The Essential Climate Variables programme in the Copernicus Climate Change Service

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European Centre for Medium-Range Weather Forecasts (ECMWF)

Climate Change

ESA Living Planet Symposium – Bonn, Germany – 23-27 May 2022

Copernicus Europe's eyes on Earth | European Commission | ECMWF

Monitoring the climate system

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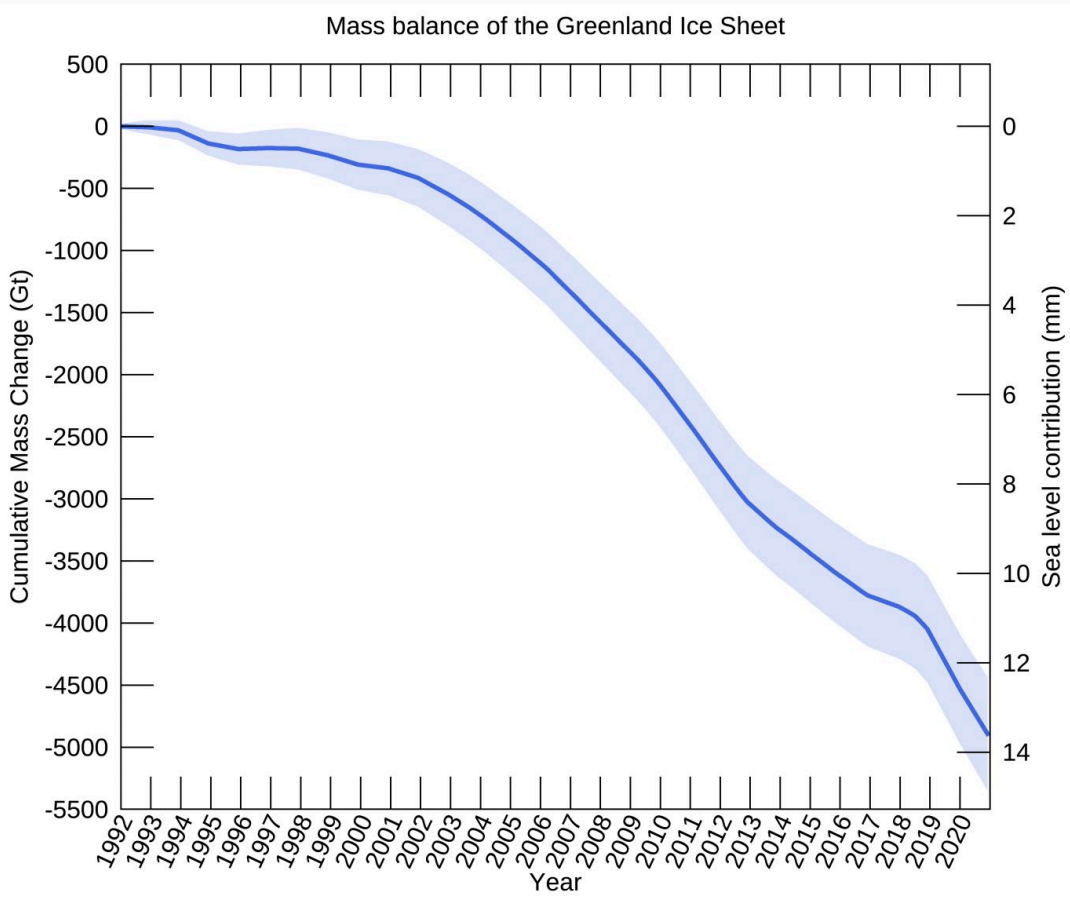

Data Source: IMBIE

Credit: IMBIE/ESA/NASA

World Economic Forum 2022, Global Risks Report: “the most severe risk on a global scale over the next 10 years is **Climate Action failure**”

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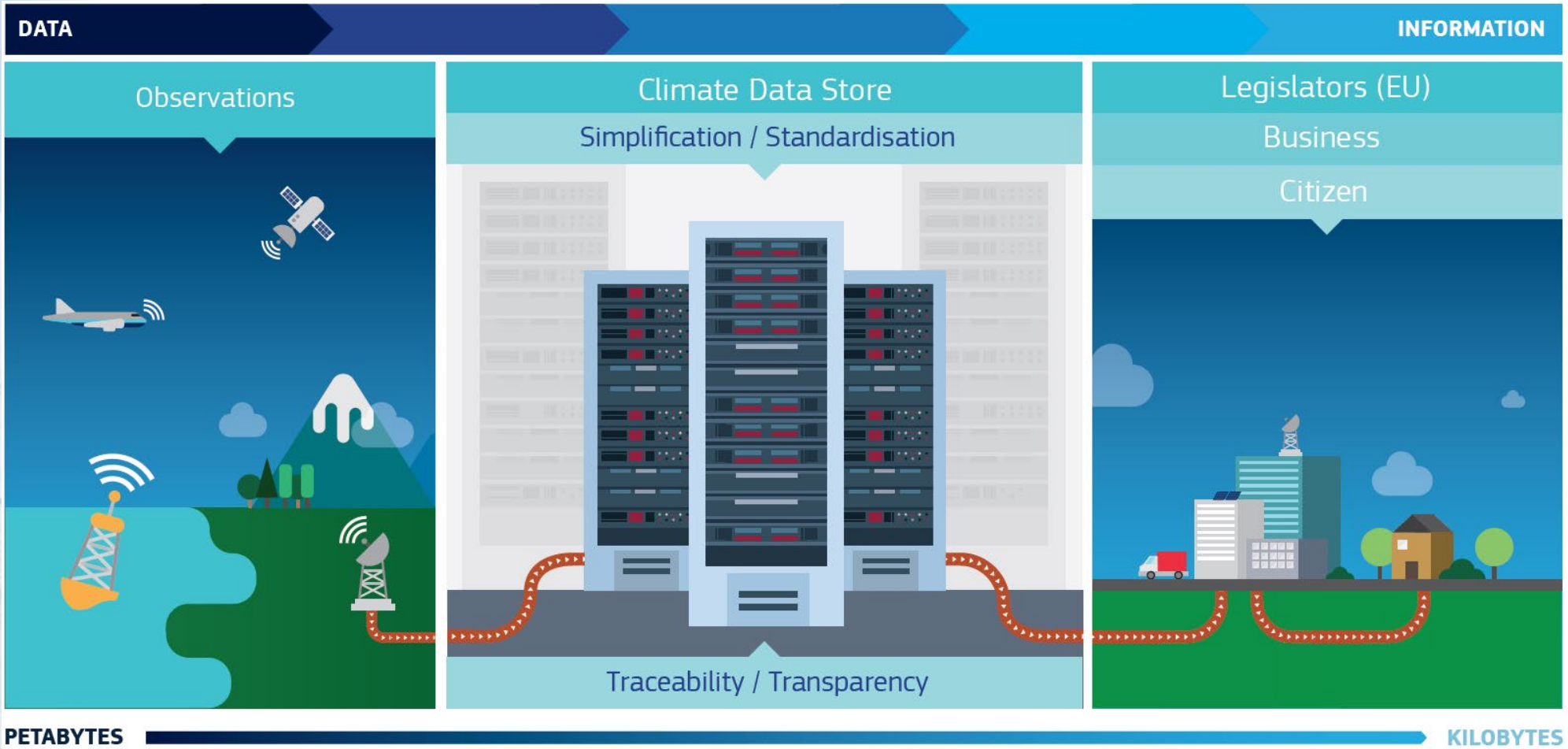
The Copernicus Climate Change Service (C3S)



authoritative quality-controlled data and information based on Earth Observation about the past, present and future climate;

tools to inform climate change mitigation and adaptation strategies by policy makers and businesses;

examples of best practice in the use of climate information.

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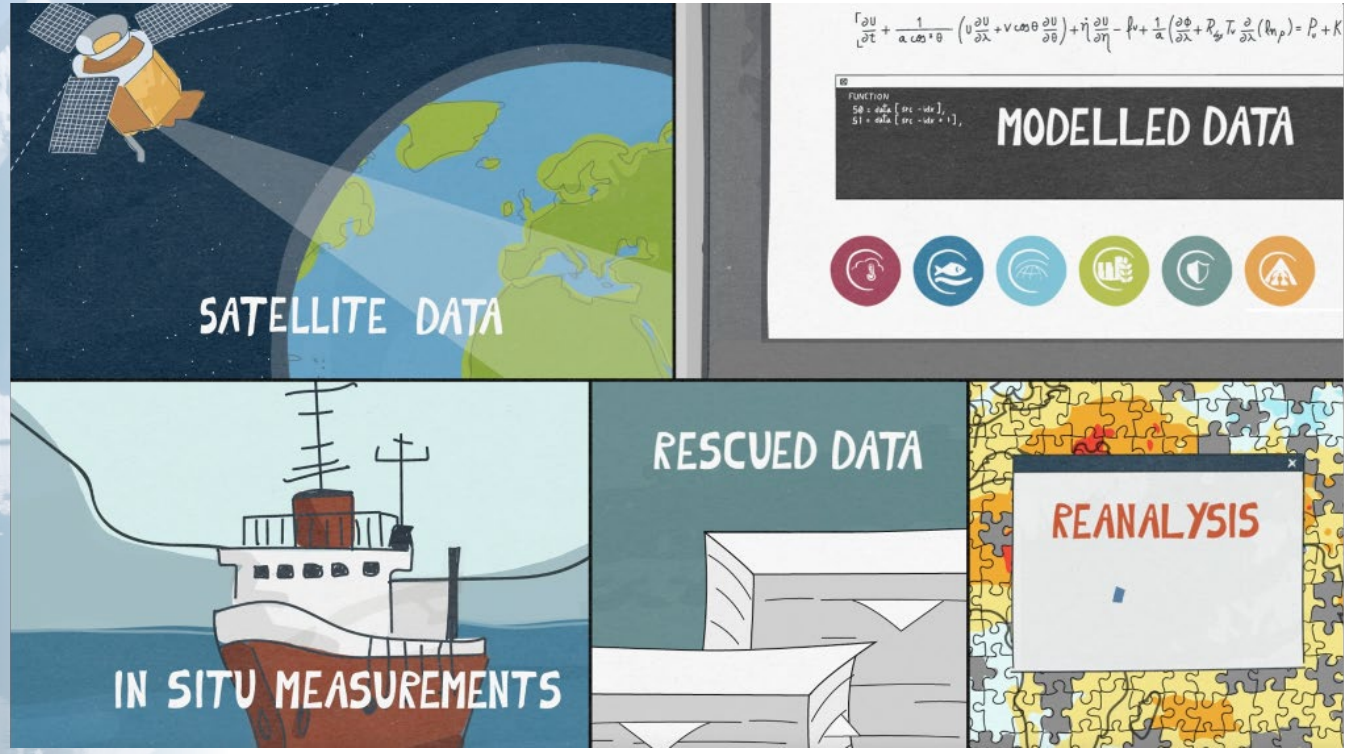
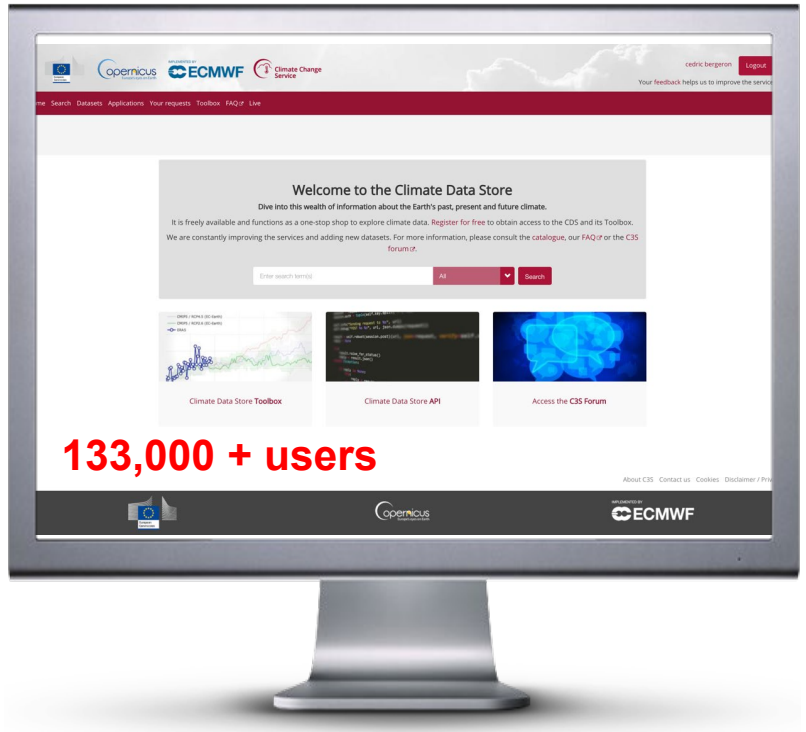
The Climate Data Store – ‘A one stop shop for climate data’





https://cds.climate.copernicus.eu

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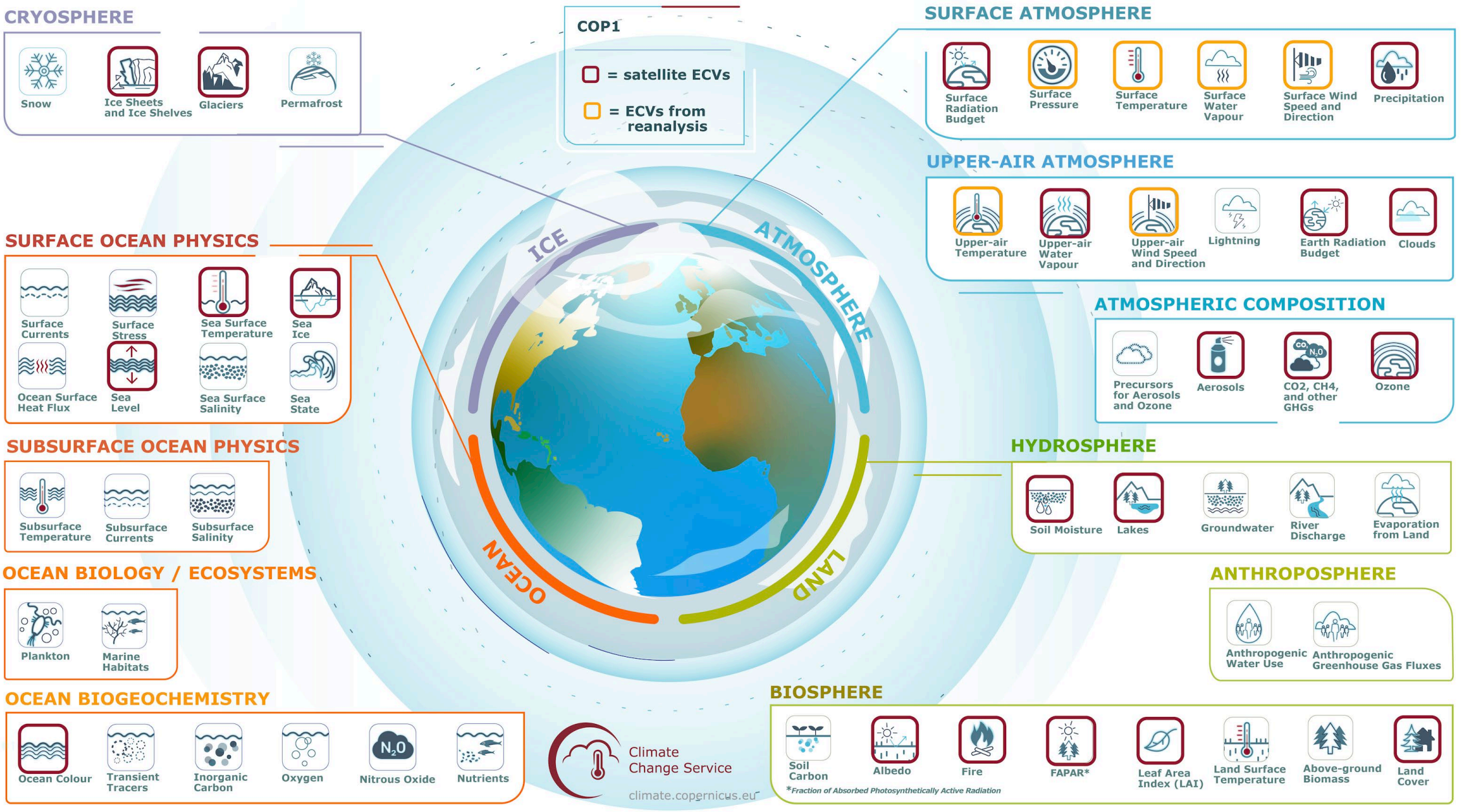
The Essential Cllimate Variables (ECVs)



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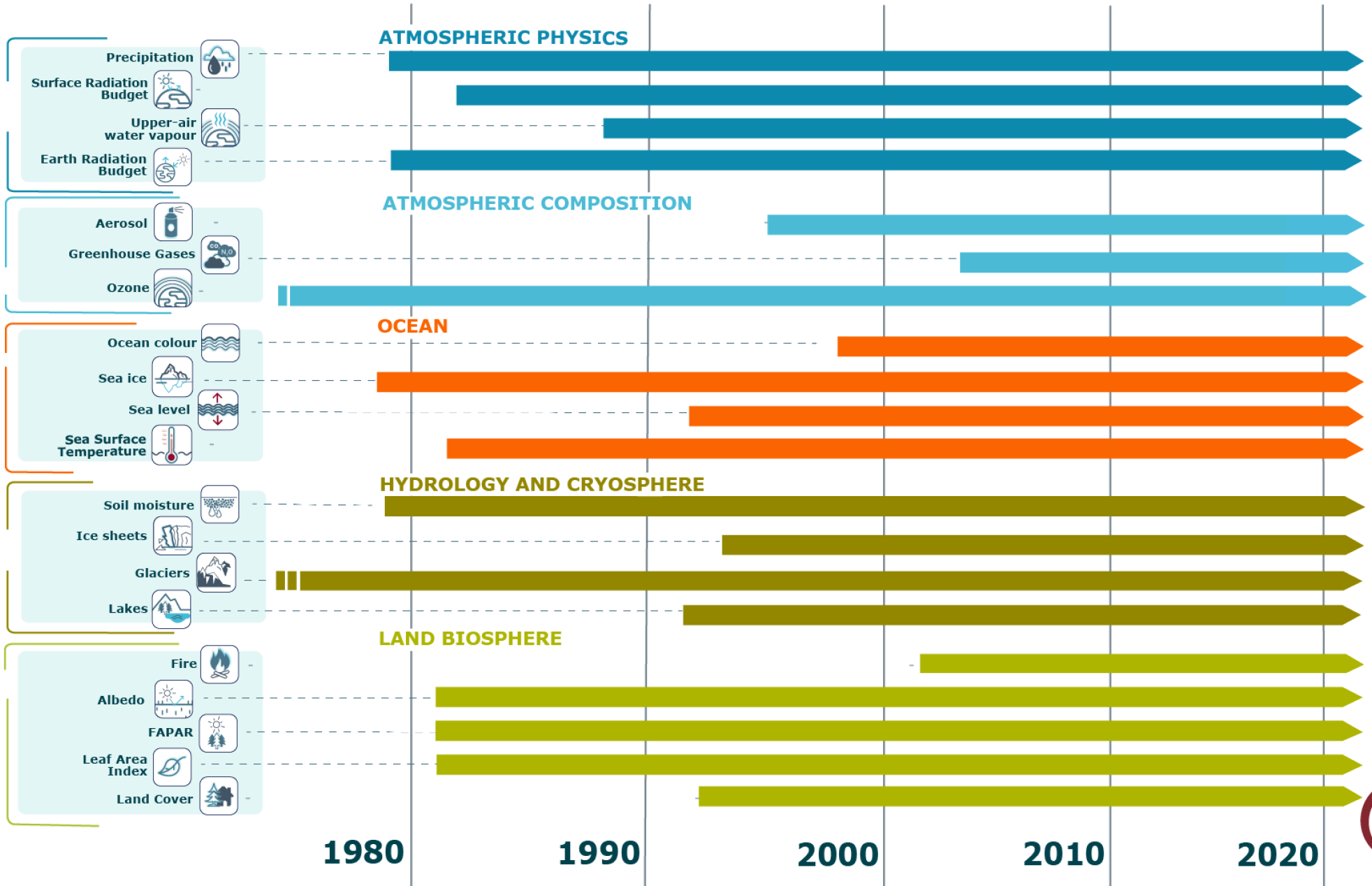
Satellite ECV data records



IN COLLABORATION with more than **50** organisations.

EUMETSAT

esa

Mainly use **Sentinel-3** data

Future use of other Sentinel data

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ECVs in numbers

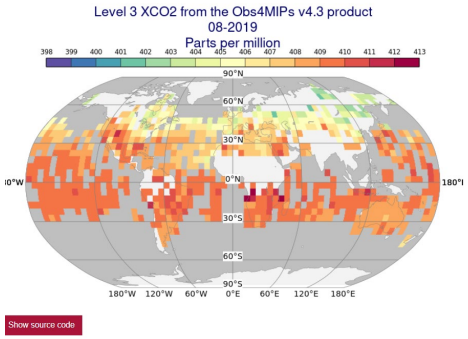
- **5 thematic ECV hubs:**
  - Atmospheric physics
  - Atmospheric composition
  - Ocean
  - Hydrology & Cryosphere
  - Land Biosphere

- > 300 user-oriented documents
- 9 tutorials
- 5 published data viewers
- 6 published toolbox applications + new applications/use cases under analysis

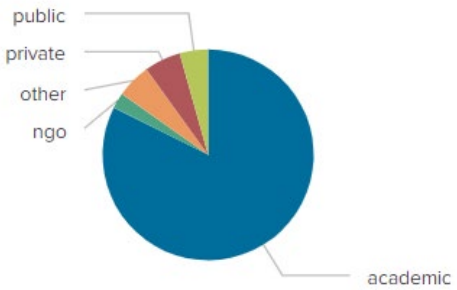
- **35 ECV products**

- **3 new products by end of 2022**
  - Cloud Properties
  - Ice Surface Temperature
  - Sea Ice Drift

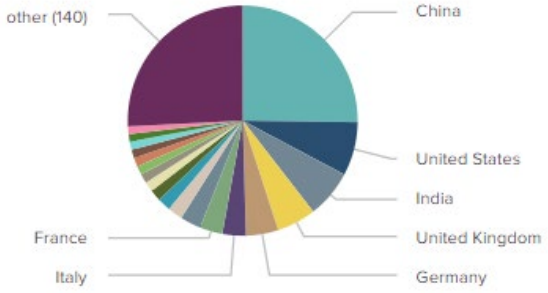
Total number users	Total volume downloaded (in GB)	Total number requests
19,142	307,201	712,407



Distribution per sector



Distribution per country



And much more…

- Full list of citations & acknowledgments per ECV product,
- Licenses for all products,
- Generation of DOI per catalogue entry
- Expert user support
- Independent and full quality control assessment per variable
- Products generated for the European State of the Climate

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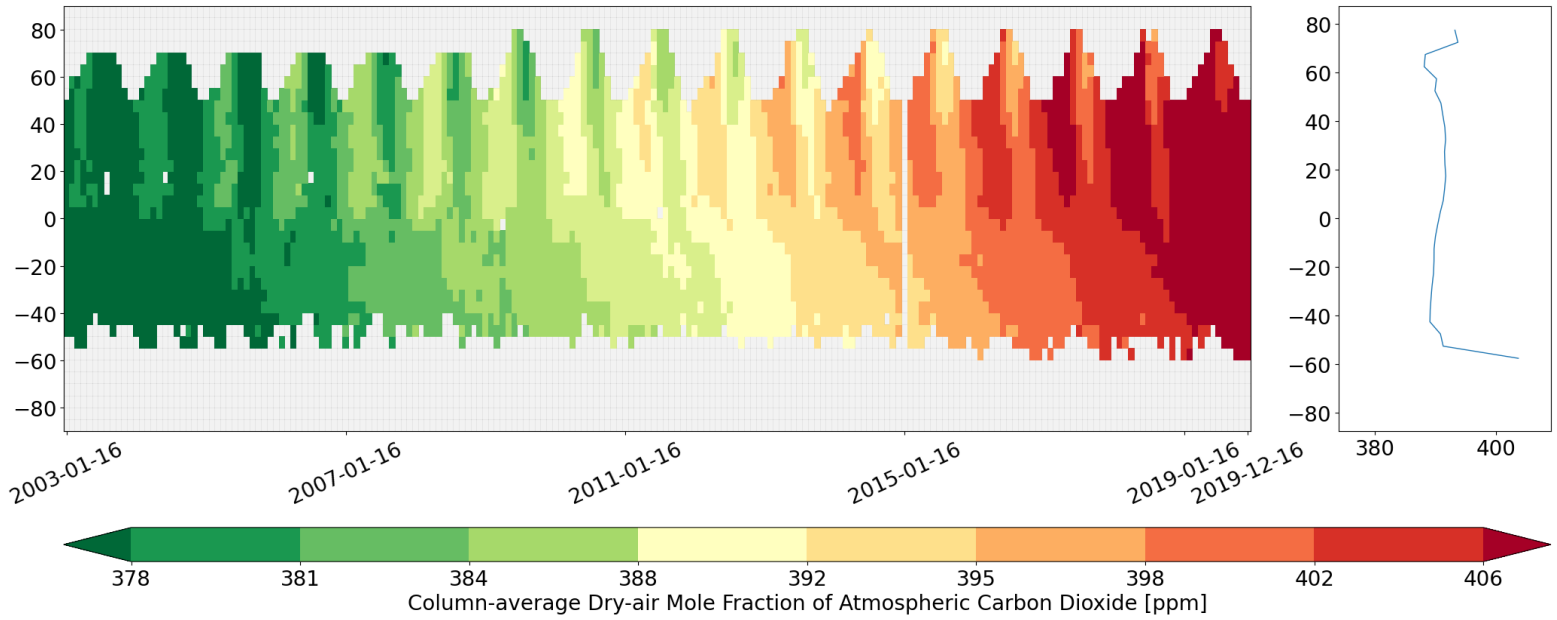
Example: EQC for Carbon Dioxide

Carbon dioxide data from 2002 to present derived from satellite observations - XCO2 Level 3 v4.2 (01/2003- 12/2019)



Maturity Matrix

Metadata	User Documentation	Uncertainty Characterisation	Public access, feedback, and update	Usage
Standards	Formal description of scientific methodology	Standards	Public Access/Archive	Research
Collection level	Formal validation report	Validation	Version	Decision support system
	Formal product user guide	Uncertainty quantification	User feedback	
		Automated quality monitoring	Updates to record	

1	2	3	4	5	6

Mean values for XCO2 as function of latitude and time (aggregated over longitude; left), and as latitudinal averages (aggregated over longitude and time; right). Grey areas represent missing values. Based on the CDS data downloaded on 28 January 2021.

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Example: EQC for Carbon Dioxide

Carbon dioxide data from 2002 to present derived from satellite observations - XCO2 Level 3 v4.2 (01/2003- 12/2019)

Mean/climatology 😐

Ok, but care has to be taken in specific regions (high-latitudes, Southeast Asia) and seasons when data availability might not be sufficiently high. Before mid of 2009, only observations over land available.

Variability 😐

The dataset length, spanning the period 2003-2019, is sufficient to allow some meaningful comparison of temporal variability with ESM, e.g. short-term variability like interannual and seasonal changes. Spatial variability can be assessed if the region of interest is well enough covered by the dataset

Trend 😐

With a temporal coverage of 17 years, the CDS XCO2 L3 (v4.2) dataset is just barely long enough to allow for meaningful trend comparisons with ESM simulations

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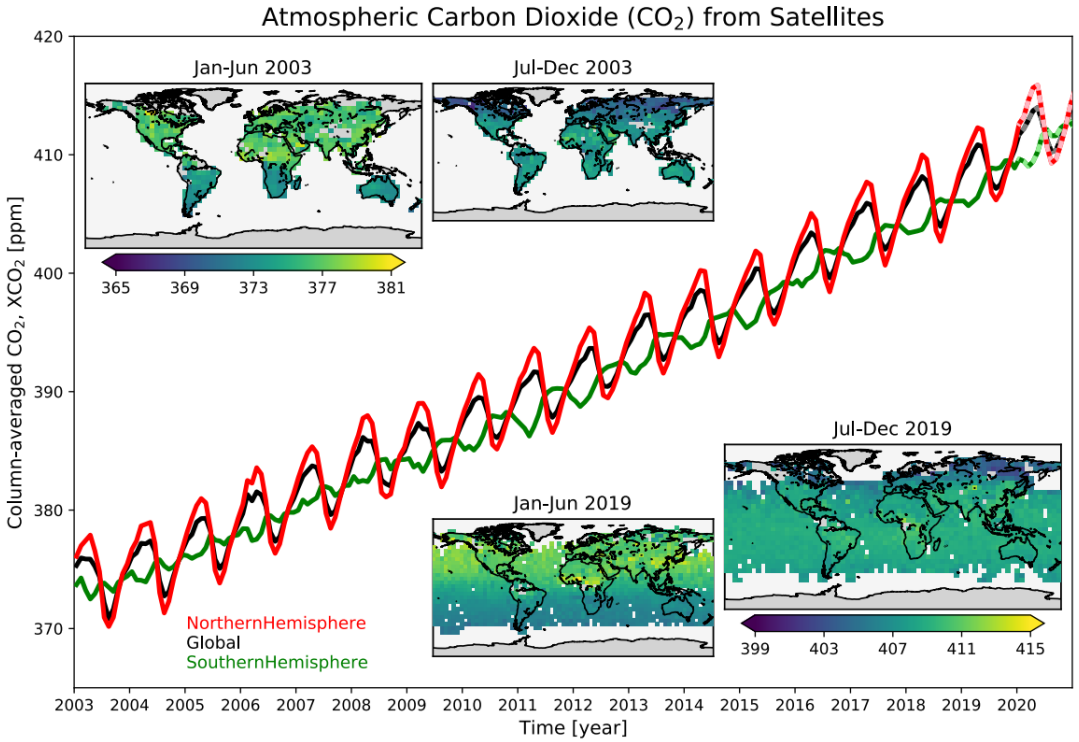
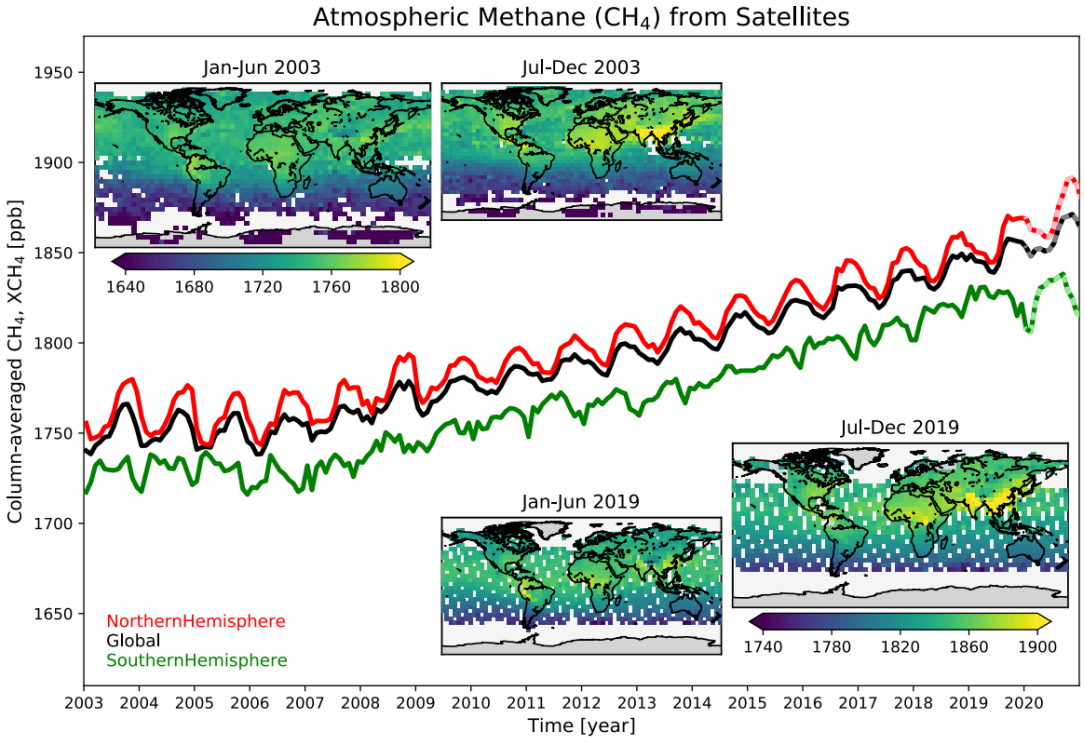
Key information for policy makers





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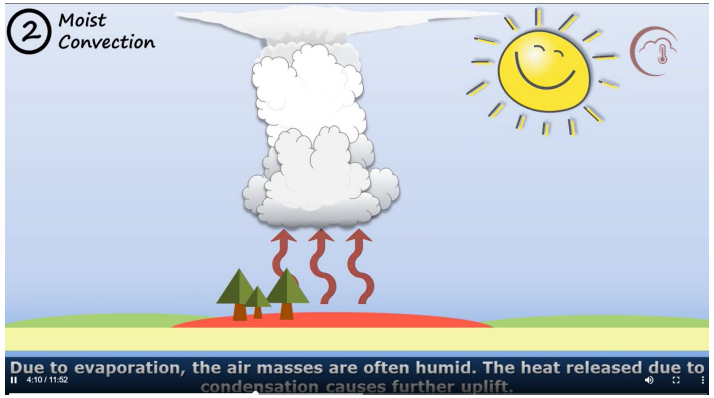
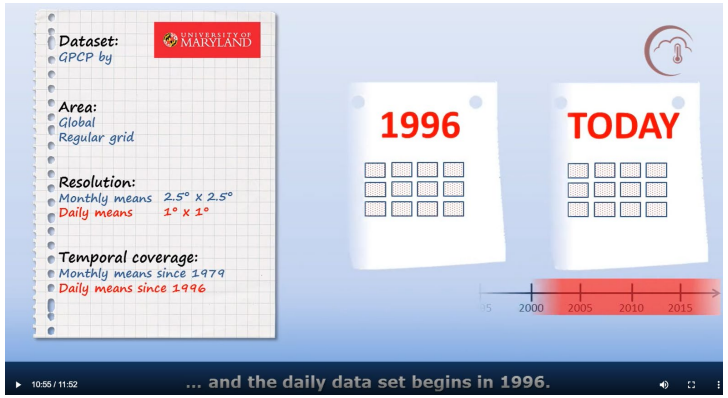
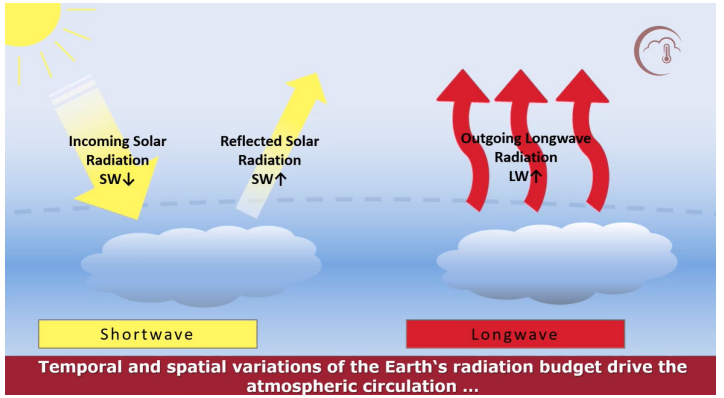
Tutorial and toolbox applications

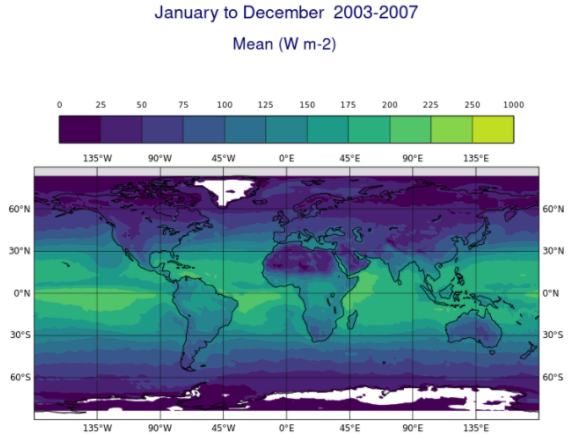
Generation of educational **Tutorials** on atmospheric physics ECVs



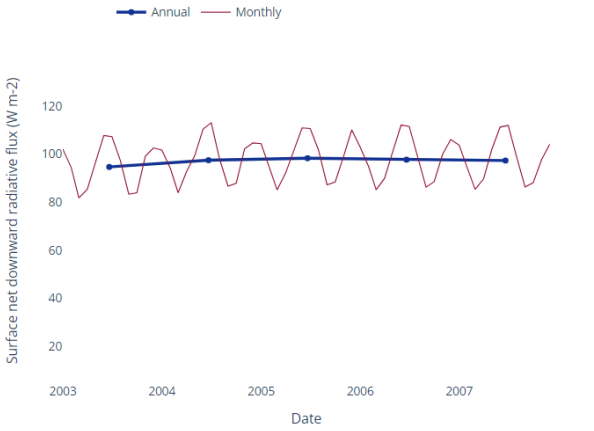




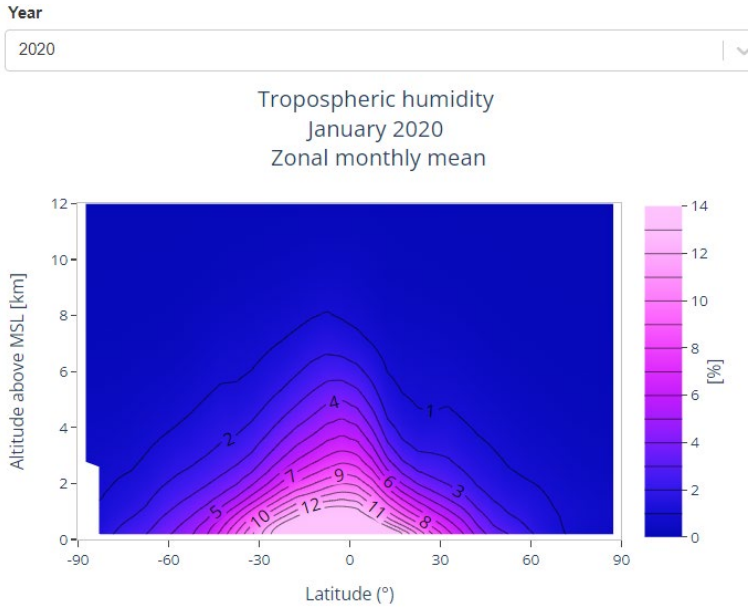
Published **toolbox applications** to provide examples of data use



Temporal mean of the surface net downward radiative flux for the Global region. The temporal period is defined as the years 2003 to 2007 and the months January to December.



Time series of the surface net downward radiative flux mean for the Global region. Series are provided for the annual mean of the selected monthly subset (January to December) and for the complete monthly mean time-series.



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414 ppm CO_2
1876 ppb CH_4
GREENHOUSE GAS CONCENTRATIONS

Europe 2.2°C
TEMPERATURE

3.1mm
SEA LEVEL

Global 0.9°C
SEA SURFACE TEMPERATURE

SURFACE TEMPERATURE

The global temperature has gone up by

1.2°C

since the pre-industrial era

Key climate indicators

- ✓ Responding to monitoring and reporting for UNFCCC
- ✓ Capture long-term trends, but also year-to-year variability

GLACIERS
Global ~ 30 m

ICE SHEETS
Greenland ~ -3800 +/-340 Gt
Antarctica ~ -2720 +/-1390 Gt

SEA ICE
Arctic ~ -12.2% /y[10]

Published in the ESoTC-2021

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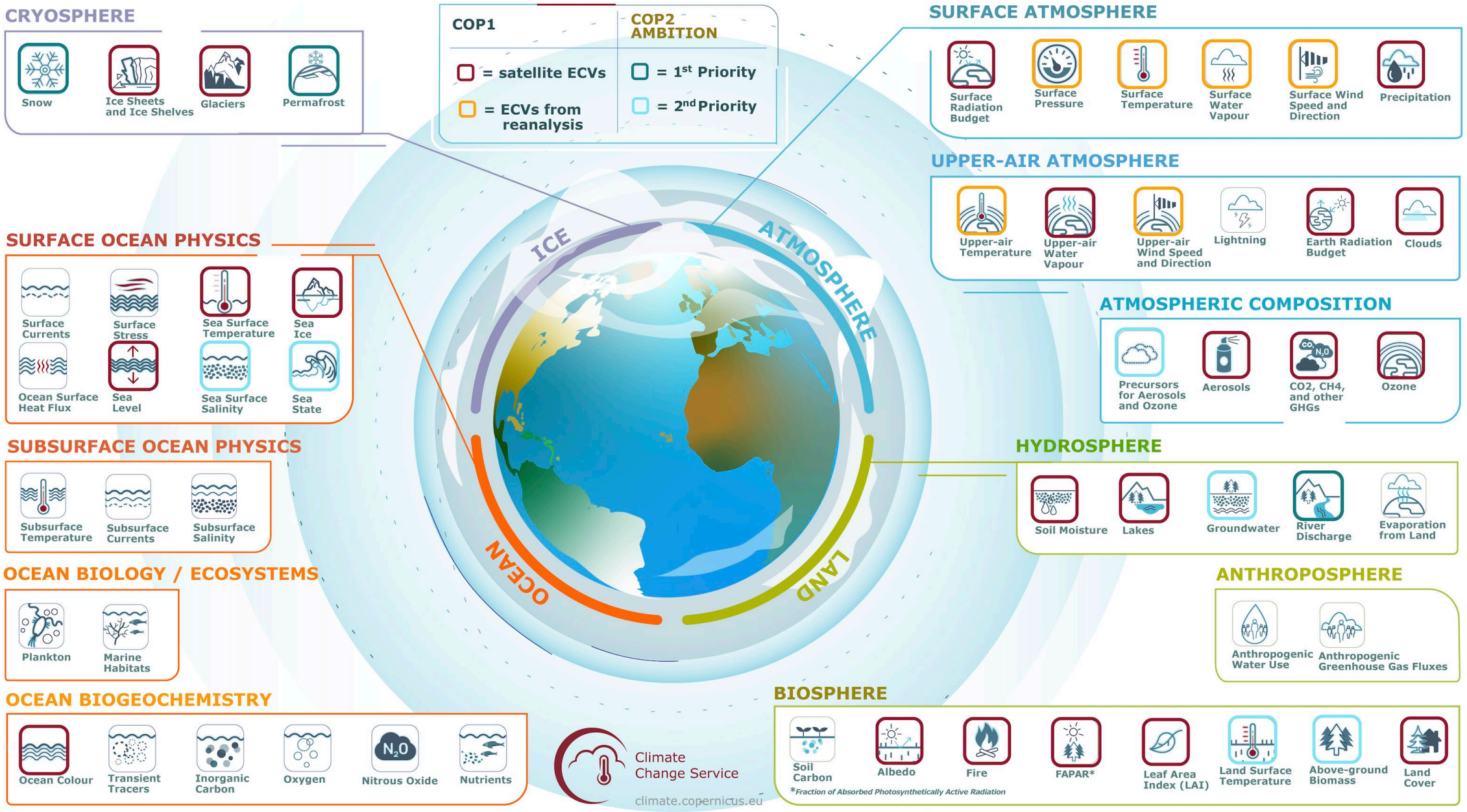
Improving our understanding of the Earth system



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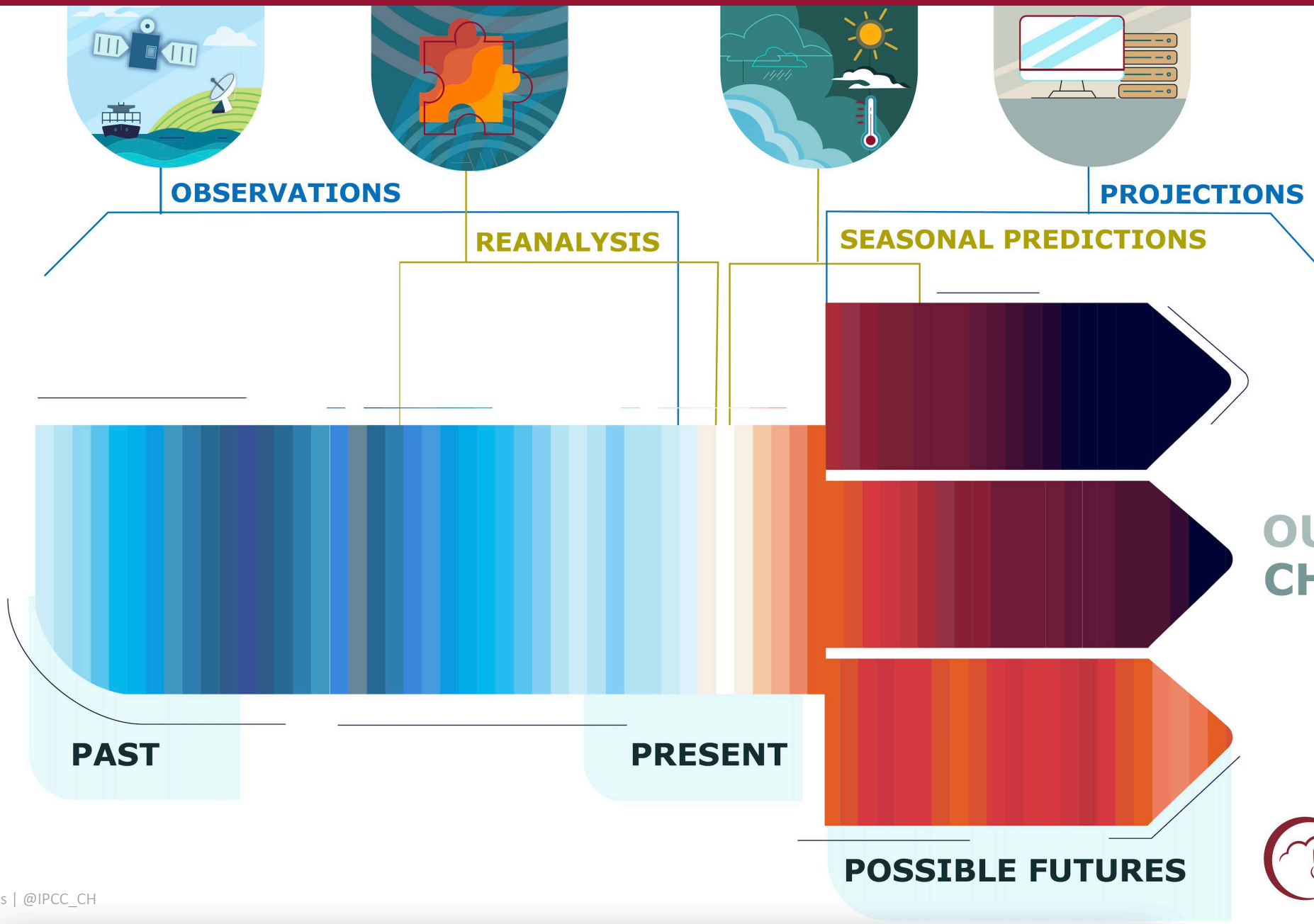
Authoritative data for smart decisions



Inspired by @Ed_Hawkins | @IPCC_CH

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Thank you for your attention

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