

# Provision of EO Data & Information

ISPL Seminar II, 10 April 2018

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Head of the Strategy, Programme & Coordination Office

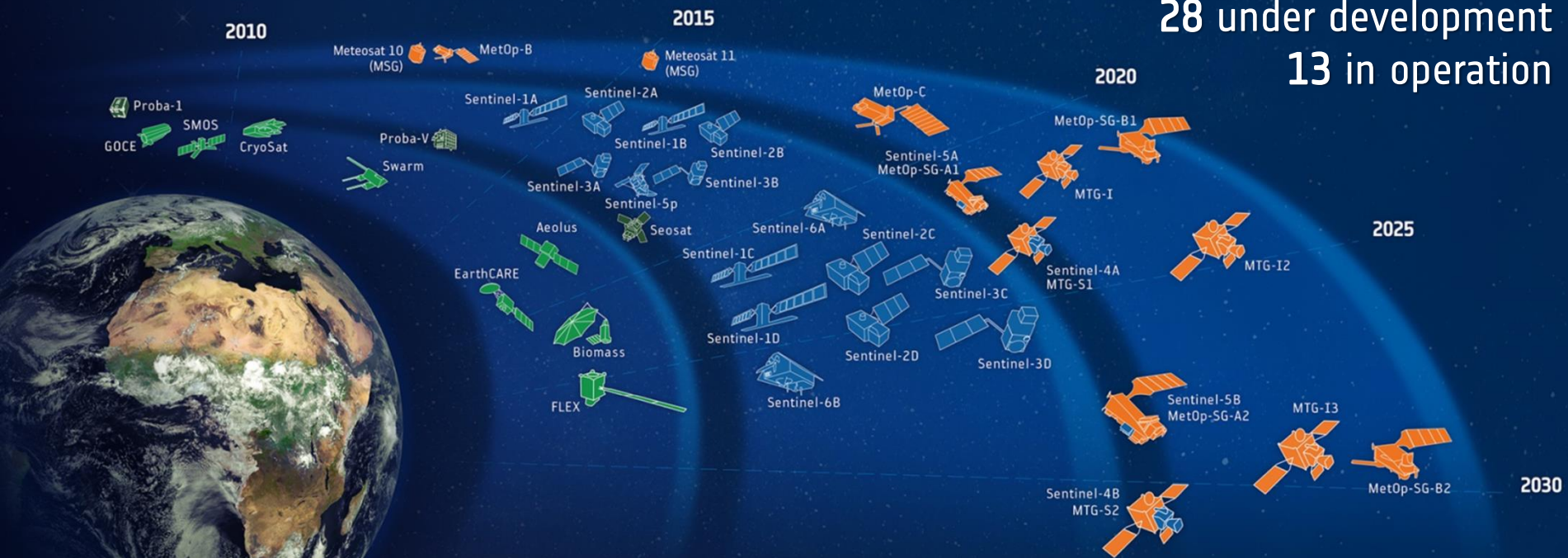
Directorate of Earth Observation Programmes

# ESA-DEVELOPED EARTH OBSERVATION MISSIONS



Satellites

28 under development  
13 in operation



Science

Copernicus

Meteorology

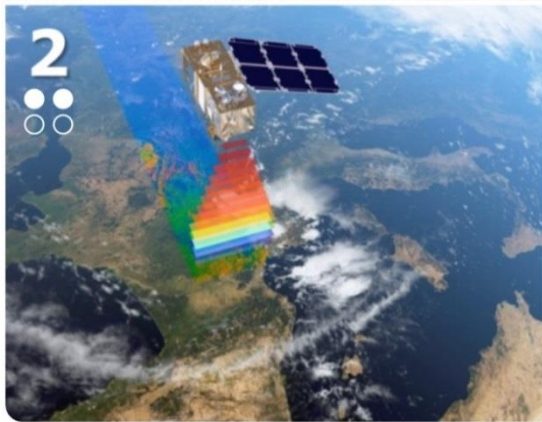
# Science: Earth Explorers



<b>GOCE</b>	<b>2009 – 2013</b>
<b>SMOS</b>	<b>2009 – Present</b>
<b>Cryosat</b>	<b>2010 – Present</b>
<b>Swarm</b>	<b>2013 – Present</b>
<b>Aeolus</b>	<b>2018</b>
<b>EarthCARE</b>	<b>2020</b>
<b>Biomass</b>	<b>2021</b>
<b>FLEX</b>	<b>2022</b>



# Copernicus – European Leadership in EO



Slide 4



# Status Copernicus Space Component



**S-1**



Radar

**A**



3 Apr. 2014

**B**



25 Apr. 2016

**C**

2022/23

**D**

> 2022/23

**S-2**



High  
Resolution  
Optical

**A**



23 Jun. 2015

**B**



6 Mar. 2017

**C**

2022/23

**D**

> 2022/23

**S-3**



Medium  
Resolution  
Optical &  
Altimetry

**A**



16 Feb. 2016

**B**

2018

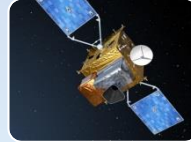
**C**

2023

**D**

> 2023

**S-4**



Atmospheric  
Chemistry  
(GEO)

**A**

2021

**B**

2027

**S-5P**



Atmospheric  
Chemistry  
(LEO)

**A**



13 Oct. 2017

**S-5**



Atmospheric  
Chemistry  
(LEO)

**A**

2021

**B**

2027

**C**

> 2027

**S-6**



Altimetry

**A**

2020

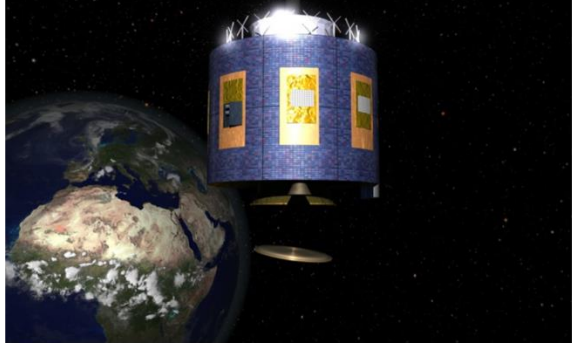
**B**

2025

# Meteorological Systems



Meteosat SG



MetOp



Meteosat TG



MetOp SG



Satellite Operations &  
Data Exploitation by  
EUMETSAT

< Current Systems

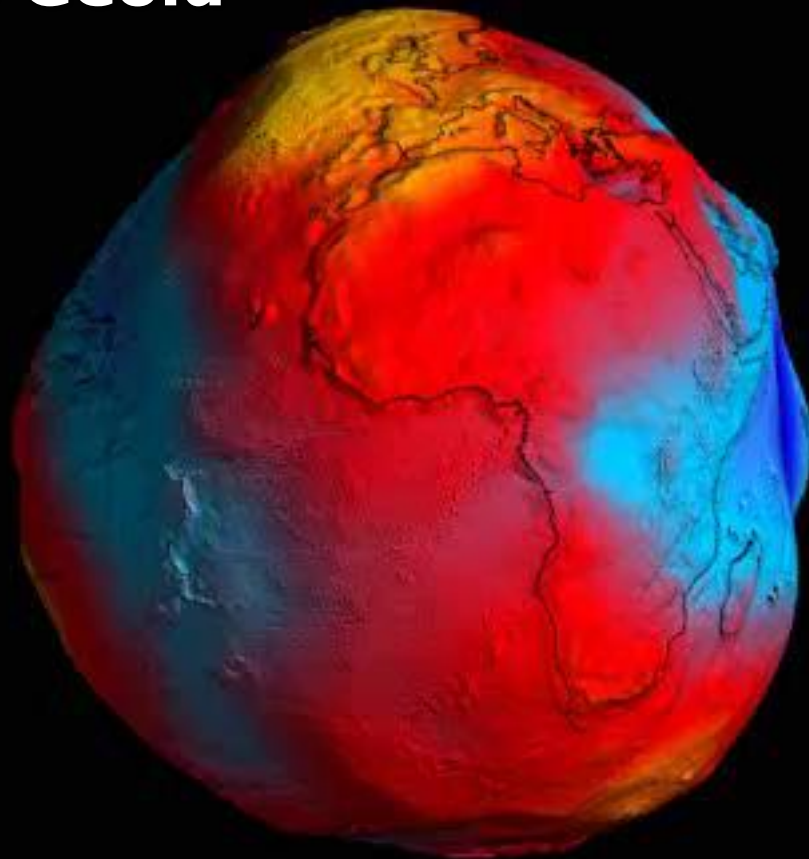
< Post-2020 Systems



A satellite image of a river delta, likely the Amazon, showing a complex network of channels and floodplains. The image is color-coded, with the river channels appearing in shades of red and orange, and the surrounding floodplains in various shades of green and blue. The background is a dark, almost black, space-like background.

# Data Exploitation & Innovation

# GOCE: Earth's Geoid



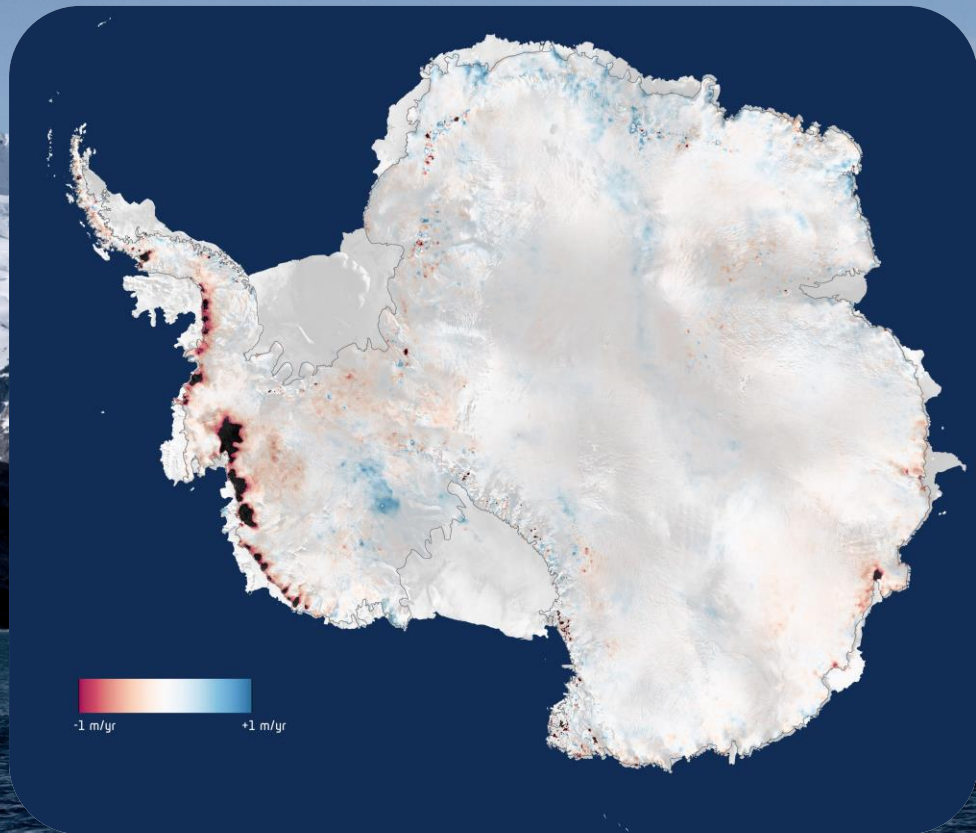
Most  
precise  
geoid ever  
produced

© ESA/HPF/DLR



European Space Agency

# Land Ice Melting



## Antarctic Ice Sheet Monitoring

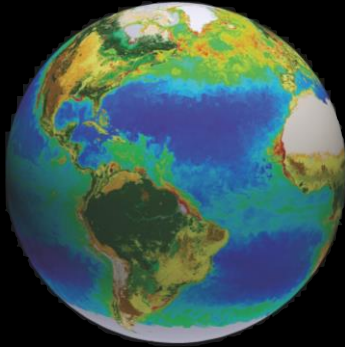
Based on Cryosat data over three years (2010 - 2013)

© CPOM/Leeds/ESA

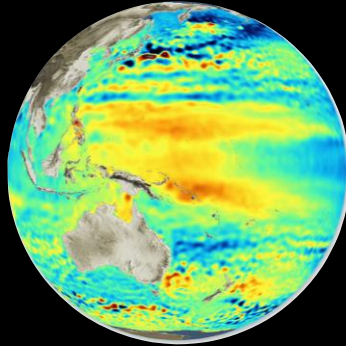
# Global & System View by Copernicus



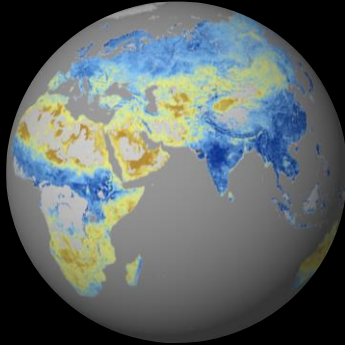
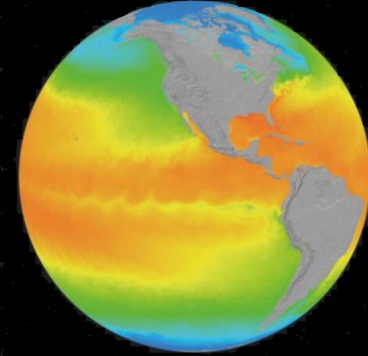
## Chlorophyll



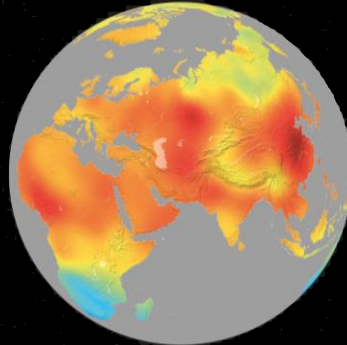
## Sea Level Height



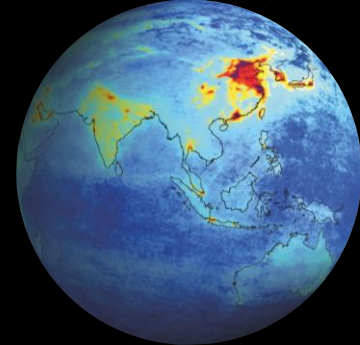
## Sea Surface Temperature



## Soil Moisture



## Carbon Dioxide



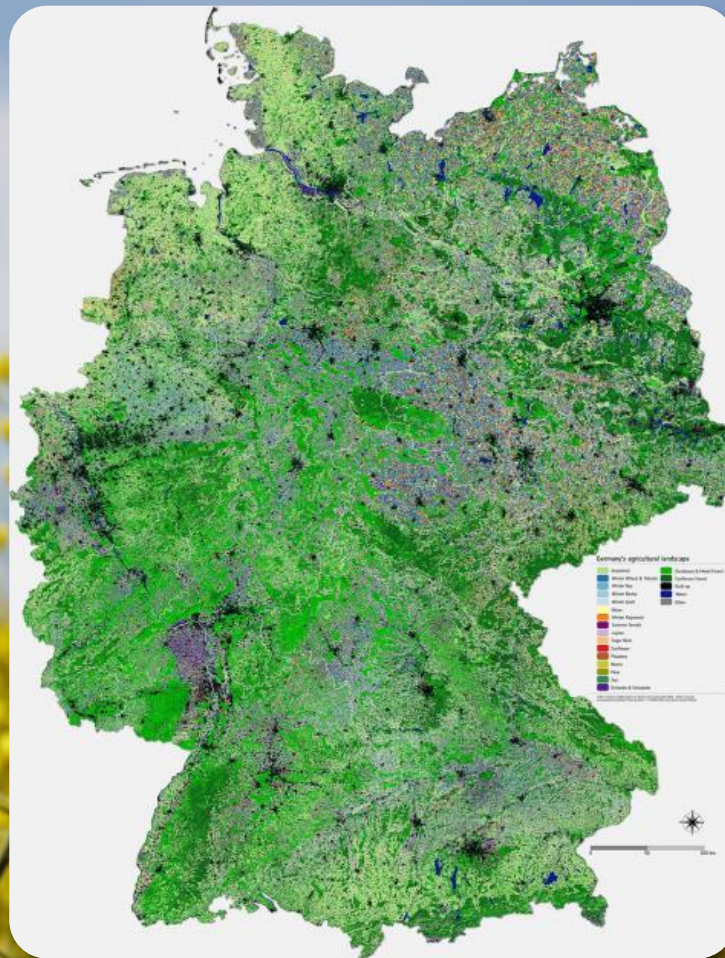
## Nitrous Oxide



# Agricultural Land Use

## Distinguishing 15 crop types Germany

Mixed Sentinel-2 and Landsat-8 Data



© Humboldt  
University Berlin  
P. Griffiths

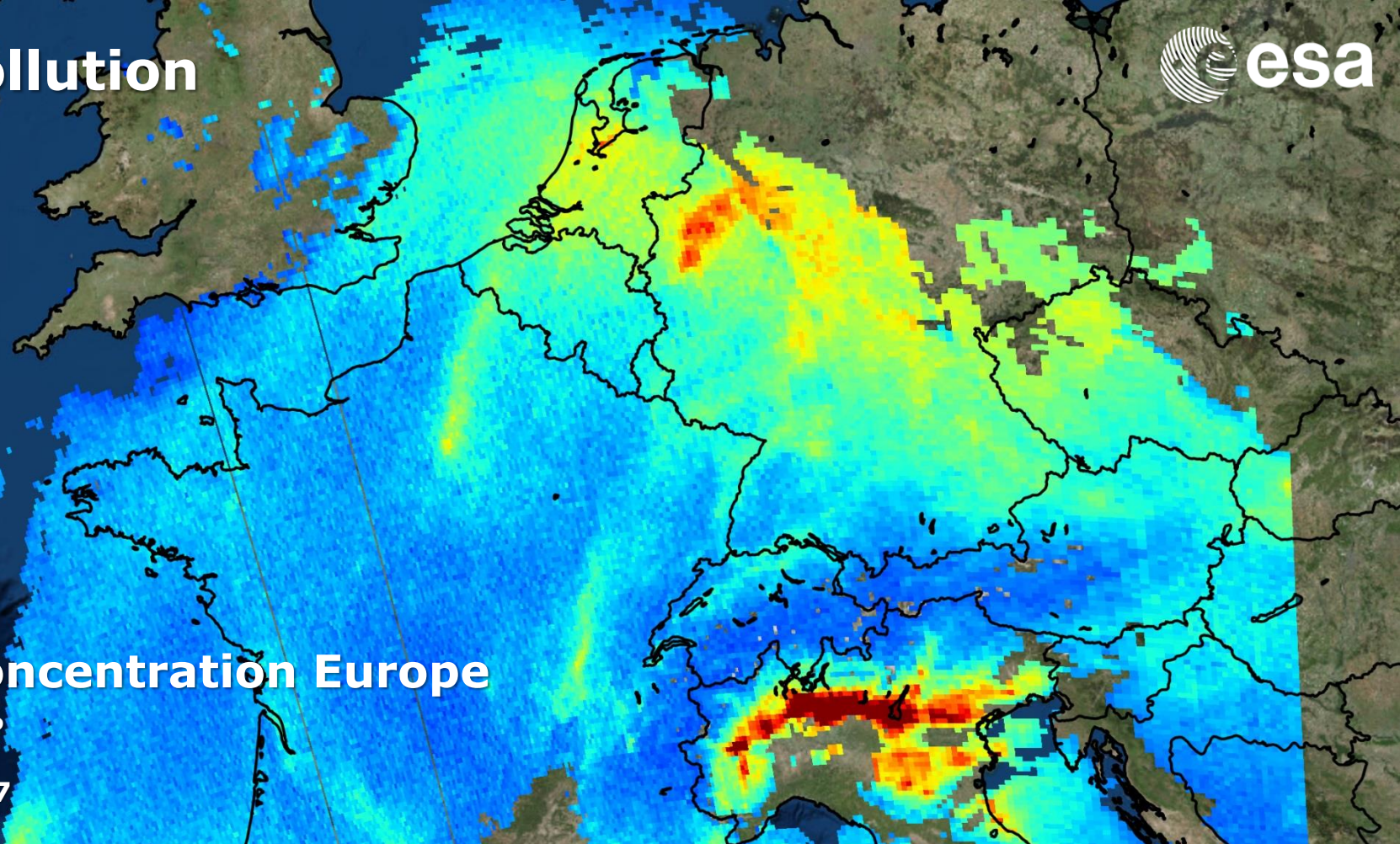
# Air Pollution



## NO<sub>2</sub> Concentration Europe

Sentinel-5P

7 Nov. 2017



# Security: Migration



< Refugee camp, near the city of Zarqa, Jordan.



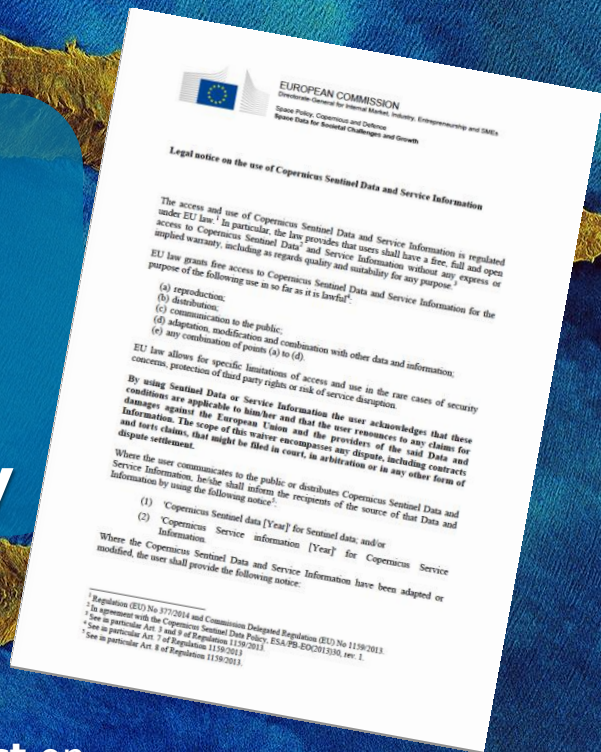
^ Boats for use of human trafficking in the Mediterranean.

# Copernicus Sentinel Data Policy



## Sentinel data are available:

- ✓ Free, Full and Open\*
- ✓ Over very long term
- ✓ Systematically, Operationally



\* **ESA Sentinel Data Policy** (Sep 2013) and **EU Delegated Act on Copernicus Data and Information Policy** (Dec 2013)



## DIAS

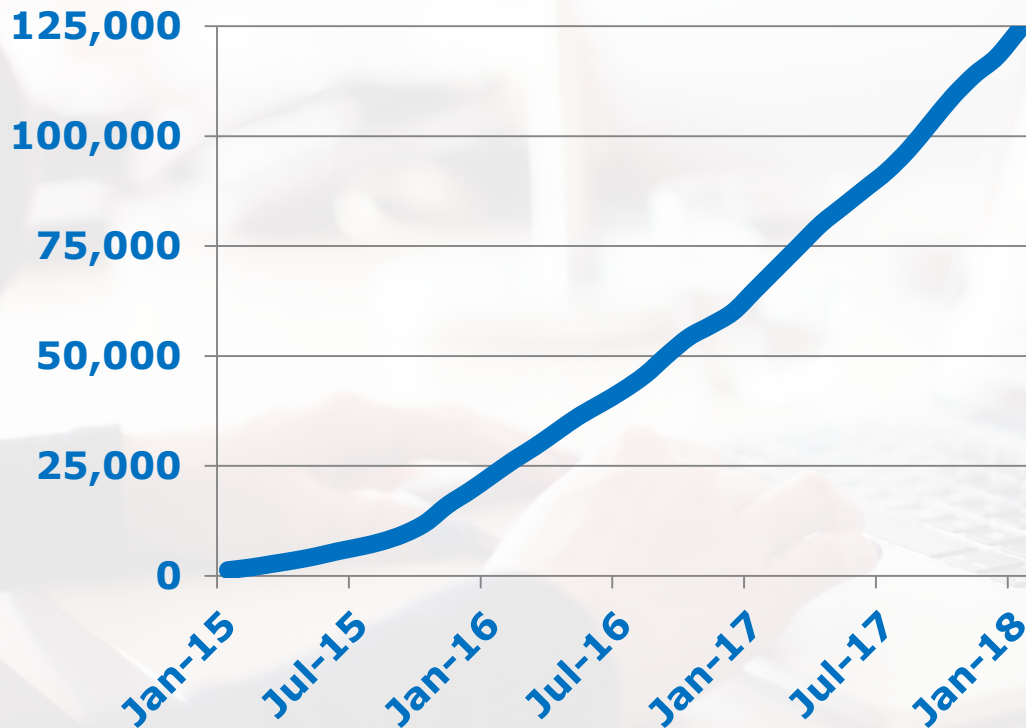
- Copernicus **D**ata and **I**nformation **A**ccess **S**ervices
- Common DG-GROW-ESA approach to EO data exploitation with Copernicus at its core
- Create & enable European EO Data ecosystem for research & business
- Started in June 2017

# Big Data Revolution

## ESA EO Data Archive Petabyte



# Registered Sentinel Users



## 53 PB

### Volume of User Downloads

### Copernicus User Uptake

The real number of users is much higher but unknown due to the free, full & open data policy.

# Supporting diverse Stakeholders



# EO Supporting Global Policies



## Sustainable Development

UN SDGs



Measuring Status & Progress

## Climate Action

Paris Agreement



Monitoring & Understanding

## Disaster Risk Reduction

Sendai Framework



Adequate Response & Resilience



**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

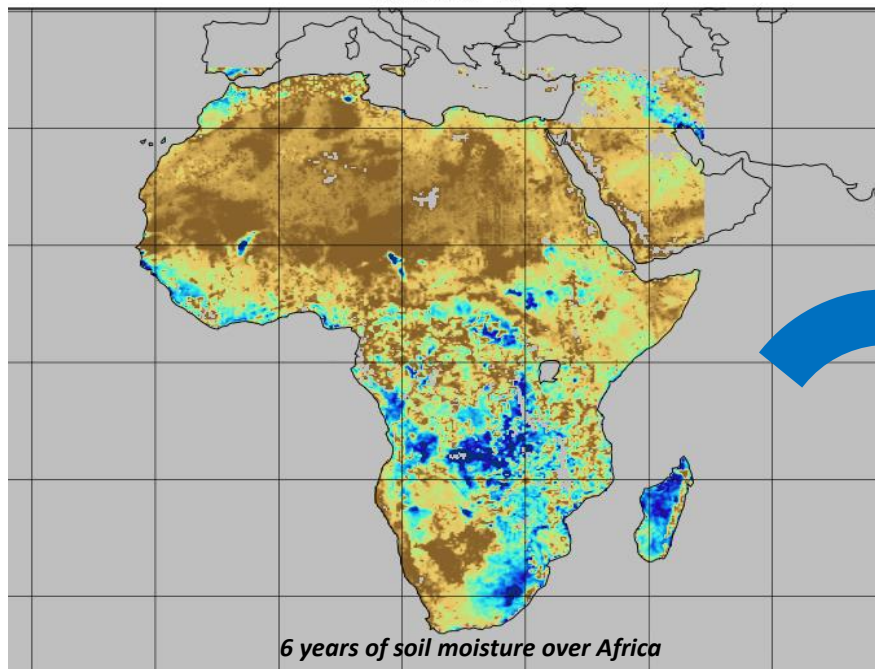
**THE GLOBAL GOALS**  
For Sustainable Development



# Soil Moisture for Drought Monitoring

SMOS mean monthly soil moisture (2011-2016)

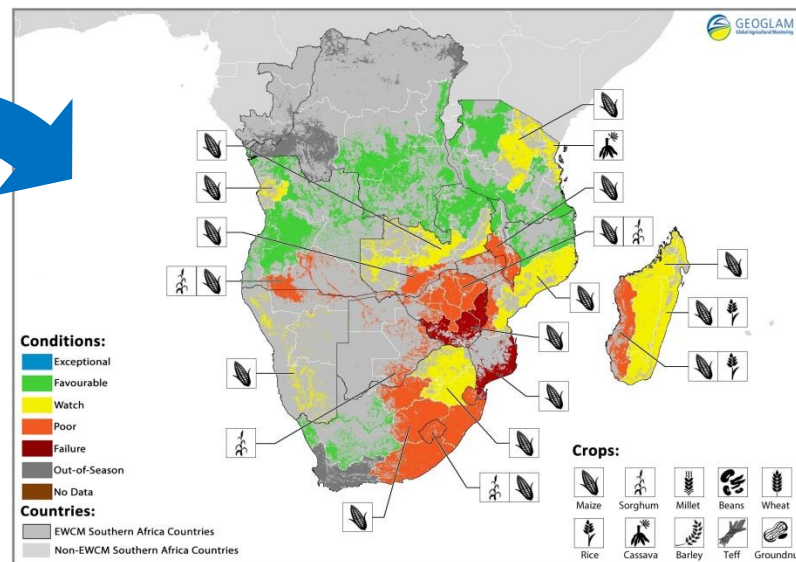
Time: 1 of 72



Retrieved soil moisture value (m<sup>3</sup>.m<sup>-3</sup>)



## Anticipated crop failure can be used to predict & prevent famine



# Climate Action: ESA Contributions



## Monitoring & Understanding

ESA Climate Change Initiative (ECVs)

Copernicus Climate Change Service (Sentinels for C3S)

Space Climate Observatory (One Planet Summit)

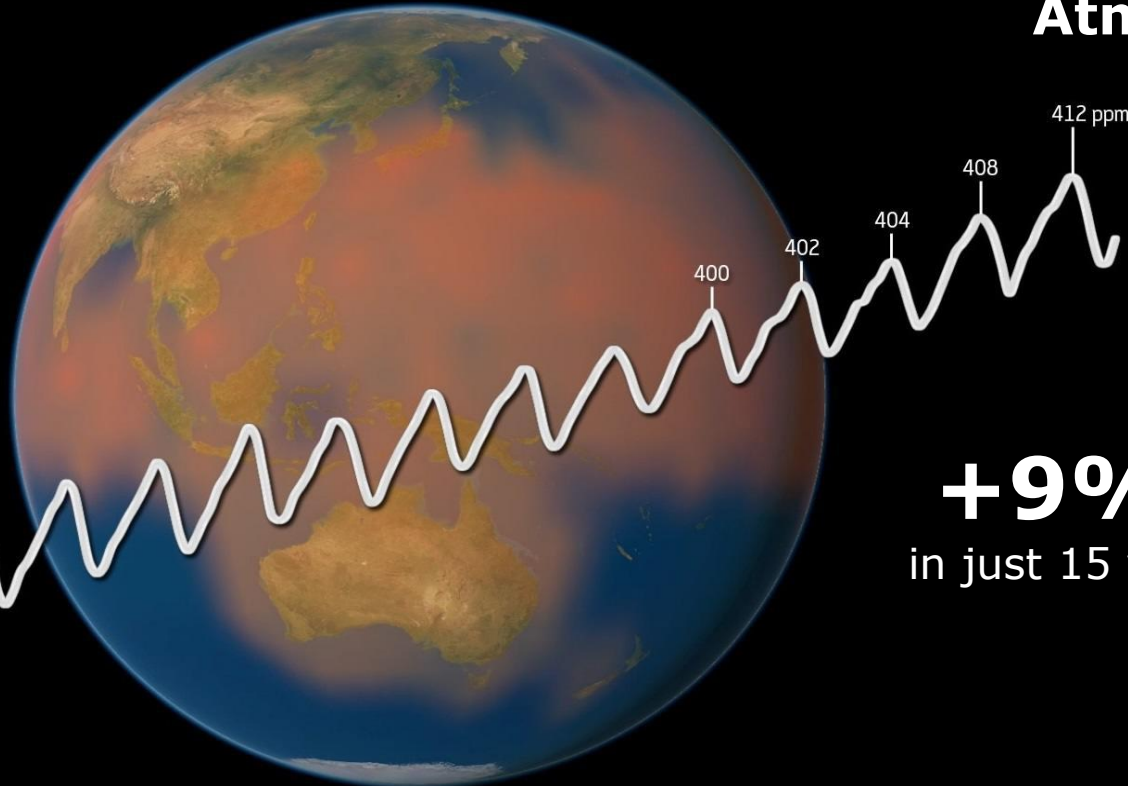


# Climate Change: Causes



## Atmospheric Carbon Dioxide

Atmospheric Carbon Dioxide



**+9% ppm**  
in just 15 years time

Global Monthly Average

2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017

© ESA CCI /  
Planetary Visions  
21 Feb. 2018



## Adequate Response & Resilience

**Disaster Prevention  
Early Warning & Alert**

Space Information for a Resilient Society

**Crisis Response**

International Charter "Space and Major Disasters"

**Post-Disaster Assessment  
Recovery & Reconstruction**

Space Information for a Resilient Society

**UNDP: "Every dollar spent on preparing for disasters saves seven dollars in economic losses."**

# Floods in Bolivia – Crisis Response



**BOLIVIA**  
Cochabamba Department

Imagery analysis: 10 February 2018 | Published 13 February 2018 | Version 1.0



FL20180209BOL

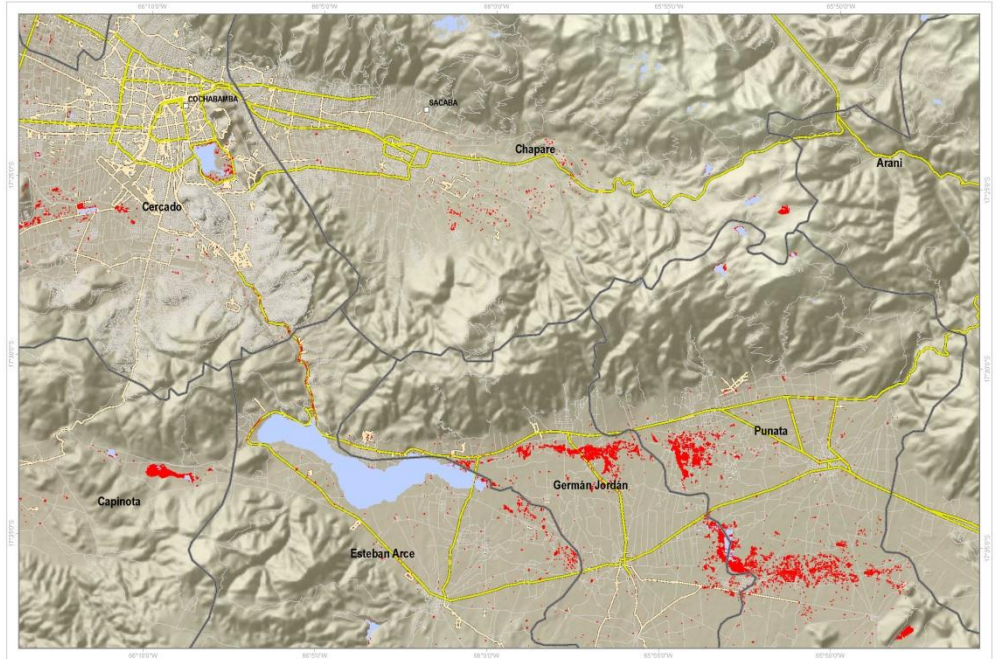


### Satellite detected waters over Cochabamba department, Bolivia

This map illustrates satellite-detected standing water over the Cochabamba department in Bolivia, as of the 10 February 2018, following heavy rainfalls that caused severe flooding in the area. The analysis was conducted using Sentinel-1a and Radarsat-2 images as of 9, 10 and 12 February 2018 respectively. UNITAR-UNOSAT identified in the analyzed area of the Cochabamba Department around 1,300 Ha of land that seem to be inundated, of which almost 35% 450 Ha, are in the province of Punata. It is likely that flood waters have been systematically underestimated within built-up urban areas because of the special characteristics of the satellite data used. This is a preliminary analysis and has not yet been validated in the field. Please send ground feedback to UNITAR-UNOSAT.

- Legend**
- City / Town
  - Highway/Primary Road
  - Secondary Road
  - Local/Urban Road
  - Reference water
  - Satellite detected water as of 10 February 2018
  - ▭ Province boundary

Map Scale for A3: 1:150,000



Satellite Data: Sentinel-1  
Imagery Date: 9 and 10 February 2018  
Resolution: 10 m  
Copyright: Copernicus 2018 / ESA  
Source: ESA

Satellite Data: Radarsat-2  
Imagery Date: 12 February 2018  
Resolution: 6 m  
Copyright: MacDonald, Dwyer and Associates, Ltd. (2018)  
Source: CSA

Road Data: Open Street Map  
Other Data: USGS, UNCC, NASA, NOAA  
Analysis: UNITAR-UNOSAT  
Production: UNITAR-UNOSAT

The depiction and use of boundaries, geographic names and related data shown here are not warranted to be error-free nor do they imply official endorsement or acceptance by the United Nations. UNOSAT is a program of the United Nations Institute for Training and Research (UNITAR), providing satellite imagery and related geographic information, research and analysis to UN humanitarian & development agencies & their implementing partners. This work by UNITAR-UNOSAT is licensed under a CC BY-NC 3.0.

Satellites detected waters over the Cochabamba department

Charter Activation #578 – Feb. 2018

Copyright: Sentinel-1 © Copernicus Sentinel data (2018)  
RADARSAT-2 Data and Products © Maxar Technologies Ltd. (2018)



# Embracing Transformative Technologies



Blockchain

Miniaturisation

Internet of Things

Big Data

AI - ML - DL

Exploitation Platforms

Cloud Computing

Crowdsourcing

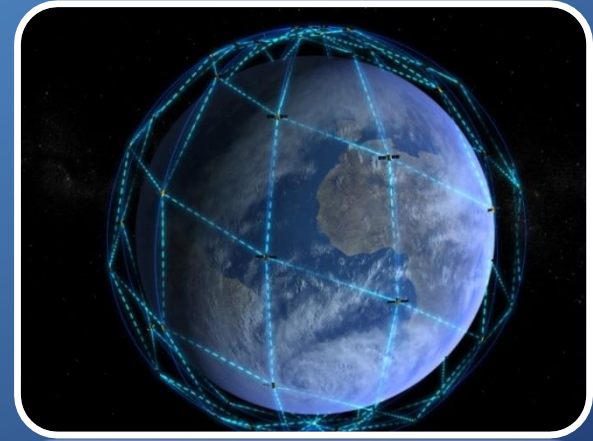
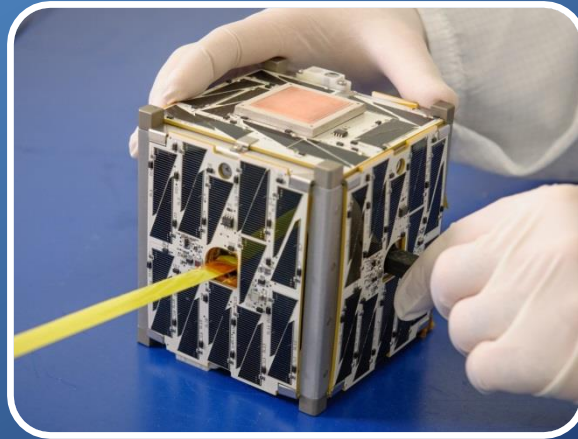


# Exploring new EO Data Platforms



**High Altitude  
Pseudo  
Satellites**

## SmallSats



**Mega-  
constellations**

Thank you for your attention!

[www.esa.int](http://www.esa.int)