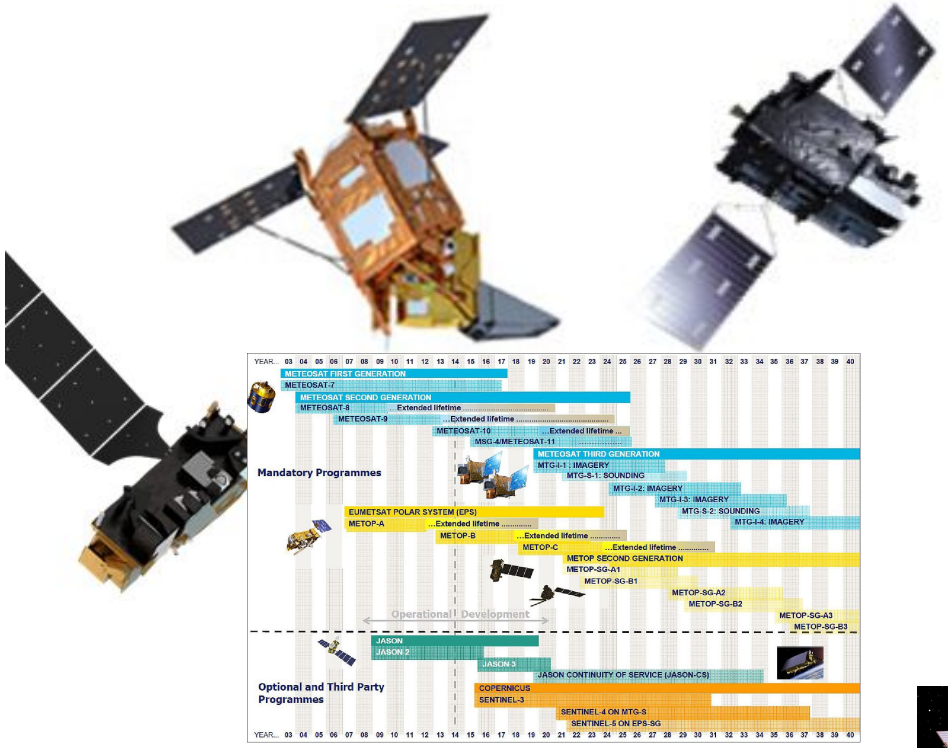
EUMETSAT data for ocean-atmosphere applications

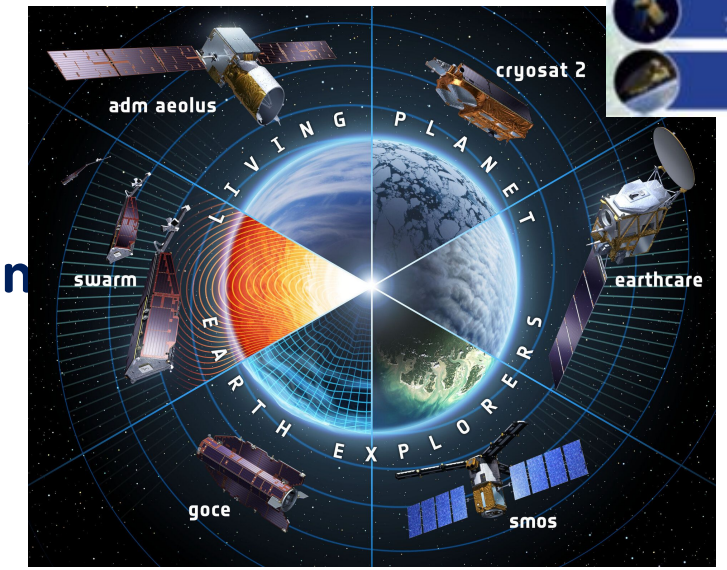
Federico Fierli, EUMETSAT

Remote Sensing for Ocean-Atmosphere Interactions Studies and Applications Workshop
1st December 2021

Unique ensemble of existing and upcoming data

copernicus.eumetsat.int





Current and future missions on Atmospheric composition

- Operational satellites
- Sentinels
- Earth Explorers

What is Copernicus ?

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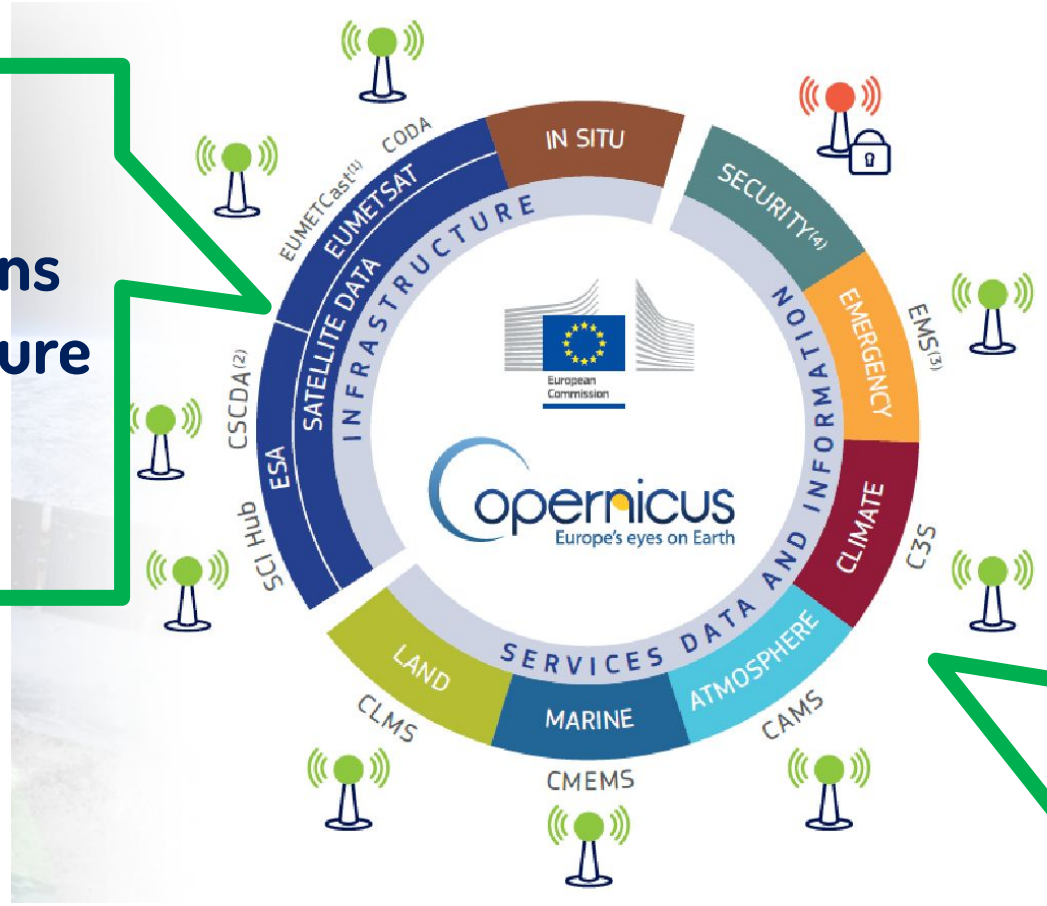
Observations Infrastructure



Services

Data for Copernicus Services

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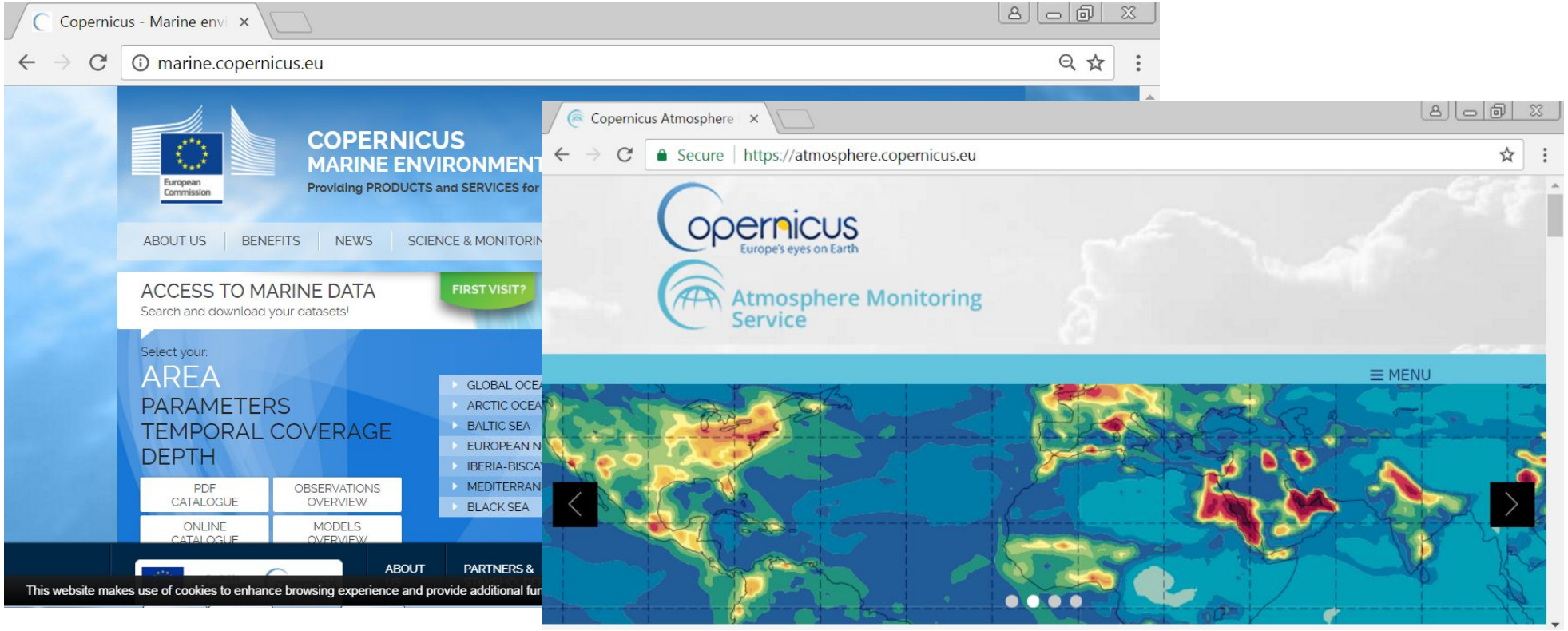

Build an innovative data value chain

A wide range of unique data and products

To be applied in different domains

To fit with different application and needs

EUMETSAT programmes overview

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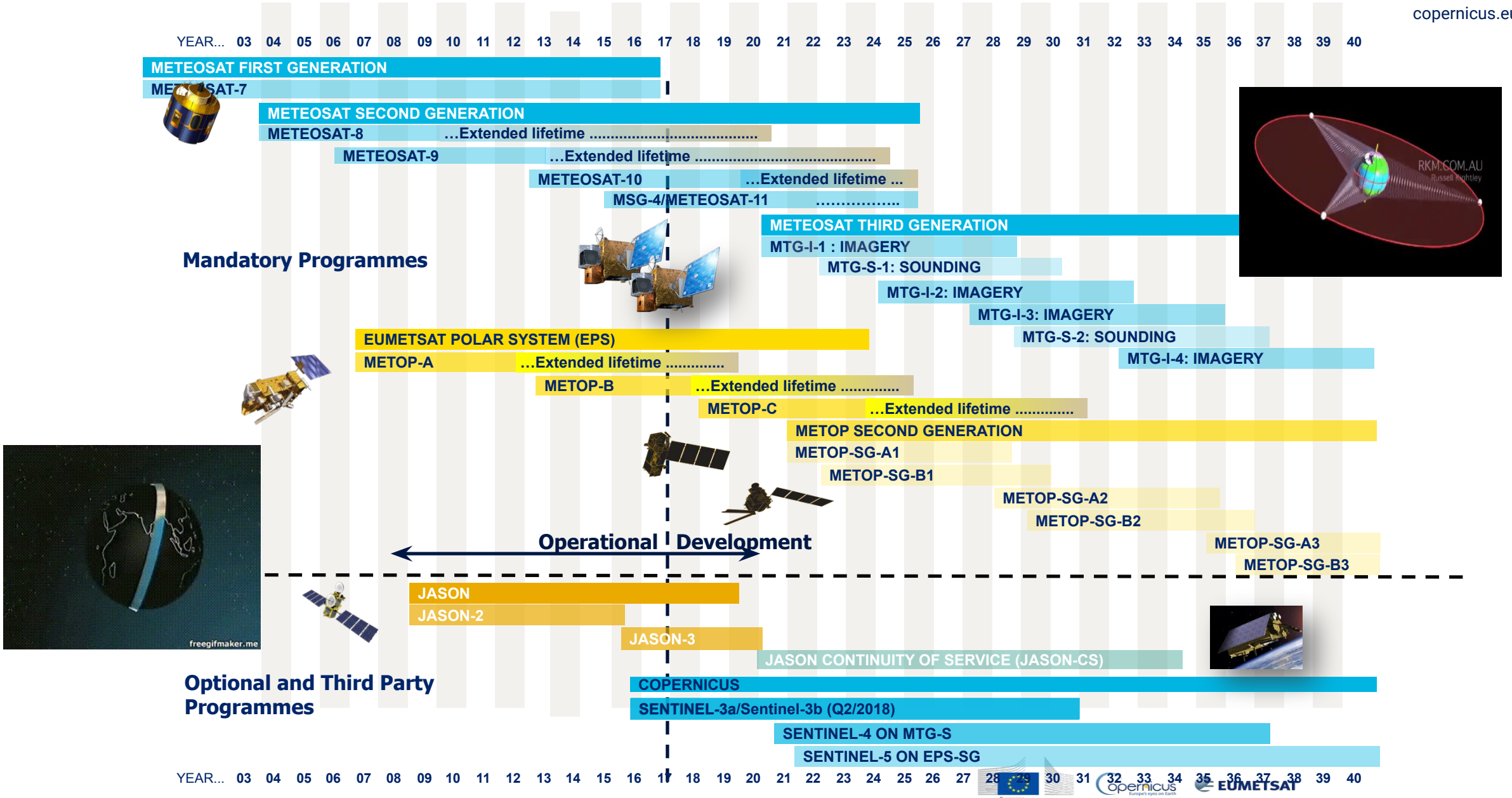
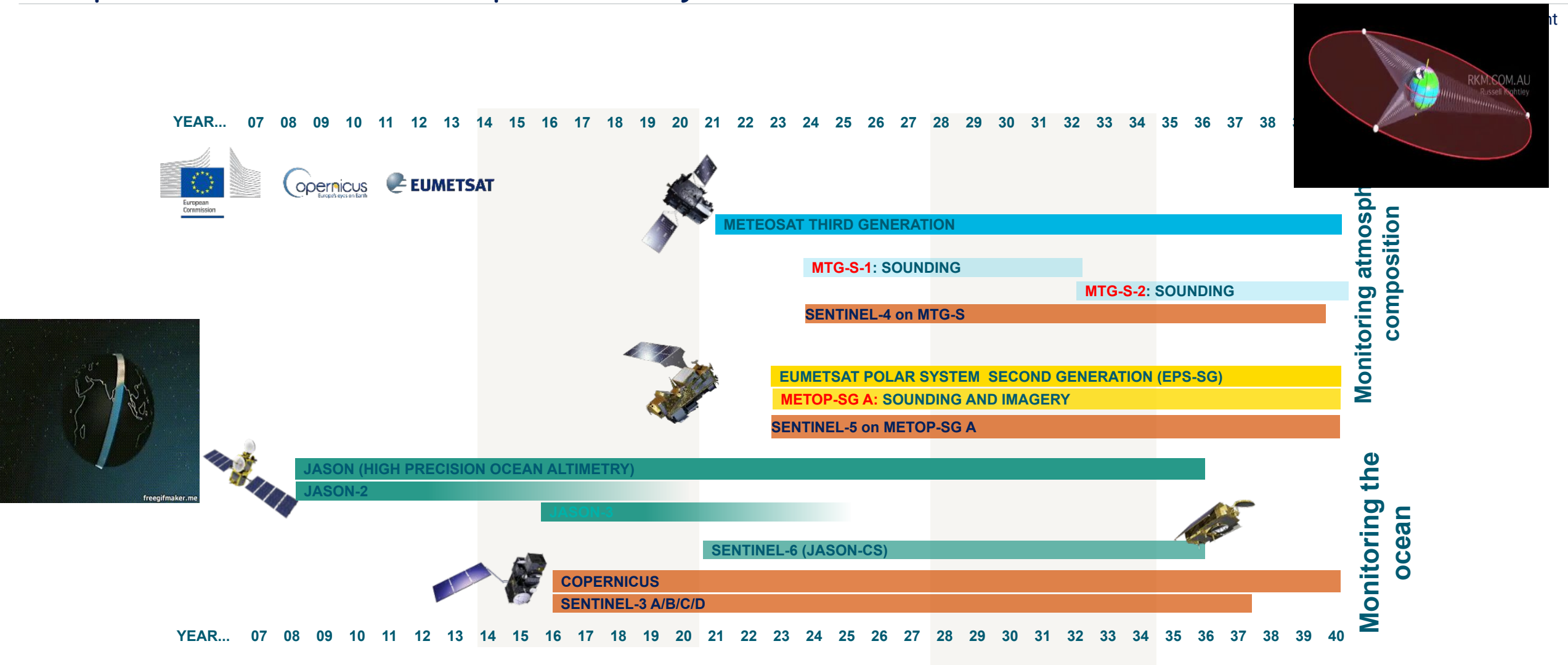


Copernicus Sentinels operated by EUMETSAT



Meteosat Third Generation (MTG): Mission overview

- **Imagery missions (MTG-I):**
  1. Full disk imagery every 10 minutes in 16 spectral bands with the Flexible Combined Imager (FCI). Fast imaging of European weather every 2.5 minutes
  2. Day/night Lightning Imager (LI)

- **Sounding mission (MTG-S):**
  1. 3D mapping of water vapour, temperature with Hyperspectral Infrared Sounder (IRS)
  2. Air quality monitoring and atmospheric chemistry in synergy with Sentinel-4 / Ultraviolet Visible & Near-infrared

- **Start of operations in 2022 and 2024**
- **Operational exploitation: 2022–2042**

METOP (EPS-SG) – (incl. Sentinel 5)

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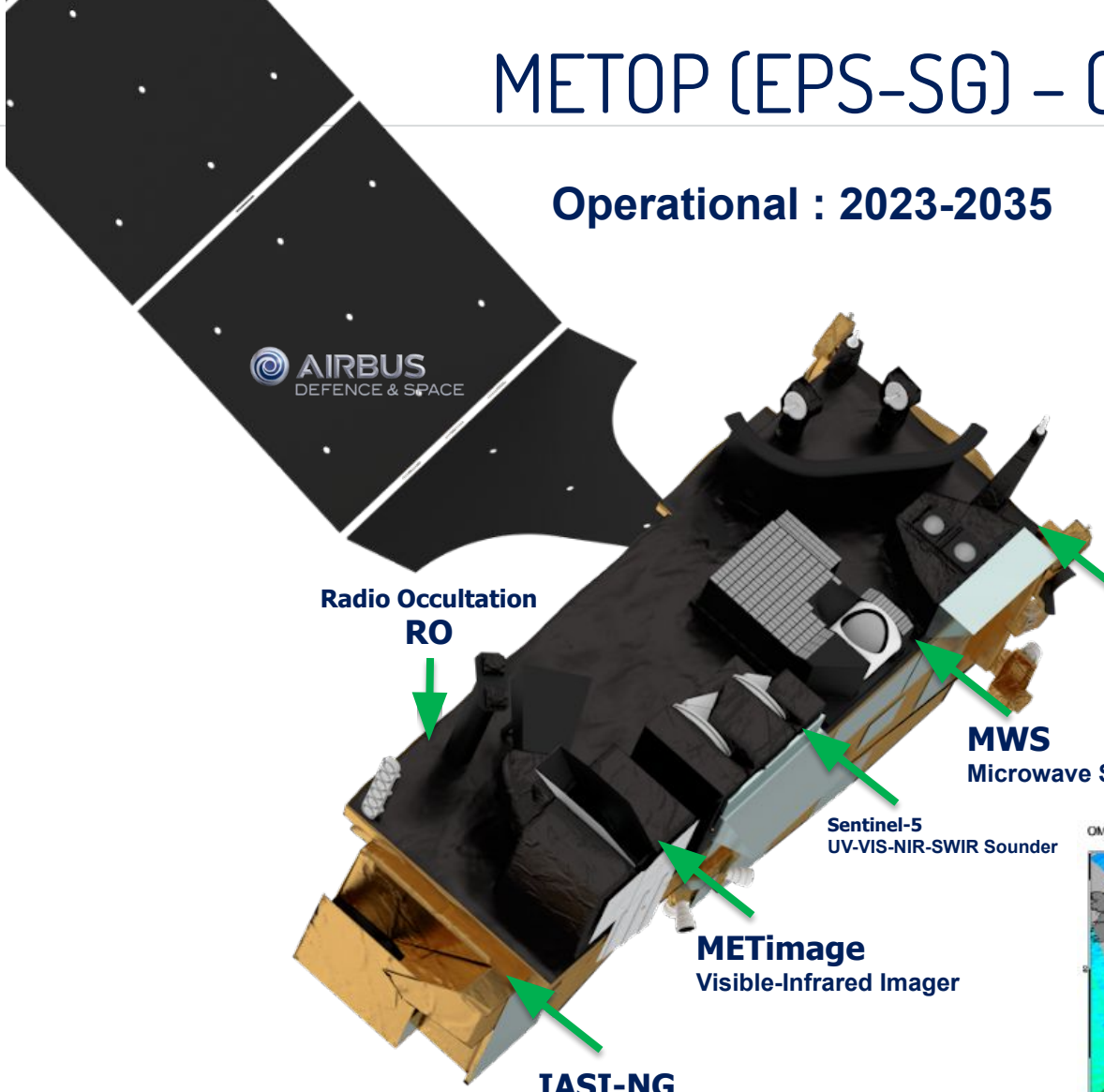
Operational : 2023-2035



Radio Occultation
RO

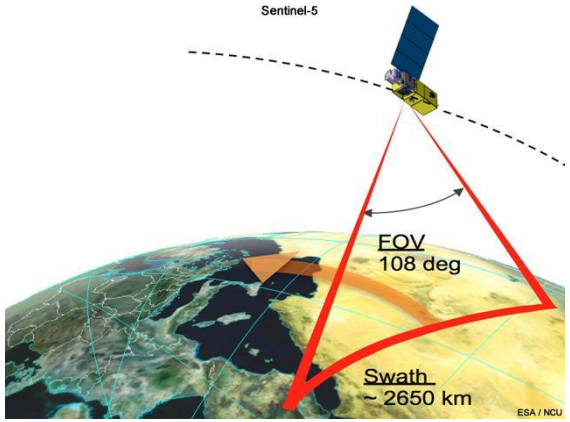
3MI
Multi-viewing,
-channel,
-polarisation
Imager

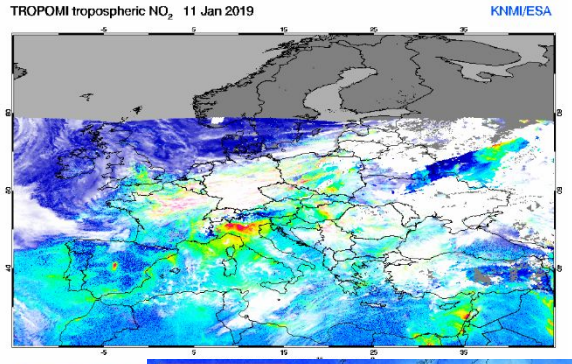
MWS
Microwave Sounder

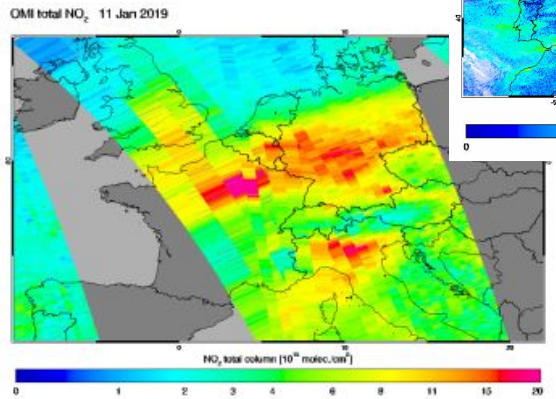
Sentinel-5
UV-VIS-NIR-SWIR Sounder

METimage
Visible-Infrared Imager

IASI-NG
Infrared Atmospheric Sounding Interferometer – New Generation







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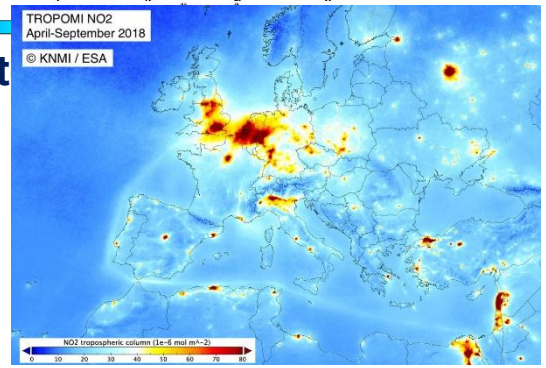

Sentinel-3: Synchronous ocean and atmosphere data

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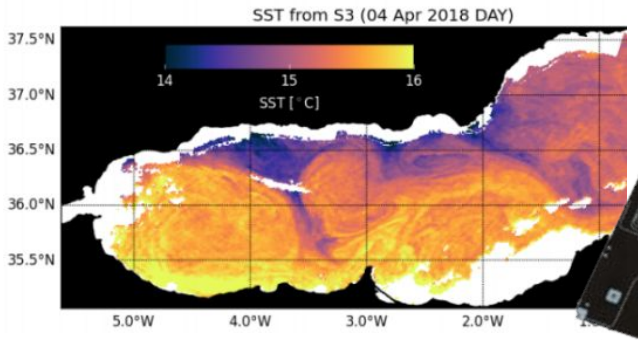
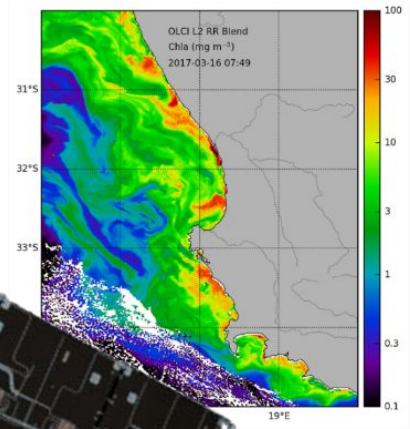
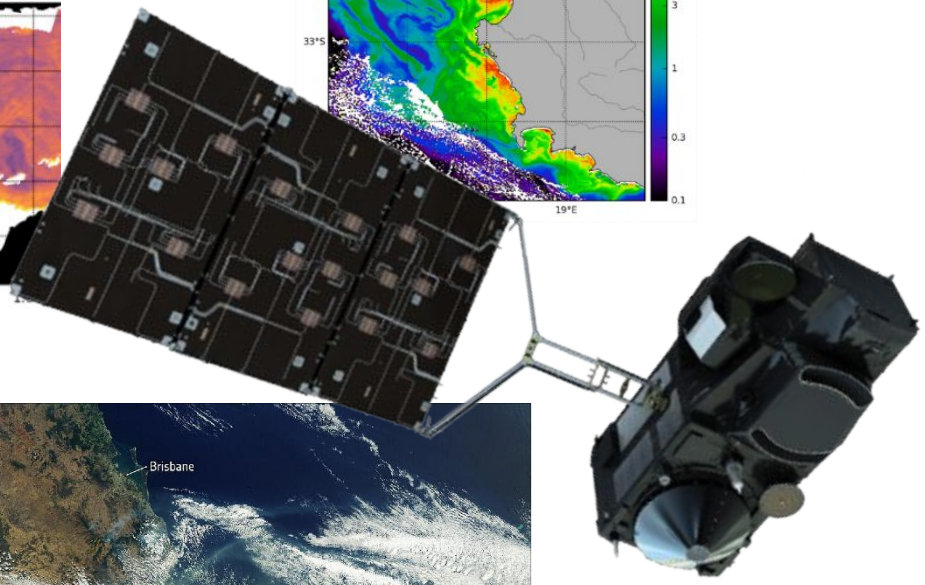
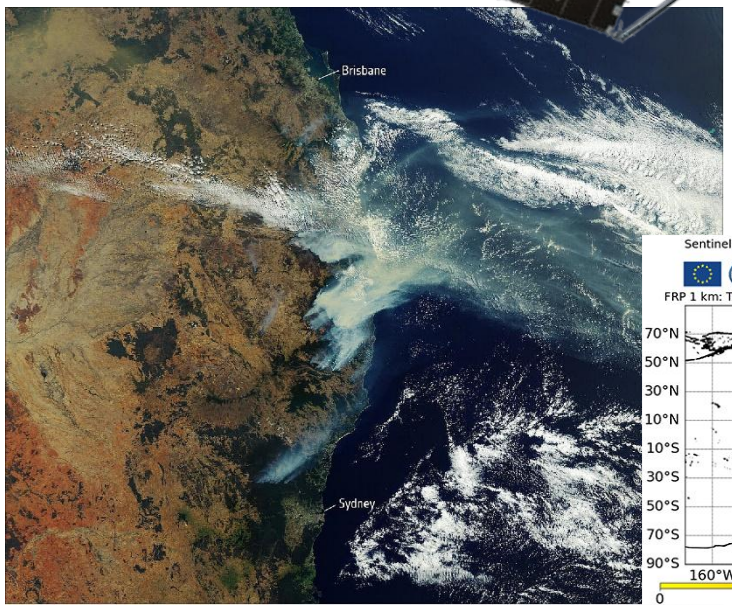
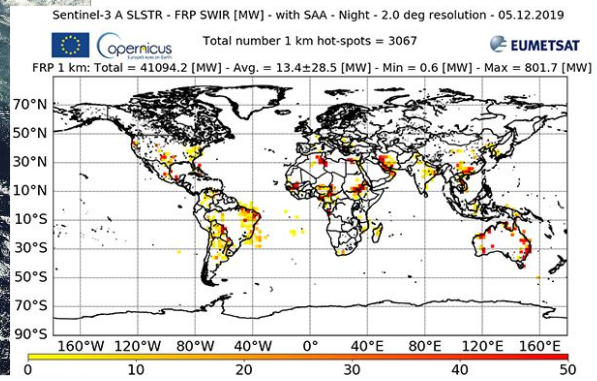
- ~ Daily data from 3 instrument packages:
  - OLCI
  - SLSTR
  - Altimetry (SRAL)
- Wide variety of relevant products:
  - Ocean colour, chlorophyll, TSM
  - Aerosols, Fire Radiative Power
- Many o-a relevant applications:
  - Carbon cycling, sediment dynamics, waves/wind, air quality fires, dust, volcanic eruptions.





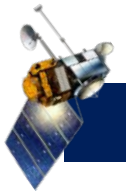






Cooperative ALTIMETRY missions: SENTINEL-6

JASON-1
2001-2013



TOPEX-POSEIDON
1992-2006

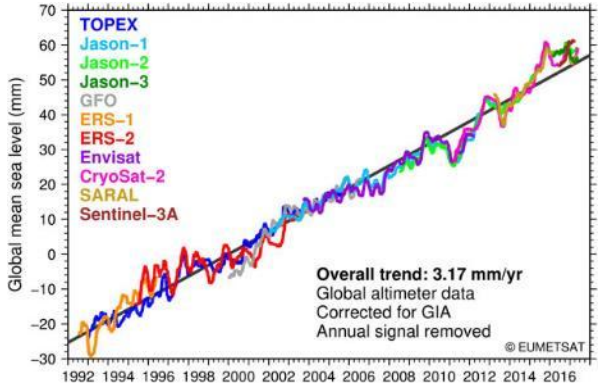
OSTM/JASON-2
2008-2019

JASON-3
2016

SENTINEL-6/JASON-CS
2020

- Altimetry mission providing low and high resolution products:
  - Continuity with Jason series for long-term sea-level measurements
  - High resolution, low noise measurements for improved coastal zone observations.
- Sea surface height, wind and wave products.
- Microwave radiometer products (AMR-C) with experimental high-resolution microwave radiometer (HRMR) subsystem.

- Additional mission – radio occultation



Sentinel-3 for ocean-atmosphere applications

ALTIMETRY (& SAR)

Ocean currents
Weather forecasting
Storm dynamics
Maritime safety
Eddies
Thermocline

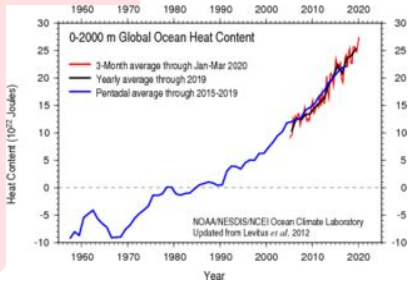
SEA SURFACE TEMPERATURE

Essential Climate Variables
Climate Model Assimilation
Marine Spatial Planning
Env. Impact Assessment
Disaster response
Insurance Risk
Ocean Fronts
ENSO

Pollutant transport
Ice detection
Oil pollution
Internal waves
Debris
Biological transport (blooms, genetics)

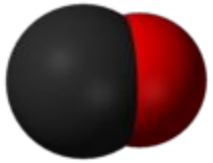
Fishing Zones
River plumes
Aquaculture productivity
Coral bleaching
Bio-toxins
Human health
HAB formation

OCEAN COLOUR

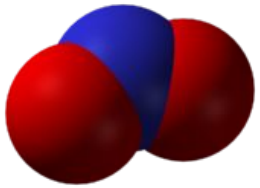


Products for Trace Gas: Present and Future

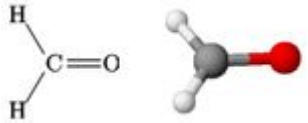
Product	PRESENT			FUTURE	
	Metop GOME-2	Sentinel 5 and 5p	Metop IASI	Metop-SG IASI-NG	MTG-S S4/UVN
O_3 total column	√	√	√	√	√
O_3 profile (incl. troposphere)	√	√	√	√	
O_3 tropospheric column	√				√
NO_2 total column	√	√			√
NO_2 tropospheric column	√	√			√
SO_2	√	√	√	√	√
SO_2 Layer Height		√	√	√	
HCHO	√	√			√
CHOCHO	√	√			√
BrO	√	√			
OClO		√			
HNO_3			√	√	
NH_3			√	√	
CO		√	√	√	
CH_4		√	√	√	
SIF	√	√			
CO_2					
H_2O	√	√			√
UV Products	√	√			√



Carbon monoxide (CO) is present in small amounts (about 80 ppb) in the Earth's atmosphere.
About half of the carbon monoxide in Earth's atmosphere is from the burning of fossil fuels and biomass (such as forest and bushfires)
Most of the rest of carbon monoxide comes from chemical reactions with organic compounds emitted by human activities and plants.



Nitrogen dioxide (NO2) is produced from oxidation of monoxide (NO) that is in turn produced by combustion – high temperatures to break nitrogen and oxygen molecules



HCHO Formaldheide also produced in fires
Synthesis product – potentially toxic

Aerosol Product map

Operational | In development | Not yet committed (under study)

* Some products at Satellite Application Facilities : Climate Monitoring (CM-SAF) and Atmospheric Composition (AC-SAF)

Product*/ Instrument	Metop	MSG	Sentinel 3			Metop-SG			MTG	
	PMAP	SEVIRI	OLCI	SLSTR	SYN	3MI	S5 - UVNS	MAP	FCI	S4 - UVN
Cloudy pixel identification										
Aerosol type										
Fine mode fraction										
Aerosol Optical Depth										
Aerosol Optical Depth (multi-band)										
Single Scattering Albedo										
Refractive index – real										
Refractive index – imaginary										
Effective radius										
Aerosol height										
Aerosol Absorbing Index										
Side Product: BPDF										
Side Product: BRDF										

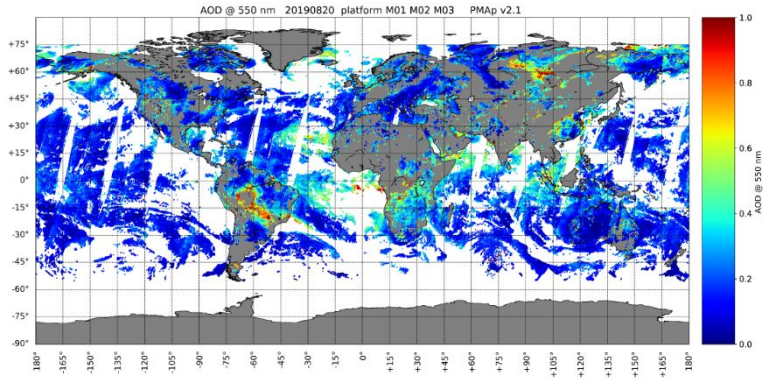
Example on merged datasets: Aerosol & the Polar Multi-sensor Aerosol Product

Version 2.4 Operational

METOP data – Polar Satellite

3 Instruments (GOME-2 - IASI - AVHRR)

AOD at 550 nm & Aerosol classes http://archive.eumetsat.int



The EUMETSAT Climate Satellite Application Facility (SAF)

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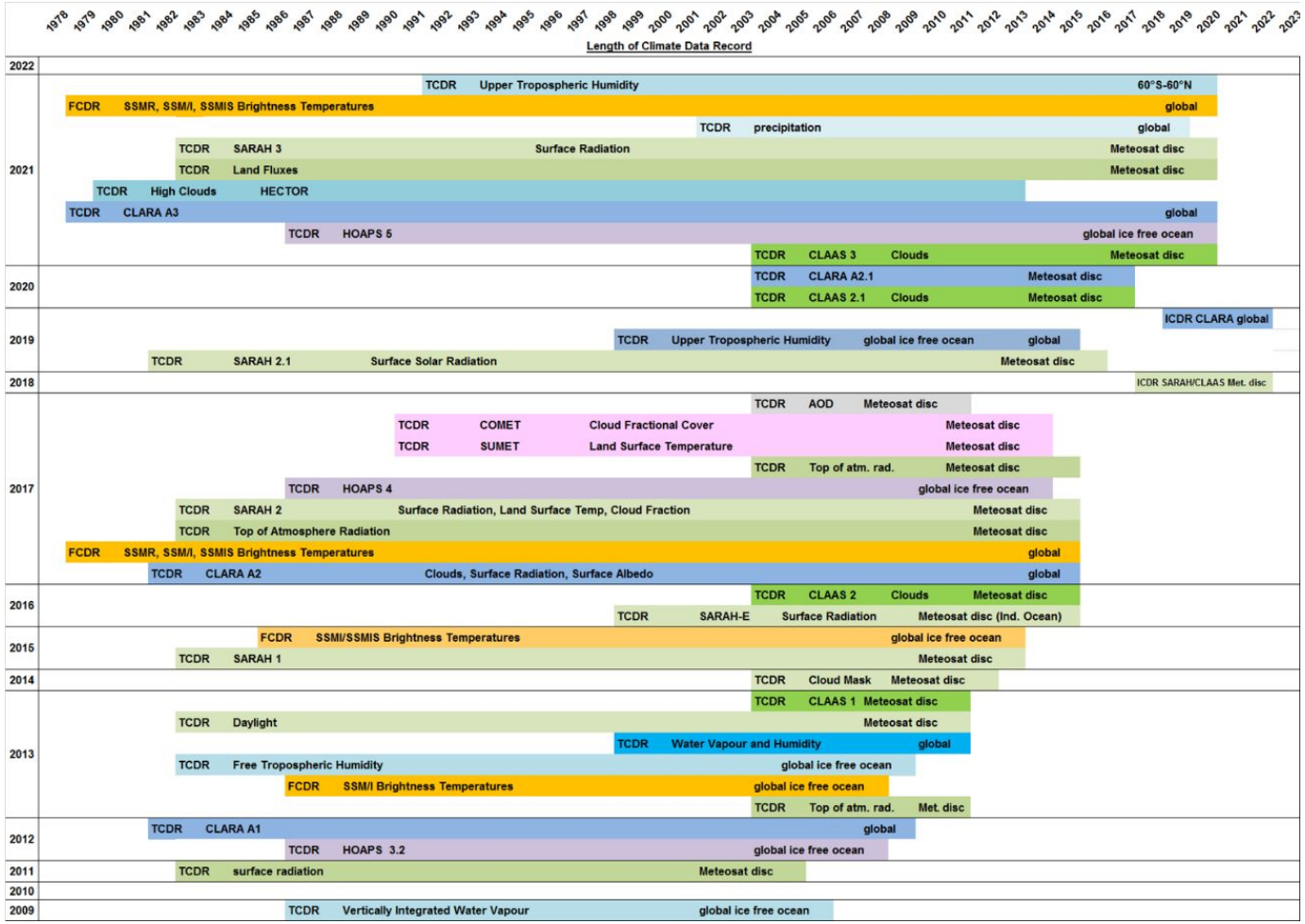
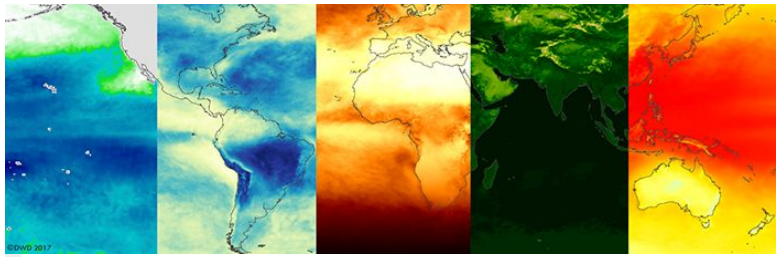


EUMETSAT
CM SAF
CLIMATE MONITORING



Deutscher Wetterdienst
Wetter und Klima aus einer Hand

Met Office

SMHI

EUMETSAT

Royal Netherlands Meteorological Institute
Ministry of Infrastructure and Water Management

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Swiss Confederation

Federal Department of Home Affairs FDHA
Federal Office of Meteorology and Climatology MeteoSwiss

RMI

European Commission

Copernicus

EUMETSAT

The EUMETSAT Ocean Satellite Application Facility (SAF)

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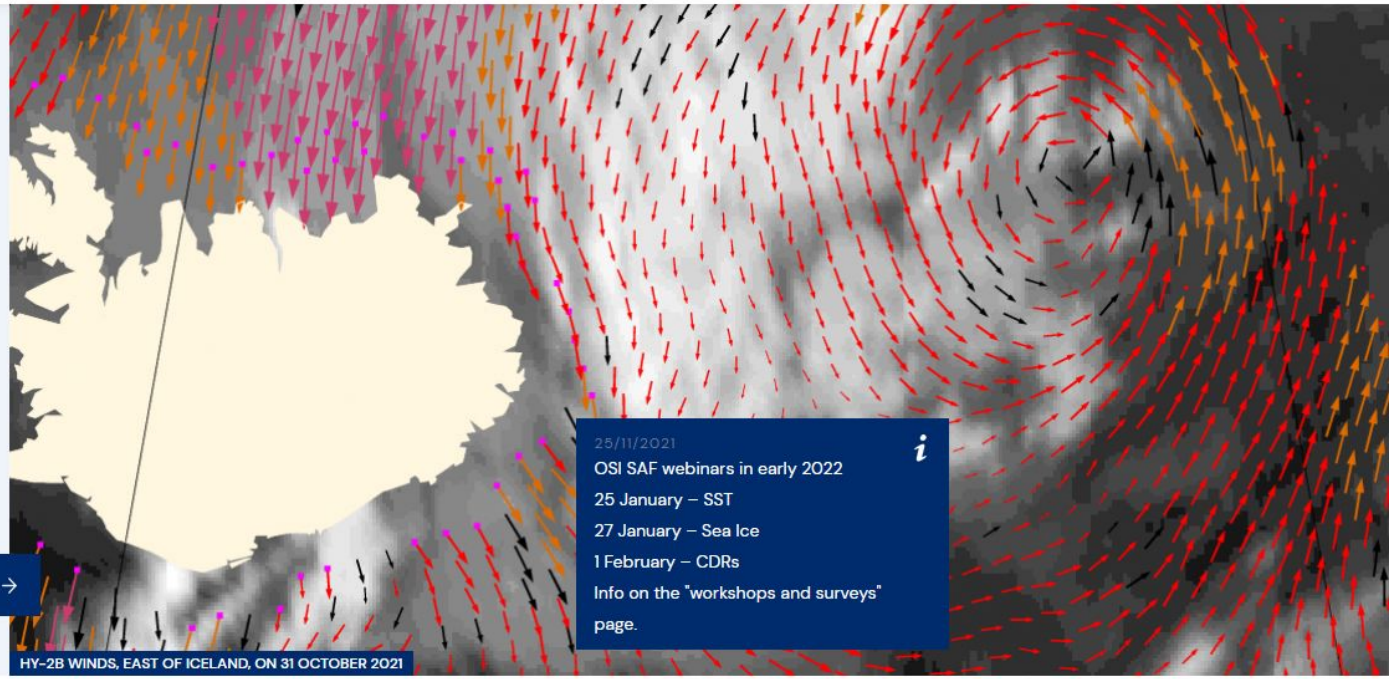
EUMETSAT OSI SAF
OCEAN AND SEA ICE

Products Documentation Community About

Observing oceans from space

The OSI SAF develops, processes and distributes, in near real-time, products related to key parameters of the ocean-atmosphere interface. The OSI SAF also offers climatological data records.
The OSI SAF team focuses on sea surface winds, sea and sea ice surface temperature, radiative fluxes : downward longwave irradiance and surface
oncentration, edge, type,



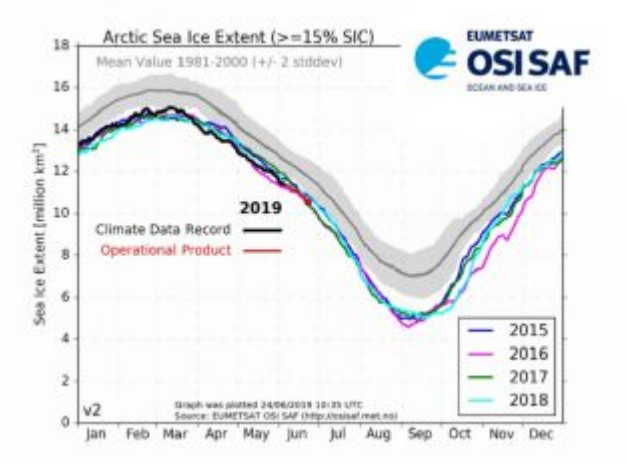
Météo-France
(Météo-France), as leading institute
WEBSITE

Danish Meteorological Institute
(DMI)
WEBSITE

Institut français de recherche pour l'exploitation de la m
(Ifremer) : French Research Institut
Exploitation of the Sea
WEBSITE

Koninklijk Nederlands Meteorologisch Instituut
(KNMI) : Royal Netherlands Meteorological Institute
WEBSITE

Norwegian Meteorological Institute
(MET Norway)
WEBSITE



The Atmospheric Composition Satellite Application Facility (SAF)

EUMETSAT AC SAF
ATMOSPHERIC COMPOSITION MONITORING
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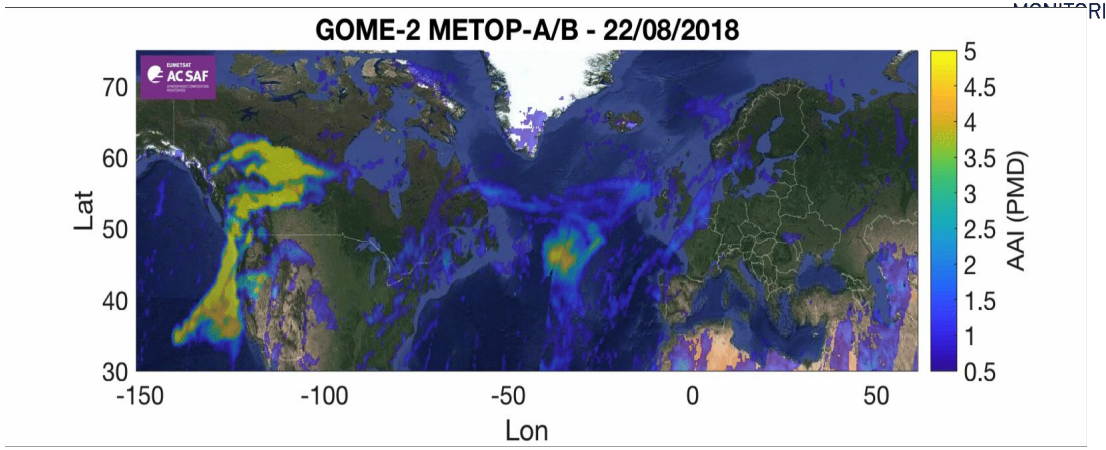
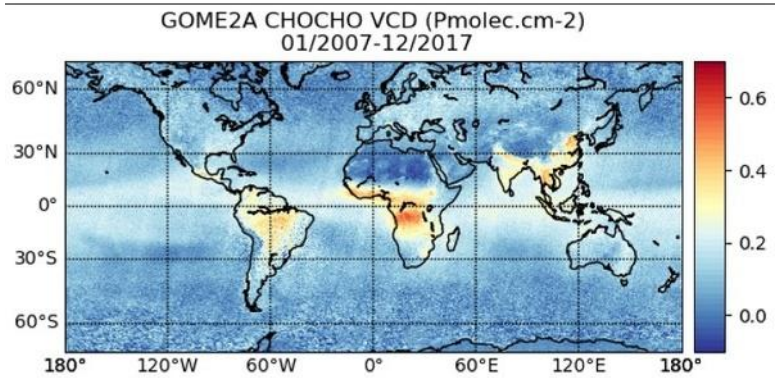
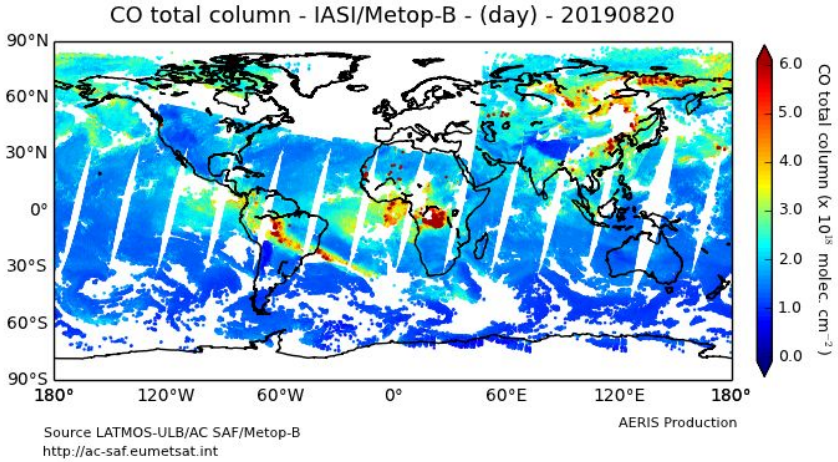
Ozone, trace gases, aerosols, UV

Global Ozone Monitoring Experiment (GOME-2) and IASI on EPS (Metop)



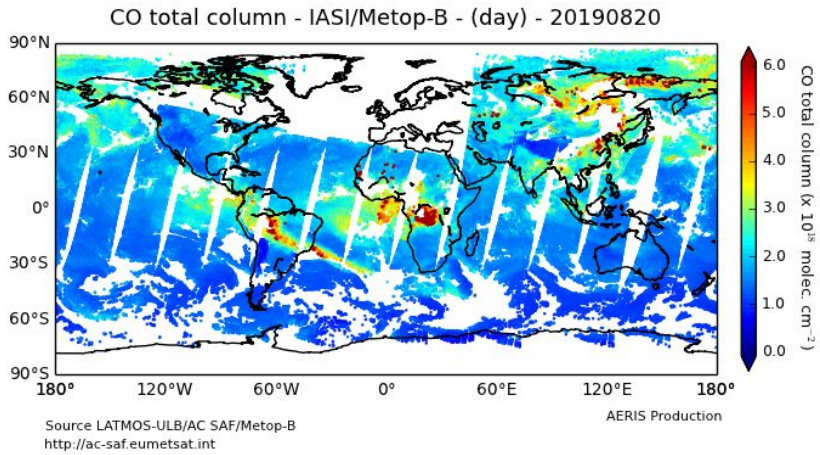


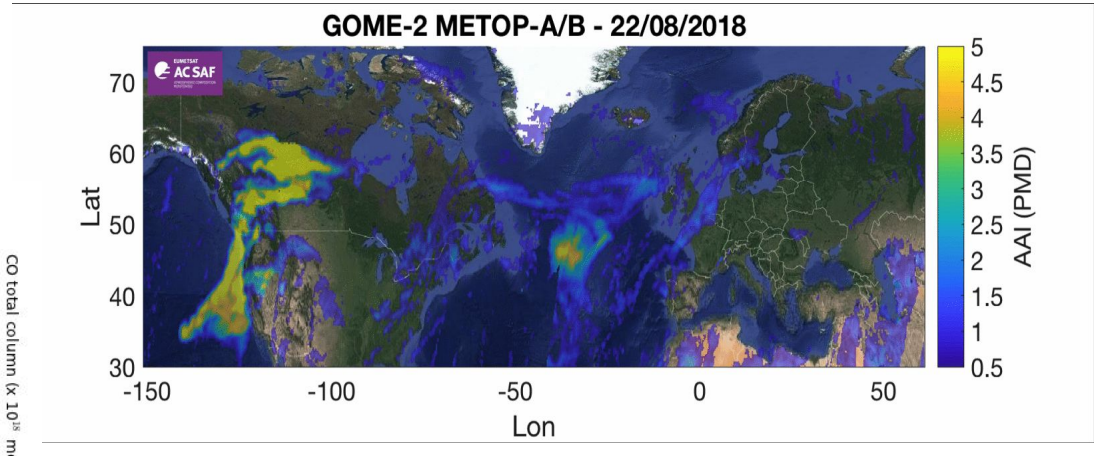


The Atmospheric Composition Satellite Application Facility (SAF)

Ozone, trace gases, aerosols UV

Global Ozone Monitoring Experiment (GOME-2) and IASI on EPS (Metop)





https://acsaf.org/

ILMATIETEEN LAITOS

EUMETSAT AC SAF ATMOSPHERIC COMPOSITION MONITORING

KMI

DMI Vejr, klima og hav

DLR

BIRA-IASB

ULB UNIVERSITÉ LIBRE DE BRUXELLES

Deutscher Wetterdienst Wetter und Klima aus einer Hand

European Commission

Copernicus

EUMETSAT