



CENTRE EUROPÉEN DE RECHERCHE ET DE FORMATION AVANCÉE EN CALCUL SCIENTIFIQUE



# Accessing Climate Data and Tools for End Users

## A Practical Overview for Users

Christian Pagé, CERFACS, Toulouse, France

IS-ENES3 virtual Autumn School on Climate data use  
for impact assessments  
4<sup>th</sup> Nov. - 11<sup>th</sup> Dec. 2020

The IS-ENES3 project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 824084.



[www.cerfacs.fr](http://www.cerfacs.fr)



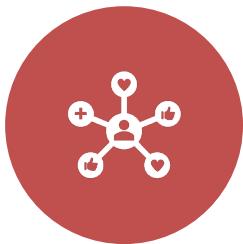
# ESGF Infrastructure

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

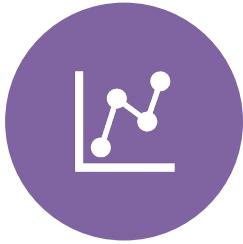




# Introduction



The Earth System Grid Federation (ESGF) is a globally distributed e-infrastructure for the hosting and dissemination of climate-related data.



Provide a means for climate data users to access and analyse the data output



ESGF was originally developed to support CMIP5 (5th Coupled Model Intercomparison Project)  
...



For 5th Assessment report made by the IPCC (Intergovernmental Panel on Climate Change).



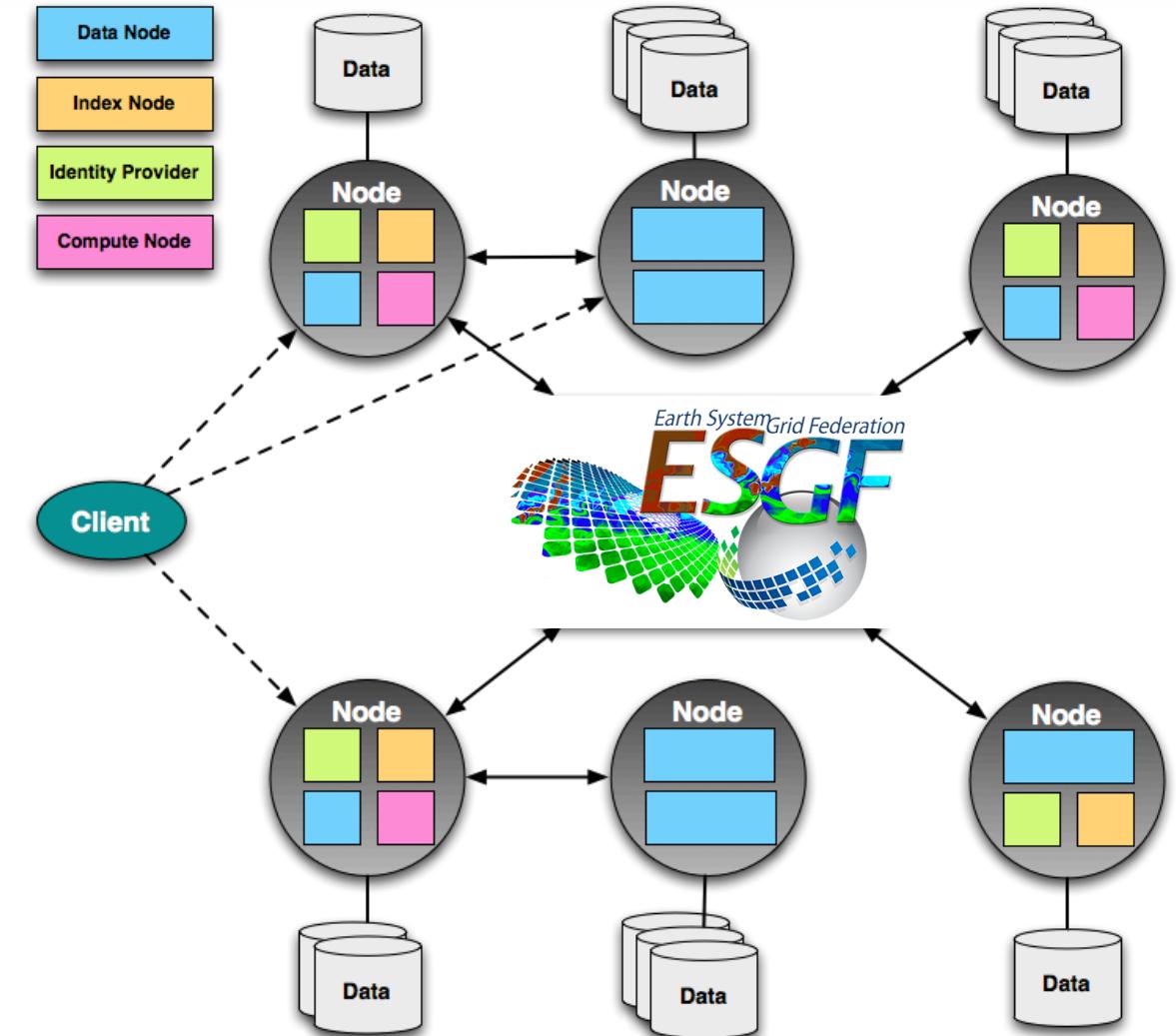
# Ten years of Operations: History and Evolution

ESGF has grown to support over 25000 registered users

Besides the CMIPs, supports a range of other projects such as:

- Energy Exascale Earth System Model
- Obs4MIPS
- CORDEX
- European Space Agency's Climate Change Initiative Open Data Portal.

Important experience gathered over the years about community collaboration for a distributed infrastructure - operational procedures and governance





# ESGF: Current Data Holdings

ESGF opened for CMIP6 data  
in June 2018

## Data holdings:

- ~ 218 Experiments
- ~ 37 Institutions
- ~ 94 CMIP6 Models
- ~ 30 Data Nodes
  
- ~ 18 Petabytes Expected

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Lawrence Livermore National Laboratory

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**WCRP CMIP6**  
World Climate Research Programme

Home Contact Us Data Nodes Status      You are at the [ESGF@DOE/LLNL node](#)      Technical Support

MIP Era      Activity      Model Cohort      Product

Source ID      Institution ID      Source Type      Nominal Resolution

Experiment ID      Sub-Experiment      Variant Label      Grid Label

Table ID      Frequency      Realm      Variable      CF Standard Name

Data Node

WARNING: Not all models include a variant "r1i1p1f1", and across models, identical values of variant\_label do not imply identical variants! To learn which forcing datasets were used in each variant, please check modeling group publications and documentation provided through ES-DOC.

CMIP6 project data downloads are unrestricted. Downloads should be performed with the -s option to a wget script without the need to login. When using this method for download, ensure you are not using additional options, eg. -s and -H should never be combined.

Enter Text:  ? [Search](#) [Reset](#) Display 10 ▼ results per page [ [More Search Options](#) ]

Show All Replicas  Show All Versions  Search Local Node Only (Including All Replicas)

The search returned 0 results.

ESGF sponsors and partners  
DoE Office of Science | IS-ENES | NASA | NOAA | NCI | NSF

CoG version v4.0.0b2  
ESGF P2P Version v4.0.4

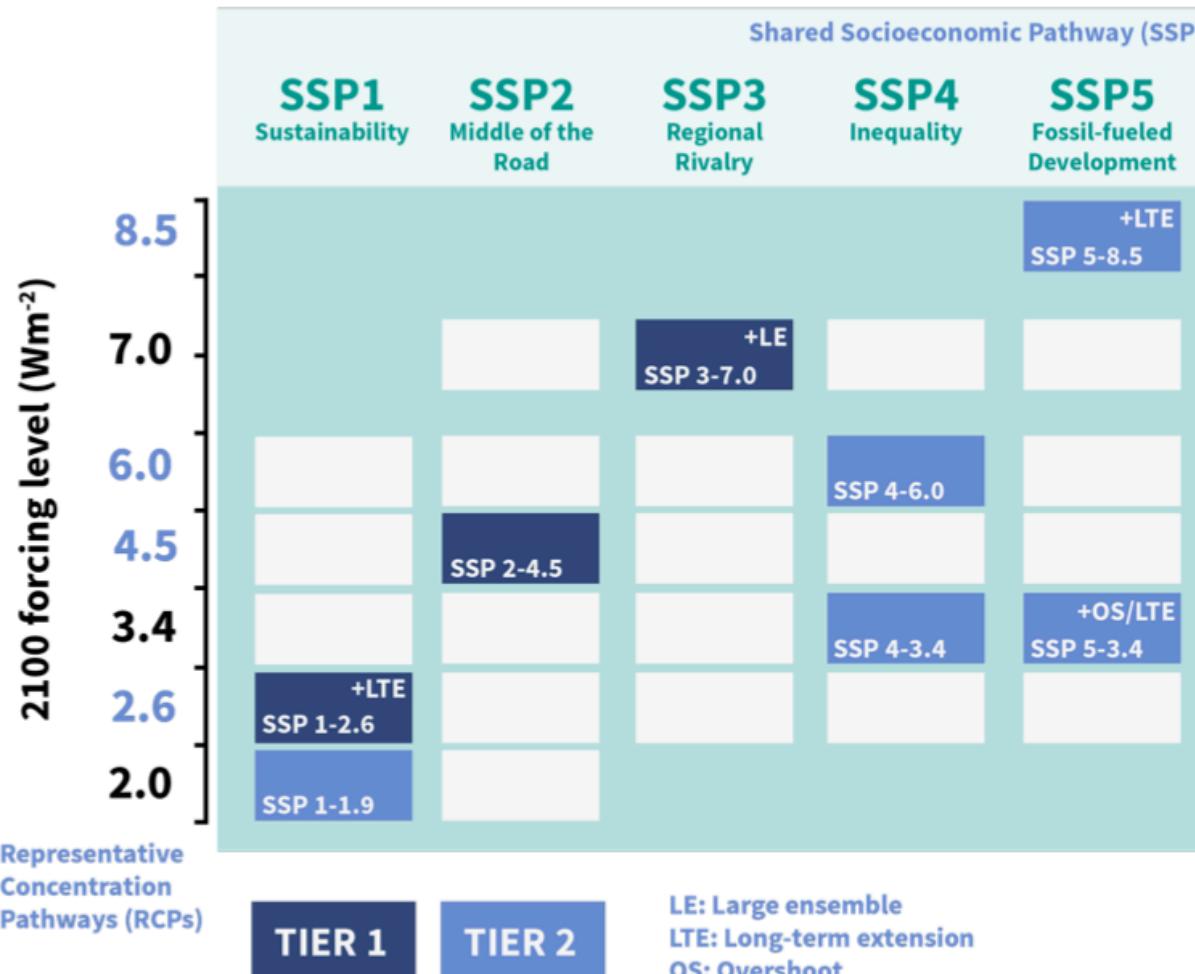
Earth System CoG sponsors and partners  
NOAA | NASA | NSF | DoE Office of Science | IS-ENES

<http://esgf-node.llnl.gov>      Privacy & Legal Notice

# CMIP6 GES Scenarios

## CMIP6

- Now we have SSPs instead of CMIP5 RCPs and CMIP3 SRES
- Here we have the correspondence between RCPs and SSPs



See: O'Neill et al., The Scenario Model Intercomparison Project (ScenarioMIP) for CMIP6, GMD, 2016



# Accessing CMIP6 data using ESGF

## CMIP6

- Accessing datasets using the ESGF Data Nodes

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**WCRP CMIP6**  
World Climate Research Programme

You are at the **ESGF@DOE/LLNL** node

Technical Support

Home Contact Us Data Nodes Search

MIP Era +  
Activity +  
Model Cohort +  
Product +  
  
Source ID +  
Institution ID +  
Source Type +  
Nominal Resolution +  
  
Experiment ID +  
Sub-Experiment +  
Variant Label +  
Grid Label +  
  
Table ID +  
Frequency +  
Realm +  
Variable +  
CF Standard Name +  
  
Data Node +

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Enter Text:  ? Search Reset Display 10  results per page [More Search Options]

Show All Replicas  Show All Versions  Search Local Node Only (Including All Replicas)

The search returned 0 results.

<https://esgf-node.llnl.gov/search/cmip6/>

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CoG version v4.0.0b2  
ESGF P2P Version v4.0.4

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<http://esgf-node.llnl.gov>

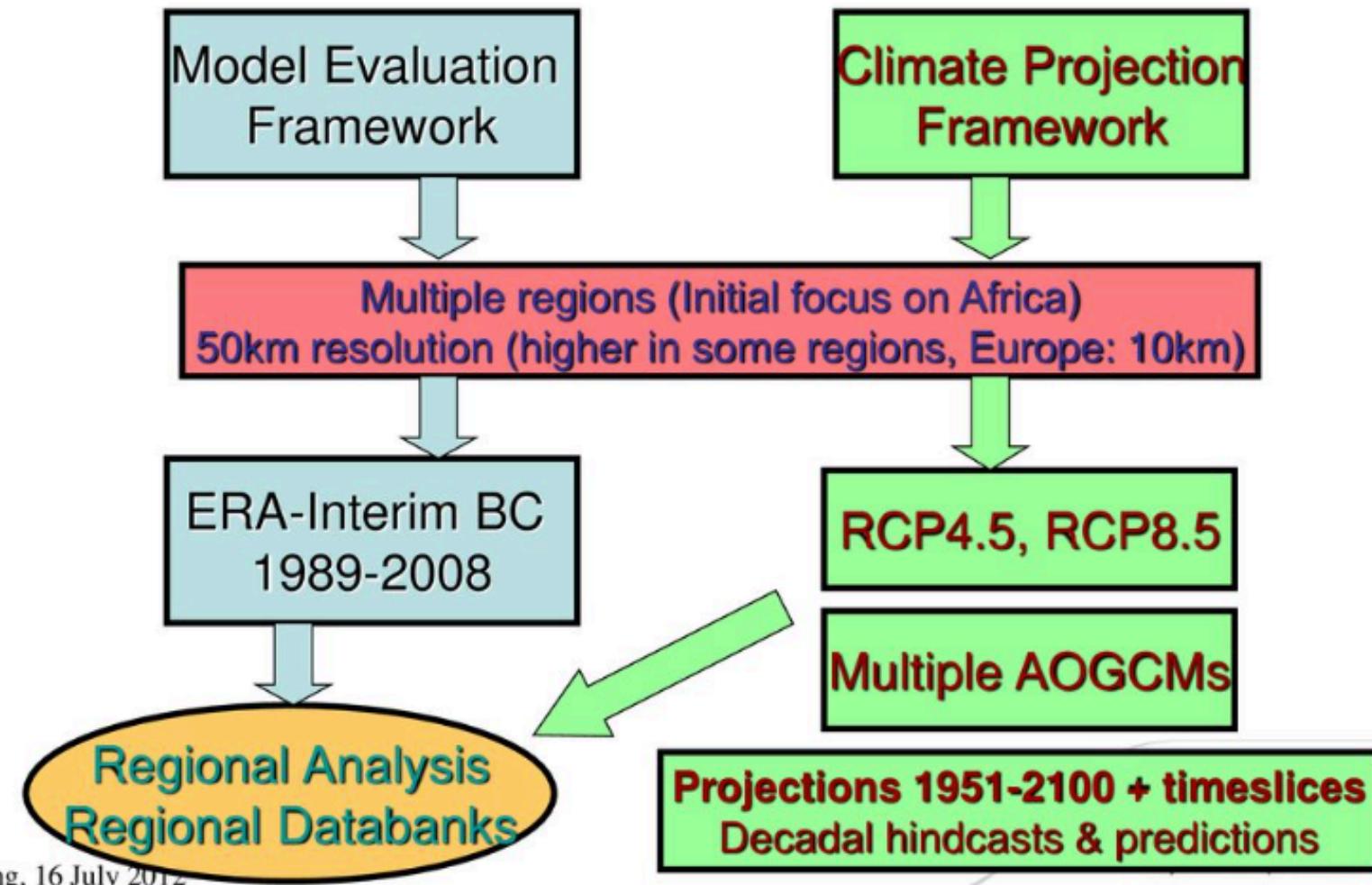
Privacy & Legal Notice



# CORDEX Experiments



**CORDEX datasets still  
CMIP5-based only**



Beijing, 16 July 2012

# CORDEX Data



CORDEX datasets still  
CMIP5-based only

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[Home](#) [Contact Us](#) [Data Nodes Status](#)

## ESGF@DOE/LLNL

### Search & Download Data

Simple Text Search



More search options



The Earth System Grid Federation (ESGF) is a collaboration that develops, deploys and maintains software infrastructure for the management, dissemination, and analysis of model output and observational data. ESGF's primary goal is to facilitate advancements in Earth System Science. It is an interagency and international effort led by the Department of Energy (DOE), and co-funded by National Aeronautics and Space Administration (NASA), National Oceanic and Atmospheric Administration (NOAA), National Science Foundation (NSF), and international laboratories such as the Max Planck Institute for Meteorology (MPI-M) German Climate Computing Centre (DKRZ), the Australian National University (ANU) National Computational Infrastructure (NCI), Institut Pierre-Simon Laplace (IPSL), and the British Atmospheric Data Center (BADC). The ESGF mission is to:

- Support current CMIP activities, and prepare for future assessments
- Develop data and metadata facilities for inclusion of observations and reanalysis products for CMIP use
- Enhance and improve current climate research infrastructure capabilities through involvement of the software development community and through adherence to sound software principles
- Foster collaboration across agency and political boundaries
- Integrate and interoperate with other software designed to meet the objectives of ESGF: e.g., software developed by NASA, NOAA, ESIP, and the European [IS-ENES](#)
- Create software infrastructure and tools that facilitate scientific advancements

ESGF is a component architecture expressly designed to handle large-scale data management for worldwide distribution. The team of computer scientists and climate scientists has developed an operational system for serving climate data from multiple locations and sources. Model simulations, satellite observations, and reanalysis products are all being served from the ESGF P2P distributed data archive.

ESGF portals like this one provide access to the output of the climate models contributing to the next assessment report of the Intergovernmental Panel on Climate Change [IPCC](#) through the Coupled Model Intercomparison Project [CMIP](#). The [WGCM Infrastructure Panel](#) is the official CMIP document home.

You are at the [ESGF@DOE/LLNL](#) node

[Technical Support](#)

### Federated ESGF-CoG Nodes

[Cog-CU](#)  
[ESGF@CEDA](#)  
[ESGF@DKRZ](#)  
[ESGF@IPSL](#)  
[ESGF@NASA/NCCS](#)  
[ESGF@NCI](#)  
[ESGF@NOAA/GFDL](#)  
[ESGF@NSC/LIU](#)  
[ESGF@PIK](#)

### Browse Projects

[This](#) [All](#) [My](#) [Tags](#)

Parent projects (0)

### Peer projects (7)

[ESGF-CEDA](#)  
[ESGF-DKRZ](#)  
[ESGF-GFDL](#)  
[esgf-gsfc](#)  
[ESGF-IPSL](#)  
[ESGF-LIU](#)  
[ESGF-PIK](#)

### Child projects (8)

[CMIP3](#)  
[CMIP5](#)  
[cmip6](#)  
[create-ip](#)  
[E3SM](#)  
[input4MIPs](#)  
[obs4MIPs](#)  
[PCMDI](#)

### Enter Tag

[Reset](#)

[Go](#)

Start typing, or use the 'Delete' key to show all available tags.

ESGF-LLNL Tags: None



# CORDEX-Adjust: be careful



High CAUTION

## Bias-adjusted RCM data

Note that even if bias adjustment (or bias correction) is widely used it is still a controversial approach with its own pros and cons. Bias-adjusted CORDEX simulations should be used carefully with full understanding of all potential limitations of the bias adjustment approach.

- Bias may not be removed completely
- When using only a bias-adjustment based on averages, **the extremes may still be over/underestimated**
- When an adjustment is performed per climate variable **this may reduce the consistencies between climate variables**
- The **bias may be different for different regions**, so adjustment should take this into account.
- The reference dataset determines strongly the bias and how it is adjusted. **If this reference dataset also contains biases, then the bias in the climate model runs can not be removed.**



# IS-ENES climate4impact (C4I)

<https://climate4impact.eu> (also called C4I)

- Access all ESGF distributed datasets
  - CMIP5
  - CMIP6
  - CORDEX
  - CORDEX-Adjust
  - ...
- Exhaustive Documentation/Guidance
  - Climate System
  - Climate Numerical Modelling
  - Downscaling techniques
  - Case studies
- On-demand Processing Capabilities

 *Exploring climate model data*

Home Data discovery Downscaling Documentation Help About us Sign in

## Welcome to IS-ENES Climate4Impact

The aim of Climate4Impact is to enhance the use of climate research data. It has been developed within the European projects IS-ENES, IS-ENES2 and CLIPC. Climate4Impact is connected to the [Earth System Grid Federation \(ESGF\) infrastructure](#), using certificate based authentication, ESGF search, openid, opendap and thredds catalogs. The portal aims to support climate change impact modellers, impact and adaptation consultants, as well anyone else wanting to use climate change data. The portal offers web interfaces for searching, visualizing, analyzing, processing and downloading datasets.

--> Visualize and download data from global climate models (GCM), regional climate models (RCM) and downscaled high resolution climate data using [Data discovery](#). Need some [help with this tool](#)?

--> Tools like indices calculations, downscaling, subsetting and regridding are available for tailoring data to your needs: goto [Process data](#).

--> Want to know more on how to use climate scenarios, how the climate models model the complex climate system, and see example use cases in several impact and adaptation themes? Go to [guidance on using climate data](#).

--> New here? [Create an account and sign in](#).



Agriculture/Forestry



Energy



Health



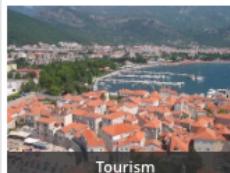
Infrastructure/Urban



Marine/Coastal



Nature/Biodiversity



Tourism



Water Management

Click on one of these images to go to a specific climate change impact and adaptation theme.



# IS-ENES climate4impact: Search Interface

<https://climate4impact.eu>

- Search Interface with facets with Quick Selects
- Explore and use your own datasets
- On-demand Map & Plots
- On-demand Processing

A completely updated C4I portal is being developed and more will be explained next week!

The screenshot shows the IS-ENES climate4impact search interface. At the top, there is a navigation bar with links for Home, Data discovery, Downscaling, Documentation, Help, About us, Sign in, and a search bar. Below the navigation bar is a secondary menu with tabs for Search, Catalogs, Explore your own catalogs or files, Map & Plot, and Processing. A 'Filters' section contains various project and dataset categories with counts: Project (47), Parameter (6374), Frequency (27), Frequency (17), Experiment (240), Domain (46), Model (159), Source\_id (327), Access (8), Date, Geobox, Free text, and buttons for > show all filters and clear all filters. Below the filters is a 'Quick select Project' dropdown and an 'All Project properties (47)' link. The main content area displays three facets: CMIP (orange box), CORDEX (blue box), and OBSERVATIONS (green box). Each facet lists data types with checkboxes: CMIP includes GCM data CMIP6 project, GCM data CMIP5 project, and GCM data NEXGDDP project; CORDEX includes RCM data CORDEX and RCM data CORDEX-Adjust; OBSERVATIONS includes satellite data obs4MIPs and station data CLIPC project. A 'Selected filters' section below shows 'none'. At the bottom, it says 'Found 8926200 datasets. Displaying page 1 of 357049.' with a navigation bar for pages 1 through 11, an ellipsis, 357049, and Next. There is also an 'Export to CSV' button. The search results list four entries, each with a download icon and a file path: CMIP6.CMIP.CSIRO.ACCESS-ESM1-5.esm-hist.r8i1p1f1.Emon.fracLut.gn.v20200730, CMIP6.DCPP.CCCma.CanESM5.dcppA-hindcast.s1979-r4i1p2f1.Slday.sitimefrac.gn.v20190429, CMIP6.AerChemMIP.NERC.UKESM1-0-LL.hist-1950HC.r2i1p1f2.Amon.cl.gn.v20201103, and CMIP6.DCPP.CCCma.CanESM5.dcppA-hindcast.s1975-r3i1p2f1.Slday.sitimefrac.gn.v20190429.



# Copernicus Climate Data Store

**Copernicus CDS**  
<https://cds.climate.copernicus.eu>

- Operational Service
- Toolbox, API and Applications
- Climate-Service like approach
- CMIP5, CORDEX, EOBS, ... most used datasets are available (not all experiments)
- CMIP6 datasets not yet available
- Not all experiments/models are available, a selection is made
- There is a quality assurance
- Support is available

The screenshot shows the official website for the Copernicus Climate Data Store. At the top, it features logos for the European Commission, Copernicus (Europe's eyes on Earth), ECMWF (Implemented by ECMWF), and Climate Change Service. On the right, there are links for "Christian Pagé" and "Logout", and a message encouraging users to provide feedback. A navigation bar below includes links for Home, Search, Datasets, Applications, Your requests, Toolbox, FAQ, and Live. The main content area has a light gray background with a large white box containing the text "Welcome to the Climate Data Store" and a subtext about exploring climate data. It also includes links to the catalogue, FAQ, and C3S forum. Below this, there are three smaller boxes: "Climate Data Store Toolbox" showing a line graph, "Climate Data Store API" showing a snippet of code, and "Access the C3S Forum" showing a brain-like graphic.

Christian Pagé Logout

Your feedback helps us to improve the service

Home Search Datasets Applications Your requests Toolbox FAQ Live

## Welcome to the Climate Data Store

Dive into this wealth of information about the Earth's past, present and future climate.

It is freely available and functions as a one-stop shop to explore climate data. [Register for free](#) to obtain access to the CDS and its Toolbox.

We are constantly improving the services and adding new datasets. For more information, please consult the [catalogue](#), our [FAQ](#) or the [C3S forum](#).

Enter search term(s) All Search

Climate Data Store Toolbox

Climate Data Store API

Access the C3S Forum



# Copernicus Climate Data Store: Download data

**Copernicus CDS**  
<https://cds.climate.copernicus.eu>

- Example for CMIP5 data selection
- Tutorials are available in the User Learning Service

The screenshot shows the CDS interface for selecting CMIP5 monthly data on single levels. At the top, there are logos for the European Commission, Copernicus (Europe's eyes on Earth), ECMWF (IMPLEMENTED BY), and Climate Change Service. The navigation bar includes links for Home, Search, Datasets, Applications, Your requests, Toolbox, FAQ, and Live. On the right, there are links for Christian Pagé and Logout, and a note that feedback helps improve the service.

The main content area is titled "CMIP5 monthly data on single levels". Below it, there are tabs for Overview, Download data (which is selected), Quality assessment, and Documentation. A "Clear all" link is located at the top right of this section.

The "Experiment" section contains radio buttons for AMIP, Historical, RCP 2.6, RCP 4.5 (selected), RCP 6.0, and RCP 8.5. Another "Clear all" link is located below the experiment section.

The "Variable" section contains two columns of checkboxes. The left column includes: 10m wind speed, 10m v-component of wind, Eastward turbulent surface stress, Maximum 2m temperature in the last 24 hours, Mean sea level pressure, Near-surface relative humidity, Northward turbulent surface stress, Sea ice fraction, Sea ice thickness, Sea surface temperature, Sea surface height above geoid, and Snow depth over sea ice. The right column includes: 10m u-component of wind, 2m temperature (selected), Evaporation, Mean precipitation flux, Minimum 2m temperature in the last 24 hours, Near-surface specific humidity, Runoff, Sea ice plus snow amount, Sea surface salinity, Sea ice surface temperature, Skin temperature, and Snowfall.

To the right of the main content area, there is a sidebar with sections for Contact (copernicus-support@ecmwf.int), Licence (CMIP5 - Data Access - Terms of Use), Publication date (2018-06-14), and Related data (links to CMIP5 daily data on pressure levels, CMIP5 daily data on single levels, and CMIP5 monthly data on pressure levels).



# Copernicus Climate Data Store: Toolbox

Copernicus CDS  
<https://cds.climate.copernicus.eu>

- Toolbox using python code
- Processing done remotely
- Applications Community Sharing
- Can do the same using API for programming applications

Screenshot of the Copernicus Climate Data Store (CDS) Toolbox interface.

The interface includes:

- Logos:** European Commission, Copernicus (Europe's eyes on Earth), ECMWF, Climate Change Service.
- User Information:** Christian Pagé, Logout, Your feedback helps us to improve the service.
- Navigation Bar:** Home, Search, Datasets, Applications, Your requests, Toolbox, FAQ, Live.
- Toolbox Editor:** Shows a Python code editor for the "10\_anomaly\_plot" application. The code defines variables for years, months, and countries, and plots monthly anomalies for France from 1980 to 2020.
- Output Area:** Displays two time series plots:
  - Monthly anomalies - France (1980-2020)
  - 12-month anomalies - France (1980-2020)Both plots show temperature anomalies relative to the 1981-2010 average.
- Filters:** Country (France), Bulletin for (Feb 2020).



# WorldClim: basic methodology

## WorldClim

<https://www.worldclim.org>

- Fine resolution observation and future projections
- Very basic scientific downscaling methodology
  - No corrections for inhomogeneities
  - Interpolation using elevation and distance
- Difficult to assess pros and cons of datasets
- Very sparse documentation and information on the methods used
- Be very cautious ! ! ! ! know what you are using.... because data may not be appropriate and usable for your application



Home

## Historical climate data

[Historical climate data](#)  
[Historical monthly weather data](#)  
[Future climate data](#)

This is WorldClim version 2.1 climate data for 1970-2000. This version was released in January 2020.

There are monthly climate data for minimum, mean, and maximum temperature, precipitation, solar radiation, wind speed, water vapor pressure, and for total precipitation. There are also 19 "bioclimatic" variables.

The data is available at the four spatial resolutions, between 30 seconds (~1 km<sup>2</sup>) to 10 minutes (~340 km<sup>2</sup>). Each download is a "zip" file containing 12 GeoTiff (.tif) files, one for each month of the year (January is 1; December is 12).

| variable  | 10 minutes | 5 minutes | 2.5 minutes | 30 seconds |
|---|------------|-----------|-------------|------------|
| minimum temperature (°C)                                | tmin 10m   | tmin 5m   | tmin 2.5m   | tmin 30s   |
| maximum temperature (°C)                                | tmax 10m   | tmax 5m   | tmax 2.5m   | tmax 30s   |
| average temperature (°C)                                | tavg 10m   | tavg 5m   | tavg 2.5m   | tavg 30s   |
| precipitation (mm)                                      | prec 10m   | prec 5m   | prec 2.5m   | prec 30s   |
| solar radiation (kJ m <sup>-2</sup> day <sup>-1</sup> ) | srad 10m   | srad 5m   | srad 2.5m   | srad 30s   |
| wind speed (m s <sup>-1</sup> )                         | wind 10m   | wind 5m   | wind 2.5m   | wind 30s   |
| water vapor pressure (kPa)                              | vapr 10m   | vapr 5m   | vapr 2.5m   | vapr 30s   |

Below you can download the standard (19) WorldClim [Bioclimatic variables](#) for WorldClim version 2. They are the average for the years 1970-2000. Each download is a "zip" file containing 19 GeoTiff (.tif) files, one for each month of the [variables](#).

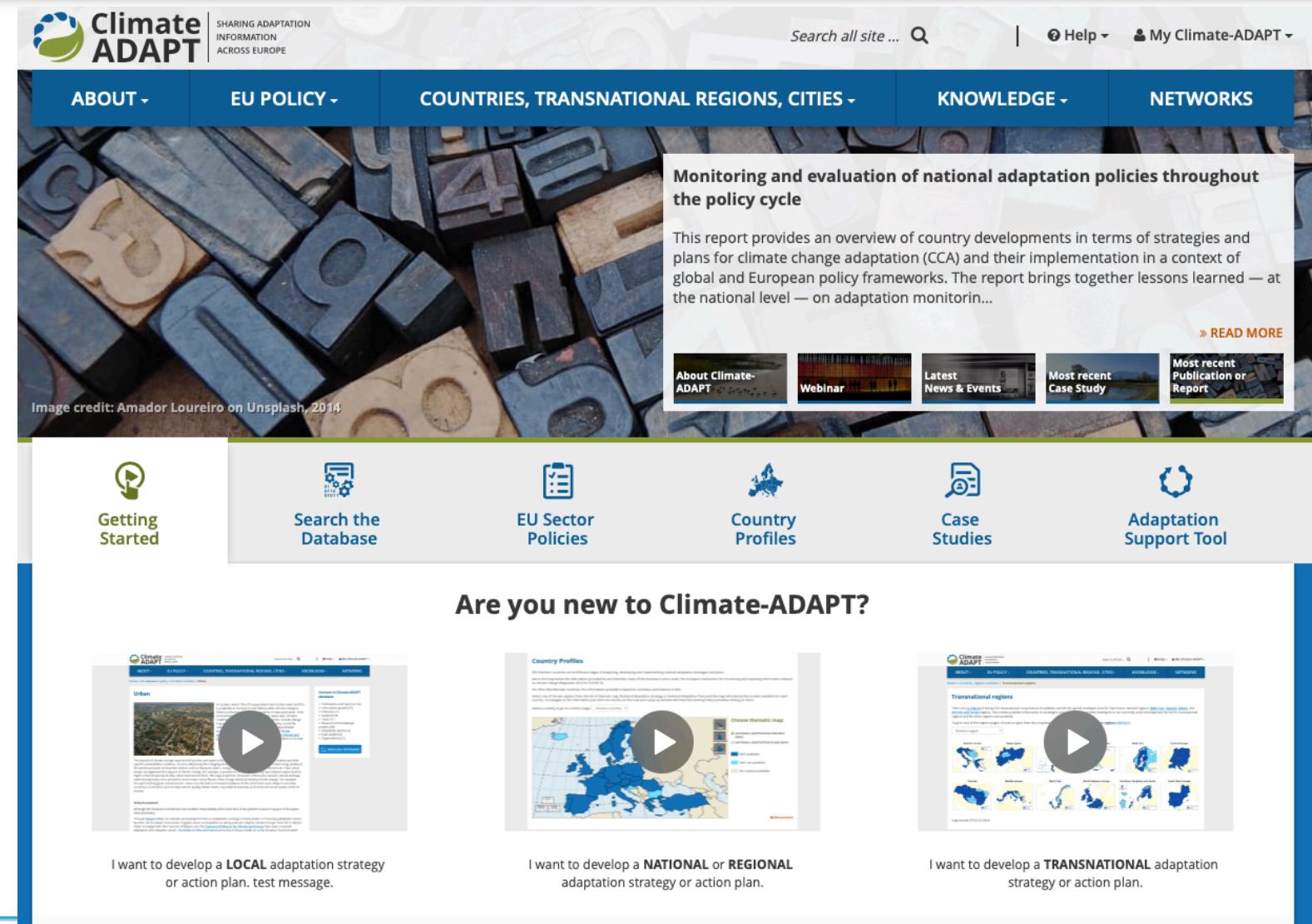


# Climate ADAPT: Resources on how to do adaptation plans

## Climate ADAPT (EEA)

<https://climate-adapt.eea.europa.eu>

- Large documentation and guidance
- Explore other adaptation studies
- Guidance on how to develop adaptation strategies
- Not a data portal but give links to external resources



Climate ADAPT: SHARING ADAPTATION INFORMATION ACROSS EUROPE

ABOUT | EU POLICY | COUNTRIES, TRANSNATIONAL REGIONS, CITIES | KNOWLEDGE | NETWORKS

Search all site ... | Help | My Climate-ADAPT

Monitoring and evaluation of national adaptation policies throughout the policy cycle

This report provides an overview of country developments in terms of strategies and plans for climate change adaptation (CCA) and their implementation in a context of global and European policy frameworks. The report brings together lessons learned — at the national level — on adaptation monitorin...

» READ MORE

About Climate-ADAPT | Webinar | Latest News & Events | Most recent Case Study | Most recent Publication or Report

Image credit: Amador Loureiro on Unsplash, 2014.

Getting Started | Search the Database | EU Sector Policies | Country Profiles | Case Studies | Adaptation Support Tool

Are you new to Climate-ADAPT?

I want to develop a LOCAL adaptation strategy or action plan. test message.

I want to develop a NATIONAL or REGIONAL adaptation strategy or action plan.

I want to develop a TRANSNATIONAL adaptation strategy or action plan.

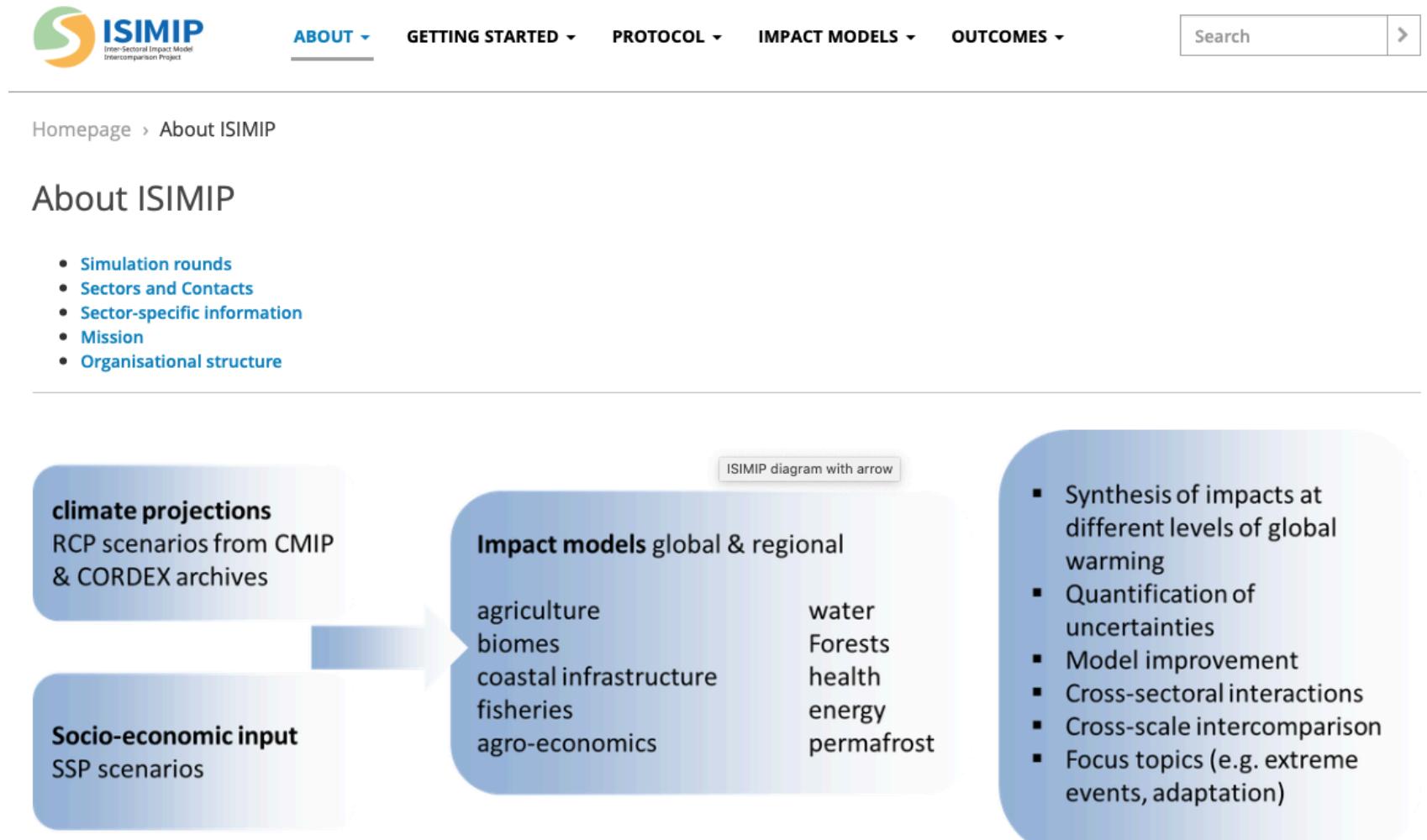


# ISIMIP: Impact Model Intercomparison

ISIMIP

<https://www.isimip.org>

- Inter-Sectoral Impact Model Intercomparison Project
- Large number of impact modelling datasets
- Guidance on how to run impact models
- Access to outputs of the impact models through the ESGF data nodes





# ISIMIP: Impact Model Intercomparison

ISIMIP

<https://www.isimip.org>

- Inter-Sectoral Impact Model Intercomparison Project



## GETTING STARTED



Contact information, information for impacts modellers, including simulation protocol, input data, and ISIMIP newsletter.

## IMPACT MODELS



Searchable and downloadable database of all climate-impact models participating in ISIMIP, with technical summaries, key characteristics and contact person.

## OUTPUT DATA



See which climate-impact data have been generated within ISIMIP on a sector-by-sector basis, including a log of changes to uploaded data.

## OUTCOMES



Papers, reports and other products based on ISIMIP climate-impacts simulations. Links to past ISIMIP workshops and events.



# ENES Climate Analytics Service (ECAS)

<https://portal.enes.org/data/data-metadata-service/processing/ecas>

## IS-ENES ECAS

- Remote Calculations
- Two endpoints: CMCC (Italy) and DKRZ (Germany)
- Significant computing resources
- Free registration
- Example workflows, python-based using Jupyter notebooks
- Training material available

## ENES Climate Analytics Service (ECAS)

last modified May 02, 2019 09:29 AM

The ENES Climate Analytics Service (ECAS) allows end-users to perform server-side processing on climate data



The ENES Climate Analytics Service (ECAS) is a server-side processing service offered to ENES users with current cluster installations at CMCC and DKRZ. ECAS offers a virtual work environment based on Jupyter notebooks, allowing you to process and analyse data (including CMIP5 and CMIP6 data) using Python. Support for fast computations is provided via the Ophidia data analytics framework. The service is free for use by ENES users at the current installations at DKRZ and CMCC.

ECAS is integrated with other e-infrastructure services as part of the [European Open Science Cloud](#) in the frame of the EOSC-hub project.

### CMCC service information

- The CMCC ECAS instance: <https://ophidialab.cmcc.it>
- Usage requires free registration. [Please follow the instructions](#) on the website.
- The CMCC instance offers access to multiple computing environments, including a "fat node" cluster.

### DKRZ service information

- The DKRZ ECAS instance: <https://ecaslab.dkrz.de>
- Usage requires free registration. [Please follow the instructions](#) on the website.
- The DKRZ instance offers direct access to the CMIP5 and CMIP6 data pools. During the CMIP6 operational phase, the CMIP6 data pool is continually updated with newly available data.

### Example workflows available

Example experiments and Jupyter notebooks are available at the DKRZ and CMCC instances and [on GitHub](#). There is also [training material](#) available on GitHub.

Concerning use of the computing framework, the [documentation on the Ophidia framework websites](#) contains starter tutorials, descriptions of all processing operators and example workflows.



# Some other portals

## Portals with Data and Tools

- ◆ Climate Explorer: <https://climexp.knmi.nl/start.cgi> (new version under flag of WMO)
- ◆ ECA&D and ICA&D (European/international Climate Assessment Database): <https://www.ecad.eu/>,  
<https://www.ecad.eu/icad.php> (E-OBS through C3S CDS)
- ◆ Climate Data Guide: <https://climatedataguide.ucar.edu/>

## Portal with Tools

- ◆ Climate Data Tool: <https://iri.columbia.edu/our-expertise/climate/tools/cdt/>

## Impact Data

- ◆ Impact2C: <https://www.atlas.impact2c.eu/en/>

## National Portals

- ◆ Example for France, the DRIAS portal: <http://www.drias-climat.fr>



## Some thoughts

- A large variety of portals is available
  - Non-homogeneity in available datasets
  - Very different capabilities and interfaces
- May be difficult to know which one is suitable for specific needs and knowledge
- Guidance is usually not always sufficient
- Support may not be available
- Applicability and cautions about datasets and their possible use may not always be obvious
- On-demand remote calculations and subsetting is not always possible
- Downloading results in digital format is not always possible
- Also be attentive to FAIRness compliance, especially reproducibility and lineage
- For national, regional and local studies, always seek first for National portals, but be careful about uncertainties aspects
- The Climate Adapt portal is a good resource for guidance on how to perform an impact study properly



## Some more thoughts ...

- There has never been so many accessible climate datasets!
- On-demand remote calculations is rapidly developing
- There is an increasing number of higher spatial and time resolution datasets
  - This is also true for gridded observation and reanalysis datasets
- Uncertainties can be better estimated thanks to the higher number of ensembles of simulations
- European-based portals integrating several infrastructures are being developed and launched
- Cloud-based solutions are emerging



CENTRE EUROPÉEN DE RECHERCHE ET DE FORMATION AVANCÉE EN **CALCUL SCIENTIFIQUE**

