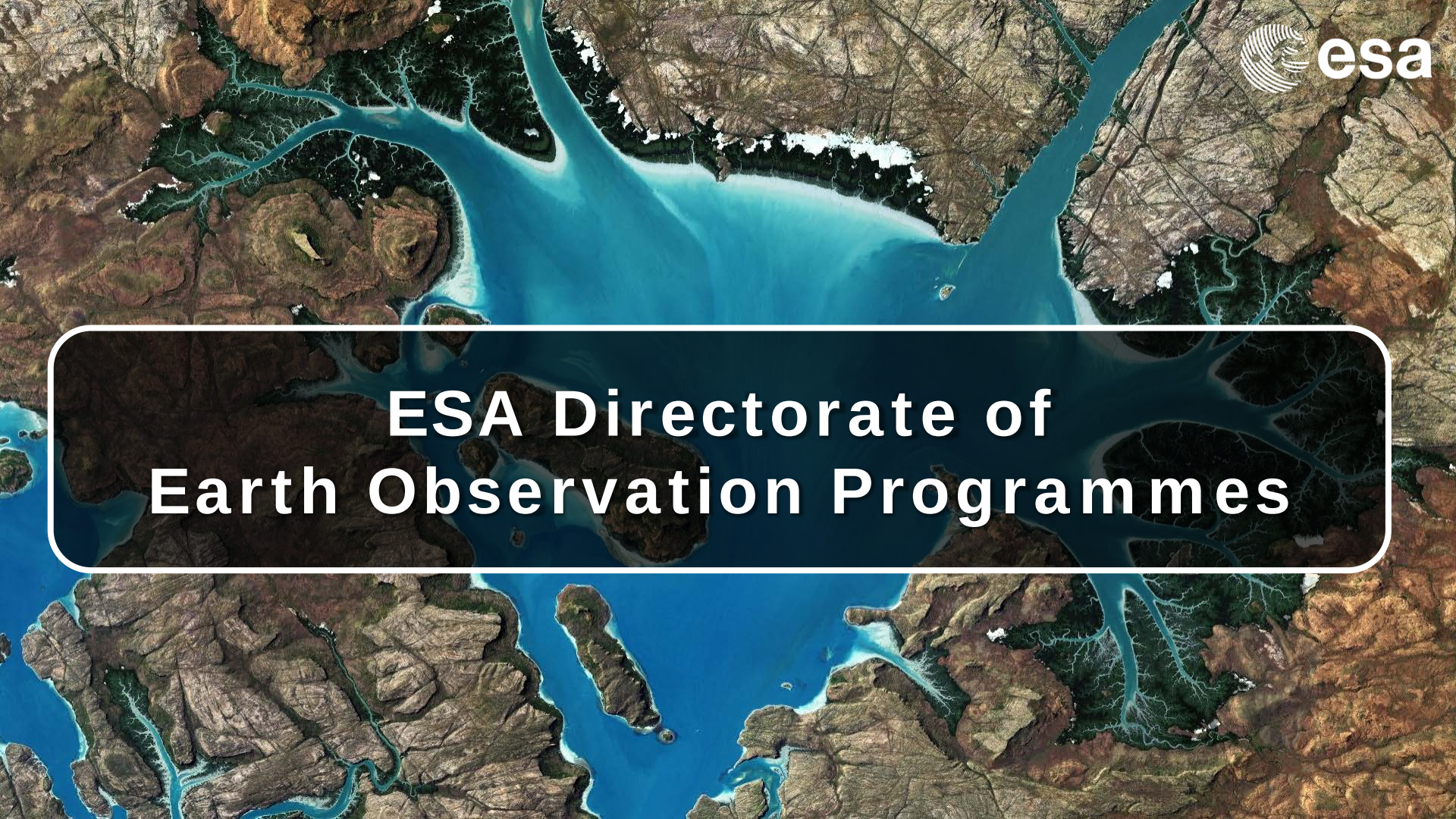


# ESA Earth Observation Programmes Status and Future Challenges

Space Science Week  
Washington DC, 27 March 2018

**Maurice Borgeaud, ESA**

Head of the Science, Applications & Climate Department

A satellite image of a coastal region, likely the fjord area of Norway. The image shows a large body of water in shades of blue and turquoise, surrounded by rugged, brown and tan mountains. Several small islands and peninsulas are visible, with some snow patches on the higher elevations. The water reflects the surrounding land, creating a complex pattern of light and dark areas.

# ESA Directorate of Earth Observation Programmes

# ESA Budget per Domain - 2018



Navigation\*  
14.0%, 782.6 M€

Space Transportation\*  
19.8%, 1,110.7 M€

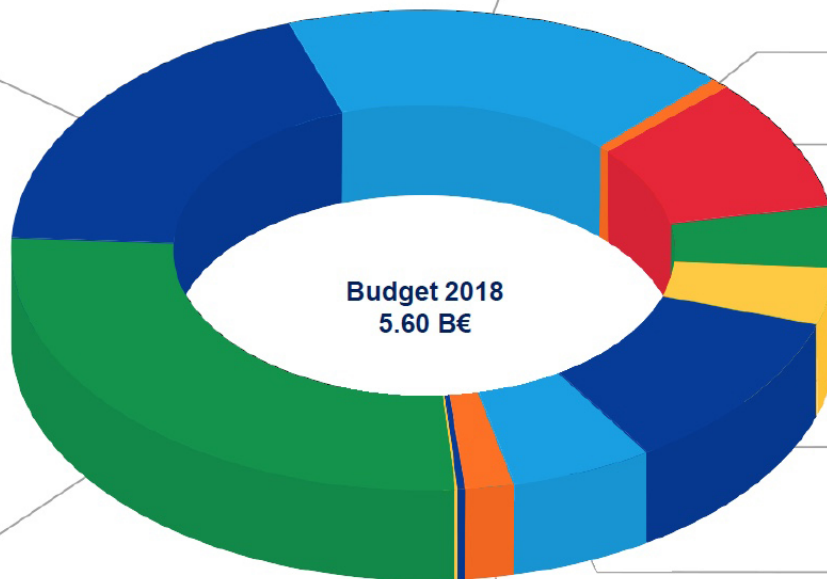
**B€: Billion Euro**

**M€: Million Euro**

\*includes programmes  
implemented for other  
institutional partners

Earth Observation\*  
26.0%, 1,455.8 M€

European Cooperating  
States Agreements  
0.1%, 6.9 M€



Prodex  
1.2%, 65.4 M€

Scientific Programme  
9.2%, 518.2 M€

Basic Activities  
4.2%, 237.2 M€

Associated with General Budget  
3.9%, 218.4 M€

Human Spaceflight, Micro. And  
Expl.  
13.1%, 731.9 M€

Telecom & Integrated Applications\*  
4.9%, 275.0 M€

Technology Support\*  
3.2%, 177.9 M€

Space Situational Awareness  
0.4%, 22.9 M€

Slide 3



European Space Agency

# Directorate of Earth Observation Programmes



## Personnel

**555**

234  
Contractors

321  
Staff

## Budget

€ **1.5 bn**  
in 2018  
(\$ 1.85 Billion)

## 5 Sites

ESRIN    ECSAT  
          HQ  
ESTEC    EBO

Slide 4



European Space Agency



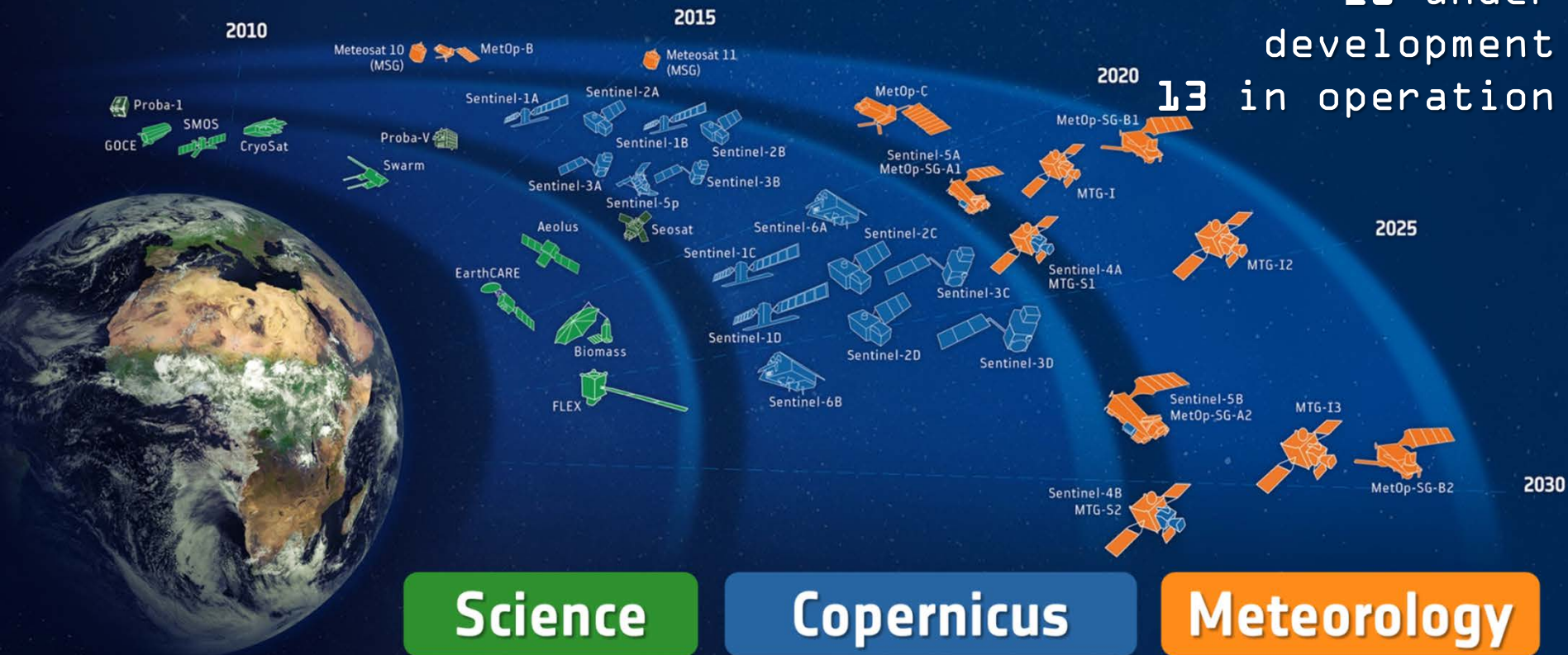
# **Our Mission**

**Develop world-class Earth  
Observation systems  
addressing scientific &  
societal challenges  
with European and global  
partners**

# ESA-DEVELOPED EARTH OBSERVATION MISSIONS



Satellites  
28 under  
development  
13 in operation



# Science: Earth Explorers



**GOCE** 2009 – 2013

**SMOS** 2009 – Present

**Cryosat** 2010 – Present

**Swarm** 2013 – Present

**Aeolus** 2018

**EarthCARE** 2020

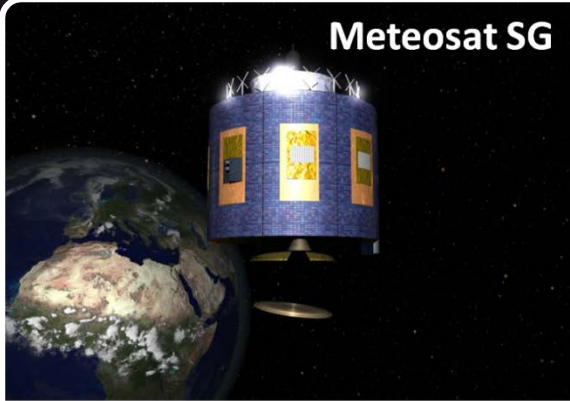
**Biomass** 2021

**FLEX** 2022



# Meteorology

Meteosat SG



MetOp



Meteosat TG



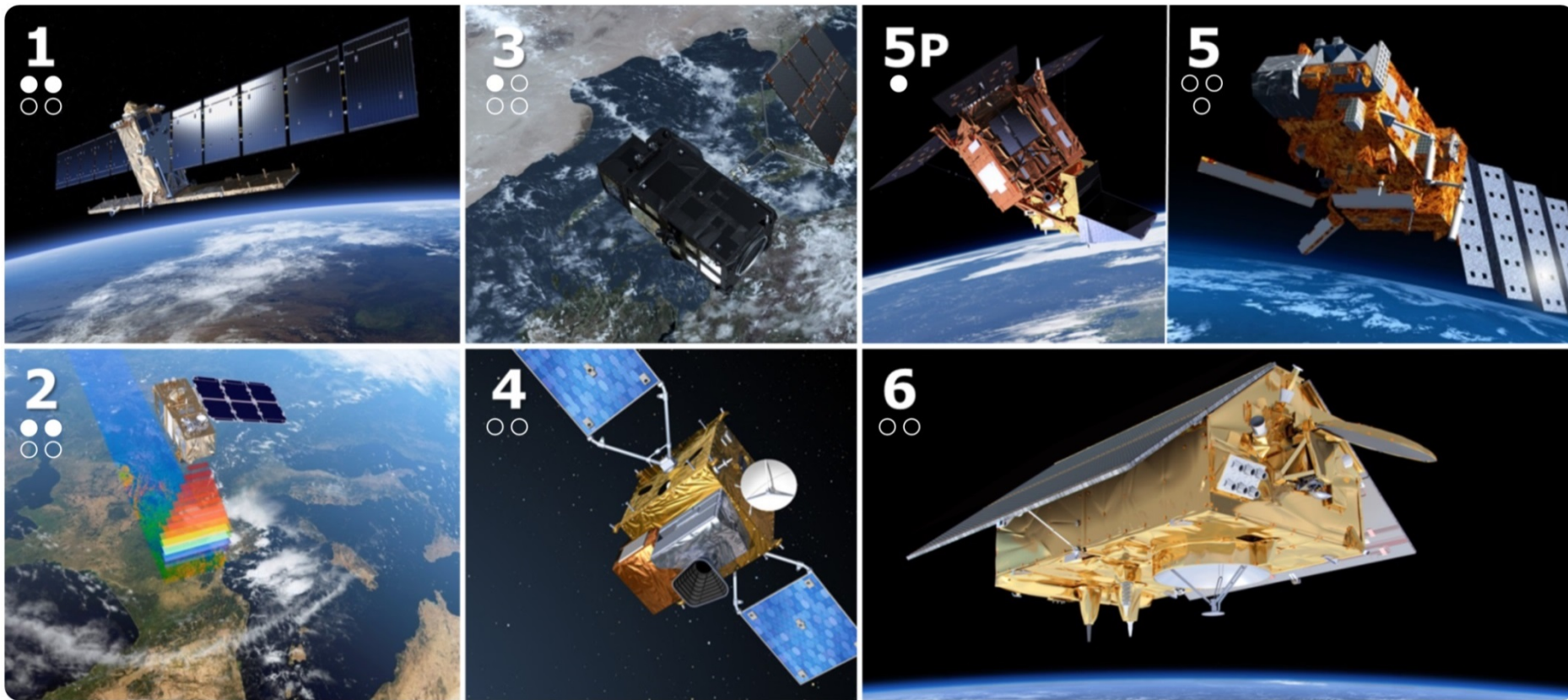
MetOp SG



< Current Systems

< Post-2020 Systems

# Copernicus – European Leadership in EO



Slide 9



European Space Agency

# Sentinel Launches



**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**

25/4/2018

**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

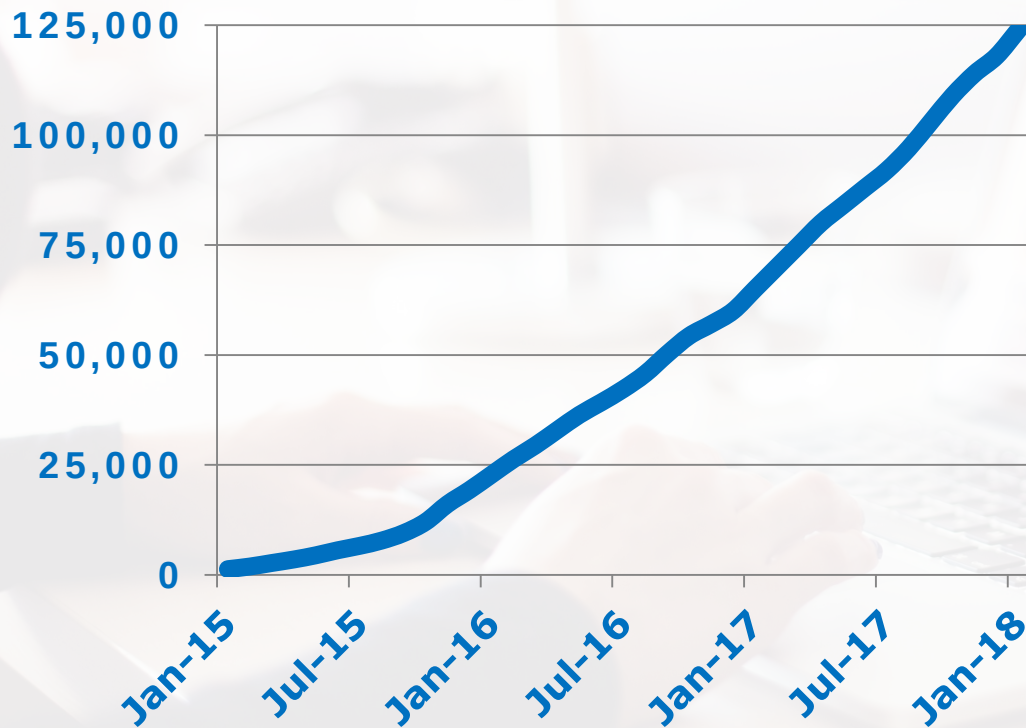
**A**

2020

**B**

2025

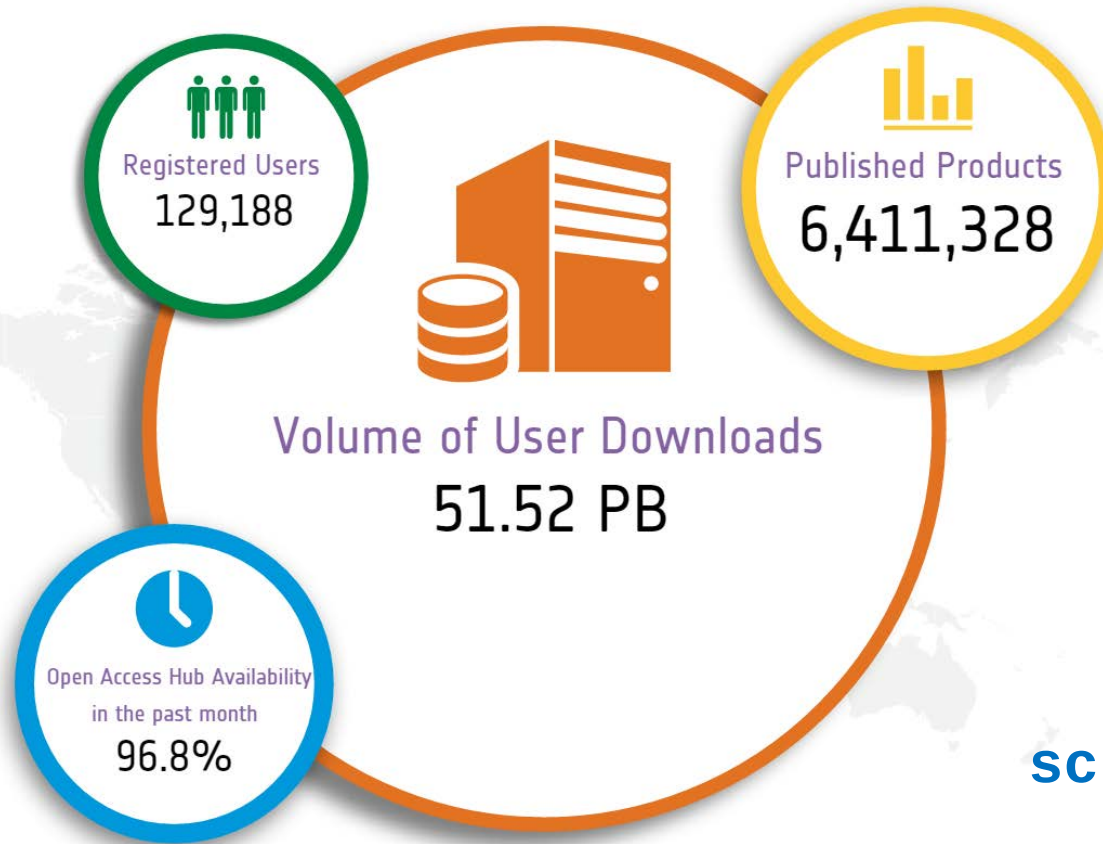
# Registered Sentinel Users



## Copernicus User Uptake

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

# Sentinel Open Access Data Hub



Statistics on  
13 March 2018

[scihub.copernicus.eu](https://scihub.copernicus.eu)

Slide 12

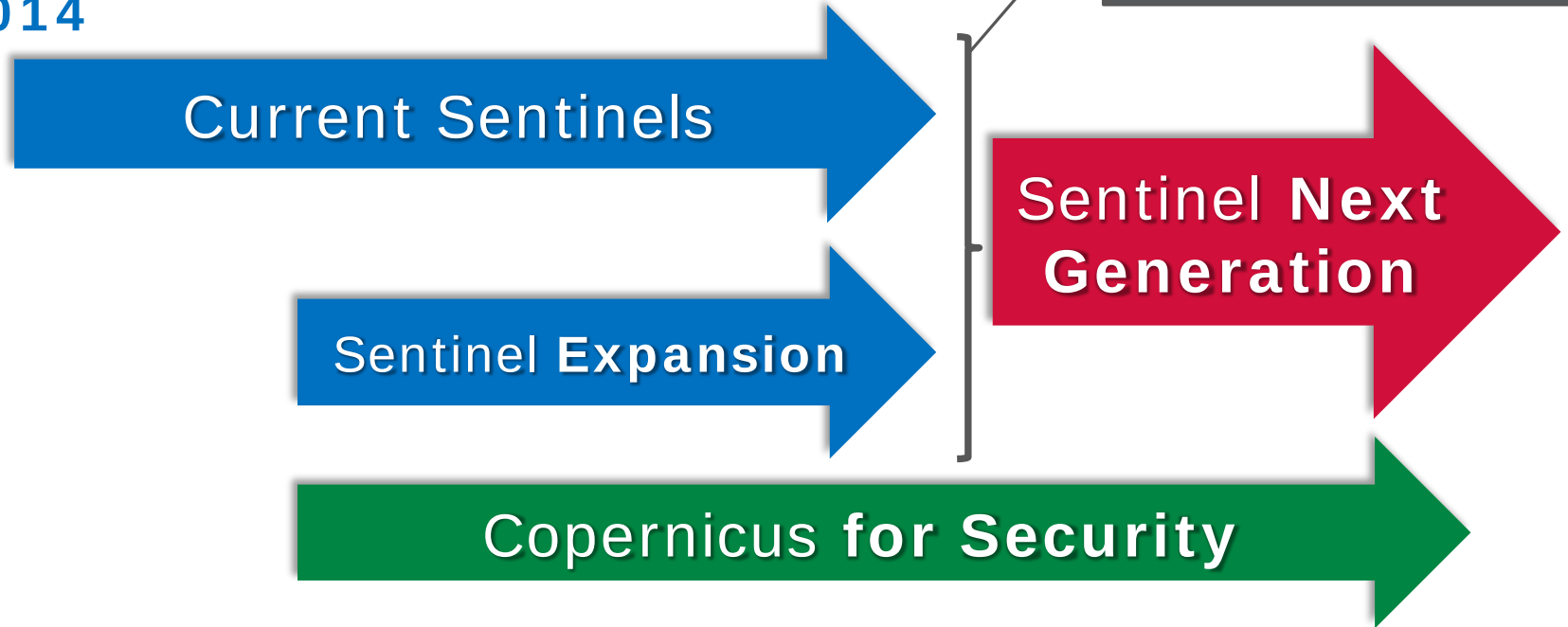


European Space Agency

# Copernicus Space Component Evolution



2014



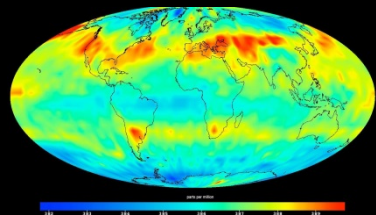
Slide 13



# Sentinel Expansion (7 to 11)



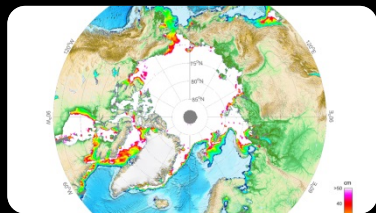
## High Priority Candidate Missions



Anthropogenic  
 $\text{CO}_2$



Polar Ice & Snow  
Topography



Passive Microwave  
Imaging

## Applications

Climate Change  
(Causes)

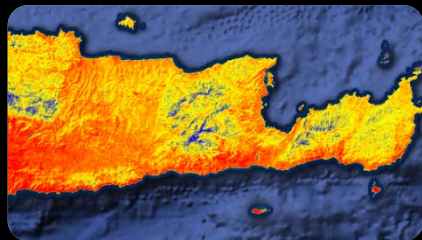
Climate Change  
(Effects)

Sea Ice  
Concentration

# Sentinel Expansion (7 to 11)



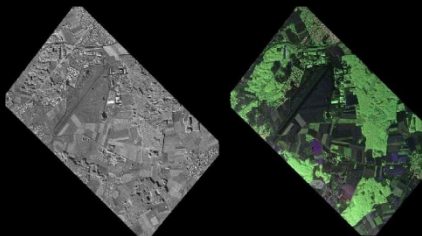
## High Priority Candidate Missions



High Resolution  
Land Surface  
Temperature



HyperSpectral  
Imaging



L-band  
SAR

## Applications

Agriculture & Urban  
Management Services

Agricultural Management  
& Food Security, Soil &  
Mineral Resources

Soil, Vegetation, Ice  
extend, Food Security &  
Ground Motion



## Four Lines of Activity

- R&D on existing ECV
- Knowledge Exchange
- New ECV
- Cross-ECV Scientific Exploitation

A satellite image of a river delta, likely the Amazon, showing a complex network of channels and floodplains. The land is colored in shades of red and brown, while the water is a deep blue. The image is used as a background for the title.

# EOP Embracing Sharp Innovations

# Big Data Revolution

## ESA EO Data Archive Petabyte



## New ESA Initiative

Shaping the Future of EO

Leveraging the Data &  
Tech Revolutions



In one sentence

“Opening ESA  
to disruptive  
innovation  
in EO”

# COP 21: ESA Contributions



## Monitoring & Understanding

ESA Climate Change Initiative (ECVs)

Copernicus Climate Change Service (Sentinels for C3S)

Space Climate Observatory (One Planet Summit)



COP21 Climate Conference  
Le Bourget, 2015

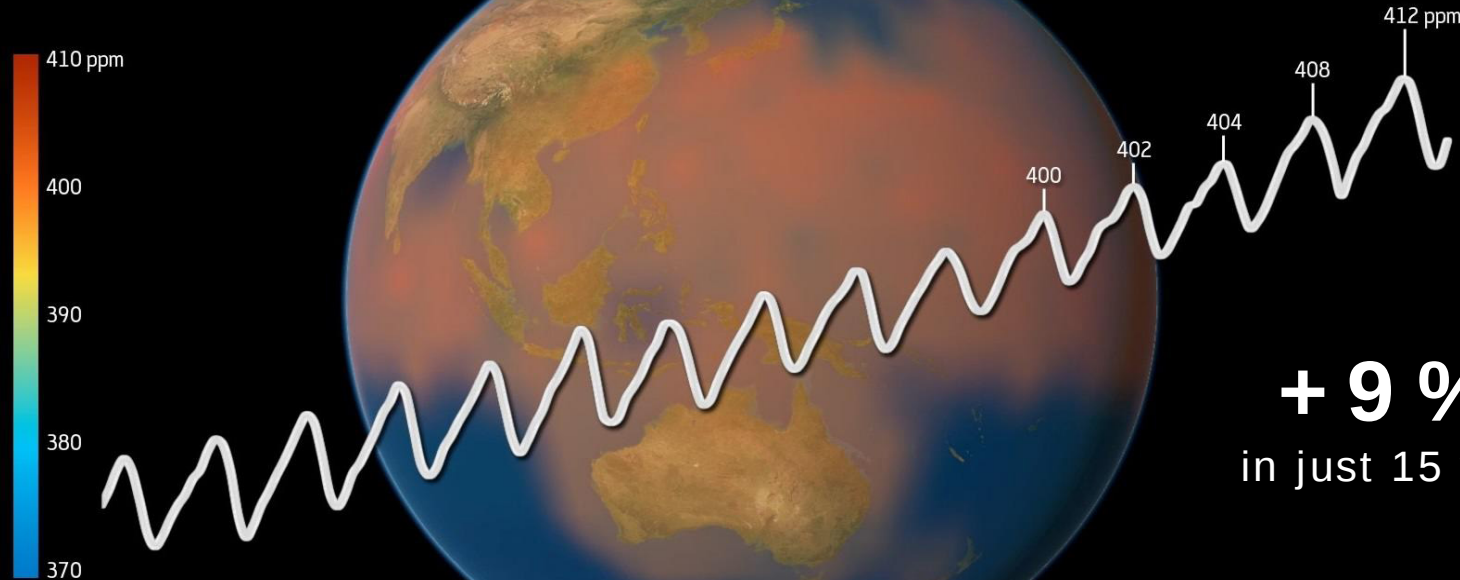


# Climate Change Causes - GHG



## Atmospheric Carbon Dioxide

Atmospheric Carbon Dioxide



Global Monthly Average

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

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

© ESA CCI /  
Planetary Visions  
21 Feb. 2018



European Space Agency



# SUSTAINABLE DEVELOPMENT GOALS



ELYX By YAK

# Thank you for your attention!

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