

The evolution of C3S satellite ECV datasets in COP2



Climate Change

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European Centre for Medium-Range Weather Forecasts (ECMWF)

C3S General Assembly – Den Haag, The Netherlands – 13-15 Sept 2022





Climate
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Why Essential Climate Variables (ECVs)?

Required to support the work of the UNFCCC and the IPCC

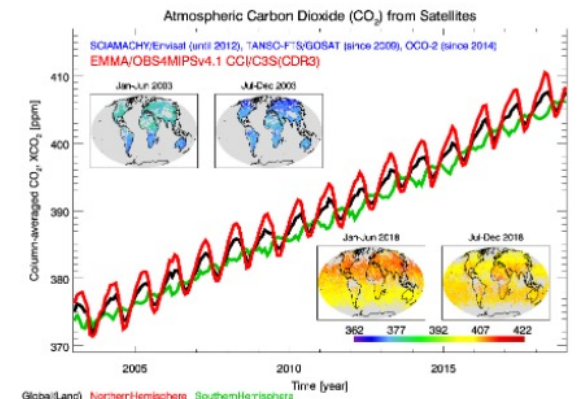
- Provide empirical evidence to understand the evolution of climate (climate indicators)
- Guide mitigation and adaptation measures (decision making)
- Assess risks and enable attribution of climate events to underlying causes
- Underpin climate services.

Climate Data Record: A (Thematic) Climate Data Record is a time series of measurements of sufficient length, consistency, and continuity to determine climate variability and change.

Essential Climate Variables: An Essential Climate Variable is a bio-physical variable (or a group of linked variables) that critically contributes to the characterization of Earth's climate.

→ Relevant, Feasible, Cost-effective

We use historical observations from satellite sensors to build Climate Data Records of Essential Climate Variables (ECVs)



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Climate Change

The Essential Climate Variables (ECVs)

CRYOSPHERE



Snow



Ice Sheets and Ice Shelves



Glaciers



Permafrost

COP1

□ = satellite ECVs

□ = ECVs from reanalysis

SURFACE ATMOSPHERE



Surface Radiation Budget



Surface Pressure



Surface Temperature



Surface Water Vapour



Surface Wind Speed and Direction



Precipitation

UPPER-AIR ATMOSPHERE



Upper-air Temperature



Upper-air Water Vapour



Upper-air Wind Speed and Direction



Lightning



Earth Radiation Budget



Clouds

ATMOSPHERIC COMPOSITION



Precursors for Aerosols and Ozone



Aerosols



CO₂, CH₄, and other GHGs



Ozone

SURFACE OCEAN PHYSICS



Surface Currents



Surface Stress



Sea Surface Temperature



Sea Ice



Ocean Surface Heat Flux



Sea Level



Sea Surface Salinity



Sea State

SUBSURFACE OCEAN PHYSICS



Subsurface Temperature



Subsurface Currents



Subsurface Salinity

OCEAN BIOLOGY / ECOSYSTEMS



Plankton



Marine Habitats

OCEAN BIOGEOCHEMISTRY



Ocean Colour



Transient Tracers



Inorganic Carbon



Oxygen



Nitrous Oxide



Nutrients

BIOSPHERE



Soil Carbon



Albedo



Fire



FAPAR*



Leaf Area Index (LAI)



Land Surface Temperature



Above-ground Biomass



Land Cover

*Fraction of Absorbed Photosynthetically Active Radiation

HYDROSPHERE



Soil Moisture



Lakes



Groundwater



River Discharge



Evaporation from Land

ANTHROPOSPHERE



Anthropogenic Water Use



Anthropogenic Greenhouse Gas Fluxes



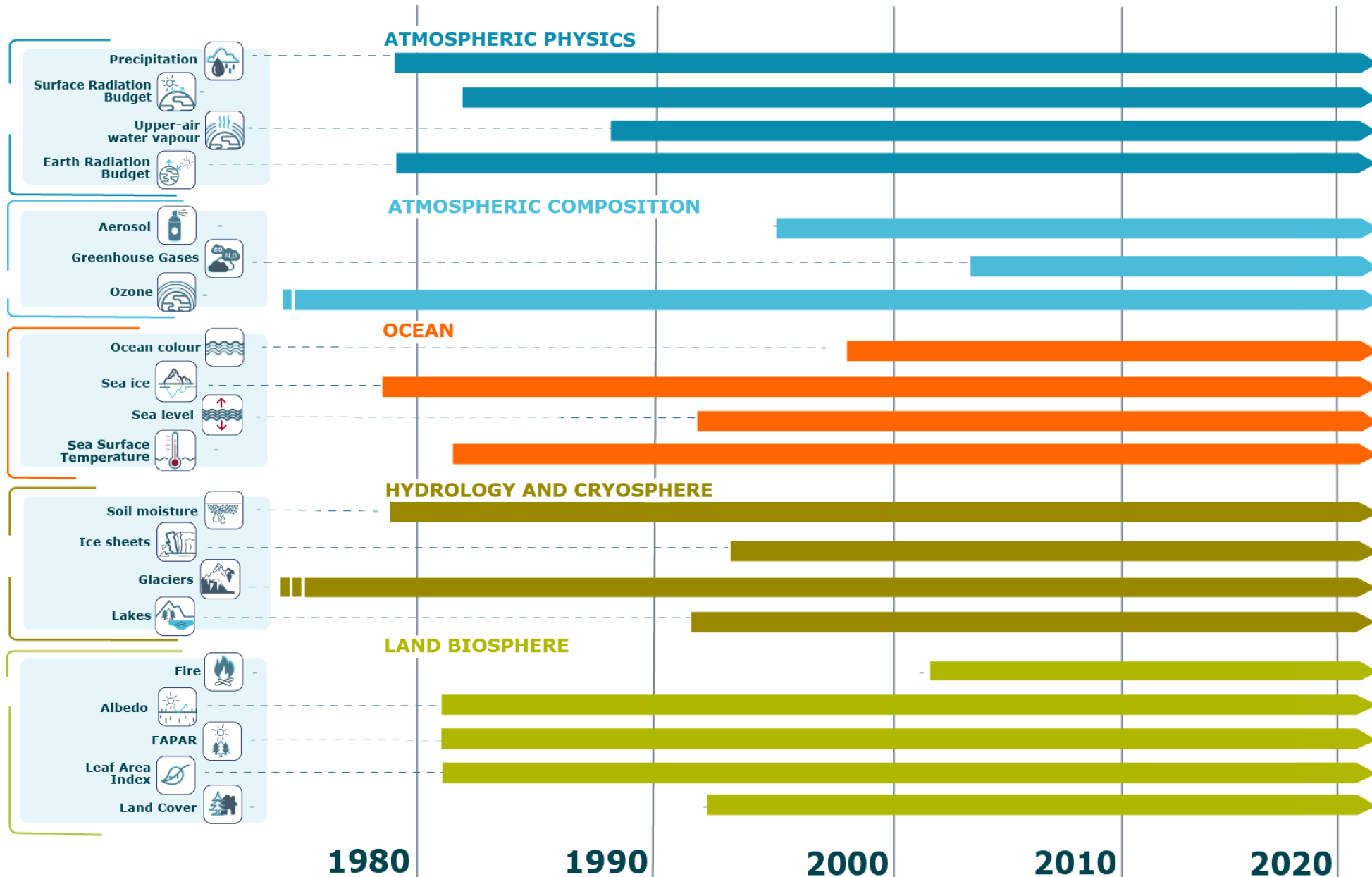
Climate Change Service

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Satellite ECV data records. What is our current offer?



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



Mainly use Sentinel-3 data

Future use of other Sentinel data



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What do we aim in COP2?

~~Revolution?~~

No, rather consolidation of ECV services through **continuation**, and **evolution**



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What do we aim in COP2?

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Aerosol Properties

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Aerosol properties gridded data from 1995 to present derived from satellite observations

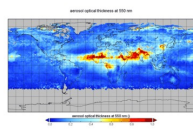
Overview Download data Quality assessment Documentation View

This data set provides observational records of aerosol properties obtained from observations collected by various satellite instruments. Aerosols are minor constituents of the atmosphere by mass, but critical components in terms of impact on climate. Aerosols influence the global radiation balance directly by scattering and absorbing radiation, and indirectly through influencing cloud reflectivity, cloud cover and cloud lifetime.

The main variables provided by this dataset are: aerosol optical depth, fine mode aerosol optical depth, dust aerosol optical depth, single scattering albedo, aerosol layer height and aerosol extinction coefficient. These variables are derived from observations from several sensors using a set of different processing techniques. This provides the possibility to derive a large set of complementary aerosol properties needed to describe the complex nature of atmospheric aerosols. Furthermore, different algorithms have their specific strengths and weaknesses, meaning that datasets originating from the same sensor but processed by different algorithms provide a way to evaluate uncertainties (e.g. areas of good or bad agreement between them). Altogether, the aerosol properties dataset is very extensive and offers a choice of complementary options - which is appropriate depends on the intended application.

Selected observational records in this dataset are extended in time on a semi-annual basis. At the moment of extending, these records are up-to-date until five months behind present time.

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Publication date
2019-12-11
References
DOI: 10.24381/cds.2394815c



Cloud Properties

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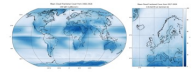
Cloud properties global gridded monthly and daily data from 1982 to present derived from satellite observations

Overview Download data Documentation

This dataset provides the Essential Climate Variable (ECV) Cloud Properties. Cloud properties describe the state of the Earth's upper-air atmosphere. Clouds have an effect on weather and climate through their contribution to the Earth's water cycle and impact on the Earth's energy budget. They influence the motion of the atmosphere on many scales and modify the atmospheric composition. By accumulating and carrying the evaporated and transported water in the atmosphere, clouds redistribute water over the globe, which often involves precipitation. Further, the variable cloud properties determine the feedback mechanism that clouds have on the hydrological cycle, directly in terms of precipitation, but also indirectly on the Earth's energy budget by interacting with radiation fluxes. Usually, clouds reflect more solar radiation back to space than the underlying surface and absorb and re-emit infrared (IR) radiation, leading to less IR radiation leaving the system than without clouds. According to the 5th Intergovernmental Panel on Climate Change (IPCC) assessment report, clouds (together with aerosols) contribute the largest uncertainty to the estimates of the Earth's energy budget, as well as to the potential feedback mechanisms and responses to climate change.

The ECV Cloud Properties contains four main variables, which can be separated into averaged cloudiness, cloud height products and cloud physical properties for ice and liquid water phase. These variables were produced by two "product families", based on the data from different sensors and algorithms that cover the same four variables. The "CCI product family" was originated by different projects within different organisations at different times. The third organisation, alongside CM SAF and CC, the Copernicus Climate Change Service (CCS) is only associated with the CCI product family in this dataset to which it provides a continuation of their production chain. This means that the datasets contains three organisations but just two product families.

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Publication date
2022-06-01
Resource updated
2022-08-22
References



Sea Surface Temperature

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Sea surface temperature daily data from 1981 to present derived from satellite observations

Overview Download data Quality assessment Documentation

This dataset provides daily estimates of global sea surface temperature (SST) based on observations from multiple satellite sensors since September 1981. SST is known to be a significant driver of global weather and climate patterns and to play important roles in the exchanges of energy, momentum, moisture and gases between the ocean and atmosphere. As such, its knowledge is essential to understand and assess variability and long term changes in the Earth's climate.

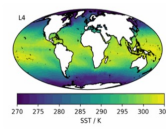
The SST data provided here are based on measurements carried out by the following infrared sensors: SeaWiFS, the series of Advanced Very High Resolution Radiometers (AVHRR), the series of Along Track Scanning Radiometers (ATSRs), and the Sea and Land Surface Temperature Radiometer (SLSTR).

The dataset provides SST products of different processing levels. Only Level-3 Collocated and Level-4 and served through this entry in the Catalogue. Due to the large number of files at Level-2 Pre-processed and Level-3 Collocated these products are served through the Climate Data Store API. For more information on how to access these levels consult the documentation.

The four types of products are:

- Level-2 Pre-processed (L2P): SST data on the native satellite swath grid and derived from single-sensor measurements.
- Level-3 Uncollocated (L3U): SST product generated by regriding L2P data onto a global latitude-longitude grid.
- Level-3 Collocated (L3C): global daily (day and night) single-sensor SST product based on collocated L3U data.

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SST CCI datasets licence
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Publication date
2019-12-13
Resource updated
2022-08-23
References
DOI: 10.24381/cds.c608234z



Glaciers Distribution

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Glaciers distribution data from the Randolph Glacier Inventory for year 2000

Overview Download data Documentation

This dataset, commonly known as the Randolph Glacier Inventory (RGI), provides global glacier outlines compiled from maps, aerial photographs and satellite images. The data is provided as a "snapshot" (single time-slice) constructed from images that were mostly acquired in the period 2000-2010.

The dataset represents the latest globally complete and homogenized state-of-the-art glacier outline collection. The regional datasets have been created by scientists from all over the world and were provided to the Global Land Ice Measurements from Space (GLIMS) glacier database at the National Snow and Ice Data Center (NSIDC). Among others, the dataset plays a key role in determining the contribution of glacier melt to global sea-level rise and regional hydrology, as well as modelling of past and future glacier evolution.

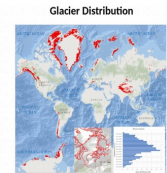
The provided RGI is broken from the GLIMS glacier database at NSIDC and consists of two datasets which provide:

- glacier outlines with attribute information in shape file format
- tabular data describing the area of each glacier in a specific elevation interval, i.e. its hypsometry

Both datasets are arranged in 19 first order regions that cover all glaciated regions in the world. Coordinates are in longitude and latitude with the World Geodetic System 1984 (WGS84) datum.

The RGI glacier outlines provided here are widely used by the glacier community to spatially constrain

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Publication date
2018-06-14
References
DOI: 10.24381/cds.553f1387z
Related data
Glaciers elevation and mass change data



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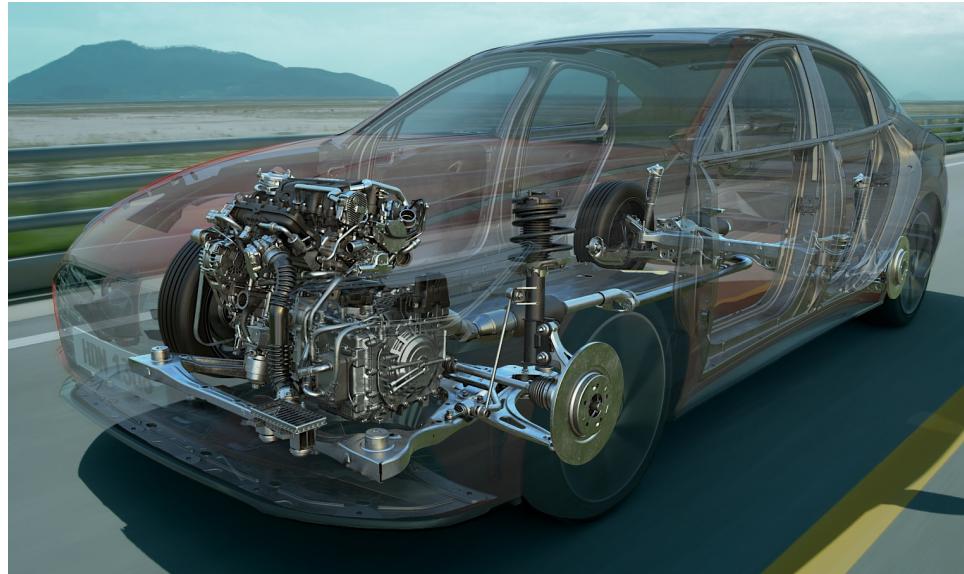
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What do we aim in COP2?



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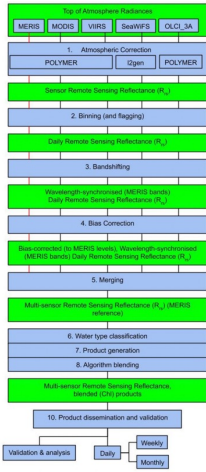
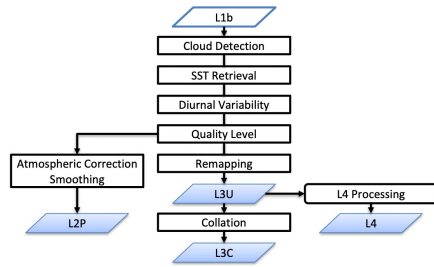
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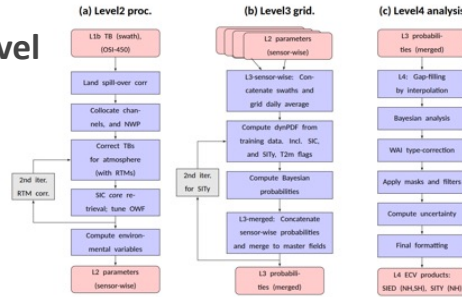
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What do we aim in COP2?

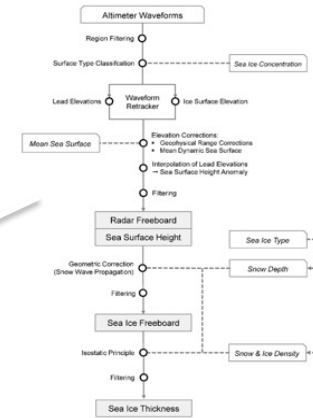
Sea Surface Temperature



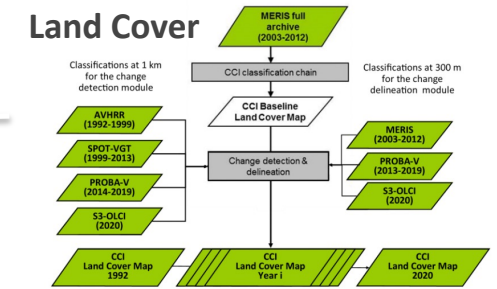
Sea Level



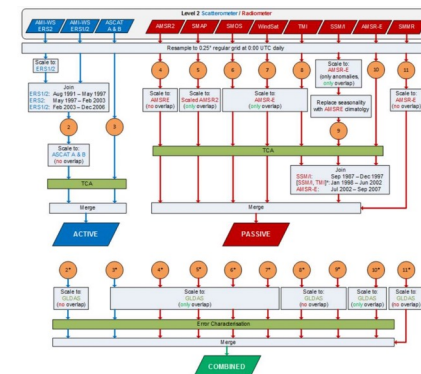
Sea Ice Thickness



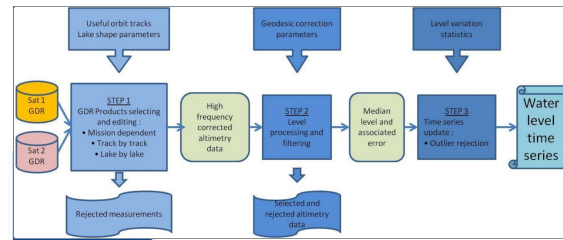
Land Cover



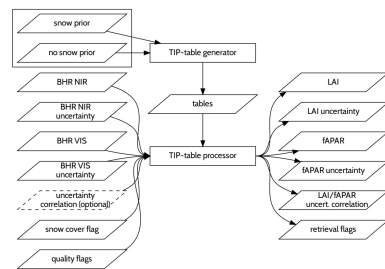
Soil Moisture



Lake Water Level



LAI & fAPAR

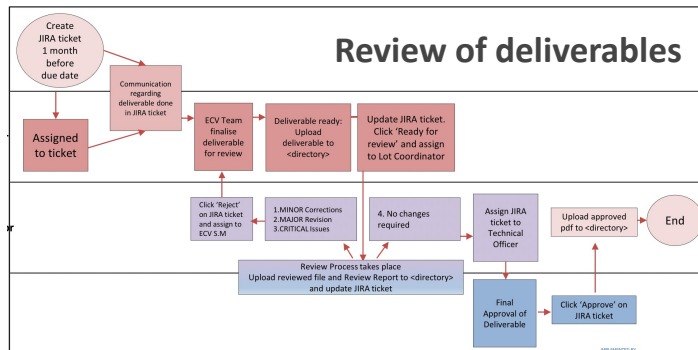


Ocean Colour

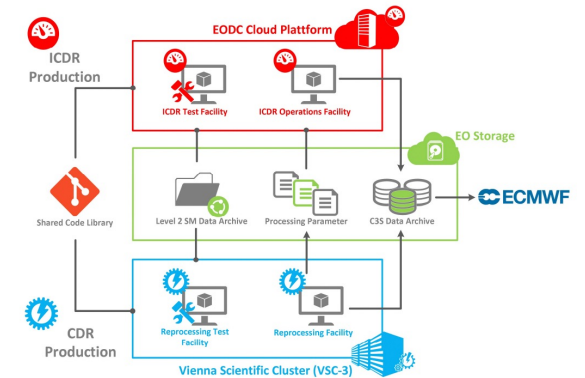
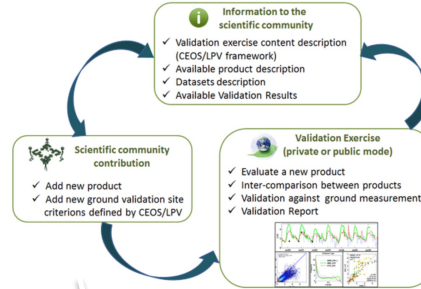


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What do we aim in COP2?



Validation protocols

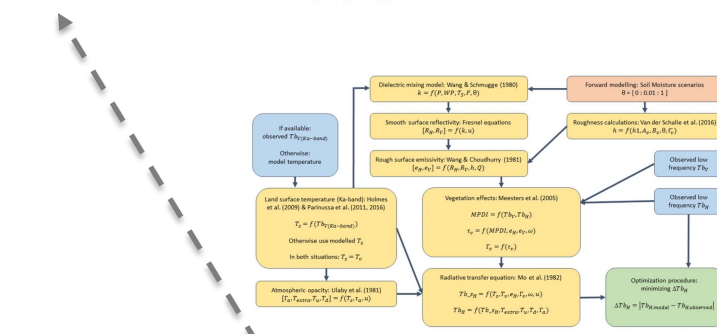
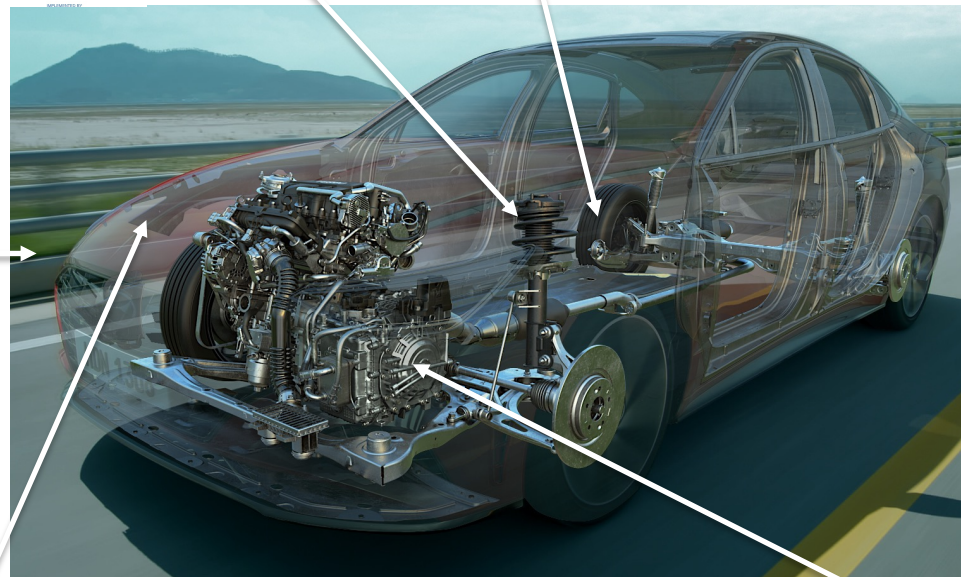


Maturity Matrix

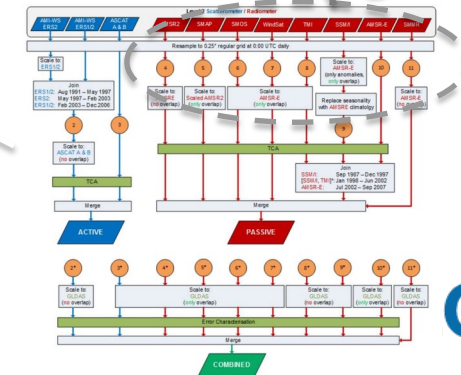
Metadata	User Documentation	Uncertainty Characterisation	Public access, feedback, and update	Usage
Standards	Formal description of scientific methodology	Standards	Public Access/Archive	Research
Collection level	Formal validation report	Validation	Version	Decision report system
	Formal product user guide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

EQC

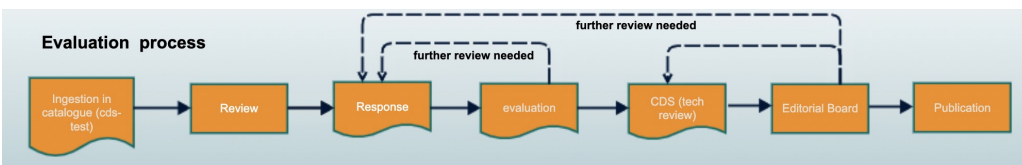
1 2 3 4 5 6



Soil Moisture



Integration & Publication



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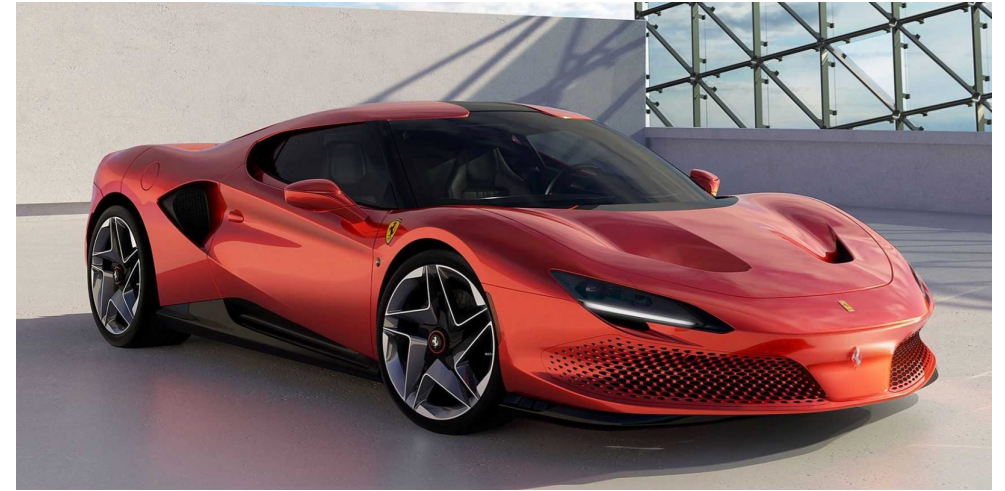
What do we aim in COP2?

Do we want a “Ferrari-type” system, with ‘all included’?

Yes, but...

- It takes years to design it & build it up
- It is expensive to maintain
- Power without control is unpredictable

We target an **efficient, fully equipped** system with less maintenance, good control over all contributing processes, easy to use and attractive to the user



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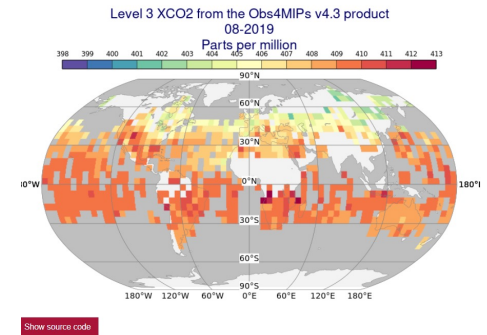
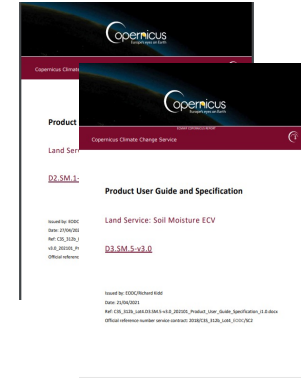
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ECVs in numbers

- **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 + multiple examples of use cases**
- **37 ECV products**
- **2 new products by end of 2022**
 - Ice Surface Temperature
 - Sea Ice Drift

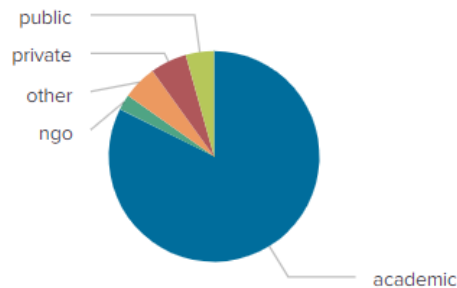


Total number users
22,169

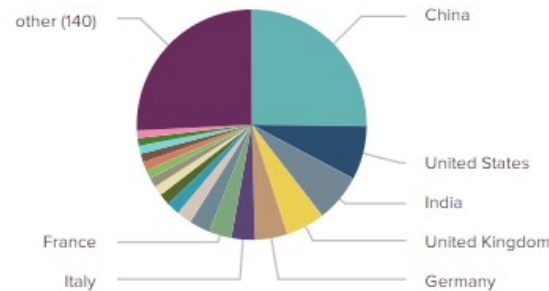
Total volume downloaded (in GB)
307,201

Total number requests
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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Climate Change

Evolution

CRYOSPHERE



Snow



Ice Sheets and Ice Shelves



Glaciers



Permafrost

COP1

□ = satellite ECVs

□ = ECVs from reanalysis

COP2 AMBITION

□ = 1st Priority

□ = 2nd Priority

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Surface Radiation Budget



Surface Pressure



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Surface Wind Speed and Direction



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Soil Carbon



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Land Surface Temperature



Above-ground Biomass



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*Fraction of Absorbed Photosynthetically Active Radiation

Summary

- We use historical observations from satellite sensors to **build Climate Data Records of Essential Climate Variables (ECVs)**
- The C3S ECV services consist of a series of **complex workflows**, with different levels of critical connections
- COP2: We don't target a revolution, but primarily a **consolidation of the current services** through continuation, and **evolution with potential new ECVs**
- In COP2 ECV services will have a **special focus on users**





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Thank you for your attention



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