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Climate related datasets, Copernicus related data

Antti Mäkelä

Finnish Meteorological
Institute (FMI)

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Contents

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- Copernicus Climate Change Service (C3S) data
- Summary



What is climate data?

- Climate = *"The description of the variability of weather conditions prevailing in a particular region or latitude zone over a specific period of time, as derived from statistical information about various meteorological elements."* (Oxford Dictionary of Weather)
- Often, "climate data"-term is used for any meteorological data (i.e., also for momentary observations)
- Atmospheric Essential climate variables (ECV's) →
 - Similarly, Land and Ocean have their own ECV's
- Observed vs. simulated and their combinations (e.g. reanalysis)

An ECV is a physical, chemical or biological variable or a group of linked variables that critically contributes to the characterization of Earth's climate.

ECV	Products
Surface	
Precipitation	Estimates of liquid and solid precipitation
Pressure (surface)	Pressure
Surface Radiation Budget	Surface ERB longwave; Surface ERB shortwave
Surface Wind Speed and direction	Surface wind speed and direction
Temperature (near surface)	Temperature
Water Vapour (surface)	Water vapour
Upper Atmosphere	
Earth Radiation Budget	Top-of-atmosphere ERB longwave; Top-of-atmosphere ERB shortwave (reflected); Total solar irradiance; Solar spectral irradiance
Lightning	Number of lightnings
Temperature (upper-air)	Tropospheric Temperature profile; Stratospheric Temperature profile; Temperature of deep atmospheric layers
Water Vapour (upper air)	Total column-water vapour; Tropospheric and lower-stratospheric profiles of water vapour; Upper tropospheric humidity
Cloud Properties	Cloud amount; Cloud Top Pressure; Cloud Top Temperature; Cloud Optical Depth; Cloud Water Path (liquid and ice); C, effective particle radius (liquid and ice)
Wind speed and direction (upper-air)	Upper-air wind retrievals
Atmospheric Composition	
Aerosols properties	optical depth; single-scattering albedo; layer height; extinction profiles for the troposphere and the lower to middle stratosphere
Carbon Dioxide, Methane and other Greenhouse gases	Tropospheric CO ₂ column; Tropospheric CO ₂ ; Tropospheric CH ₄ column; Tropospheric CH ₄ ; Stratospheric CH ₄
Ozone	Total column ozone; troposphere Ozone; Ozone profile in upper and lower stratosphere; Ozone profile in upper strato- and mesosphere
Precursors (supporting the Aerosol and Ozone ECVs)	NO ₂ tropospheric column; SO ₂ , HCHO tropospheric columns; CO tropospheric column; CO tropospheric profile



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<https://public.wmo.int/en/programmes/global-climate-observing-system/essential-climate-variables>

Availability of climate data

- At present, extensive amounts of data exists
 - From Met.Services (e.g., FMI's OpenData-service)
 - Other national/European Research Institutes
- Some are free
 - At USA basically all data is free to be used (e.g., from NOAA)
 - WMO
 - In Europe many Met.Services (but not all) share their data for free
 - C3S
- Some are available only for members
 - EUMETSAT
 - ECMWF (some is free)
 - Other
- It is impossible to list all sources!

Data sets made available

The data sets are made available in machine-readable, digital format. Most of the data sets are already published. Rest of the data sets will be shared in phases as soon as it is technically ready for publishing. The Finnish Meteorological Institute also distributes the road weather observations of the Finnish Transport Infrastructure Agency, the radiation measurements of the Radiation and Nuclear Safety Authority and air quality observations from Finnish municipalities.

The Finnish Meteorological Institute share the following data

The data sets to be made available can be divided into three types: real-time observations, time series and forecasts.

Real-time observations

This category contains continuously made observations that are used for monitoring the state or properties of the atmosphere and the Baltic Sea. Measurements are made mostly at observation stations more often than ones a day.

- Wave and other observations from buoys
- Sea level observations
- Weather observations
- Sun radiation observations
- Lightning strikes
- Radar images

Forecast models

The category contains forecast data from weather, sea, and air quality models that gives information about the future state of the atmosphere and the Baltic Sea. The output of a forecast model is usually grid like data. New forecast is commonly produced for a model more often than ones a day.

Time

The c
obser
longer

- Weather forecast models RCR HIRLAM and HARMONIE
- Air quality forecast models SILAM and FMI-ENFUSER
- Sea ice model HELMI
- Wave model WAM
- The HIROMB-BOOS -circulation model (HBM) for the Baltic Sea
- OAAS Sea level model for predefined points
- Climate change forecasts for the 30-year periods 2010 - 2039, 2040 - 2069 and 2070 - 2099

Warnings

- Warnings in CAP-format. [Read more about warnings](#)

<https://climate.copernicus.eu/>

Implemented by ECMWF as part of The Copernicus Programme

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European Commission Copernicus Europe's eyes on Earth Climate Change Service

About Us What we do **Data**

Climate Change

We provide authoritative information about the past, present and future climate, as well as tools to enable climate change mitigation and adaptation strategies by policy makers and businesses.

European Commission Copernicus Europe's eyes on Earth IMPLEMENTED BY ECMWF

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C3S Climate Data Store (CDS)

<https://cds.climate.copernicus.eu/#!/home>



Welcome to the Climate Data Store

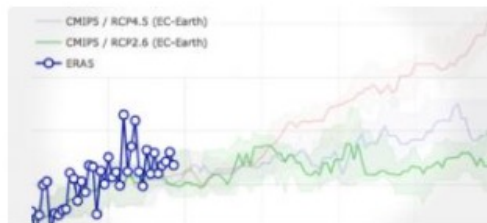
Dive into this wealth of information about the Earth's past, present and future climate.

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.

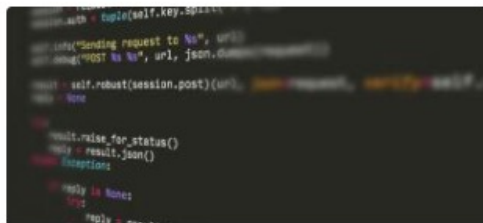
We are constantly improving the services and adding new datasets. For latest announcements, watch the posts on the [C3S forum](#).

All

Search



Climate Data Store **Toolbox**

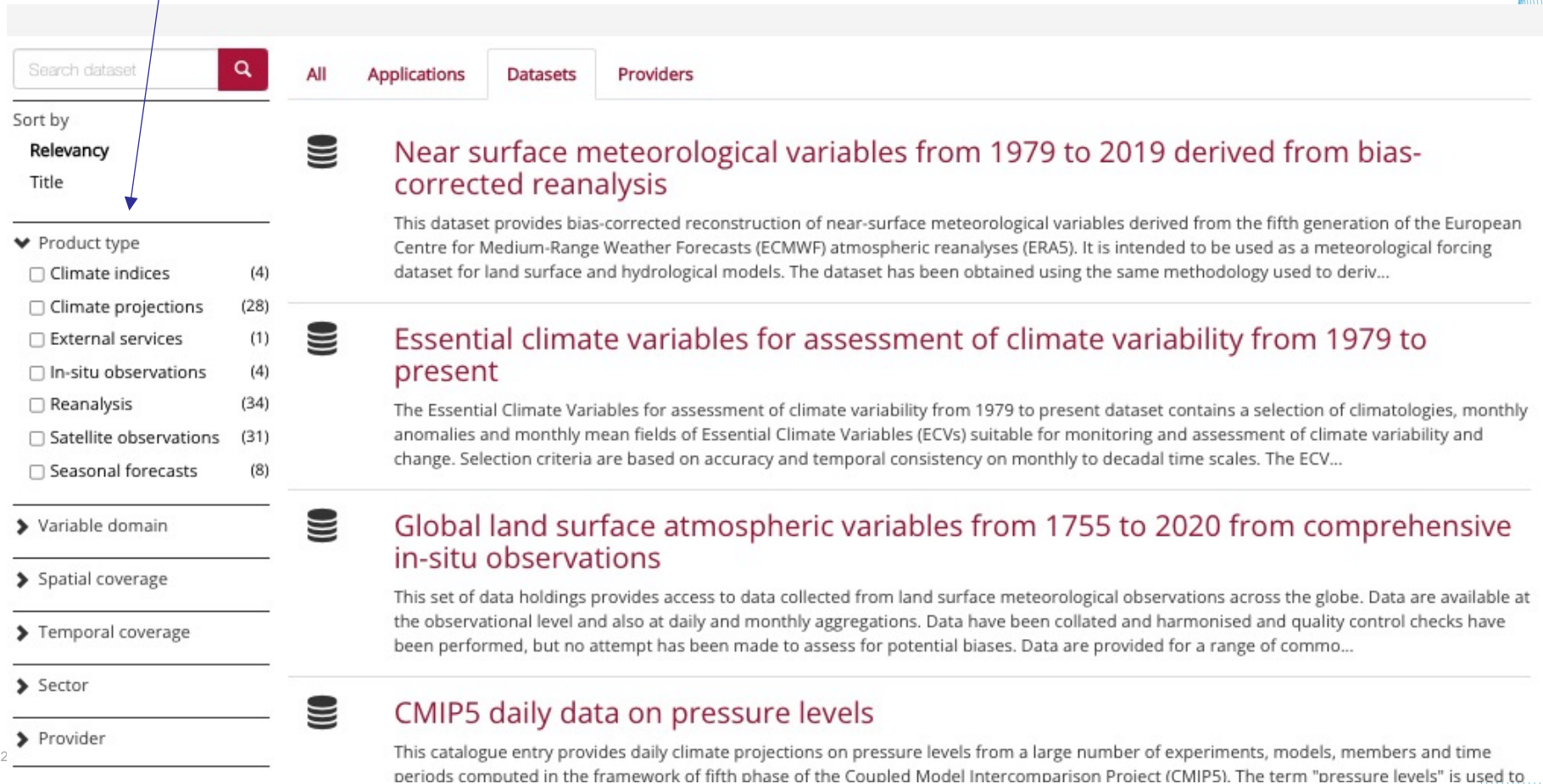


Climate Data Store **API**




Access the **ECMWF Support Portal**

CDS data (and product) types



The screenshot displays the Copernicus Data Store (CDS) interface. At the top, there is a search bar labeled 'Search dataset' with a magnifying glass icon. Below the search bar, there are tabs for 'All', 'Applications', 'Datasets', and 'Providers'. On the left side, there is a 'Sort by' dropdown menu with 'Relevancy' selected. Below this, there is a 'Product type' section with a list of categories and their counts: Climate indices (4), Climate projections (28), External services (1), In-situ observations (4), Reanalysis (34), Satellite observations (31), and Seasonal forecasts (8). Further down, there are sections for 'Variable domain', 'Spatial coverage', 'Temporal coverage', 'Sector', and 'Provider'. The main content area displays four dataset entries, each with a database icon, a title, and a description. A blue arrow points from the title 'CDS data (and product) types' to the 'Relevancy' option in the 'Sort by' dropdown menu.

Search dataset 

Sort by
Relevancy
Title

▼ Product type

- ☐ Climate indices (4)
- ☐ Climate projections (28)
- ☐ External services (1)
- ☐ In-situ observations (4)
- ☐ Reanalysis (34)
- ☐ Satellite observations (31)
- ☐ Seasonal forecasts (8)


► Variable domain

► Spatial coverage


► Temporal coverage

► Sector


► Provider

 **Near surface meteorological variables from 1979 to 2019 derived from bias-corrected reanalysis**


This dataset provides bias-corrected reconstruction of near-surface meteorological variables derived from the fifth generation of the European Centre for Medium-Range Weather Forecasts (ECMWF) atmospheric reanalyses (ERA5). It is intended to be used as a meteorological forcing dataset for land surface and hydrological models. The dataset has been obtained using the same methodology used to deriv...

 **Essential climate variables for assessment of climate variability from 1979 to present**

The Essential Climate Variables for assessment of climate variability from 1979 to present dataset contains a selection of climatologies, monthly anomalies and monthly mean fields of Essential Climate Variables (ECVs) suitable for monitoring and assessment of climate variability and change. Selection criteria are based on accuracy and temporal consistency on monthly to decadal time scales. The ECV...

 **Global land surface atmospheric variables from 1755 to 2020 from comprehensive in-situ observations**

This set of data holdings provides access to data collected from land surface meteorological observations across the globe. Data are available at the observational level and also at daily and monthly aggregations. Data have been collated and harmonised and quality control checks have been performed, but no attempt has been made to assess for potential biases. Data are provided for a range of commo...

 **CMIP5 daily data on pressure levels**

This catalogue entry provides daily climate projections on pressure levels from a large number of experiments, models, members and time periods computed in the framework of fifth phase of the Coupled Model Intercomparison Project (CMIP5). The term "pressure levels" is used to

Example: climate projections

Sort by

Relevancy

Title

Showing 1-28 of 28 results for **Climate projections** x

▼ Product type

- ☐ Climate indices (4)
- ☒ Climate projections (28)
- ☐ External services (1)
- ☐ In-situ observations (4)
- ☐ Reanalysis (34)
- ☐ Satellite observations (31)
- ☐ Seasonal forecasts (8)

▼ Variable domain

- ☐ Atmosphere (surface) (11)
- ☐ Atmosphere (upper air) (6)
- ☐ Land (biosphere) (4)
- ☐ Land (hydrology) (2)
- ☐ Ocean (physics) (5)

▼ Spatial coverage

- ☐ Europe (17)
- ☐ Global (9)

▼ Temporal coverage

- ☐ Future (27)
- ☐ Past (22)
- ☐ Present (21)

▼ Sector

- ☐ Water management (2)



CMIP5 daily data on pressure levels

This catalogue entry provides daily climate projections on pressure levels from a large number of experiments, models, members and time periods computed in the framework of fifth phase of the Coupled Model Intercomparison Project (CMIP5). The term "pressure levels" is used to express that the variables were computed at multiple vertical levels, which may differ in number and location among the dif...



CORDEX regional climate model data on single levels

This catalogue entry provides Regional Climate Model (RCM) data on single levels from a number of experiments, models, domains, resolutions, ensemble members, time frequencies and periods computed over several regional domains all over the World in the framework of the Coordinated Regional Climate Downscaling Experiment (CORDEX). The term "single levels" is used to express that the variables are 2...



CMIP5 monthly data on single levels

This catalogue entry provides monthly climate projections on single levels from a large number of experiments, models, members and time periods computed in the framework of fifth phase of the Coupled Model Intercomparison Project (CMIP5). The term "single levels" is used to express that the variables are computed at one vertical level which can be surface (or a level close to the surface) or a ded...



CMIP5 daily data on single levels

This catalogue entry provides daily climate projections on single levels from a large number of experiments, models, members and time periods computed in the framework of the fifth phase of the Coupled Model Intercomparison Project (CMIP5). The term "single levels" is used to express that the variables are computed at one vertical level which can be surface (or a level close to the surface) or a d...



CMIP5 monthly data on pressure levels

This catalogue entry provides monthly climate projections on pressure levels from a large number of experiments, models, members and time periods computed in the framework of the fifth phase of the Coupled Model Intercomparison Project (CMIP5). The term "pressure levels" is used to express that the variables were computed at multiple vertical levels, which may differ in number and location among t...



Agroclimatic indicators from 1951 to 2099 derived from climate projections

This dataset provides agroclimatic indicators used to characterise plant-climate interactions for global agriculture. Agroclimatic indicators are useful in conveying climate variability and change in the terms that are meaningful to the agricultural sector. The objective of this dataset is to provide these indicators at a global scale in an easily accessible and usable format for further downstrea...



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Example: climate projections

Data overview

Single-model vs. multi-model projections → multi-model is typically the best option

CMIP5 monthly data on single levels

Overview

Download data

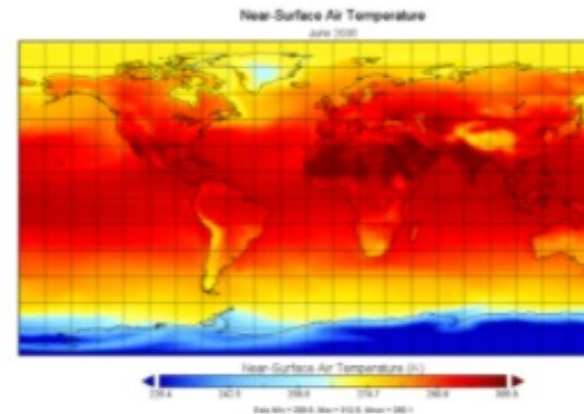
Quality assessment

Documentation

This catalogue entry provides monthly climate projections on single levels from a large number of experiments, models, members and time periods computed in the framework of fifth phase of the Coupled Model Intercomparison Project (CMIP5). The term "single levels" is used to express that the variables are computed at one vertical level which can be surface (or a level close to the surface) or a dedicated pressure level in the atmosphere. Multiple vertical levels are excluded from this catalogue entry.

CMIP5 data are used extensively in the Intergovernmental Panel on Climate Change Assessment Reports (the latest one is IPCC AR5, which was published in 2014). The use of these data is mostly aimed at:

- addressing outstanding scientific questions that arose as part of the IPCC reporting process;
- improving the understanding of the climate system;
- providing estimates of future climate change and related uncertainties;
- providing input data for the adaptation to the climate change;
- examining climate predictability and exploring the ability of models to predict climate on decadal time scales;
- evaluating how realistic the different models are in simulating the recent past



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Example: climate projections

Data download

CMIP5 monthly data on single levels

[Overview](#)[Download data](#)[Quality assessment](#)[Documentation](#)[Clear all](#)

Experiment ?

At least one selection must be made

- ☐ AMIP ☐ Historical ☐ RCP 2.6 ☐ RCP 4.5 ☐ RCP 6.0 ☐ RCP 8.5

Variable ?


At least one selection must be made

- | | |
|--|--|
| <input type="checkbox"/> 10m wind speed | <input type="checkbox"/> 10m u-component of wind |
| <input type="checkbox"/> 10m v-component of wind | <input type="checkbox"/> 2m temperature |
| <input type="checkbox"/> Eastward turbulent surface stress | <input type="checkbox"/> Evaporation |
| <input type="checkbox"/> Maximum 2m temperature in the last 24 hours | <input type="checkbox"/> Mean precipitation flux |
| <input type="checkbox"/> Mean sea level pressure | <input type="checkbox"/> Minimum 2m temperature in the last 24 hours |
| <input type="checkbox"/> Near-surface relative humidity | <input type="checkbox"/> Near-surface specific humidity |
| <input type="checkbox"/> Northward turbulent surface stress | <input type="checkbox"/> Runoff |
| <input type="checkbox"/> Sea ice fraction | <input type="checkbox"/> Sea ice plus snow amount |
| <input type="checkbox"/> Sea ice thickness | <input type="checkbox"/> Sea surface salinity |
| <input type="checkbox"/> Sea surface temperature | <input type="checkbox"/> Sea ice surface temperature |
| <input type="checkbox"/> Sea surface height above geoid | <input type="checkbox"/> Skin temperature |
| <input type="checkbox"/> Snow depth over sea ice | <input type="checkbox"/> Snowfall |
| <input type="checkbox"/> Soil moisture content | <input type="checkbox"/> Surface latent heat flux |
| <input type="checkbox"/> Surface sensible heat flux | <input type="checkbox"/> Surface pressure |
| <input type="checkbox"/> Surface thermal radiation downwards | <input type="checkbox"/> Surface upwelling longwave radiation |
| <input type="checkbox"/> Surface solar radiation downwards | <input type="checkbox"/> Surface upwelling shortwave radiation |
| <input type="checkbox"/> Surface snow amount | <input type="checkbox"/> TOA outgoing longwave radiation |
| <input type="checkbox"/> TOA outgoing clear-sky longwave radiation | <input type="checkbox"/> TOA incident solar radiation |
| <input type="checkbox"/> TOA outgoing shortwave radiation | <input type="checkbox"/> TOA outgoing clear-sky short wave radiation |
| <input type="checkbox"/> Total cloud cover | |

[Select all](#)

Example: climate projections

Data download → also API-request

Format 


☒ Zip file (.zip) ☐ Compressed tar file (.tar.gz)

Clear all

Show API request

Show Toolbox request

Please check mandatory fields



Example: climate projections

Quality assessment → this is important: always try to find out something regarding the quality of the data (has it been assessed, how, etc)?

CMIP5 monthly data on single levels

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This is a new feature, work in progress. Should any inconsistency be found, please report to copernicus-support@ecmwf.int

The CDS datasets are assessed by the Evaluation and Quality Control (EQC) function of C3S independently of the data supplier. EQC encompasses a framework of processes aimed to assure technical and scientific quality harmonized across all dataset types available through the CDS. During the EQC process, the documentation provided with the dataset is scrutinized and data are checked for usability and reliability.

Variable:

Model:

Experiment:

Select the fields above to see the related quality assurance information



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Example: climate projections

Documentation

CMIP5 monthly data on single levels

[Overview](#)[Download data](#)[Quality assessment](#)[Documentation](#)

- [CMIP5 data in the Copernicus Climate Data Store](#)

Specific information on how climate projections are served and presented in the CDS Catalogue with particular information on CMIP5 and CMIP6.

- [CMIP5 essential information \(.html\)](#)

The link above provides simple and direct information on CMIP5. It also works as an entry point for more in-depth documentation on CMIP5 data and experiments.



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Let's visit the C3S CDS

- <https://cds.climate.copernicus.eu/cdsapp#!/home>



Some other sources/archives

<http://climexp.knmi.nl/start.cgi>



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European Climate Assessment & Dataset KNMI

Climate Explorer

Home | Help | News | About | World weather | Effects of ENSO | Climate Change Atlas

Home — Starting point:

Starting point

Welcome, anonymous user

The KNMI Climate Explorer is a tool to investigate the climate. Start by selecting a class of climate data from the right-hand menu. After you have selected the time series or fields of interest, you will be able to investigate it, correlate it to other data, and generate derived data from it.

Some restrictions are in force: the site does not remember how you filled out the forms, you cannot define your own indices, nor upload data into the Climate Explorer or handle large datasets. If you want to use these features please [log in or register](#).

Select a time series

- > Daily station data
- > Daily climate indices
- > Monthly station data
- > Monthly climate indices
- > Annual climate indices
- > View, upload your time series

Select a field


- > Daily fields
- > Monthly observations
- > Monthly reanalysis fields



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Some other sources/archives

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Select a time series

- > Daily station data
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- > Monthly station data
- > Monthly climate indices
- > Annual climate indices
- > View, upload your time series

Select a field

- > Daily fields
- > Monthly observations
- > Monthly reanalysis fields



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Summary

- At present, substantial amount of climate data available
 - Past&present
 - Future
- Regarding future climate projections
 - Multi-model analysis: is known to give the “best” results (statistically gives the results closest to the observed climate)
 - Largest uncertainties derive from the greenhouse gas emissions: business as usual vs. efficient mitigation (or in between)
- Quality assurance
 - Is the data quality controlled?
- C3S
 - Please use!
 - Evaluated and quality controlled
 - User support & learning services
 - Lots of data and more will be coming
 - Cloud processing → CDS Toolbox (next lecture)





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Thank You!

