

Visualising Forests in a Changing Climate : An ESA-CCI Data Challenge

24/09/2025 - Training Session

Agenda

1.Introduction

- CCI KE activities and ECVs background
- Introduction to the CCI Toolbox

1.Registration on JupyterLab Environment:

- Setting up access for participants on the dedicated JupyterLab environment
- Presentation of the Training environment

1.Tutorial of the Jupyter Notebook and hands on work

- Live Demo: Jupyter Notebook Walkthrough (45 mins)
- Individual work (20 mins)

1.Competition Guidelines Overview:

- Presentation of the competition challenge and guidelines
- Presentation on Effective Science Communication & Storytelling

Training Session

Christopher Phillips (Imperative Space UK)

ESA Climate Change Initiative (CCI) Knowledge Exchange training activities: accessible hands-on-training, resources, competitions and discussions tailored to diverse audiences—from ECS, to subject specialists and policymakers to empower users with the skills to better understand the benefits and leverage CCI ECVs datasets for applications of climate information for research, policy, and innovation.

Find out more on the CCI
website:

<https://climate.esa.int/en/climate-change-initiative-training/>

Climate Change Initiative Training



Training

An archive of Climate Change Initiative training, hands on resources and recordings including interactive Jupyter Notebooks to support users in developing climate data manipulation, analysis and visualisation.



Seminars

Archived Climate Change Initiative seminars, highlighting the latest research insights, case studies and best practices from the programme.



Competitions

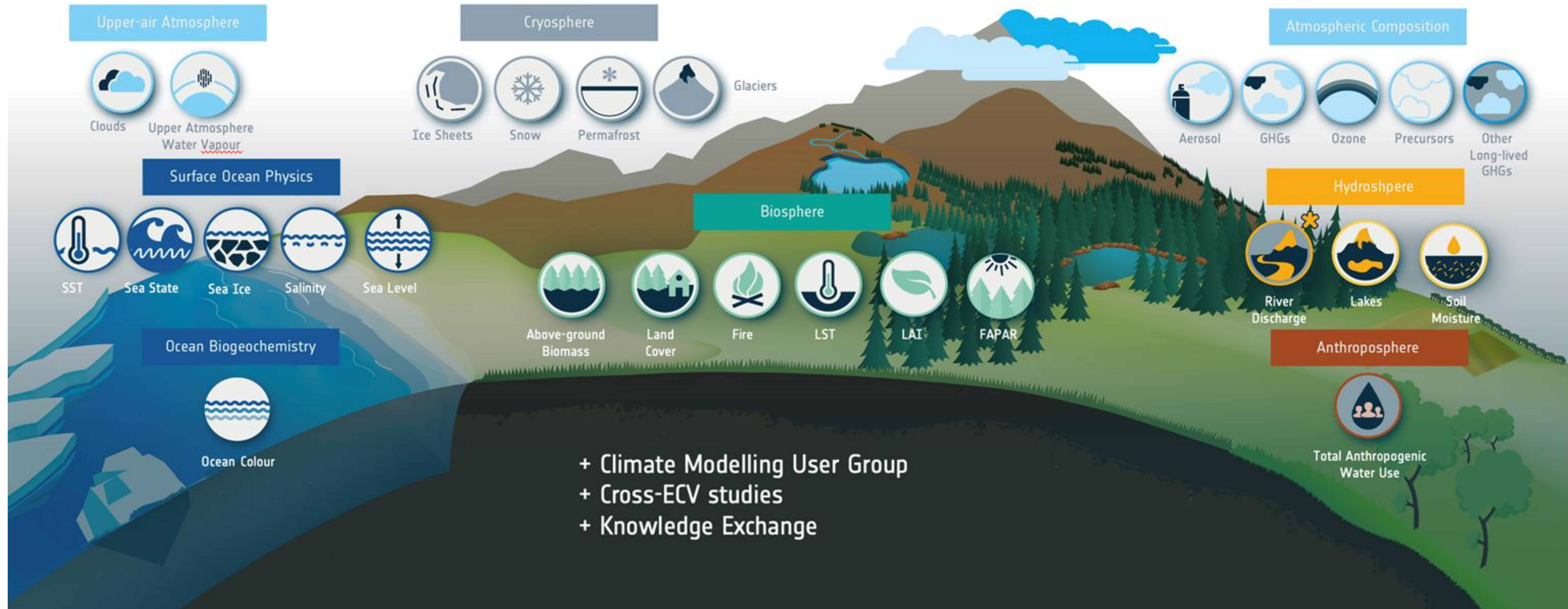
This archive contains products which were developed during the Climate Change Initiative (CCI) Knowledge Exchange competitions.

COMING SOON

ESA CLIMATE CHANGE INITIATIVE (ESA-CCI) ECVs



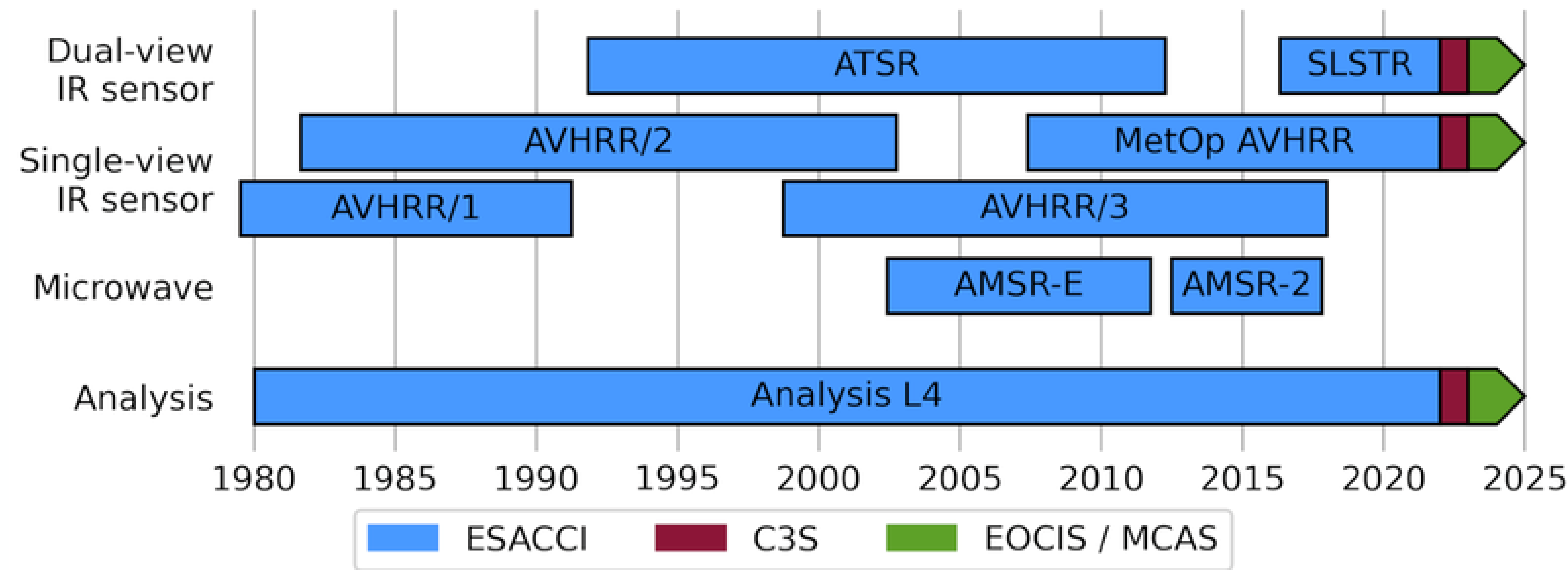
GCOS defined **55** Essential Climate Variables | **36** benefit from space observations | **27** generated by ESA Climate Change Initiative

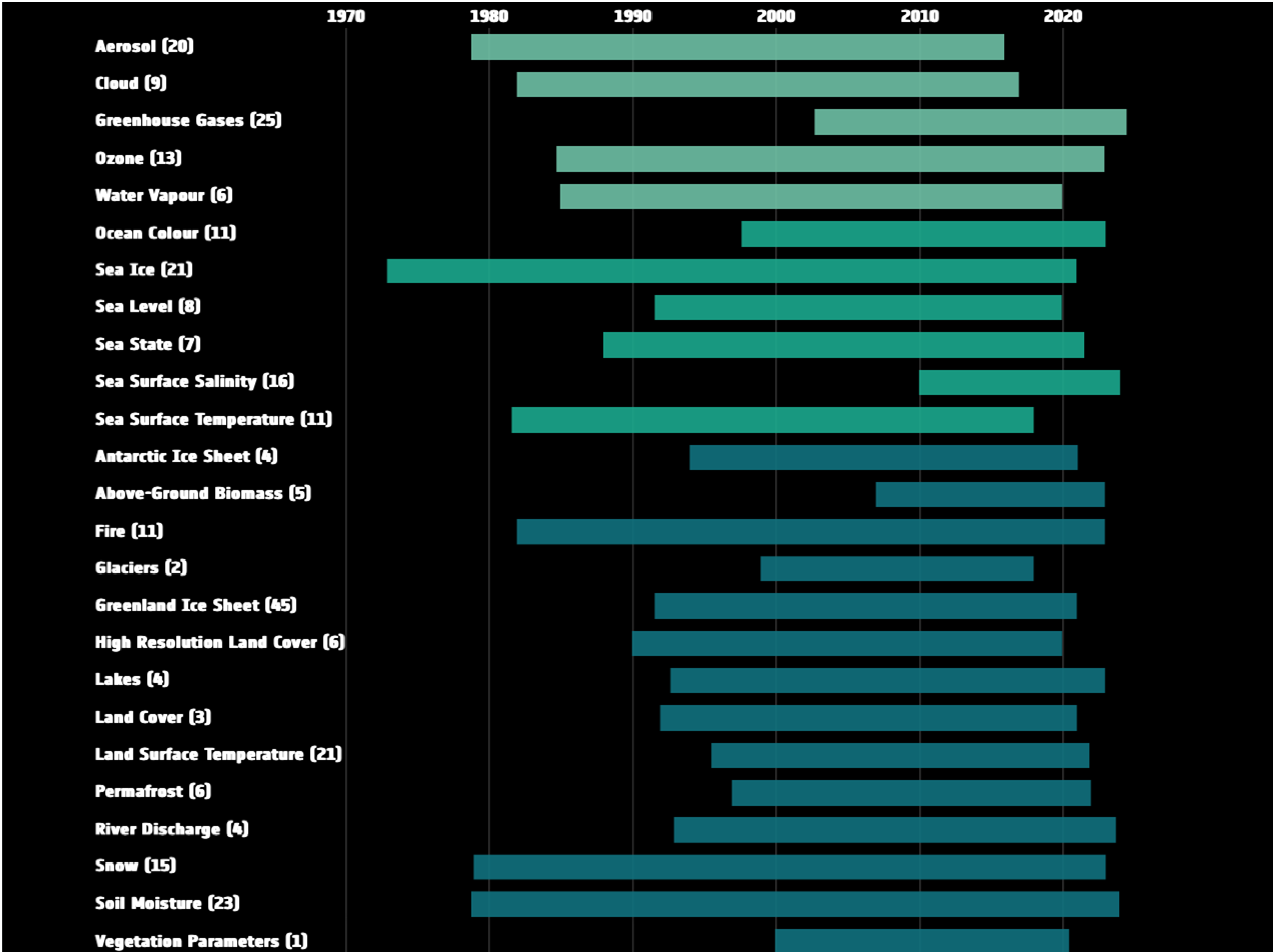


Creating a Climate Data Record



By piecing together all the individual satellite sensors to create one long term, robust data record, we can understand how climate is changing.



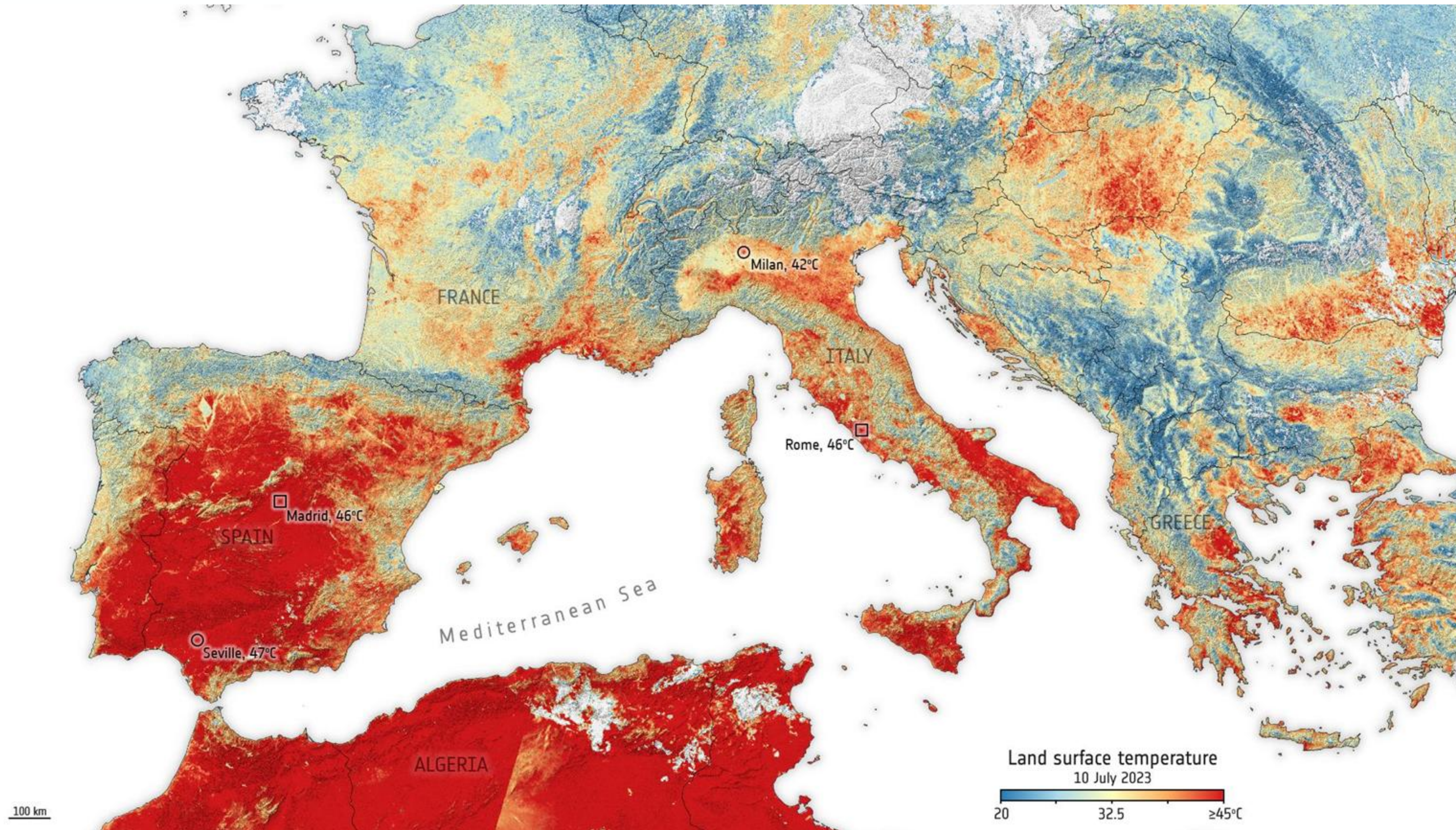


The ESA-CCI Open Data Portal offers free, and easy access to the CCI ECVs, find out more on: climate.esa.int/data

Why do ECVs matter for studying climate change ?

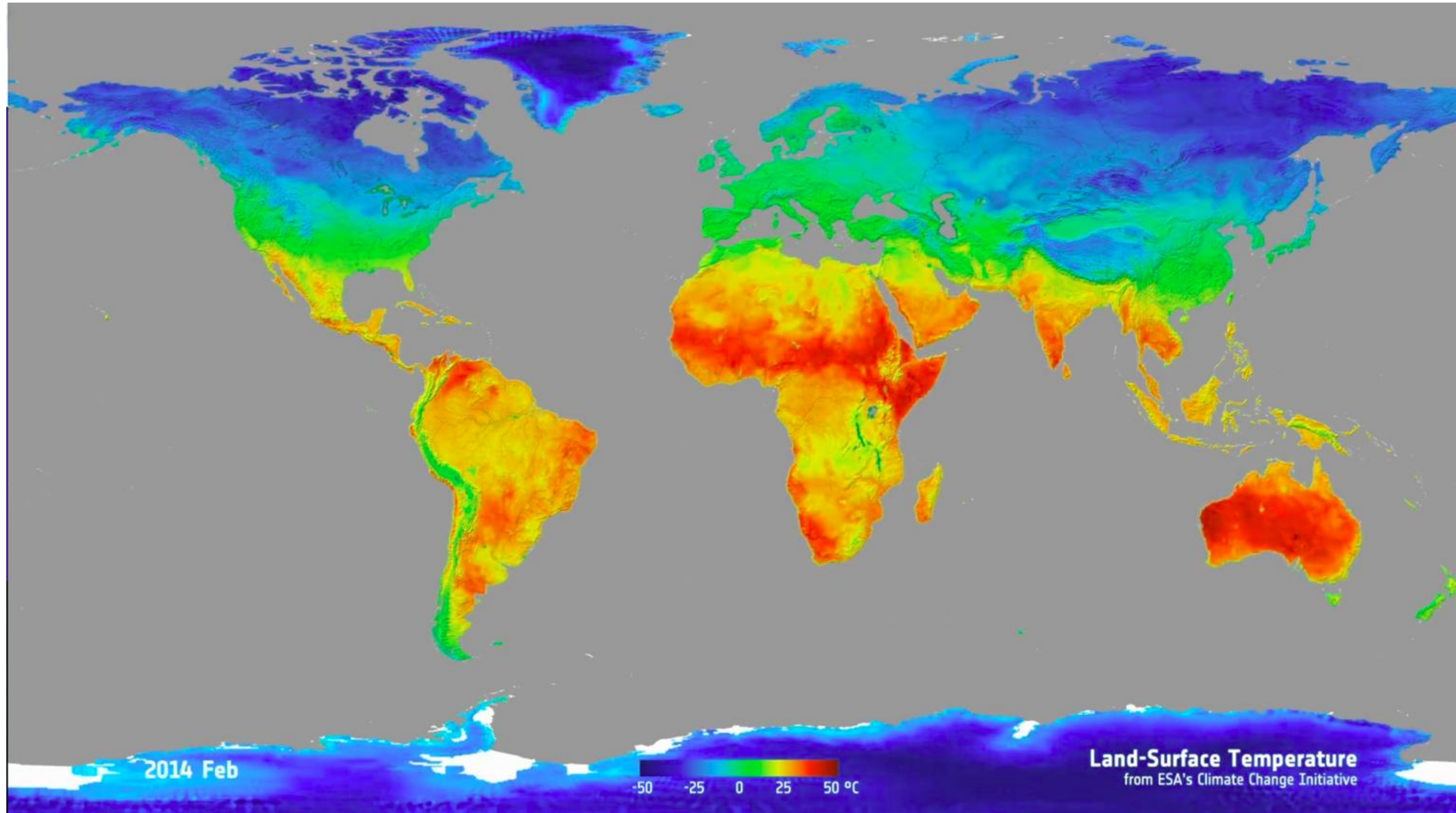
A few examples

Monitoring land heatwaves from space



This image uses data from the Copernicus Sentinel-3 mission's radiometer instrument. Land surface temperatures hit 46°C in Rome, Italy, while Madrid and Seville reached 46 and 47°C, respectively.

Monitoring land heatwaves from space



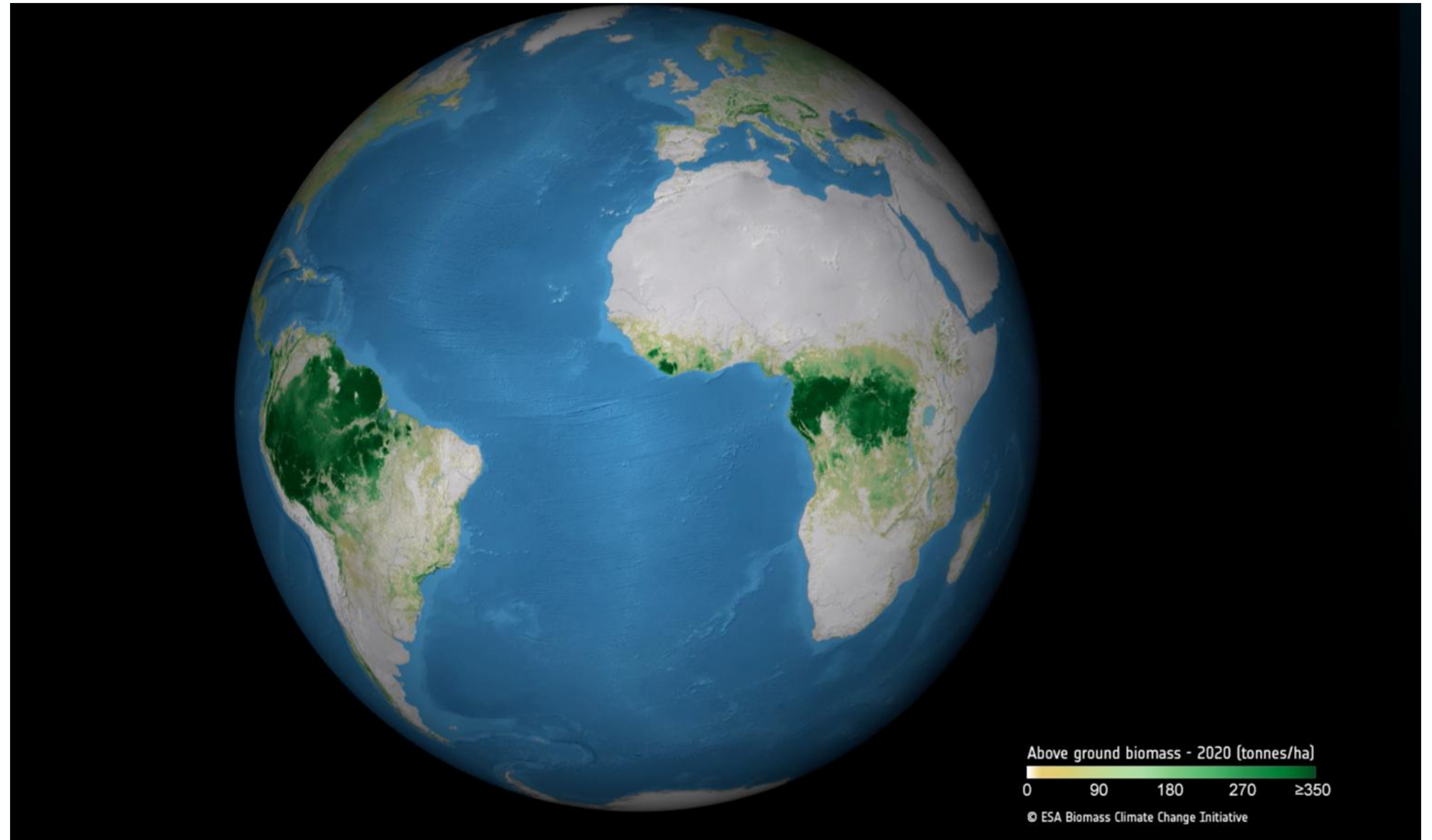
Long-term record (25 years) of Land Surface Temperature developed, showing a an increase in land surface temperature (LST) of $0.2^{\circ}\text{C}/\text{decade}$, with strong regional variability.



Monitoring changes in carbon from space

The latest of ESA's CCI above ground biomass dataset makes it possible for the first-time to robustly monitor biomass changes at a global scale.

Including the new and more robust global forest biomass data in the stocktake will help to quantify with greater certainty, the net gains and losses of carbon associated with forest growth, loss and degradation



ESA-CCI's Toolbox

Tonio Fincke - Brockmann Consult

Access to CCI Data from 22 ECVS

Processing Operations

Anomaly Detection

Co-registration

Gap Filling

Resampling

Subsetting

Time Series

...

Python Package

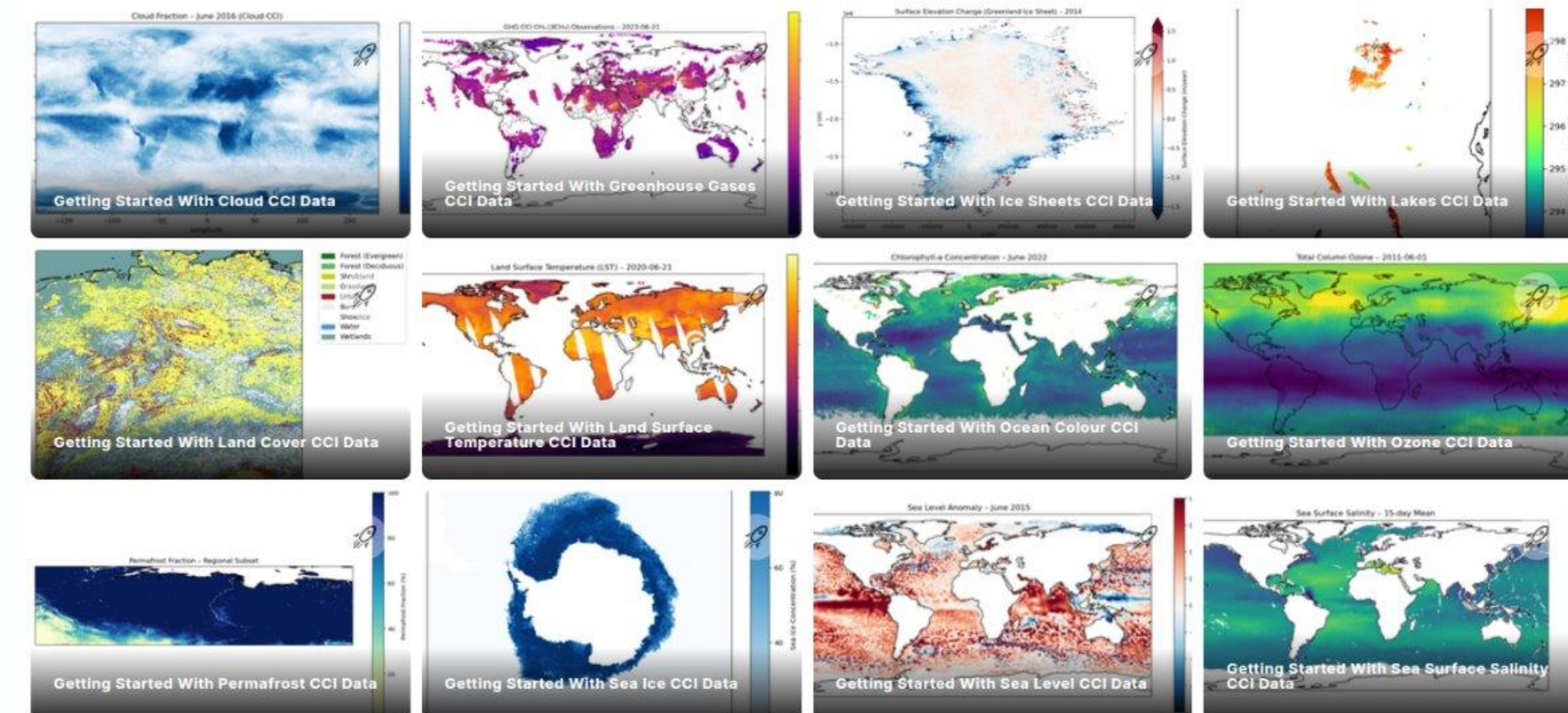
<https://github.com/esa-cci/esa-climate-toolbox>

<https://pypi.org/project/esa-climate-toolbox>

<https://anaconda.org/conda-forge/esa-climate-toolbox>

Documentation

<https://esa-climate-toolbox.readthedocs.io>



ESA CCI Toolbox

latest

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2. About the ESA CCI Toolbox

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The ESA CCI Toolbox is a software developed to facilitate processing and analysis of all the data products generated by the [ESA Climate Change Initiative Programme \(CCI\)](#). It supports analysis and interactive visualisation of these data products using its Python interface. The ESA CCI Toolbox **Python API** allows using the functions of the ESA CCI Toolbox in Python programs and may also be used to build extensions.

ESA CCI Toolbox

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6.2. Functions

6.3. Operations

6.4. Operation Registration API

6.5. Operation Execution API

6.6. Task Monitoring API

6. API Reference

View page source

6. API Reference

6.1. Datasets and Datastores

6.1.1. Exploring Data

`esa_climate_toolbox.core.find_data_store(ds_id: str) → Tuple[str | None, DataStore | None]`

Find the data store that includes the given `ds_id`. This will raise an exception if the `ds_id` is given in more than one data store.

Parameters: `ds_id` – A data source identifier.
Returns: All data sources matching the given constraints.

`esa_climate_toolbox.core.get_store(store_id: str)`

Returns the data store of the given name. :param store_id: The name of the store should have.

Returns: A data store

Data are read in as
xarray datasets
geopandas geodataframes

Toolbox relies on widely used and well-maintained technology stack
Compatible with other packages

```
cube = zarr_store.open_data('ESACCI-SOILMOISTURE-L3S-SSMV-COMBINED-1978-2021-fv07.1.zarr')
cube
```

xarray.Dataset

► Dimensions: (time: 15767, lat: 720, lon: 1440)

▼ Coordinates:

lat	(lat)	float64	89.88 89.62 89.38 ... -89.62 -89.88		
lon	(lon)	float64	-179.9 -179.6 ... 179.6 179.9		
time	(time)	datetime64[ns]	1978-11-01 ... 2021-12-31		

▼ Data variables:

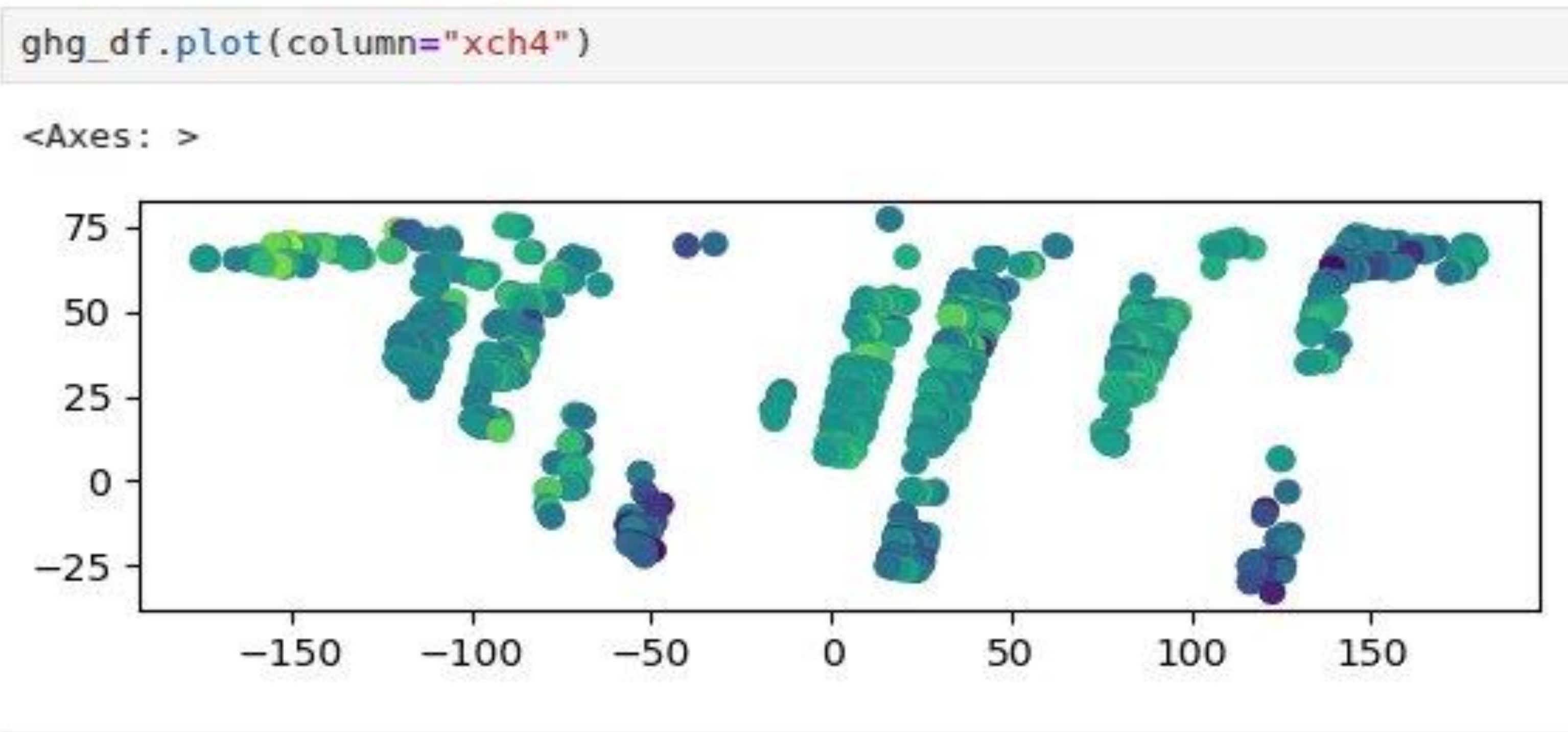
dnflag	(time, lat, lon)	float32	dask.array<chunksize=(16, 720, 720), meta=n...		
flag	(time, lat, lon)	float32	dask.array<chunksize=(16, 720, 720), meta=n...		
freqbandID	(time, lat, lon)	float32	dask.array<chunksize=(16, 720, 720), meta=n...		
mode	(time, lat, lon)	float32	dask.array<chunksize=(16, 720, 720), meta=n...		
sensor	(time, lat, lon)	float64	dask.array<chunksize=(16, 720, 720), meta=n...		
sm	(time, lat, lon)	float32	dask.array<chunksize=(16, 720, 720), meta=n...		
sm_uncertainty	(time, lat, lon)	float32	dask.array<chunksize=(16, 720, 720), meta=n...		
t0	(time, lat, lon)	float64	dask.array<chunksize=(16, 720, 720), meta=n...		

► Indexes: (3)

► Attributes: (44)

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2	POINT (21.32617 53.16351)	1834.837891	361.529053	2010-07-04T00:00:00
3	POINT (17.02777 53.6568)	1767.532104	357.012085	2010-07-04T00:00:00
4	POINT (15.31268 53.61804)	1846.445312	384.051636	2010-07-04T00:00:00
...
3546	POINT (176.04736 62.59637)	1756.709839	379.857666	2010-07-04T00:00:00
3547	POINT (173.65729 62.86865)	1774.327759	357.646545	2010-07-04T00:00:00
3548	POINT (174.71912 62.44507)	1805.762573	374.800110	2010-07-04T00:00:00
3549	POINT (173.18512 62.00031)	1841.642090	350.549011	2010-07-04T00:00:00
3550	POINT (171.62189 61.54938)	1752.140625	350.487610	2010-07-04T00:00:00

3551 rows x 4 columns





ESA-CCI's Training Environment

Tonio Fincke - Brockmann Consult



Welcome to **ESA CCI!**

Log in with username & password

Username

Password

[Forgot Password?](#)

Sign In

Alternative log in methods

GitHub

New user? [Register](#)

If you have trouble logging in contact us

Overview of the Training Environment



Home

Resources

Examples Explorer

JupyterHub

conda-store

Provide Feedback

Contact support

CSKE Workspace

am

jupyterhub

Home

Token

Server Options

Choose your environment and resources

Image

EOX JupyterLab for CSKE
JupyterLab 4.0.0 with Conda-Store [climate

Resource Allocation

2 GB RAM, upto 1 CPUs

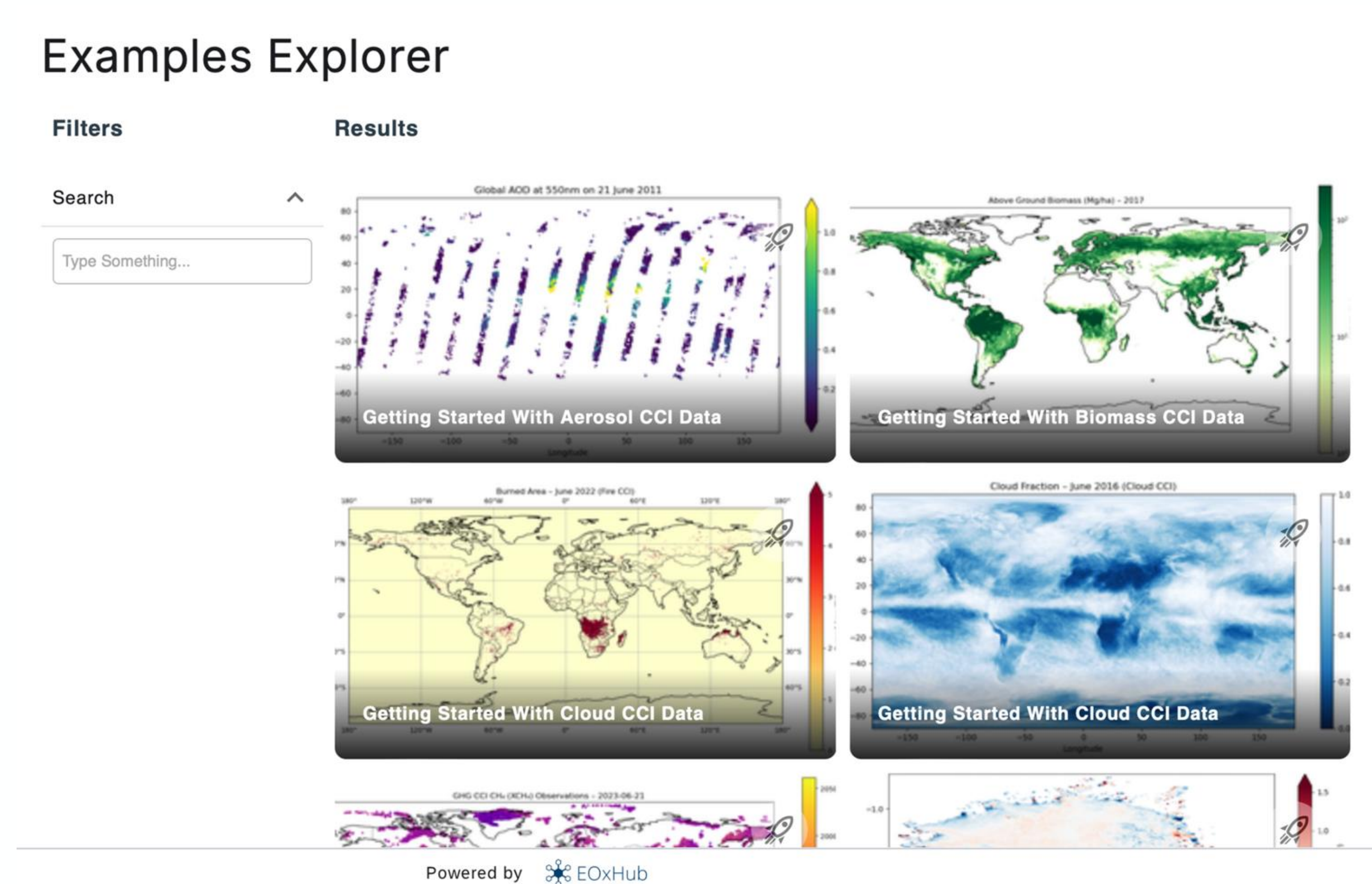
Start

Permalink

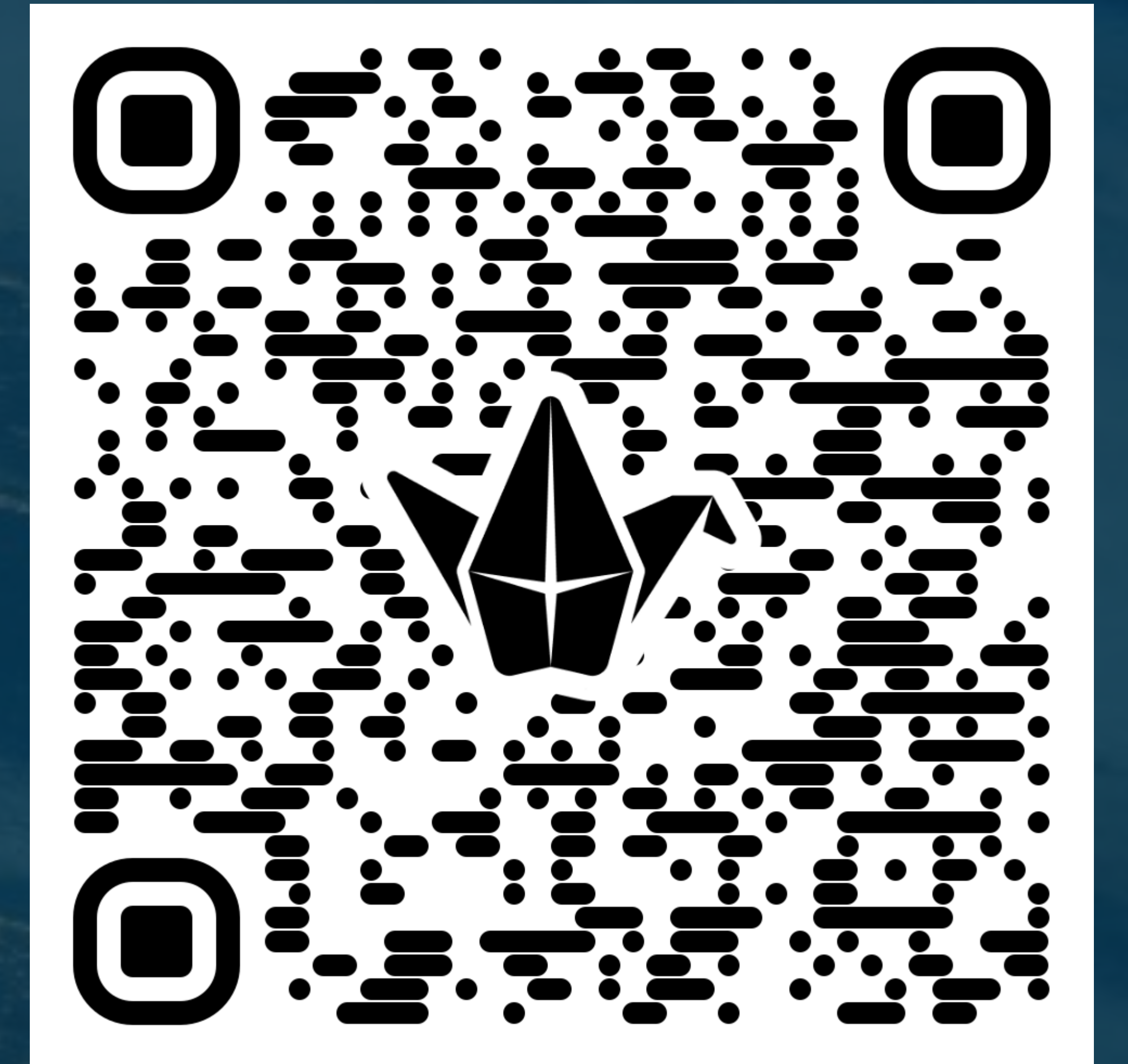
Notebooks for each ECV available on Github

A series of Notebooks is available on the Training Environment to understand how to use and explore the different ESA CCI ECVs using Python and the Toolbox functionalities.

These notebooks are also accessible on [Github](#).



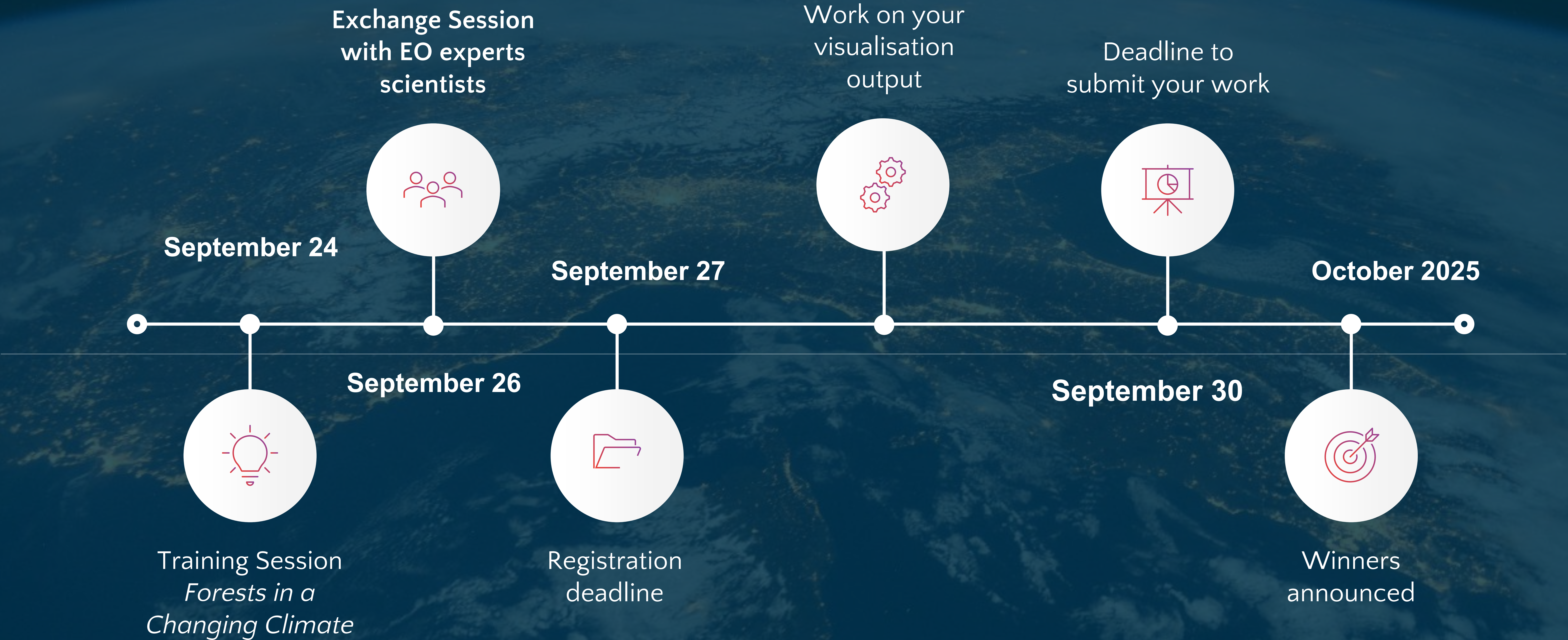
Your turn !



Access the training padlet here: https://padlet.com/CCI_KE/forests_training

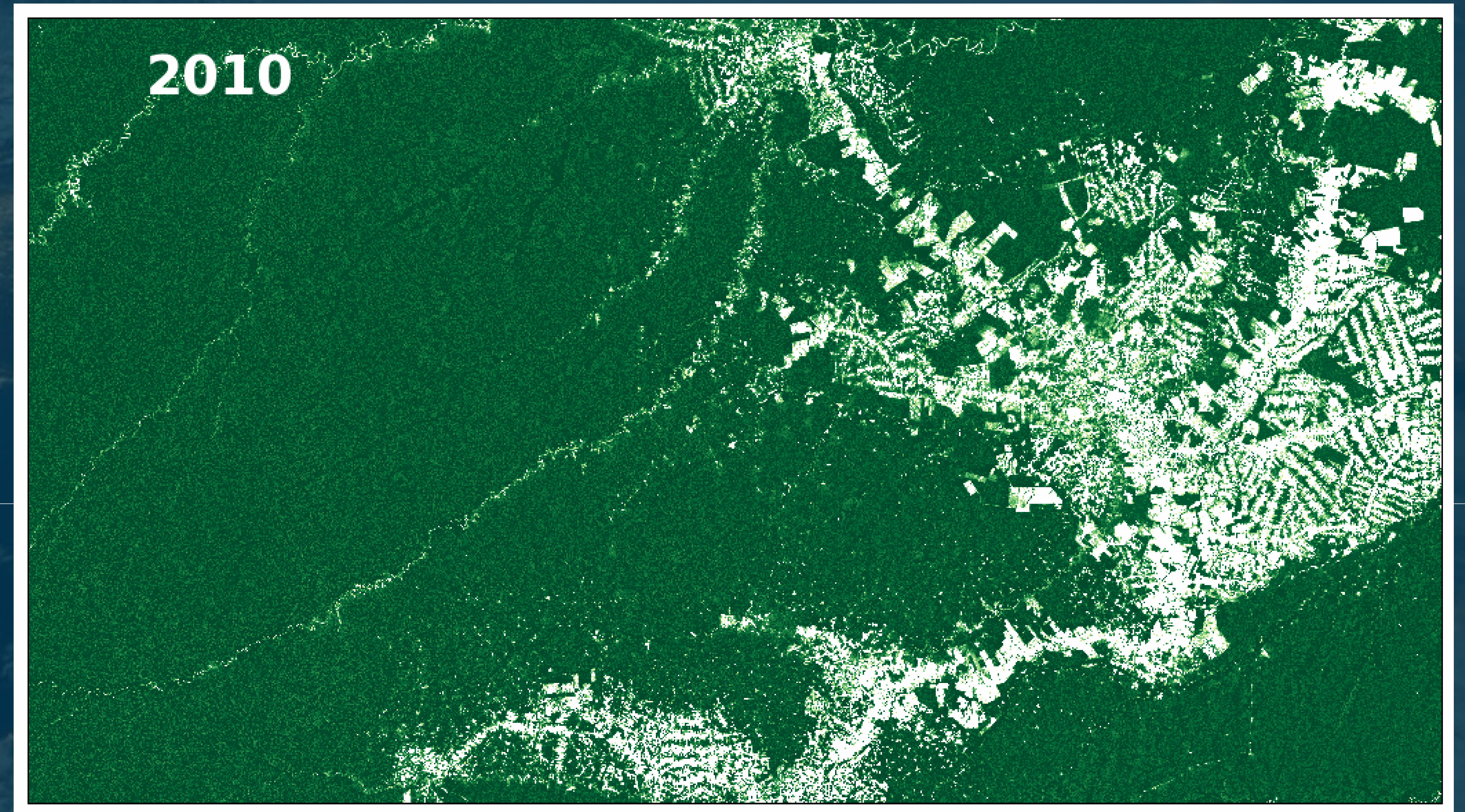
Enter the competition [here](#) !

EO Data Visualisation Competition - Timeline



The Challenge: Forests roles in a changing climate

- Forests serve as a major sink of CO₂ and a key regulator of local and regional climate by influencing the surface energy balance and driving the water cycle. They also provide 80% of all terrestrial species.
- Rising global temperature threaten vital forests ecosystem services provided by forests, such as climate regulation, carbon sequestration and habitat provision.
- Deforestation is the primary source of anthropogenic CO₂ emissions after fossil fuels combustion.



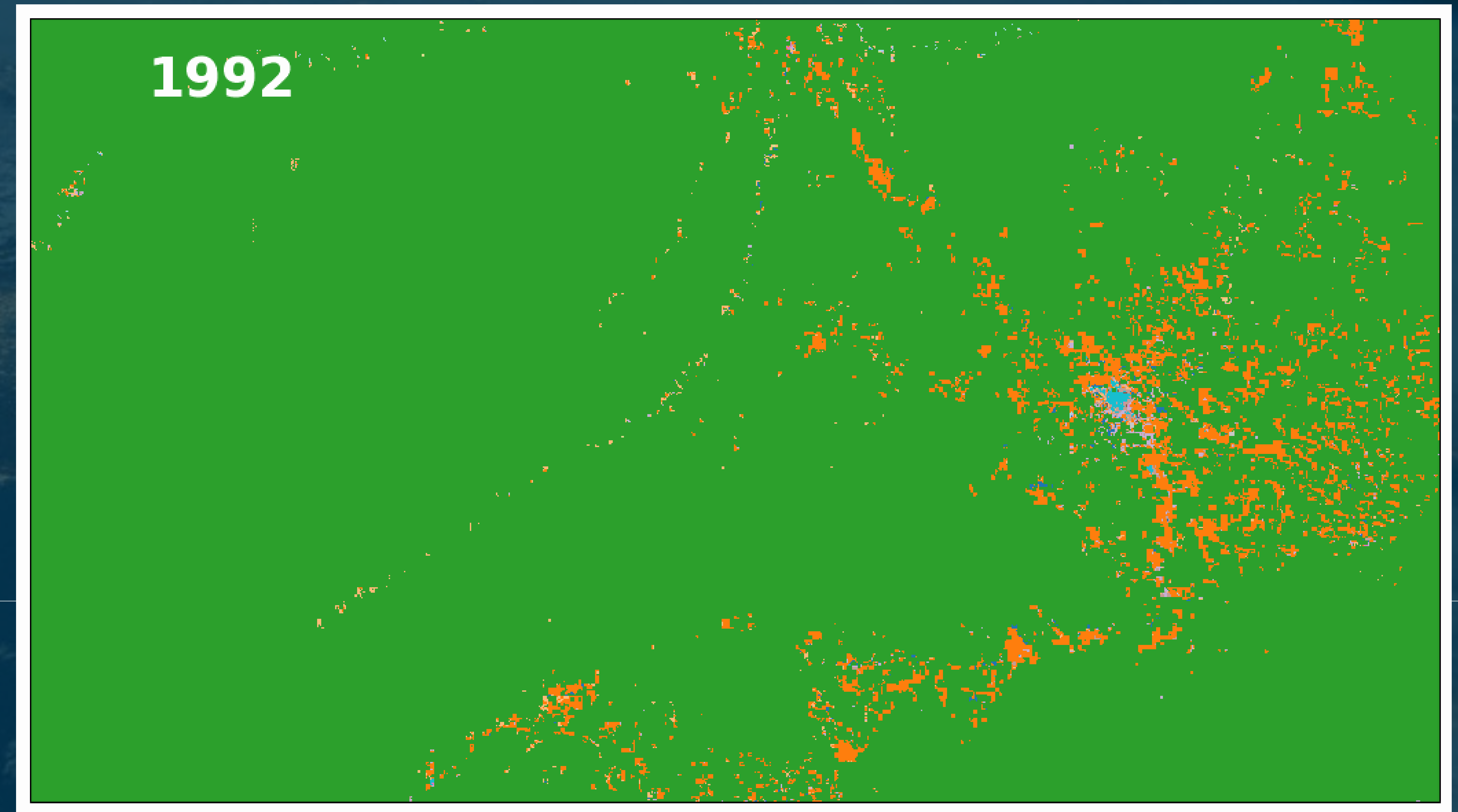
Biomass changes since 2010 in North Bolivia (ESA-CCI data)

Using ESA-CCI ECVs, can you turn this science into a wake-up call ?

Using ESA-CCI ECVs, can you turn this science into a wake-up call ?

Here are some of the many angles you could explore with your climate data visualisation:

- Biomass changes over time
- Impacts of deforestation on emissions
- Visualise changes in forests biomass due to extreme weather events
- Investigate biomass changes in combination with other parameters, such as changes in clouds and explore the implications for climate feedback loops.



Land Cover Changes since 1993 in North Bolivia (ESA-CCI data)

Using ESA-CCI ECVs, can you turn this science into a wake-up call ?

EO Data Visualisation Competition Guidelines



Bring ESA-CCI ECVs data to life with stunning visualisations and demonstrate your creativity in one of three competition categories:

- 01 | Static image: An infographic with a clear and impactful message**
- 02 | Animated: timelapse , GIF , YT/ Instagram Short illustrating changes over time**
- 03 | Interactive: A scrollable story or dashboard allowing user engagement**

Why join ?

1

Showcase your data visualisation skills and learn more about ESA's Climate Change Initiative data from science and communication experts

2

Encourage climate action with data storytelling

3

Win visibility and more : Top entries will be shown on ESA's official website and socials during COP 30 and receive ESA-branded prizes. The overall winner, selected by community voting, will be invited to an all expenses paid tour of the Φ -experience , ESA's Earth Observation multimedia centre, located at ESA's ESRIIN facility Frascati, Italy.

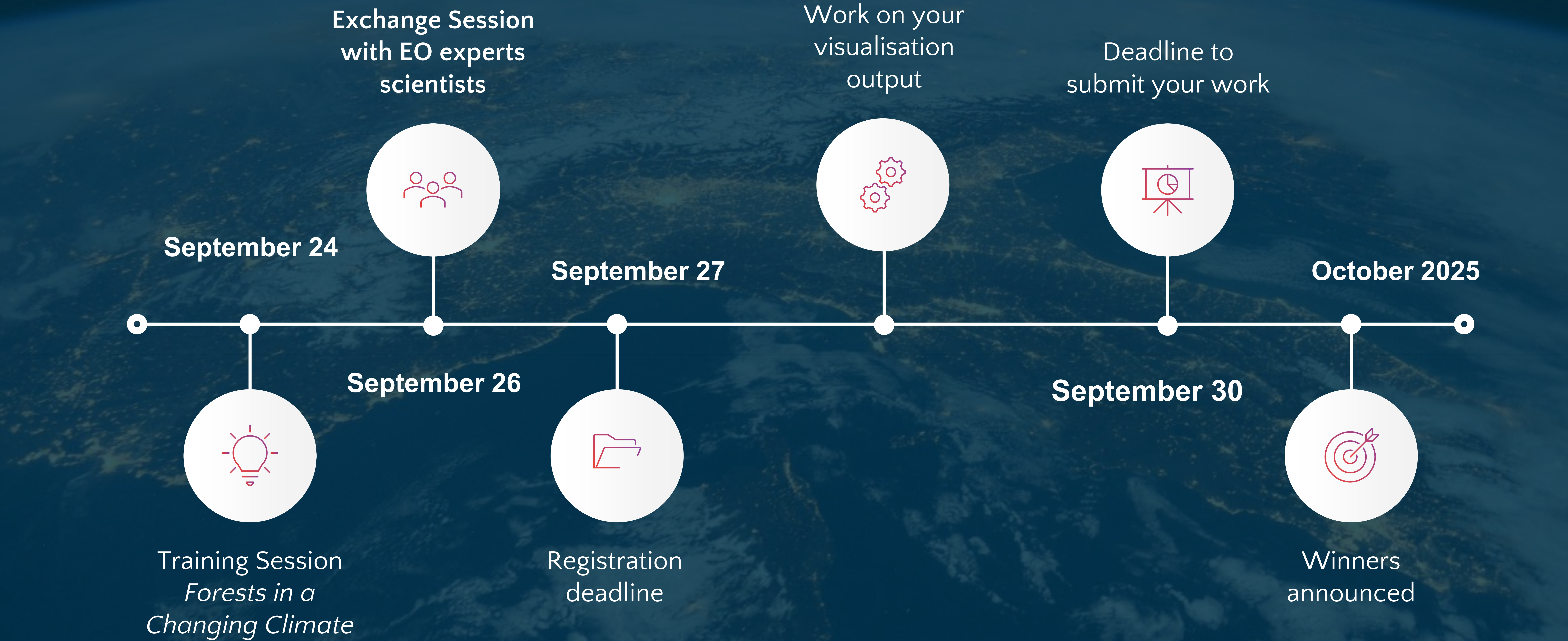
Who can enter?

- 01** | Participants must be from an ESA member state or associate state
- 02** | Participants need to be 18 years and above
- 03** | Group submissions are accepted

Judging criterias

- 01 | At least one ESA-CCI ECVs **must be used**
- 02 | Strong message **linked to climate change**
- 03 | **Aesthetic and shareability** of the visualisation

EO Data Visualisation Competition - Timeline



How to submit your work ?

Each submission on Dropbox must include:

- The visualisation output
- A user-friendly Jupyter Notebook (or, alternatively, a read-me file in Markdown or Text format), clearly demonstrating how the visualisation was produced and which ESA-CCI data and any auxiliary data were used.
- Include any relevant information needed to run the notebooks material (i.e environment file for additional libraries required, link to a generated website/platform)

All files must be combined into a single compressed folder (.zip or .rar) named: `'{CONTESTANTLASTNAME}_{ENTRYCATEGORY}_submission{#number}.zip'` and submitted here.

ESA CCI Forests in a Changing Climate Competition

All files must be combined into a single compressed folder (.zip or .rar) named: `'{CONTESTANTLASTNAME}_{ENTRYCATEGORY}_submission{#number}.zip'`

Ajouter des fichiers

ou faites glisser des éléments ici

Effective Science Communication & Storytelling

Klenk & Hoursch