



Co-funded by the
Erasmus+ Programme
of the European Union



3rd ClimEd Online Training on “Digital Tools and Datasets for Climate Change Education”

26 October – 12 November 2021

Hosts: University of Helsinki (UHEL, Helsinki, Finland) & Odessa State Environmental University (OSEN, Odessa, Ukraine)

Introduction to Home-Work-Assignments (HWAs) / Group Projects

Alexander Mahura, UHEL-INAR

Svitlana Krakovska, UHMI


Putian Zhou, UHEL/FMI

Larisa Sogacheva, FMI

Inna Khomenko, OSEN

Online 3rd ClimEd Training

28 October 2021

 in Kyiv, UA time	LECTURING			HOME-WORK-ASSIGNMENTS (HWAs) / WORK IN GROUPS				FINALS
	Day 1	Day 2	Day 3	during 2 weeks				Final day
	Tuesday 26 October 2021	Wednesday 27 October 2021	Thursday 28 October 2021	from 28 th October 2021	Tuesday 2 Nov 2021	Wednesday 9 Nov 2021	until 11 th November 2021	Friday 12 November 2021
	09:45 – 10:00	10:00 – 10:45	10:45 – 11:00	11:00 – 11:45	11:45 – 12:00	12:00 – 12:45	12:45 – 13:00	13:00 – 13:45
	Welcome words							Welcome words
	L1. Regional focus of IPCC Assessment Report in Ukraine Context (Svitlana Krakovska, UHMI)	L5. Remote sensing/Satellite observations: current state, perspectives, databases, and applicability of results (Larisa Sogacheva, FMI)	L9. Climate related datasets, Copernicus related data (Antti Mäkelä, FMI)					Presentations and Defences of HWAs by Groups C1, C2, C3
	Coffee/ Tea Br.	Coffee/ Tea Br.	Coffee/ Tea Br.					Coffee/ Tea Br.
	L2. UHMI activities in support climate related research: current status and perspectives (Svitlana Krakovska, UHMI)	L6. Global scale climate modelling: current state, perspectives, databases, and applicability of results (Putian Zhou, UHEL/FMI)	L10. Tools for visualization and analysis of climate related data (Antti Mäkelä, FMI)					Presentations and Defences of HWAs by Groups C4, C5, C6
	Coffee/ Tea Br.	Coffee/ Tea Br.	Coffee/ Tea Br.					Coffee/ Tea Br.
	L3. WMO integrated climate services: current status and perspectives (Wilfran Moufouma Okia, WMO)	L7. Regional scale climate modelling: current state, perspectives, data/databases, and applicability of results (Tomas Halenka, Univ Charles)	L11. Introductions to HWAs/ Group projects Alexander Mahura, UHEL-INAR; Svitlana Krakovska, UHMI; Putian Zhou, UHEL/FMI; Larisa Sogacheva, FMI; Inna Khomenko, OSENU					Presentations and Defences of HWAs by Groups C7, C8, C9
	Coffee/ Tea Br.	Coffee/ Tea Br.	Coffee/ Tea Br.					Coffee/ Tea Br.
	L4. Observations for climatic variables: obs. system, specifics, challenges (Antti Mäkelä, FMI)	L8. Urban scale modelling for climate applications (Igor Esau, NERSC)	L12. Introductions to HWAs/ Group projects Alexander Mahura, UHEL-INAR; Svitlana Krakovska, UHMI; Putian Zhou, UHEL/FMI; Larisa Sogacheva, FMI; Inna Khomenko, OSENU					Presentations and Defences of HWAs by Groups C10, C11, C12
					Alexander Mahura, Svitlana Krakovska, Putian Zhou, Larisa Sogacheva, Inna Khomenko	Alexander Mahura, Svitlana Krakovska, Putian Zhou, Larisa Sogacheva, Inna Khomenko		14:00-14:30 - Awarding Diplomas/ Certificates & Official closure of the Training

Groups C1-C6 for HWAs



N	Participant: Surname Name	Group	University
1	Serga Eduard	A1	OSENU
2	Zhukova Olena	A1	KNUCA
3	Martyniuk Maksym	A1	OSENU
4	Kryvyi Vladyslav	A2	KhSAEU
5	Ellina Agayar	A2	OSENU
6	Inna Semenova	A2	OSENU
7	Semerhei Chumachenko Alina	A2	OSENU
8	Diadin Dmytro	A3	BNUUEK
9	Kotova Tetyana	A3	KNUCA
10	Tkachenko Tetyana	A3	KNUCA
11	Boiko Yurii	A3	ONMU
12	Vergeles Yuriy	A4	BNUUEK
13	Perebynos Alona	A4	KNUCA
14	Bohushenko Anna	A4	OSENU
15	Honcharenko Artem	A5	KNUCA
16	Goptsiy Maryna	A5	OSENU
17	Kushchenko Liliia	A5	OSENU
18	Savchenko Antonina	A6	KNUCA
19	Borovska Halyna	A6	OSENU
20	Prokofiev Oleg	A6	OSENU
21	Nedostrelova Larisa	A6	OSENU

Groups C7-C12 for HWAs



22	Krasnozhon Alla	A7	EGIS Ukraina
23	Sabadash Vira	A7	LPNU
24	Gamaiun Artem	A7	OSENU
25	Buchynska Iruna	A7	OSENU
26	Bocharov Boris	A8	BekNU
27	Babenko Olena	A8	BNUUEK
28	Zavalniuk Vitalii	A8	KNUCA
29	Sliusar Vira	A8	LPNU
30	Maksimova Victoria	A9	INEP
31	Losev Aleksandr	A9	PGI
32	Das Suvendu	A9	VBV
33	Savenets Mykhailo	A9	UHMI
34	Papakina Nataliia	A10	KhSAEU
35	Hustenko Aleksey	A10	OSENU
36	Mishchenko Natalia	A10	OSENU
37	Danilova Natalia	A10	OSENU
38	Drozd Olena	A11	BTNAU
39	Voloshkina Olena	A11	KNUCA
40	Liuta Oksana	A11	LPNU
41	Kuznichenko Svitlana	A11	OSENU
42	Khandogina Olga	A12	BNUUEK
43	Stavetska Ruslana	A12	BTNAU
44	Kryshtop Lidiia	A12	NGO
45	Slobodianyk Kateryna	A12	OSENU

Affiliations of Participants



- OSENU - Odessa State Environmental University
 - KNUCA - Kyiv National University of Construction and Architecture
 - BNUUEK - O. Beketov National University of Urban Economy
 - LPNU - Lviv Polytechnic National University
 - BTNAU - Bila Tserkva National Agrarian University
 - ONMU - Odessa National Medical University
 - KhSAEU - Kherson State Agrarian and Economic University
 - UHMI - Ukrainian Hydrometeorological Institute
 - EGIS - EGIS Ukraina
 - INEP - Institute Northern Environmental Problems
 - PGI - Polar Geophysical Institute
 - VBU - Visva-Bharati University
 - NGO - Non-Governmental Organization
-
- FMI - Finnish Meteorological Institute
 - UHEL - University of Helsinki
 - WMO - World Meteorological Organization
 - CUNI - Charles University in Prague
 - NERSC - Nansen Environmental and Remote Sensing Center
 - UHMI - Ukrainian Hydrometeorological Institute
 - OSENU - Odessa State Environmental University

ClimEd Main Themes for HWAs/Group Projects



HWAs as development and realization of the small-scale research project (SSRP)

- **Agriculture**
- **Energy**
- **Technical Design and Construction**
- **Urban Economy**
- **Water Management**
- **Health-care**

➤ Agriculture

(air temperature; maximum and minimum air temperature; soil temperature at different depths; precipitation; relative humidity; repeatability of rainless periods; severity criteria for atmospheric drought; number of days with maximum air temperature; number of days with deficient water vapor saturation; number of days with dry wind; depth of soil freezing; productive moisture reserves; state of crops at different stages of development; ...)

➤ Energy

(strong wind; average wind speed; heavy precipitation (rain, snow); extremely high and low temperatures; maximum and minimum river runoff; wind load; characteristics of solar radiation and illumination; extreme phenomena – hail, lightning, ...)

➤ Technical Design and Construction

(strong wind heavy rain; extremely high and low temperatures; maximum and average snow depth; maximum river flow; repeatable wind directions; annual precipitation; annual amount of liquid precipitation; wind load; seasonal depth of soil freezing; average air temperature for heating season; ...)

➤ **Urban Economy**

(strong wind; heavy rain; extremely high and low temperatures; maximum snow depth; maximum river flow; annual precipitation; wind load; average air temperature for the heating season; characteristics of solar radiation and illumination; transition of average daily temperature through +8C; icing; ...)

➤ **Water Management**

(climate info: air temperature; precipitation; duration of rainless periods; hydro info: maximum river flow; water temperature; minimum river flow; forecast info: heavy rain; extreme high and low temperatures; ...)

➤ **Health-care**

(average daily variability of air temperature and number of hot days; intraday variability of atmospheric pressure; intraday temperature variability; duration of sunshine; physiological deficit of humidity; extremely high temperatures; icing; extremely low temperatures; snowfalls and blizzards; number of tropical days and nights; heavy rain causing floods; strong wind; ...)

ClimEd Main Themes for HWAs/Group Projects



- Agriculture
- Energy
- Technical Design and Construction
- Urban Economy
- Water Management
- Health-care
- **Or propose your own theme of interest**

based on internal discussions in Groups

&

inform Inna Khomenko OSENU <innchom.ik@gmail.com>

(until 2nd November)

Individual HWAs: ERA5 Explorer

← → ↺ 🏠

🔒 https://cds.climate.copernicus.eu/cdsapp#!/software/app-era5-explorer?tab=app

⋮ ☆ ⬇ 📄 👤 ☰

Overview

Application

Documentation

Source code

<https://cds.climate.copernicus.eu/cdsapp#!/software/app-era5-explorer>

Full screen

Click anywhere on the map or search for a city to discover a range of local climate statistics for the period 1979-2020.

This application is driven by [ERA5](#), the fifth generation ECMWF atmospheric reanalysis of the global climate. Inspired by [Lobelia's Past Climate Explorer](#).

+

-

Search...

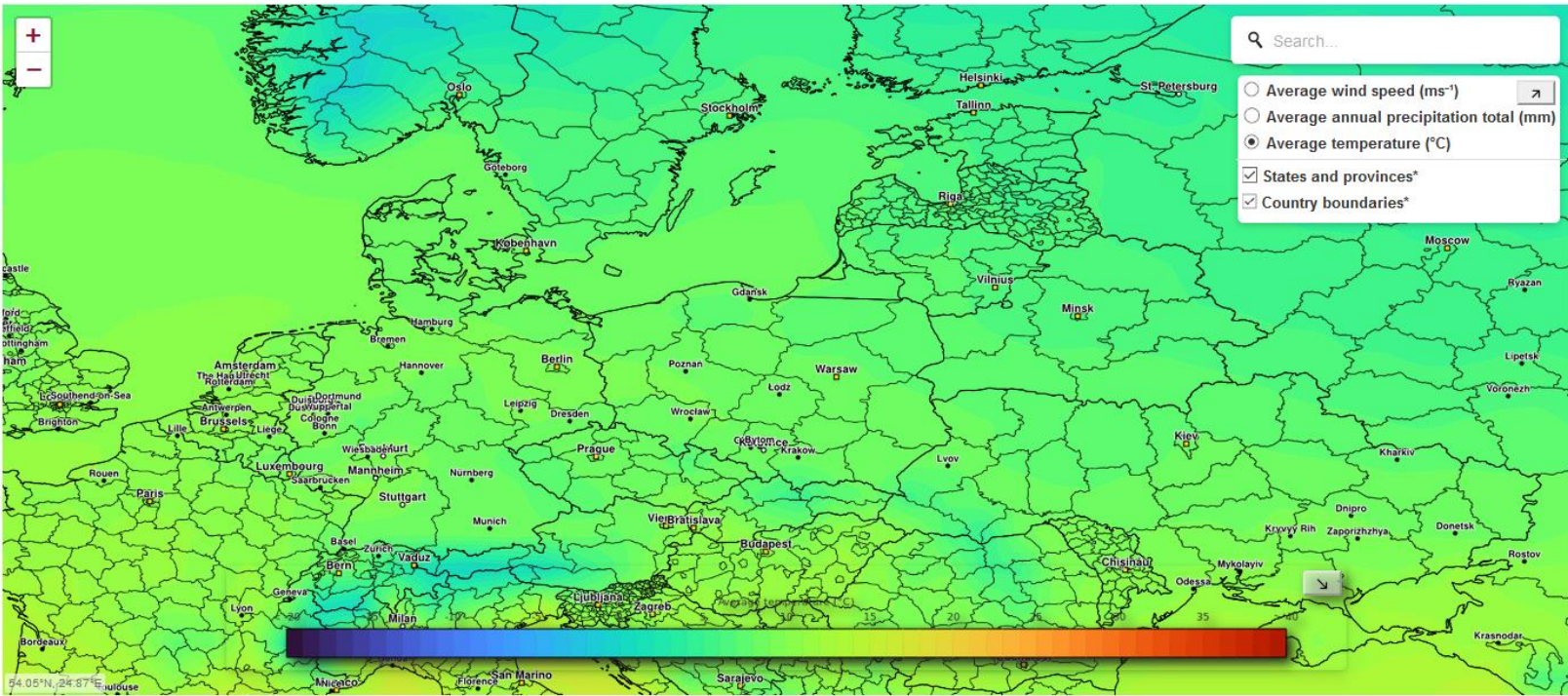
☐ Average wind speed (ms⁻¹)

☐ Average annual precipitation total (mm)

☒ Average temperature (°C)

☒ States and provinces*

☒ Country boundaries*



54.05°N, 24.87°E

Jul 2025

Contact

ECMWF Support Portal

Licence

Licence to use Copernicus Products

Publication date

2019-10-01

Related applications

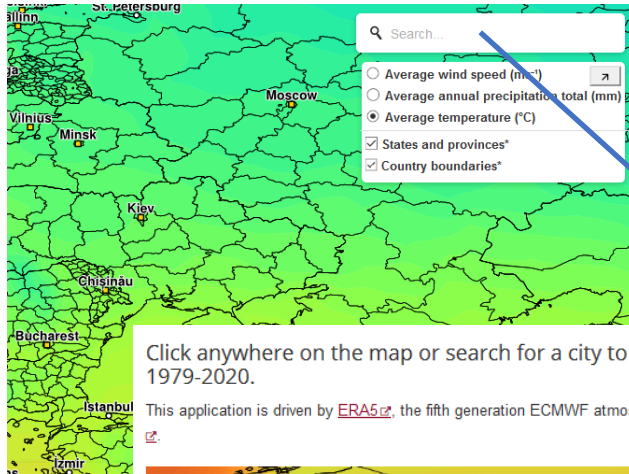
C3S monthly climate bulletin explorer

*The designations employed and the presentation of material on the map do not imply the expression of any opinion whatsoever on the part of the European Union concerning the legal status of any country, territory or area or of its authorities, or concerning the delimitation of its frontiers or boundaries.

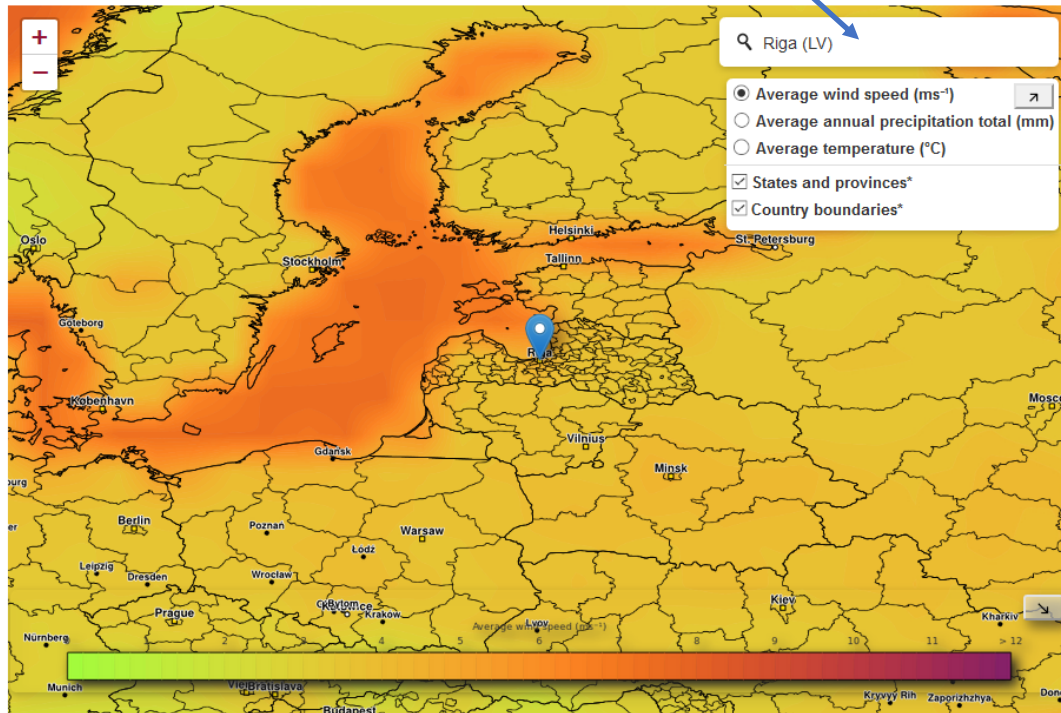
Version: 4.30.0 - build bcc7983

Hi, I am the Knowledge Duck and I'm here to help you.

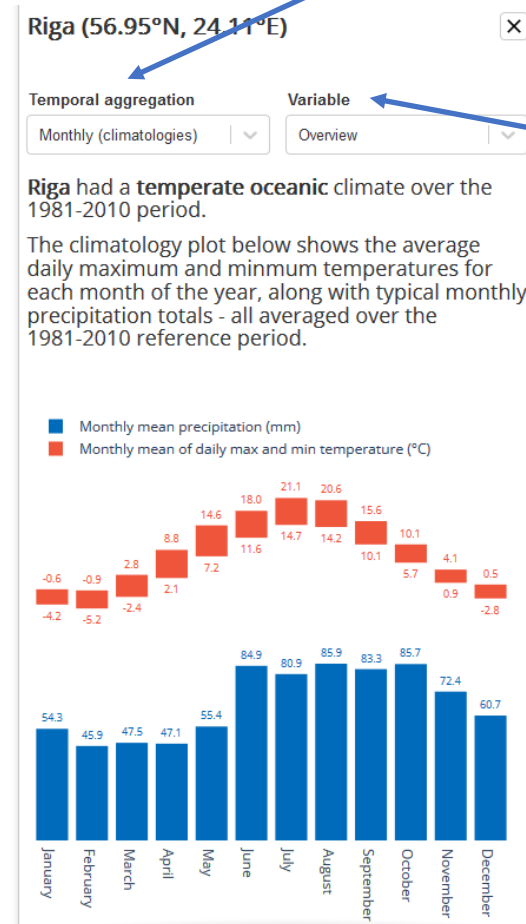
Individual HWAs: City of Your Dream Summer Vacation



- Average wind speed (ms^{-1})
- Average annual precipitation total (mm)
- Average temperature ($^{\circ}\text{C}$)



*The designations employed and the presentation of material on the map do not imply the expression of any opinion whatsoever on the part of the European Union concerning the legal status of any country, territory or area or of its authorities, or concerning the delimitation of its frontiers or boundaries.



Temporal aggregation

- Monthly (climatologies)
- Annual

Variable

- Overview
- Temperature
- Precipitation
- Wind speed and direction
- First days and tropical nights

Individual HWAs: City of Your Dream Summer Vacation

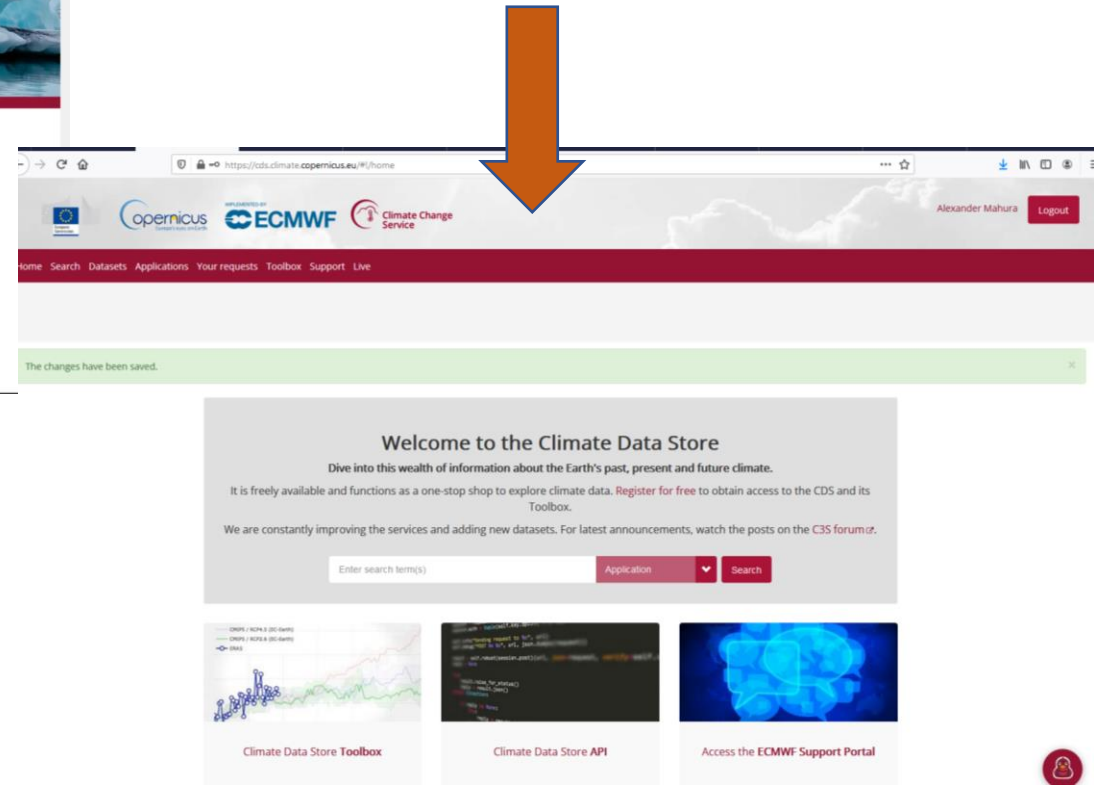


- **prepare individual presentation** (use your own style of preference), which should include:
 - for selected country (or region/county) and city
 - results of visualization and analysis of temperature, wind, precipitation patterns including month-to-month variabilities
- **upload until 2nd November** your presentation (MSPPoint/ pdf- file) into your OSENU's Moodle account with a unique name:
GroupNumber_SurnameName
for example: A1_PetroPetrenko.pptx / A1_PetroPetrenko.pdf

Group HWAs: Step 1 – Access Website

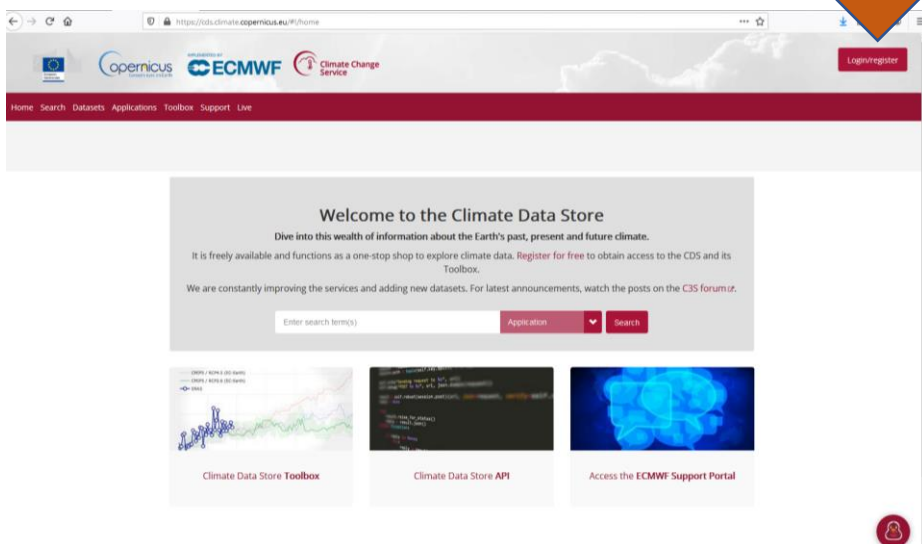


<https://climate.copernicus.eu>

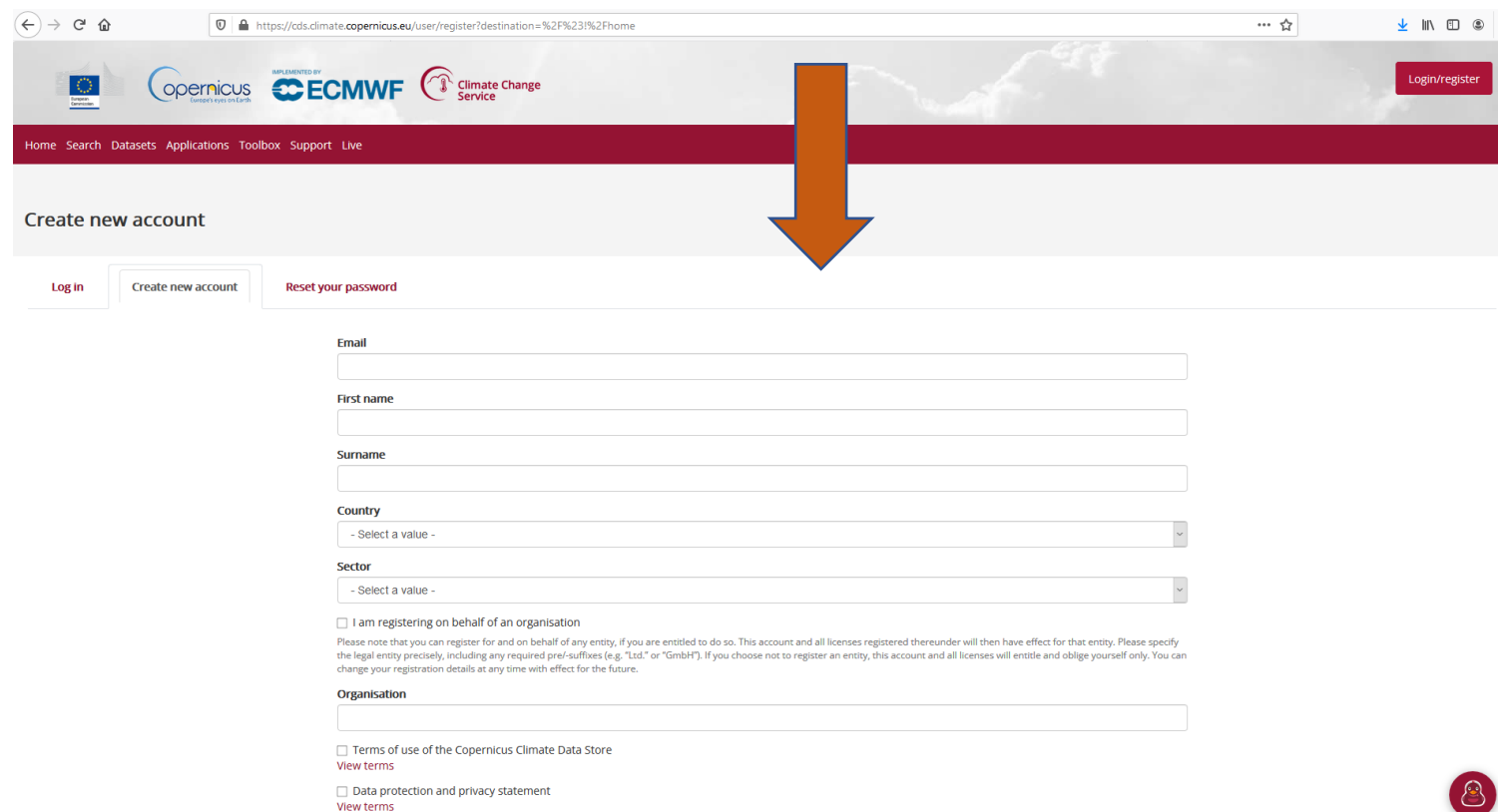


<https://cds.climate.copernicus.eu/#!/home>

Group HWAs: Step 2 – Register for CDS



CDS – Climate Data Store



Log in/register

Home Search Datasets Applications Toolbox Support Live

Create new account

Log in Create new account Reset your password

Email

First name

Surname

Country

Sector

☐ I am registering on behalf of an organisation

Please note that you can register for and on behalf of any entity, if you are entitled to do so. This account and all licenses registered thereunder will then have effect for that entity. Please specify the legal entity precisely, including any required pre-fixes (e.g. "Ltd." or "GmbH"). If you choose not to register an entity, this account and all licenses will entitle and oblige yourself only. You can change your registration details at any time with effect for the future.

Organisation

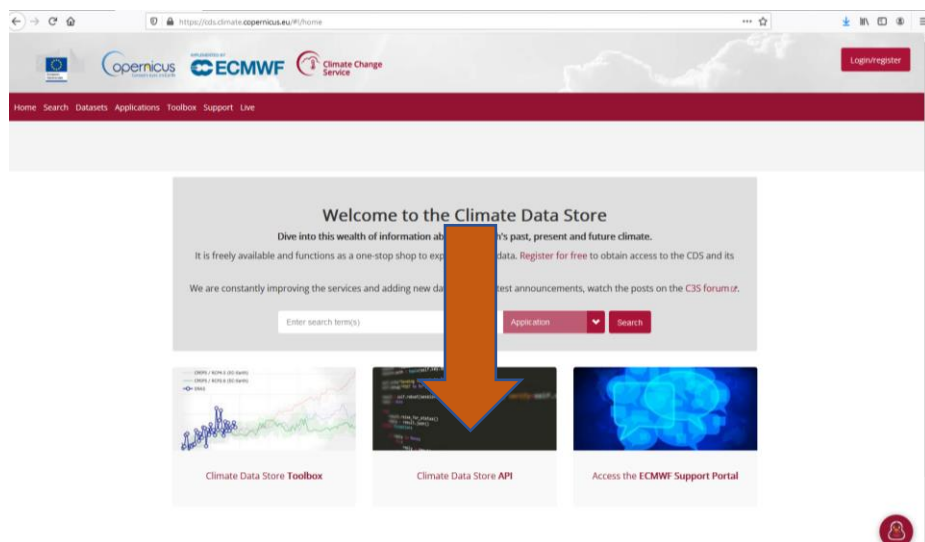
☐ Terms of use of the Copernicus Climate Data Store
View terms

☐ Data protection and privacy statement
View terms

Group HWAs: Step 2 – Install CDS API



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



[Home](#)
[Search](#)
[Datasets](#)
[Applications](#)
[Your requests](#)
[Toolbox](#)
[Support](#)
[Live](#)

Alexander Mahura [Logout](#)

How to use the CDS API

The **Climate Data Store Application Program Interface** is a service providing programmatic access to CDS data. In this page you will find explanations and examples showing how to use the CDS API

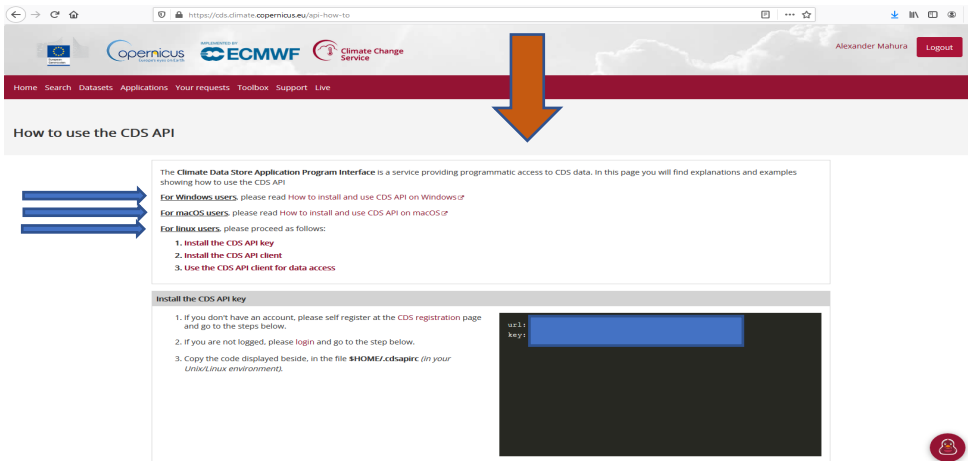
- For Windows users**, please read [How to install and use CDS API on Windows](#)
- For macOS users**, please read [How to install and use CDS API on macOS](#)
- For linux users**, please proceed as follows:
 1. **Install the CDS API key**
 2. **Install the CDS API client**
 3. **Use the CDS API client for data access**

Install the CDS API key

1. If you don't have an account, please self register at the [CDS registration page](#) and go to the steps below.
2. If you are not logged, please [login](#) and go to the step below.
3. Copy the code displayed beside, in the file `$HOME/.cdsapirc` (in your *Unix/Linux environment*).

```
url:
key:
```

Group HWAs: Step 2 – Install CDS API On Windows



Prerequisites Step-by-step guide

SPACE SHORTCUTS

- ERAS: data documentation

PAGE TREE

- Access Copernicus data and service
- General articles
- Copernicus Atmosphere Monitoring Service
- Copernicus Climate Change Service
 - What data and maps are available
 - How to acknowledge, cite and reuse
 - Conversion table for accumulated data
 - What are the changes from ERA-Interim
 - Climate Data Store (CDS) infrastructure and API
 - How to install and use CDS API on Windows
 - How to install and use CDS API on macOS
 - Climate Data Store (CDS) API interface
 - Climate Data Store (CDS) API user guide
 - Common Error Messages for CDS API
- CDS dataset documentation
- CDS application documentation
- CDS precursor dataset documentation
- EQC documentation
- ECMWF model and products

Dashboard / ... / Climate Data Store (CDS) infrastructure and API

How to install and use CDS API on Windows

Last modified on Jun 15, 2021 13:03

- Prerequisites
- Step-by-step guide
- Related articles

⚠ You only need to go through this procedure once, before you can use the CDS API on Windows to programmatically download data from either the [Climate Data Store \(CDS\)](#) or the [Atmosphere Data Store \(ADS\)](#).

Prerequisites

1. You need to have a CDS or ADS account. If you don't have an account, please self register at the [CDS registration](#) page or the [ADS registration](#), whichever is appropriate.
2. You need to have **Python (and pip)** installed on your Windows environment.
 - Instructions to install Python (no admin privileges needed)
3. Add the installation and Script folder path in PATH using **set** (temporary) or **setx** (permanent) in a Command Prompt window.

This is to make sure that your computer knows where to find the Python interpreter. To do this you will have to modify a setting called PATH, which is a list of directories where Windows will look for programs.

Further details and examples are available [here](#).

You may choose also to set your environment variables into a batch file (e.g. set-env.bat which you will need to run from the Command Prompt).

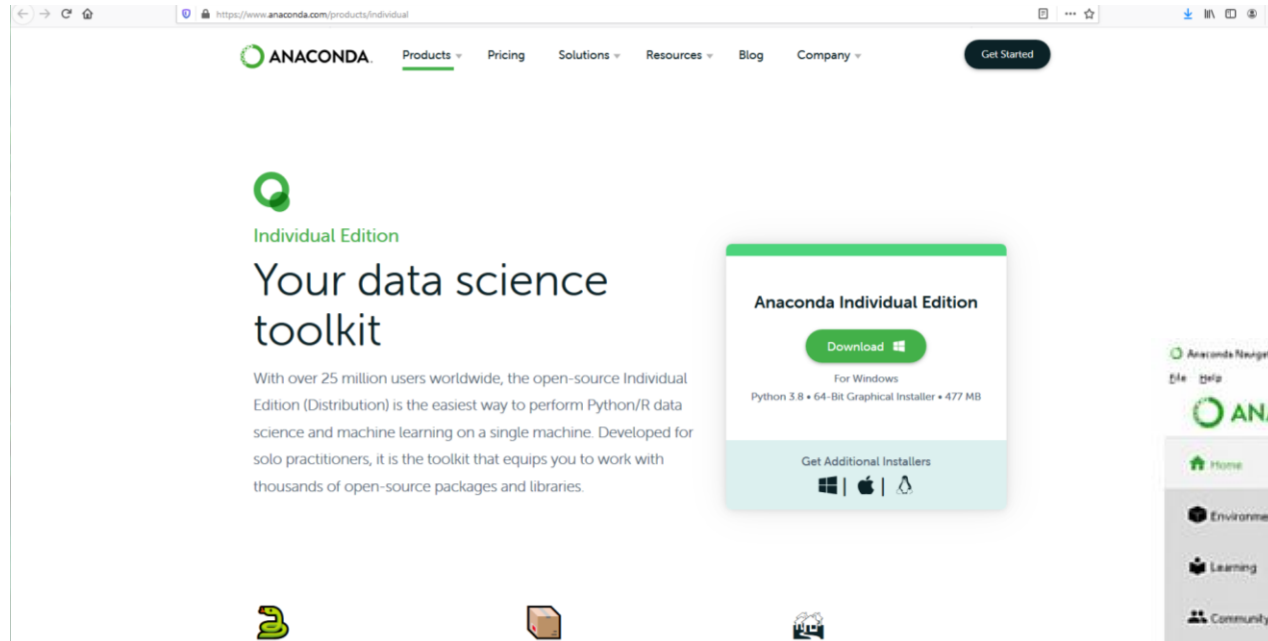
 - Example of the content of a batch file to run in Command Prompt window
4. If you have Anaconda installed you can install the CDS API by

```
<install_path>/conda/anaconda2/bin/conda config --add channels conda-forge
<install_path>/conda/anaconda2/bin/conda install cdsapi
```

<https://confluence.ecmwf.int/display/CKB/How+to+install+and+use+CDS+API+on+Windows>

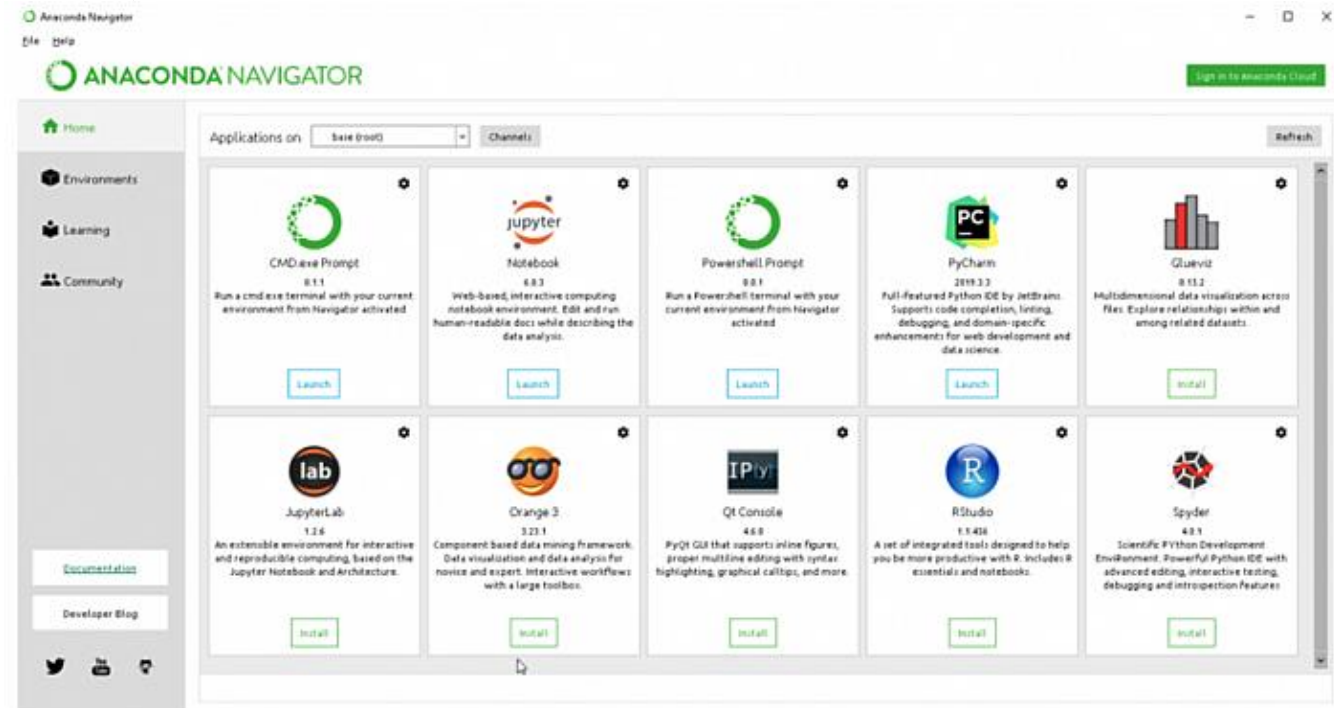


Group HWAs: Step 3 – Install Anaconda



<https://www.anaconda.com/products/individual>

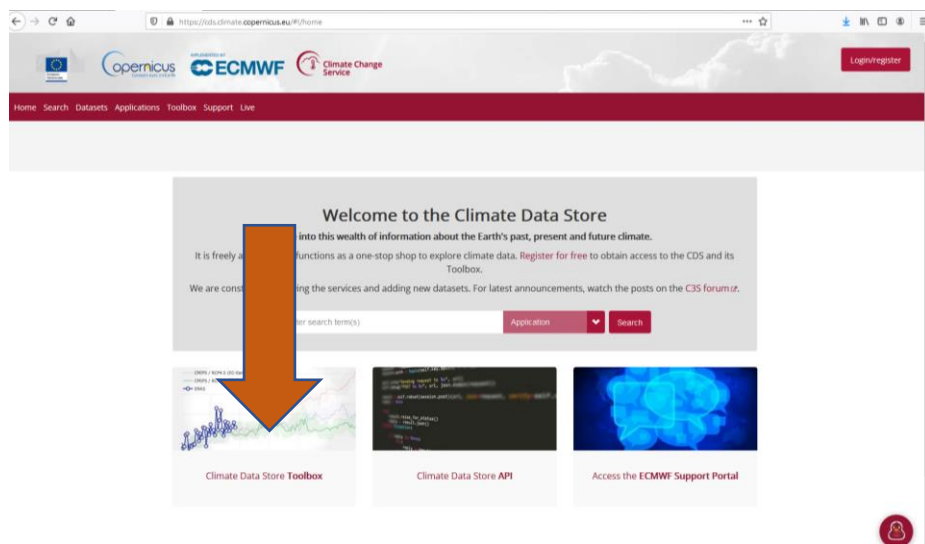
<https://docs.anaconda.com/anaconda/install>



Group HWAs: Step 4.1 – Goto Toolbox

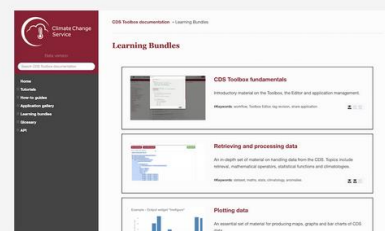


<https://cds.climate.copernicus.eu/#/home>



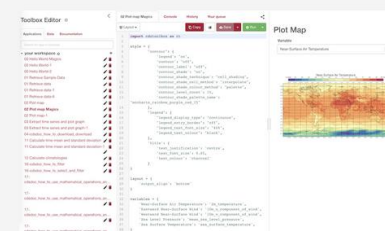
Welcome to the Toolbox

Toolbox Documentation



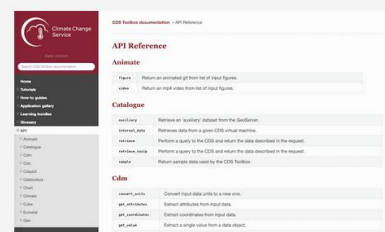
Access the full set of documentation material, including tutorials, how-to guides and a glossary.

Toolbox Editor



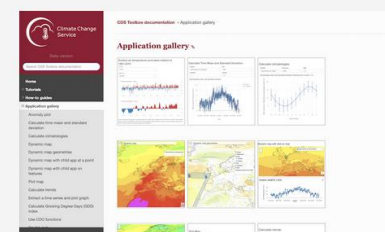
Enter your personal workspace where you can craft, edit and run applications.

API



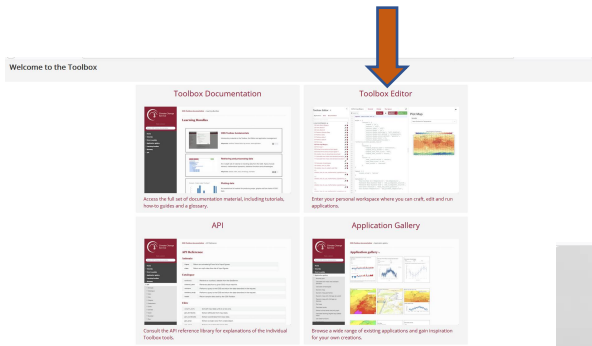
Consult the API reference library for explanations of the individual Toolbox tools.





Application Gallery



Browse a wide range of existing applications and gain inspiration for your own creations.

Group HWAs: Step 4.2 – Goto Toolbox





Alexander Mahura Logout

Home Search Datasets Applications Your requests Toolbox Support Live

Toolbox Editor

Applications Data Documentation

Search for app or example

your workspace

No applications

examples

00 Hello World

01 Retrieve data

02 Plot map

03 Extract time series and plot graph

11 Calculate time mean and standard deviation

12 Calculate climatologies

21 Calculate regional mean and anomalies

31 Calculate trends

41 Calculate GDD

00 Hello World

Console Your queue Runtime profile

Layout

```
1 import cds toolbox as ct
2
3 @ct.application(title='Hello World!')
4 @ct.output.figure()
5 def application():
6     """
7     HELLO WORLD!
8     This is your first application using the CDS Toolbox.
9
10    Here, 3 basic tasks:
11
12    - retrieve the 2 meter temperature from the CDS Catalogue
13    - print info about the data (see it in the 'Console' tab!)
14    - show the data on a map.
15    """
16
17    data = ct.catalogue.retrieve(
18        'reanalysis-era5-single-levels',
19        {
20            'variable': '2m_temperature',
21            'product_type': 'reanalysis',
22            'year': '2017',
23            'month': '01',
24            'day': '01',
25            'time': '12:00',
26            'grid': ['3', '3'],
27        }
28    )
29
30    # Create a simple Magics map
31    fig = ct.map.plot(data)
32    # To learn how to create simple Magics map consult the beginner's How to guide:
33    # https://ods.climate.copernicus.eu/toolbox/doc/how-to/21_how_to_make_a_map_with_magics_part1
34    # 21_how_to_make_a_map_with_magics_part1.html
35
36    return fig
```

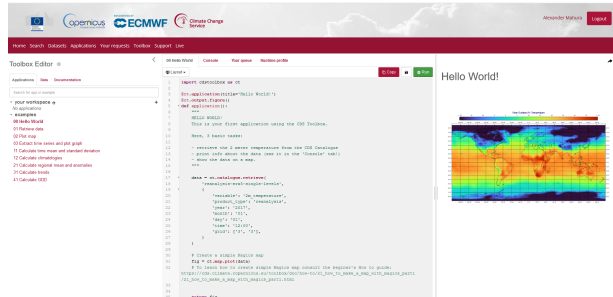
Copy Run

Hello World!



Near-Surface Air Temperature

Group HWAs: Step 4.3 – Goto Toolbox



your workspace
No applications
examples

00 Hello World

01 Retrieve data

02 Plot map

03 Extract time series and plot graph

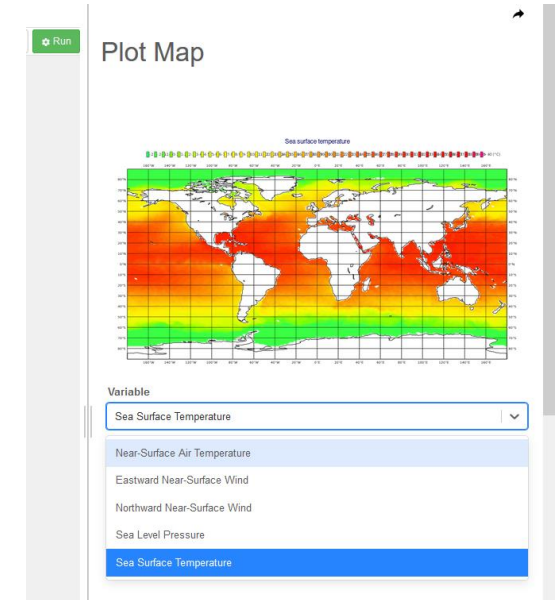
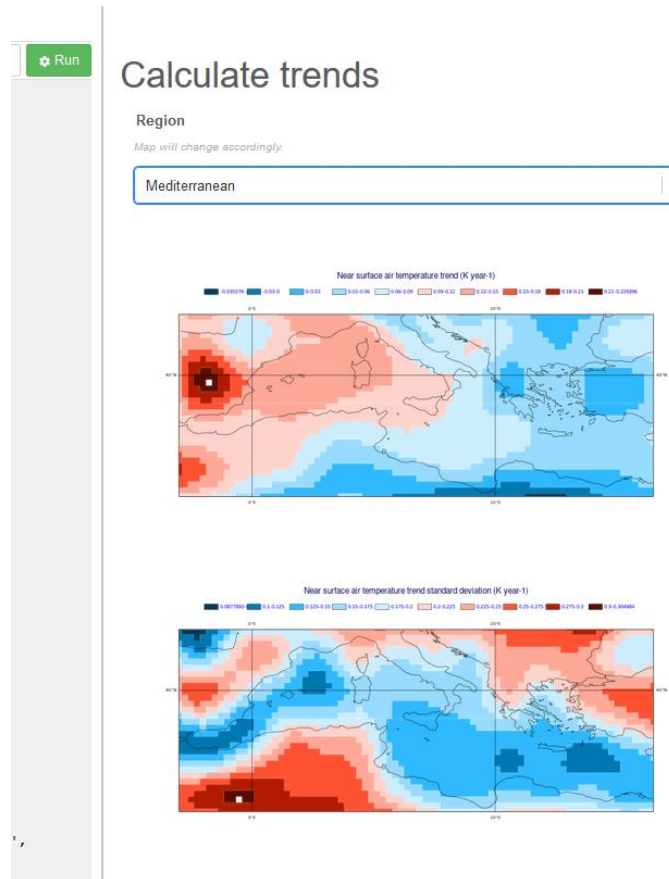
11 Calculate time mean and standard deviation

12 Calculate climatologies

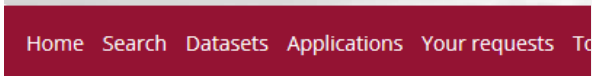
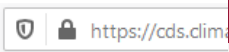
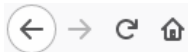
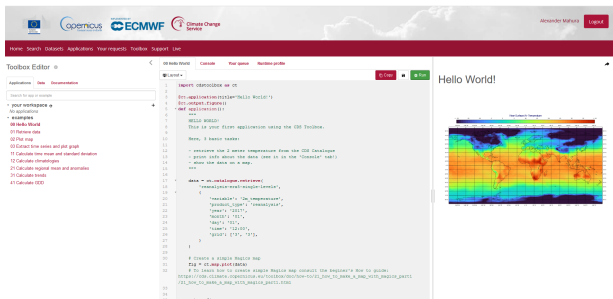
21 Calculate regional mean and anomalies

31 Calculate trends

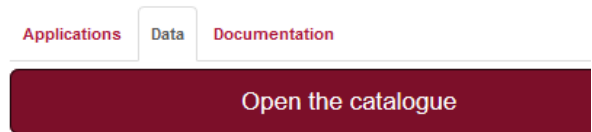
41 Calculate GDD



Group HWAs: Datasets



Toolbox Editor



Home

Search

Datasets

Applications

Your requests

Toolbox

Support

Live

Search results

Search dataset

Sort by

Relevancy

Title

Product type

Variable domain

Spatial coverage

Temporal coverage

Sector

Provider

All

Applications

Datasets

Providers

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...

In situ temperature, relative humidity and wind profiles from 2006 to March 2020 from the GRUAN reference network

The Global Climate Observing System (GCOS) Reference Upper-Air Network (GRUAN) is an international reference observing network, established in 2006, of sites measuring essential climate variables above Earth's surface, designed to fill an important gap in the current global observing system. GRUAN measurements are providing high-quality climate data records from the surface, through the tropospher...

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 express that the variables were computed at multiple vertical levels, which may differ in number and location among the dif...

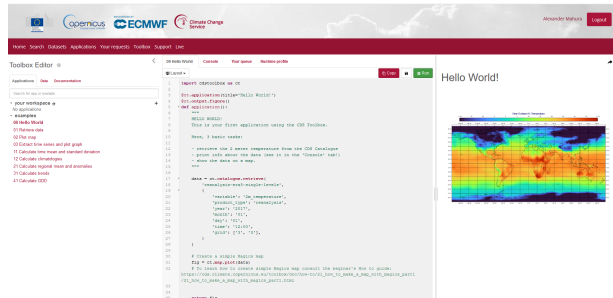
E-OBS daily gridded meteorological data for Europe from 1950 to present derived from in-situ observations

E-OBS is a daily gridded land-only observational dataset over Europe. The blended time series from the station network of the European Climate Assessment & Dataset (ECA&D) project form the basis for the E-OBS gridded dataset. All station data are sourced directly from the European National Meteorological and Hydrological Services (NMHSs) or other data holding institutions. For a considerable numbe...

climate.copernicus.eu

<https://cds.climate.copernicus.eu/cdsapp#!/search?type=dataset>

Group HWAs: Documentation



Toolbox Editor

Applications Data Documentation

Search for documentation

Toolbox documentation

API Reference

▼ cdstoolbox

Layout

application

child

► input

► output

► animate

► catalogue

► cdm

► cdsplot

► cdstools

► chart

► climate

► cube

► eurostat

► geo

► livemap

► map

► math

► observation

► operator

► sectoral

► shapes

► stats

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► sectoral

► shapes

► stats

Towards Climate Services

WEATHER CLIMATE WATER
TEMPS CLIMAT EAU

The World Meteorological Organization's perspective on climate services



Wilfran MOUTFOUMA-OKIA and Anahit HOVSEPYAN and Alvaro ALVES SILVA

Regional Climate Prediction services Division, Climate Services Branch, Services Department, WMO

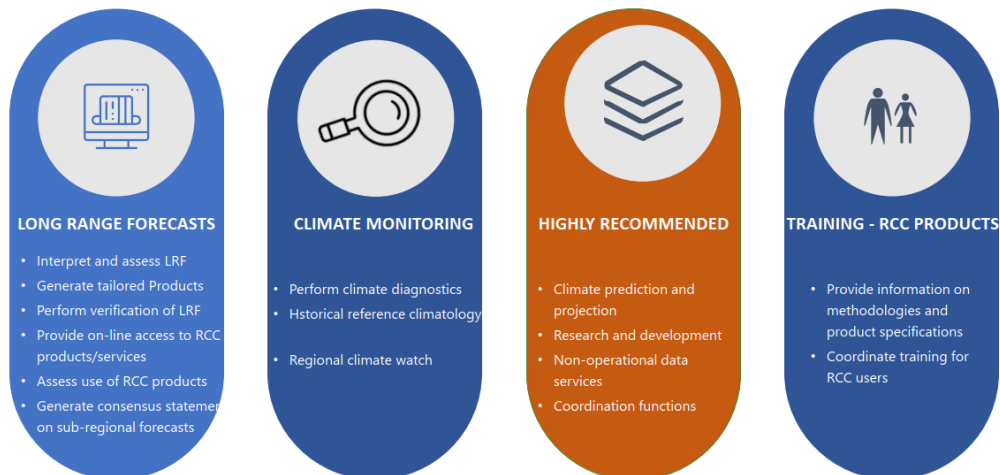


WMO OMM
World Meteorological Organization
Organisation météorologique mondiale

Digital Tools and Datasets for Climate Change Education, ClimEd 3rd Training, Helsinki, Finland, 26-28 Oct 2021

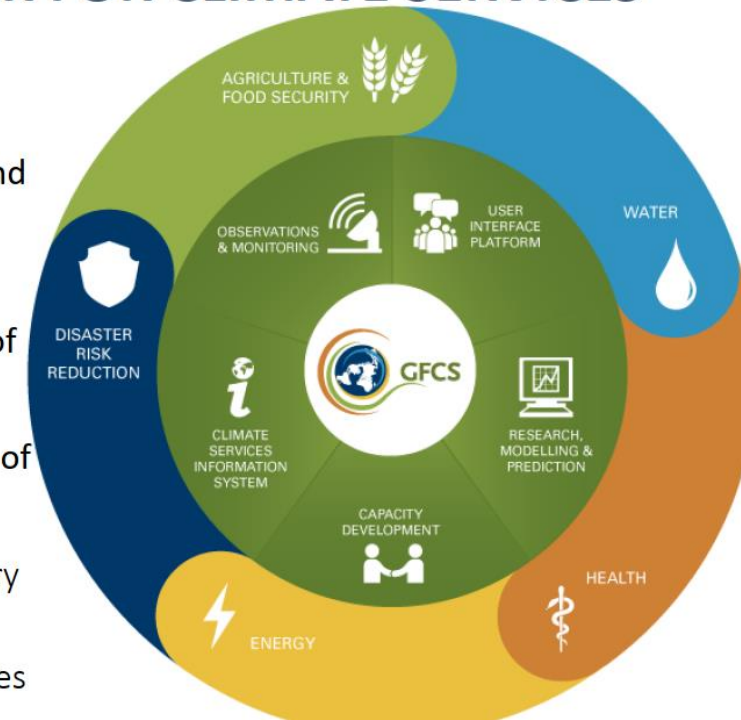
Courtesy – Wilfran Moufouma Okia, WMO

WMO REGIONAL CLIMATE CENTRES - FUNCTIONS



GLOBAL FRAMEWORK FOR CLIMATE SERVICES

- **User Interface Platform:** Means for users and climate service providers to interact.
 - **Observations and monitoring:** Climate observations necessary to meet the needs of climate services are generated.
 - **Research, Modeling and Prediction:** Needs of climate services within research agendas
- Capacity building:** Development of necessary institutions, infrastructure and human resources to provide effective climate services



**New Jobs
linked to "Big Data" Analysis
based on results of
Observations/ Modelling/ Assessment**

IPCC WGI Interactive Atlas



The screenshot shows the top section of the IPCC WGI Interactive Atlas website. At the top left is the IPCC logo with the text "INTERGOVERNMENTAL PANEL ON climate change". To the right, it says "IPCC Working Group I (WGI): Sixth Assessment Report". Below the IPCC logo is the title "IPCC WGI Interactive Atlas" followed by a description: "A novel tool for flexible spatial and temporal analyses of much of the observed and projected climate change information underpinning the Working Group I contribution to the Sixth Assessment Report, including regional synthesis for Climatic Impact-Drivers (CIDs)". There are two buttons: "Participate in the user testing survey" and "Errata and problem reporting". On the right, there is a circular globe with the text "OUR POSSIBLE CLIMATE FUTURES" and a vertical list of temperature projections: "+1.5°C", "+2°C", "+3°C", and "+4°C". Below the globe are two buttons: "Temperature" and "Precipitation". At the bottom, there are three blue boxes with white icons and text: "Simple (CLIMATE FUTURES) Advanced REGIONAL INFORMATION", "REGIONAL SYNTHESIS", and "DOCUMENTATION".

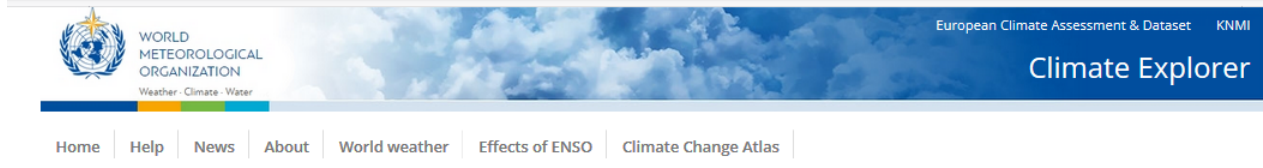
A novel tool for flexible spatial and temporal analyses of much of the observed and projected climate change information ...

<https://interactive-atlas.ipcc.ch>

The banner is for a training session titled "Regional Focus of IPCC AR6 In Ukraine Context". It features the IPCC logo and the text "SIXTH ASSESSMENT REPORT Working Group I – The Physical Science Basis". The date and location are "26 October 2021, ClimEd 3rd Training". The main title is "Regional Focus of IPCC AR6 In Ukraine Context". Below this, it lists the speaker: "Svitlana Krakovska, Leading Author of IPCC WGI AR6, Chapter Atlas Head of Applied Climatology Laboratory of the UHMI Senior Scientist of National Antarctic Scientific Center of Ukraine". On the right, there is a photo of Svitlana Krakovska holding a banner that says "Third Lead Author Meeting". At the bottom, there is a colorful map of Europe and the text "#ClimateReport #IPCC".

Courtesy – Svitlana Krakovska, UHMI

Climate Explore



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

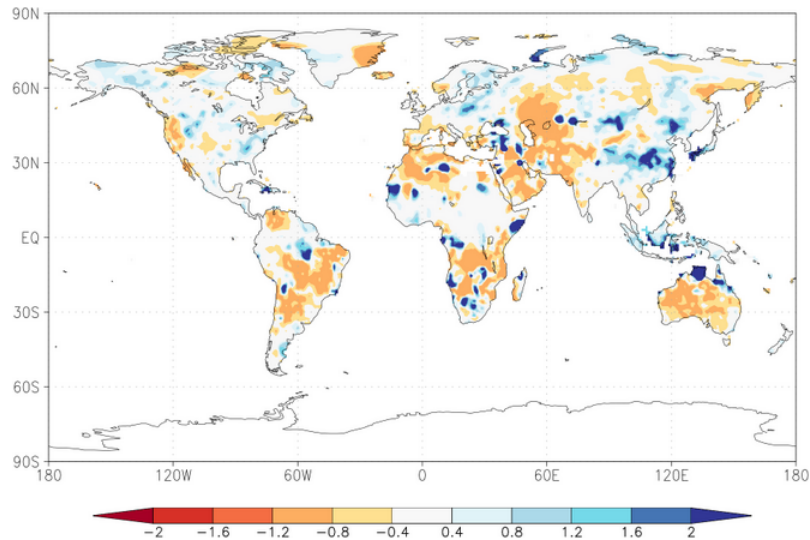
Starting point

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](#).

Relative precipitation anomalies wrt 1981-2010 [fraction] in August 2021 (source: GPCP). More under "World weather"



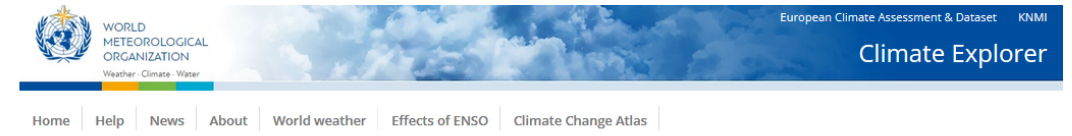
News

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
- > Monthly and seasonal historical reconstructions
- > Monthly seasonal hindcasts
- > Monthly CMIP3+ scenario runs
- > Monthly CMIP5 scenario runs
- > Annual CMIP5 extremes
- > Monthly CMIP6 scenario runs
- > Monthly CORDEX scenario runs
- > Attribution runs
- > View, upload your field



Home — KNMI Climate Change Atlas

KNMI Climate Change Atlas

Select a region	
Type:	<input type="radio"/> IPCC WG1 <input type="radio"/> IPBES <input checked="" type="radio"/> countries <input type="radio"/> place <input type="radio"/> box
Country:	<input type="text" value="Ukraine"/>
Select a season	
Season:	First month <input type="text" value="Jan"/> , length <input type="text" value="12"/> months
Select a dataset and variable	
Dataset:	<input type="text" value="GCM: CMIP5 (IPCC AR5 Atlas subset)"/>
Variable:	<input type="text" value="near-surface temperature"/>
<input checked="" type="radio"/> absolute <input type="radio"/> relative changes are shown	
Output:	<input checked="" type="radio"/> map <input type="radio"/> time series
Map options	
Scenario:	<input type="text" value="Historical + RCP4.5"/>
Measure:	<input type="text" value="Difference of two periods"/>
Reference period:	<input type="text" value="1986"/> - <input type="text" value="2005"/>
Future period:	<input type="text" value="2081"/> - <input type="text" value="2100"/>
Mean/percentiles:	<input type="text" value="mean"/>
<input type="button" value="Make map"/> May take up to 15 minutes the first time a season / measure is selected	

Users are strongly advised to study the short introduction. Specific help is available under the icons.

Further information

- > Short introduction
- > IPCC WG1 AR5 report, notably Annex I "Atlas"
- > CMIP5 co-ordinated climate model experiments
- > RCP scenario's

Funding

- > KNMI
- > SPECS
- > Red Cross / Red Crescent Climate Centre
- > Dutch Ministry of Infrastructure and Environment, DGMI

https://climexp.knmi.nl/plot_atlas_form.py

Courtesy – Inna Khomenko, OSENU & Antti Makela, FMI

Data from Observations & Multi-Scale Modelling



Courtesy – Antti Mäkelä (FMI)
Larisa Sogacheva (FMI)
Putian Zhou (UHEL/FMI)
Tomas Halenka (CUNI)
Igor Esau (NERSC)

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METEOROLOGISKA INSTITUTET
FINNISH METEOROLOGICAL INSTITUTE

Observations for climatic variables: obs. system, specifics, challenges

Antti Mäkelä
Finnish Meteorological
Institute (FMI)

Global scale climate modelling ...

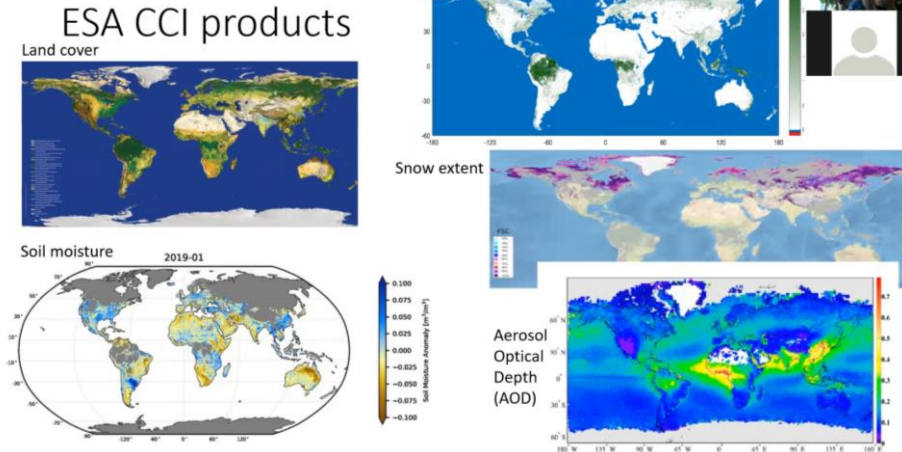
Earth System Models (ESMs)

- Coupled atmosphere-ocean-sea-ice-land models
- Interactive Carbon Cycle
- Interactive Vegetation (dynamic vegetation model)
- Interactive biogenic aerosol precursor emissions
- Chemical reactions
- Aerosol-cloud interactions
- ...

Urban scale modelling for climate applications

Igor Esau
Nansen Environmental and Remote Sensing
Centre, Bergen, Norway
University in Tromsø – Norwegian Arctic
University
igor.esau@neresc.no

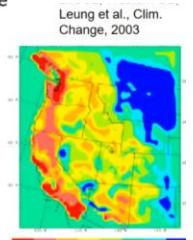
Remote sensing/Satellite observations



Regional scale climate modelling ...

Why regional climate modelling?

- Regional climates are determined by the interactions of planetary/large scale processes and regional/local scale processes
 - Planetary/large scale forcings and circulations determine the statistics of weather events that characterize the climate of a region
 - Regional and local scale forcings and circulations modulate the regional climate change signal, possibly feeding back to the large scale circulations
- In order to simulate climate (and more specifically climate change) at the regional scale it is thus necessary to simulate processes at a wide range of spatial (and temporal) scales
- Practical aspects (hi-res for less resources, higher resolution, etc. – in future with hi-res GCMs?)

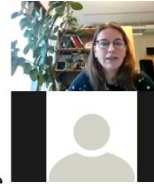


Remote Sensing Data



Courtesy – Larisa Sogacheva (FMI)

EO data access



Earth Observation data can be acquired through different channels. Free of cost data is generally provided by public agencies, under potential conditions linked to the application envisaged and the nationality of the entity requiring access.

PUBLIC EO DATA PROVIDERS

ESA	https://earth.esa.int/web/guest/home
ESA-Sentinel	https://sentinel.esa.int/web/sentinel/
Sentinel Hub	https://www.sentinel-hub.com/
Eumetsat	http://www.eumetsat.int/website/home/index.html
USGS (Landsat)	http://earthexplorer.usgs.gov/
NOAA	http://www.ospo.noaa.gov/
NASA	https://earthdata.nasa.gov/earth-observation-data
Japan	http://www.eorc.jaxa.jp/en/about/distribution/index.html
China	http://www.cma.gov.cn/en
India	http://bhuvan.nrsc.gov.in/bhuvan_links.php

Worldview, NASA <https://worldview.earthdata.nasa.gov/?v=8.212028631284909,-46.54687500000001,192.3192213687151,53.01562500000001&t=2021-10-28-T05%3A01%3A35Z>

Giovanni, NASA, <https://giovanni.gsfc.nasa.gov/giovanni/>

Copernicus Climate data store <https://cds.climate.copernicus.eu/#!/home>

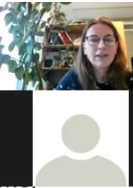
Data access

In the case of the Sentinel EO satellites, developed by ESA for the European Commission's Copernicus programme, access to data is provided through multiple channels:

The [Copernicus Open Access Hub](#) provides free and open access to a rolling repository of Sentinel user products. A simple and fast registration is required to create an account, before getting free access to the Sentinel data. The data access is configured to avoid saturation resulting from massive downloads by a limited number of users (e.g. maximum number of parallel downloads, maximum volume per retrieval).

2. A collaborative ground segment is also in development in several member states (e.g. <http://sentinels.space.noa.gr/> (Greece) or <http://sedas.satapps.org/> (UK)). It is intended to allow complementary access to Sentinel data and/or to specific data products by establishing additional pick-up points (e.g. mirror sites). It is composed of elements funded by third parties (i.e. from outside the ESA/EU Copernicus programme).

3. [Copernicus Space Component Data Access](#) (CSCDA) is restricted to users eligible to Copernicus Services, as defined by the European Commission (e.g. institutions and bodies of the EU, participants to a research project financed under the EU research programmes, international organisations and NGOs...). Access is provided with committed performances, together with possibilities to order specific tasking of the satellites participating in Copernicus.



Climate Modelling Data



Courtesy – Putian Zhou (UHEL/FMI)

- ESGF: Earth System Grid Federation
- A data platform where CMIP data are saved and managed
- Everyone can search and download the CMIP data from ESGF
- Homepage: <https://esgf.llnl.gov/>
- Federated ESGF-CoG Nodes
 - LLNL: USA
 - CEDA: UK
 - DKRZ: Germany
 - GFDL: USA
 - IPSL: France
 - LIU: Sweden
 - NCI: Australia
 - NCCS: USA



CMIP6 data portal:
<https://esgf-node.llnl.gov/search/cmip6>



ESGF

Node information

You can search
by using global
attributes and
CMIP6 CVs

Emission Databases

- **EDGAR** (The Emission Database for Global Atmospheric Research)
 - <https://edgar.jrc.ec.europa.eu/>
 - CH₄, CO₂, N₂O, BC, CO, NMVOC, NO_x, SO₂, ...
- **ECLIPSE** (Evaluating the CLimate and Air Quality ImPacts of Short-livEd Pollutants)
 - <http://eclipse.nilu.no/>
 - SO₂, NO_x, NH₃, NMVOC, BC, OC, OM, PM_{2.5}, PM₁₀, CO, CH₄, ...
- **CEDS** (Community Emissions Data System) (Hoesly et al., 2018, GMD): based mostly on EDGAR v4.2 and ECLIPSE datasets, and used for CMIP6 input
 - <http://www.globalchange.umd.edu/ceds/>
 - CO, CH₄, NH₃, NO_x, SO₂, NMVOCs, BC, OC, CO₂, ...
- **CAMS** (Copernicus Atmosphere Monitoring Service): based on national reported emissions, EDGAR, ECLIPSE, CEDS
 - <https://atmosphere.copernicus.eu/anthropogenic-and-natural-emissions>
- **GFED** (Global Fire Emission Database) (van Marle et al., 2017, GMD): biomass burning emissions
 - <https://www.globalfiredata.org/index.html>
 - BC, OC, CH₄, CO, SO₂, ...
- **ECCAD** (Emissions of atmospheric Compounds and Compilation of Ancillary Data): website to download nearly all the emission datasets
 - <https://eccad3.sedoo.fr/>

Climate Related Datasets/ Tools

Courtesy – Antti Mäkelä (FMI)



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Observations for climatic variables: obs. system, specifics, challenges

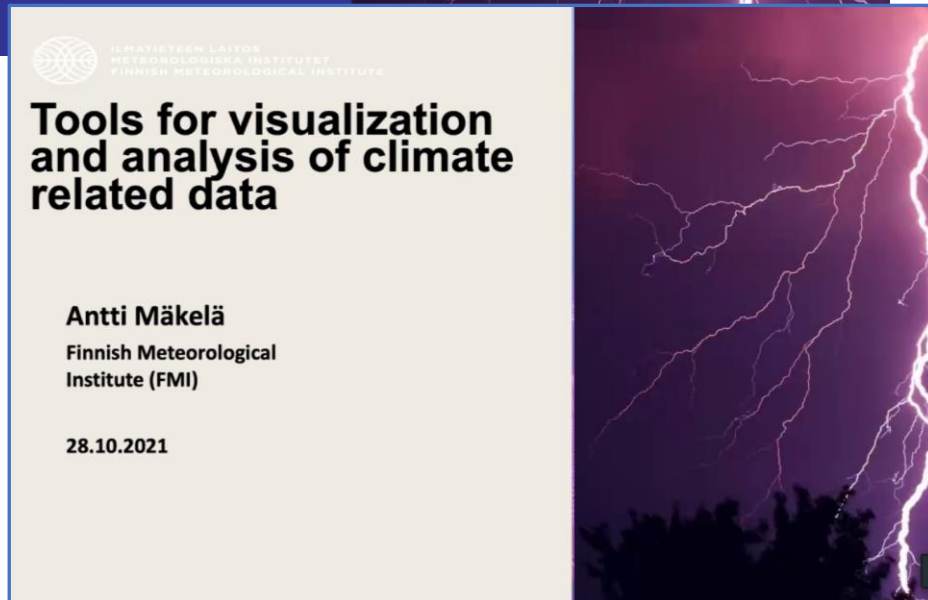
Antti Mäkelä
Finnish Meteorological
Institute (FMI)



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FINNISH METEOROLOGICAL INSTITUTE

Climate related datasets, Copernicus related data

Antti Mäkelä
Finnish Meteorological
Institute (FMI)

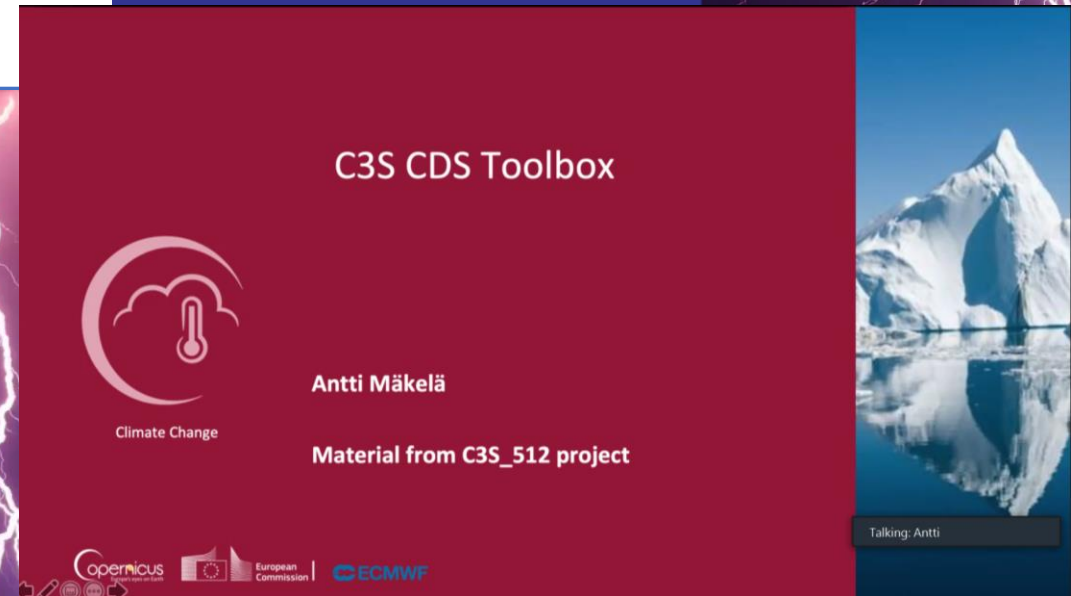


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Tools for visualization and analysis of climate related data

Antti Mäkelä
Finnish Meteorological
Institute (FMI)

28.10.2021



C3S CDS Toolbox

Climate Change

Antti Mäkelä
Material from C3S_512 project

Talking: Antti

Coopericus European Commission ECMWF

Extras to Analyze and Visualize Data



- **CDO** (Climate Data Operators) - tool set for working on climate and NWP model data:
<https://code.mpimet.mpg.de/projects/cdo>
& downloads (<https://code.mpimet.mpg.de/projects/cdo/files>)
& documentation (<https://code.mpimet.mpg.de/projects/cdo/wiki/Cdo#Documentation>)
- **NCO** (netCDF Operator) - toolkit manipulates and analyses data stored in netCDF-accessible formats:
<http://nco.sourceforge.net>
- **wgrib** – manipulate, inventory and decode GRIB files: <https://www.cpc.ncep.noaa.gov/products/wesley/wgrib.html>
- **wgrib2**: https://www.cpc.ncep.noaa.gov/products/wesley/wgrib2/convert_wgrib2.html
- **IDV** (Integrated Data Viewer) - 3D geoscience visualization and analysis tool (on Win, Mac, Linux platforms):
<https://www.unidata.ucar.edu/software/idv>
- **Metview** : <https://confluence.ecmwf.int/display/METV>
- **Visualization with Python**: <https://matplotlib.org> & <https://matplotlib.org/stable/gallery/index.html>
- ...

Take Initial Steps in Group HWA: Discuss &

- Select the theme (among the ClimEd proposed) or propose your own
- Select geographical region/ domain/ country of interest
- Select existing or possible problem of concern/ interest
- Formulate main aim and specific objectives of your group project
- Think to which UN SDGs results of your group project might correspond
- Select which types of data (from observations/ modelling) will be used
- Select which datasets/ repositories/ archives will be used
- Select variables/ parametrs which will be analysed
- Select approach(s) and tools you might utilize for visualisation and data analysis
- Think about expected results



Each Group should prepare **max 3 slides presentation
& present (at least, by 1 person) – **max 3 minutes**
on **2 November 2021** starting **17:00 pm** of Kyiv = Helsinki time
Same zoom-link: <https://helsinki.zoom.us/j/63972564694>**

List-to-Do before 2nd November



- Complete individual home-work-assignment in ERA5 Explorer & upload in the OSENU's Moodle
- Complete Registration for CDS
- Complete Installation of CDS API
- Preferably: also Install Anaconda
- Test access to CDS Toolbox (& try also examples)
- Take initial steps in Group HWA: discuss & select ...
& prepare 3 slides presentation & upload also in the OSENU's Moodle



<https://www.helsinki.fi/en/inar-institute-for-atmospheric-and-earth-system-research>

Thank you!



<https://www.atm.helsinki.fi/peex>