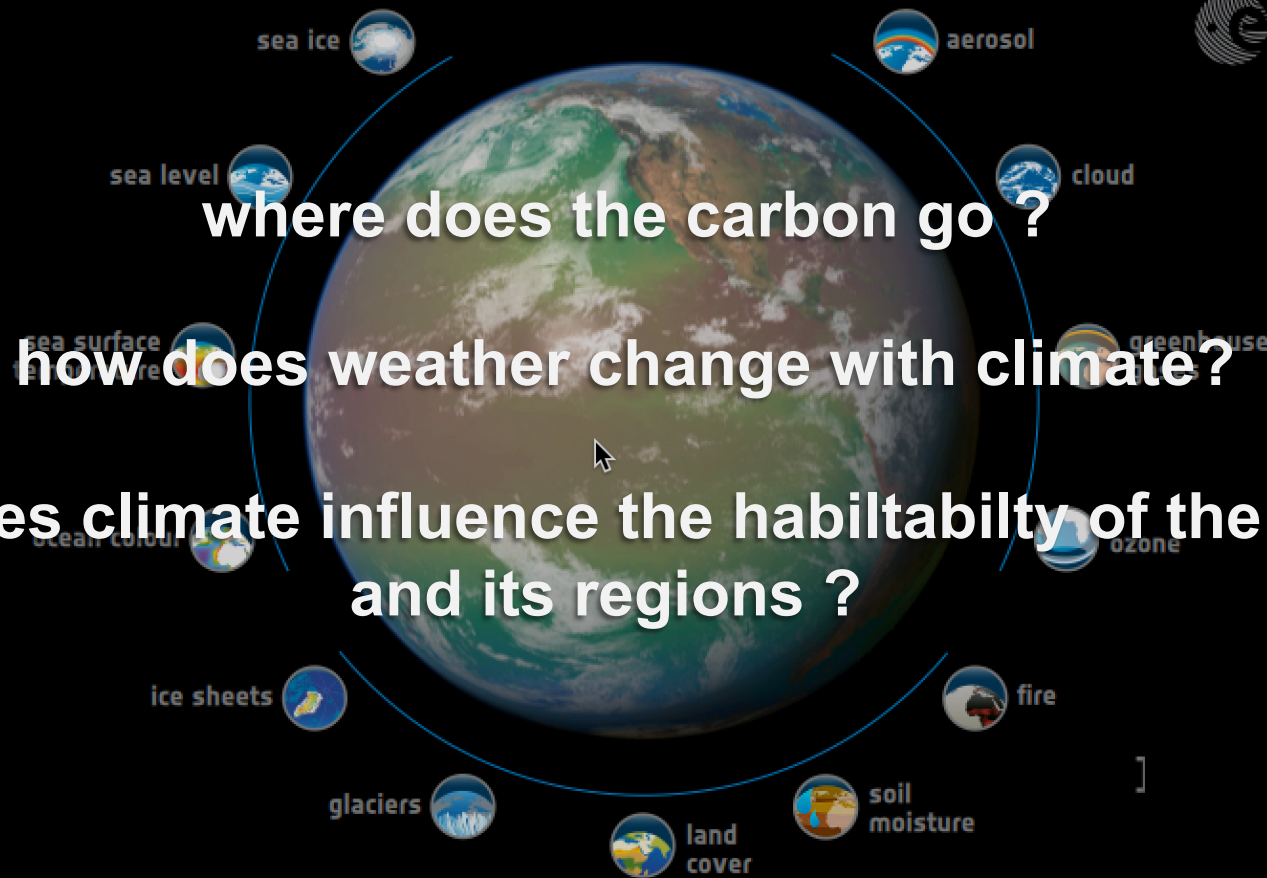




where does the carbon go ?

how does weather change with climate?

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



Marotzke et al. Nature Climate Change: 2017



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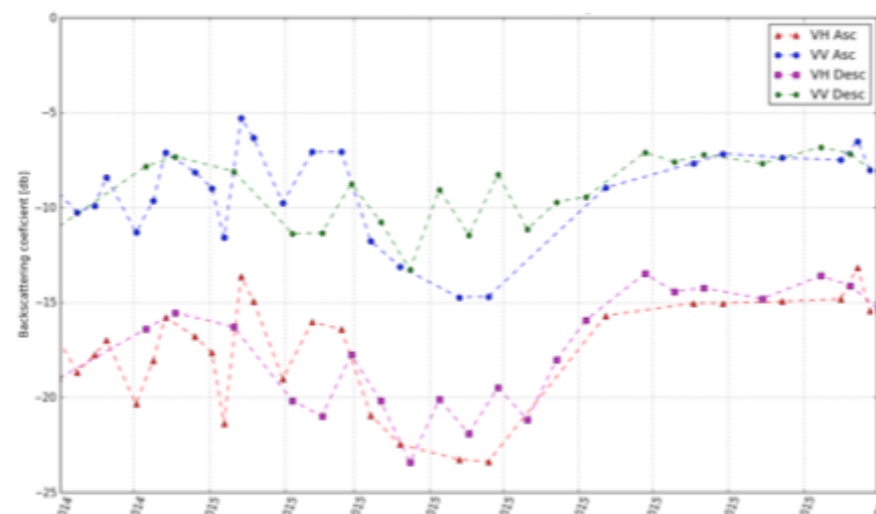


# → CZECH AGRICULTURE FROM SPACE

## Common Agricultural Policy: Dynamic National Crop Type Mapping



## Sentinel-1 time series



Contains modified Copernicus Sentinel data [2016]



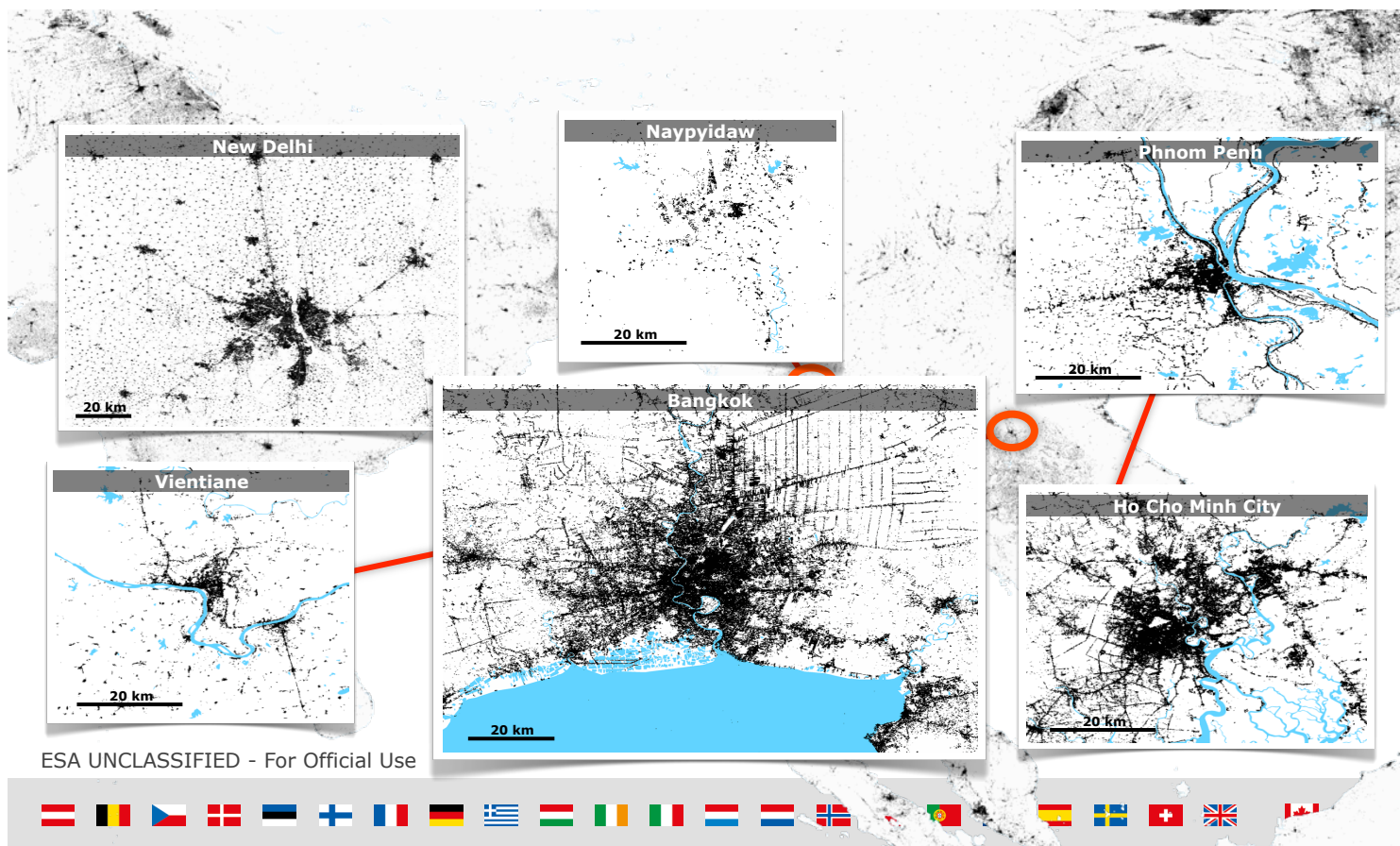
Phil Hogan EC Commissioner for AG







# Global Urban Footprint TerraSAR-X



**"Global Urban Footprint":**  
Worldwide mapping of settlements with unprecedented spatial resolution of approx. 12 m, based on imaging radar data.

Binary (black and white) map for urban/non-urban, available for 2014.

Allows for the analysis of urban structures, and hence the proportion of settled areas, the regional population distribution and the arrangement of rural and urban areas.

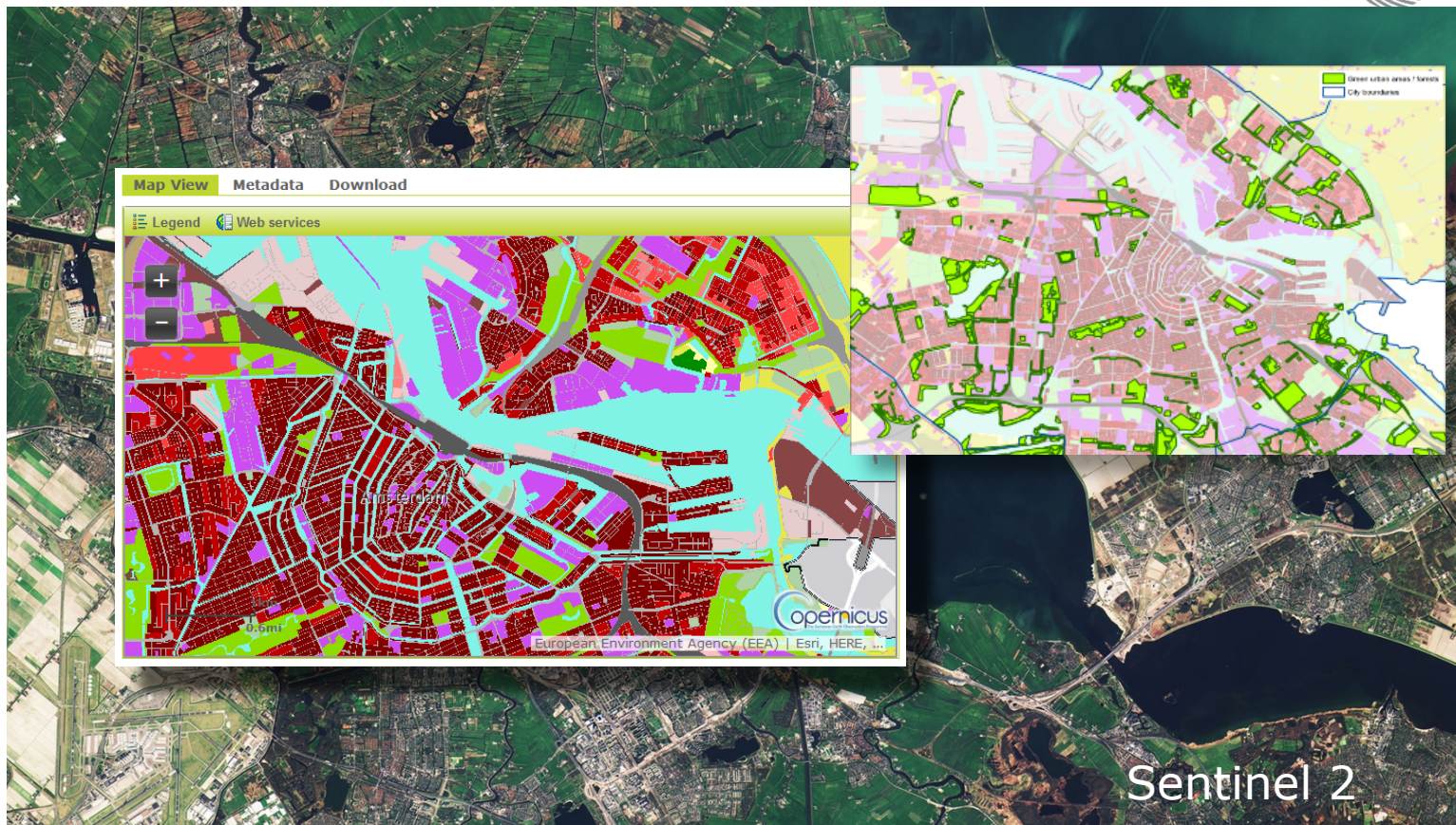
Data: TerraSAR-X, TanDEM-X.  
Processing: DLR Global Urban Footprint.



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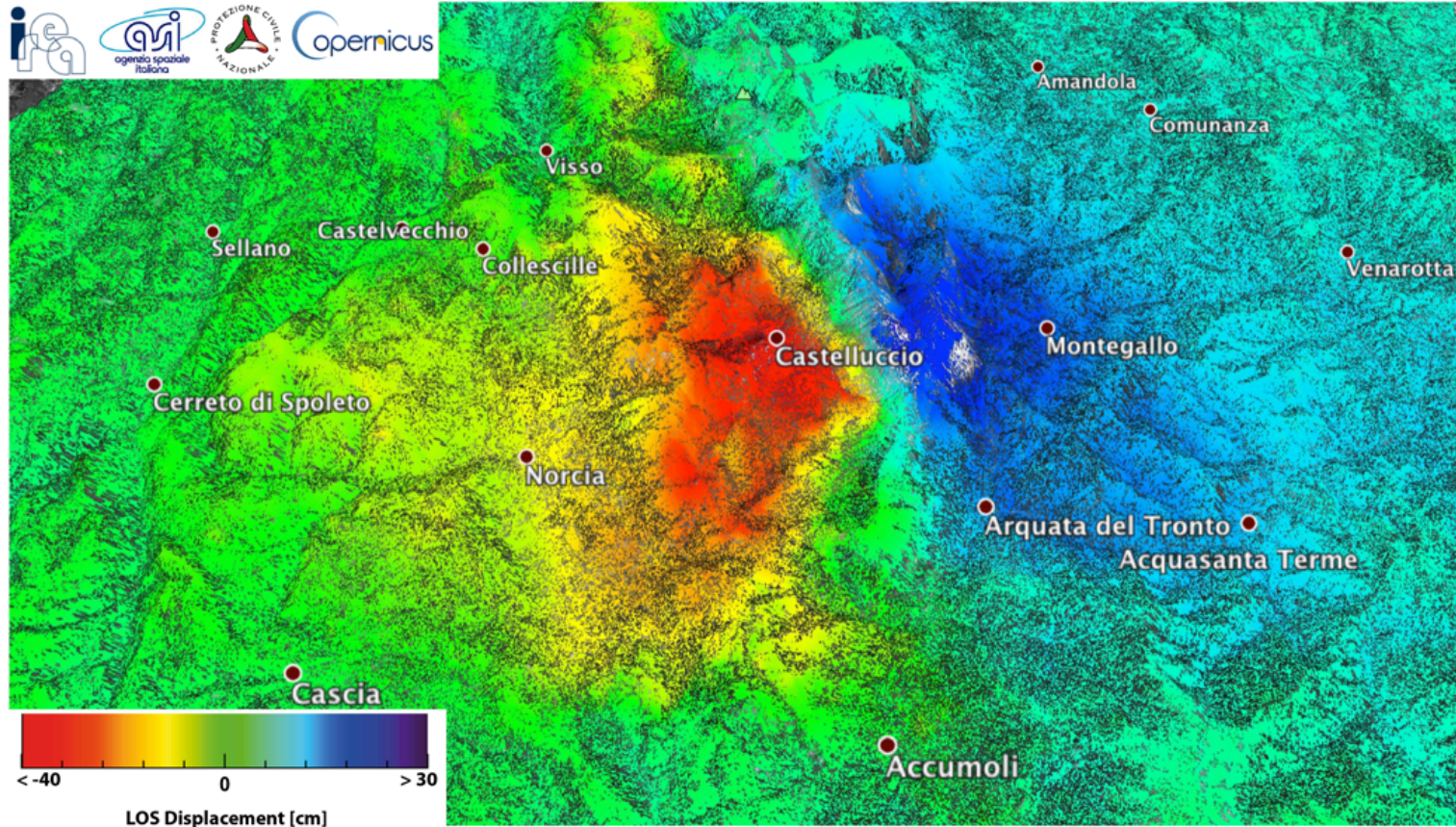
# Developing a sustainable urban environment



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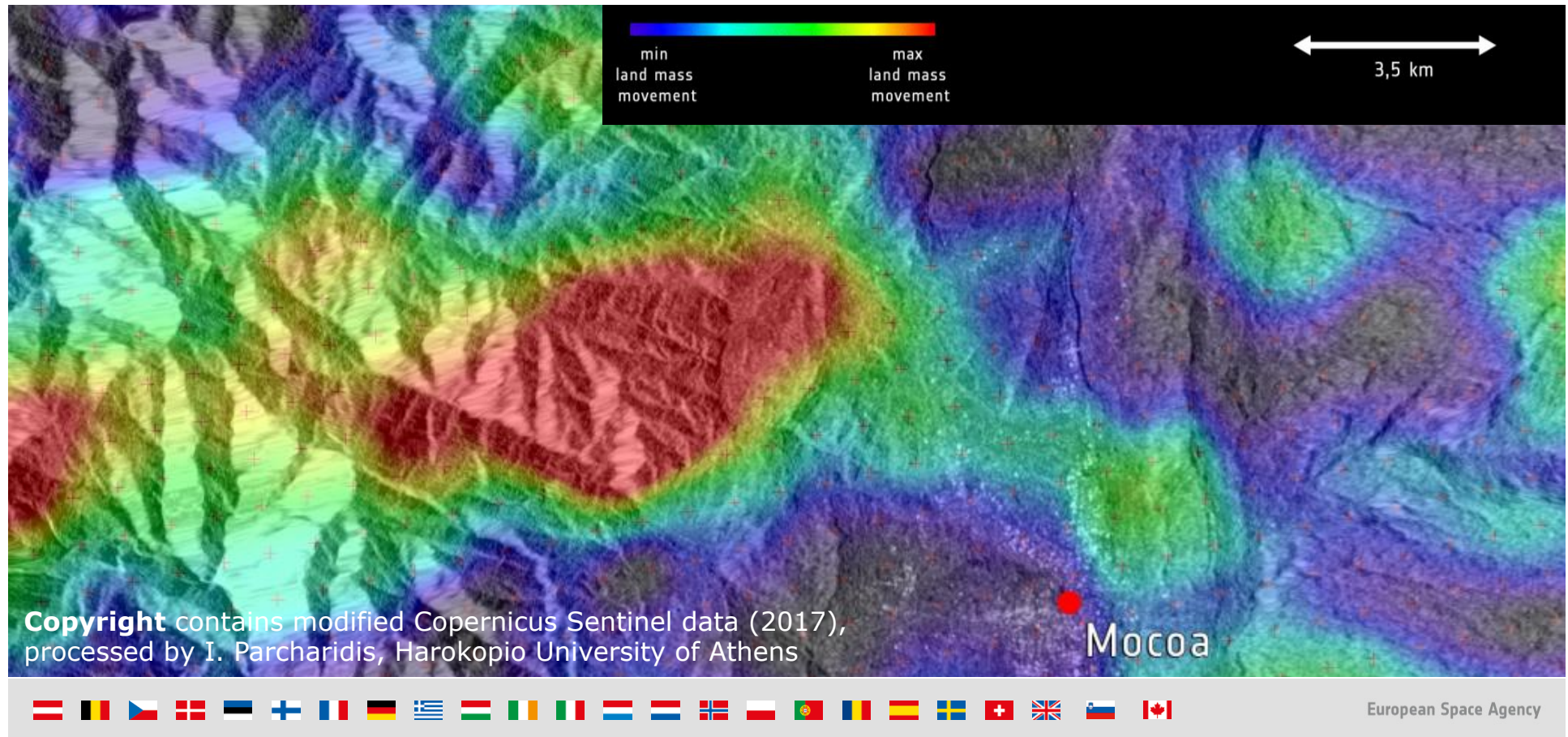
# Copernicus: Earthquake Italy 30 Oct 2016



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# Copernicus: Mocoa Landslide 1 April 2017







## Land Monitoring Service

The Copernicus land monitoring service provides information on the types of land cover and the land is used.

It also offers key information on vegetation related to plant health and to the environment.

It supports applications in such as smart agriculture.

Urban planning



## On-going Etna eruption

8 April 2017



Copernicus SENTINEL Hub

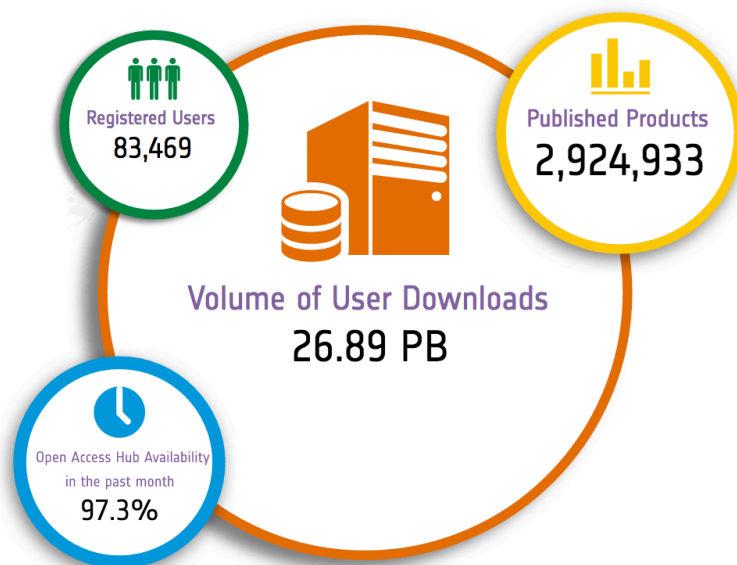


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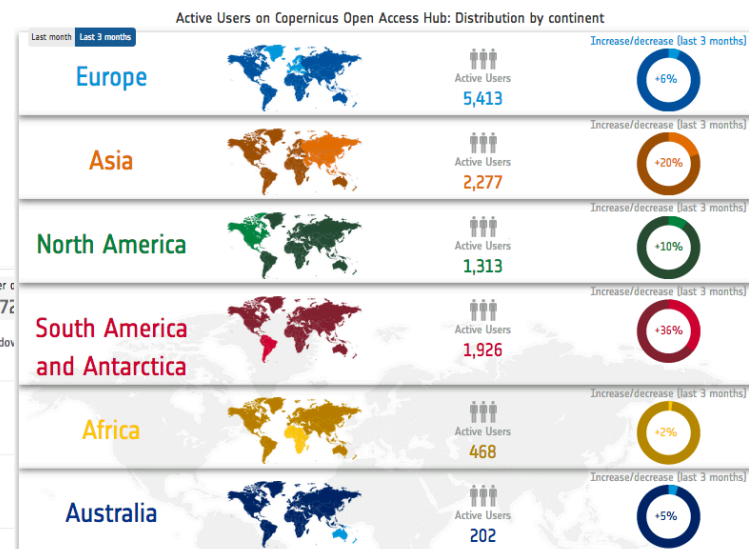
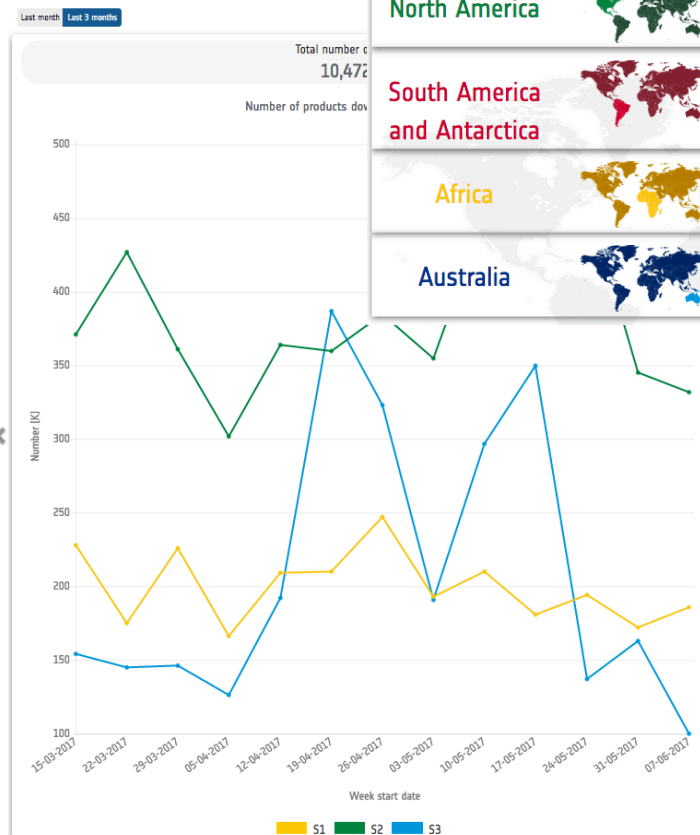


## Sentinel open access Data Hub

Statistics on  
14 June 2017



Last 3  
months

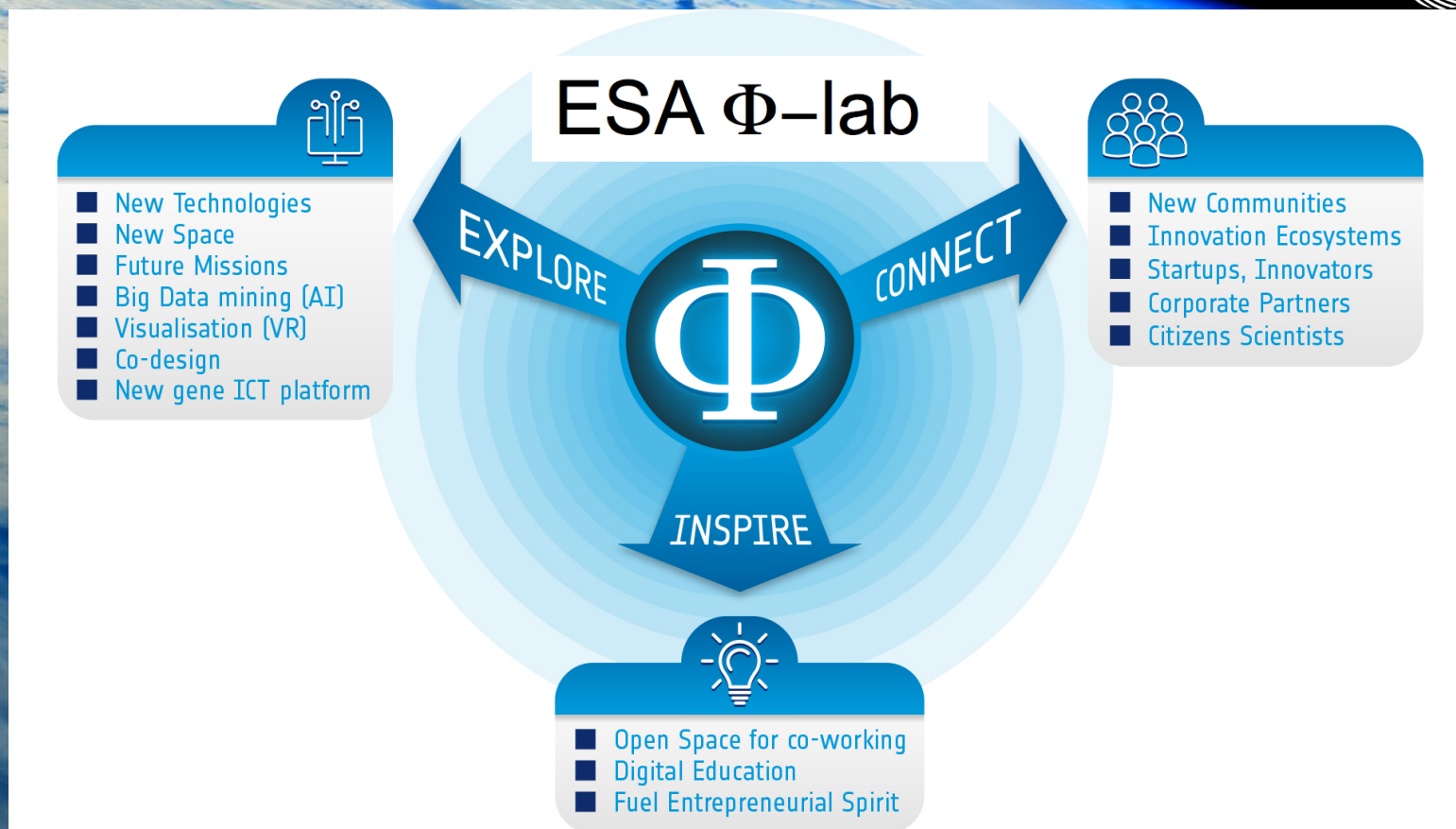




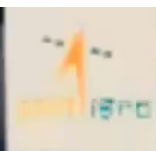
# #FutureEO

- Where is the boundary between publicly-funded and privately funded EO moving?
- What common goals & common ground do public and business actors share and can cooperate on?
- What must we do to realize the full potential of all this data and technology for economic growth, sustainable development and accelerated climate action?

[http://m.esa.int/Our\\_Activities/Observing\\_the\\_Earth/Watch\\_live\\_Paradigm\\_shifts\\_and\\_future\\_prospects\\_in\\_Earth\\_observation](http://m.esa.int/Our_Activities/Observing_the_Earth/Watch_live_Paradigm_shifts_and_future_prospects_in_Earth_observation)



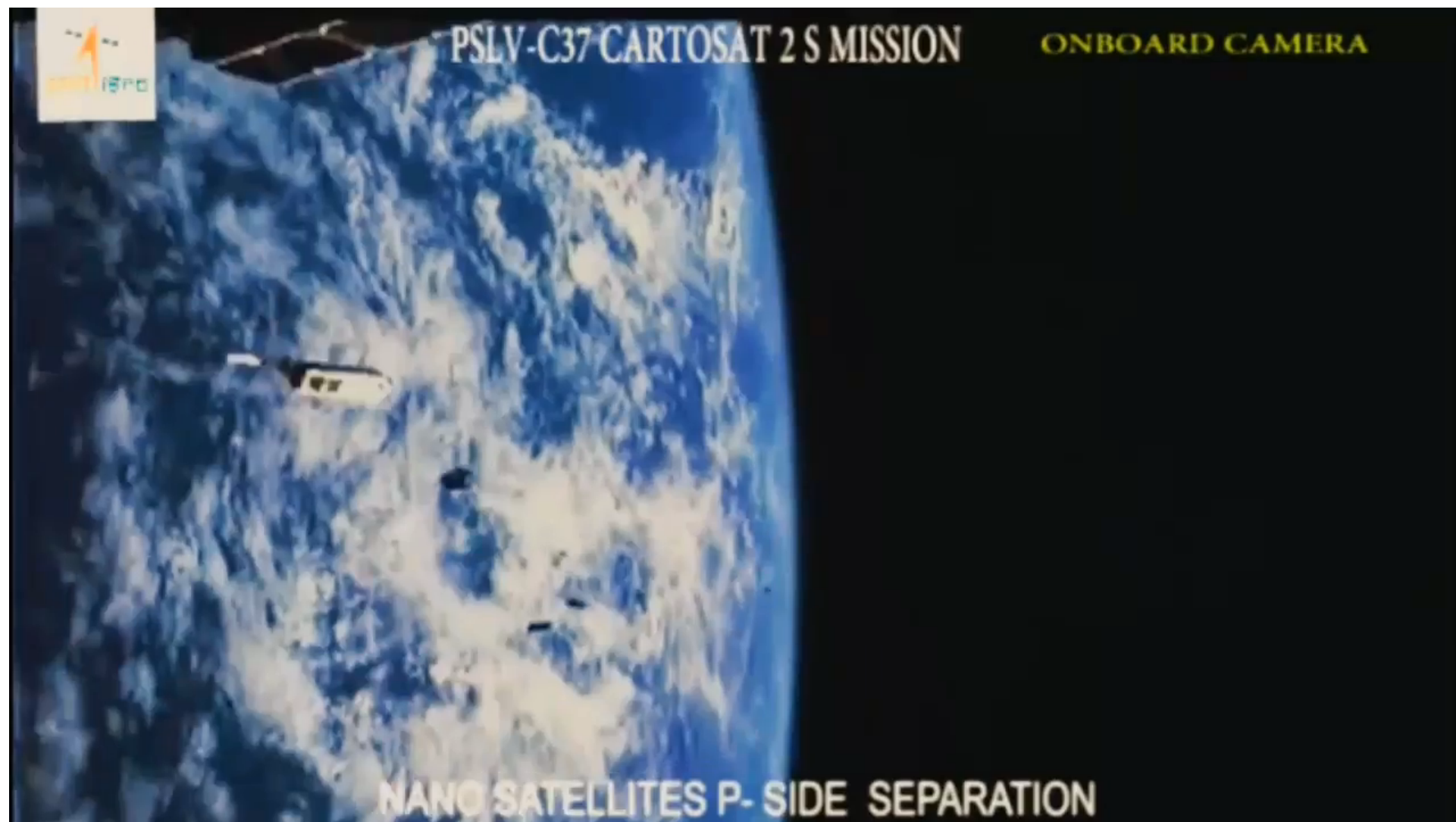




PSLV-C37 CARTOSAT 2 S MISSION

ONBOARD CAMERA

NANO SATELLITES P- SIDE SEPARATION





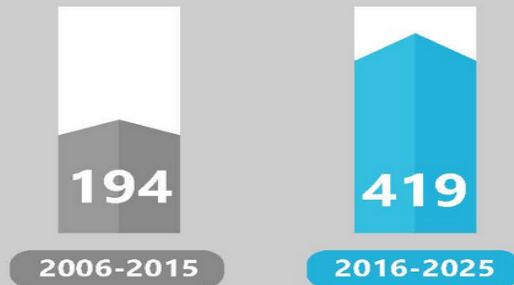


Antarctic Ice Sheet Changes Synergy: => Sentinel-1 / Cryosat

# Earth Observation trends 2016 - 2025



Number of EO Satellites >50kg



Number of Countries Expected to Launch EO Satellites



Manufacturing Revenues of EO Satellite Market



Countries with EO Programs



Earth Observa

Market Tren

Commercial

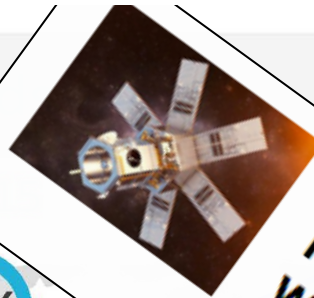
tion, a



**Planet to acquire Terra Bella from Google**  
by Jeff Foust — February 3, 2017



15%



**Canada's MDA buys DigitalGlobe, reveals next-generation WorldView satellite fleet**  
© February 27, 2017



September 07, 2016 02:30 ET

**Satellite-Based EO Represents a \$43 Billion Opportunity Over Next 10 Years**

DIGITAL MARKET

**\$1.7 B**

Increase of 100 million from 2014  
Five-year CAGR (2011-2015): 5%



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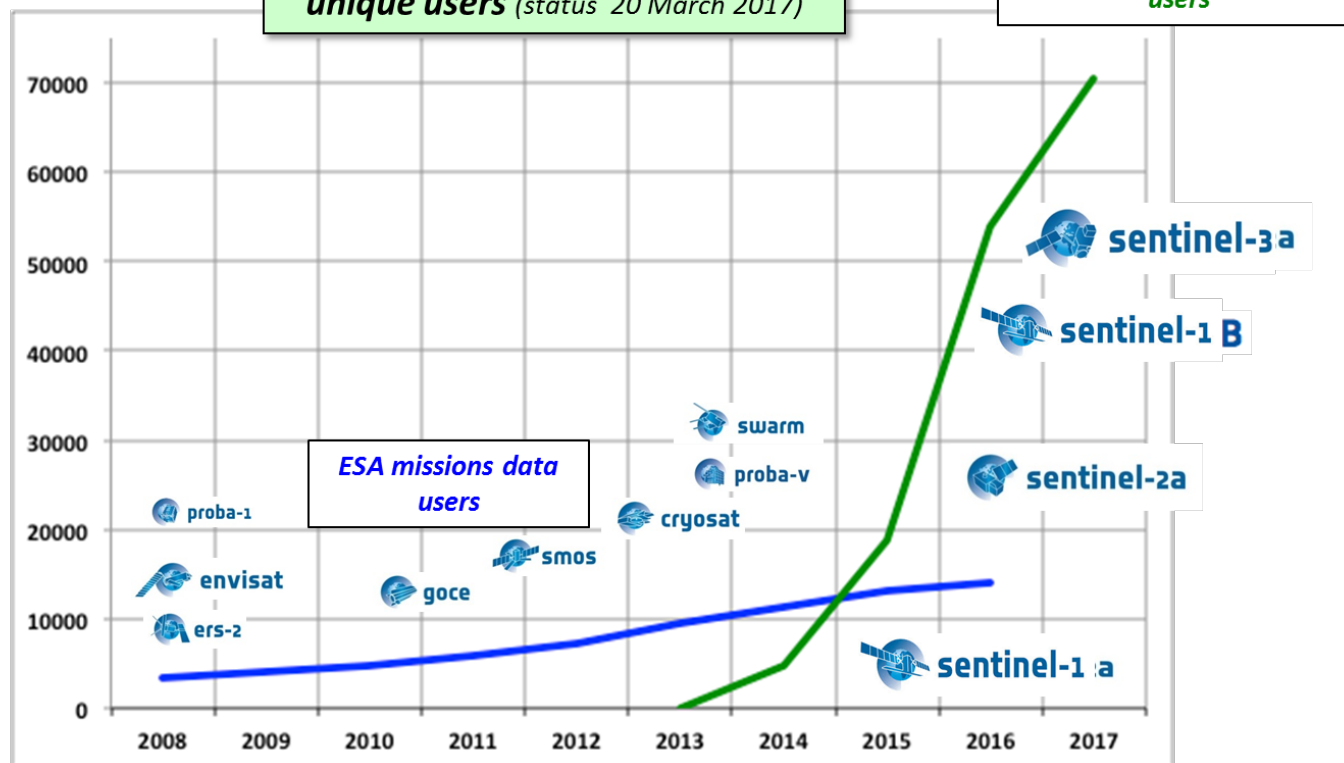
# Copernicus: User Uptake



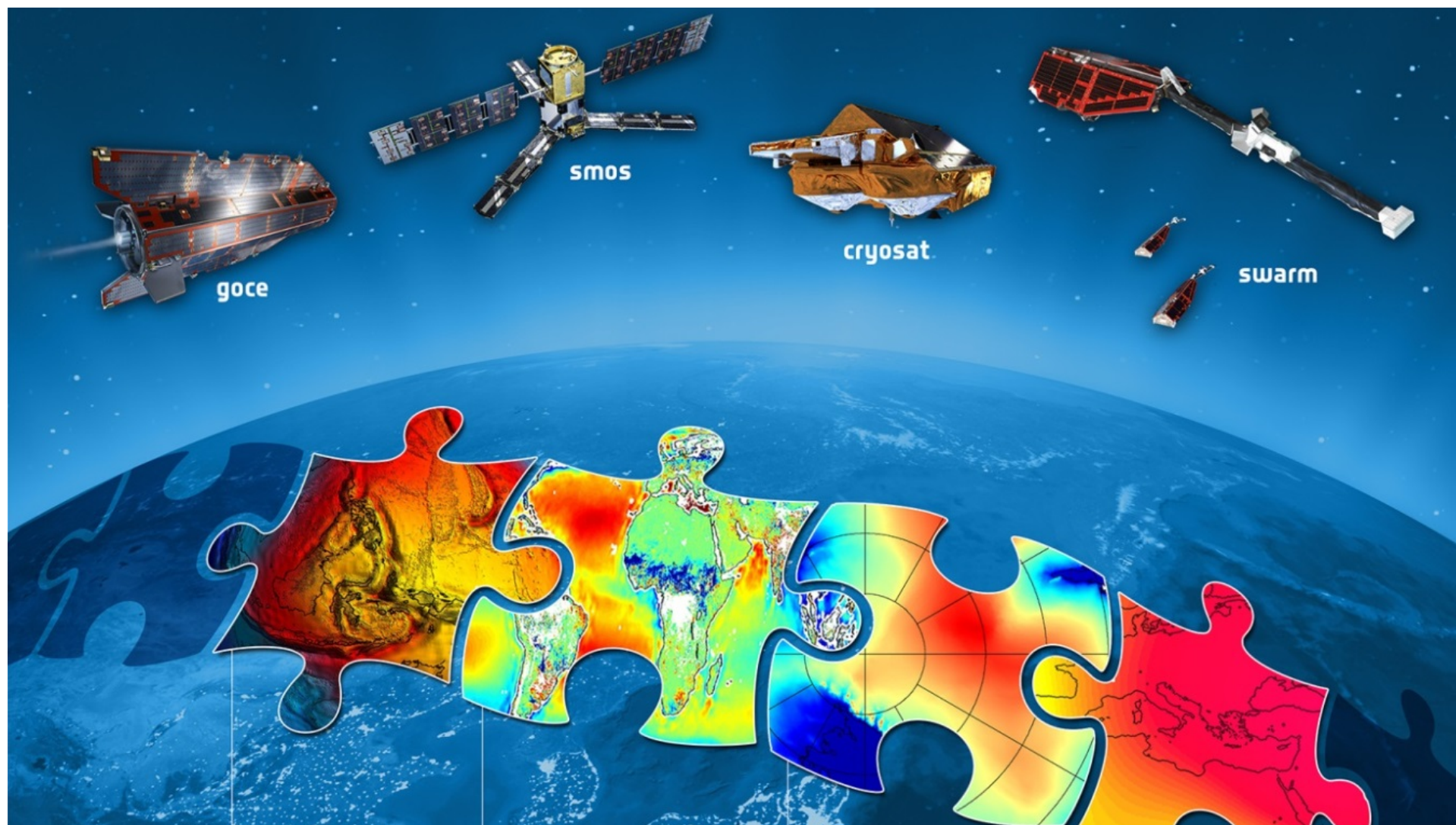
Number of registered users

**70,442 self-registered unique users** (status 20 March 2017)

*Sentinels missions data users*



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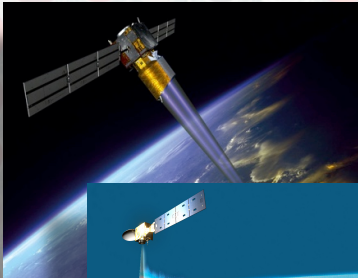


# Next Earth Explorers



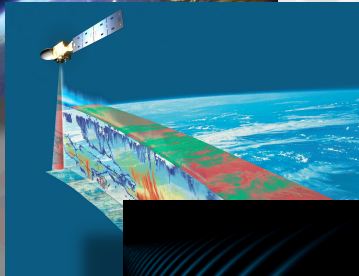
## 2018: Aeolus

- Atmospheric wind profiles



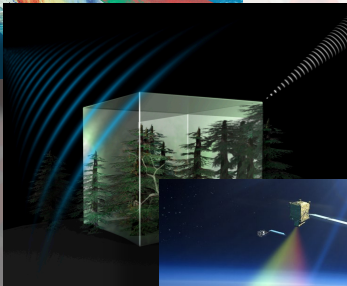
## 2019: EarthCare

- Clouds and Aerosols



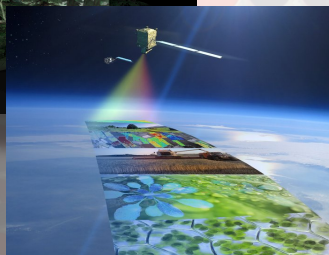
## 2021: Biomass

- Above Ground Biomass

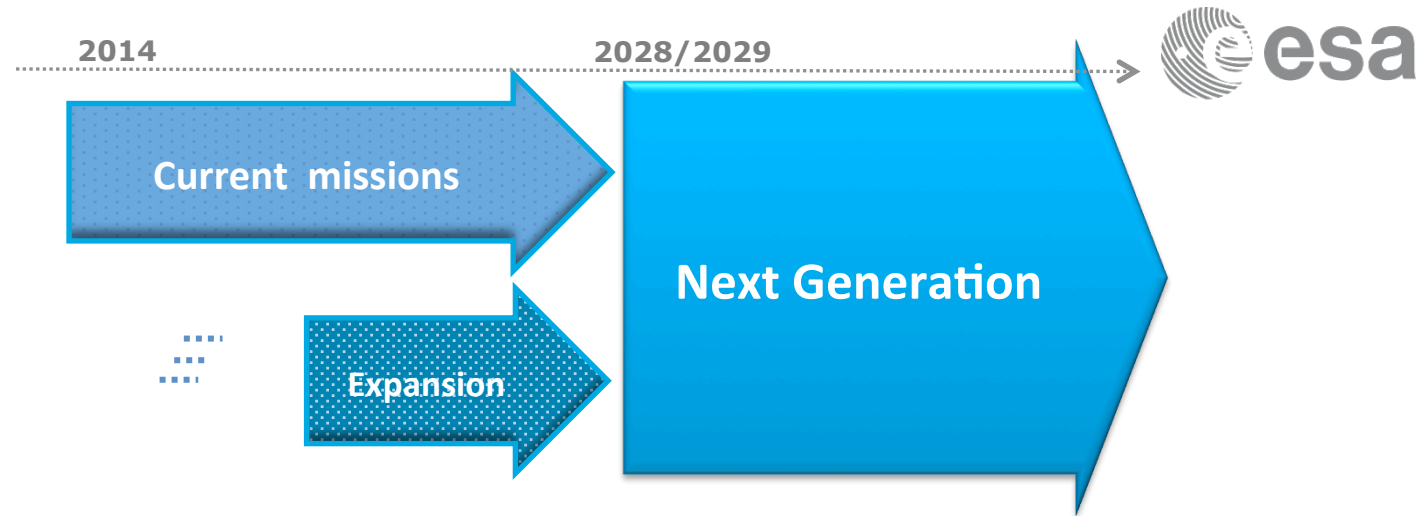


## 2022: Flex

- Plant Health



## Sentinel Expansion



Expansion candidates to be confirmed as result of user consultation process and gap analysis:

- Sentinel-7: an anthropogenic CO<sub>2</sub> monitoring mission
- Sentinel-8: a Thermal Infrared Imager (companion to Sentinel-2 C/D)
- Sentinel-9: S-9 ICE: Enhanced Ice and Snow Continuity mission  
S-9 HEO: Polar Weather Payload on a Highly Elliptical Orbit
- Sentinel-10: a Hyper-spectral mission

Candidates  
to be verified through  
requirements process !



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