

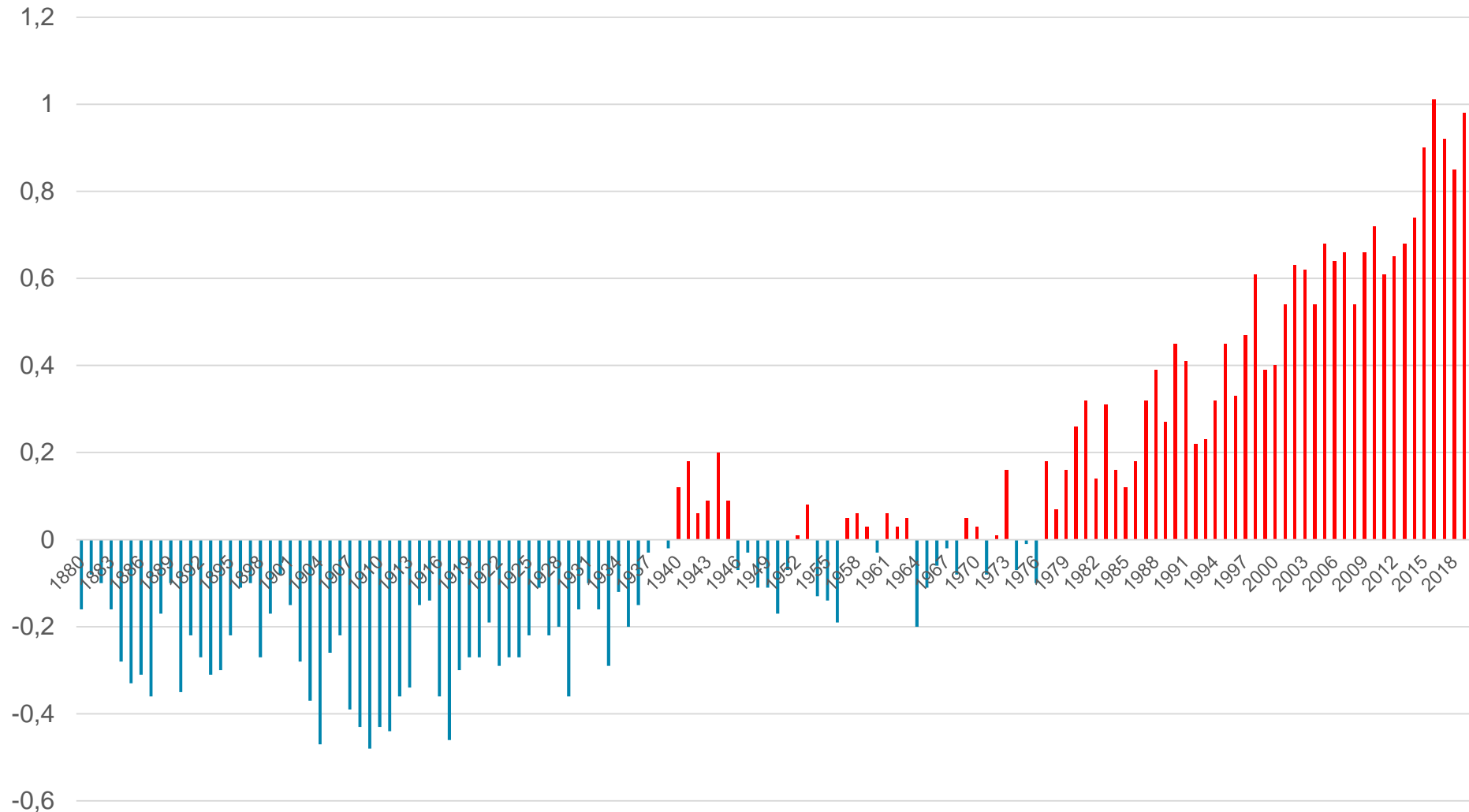


Airbus and climate change

Space monitoring to protect our planet

DEFENCE AND SPACE

AIRBUS

Average variation of global surface temperatures (Δ degC)

blue indicates areas cooler than average | red indicates areas warmer than average

Earth's climate on the rise

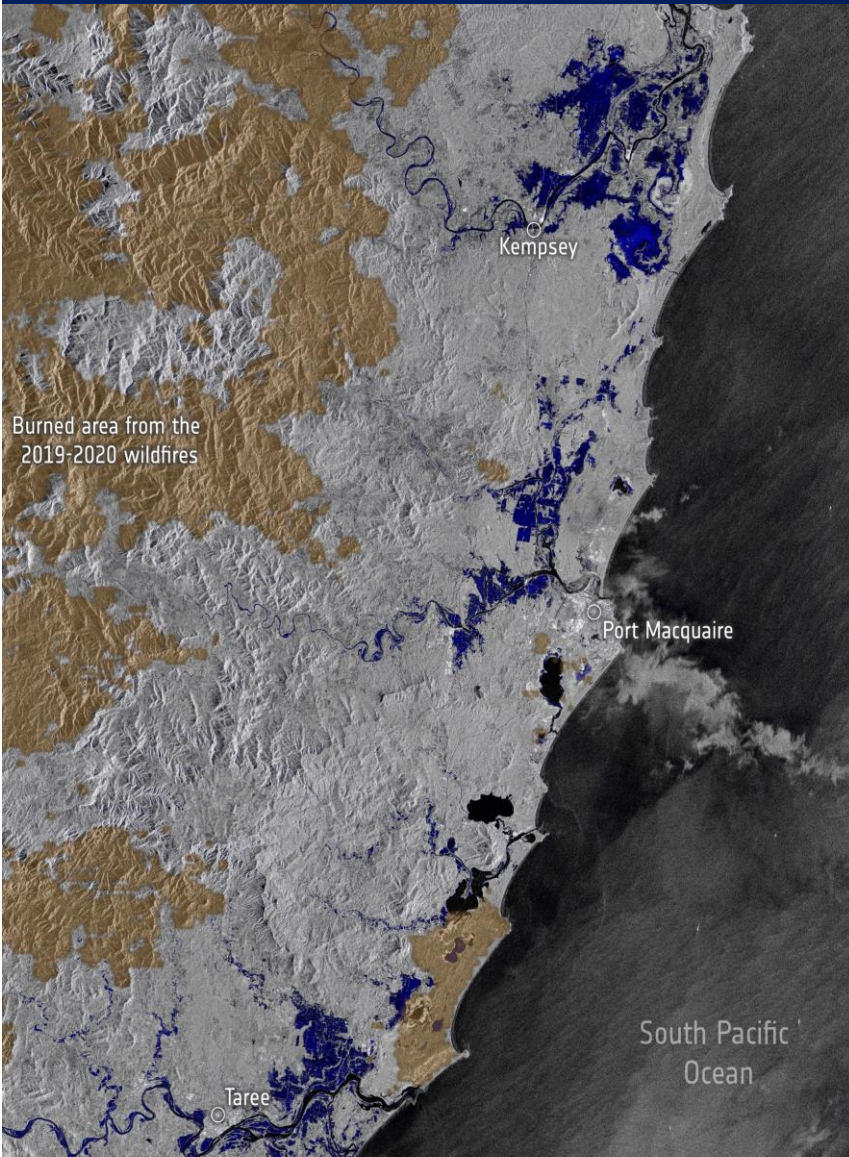
Nineteen of the warmest years have occurred since 2000, with the exception of 1998.

The years 2016 and 2020 were the warmest year on record since record-keeping began in 1880.

Looking from above

Satellites have a privileged view of what happens on Earth

Images © ESA



Burned area from the 2019-2020 wildfires

Kempsey

Port Macquaire

South Pacific Ocean

Taree

Record floods in NSW, Australia
Copernicus Sentinel-1



Desertification in West Africa
Copernicus Sentinel-2



Fires in Sweden
Copernicus Sentinel-3

DEFENCE AND SPACE

Development of **breakthrough technologies in observing techniques** to monitor and protect our planet. This programme is used by the **scientific community**.



**EARTH
EXPLORERS**



The world's largest EO programme delivering imagery for **climate monitoring, agriculture and disaster management**. This service is **free to all**.

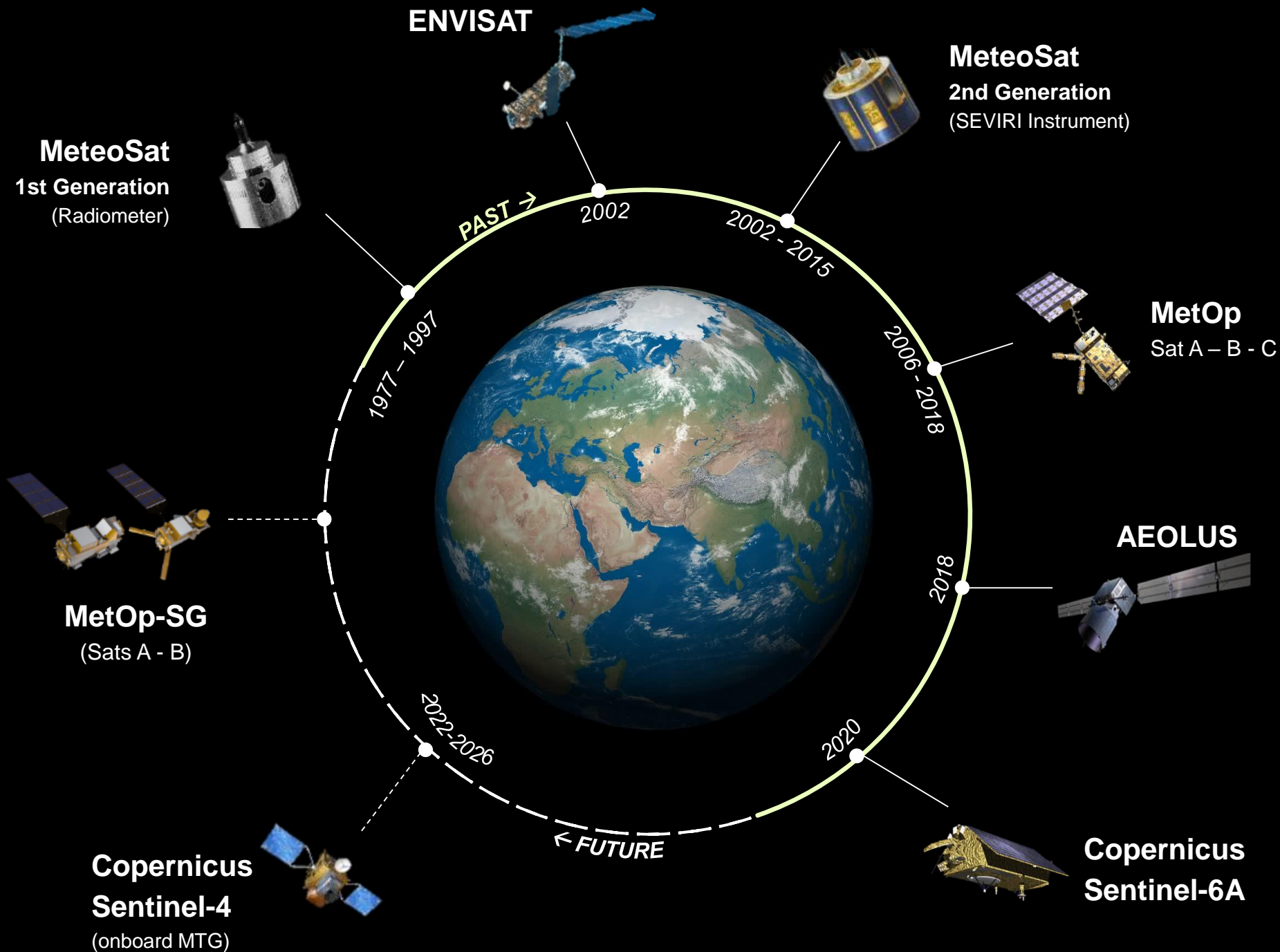


Weather forecast data shared with other agencies across the world. This service is **free to all**.

Who monitors climate from Space?

Institutions are the main actors in Europe of climate monitoring from Space. These are:

- ESA (European Space Agency)
- EC (European Commission)
- EUMETSAT (EUropean organization for the exploitation of METeorological SATellites)
- National Space Agencies



Meteorology a 40 years' legacy

Airbus legacy on meteorology and environment spans over 40 years and will continue with Copernicus and MetOp-SG programmes

The Copernicus "Sentinels"











Copernicus programme

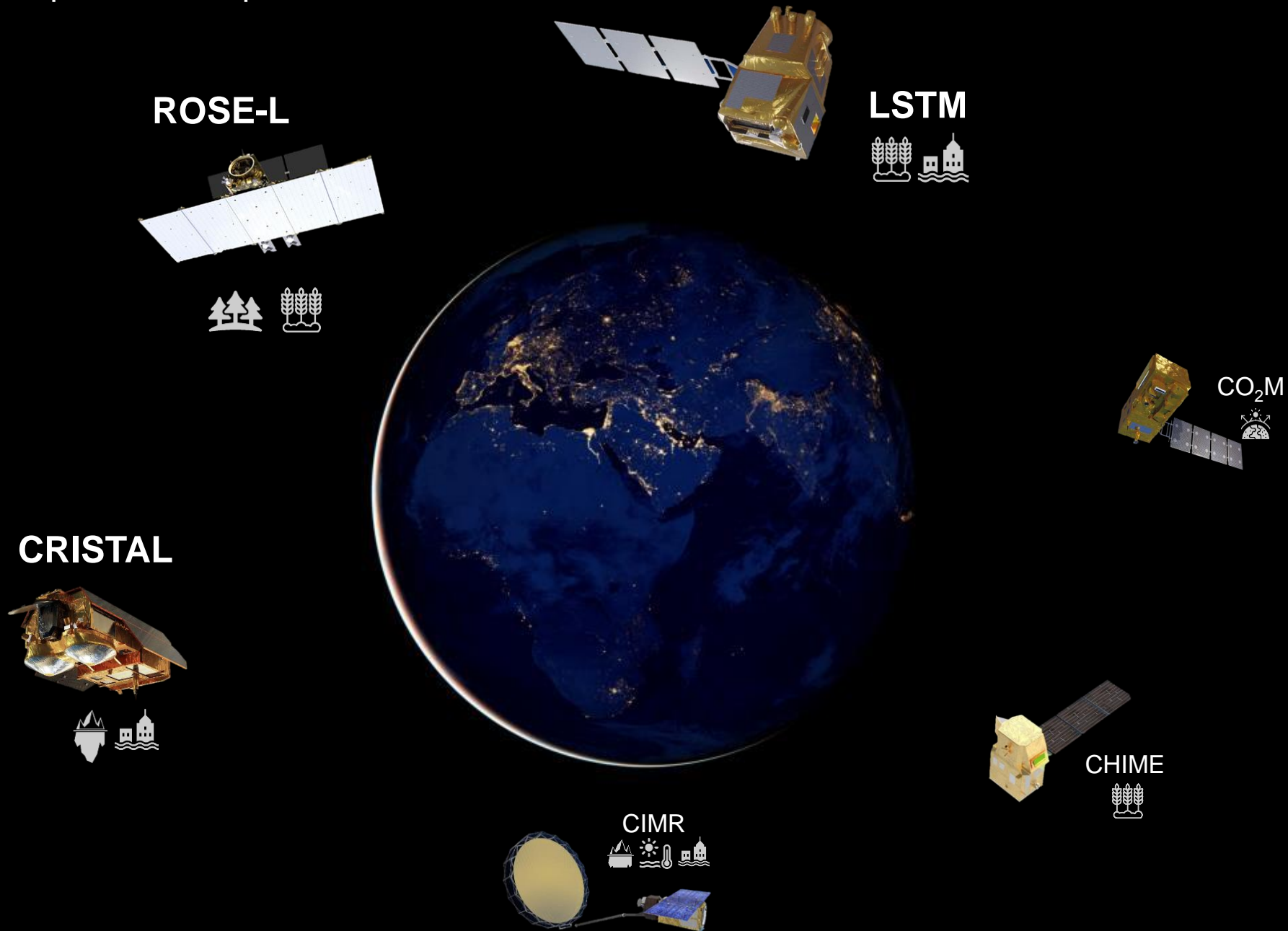
Copernicus is the European programme for monitoring the Earth. Today it is the biggest provider of Earth observation data in the world.

Airbus is involved in all 7 missions.

Aspects of the mission related to climate monitoring

 Ice status	 Sea levels
 Marine Wind	 Agriculture
 Forests	 Greenhouse gases
 Sea temperature	
 Disaster management	

The Copernicus "Expansion missions"

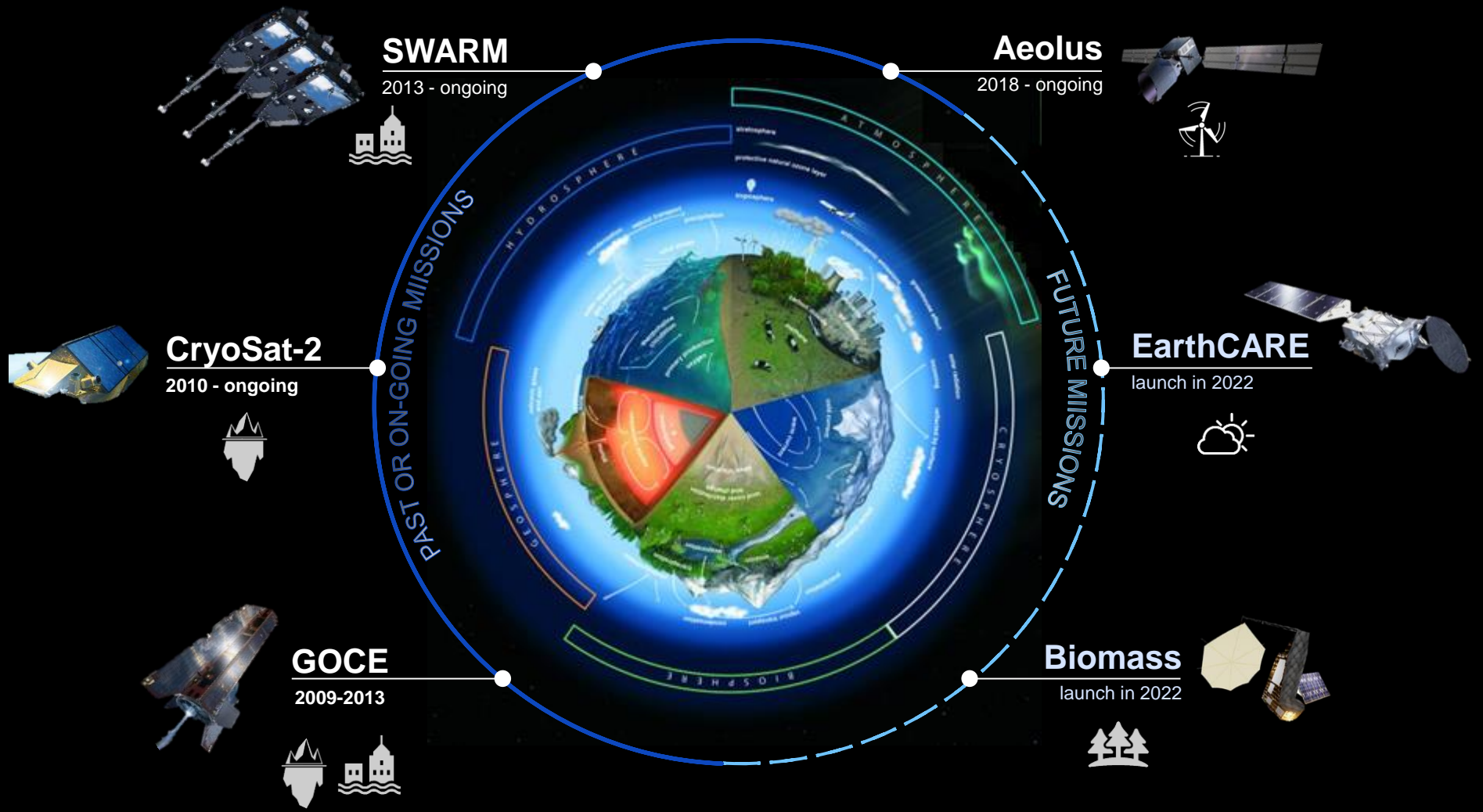


Copernicus programme

Copernicus is the European programme for monitoring the Earth. Today it is the biggest provider of Earth observation data in the world. Airbus is also involved in 3 of the 6 "Expansion missions".






Aspects of the mission related to climate monitoring

- | | |
|---|--|
|  Ice status |  Sea levels |
|  Marine Wind |  Agriculture |
|  Forests |  Greenhouse gases |
|  Sea temperature | |
|  Disaster management | |



Earth Explorers

Involved in almost all Earth Explorer satellites, Airbus is the major contributor of ESA's **Living Planet** programme.

- Aspects of the mission related to climate monitoring
-  Ice monitoring
 -  Sea levels monitoring
 -  Wind profiles monitoring
 -  Clouds / aerosols monitoring
 -  Forests monitoring

Aeolus emits short, powerful pulses of ultraviolet light from a laser and measures the Doppler shift from the very small amount of light that is scattered back to the instrument from molecules' particles.

These data are elaborated to deliver profiles of the horizontal speed of the world's winds.



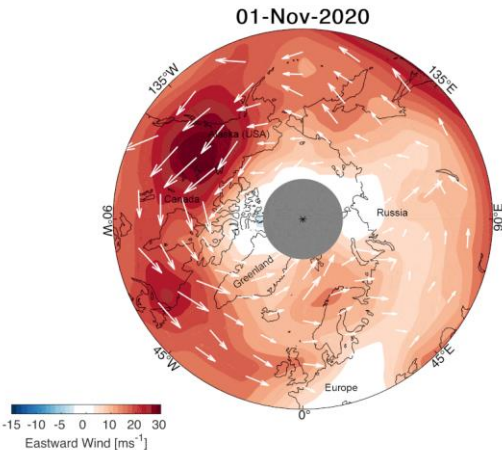
Aeolus

wind measurement from Space

Launched in 2018, Aeolus is the first satellite ever to measure multi-level wind speed from space across the whole planet.

During the 2020 spring lockdown due to CoViD-19, Aeolus has helped weather forecast compensating the reduced number of airplane measurements.

Aeolus data is now being used in operational weather forecast.



Variations of the Polar Vortex above the North Pole due to sudden stratospheric warming events (Aeolus data used to create the animation)

Scientists are using wind profiles' data to investigate whether these warming events are becoming more frequent due to climate change.



Greenhouse gases

Methane concentrations over a coal mine
Shanxi province, China



Rising temperatures

Wildfires along the
Brazilian-Bolivian border

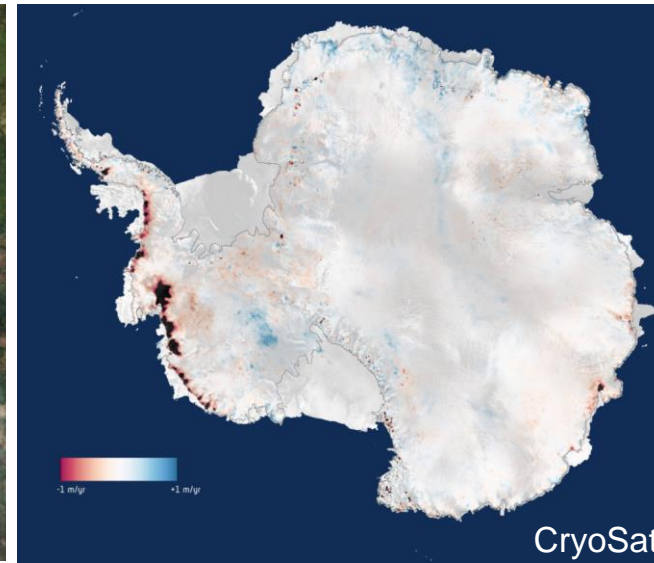
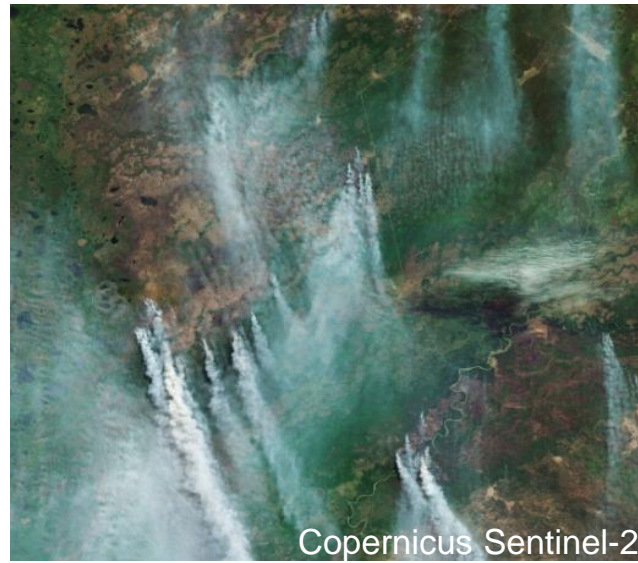
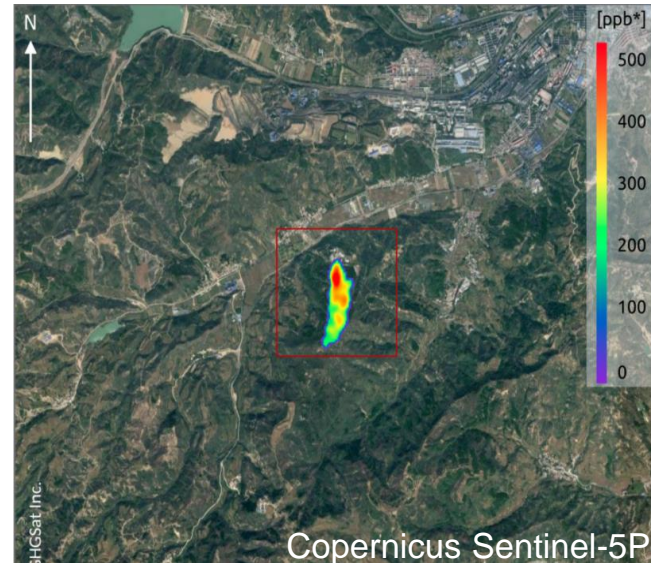


Ice loss

Antarctica

Planetary issues require a global view

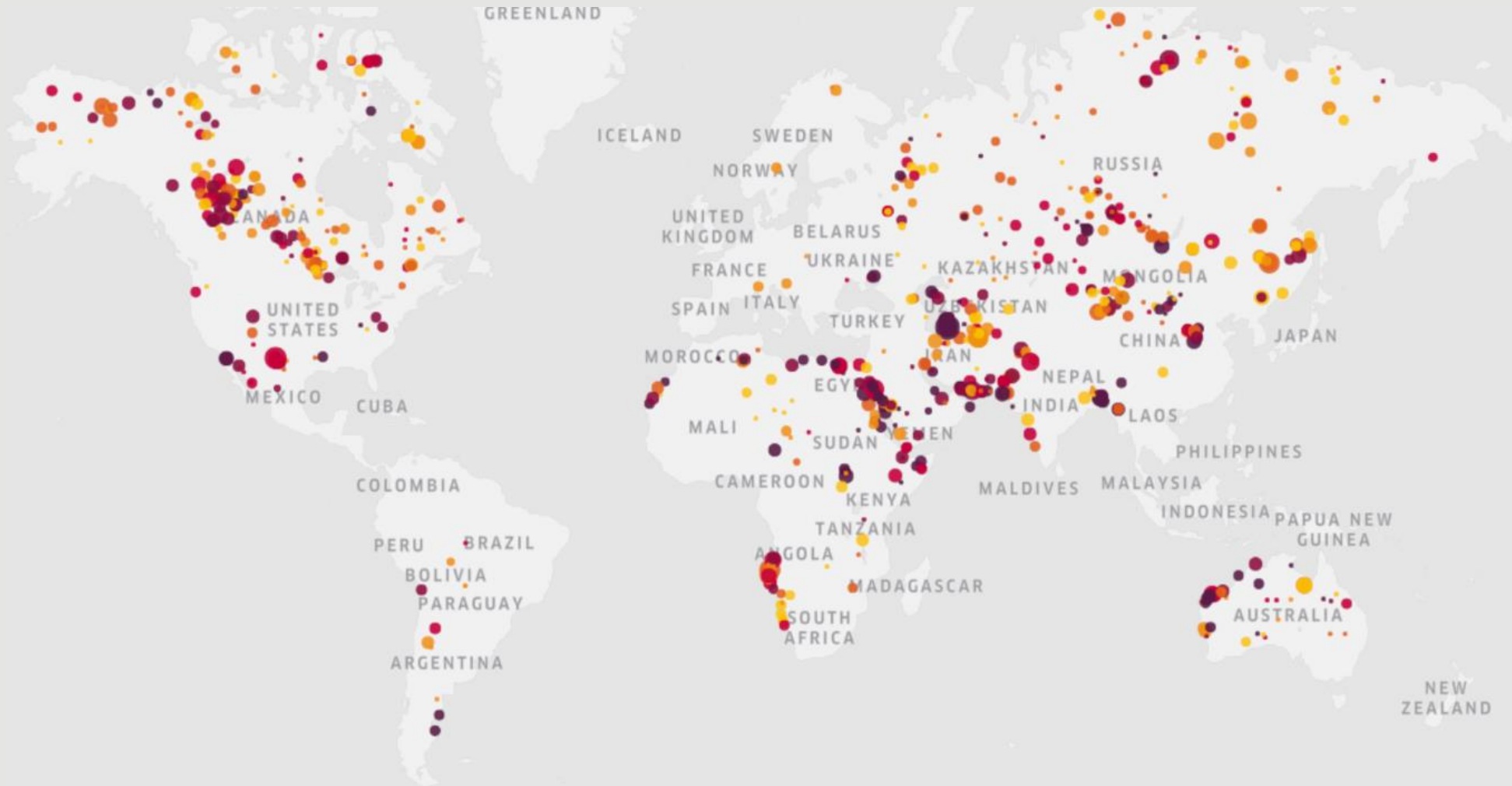
According to the UN Framework Convention for Climate Change (UNFCCC), more than 50% of the essential climate variables are measured from Space.



Carbon dioxide is generally produced by the combustion of fossil fuels, while fossil fuel production is one of the largest sources of methane emissions. Both gases have strong effects on global warming.

Higher temperatures cause droughts, wildfires and melting of ice around the Earth. Nineteen of the warmest years have occurred since 2000, with the exception of 1998.

Antarctica is losing 159 billion tonnes of ice each year. This is equivalent to a sea level rise of +0.45 mm per year. Ice loss causes desalinisation of sea waters and sea level rise.

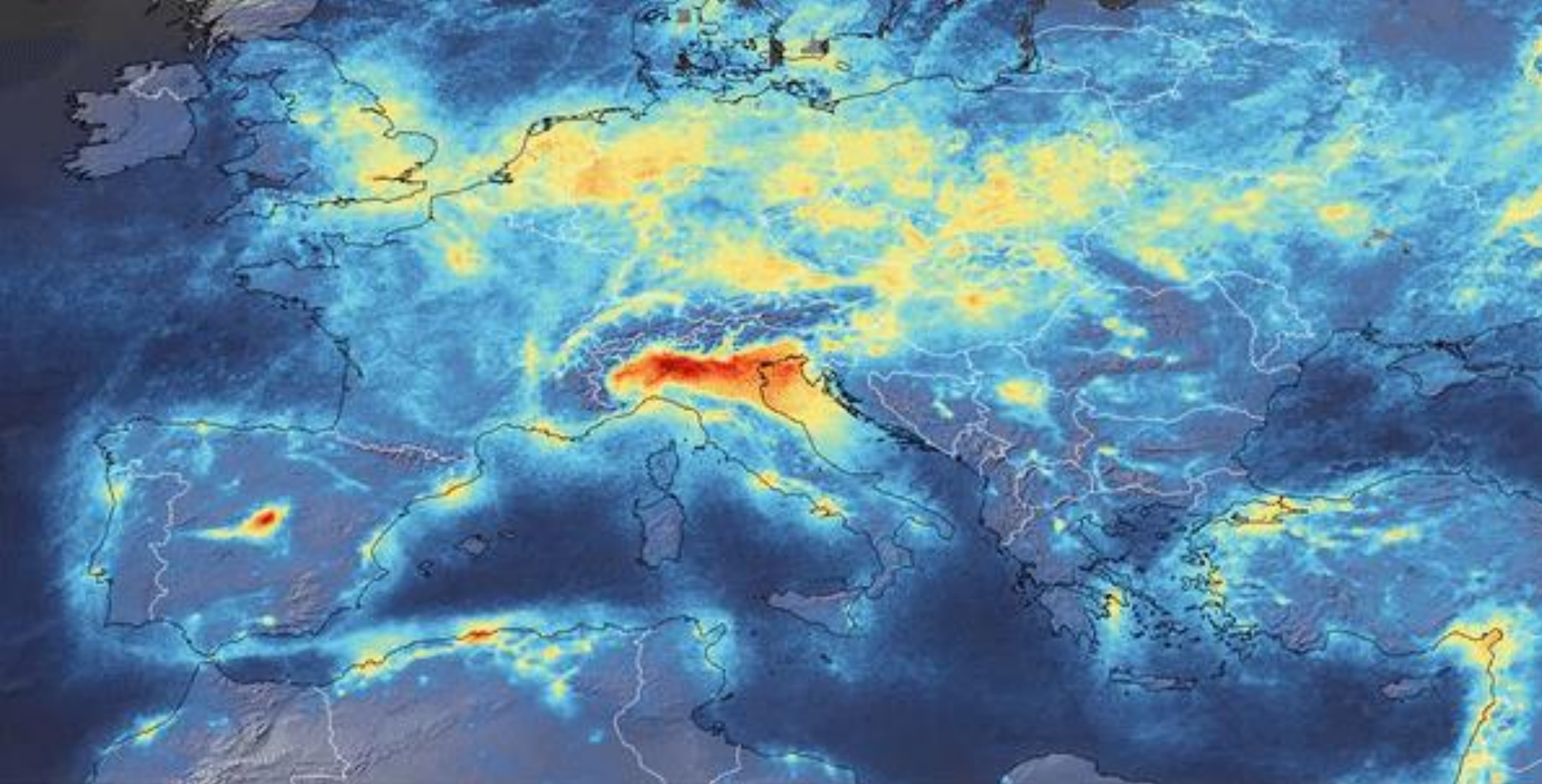


sample of abnormal methane concentrations over 2019 – © ESA

Greenhouse Gases (GHG)

Satellites have made a huge difference to detect emissions of methane and other GHG on Earth, making it more precise and affordable, and allowing to map methane concentrations on a global scale.

Satellite monitoring is essential to detect GHG leaks, especially related (but not limited to) human activities like oil and gas extraction, coal mining and other heavy industries.



GHG - Nitrous oxides

Nitrogenous gases play an important role in climate change.

Nitrous oxides are a particularly potent greenhouse gas as they are over 300 times more effective at trapping heat in the atmosphere than carbon dioxide.

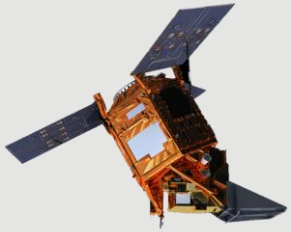
Sentinel-5P Nitrogen Dioxide tropospheric column
0 $\mu\text{mol}/\text{m}^2$ 300

January February March



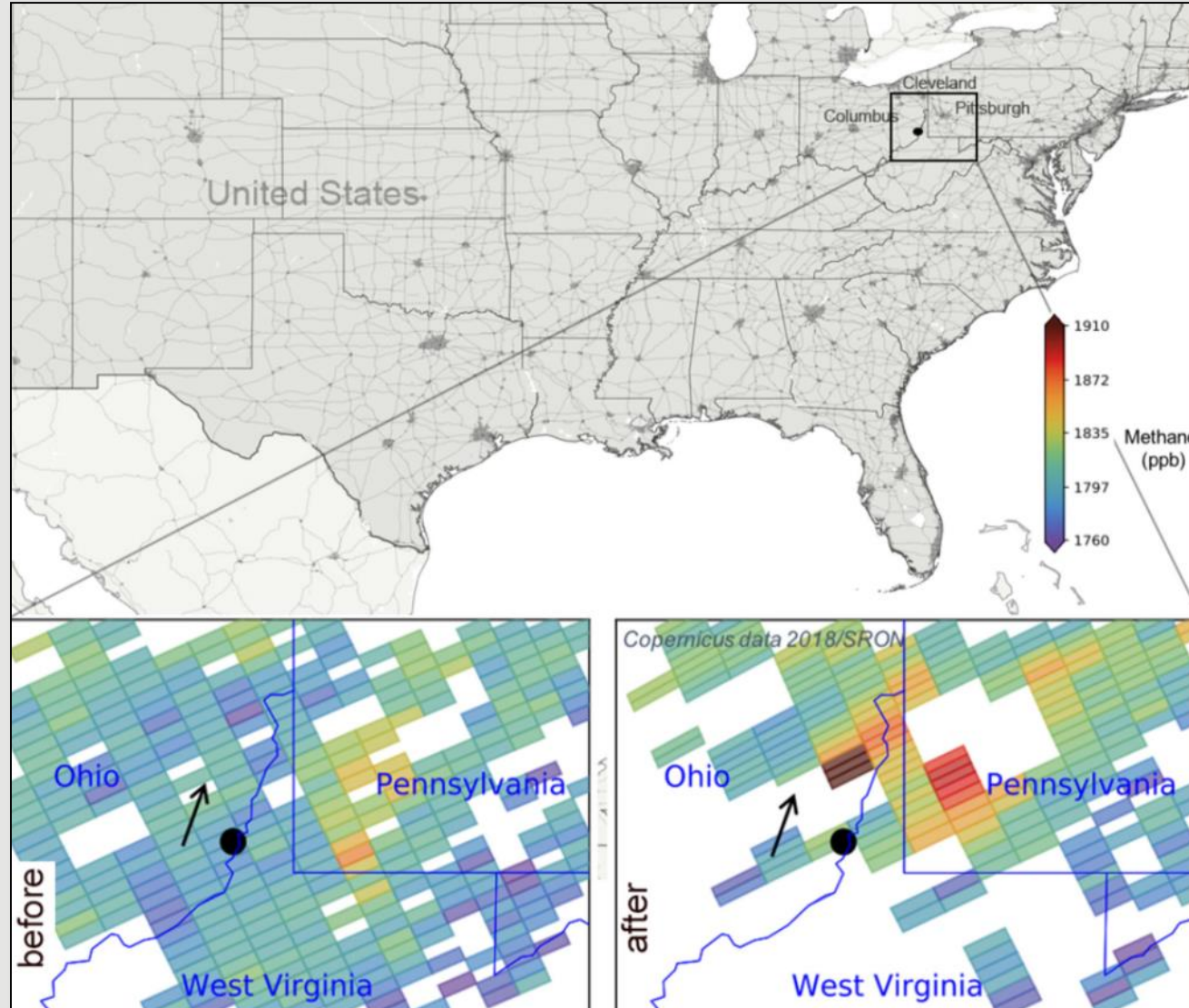
Airbus-built Copernicus Sentinel-5P detected a drastic drop of Nitrogen dioxide (NO_2) in Europe during the lock-down period following the first outbreak of the Corona virus.

This is an a clear sign of how human activities impact our environment.



Data from the **Copernicus Sentinel-5P** satellite revealed that an explosion in a natural gas well in Ohio in February 2018 released >50 000 tons of methane into the atmosphere.

The blowout leaked more of this potent GHG in 20 days than the majority of many European nations do in a year from their oil and gas industries !

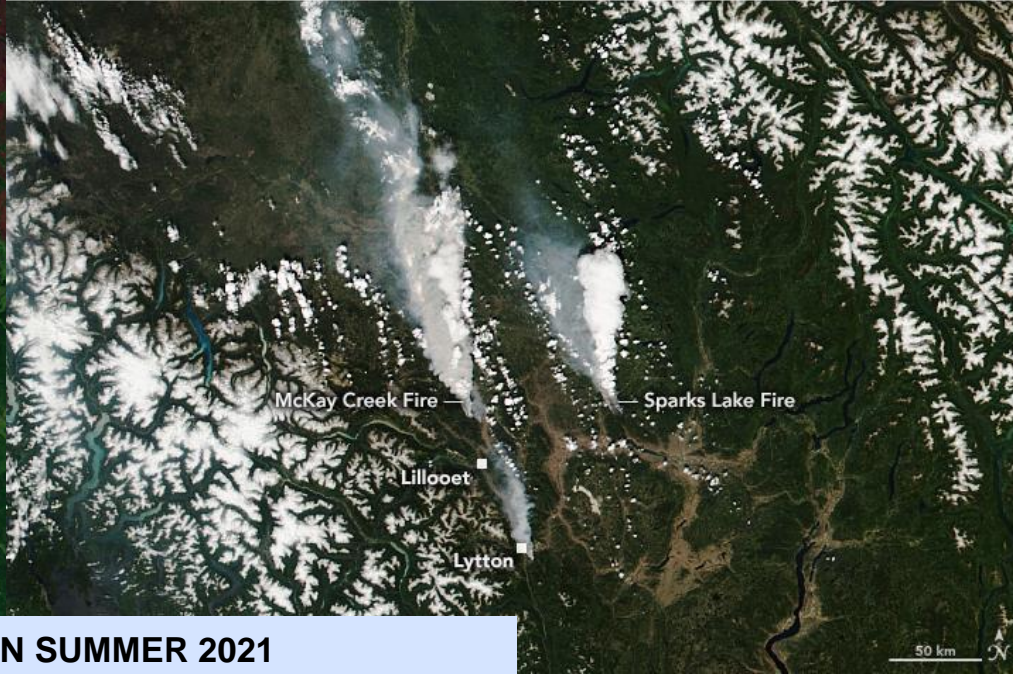


GHG - Methane

Methane (CH₄) is the second most present GHG:

- it is more powerful than CO₂ at trapping heat.
- ~60% of its emissions in the world are produced by human activities.
- its concentration in the atmosphere is currently increasing at a rate of around 1% per year.

The impact of methane in Global Warming is 80 times greater than CO₂, this element being responsible for at least 25% of today's global warming.



WILDFIRES IN SUMMER 2021
From top-left, clockwise: Siberia, Canada, Turkey, Greece



Fires and droughts

Forest fires are an essential part of our ecosystem.

If too frequent and large-scaled, they have negative impacts on air and water quality, biodiversity, soil.

In addition, they release large amounts of greenhouse gases, and they can cause economic damages and loss of human lives in populated areas.

Fire needs 3 components to start

Although these aspects are not only due to climate change, they have been affected by it in measurable ways



**HOT & DRY
WEATHER**

Warming temperatures create favourable conditions for large uncontrolled wildfires (e.g. droughts)



**BURNABLE
FUEL**

Hot air soaks water from trees, soil etc, making them dry and extremely ignitable



SPARKLE

Although the majority of ignitions are caused by men, lightning is linked to warm weather and is expected to rise by 12% for every degree of rise in global average air temperature.



Source: EFFIS European Fire Database

Fires and droughts

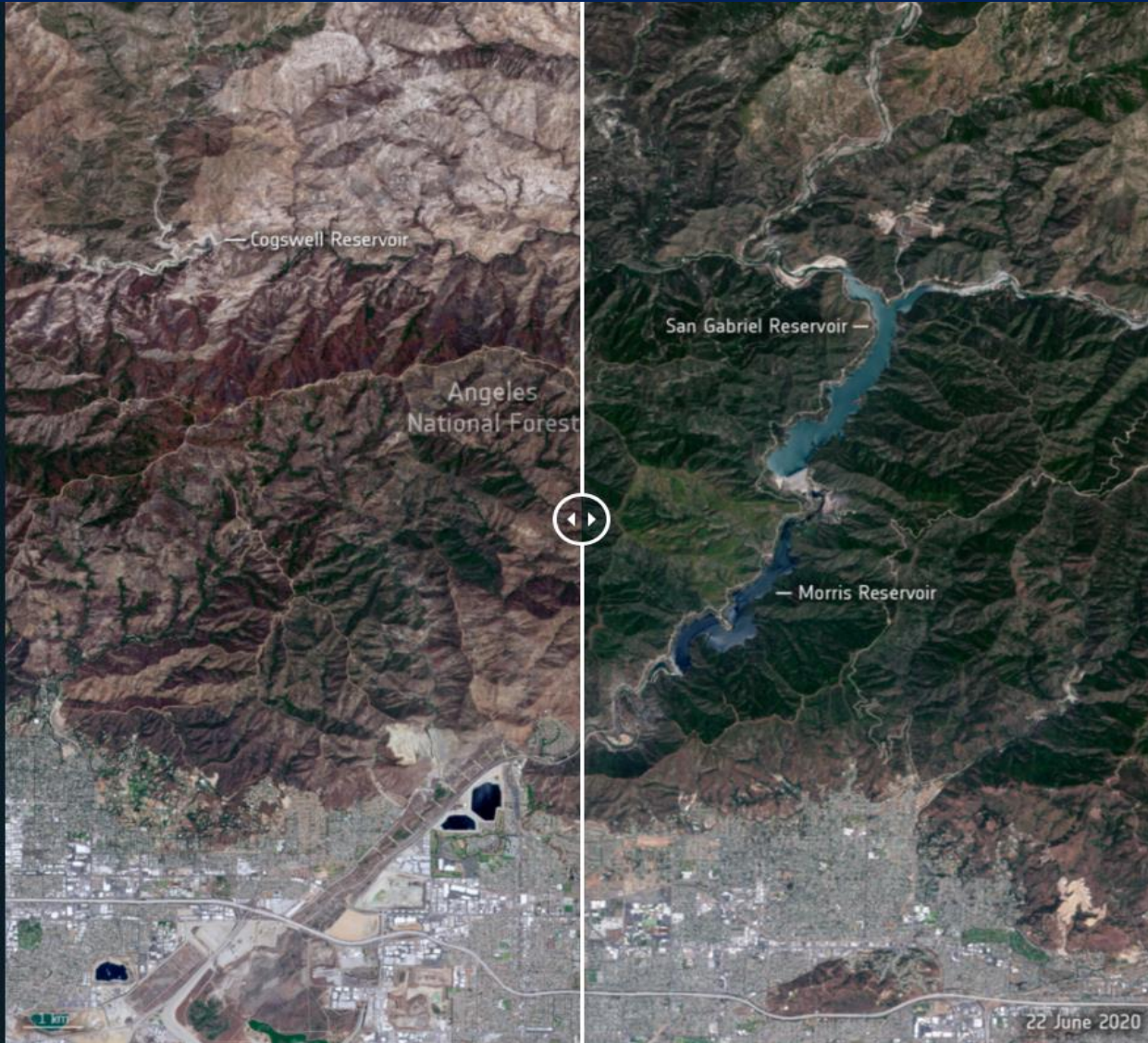
Forest fires are essential for many ecosystems but, if too frequent and large-scaled, they have negative impacts on air and water quality, biodiversity, soil.

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Looking from above

Satellites enable two key aspects of wildfire management

Images © ESA



ANCIPATION

Identifying areas suffering from extreme droughts can help authorities prevent fires before they start.



DISASTER MANAGEMENT

A follow-up of the evolution of the fire from a higher point of view can help authorities decide if evacuations are needed and where.

They reflect most of the sunlight back to Space, reducing the oceans' temperature. The rise of ocean's temperatures is associated to more extreme rainfall during hurricanes

They store more than 99% of Earth's freshwater

Poles house a variety of fauna and flora adapted to these specific conditions



Melted ice-sheets can reduce oceans' salinity, reducing their freezing temperature

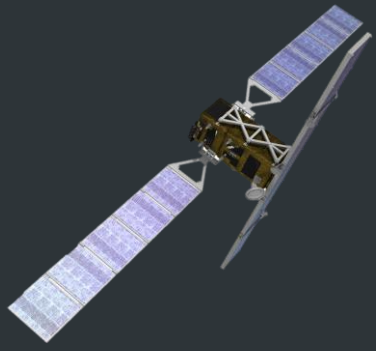
Melted ice-sheets contribute to rise of oceans' level, putting coastal communities at risk of floods

They trap large quantities of GHG that would be otherwise released in the atmosphere (also valid for permafrost)

Ice loss

Ice-sheets (poles and glaciers) play several crucial roles in our ecosystem.

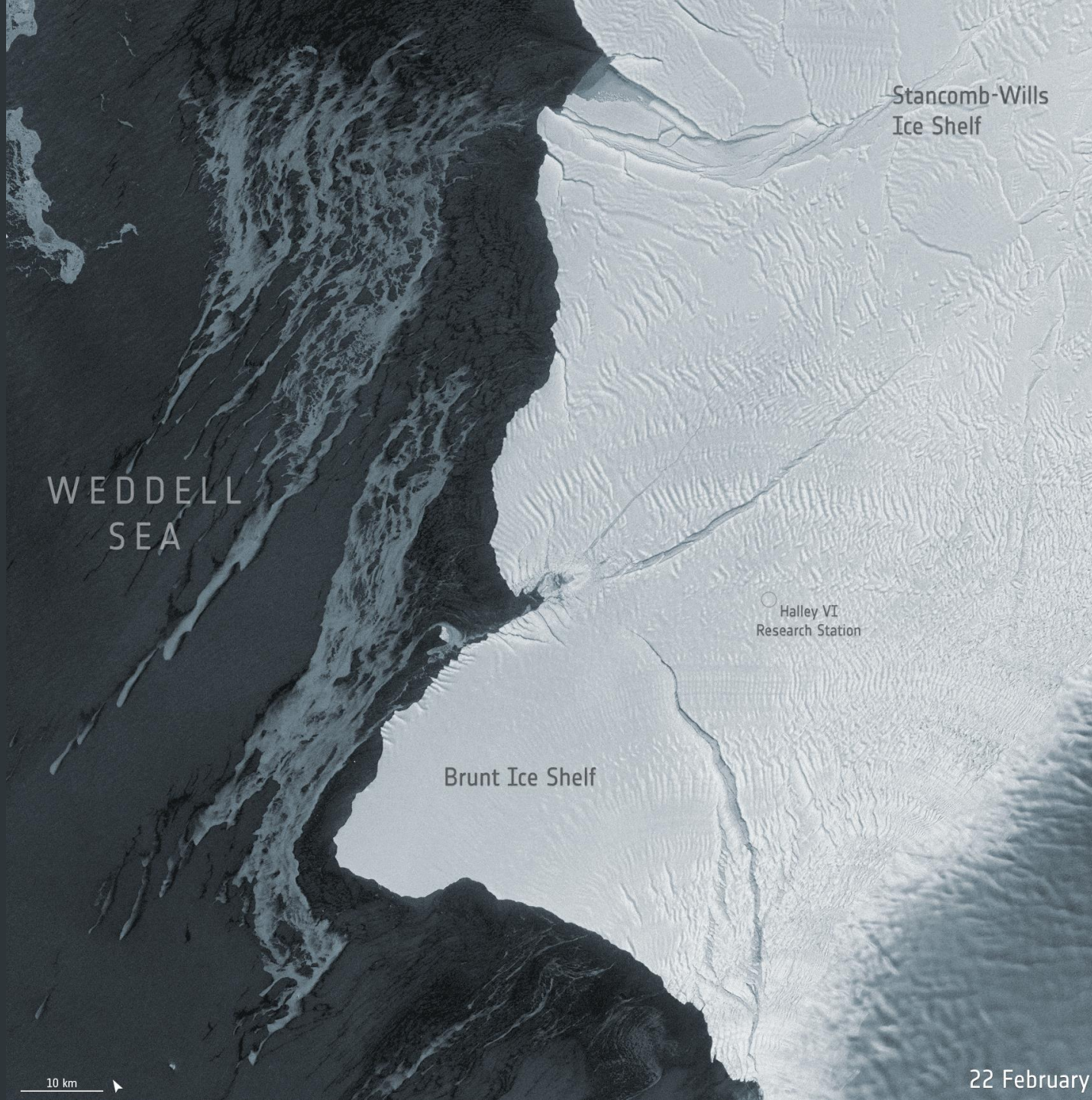
Even modest changes can influence global sea level, increase coastal flooding, and disturb oceanic currents.



Ice-pack breaking

Ice melting at a fast rate leads to giant icebergs breaking up from the main pack.

These drifting giants can pose a threat to ships and/or coastal communities.



On 26th February 2021, Copernicus Sentinel-1 detected a giant iceberg, approximately 1.5 times the size of Greater Paris, breaking off from the northern section of Antarctica's Brunt Ice Shelf.

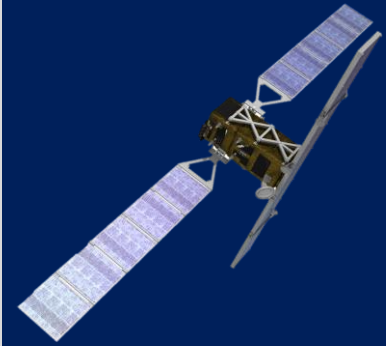
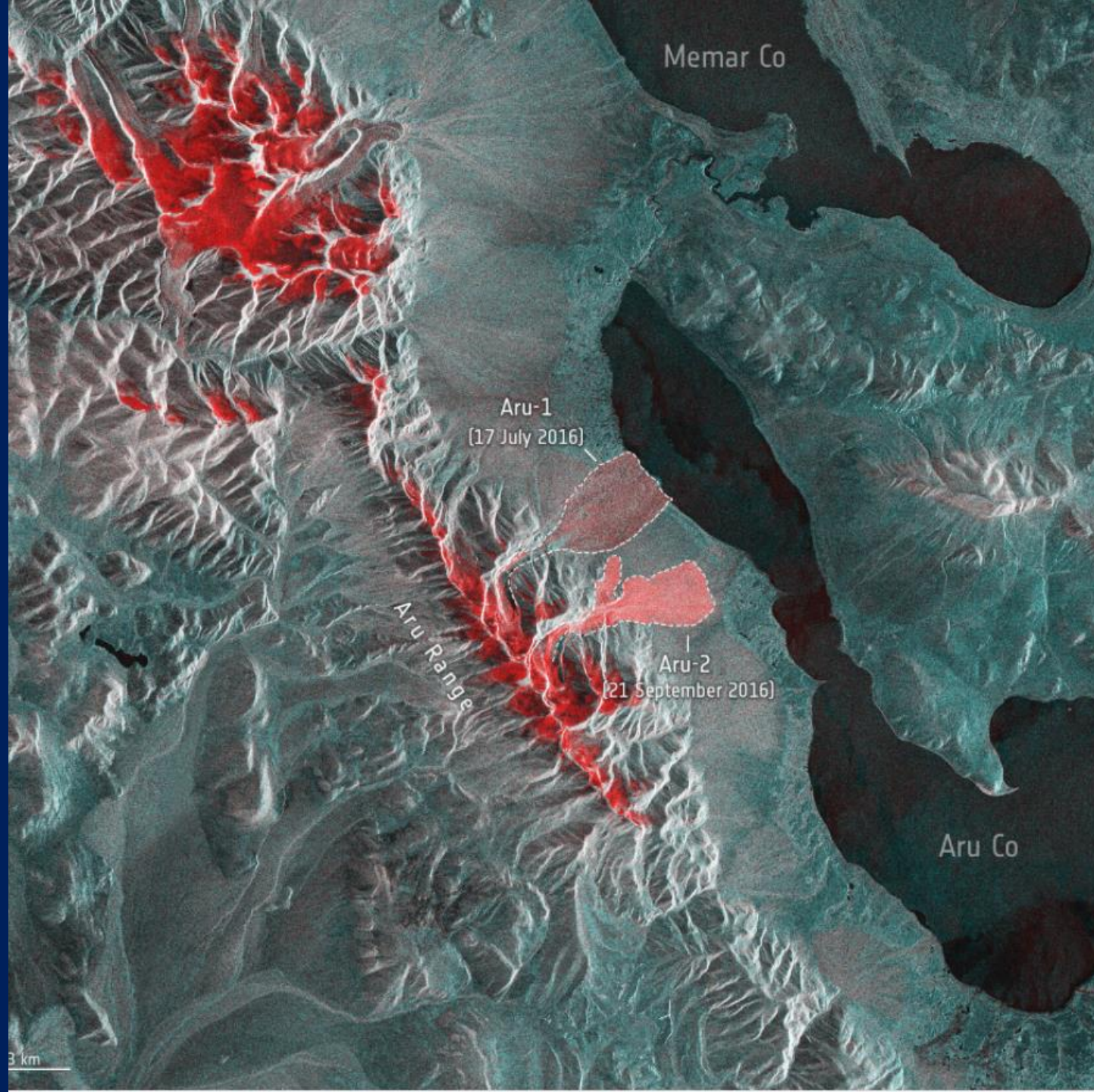
The Airbus-built radar instrument of Copernicus Sentinel-1 will help monitoring the drifting iceberg.

22 February

Glaciers melting

In 2016, a glacier in Tibet's Aru mountain range suddenly collapsed, killing 10 people and hundreds of livestock.

A few months later, a second glacier in the same mountain range also unexpectedly collapsed.



The image, based on data from the Copernicus Sentinel-1 mission, shows the traces left after the two avalanches.



More data

The more data we have the **better** our **climate monitoring and evolution models** will get...



More capacity

We need to **extend our capabilities** on Earth monitoring from Space to collect more valuable data



Better services



... and **new and better services** will be available for institutions, companies and individuals!

What's next