Climate Change

How climate information can be made user relevant and usable: the case of the Sectoral Information System of C3S

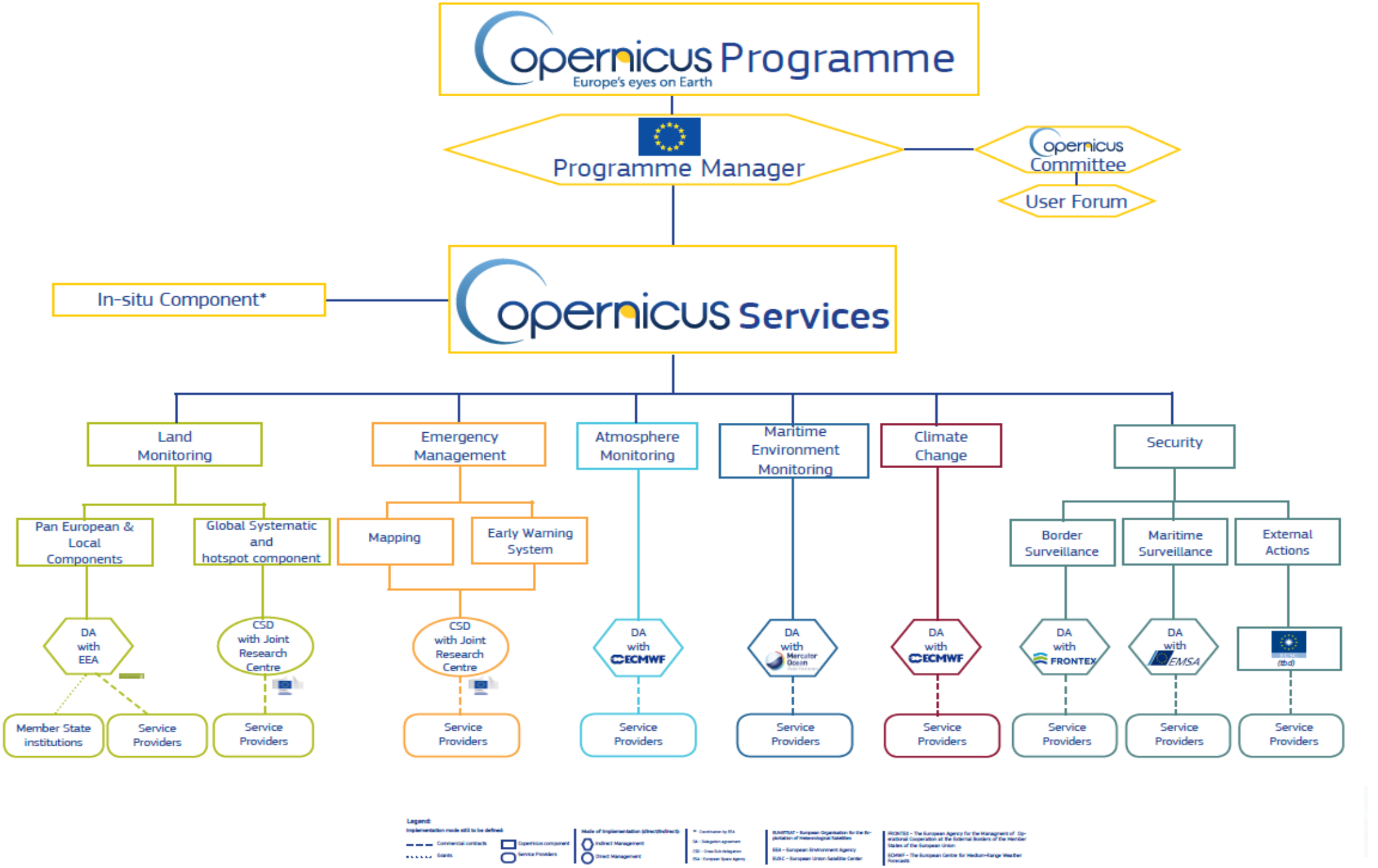
UEF 2018

Samuel Almond & Carlo Buontempo - ECMWF / C3S

Copernicus
Europe's eyes on Earth

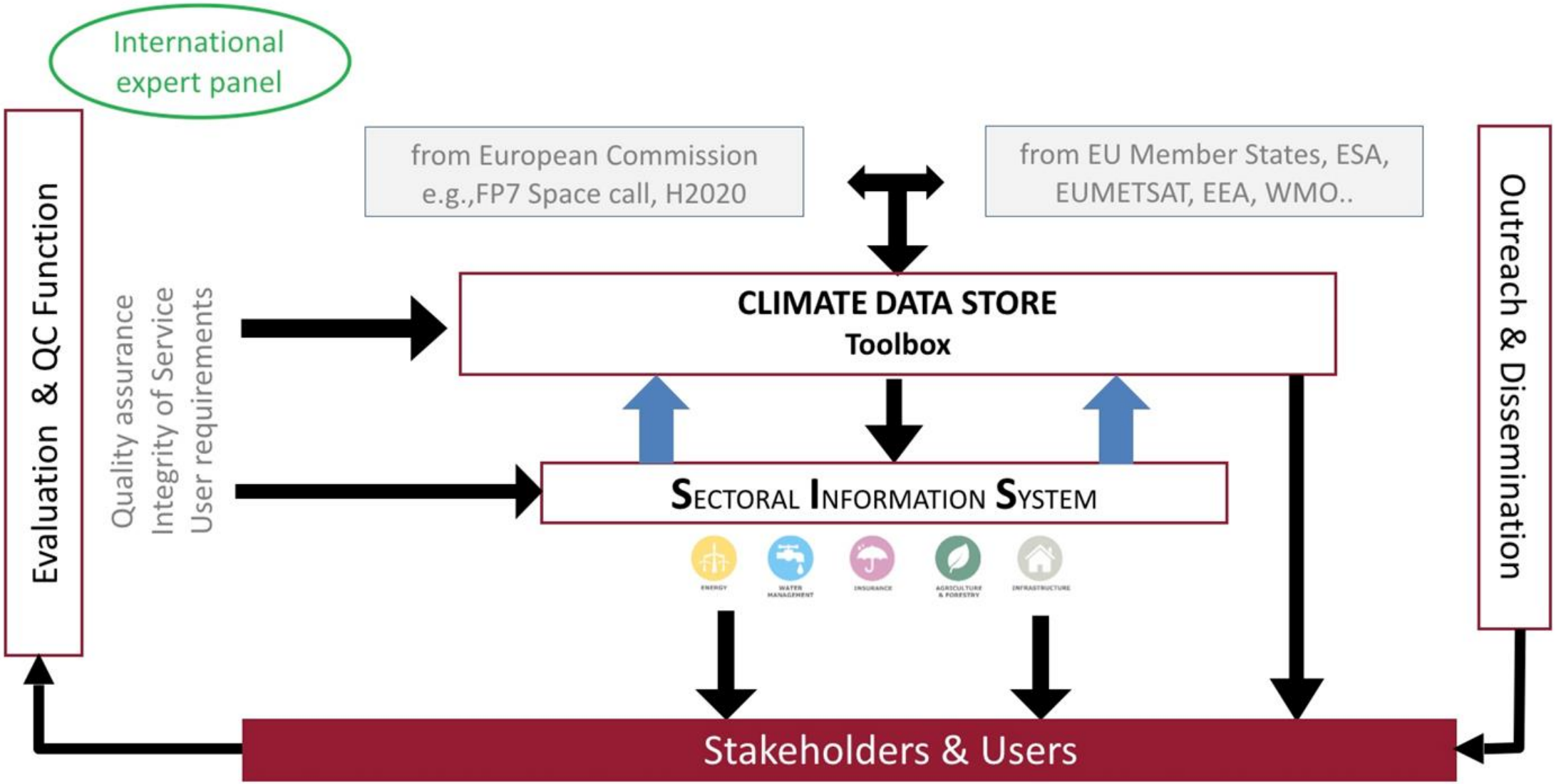
European Commission

Climate Change

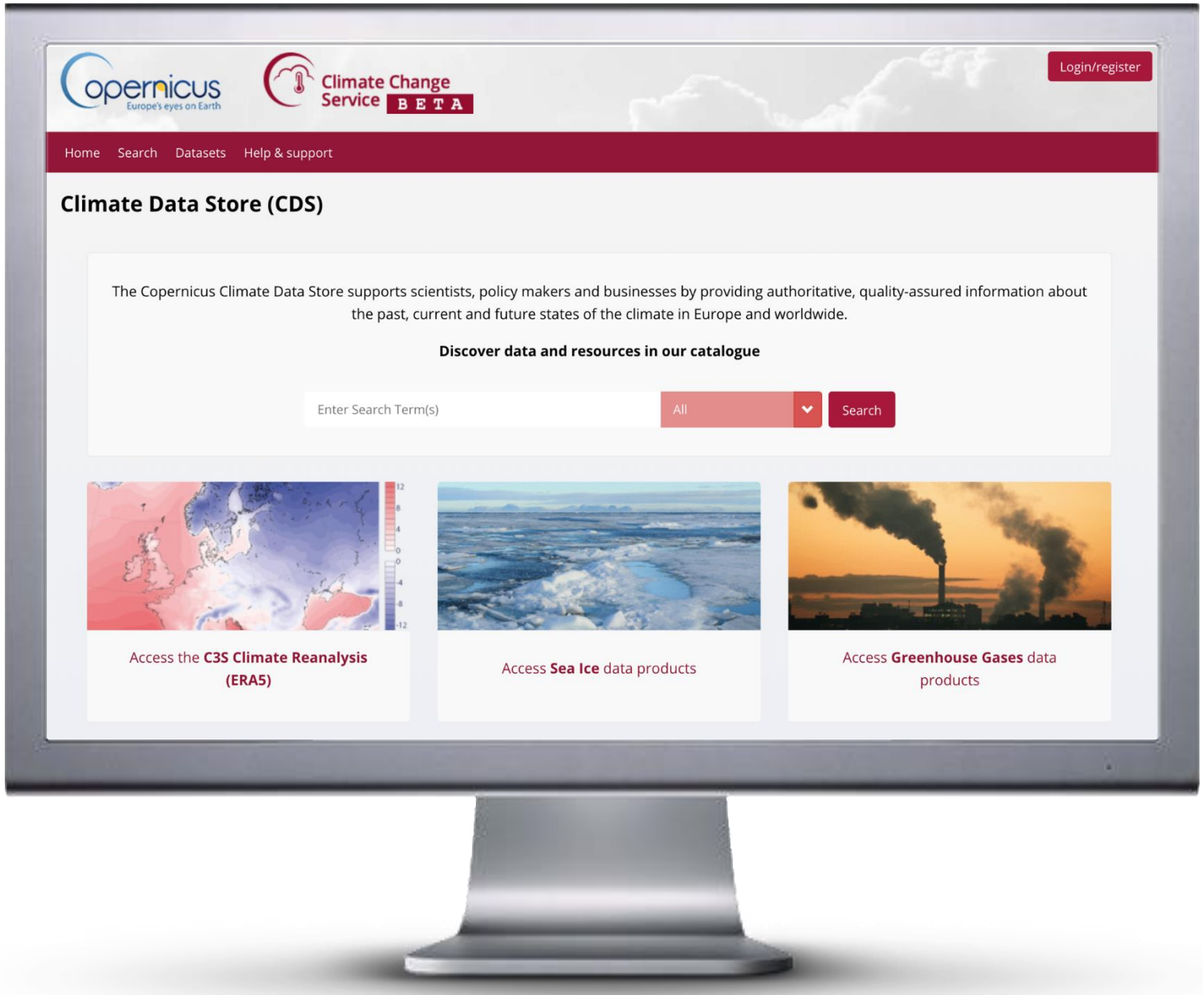


C3S in a nutshell

Climate Change



Climate Data Store – CDS



The CDS contains **observations**, global and regional **climate reanalyses**, global and regional **climate projections** and **seasonal forecasts.**

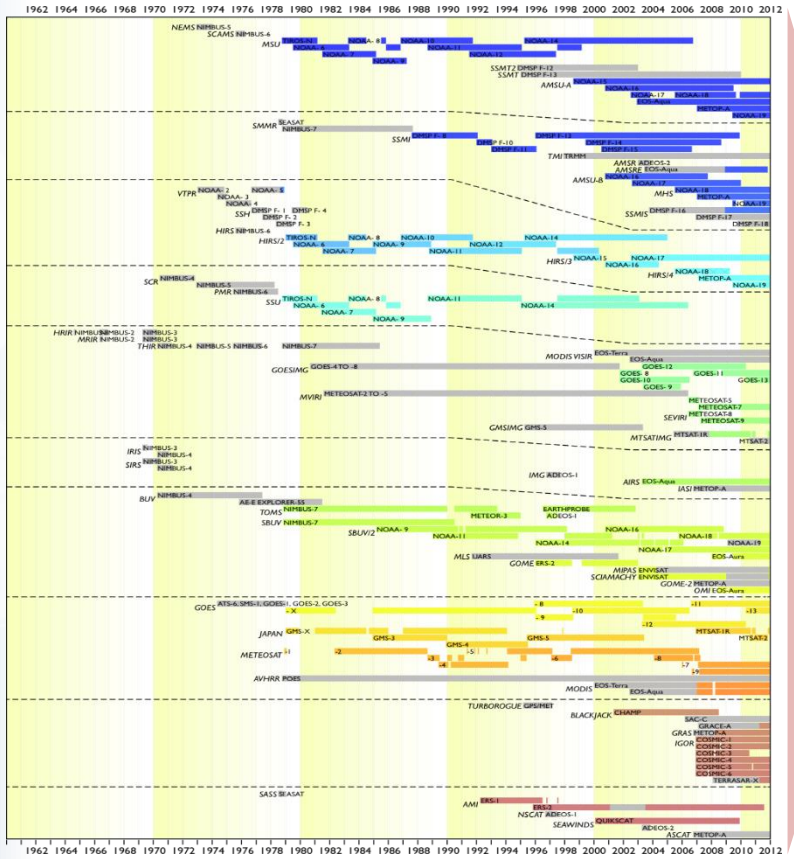
The CDS is designed as a **distributed system**, providing improved access to **existing datasets** through a **unified web interface**

Copernicus Europe's eyes on Earth
European Commission

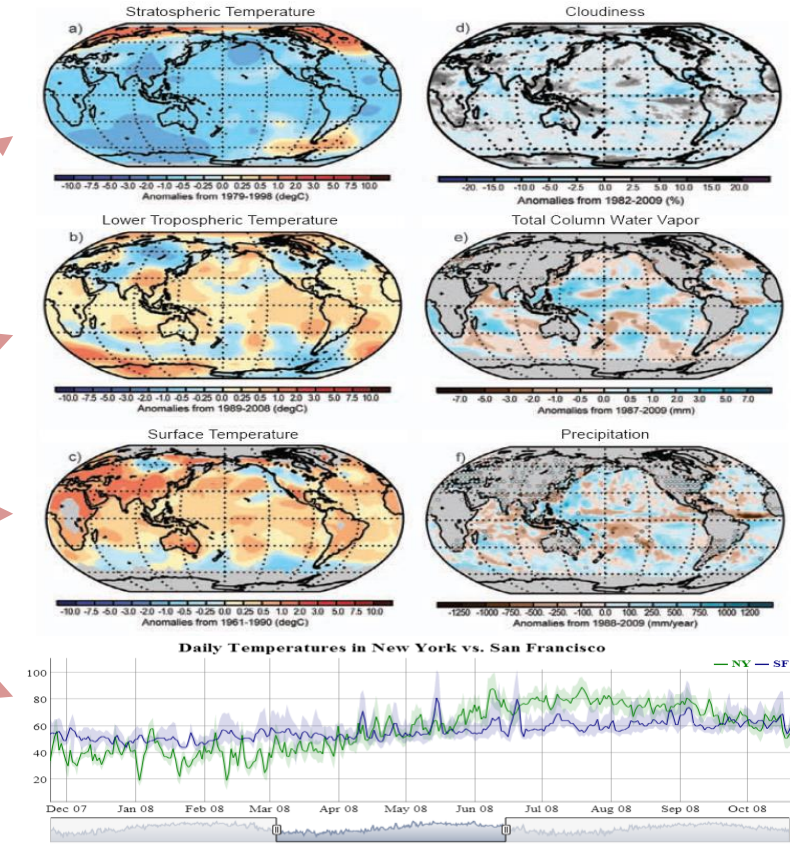
Climate reanalysis

Climate Change

Providing information based on a physically consistent set of ECV estimates, based on the Operational ECMWF Climate Reanalysis (ERA 5) by combining models with observations



Earth system model



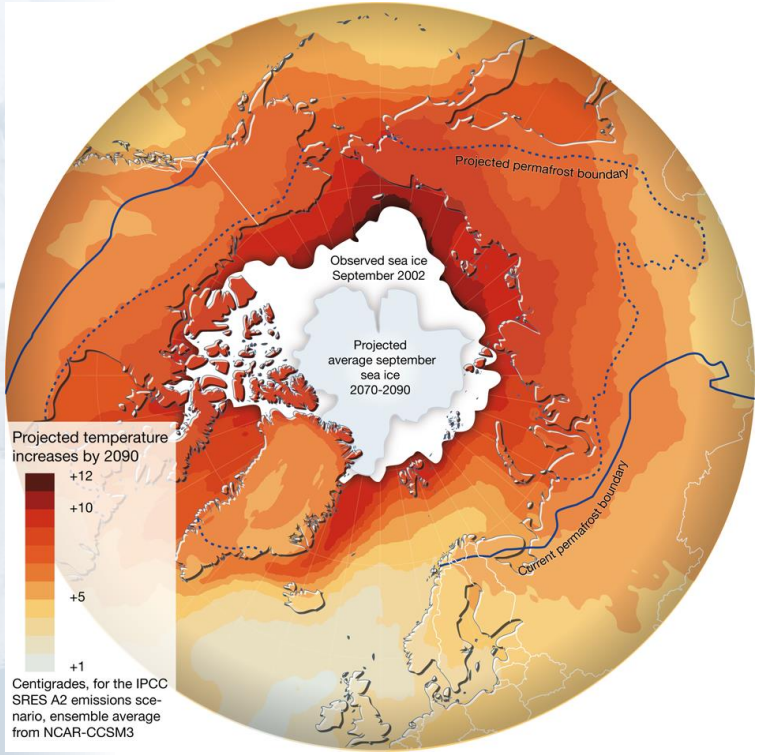
Copernicus Europe's eyes on Earth

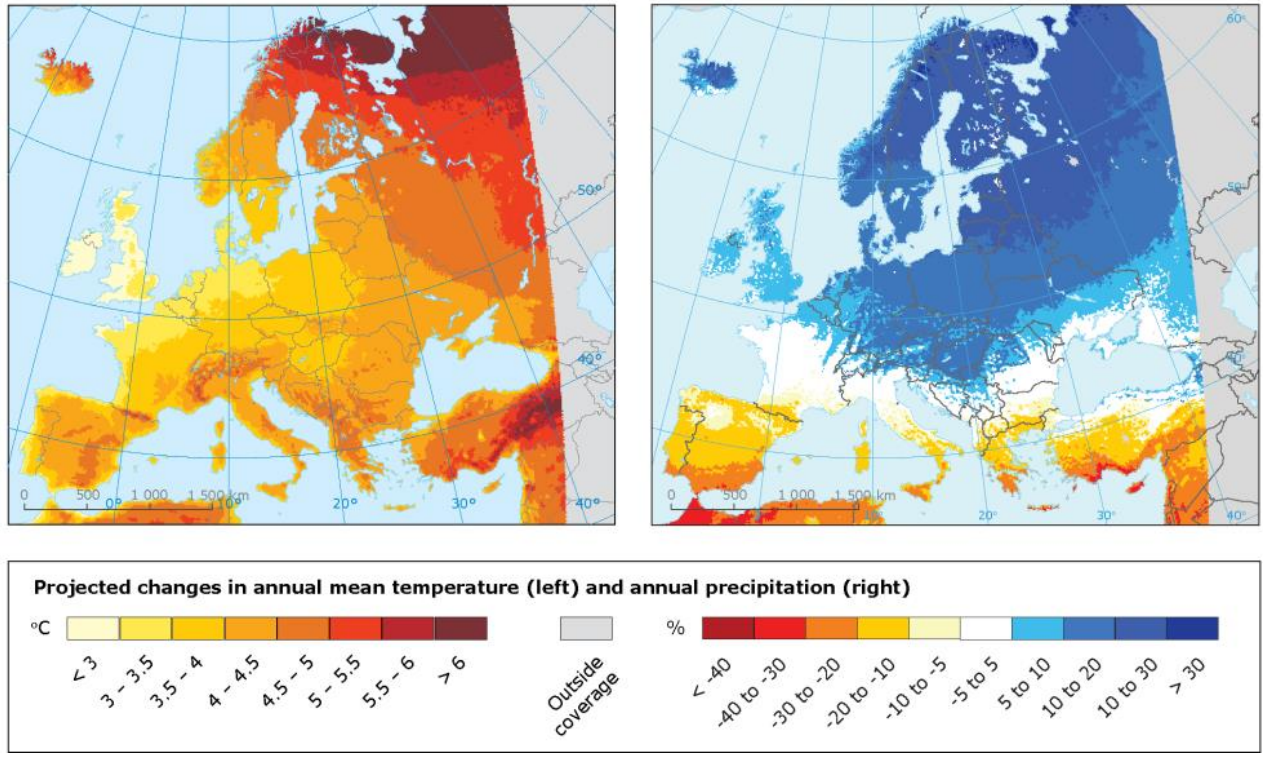
European Commission

Climate Change

Climate projections

Providing users with timely access to climate change scenarios produced with state-of-the-art climate models (CMIP, CORDEX)

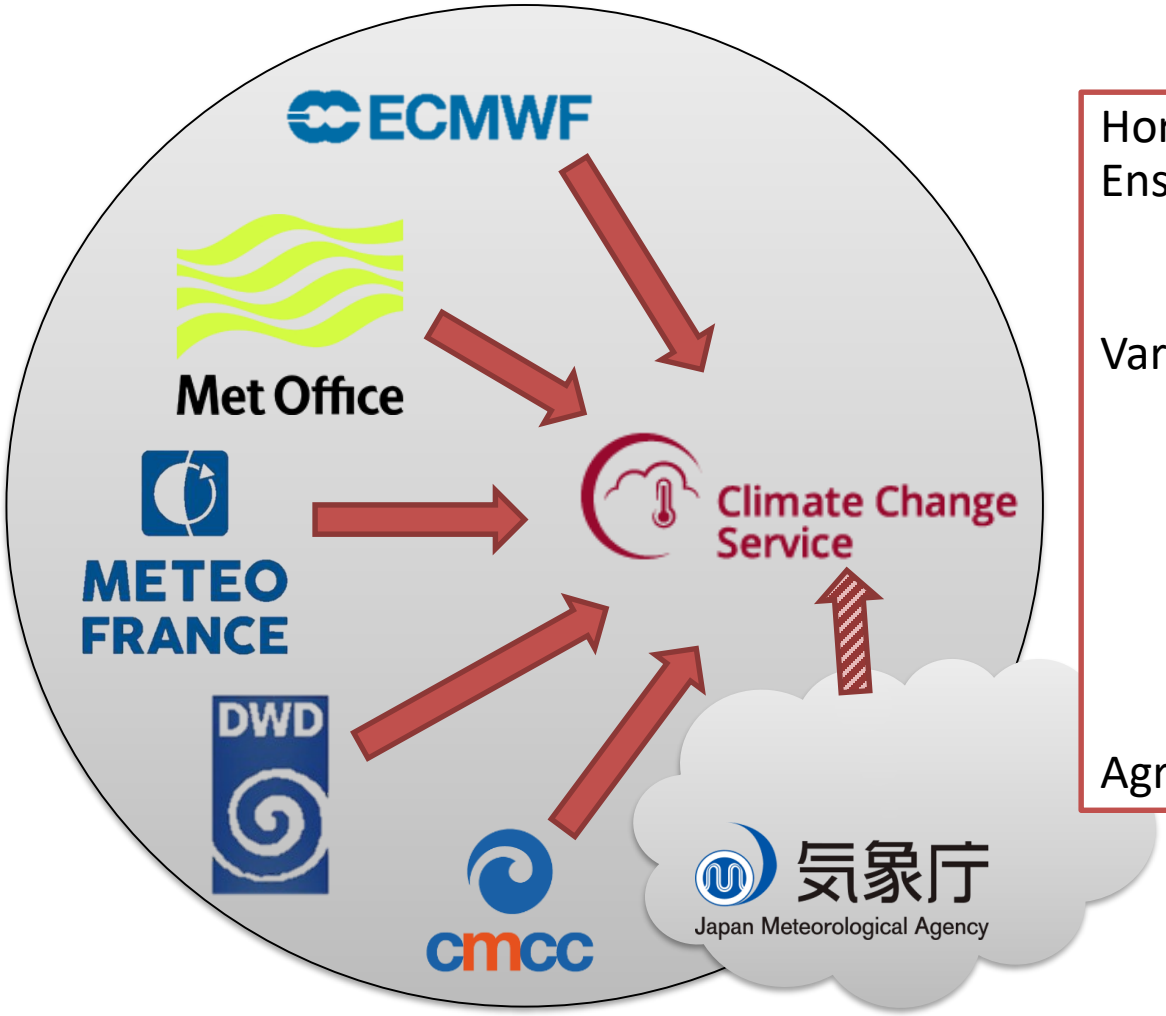




Climate Change

C3S seasonal forecasts - Introduction

Aim: to generate **seasonal forecast** products based on the **best information available**, to an **operational schedule**, and make them **publicly available**.



Horizontal grid: global 1deg x 1deg
Ensemble size:

- Forecasts: ~50 members
- Hindcasts: ~25 members x 24 years (1993-2016)

Variables

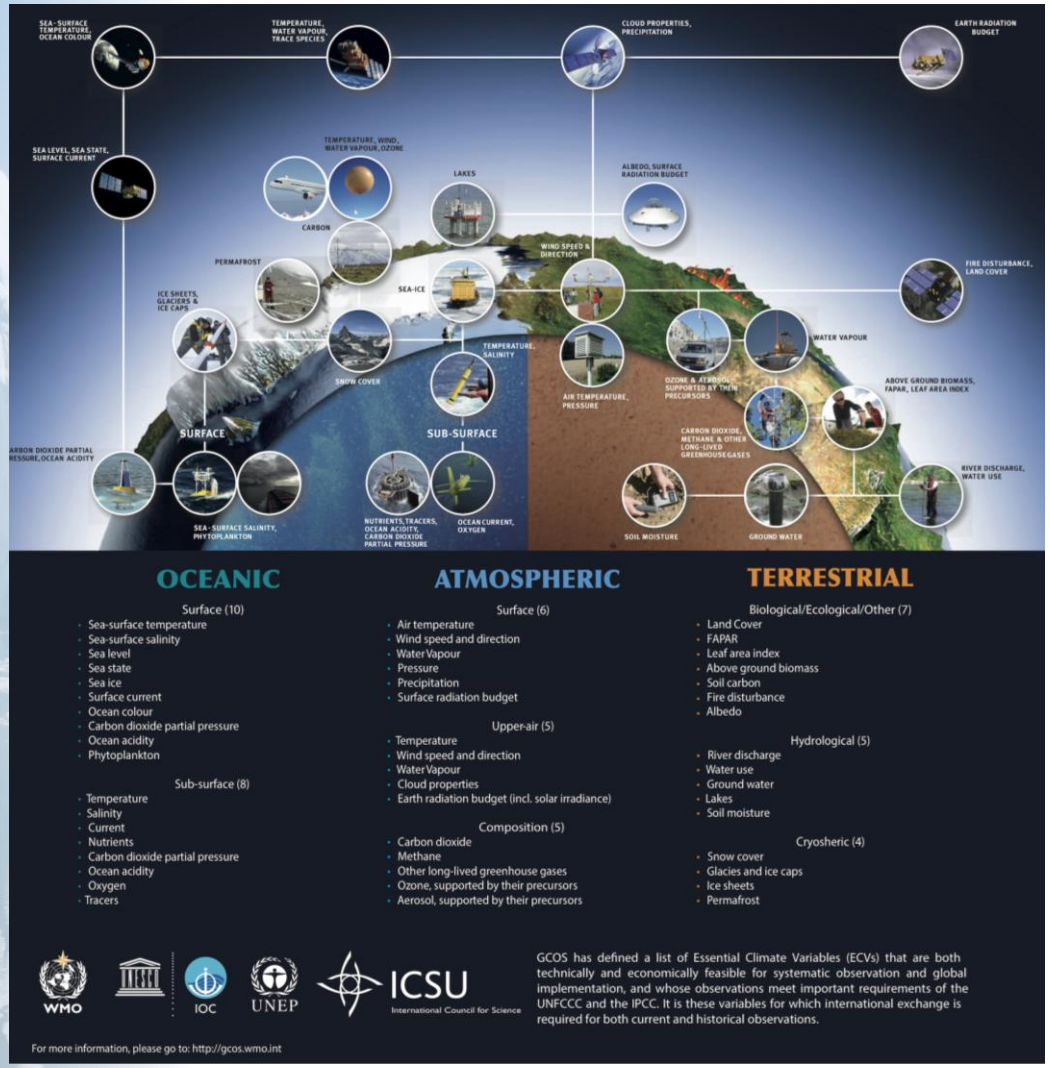
- Surface
  - 7 vars every 6h
  - +30 vars every 24h
- Pressure (11 levels, from 925 hPa to 10 hPa)
  - 8 vars every 12 h

Agreed NetCDF specification C3S-0.1 (based on CF)

opernicus Europe's eyes on Earth
European Commission

Climate Change

Essential Climate Variables



			C3S_312a				
				C3S_312b			
		GCOS	2017	2018	2019	2020	2021
Atmospheric physics							
	Precipitation	4.3.5			Lot 1		
	Surface Radiation Budget	4.3.6					
	Water Vapour	4.5.3					
	Cloud Properties	4.5.4					
	Earth Radiation Budget	4.5.5					
Atmospheric composition							
	Carbon Dioxide	4.7.1	Lot 6		Lot 2		
	Methane	4.7.2	Lot 6				
	Ozone	4.7.4	Lot 4				
	Aerosol	4.7.5	Lot 5				
Ocean							
	Sea Surface Temperature	5.3.1	Lot 3		Lot 3		
	Sea Level	5.3.3	Lot 2				
	Sea ice	5.3.5	Lot 1				
	Ocean Colour	5.3.7					
Land hydrology & cryosphere							
	Lakes	6.3.4			Lot 4		
	Glaciers	6.3.6	Lot 8				
	Ice sheets and ice shelves	6.3.7					
	Soil moisture	6.3.16	Lot 7				
Land biosphere							
	Albedo	6.3.9	Lot 9		Lot 5		
	Land Cover	6.3.10					
	Fraction of Absorbed Photosyntheti	6.3.11	Lot 9				
	Leaf Area Index	6.3.12	Lot 9				
	Fire	6.3.15					
			2017	2018	2019	2020	2021

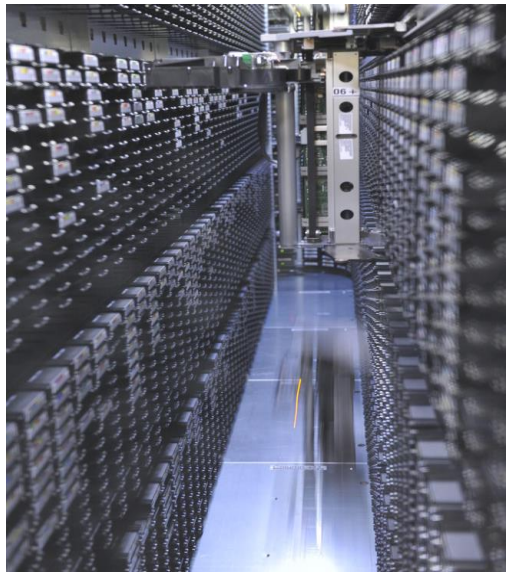
Copernicus Europe's eyes on Earth

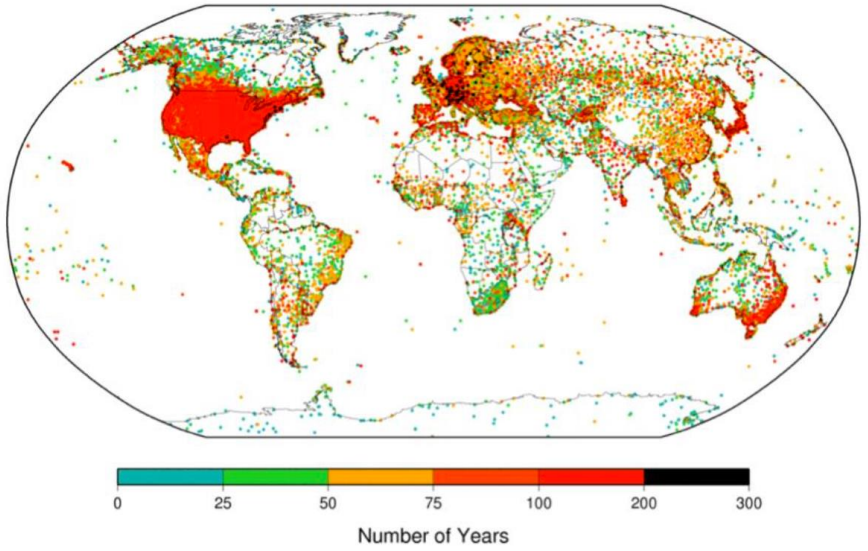
European Commission

Climate Change

Old Weather: C3S data rescue & Observations from Global Climate Data Archives

- Support for selected high-priority data rescue activities
- Merge of major land and marine surface data collections
- Data quality control and homogenisation
- Harmonisation of data and metadata under a Common Data Model
- Unified data access via the Climate Data Store

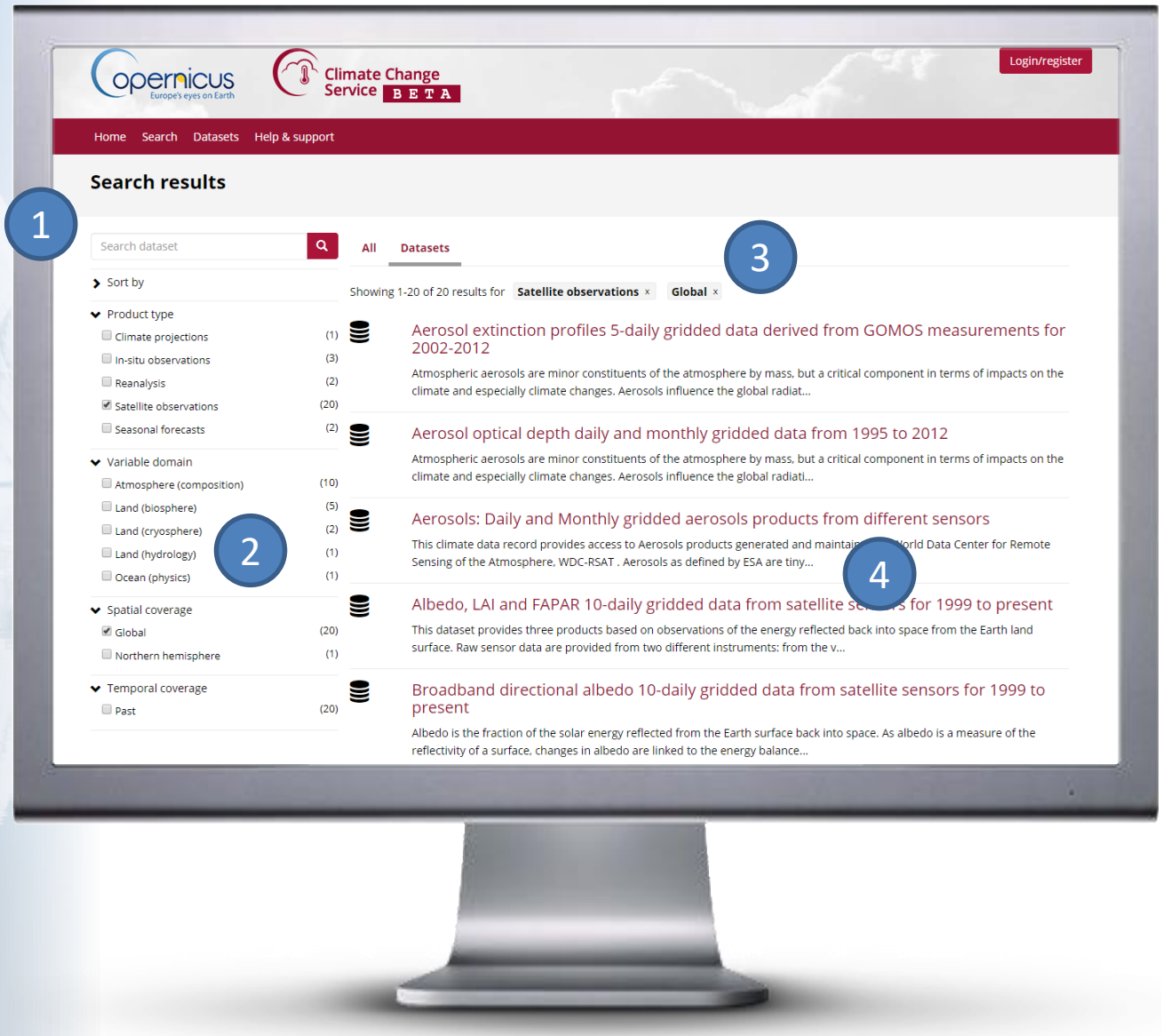




Copernicus Europe's eyes on Earth
European Commission

Climate Change

Search *"datasets"*

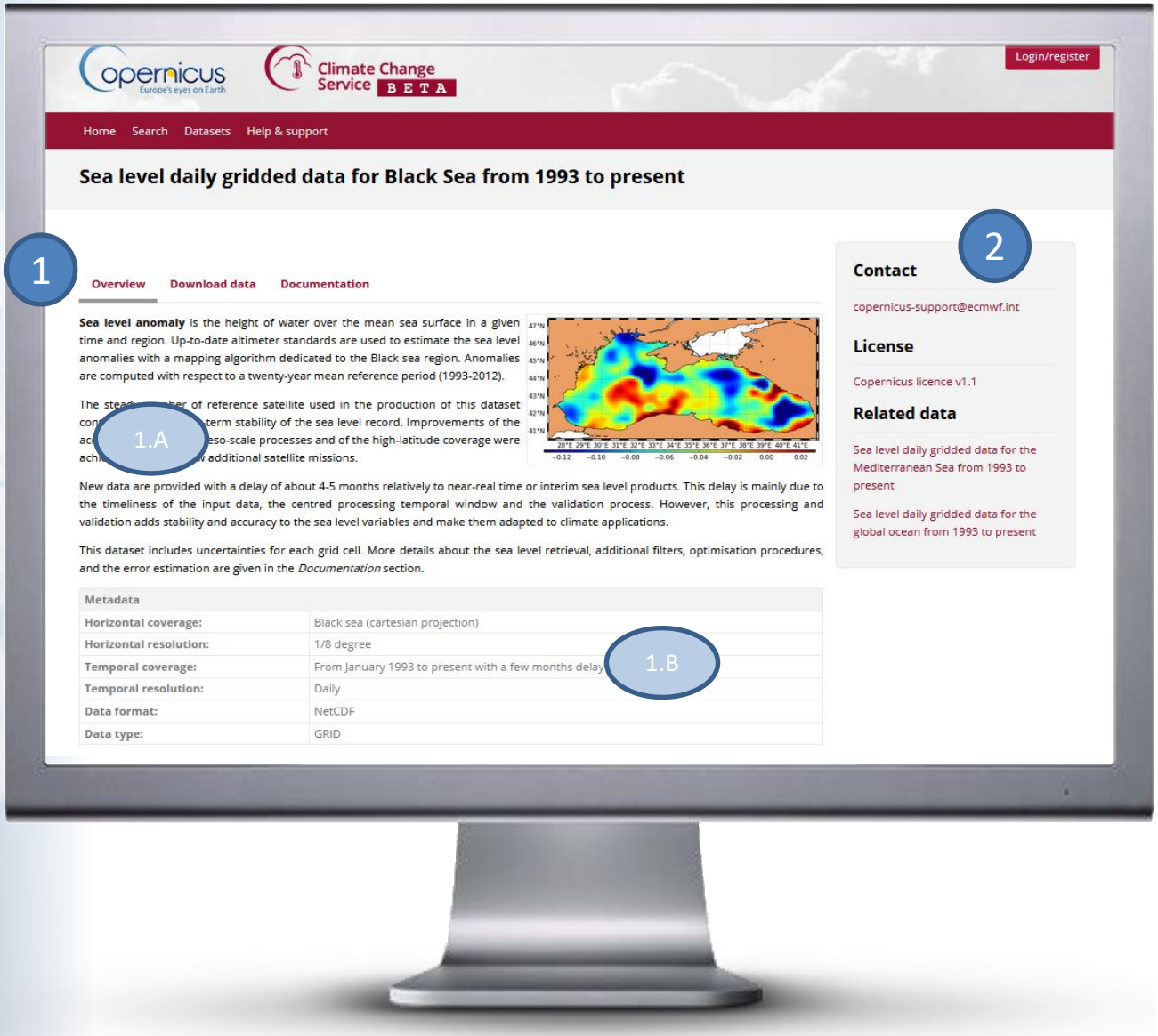


1. **Textual search**: free text.
2. **Facetted search**: Multiple criteria, only available combinations are displayed.
3. **Current searching criteria** (acumulative: textual + facetted + tipology of product)
4. **List of matching products in the catalogue**: Navigable by clicking on the title to the product dedicated area.

opernicus Europe's eyes on Earth

European Commission

Product *"overview"*



1 **Product toolbar**:

- *Overview*: Global textual description (abstract)
- *Download data*: Subsetting form.
- *Documentation*: Access to detailed documentation (technical guidelines, user manuals, EQC reports)

1.A **Abstract**: user readable explanation about the product.

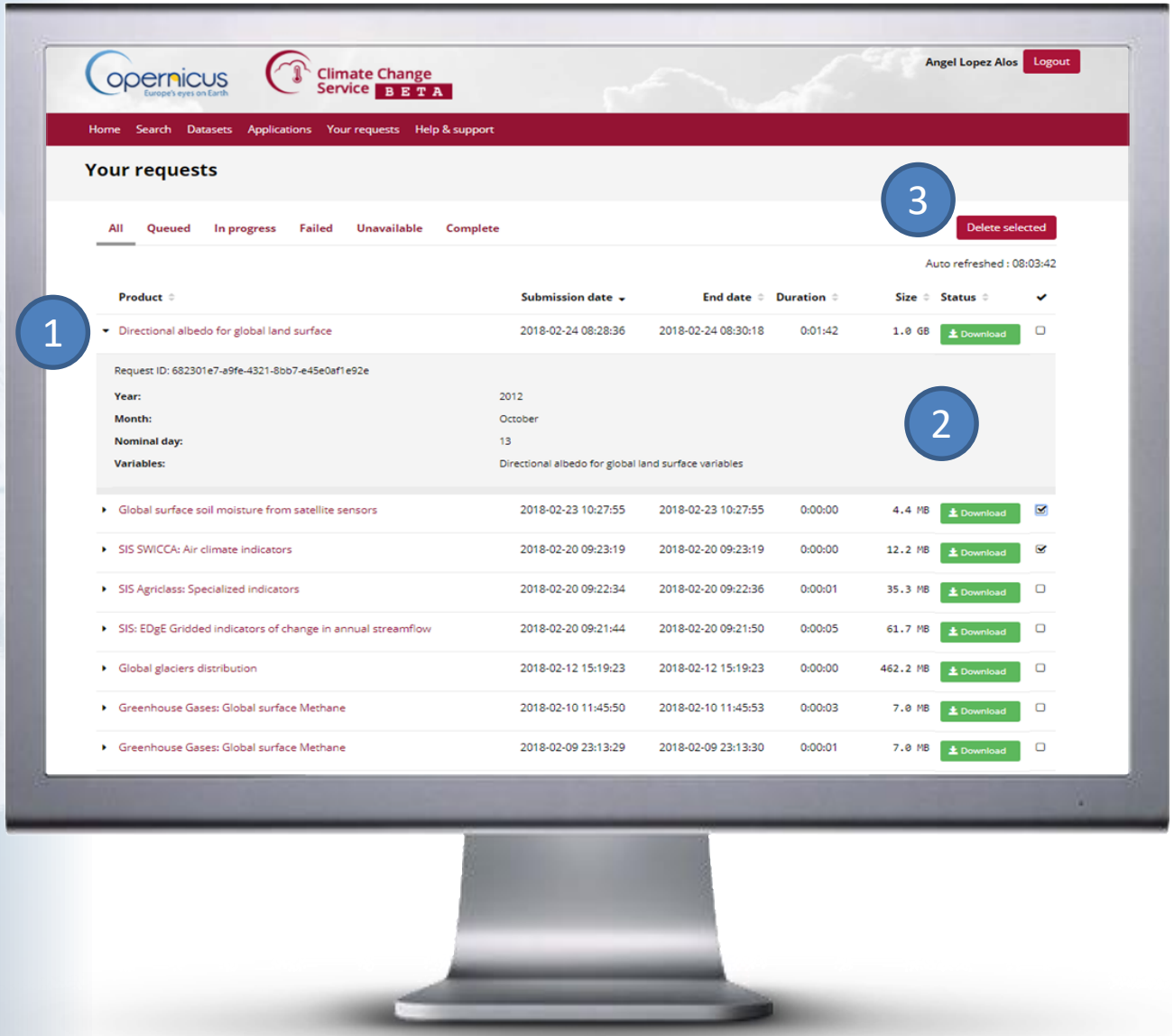
1.B **Detailed information**: Metadata about the product

2 **Related information block**:

- *Contact*: Mail box for questions about the product.
- *License*: All data is freely available but subject to some use licences.
- *Related data*: Products sharing facets.

Climate Change

"Your request" management



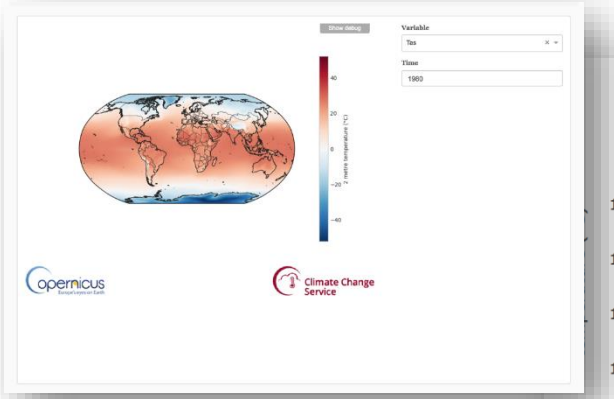
1. **Request information**: User have access to submitted requests.
   - *Product*: Short name of requested data product.
   - *Submission/End dates*.
   - *Duration*.
   - *Size of the file*.
   - *Status*:
     - Queued: waiting to by dispached to provider.
     - Running/In progress: Already dispatched to provider.
     - Download: data ready to be downloaded.
     - Failed: request migh fail. Error message should be presented.
     - Unavailable: requested result data no longer availble.

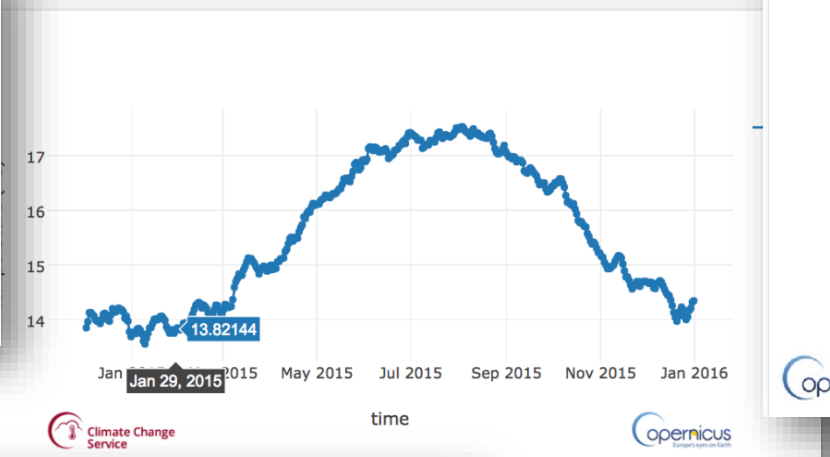
2. **Request information**: By clicking on the left arrow, detailed information about the scope of the request is diplayed.

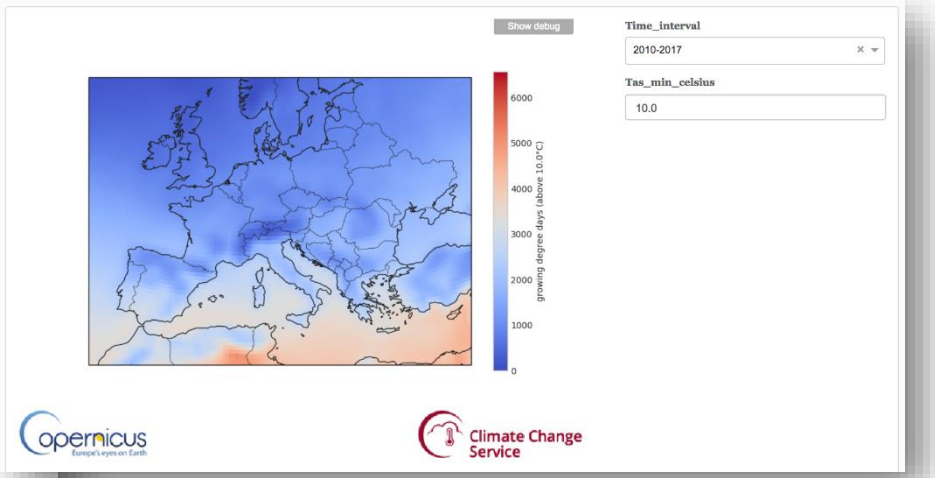
3. **Delete requests**: User can remove old requests from the list by selecting them and clicking on the delete function.

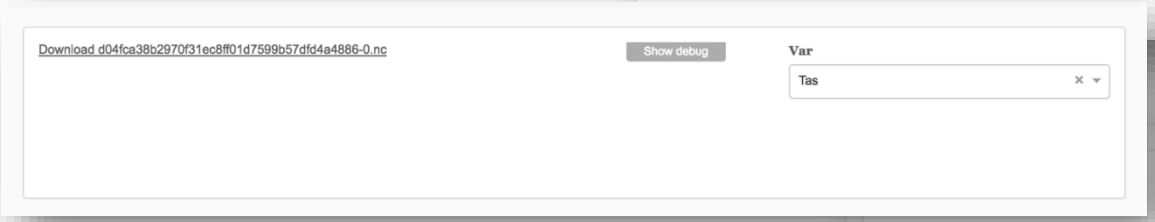
opernicus Europe's eyes on Earth
European Commission

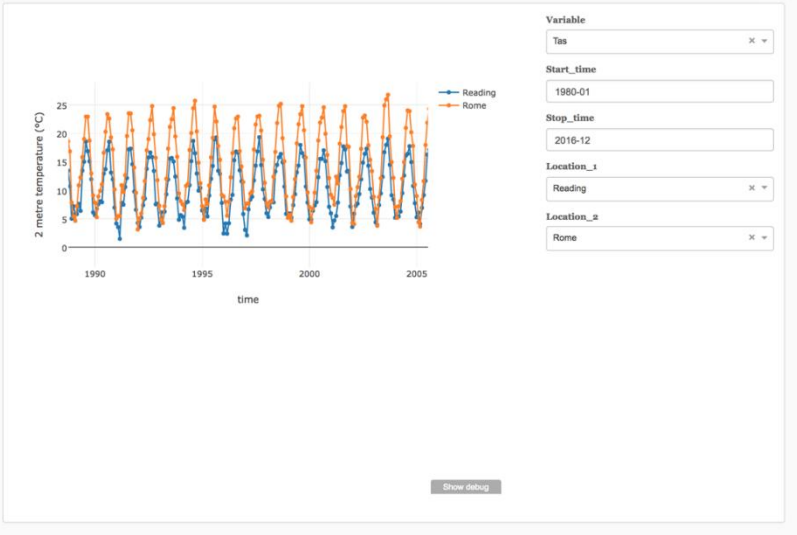
Climate Data Store - Toolbox

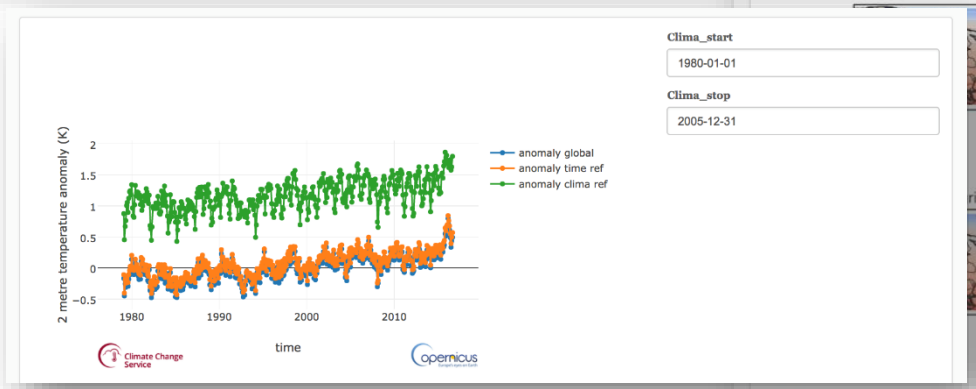


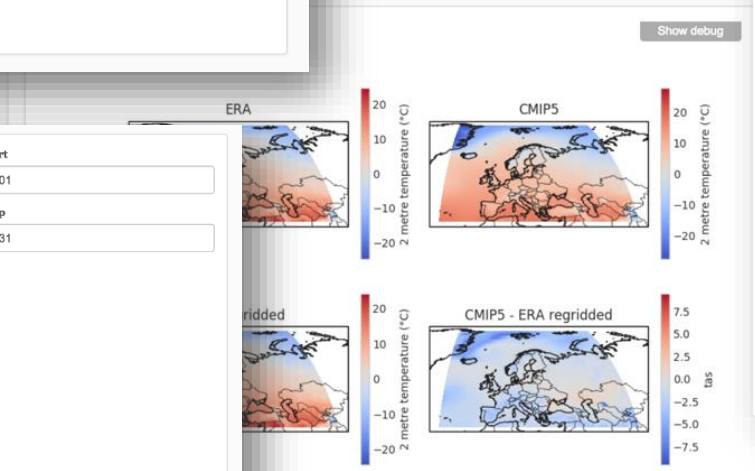










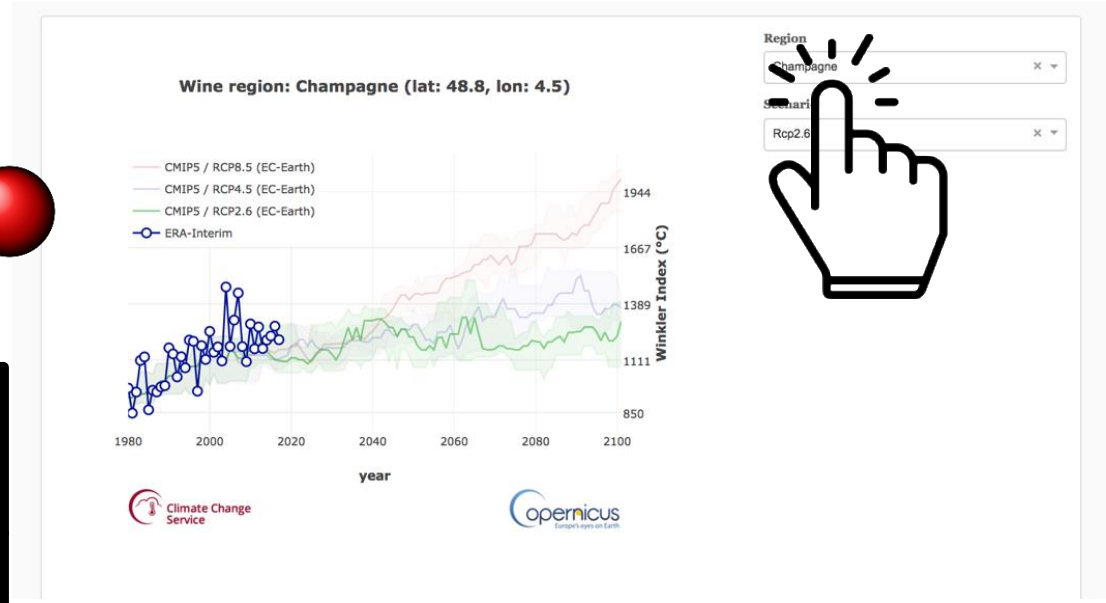


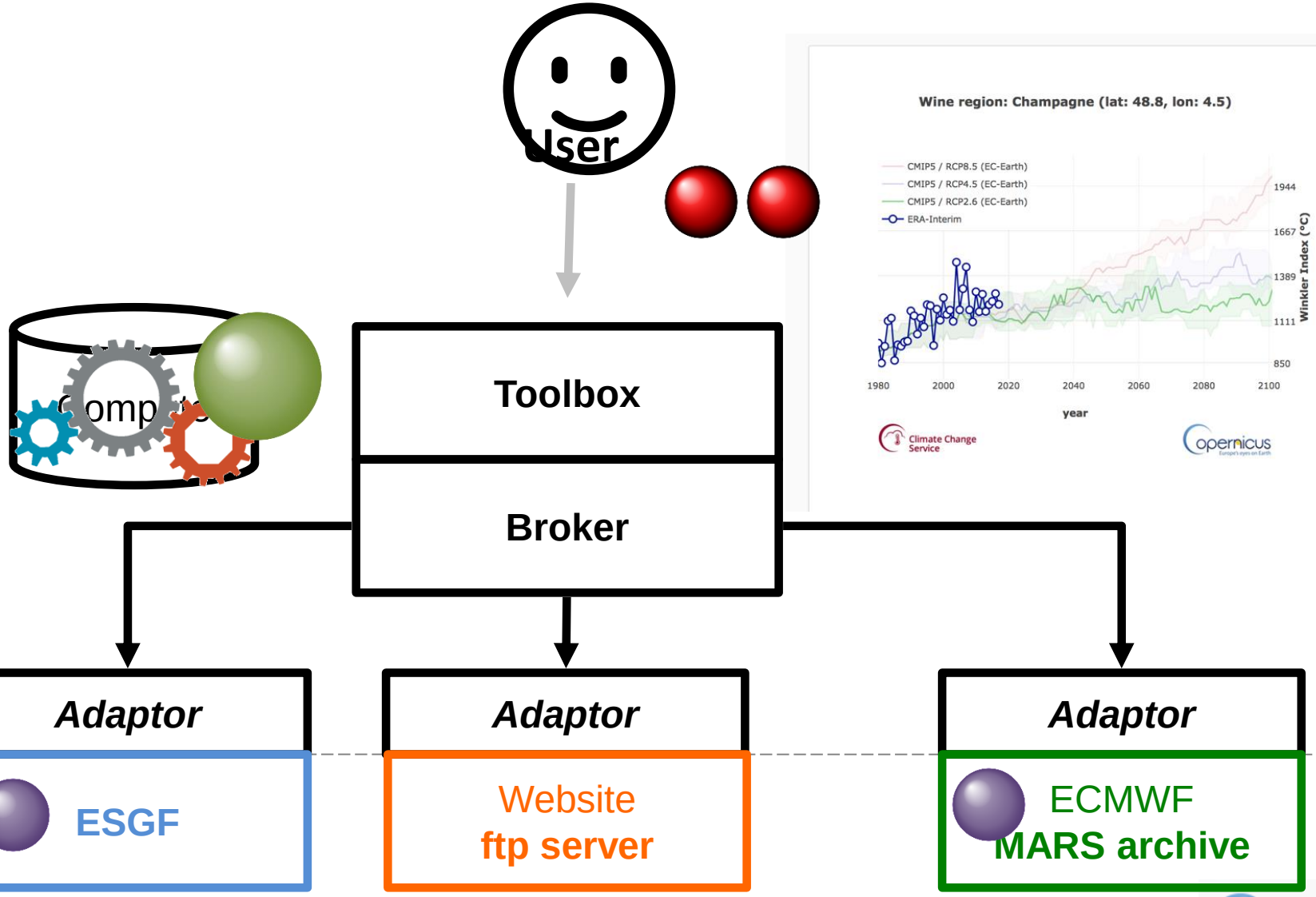
Copernicus
Europe's eyes on Earth

European Commission

Climate Change

Concept of the CDS & Toolbox: application development



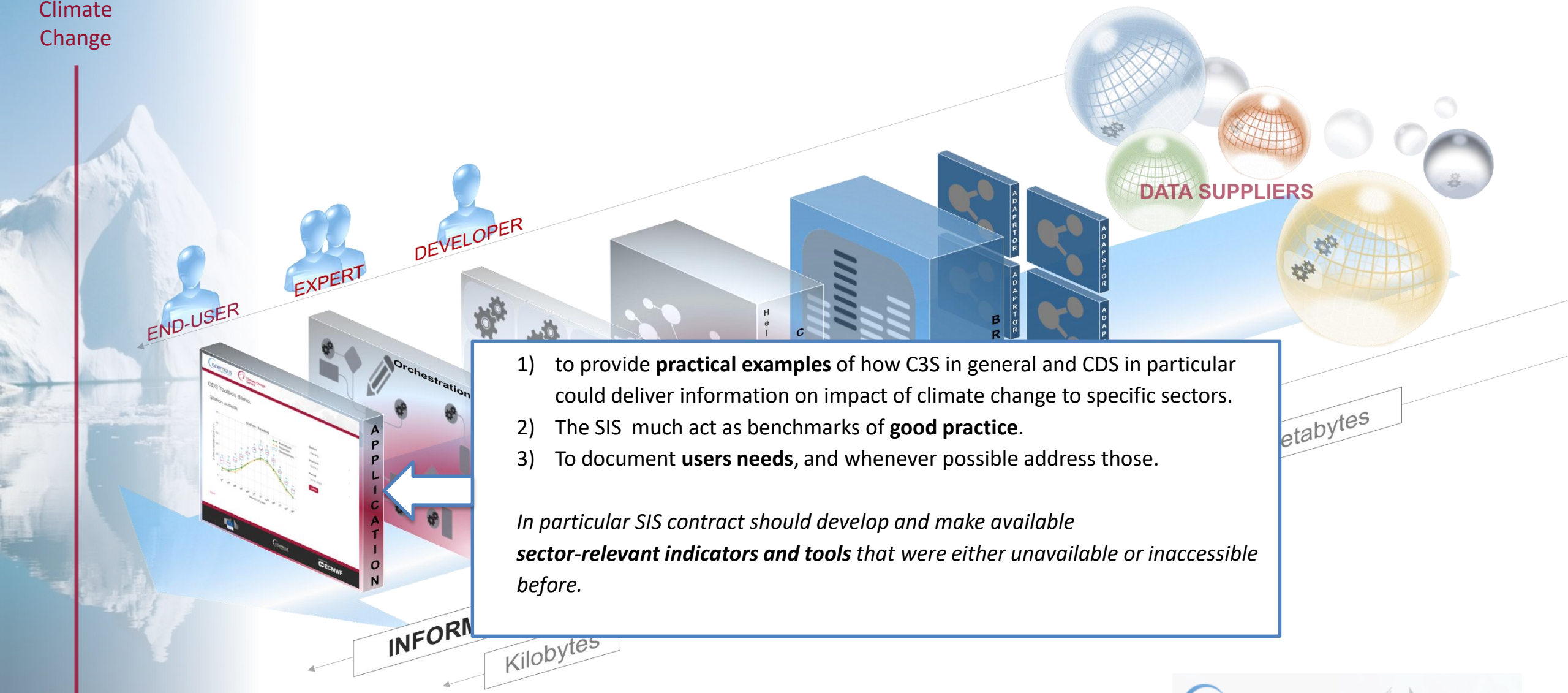


opernicus Europe's eyes on Earth

European Commission

Climate Change

Climate data store – The Sectoral Information System: From TB to Information



1) to provide **practical examples** of how C3S in general and CDS in particular could deliver information on impact of climate change to specific sectors.
2) The SIS much act as benchmarks of **good practice**.
3) To document **users needs**, and whenever possible address those.

In particular SIS contract should develop and make available ***sector-relevant indicators and tools*** *that were either unavailable or inaccessible before.*

Copernicus Europe's eyes on Earth

European Commission

Climate Change

Sectoral Information System

WHAT WILL THE INFORMATION BE USED FOR?

The wealth of climate information will be the basis for generating a wide variety of climate indicators aimed at supporting adaptation and mitigation policies in Europe in a number of sectors. These include, but are not limited to, the following:

C3S WILL DELIVER SUBSTANTIAL ECONOMIC VALUE TO EUROPE BY:

1. **INFORMING**
   POLICY DEVELOPMENT TO PROTECT CITIZENS FROM CLIMATE-RELATED HAZARDS SUCH AS HIGH-IMPACT WEATHER EVENTS
2. **IMPROVING**
   PLANNING OF MITIGATION AND ADAPTATION PRACTICES FOR KEY HUMAN AND SOCIETAL ACTIVITIES
3. **PROMOTING**
   THE DEVELOPMENT OF NEW SERVICES FOR THE BENEFIT OF SOCIETY

Copernicus Europe's eyes on Earth
European Commission

Climate Change

SIS contracts

Proof of concept

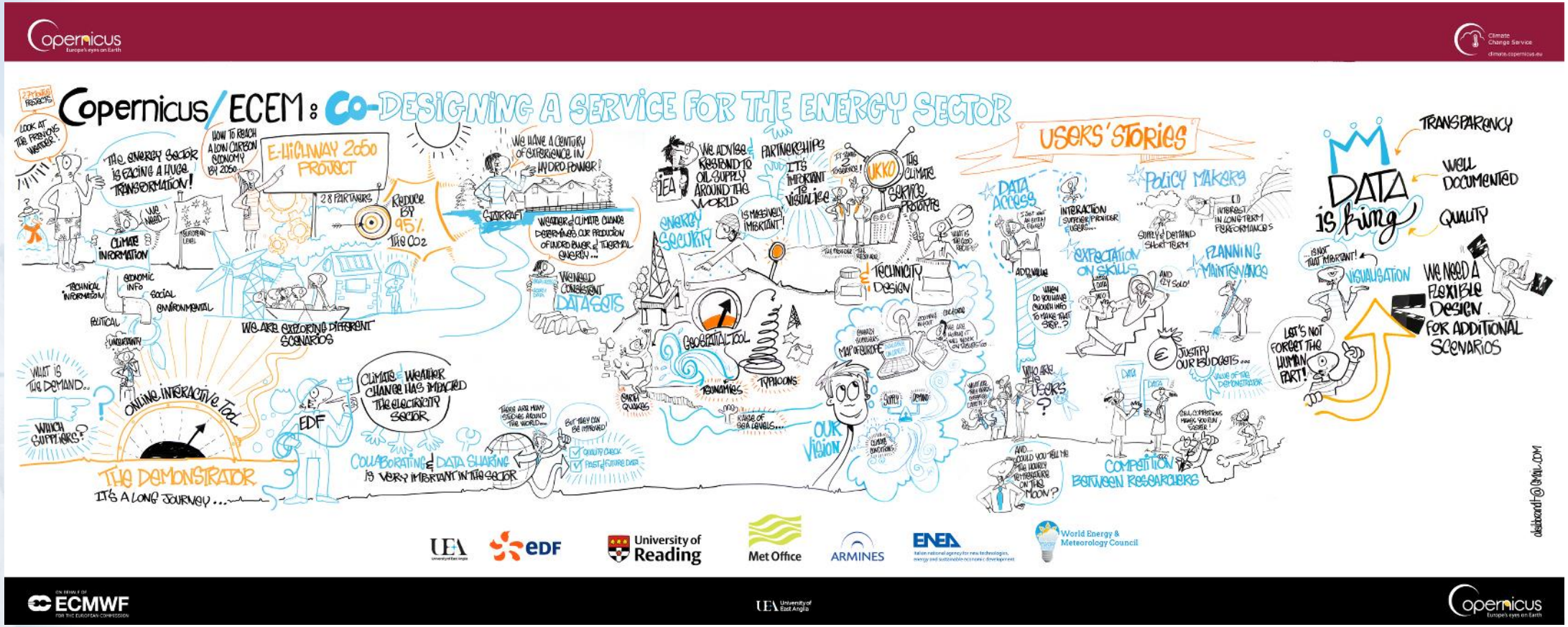
- **The past** (2016-2018):
  - Energy (UEA, CEA), Water (CEH,SMHI), Insurance (CGI), *Urban (SMHI), Agriculture (Telespazio Vega)*

Operational phase

- **The present** (2018-2019 and beyond):
  - *European*: Storm-Surges (Deltares), Fisheries (PML), Tourism (TEC), Cities/Health (Vito)
  - *Global*: Shipping (OSM), Global Impacts (SMHI), Agriculture (WEnR)
- **The future**:
  - Commenced: Energy, Water, Insurance
  - Coming Soon: Quality Assurance for SIS, Biodiversity, Forestry, Cultural heritage, Case studies, Transport, Disaster Risk Reduction

Climate Change

Stakeholder Engagement: Workshops



University of East Anglia

University of Reading

Met Office

ARMINES

ENEA

Copernicus Europe's eyes on Earth

European Commission

C2	C3	C4	C5	CP1
User Requirement (UR) description	UR class	Raw requirement	User sector	ECV
Free text. Be specific and quantify statements where possible.	**Choose from:** **- Product** (complete CP) **- Variable** (complete CP) **- General** (complete CG)	Original text. Extract from project source material.	**Choose one or more sector from C3S Sectors:** **- Agriculture and forestry - Coastal** **- Disaster risk reduction - Energy** **- Health - Infrastructure** **- Insurance - Tourism** **- Transport - Water management**	**Use terms fr**
Seasonal forecasts of precipitation for the insurance sector should be available before the underwriting/ renewal season	Variable	seasonal rainfall forecast: Seasonal forecast be made available prior to renewal timeline (Jan 1st - April 1st): Seasonal forecasts do not align with insurance timeline. To be truly useful, a seasonal forecast would need to be made prior to the underwriting/renewal season.	Insurance	Precipitation
Seasonal forecasts of sea surface temperature for the insurance sector should be available before the underwriting/renewal season	Variabl	seasonal forecast of ocean surface temperature: Seasonal forecast be made available prior to newal timeline (Jan 1st - April 1st): Seasonal forecasts do not align with insurance timeline. To be useful, a seasonal forecast would need to be made prior to the underwriting/renewal season.	Insurance	Sea surface
Seasonal forecasts of surface temperature for the insurance sector should be available before the underwriting/renewal season	V	f surface temperature: Seasonal forecast be made available prior to renewal 1st): Seasonal forecasts do not align with insurance timeline. To be truly would need to be made prior to the underwriting/renewal season.	Insurance	Surface air t
Seasonal forecasts of tropical cyclone activity, specifically the number of storms, for the insurance sector should be available before the underwriting/ renewal season		ivity: Seasonal forecast be made available prior to renewal sts do not align with insurance timeline. To be truly de prior to the underwriting/renewal season.	Insurance	
Seasonal forecasts of tropical cyclone activity, specifically the Accumulated Cyclone Energy, for the insurance sector should be available before the underwriting/renewal season	Variable	st be made available prior to renewal insurance timeline. To be truly riting/renewal season.	Insurance	
Seasonal forecasts of precipitation for the insurance sector should cover the full upcoming year	Variable	al timeline (Jan 1st - ful, a seasonal	Insurance	Precipitation
Seasonal forecasts of sea surface temperature for the insurance sector should cover the full upcoming year	Variable	seasonal fo renewal timelin truly useful, a seaso	nce	Sea surface
Seasonal forecasts of surface temperature for the insurance sector should cover the full upcoming year	Variable	seasonal forecast of surface temp timeline (Jan 1st - April 1st): Seasona useful, a seasonal forecast would need to		Surface air t
Seasonal forecasts of precipitation should have more ensemble members to capture full level of uncertainty	Variable	seasonal rainfall forecast: More ensemble to rep of ensemble members in seasonal forecasts. Current uncertainty.	nce	Precipitation
Seasonal forecasts of sea surface temperature should have more ensemble members to capture full level of uncertainty	Variable	seasonal forecast of ocean surface temperature: More ensemble an insufficient number of ensemble members in seasonal forecasts. capture the full level of uncertainty.	surance	Sea surface
Seasonal forecasts of surface temperature should have more ensemble members to capture full level of uncertainty	Variable	seasonal forecast of surface temperature: More ensemble to represent uncertain insufficient number of ensemble members in seasonal forecasts. Current ensembles the full level of uncertainty.	Insurance	Surface air t
Seasonal forecasts of precipitation should be available at a higher spatial resolution	Variable	seasonal rainfall forecast: Increasing spatial resolution	Insurance	Precipitation
Seasonal forecasts of surface temperature should be available at a higher spatial resolution	Variable	seasonal forecast of surface temperature: Increasing spatial resolution	Insurance	Surface air t
Seasonal forecasts of precipitation should include forecasts of extremes	Variable	seasonal rainfall forecast: make forecast of extremes	Insurance	Precipitation

Already ~1400 entries !

Contract led by Uni. Reading

ECMWF Copernicus Europe's eyes on Earth European Commission

Data is not information without users and context: co-design in practice

Climate Change

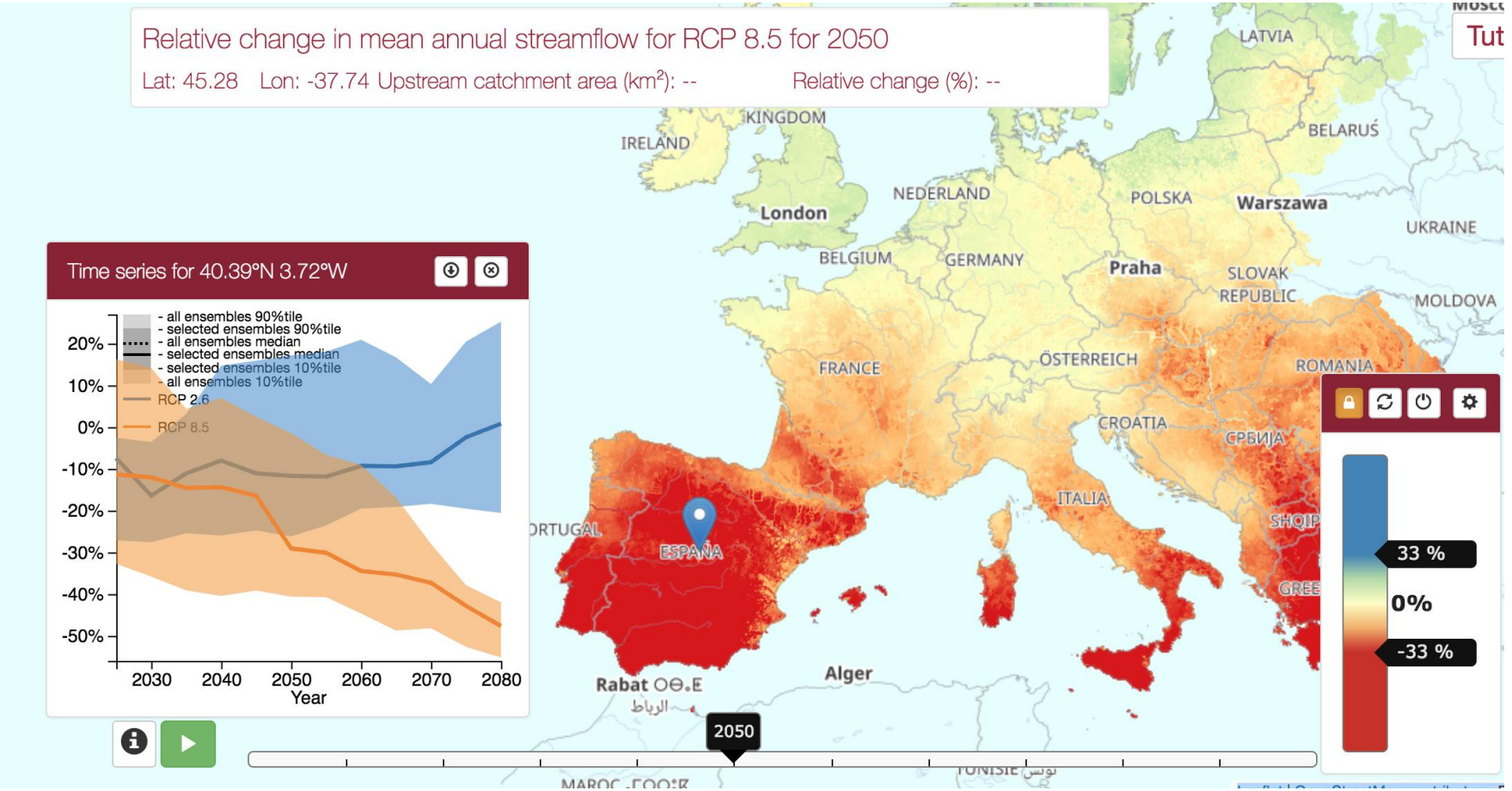
This is a small subset of the set of users SMHI have engaged with in one of our SIS (water) contracts. We had so far 17 of those contracts.
It is difficult to summarise all we learnt but:

1) Many users just want data: good data, easy to access and well characterized.
2) Our primary users are not necessarily the end-user but rather the intermediate ones

Copernicus Europe's eyes on Earth
European Commission

Climate Change

Example: Water resources and drought



Using a combination of chain of models linking future climate scenarios with hydrological parameters it has been possible to produce an operational assessment of current and future conditions..

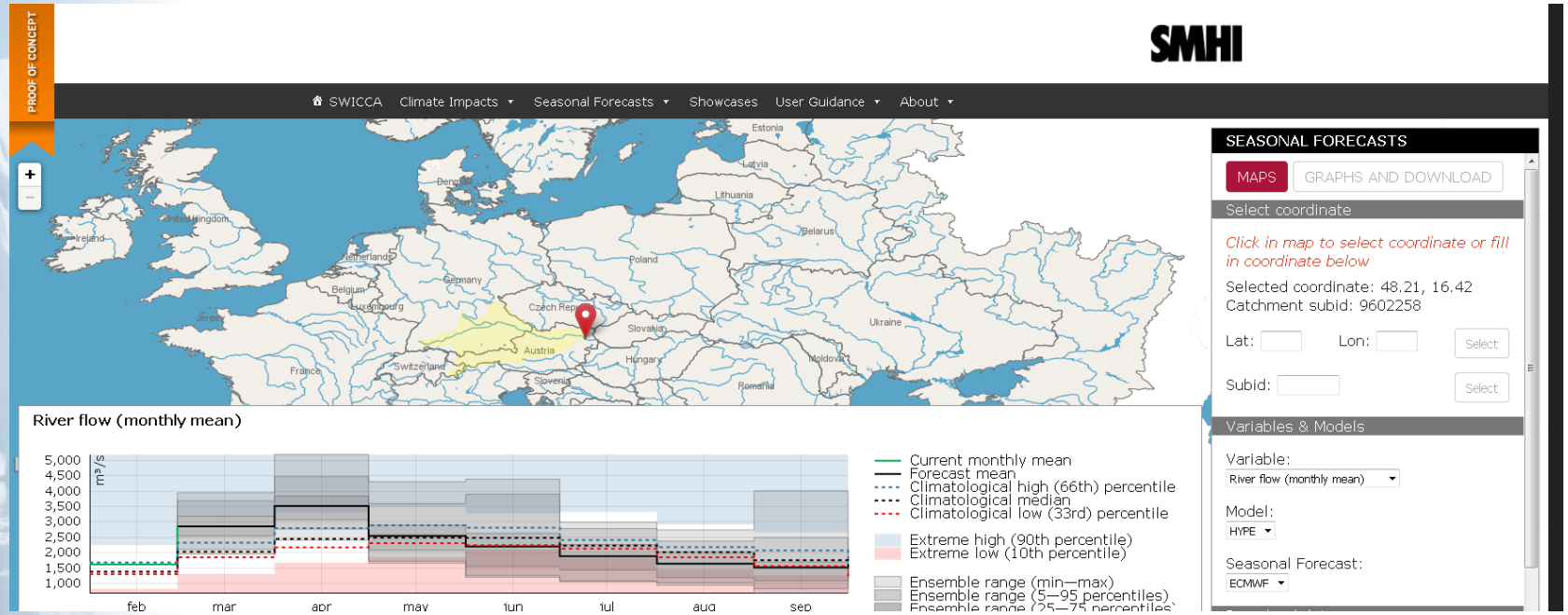
Samaniego et al. Nature Climate Change **volume 8**, pages421–426 (2018) doi:10.1038/s41558-018-0138-5

Copernicus Europe's eyes on Earth

European Commission

Operational Water SIS

Climate Change



Contract led by SMHI

We entered in an operational contract for water with SMHI.

The contract will provide:

- Multi-model (e-hype, VIC and LISFLOOD) seasonal predictions for a number of t-ECVs and SCIIs
- Seasonal Forecasting - Will use ECMWF system 5 inputs to start with.
- Climate change projections for the same variables based on Euro-Cordex
- Will run on ECMWF machines using EC-Flow and will push the data onto the CDS catalogue.

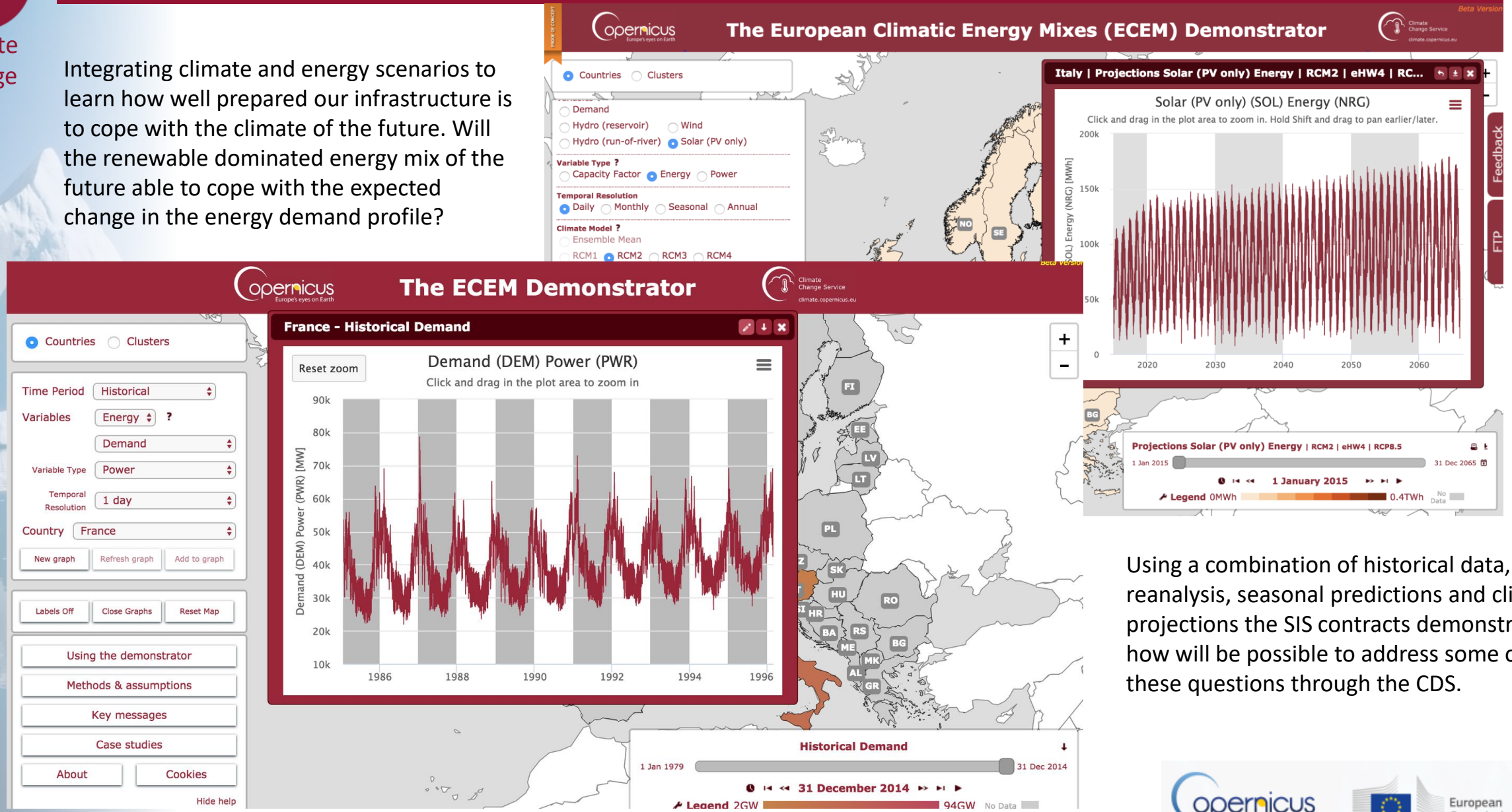
Copernicus Europe's eyes on Earth

European Commission

Example: Energy Applications

Climate Change

Integrating climate and energy scenarios to learn how well prepared our infrastructure is to cope with the climate of the future. Will the renewable dominated energy mix of the future able to cope with the expected change in the energy demand profile?



Using a combination of historical data, reanalysis, seasonal predictions and climate projections the SIS contracts demonstrated how will be possible to address some of these questions through the CDS.

Contract led by A. Troccoli UEA

Climate Change

Insurance services – Wind Storm Database

Secure | https://wisc.climate.copernicus.eu/wisc/#/indicators

WISC HOME | PRODUCTS | EXPLORE | USER GUIDANCE | ACCOUNT | HELP | C3S

Historic Losses

home > Historic Losses

This interactive visualisation shows economic losses estimated using the footprints of the most extreme windstorms to hit Europe between 1979 and 2013.

The purpose of these data is to provide consistent loss estimates across all the storms, using an open method.

For further details, click here. For help on using the tool, click here.

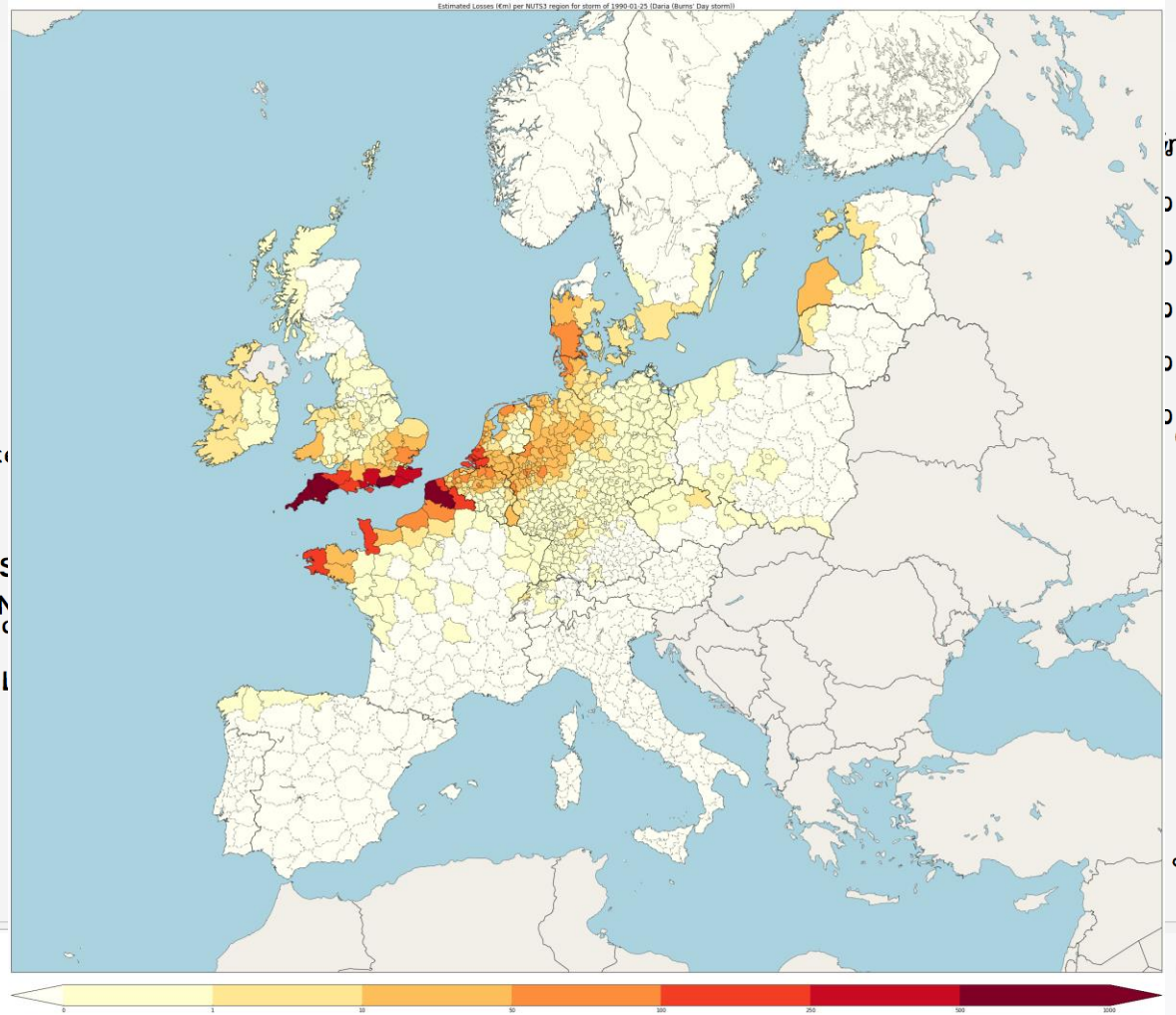
Controls

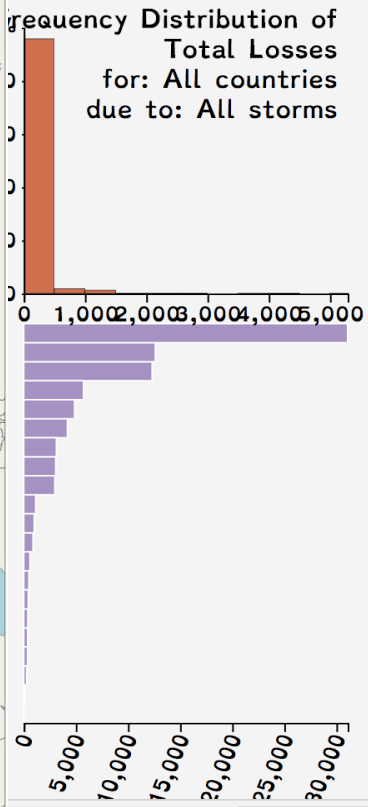
Loss type:
Total

Aggregate by year

Sort countries:
- Alphabetically
- By Total Damage

Sort storms:
- Chronologically
- By Total Damage

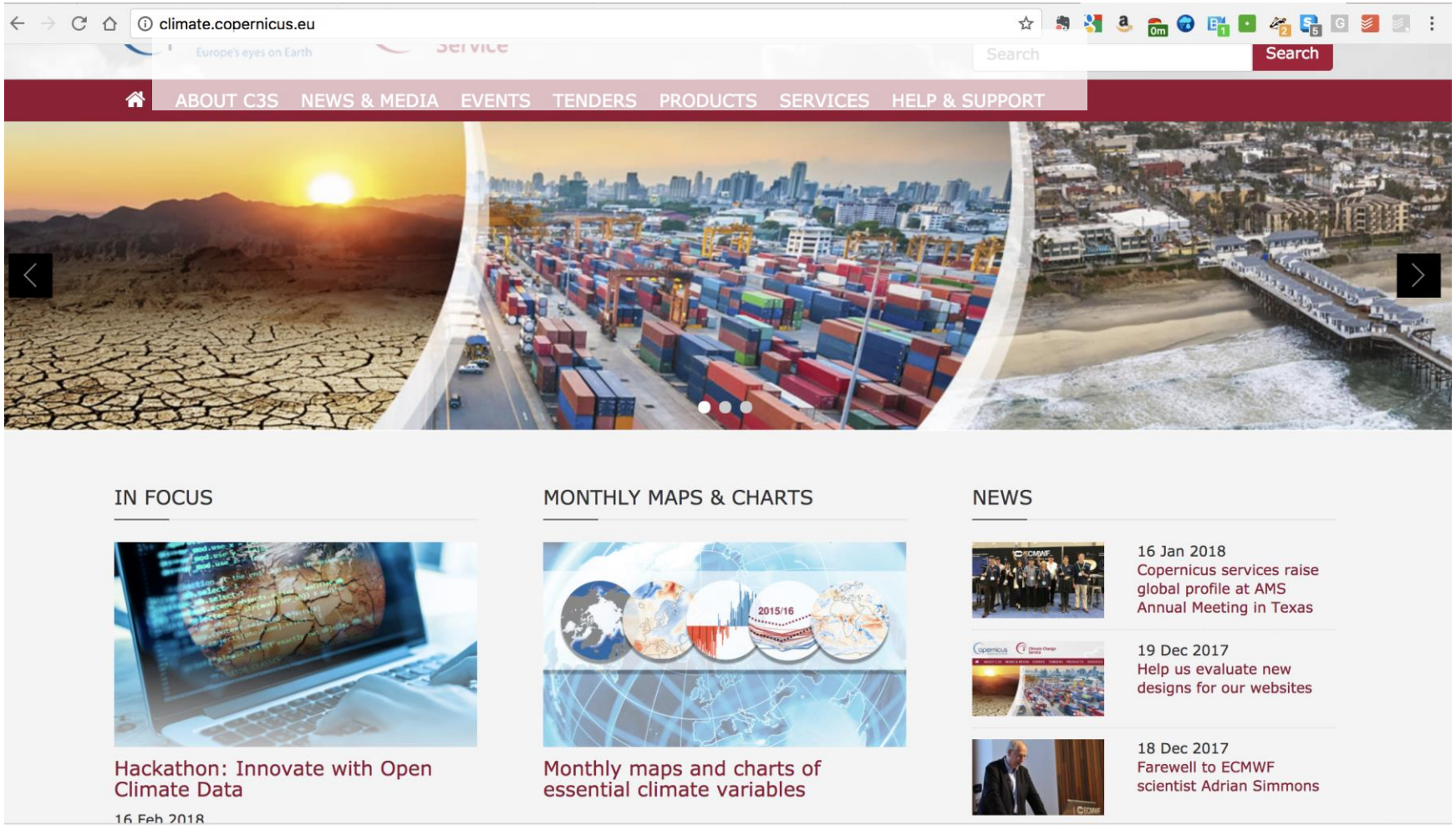




Copernicus Europe's eyes on Earth

European Commission

www.climate.copernicus.eu



Samuel.Almond@ecmwf.int

Copernicus Europe's eyes on Earth

European Commission