Climate Change

Copernicus Climate Change Service (C3S): A quick introduction

Samuel Almond / Chiara Cagnazzo - ECMWF

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European Commission

ECMWF

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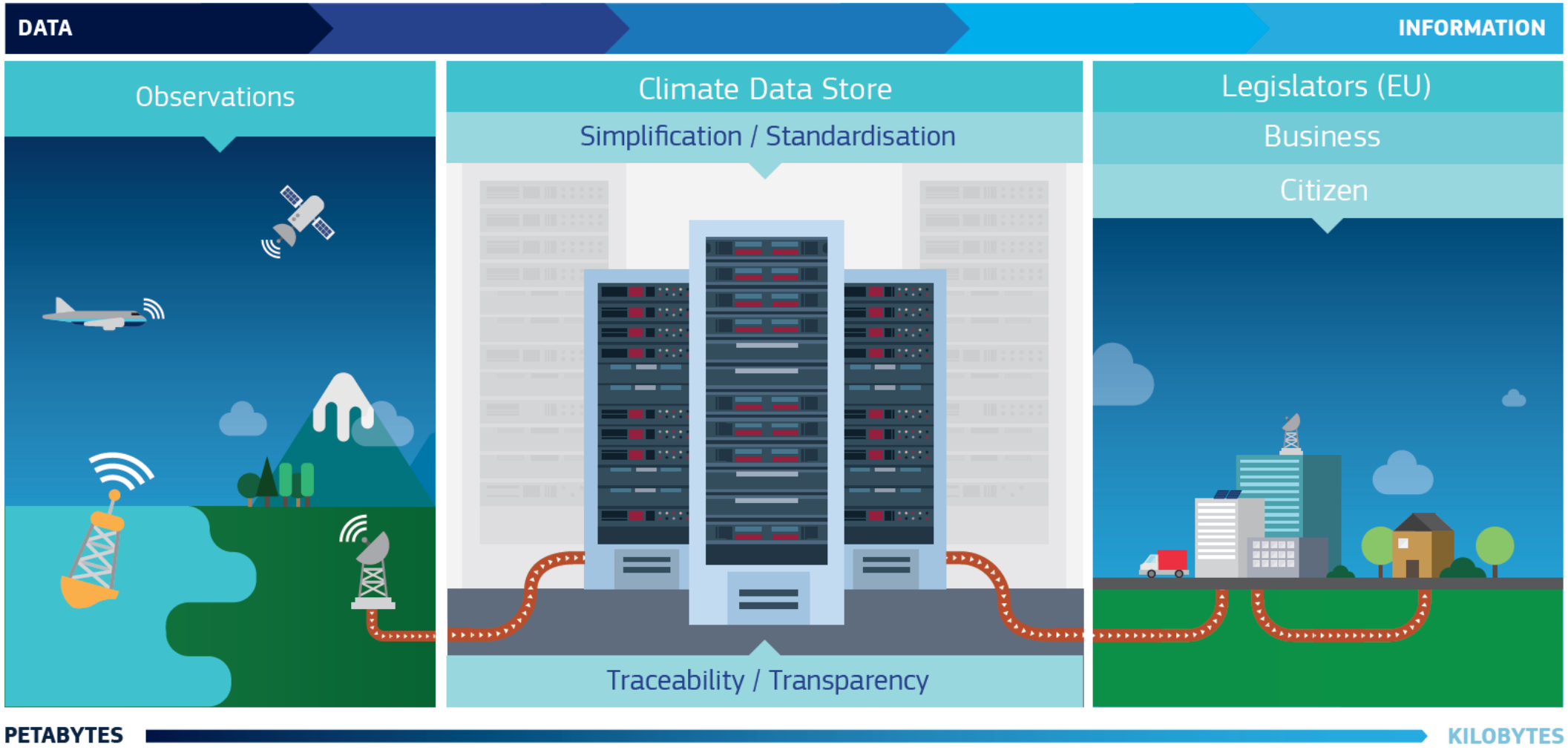
More Than Climate Data..... Climate Information



Typical download: **70 TB** /day

200,000 + users

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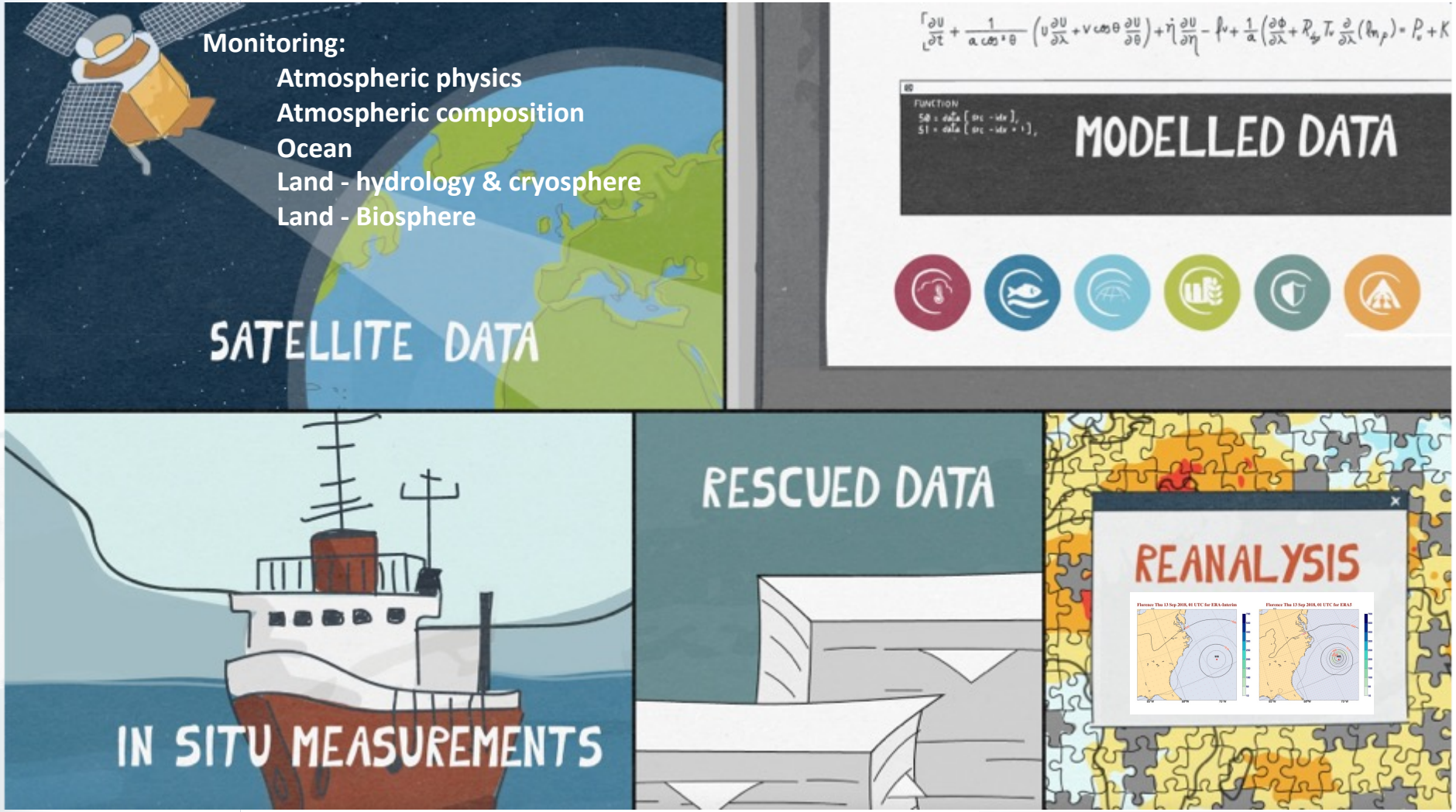
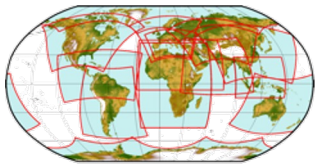
The Climate Data Store – ‘A one stop shop for climate data’





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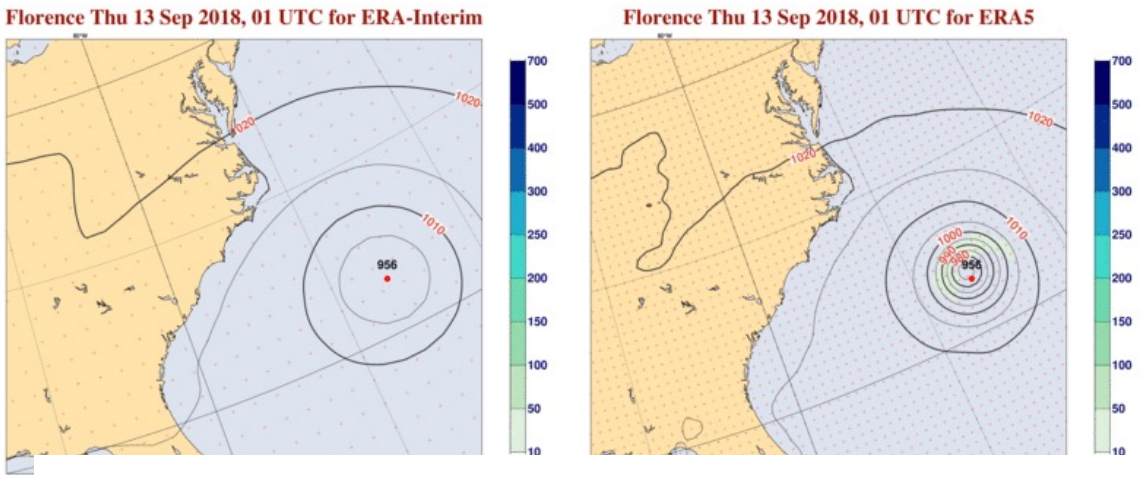
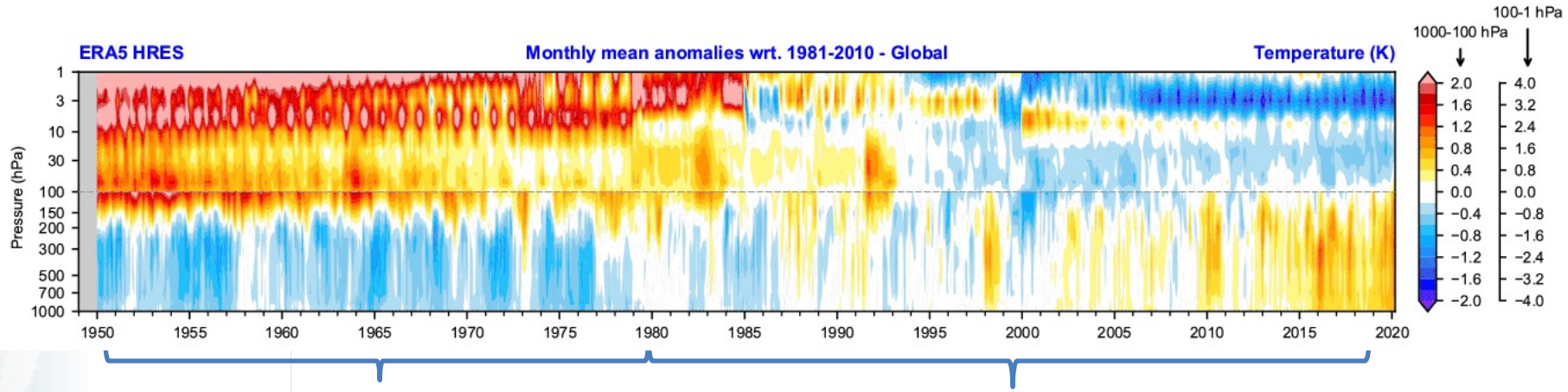
The past weather without gaps: global atmospheric reanalysis ERA5





1950 – 1979
Published end 2021

1979 – present
Complete. NRT stream runs RT – 1 day

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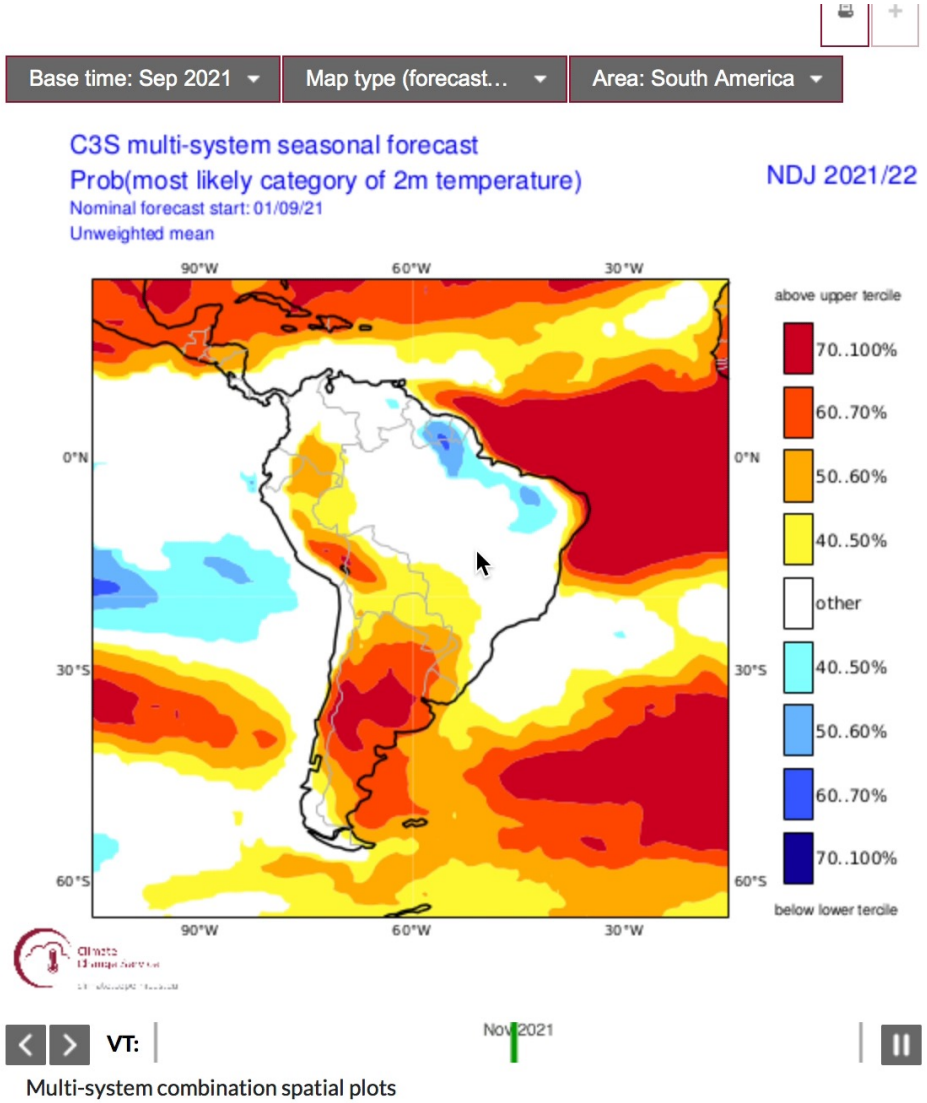
Climate Predictions – Seasonal Forecasts



Multi-system combination spatial plots

- Data – from world-leading producers
- Operational schedule – released monthly (12th of the month)
- Tools and computational environment

Free and open access to all these resources

cmcc · DWD · ECMWF · Canada · Climate Change Service · 気象庁 · METEO FRANCE · Met Office · NOAA

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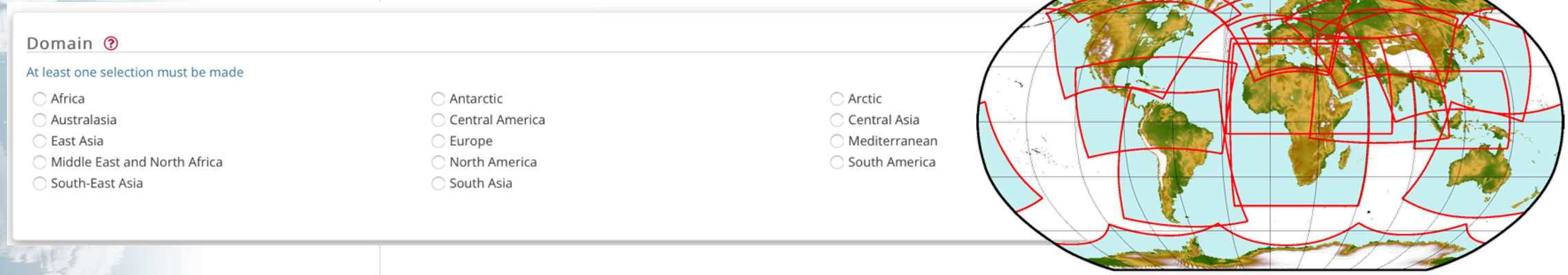
C3S Climate Projections

- **CMIP5 simulations:** in the Climate Data Store (CDS) since 2018
- **CMIP6 simulations:** published in CDS in March 2021
  - **New functionality** to improve handling of data **web-processing services**

- **World-wide CORDEX simulations:** European region in the CDS since 2019; continual update with data for other regions



IMPLEMENTED BY

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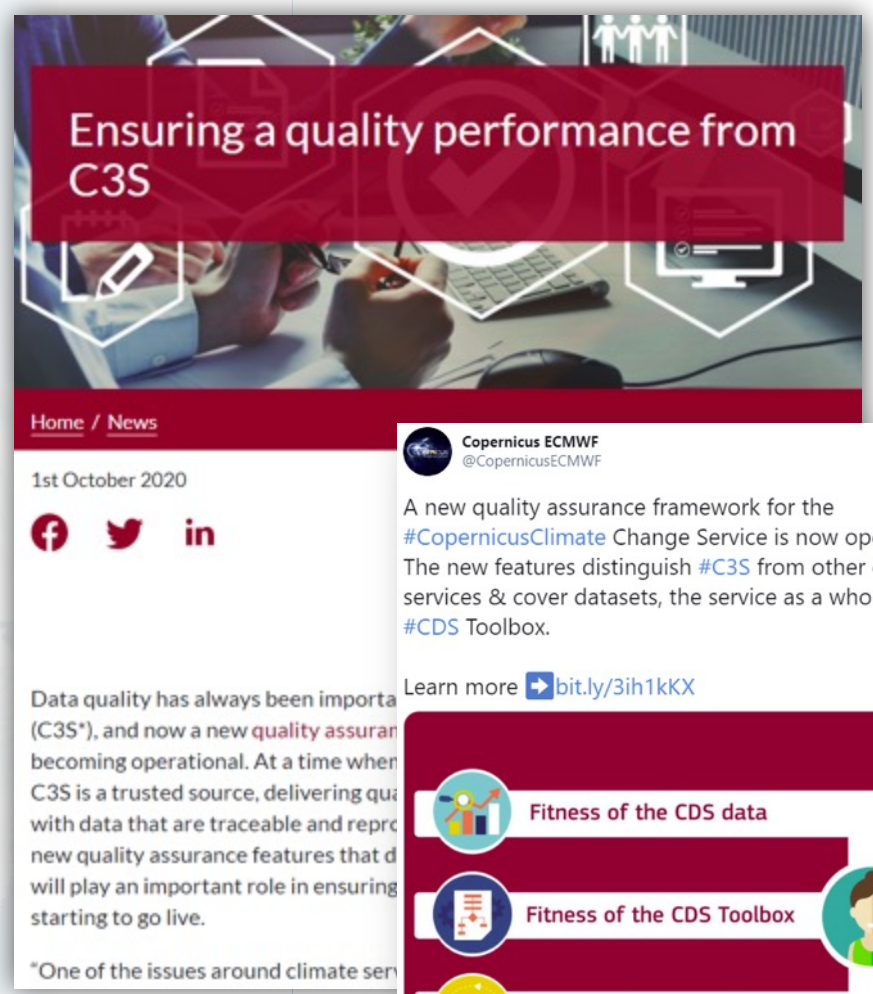
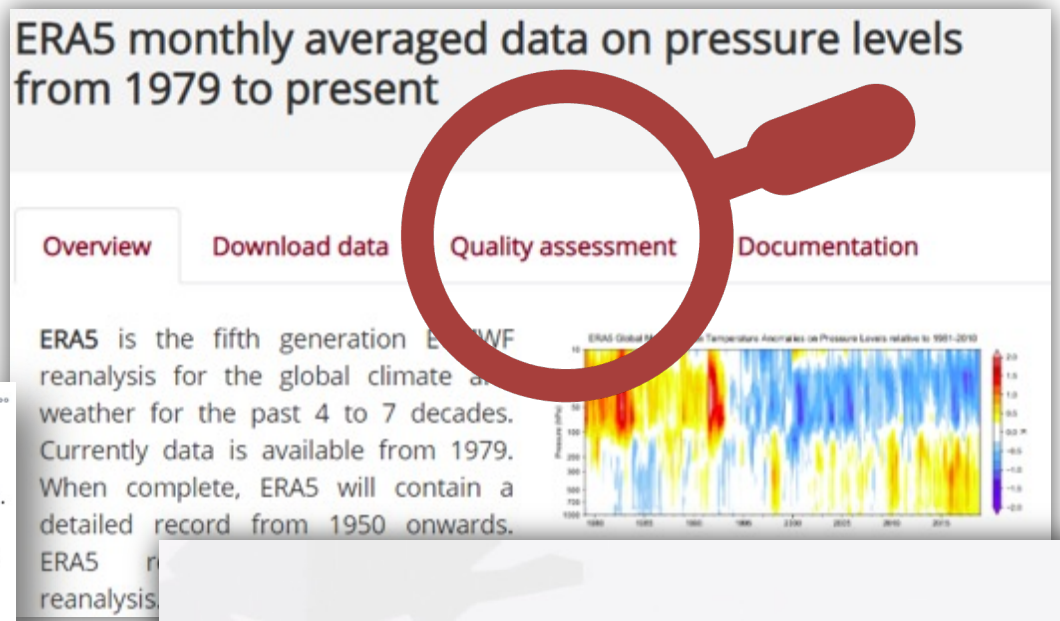
Evaluation & Quality Control framework





https://climate.copernicus.eu/ensuring-quality-performance-c3s

C3S Scope

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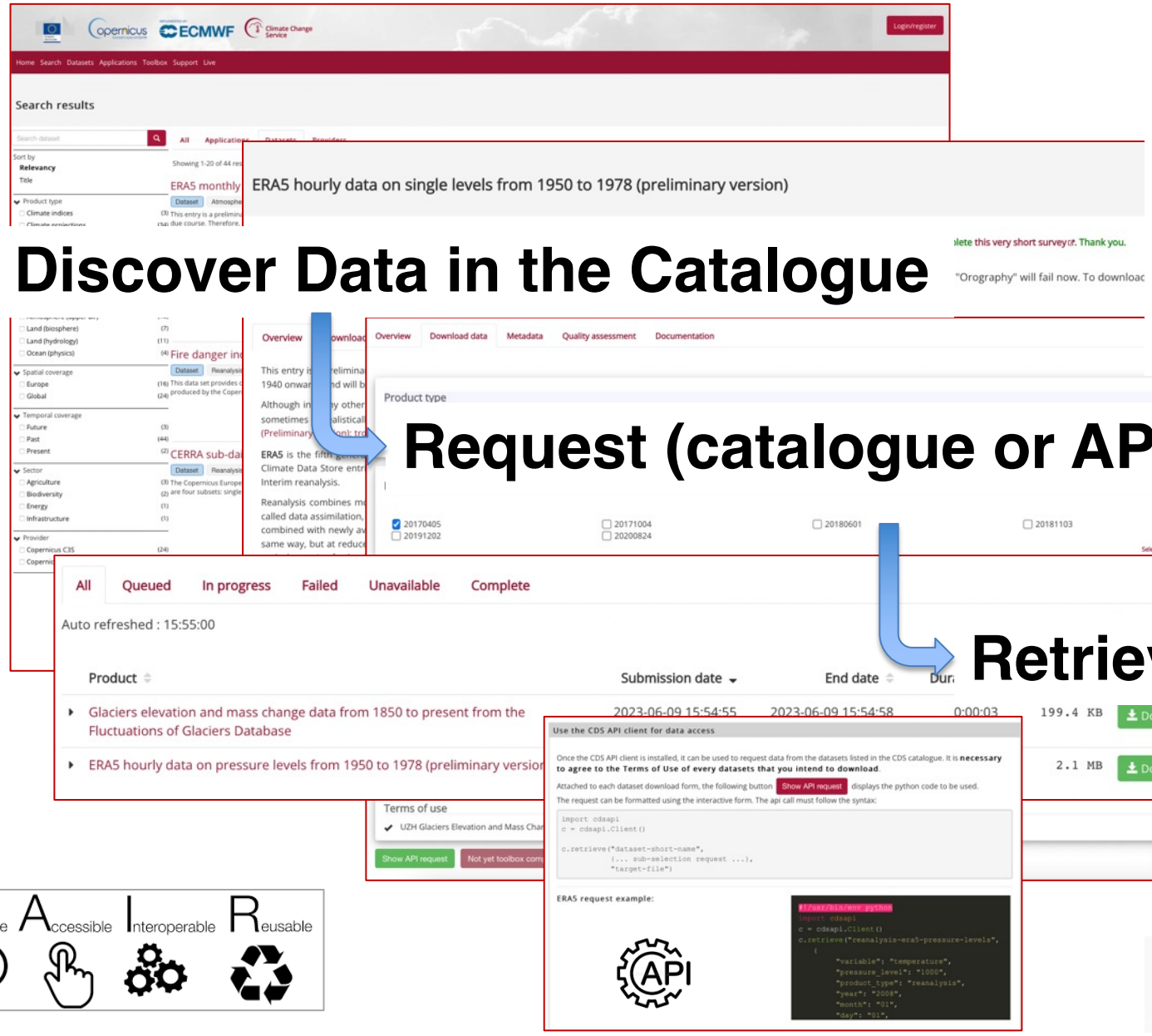

- **Standard** Metadata & Services.
- **Harmonized** Data Access interfaces.
- **Simplicity** and **consistency** are key
- **User Profiles** and Management
- **Terms of use** linked to datasets
- **Quality Control** (EQC) function
- **24/7** – User **Support**
- **Expert tools** to interact with Data

An Introduction to the Sectoral Information System

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Creating Climate Information & Applications for Users Across Sectors

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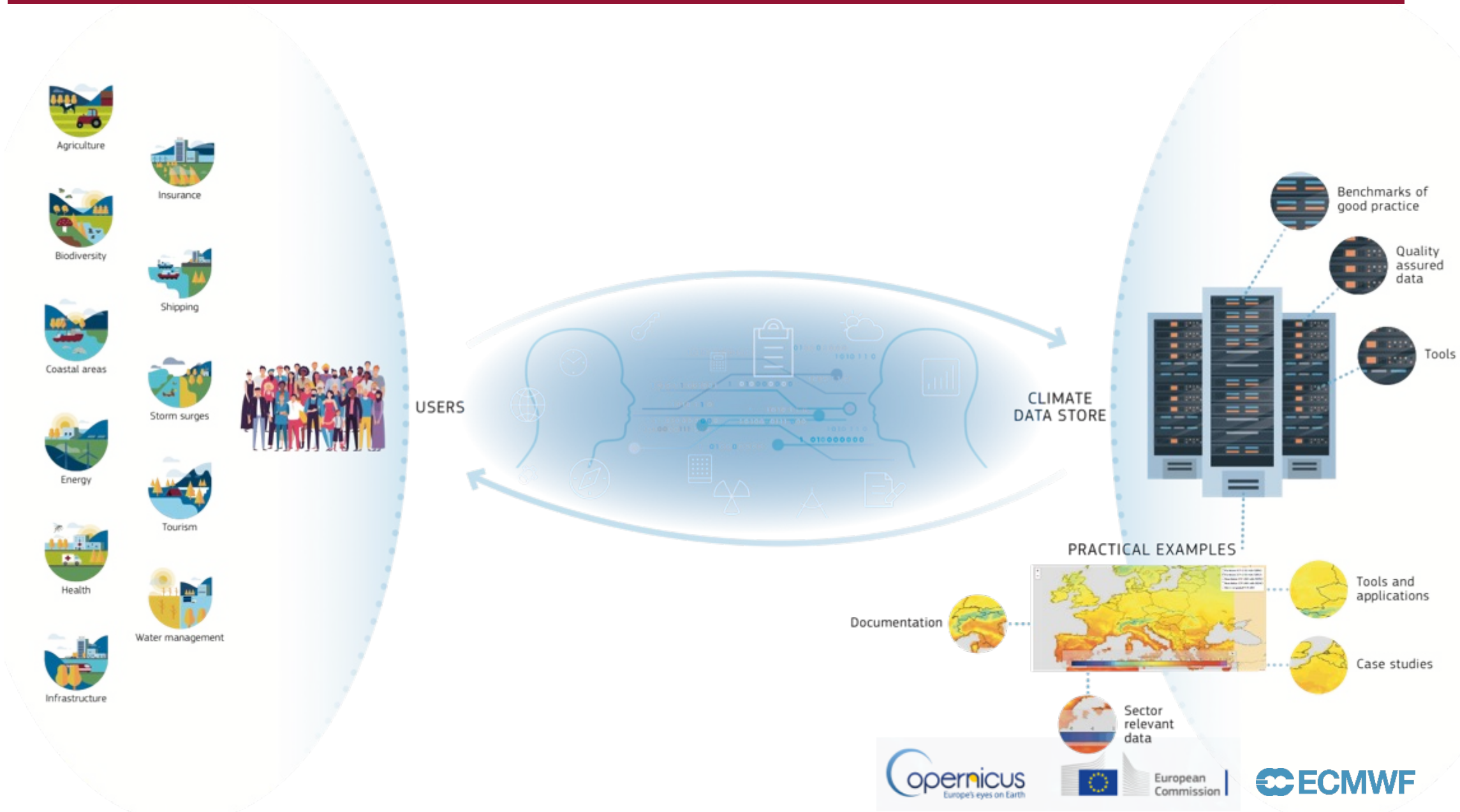

The C3S Applications Strategy

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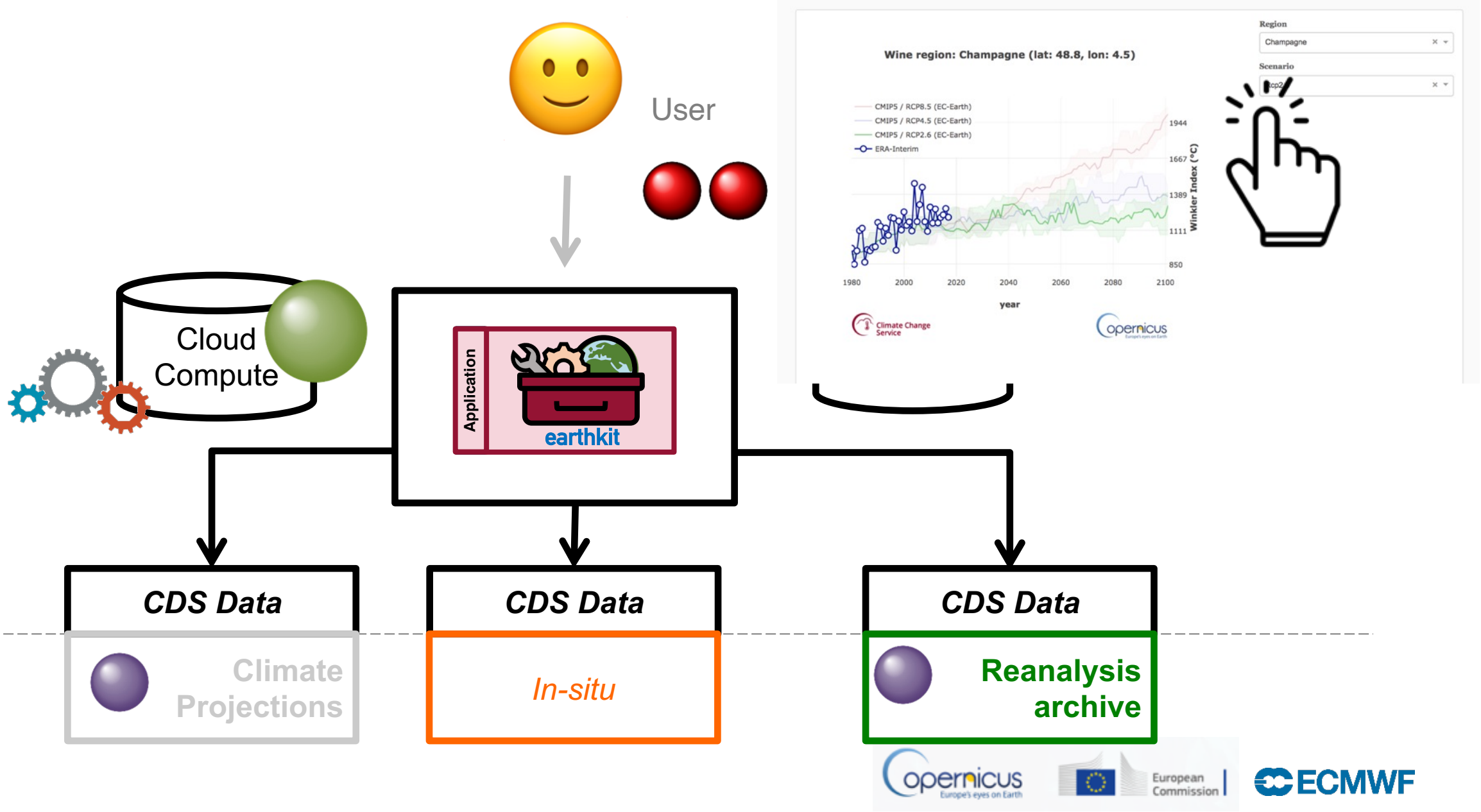

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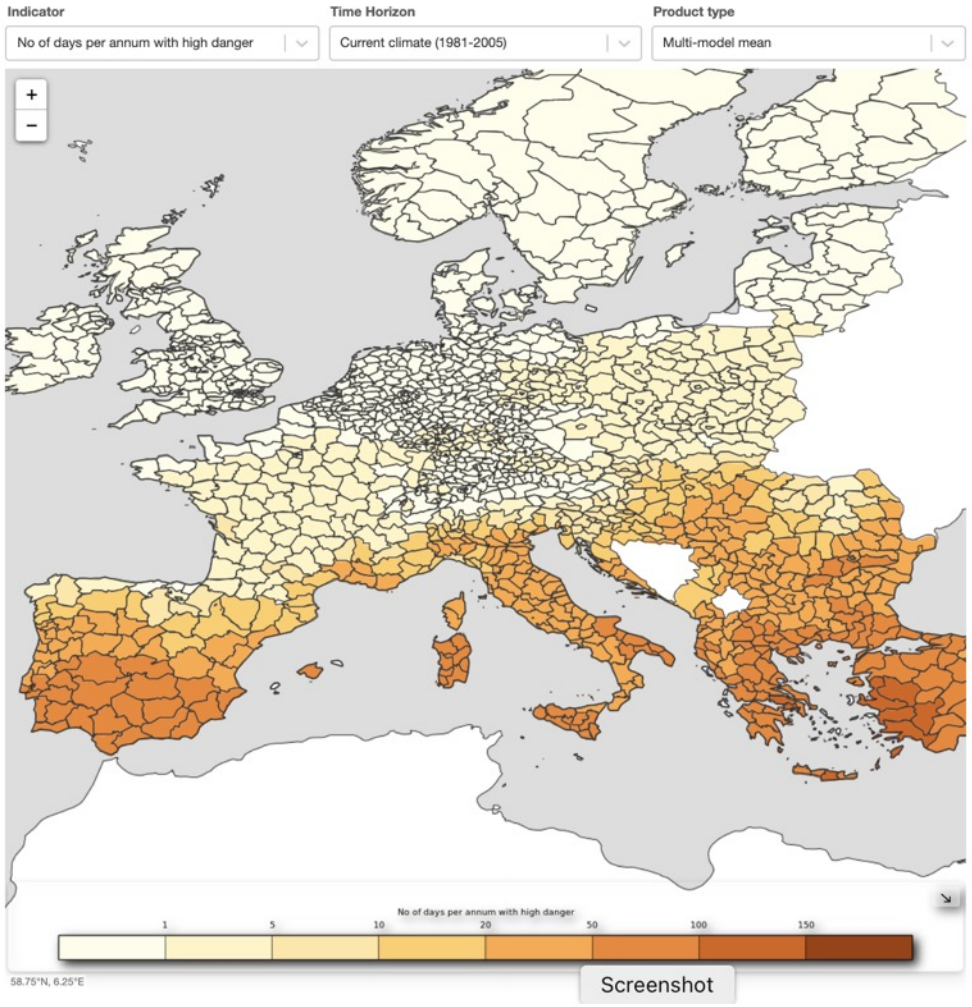
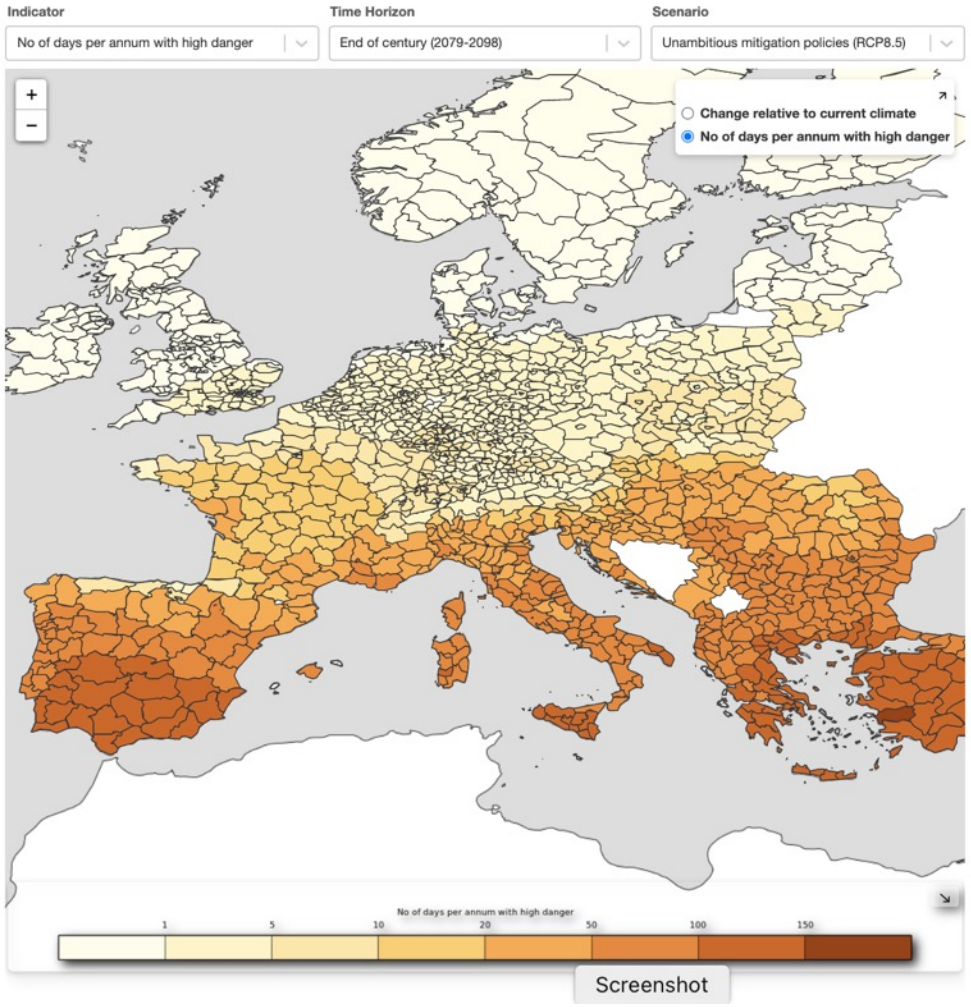
Example Application 1 – Europe's Evolving Fire Risk



Screenshot



Screenshot

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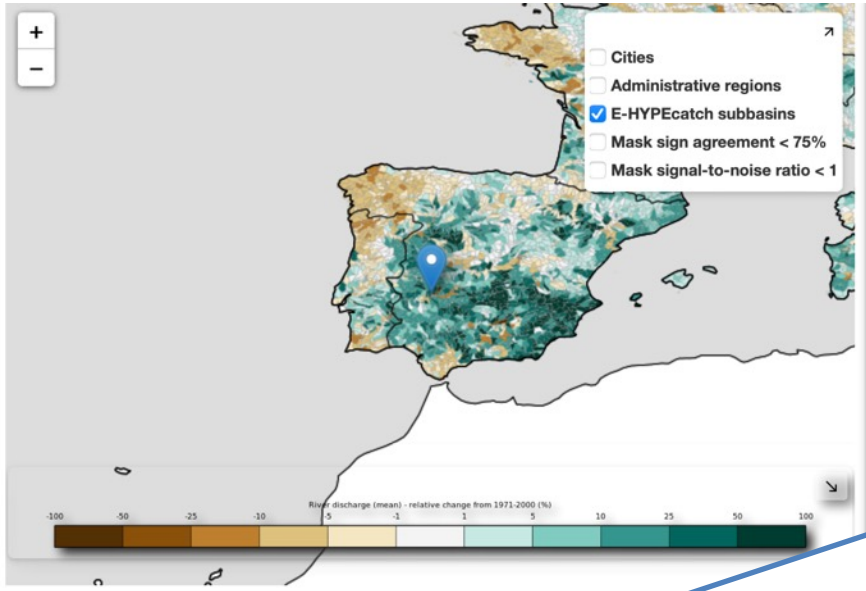
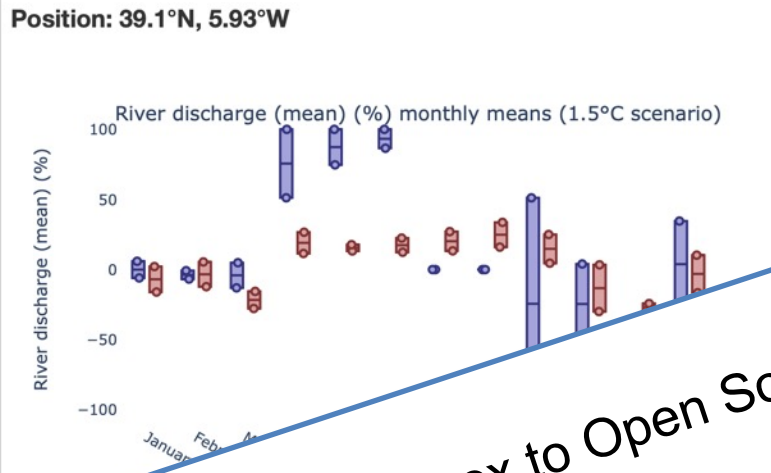
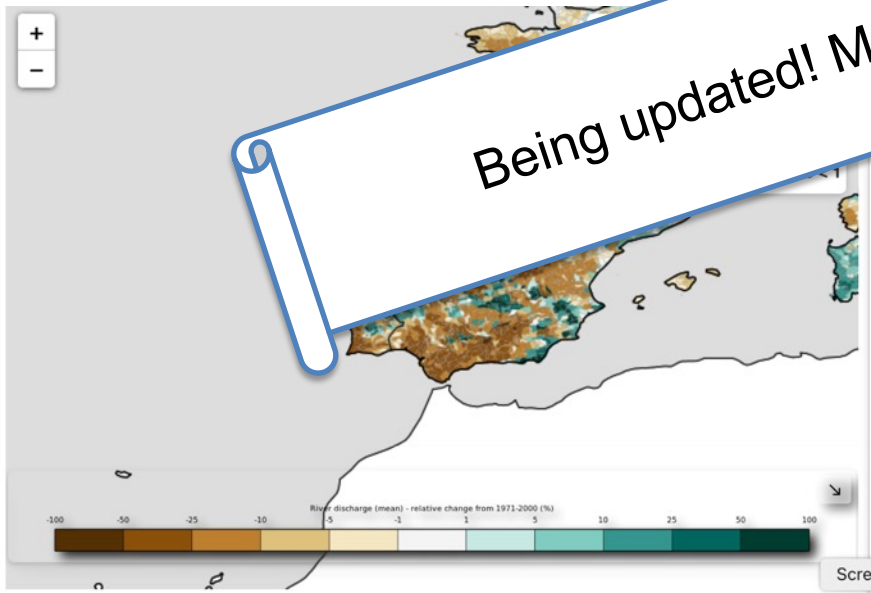
Example Application 2 – Hydrology in a 3.0 degree world!

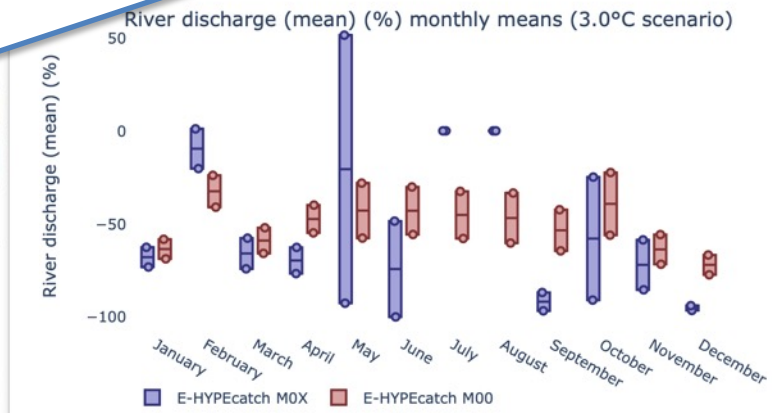




Water quantity indicators
Water quality indicators
Bias adjusted climatic indicators

Being updated! Move from CDS Toolbox to Open Source





Screenshot

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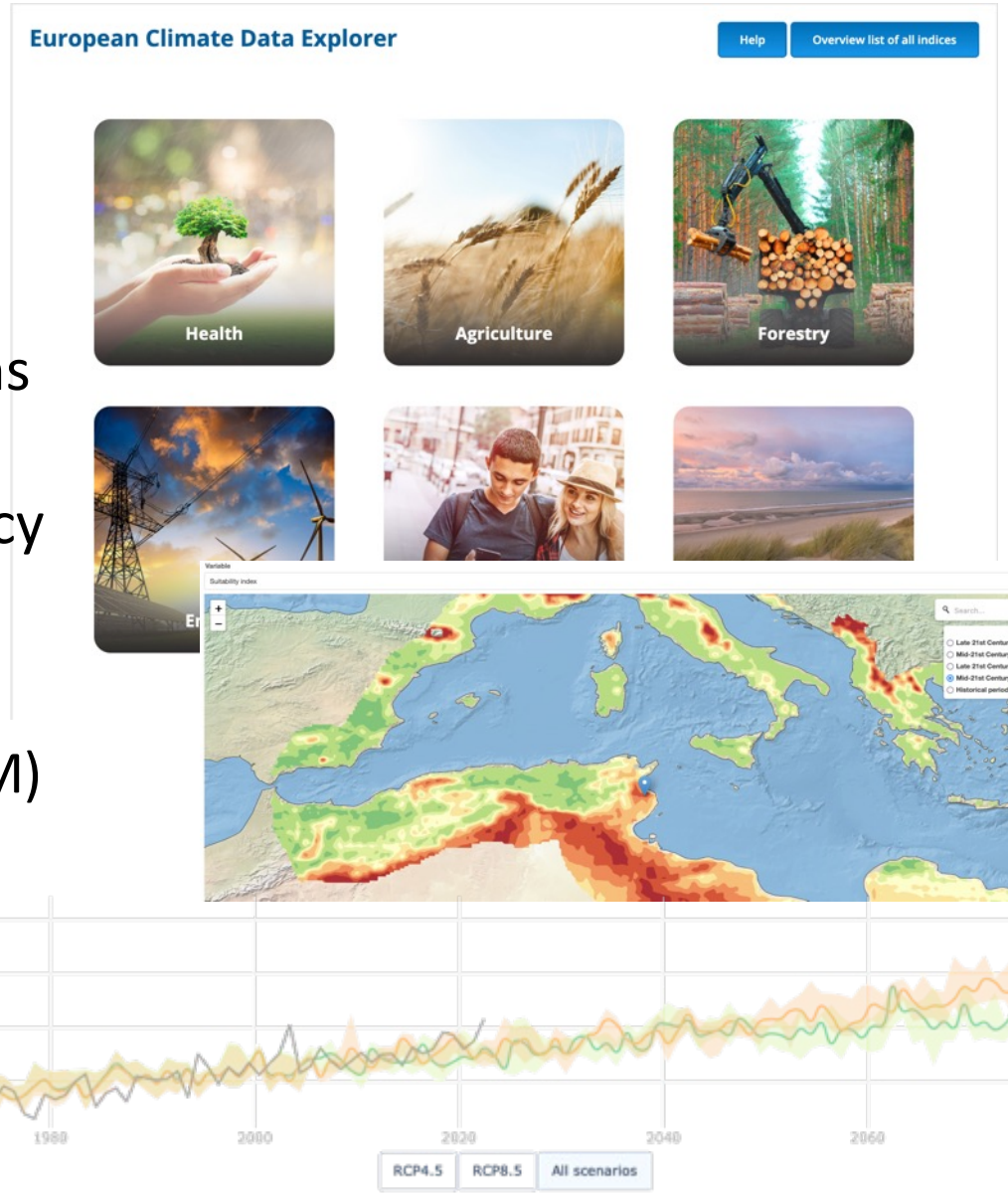
User Engagement:

Institutional services / users

Working directly with EU institutions to provide bespoke climate information relevant to users / policy requirements

- EEA
- Union For Mediterranean (UfM)
- European Investment Bank
- ENTSO-E
- ECDC
- …..



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An overview of other C3S Services

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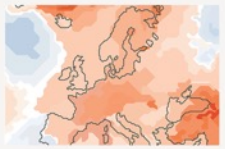
State of the Climate & Climate Bulletins

Temperature | Lake and Sea Temperatures | Wildfires | Precipitation | Soil moisture | River discharge | Land cryosphere | Atmospheric circulation | Clouds and sunshine duration | Wind and solar energy resources

Climate bulletin



The conditions of the past month are presented, using key climate change indicators. Analysis of the maps and guidance on how they are produced is also provided.

View bulletin >

ESOTC

The ESOTC provides a detailed analysis of the past calendar year, with descriptions of climate conditions and events, and explores associated variations in key climate variables across the Earth system.

View ESOTC >

Back to top

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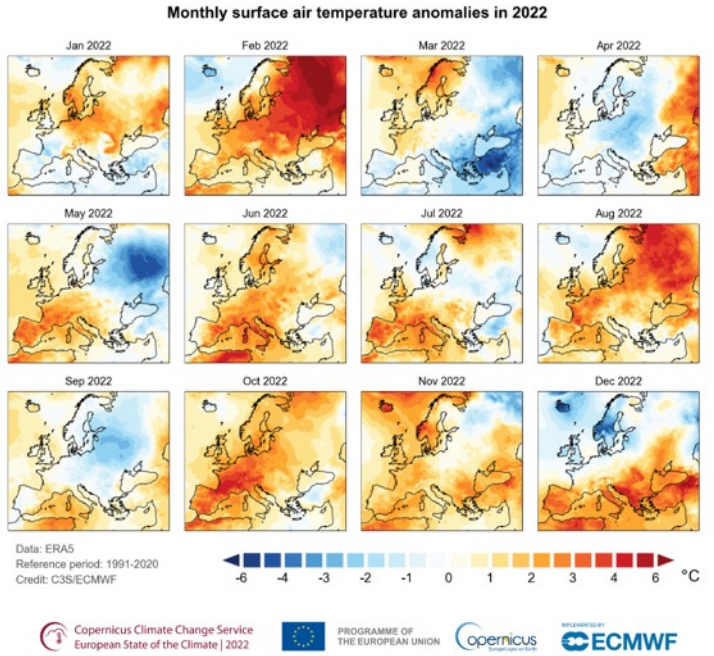

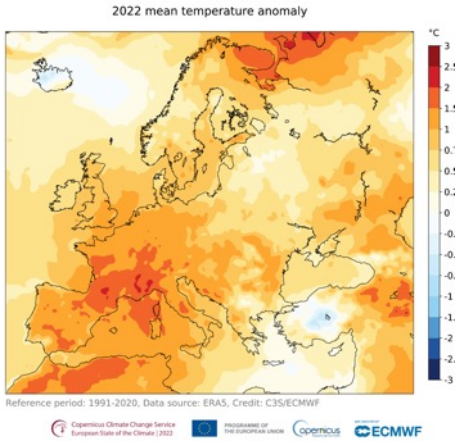

- Globe
- Europe
- Arctic

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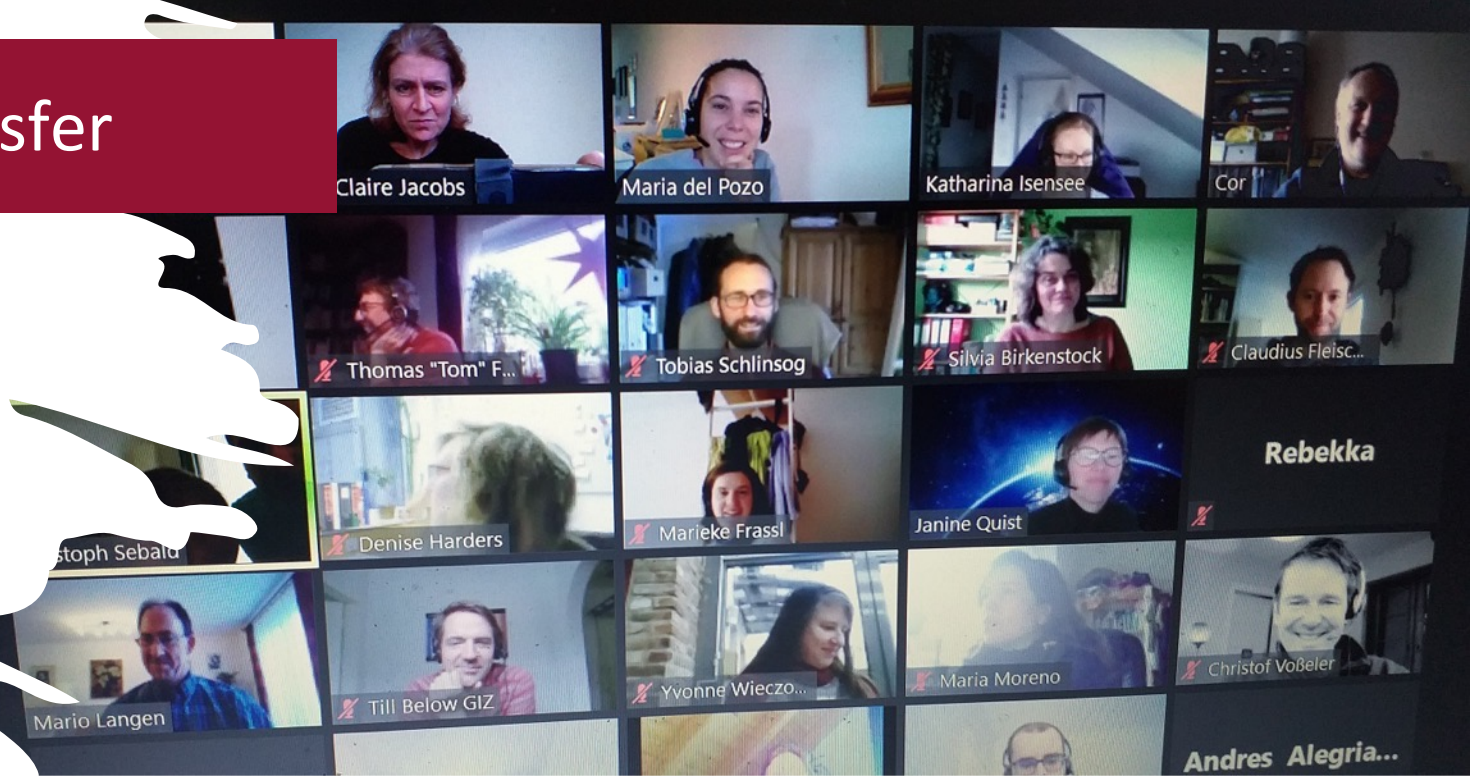
Training & Knowledge Transfer

As operational services, both the Copernicus Climate Change and Atmosphere Monitoring Services provide high quality training and knowledge transfer to facilitate use of our products



- **Free training material**
  - Data tutorials
  - E-learning resources
  - Material from training events
- **Training courses**
  - Targeting specific user communities
  - Variety of formats (online, f2f, blended)
  - Train-the-trainers approach
- **Capacity building**
  - Support to CB programmes (e.g. ClimSA)
  - Training in collaboration with regional entities

Tell us how we could best support you!

Climate

jupyter

Jupyter Notebook Viewer

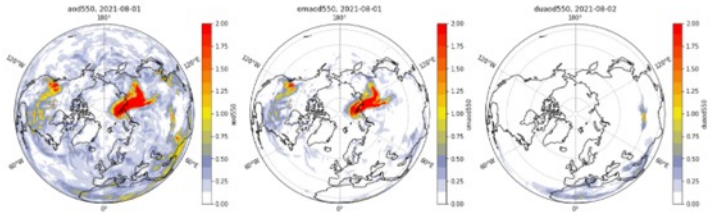
nbviewer.org/gi...

jupyter nbviewer

JUPYTER FAQ

```
In [10]: variables[0], variables[1] = variables[1], variables[0]

In [11]: variables

Out[11]: ['aod550', 'omaod550', 'duaod550']

In [12]: fig, axs = plt.
                   t_kw={'projection': c

for i in range(
    da = ds[varia
    axs[i].gridli                color='gray', alpha=0.5,
    axs[
    im =                         :],
                    transform = ccrs.PlateCarree(), cmap=camscmp, vmi
    axs[i].coastlines(color='black') # Add coastlines
    cbar = fig.colorbar(im, ax=axs[i], fraction=0.046, pad=0.04) # Specify th
    cbar.set_label(variables[i]) # Define the colourbar label

plt.show() # Display the figure
fig.savefig(f'{DATADIR}AOD_NHem.png') # Save the figure
```

Data access & visualization (images, animations, plots)



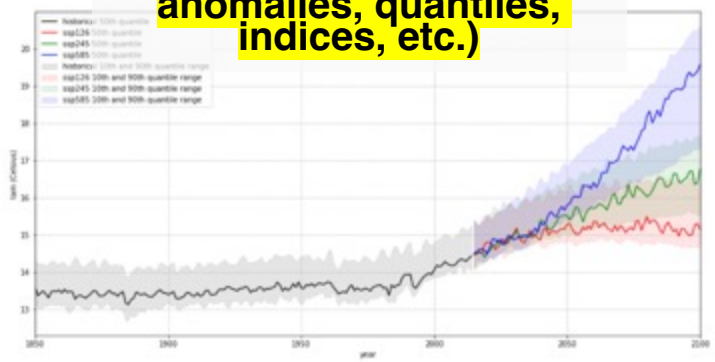
We can see that the high values of AOD seem to be mainly due to organic matter in North America and Siberia, which saw many wildfire activity in this period, while further south we can see a dust contribution.

CAMS global reanalysis (EAC4) monthly averaged fields

In this part of the tutorial we will look at another CAMS dataset, the fourth generation ECMWF

```
for i in np.arange(len(experiments)):
    ax.plot(data_50.year, data_50[i,:], color=f'{colours[i]}',
            label=f'{data_50.experiment[i].values} 50th quantile')
    ax.fill_between(data_50.year, data_90[i,:], data_10[i,:], alpha=0.1, colo
            label=f'{data_50.experiment[i].values} 10th and 90th quantile ran

ax.set_xlim(1850,2100)
ax.set_title('CMIP6 annual global average temperature (1850 to 2100)')
ax.set_ylabel('tam (Celsius)')
ax.set_xlabel('year')
handles, labels = ax.get_legend_handles_labels()
ax.legend(handles, labels)
ax.grid(linestyle='--')

fig.savefig(f'{DATADIR}
```

Processing (climate normal, anomalies, quantiles, indices, etc.)



The visualization of the `CMIP6 annual global average temperature (1850 to 2100)` above shows that the global average temperature was more or less stable in the pre-industrial phase, but steadily increases since the 1990s. It shows further that, depending on the SSP scenario, the course and increase of the global annual temperature differs. While for the best case `SSP1-2.6` scenario, the global annual temperature could stabilize around 15 degC, in the worst case `SSP5-8.5` scenario, the global annual temperature could increase to above 20 degC.

training / C3S_heatwave-analysis.ipynb

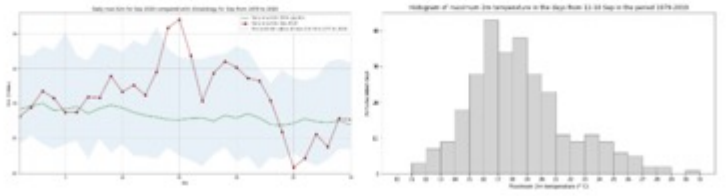
PROGRAMME OF THE EUROPEAN UNION | opernicus | ECMWF

Analysis of the September 2020 European heatwave using data from the Copernicus Climate Change Service

In September 2020, a record-breaking heatwave occured in large parts of western Europe, (see a description here). The
in September 2020 sinc
data from the Climate D
The tutorial compri

1. Search, download and view data
2. View daily maximum 2m temperature for September 2020
3. Compare maximum temperatures with climatology

Case studies (heatwaves, dust, fires, etc.)



How to access the notebook

This tutorial is in the form of a Jupyter notebook. You will not need to install any software for the training as there are a number of free cloud-based services to create, edit, run and export Jupyter notebooks such as this. Here are some suggestions (simply click on one of the links

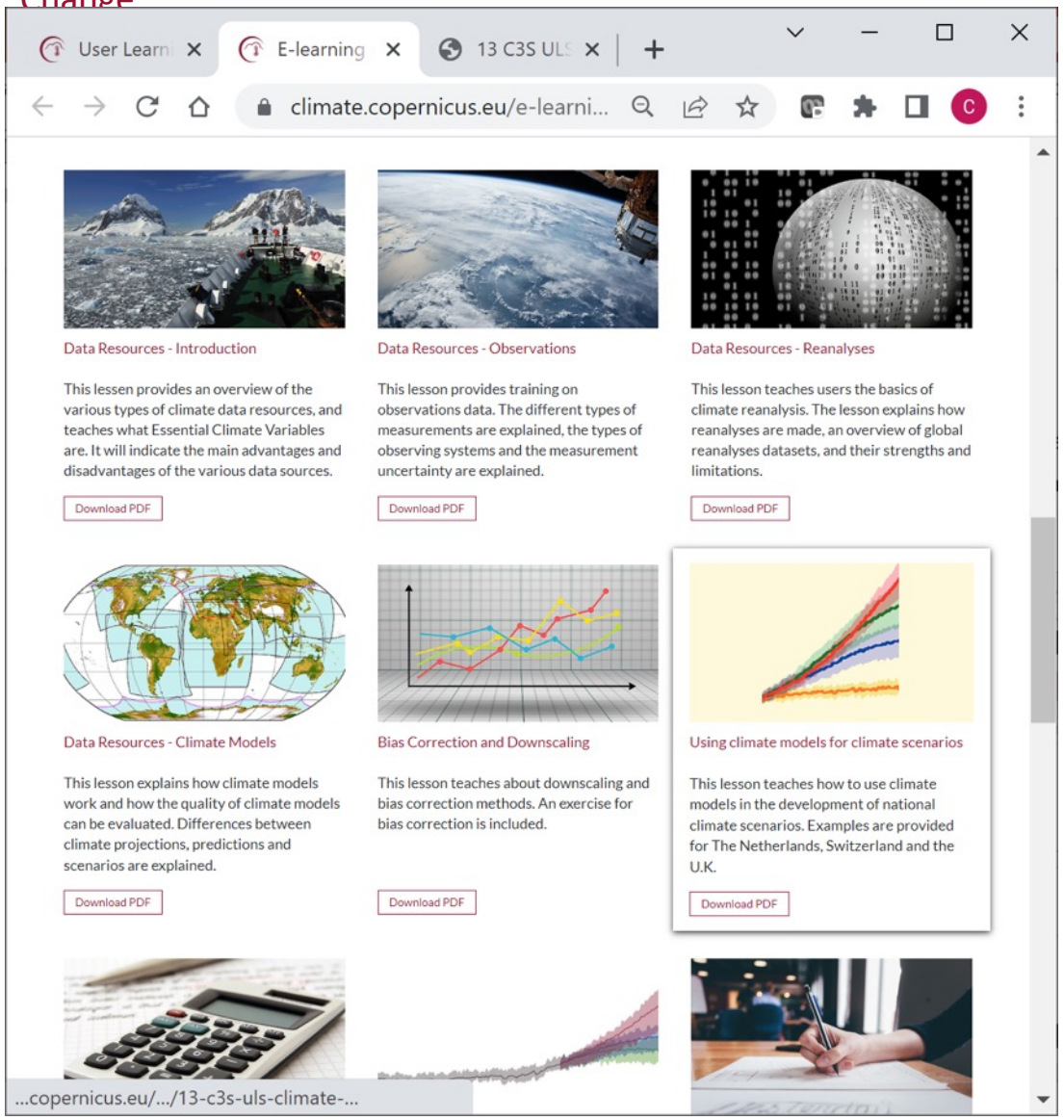
opernic Europe's eyes

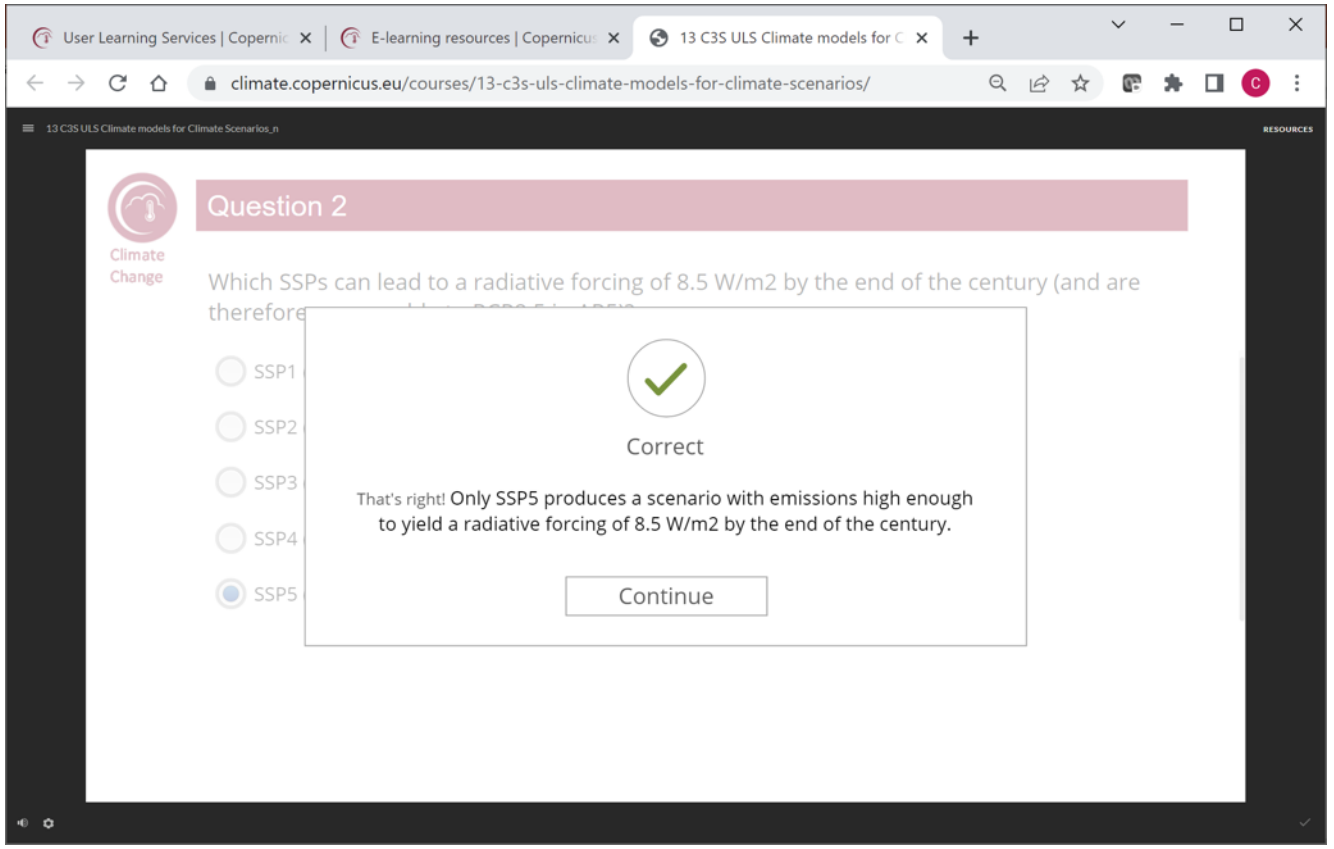
Focus on technical users!

E-learning modules

https://climate.copernicus.eu/e-learning-resources

- More theoretical, less practical
- No programming needed
- Interactive





Thank you for your attention

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