

# Building actionable climate products for end users using EGI-ACE resources

Christian Pagé  
christian.page@cerfacs.fr  
Abel Aoun

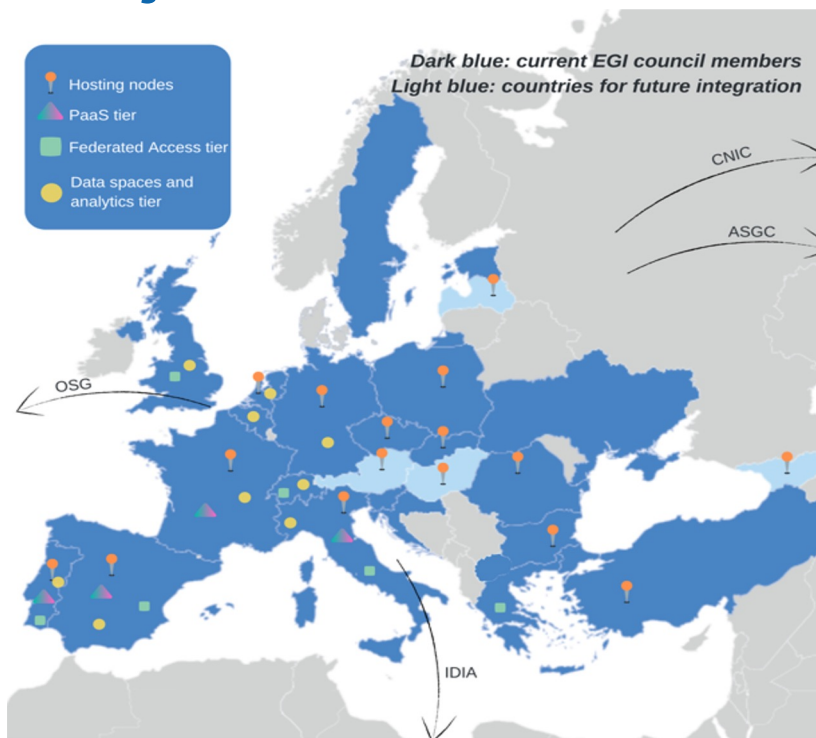
CERFACS, Toulouse, France

Pan-European digital assets  
supporting research communities -  
Benefits & opportunities  
05-06 December 2022  
Online

## EGI-ACE Mission

Implement the **Compute Platform of the EOSC** and contribute to the **EOSC Data Commons** by delivering integrated computing, platforms, data spaces and tools as an integrated solution that is **aligned with** major European cloud federation projects and HPC initiatives.

# Project Overview



## EGI Advanced Computing for EOSC Grant agreement ID: 101017567

### Budget

- Total budget: € 12,009,988
- EC budget: € 8,000,000

### Consortium

- Coordinator - Stichting EGI
- 33 Partners, 23 third parties

### Effort

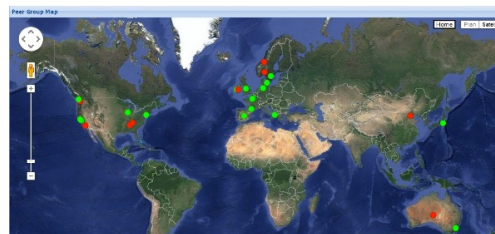
- 1472 PMs, 48 FTEs
- **49% Virtual Access** (35 services, 38 providers)

### Duration

- Jan 2021 - June 2023 (30 months)

## Climate data distribution

- Climate data is distributed using the Earth System Grid Federation (ESGF)
- Data Nodes interface is not straightforward to use for non-expert users
- Available variables are "raw" output from climate models: temperature, humidity, precipitation, ...
- Daily, monthly, ... frequencies



ESGF represents a **multinational** effort to securely **access, monitor, catalog, transport, and distribute** reference **data** for **climate** research experiments and observations.

## Gap between Users needs and available data

- Often significant gaps between distributed datasets and users' needs:
  - Assessing climate change anomalies
  - Evaluating climate extremes
  - Understanding climate change impacts
  - ...
- Users' Stories examples
  - Will there be more droughts in northeast Spain?
  - How likely landslides will occur in this mountainous valley?
  - Which region in my Europe will see the greatest change in heatwave intensity and occurrence?

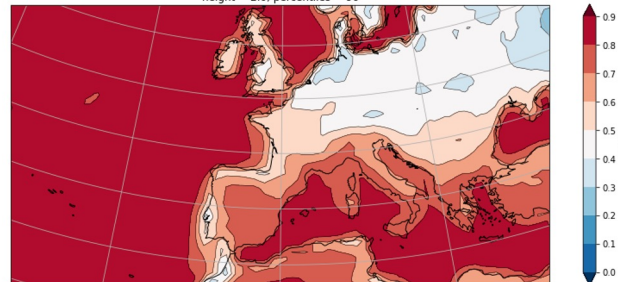
*In the future climate compared to now*

## What is a climate index

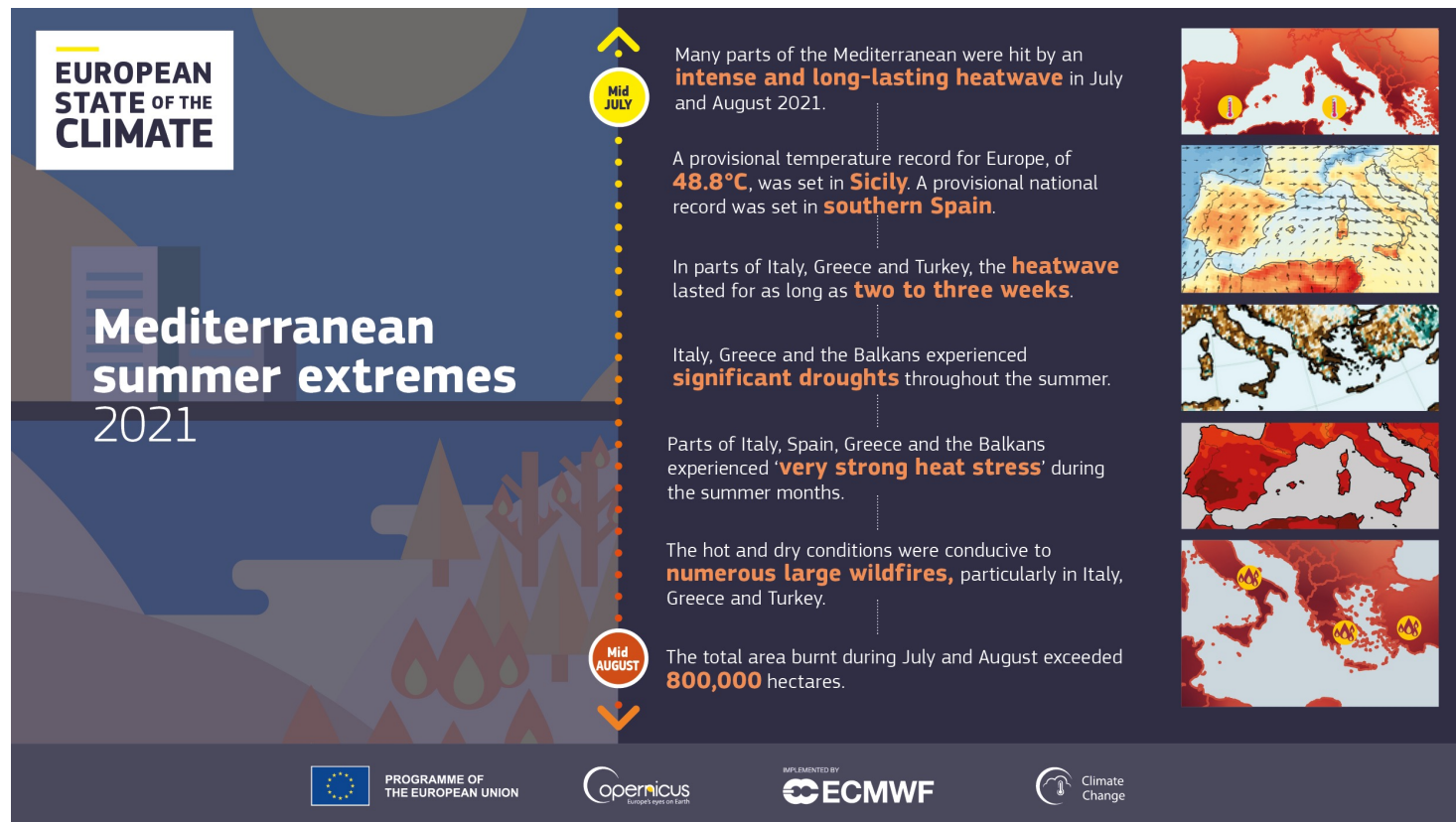
- A Climate Index is derived from basic climate variables such as temperature, humidity, precipitation, wind, ...
  - Warm days (*days with mean temperature > 90th percentile of daily mean temperature*) – **TG90p**
  - Summer days (*days with max temperature  $\geq 25$  °C*) – **SU**
- Most of Climate Indices are standardized within the international community
  - ETCCDI, ECA&D, ET-SCI, ...

Percentage of days when Tmax > 90th percentile Period 2081-2100 Reference 1981-2000 TX90p

height = 2.0, percentiles = 90



# What is a climate index



## icclim: a flexible tool, but still



- Tool: **icclim**, an open source python software package to calculate climate indices
- Simple and flexible API and interface, fast processing
- Difficult for users to process a sufficient numbers of climate projections to calculate those climate indices
  - Assess Uncertainties
  - Explore several Greenhouse Gas Emission Scenarios
  - Impossibility to download all required input data
  - Even with all data available, very time consuming and complex to calculate all what's needed



## Project

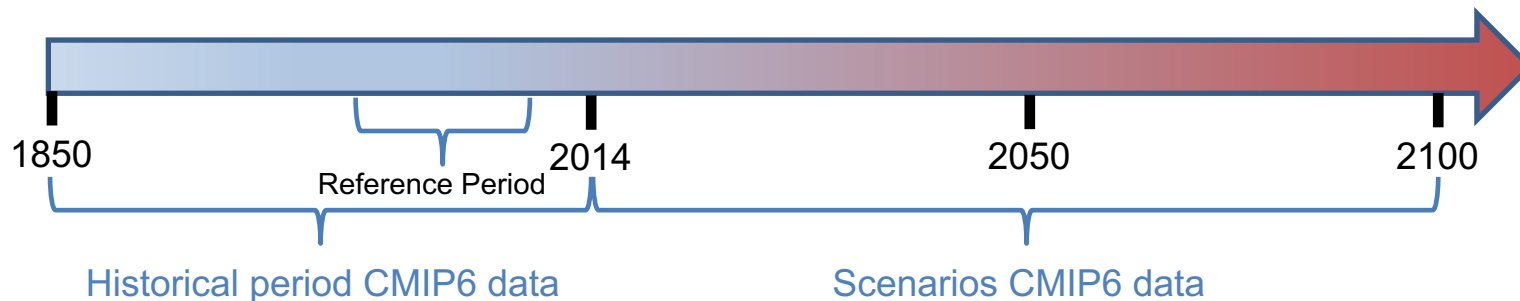
- Pre-generate 50 standard climate indices

### CMIP6 (most common experiments used)

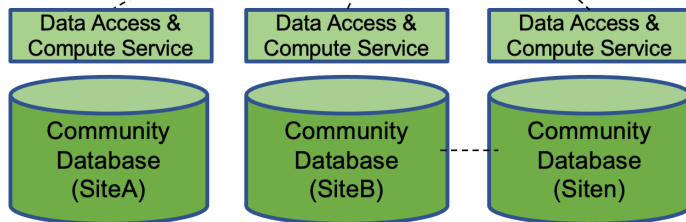
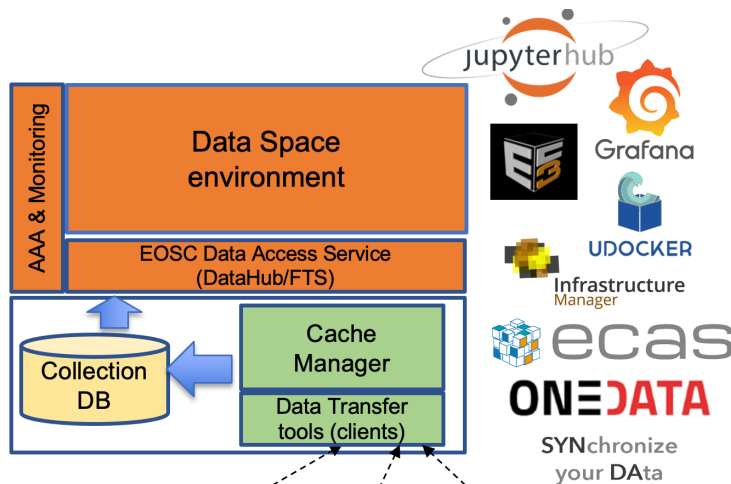
- Core set of simulations
  - **All**: climate models, greenhouse gas scenarios (aka SSPs...), ensemble members, versions
  - Daily time frequency

## Choices to be made

- Reference period for percentiles
  - 1981–2010 (within historical period of climate simulations 1850–2014)



- Standard thresholds of standard indices
  - **Example:** Summer day is a day with maximum temperature  $\geq 25^{\circ}\text{C}$



https://enesdataspace.vm.fedcloud.eu

## ENES Data Space

Home Notebooks User guide Login

The ENES Data Space delivers an open, scalable and cloud-enabled data science environment for climate data analysis on top of the EOSC Compute Platform. It provides both storage and computational capabilities.

It consists of a JupyterHub instance jointly with a large set of pre-installed Python libraries for running data manipulation, analysis, and visualization, and a data publication service enabling file browsing and data access for scientific datasets.

The ENES Data Space hosts (open) data from the ESGF federated data archive on compute cloud to support meteorological and industrial researchers in realistic climate model analysis experiments.

EUROPEAN OPEN SCIENCE CLOUD

Find resource... All resour... Q My EOSC Marketplace

Resources Processing & Analysis Data Analysis Image/Data Analysis ENES Data Space

cmcc  
IPSL

### ENES Data Space

Data science environment for climate data analysis on top of the EOSC Compute Platform

Organisation: Euro-Mediterranean Center on Climate Change

☆☆☆☆☆ (0.0/5) 0 reviews ☐ Add to comparison ☐ Add to favourites

OPEN ACCESS

Access the resource

Webpage Helpdesk e-mail

Ask a question about this resource?

File Edit View Run Kernel Tabs Settings Help

Name	Last Modified
dask-worker-space	3 months ago
data	3 months ago
C4I_Summer_days_Calculat...	a month ago
C4I_Summer_days_Calculat...	a day ago
file_pr.txt	4 months ago
file_tas.txt	4 months ago
file_tasmax.txt	4 months ago
file_tasmin.txt	4 months ago
filelist.txt	4 months ago
nohup.out	2 days ago
pr.txt	4 months ago
su_liclim.py	4 days ago
tas.txt	4 months ago
tasmax.txt	4 months ago
tasmin.txt	4 months ago

```
jovyan@jupyter-cpage: ~/wX
C4I_Summer_days_Calculat...
Python 3 (ipykernel)

x1, x2 = range1.start, range1.stop
y1, y2 = range2.start, range2.stop
return x1 <= y2 and y1 <= x2

[ ]: HOME = os.getenv('HOME')

historical = "CHIP"
ssp = "ScenarioMIP"
frequency = "day"

cmpi6_dir = HOME + '/data/CHIP6'

dirs = {}
dirs["historical"] = cmpi6_dir + '/' + historical
dirs["ssp"] = cmpi6_dir + '/' + ssp

indices = {"tas": ["TG", "GD4", "HD17", "TG10p", "TG90p"],
           "tasmin": ["TN", "TNx", "Tn", "TR", "CFD", "TN10p", "TN90p", "CSDI"],
           "tasmax": ["TX", "TXx", "TXn", "SU", "CSU", "ID", "TX10p", "TX90p", "WSDI"],
           "tasminmax": ["DTR", "ETR", "vDTR"],
           "pr": ["PRCPTOT", "RR1", "SDII", "CWD", "CDD", "R10mm", "R20mm", "RX1day", "RX5day", "R75p"],
           "prsn": ["SD", "SD1", "SD5cm", "SD50cm"],
           "taspr": ["CD", "CW", "WD", "WW"]}

indices_percentiles = ["CD", "CW",
                       "R75p", "R75pTOT", "R95p", "R95pTOT", "R99p", "R99pTOT",
                       "TG10p", "TG90p", "TN10p", "TN90p", "TX10p", "TX90p",
                       "WD", "WW"]

indices_vars = {"tas": ["tas"],
               "tasmin": ["tasmin"],
               "tasmax": ["tasmax"],
               "tasminmax": ["tasmin", "tasmax"],
               "pr": ["pr"],
               "prsn": ["prsn"],
               "taspr": ["tas", "pr"]}

reference_period = [1981, 2010]
# base period
base_dt1 = datetime.datetime(1981,1,1)
base_dt2 = datetime.datetime(2010,12,31)

institutes = {}
institutes["historical"] = os.listdir(dirs["historical"])
institutes["ssp"] = os.listdir(dirs["ssp"])
```

```
jovyan@jupyter-cpage: ~/wX
Process == false
Index: HD17
/home/jovyan/work/data/CHIP6/CHIP/BCC-BESM1/historical/r3ilp1f/HD17/gn/v20181220/HD17_day_BCC-BESM1_historical_r3ilp1f_gn_18500101-20141231.nc
Process == false
Index: TG10p
/home/jovyan/work/data/CHIP6/CHIP/BCC-BESM1/historical/r3ilp1f/TG10p/gn/v20181220/TG10p_day_BCC-BESM1_historical_r3ilp1f_gn_18500101-20141231.nc
Processing TG10p and creating /home/jovyan/work/data/CHIP6/CHIP/BCC-BESM1/historical/r3ilp1f/TG10p/gn/v20181220/TG10p_day_BCC-BESM1_historical_r3ilp1f_gn_18500101-20141231.nc
Key: tasmin
tasmin
First var test: /home/jovyan/data/CHIP6/CHIP/BCC-BESM1/historical/r3ilp1f/day/tasmin
Key: tasmax
tasmax
First var test: /home/jovyan/data/CHIP6/CHIP/BCC-BESM1/historical/r3ilp1f/day/tasmax
Key: tasminmax
tasmin tasmax
First var test: /home/jovyan/data/CHIP6/CHIP/BCC-BESM1/historical/r3ilp1f/day/tasmin
Key: pr
pr
First var test: /home/jovyan/data/CHIP6/CHIP/BCC-BESM1/historical/r3ilp1f/day/pr
Key: prsn
prsn
First var test: /home/jovyan/data/CHIP6/CHIP/BCC-BESM1/historical/r3ilp1f/day/prsn
Key: taspr
tas pr
First var test: /home/jovyan/data/CHIP6/CHIP/BCC-BESM1/historical/r3ilp1f/day/tas
Version: v20181220
Period: 18500101-20141231
Members: r3ilp1f
Key: tas
tas
First var test: /home/jovyan/data/CHIP6/CHIP/BCC-BESM1/historical/r3ilp1f/day/tas
Version: v20181220
Period: 18500101-20141231
Index: TG
/home/jovyan/work/data/CHIP6/CHIP/BCC-BESM1/historical/r3ilp1f/TG/gn/v20181220/TG_day_BCC-BESM1_historical_r3ilp1f_gn_18500101-20141231.nc
Process == false
Index: GD4
/home/jovyan/work/data/CHIP6/CHIP/BCC-BESM1/historical/r3ilp1f/GD4/gn/v20181220/GD4_day_BCC-BESM1_historical_r3ilp1f_gn_18500101-20141231.nc
Process == false
Index: HD17
/home/jovyan/work/data/CHIP6/CHIP/BCC-BESM1/historical/r3ilp1f/HD17/gn/v20181220/HD17_day_BCC-BESM1_historical_r3ilp1f_gn_18500101-20141231.nc
Processing TG10p and creating /home/jovyan/work/data/CHIP6/CHIP/BCC-BESM1/historical/r3ilp1f/TG10p/gn/v20181220/TG10p_day_BCC-BESM1_historical_r3ilp1f_gn_18500101-20141231.nc
Key: tasmin
tasmin
First var test: /home/jovyan/data/CHIP6/CHIP/BCC-BESM1/historical/r3ilp1f/day/tasmin
Version: v20181220
Period: 18500101-20141231
```

Simple 9 1 Python 3 (ipykernel) | Idle Mem: 863.93 / 15360.00 MB Mode: Command Ln 1, C

Significant step toward  
more actionable climate  
data information



- Future actions
  - Validate calculations (end of 2022 – beginning of 2023)
  - Decide on where to store database permanently
    - NetCDF, zarr, Commercial and Public Clouds, ...
  - Make it accessible within the IS-ENES C4I platform
  - Use database to support Horizon Europe interTwin project
  - Disseminate information about this climate indices database
- Possible extensions
  - ERA5, and other re-analyses
  - CORDEX
  - CMIP5
  - CMIP7, Future CORDEX...

# Thanks !



Christian Pagé  
Abel Aoun

christian.page@cerfacs.fr

**THE CONSORTIUM**

Coordinated by CNRS-IPSL, the IS-ENES3 project gathers 22 partners in 11 countries



*This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N°824084*



Our website  
<https://is.enes.org/>



Follow us on Twitter !  
**@ISENES\_RI**



Contact us at  
[is-enes@ipsl.fr](mailto:is-enes@ipsl.fr)



Follow our channel  
**IS-ENES3 H2020**

