Pan-Eurasian Experiment PEEX · ACCC ATMOSPHERE AND CLIMATE COMPETENCE CENTRE · CLIMATE COMPETENCIES · INAR · UHMI · NERSC

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 (OSENU, 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, OSENU

Online 3rd ClimEd Training

28 October 2021

ClimEd 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 28th October 2021	Tuesday 2 Nov 2021	Wednesday 9 Nov 2021	until 11th November 2021	Friday 12 November 2021
09:45 – 10:00	*Welcome words*							*Welcome words*
10:00 – 10:45	**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)	*2 weeks of work in Groups on HWAs*	*2 weeks of work in Groups on HWAs*	*2 weeks of work in Groups on HWAs*	*2 weeks of work in Groups on HWAs*	Presentations and Defences of HWAs by Groups C1, C2, C3
10:45 – 11:00	*Coffee/ Tea Br.*	*Coffee/ Tea Br.*	*Coffee/ Tea Br.*					*Coffee/ Tea Br.*
11:00 – 11:45	**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)	*2 weeks of work in Groups on HWAs*	*2 weeks of work in Groups on HWAs*	*2 weeks of work in Groups on HWAs*	*2 weeks of work in Groups on HWAs*	Presentations and Defences of HWAs by Groups C4, C5, C6
11:45 – 12:00	*Coffee/ Tea Br.*	*Coffee/ Tea Br.*	*Coffee/ Tea Br.*					*Coffee/ Tea Br.*
12:00 – 12:45	**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	*2 weeks of work in Groups on HWAs*	*2 weeks of work in Groups on HWAs*	*2 weeks of work in Groups on HWAs*	*2 weeks of work in Groups on HWAs*	Presentations and Defences of HWAs by Groups C7, C8, C9
12:45 – 13:00	*Coffee/ Tea Br.*	*Coffee/ Tea Br.*	*Coffee/ Tea Br.*					*Coffee/ Tea Br.*
13:00 – 13:45	**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	*2 weeks of work in Groups on HWAs*	*time TBD* **Questions** to Teachers of Groups' Projects	*time TBD* **Questions** to Teachers of Groups' Projects	*2 weeks of work in Groups on HWAs*	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

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	VBU
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**

ClimEd Main Themes for HWAs/Group Projects

➢ **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; …)

ClimEd Main Themes for HWAs/Group Projects

➤ **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

Source:

Individual HWAs: City of Your Dream Summer Vacation
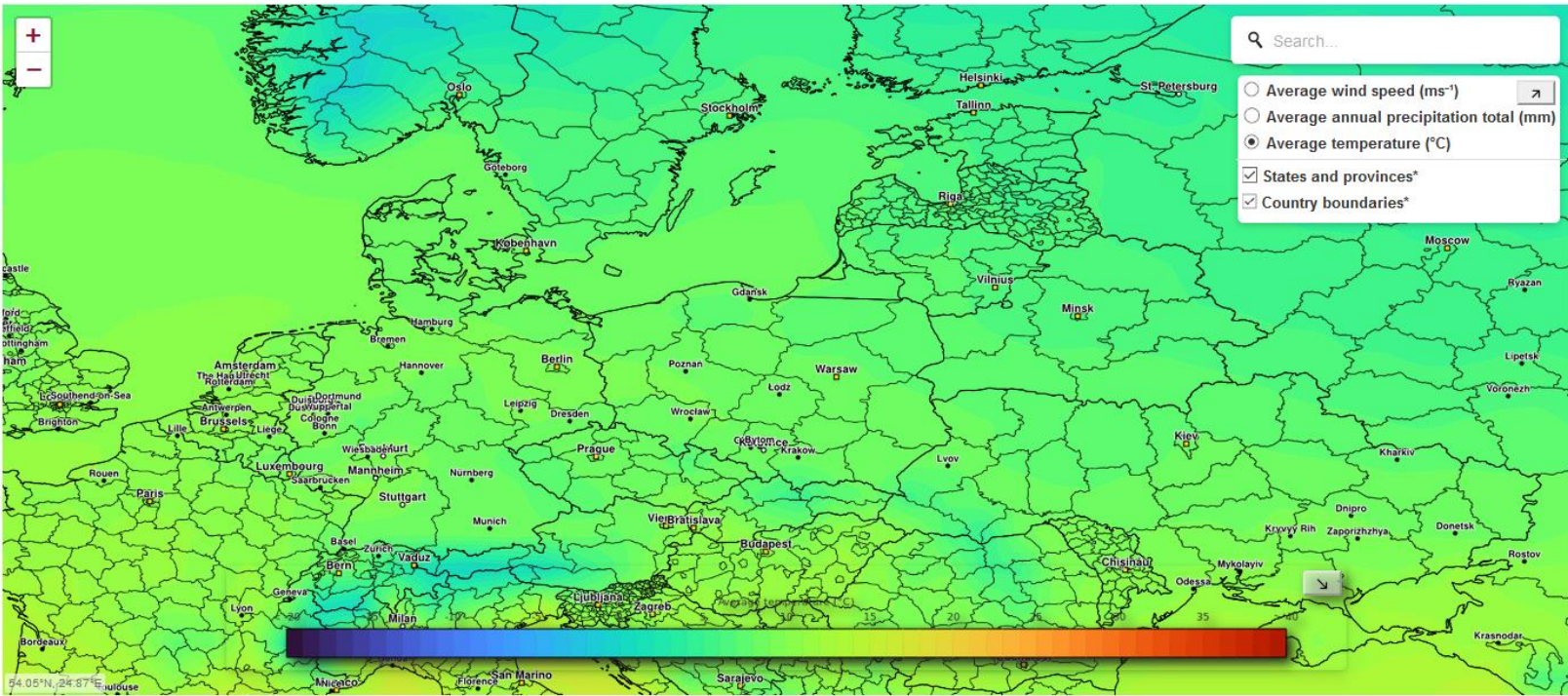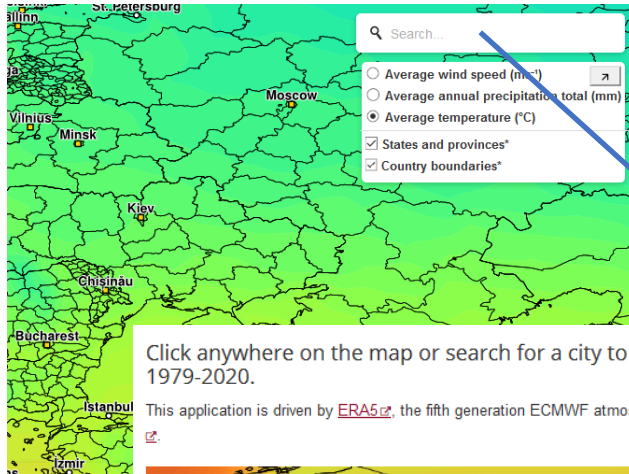
- Average wind speed (ms⁻¹)
- Average annual precipitation total (mm)
- Average temperature (°C)
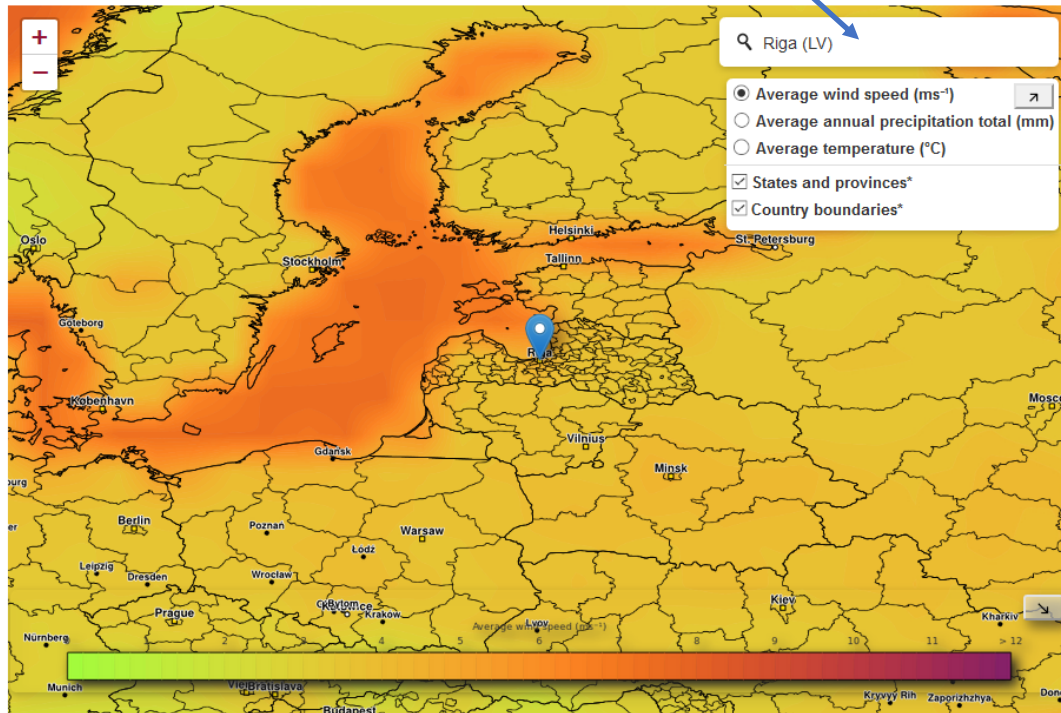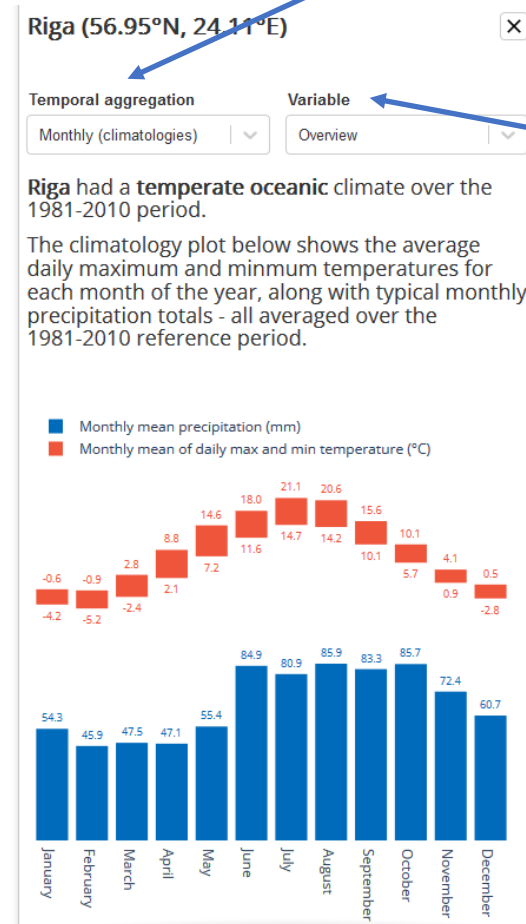
Temporal aggregation
- Monthly (climatologies)
- Annual

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

Source:

o **prepare individual presentation** (use your own style of preference), which should include:

o for selected country (or region/county) and city
o results of visualization and analysis of temperature, wind, precipitation patterns including month-to-month variabilities

o **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
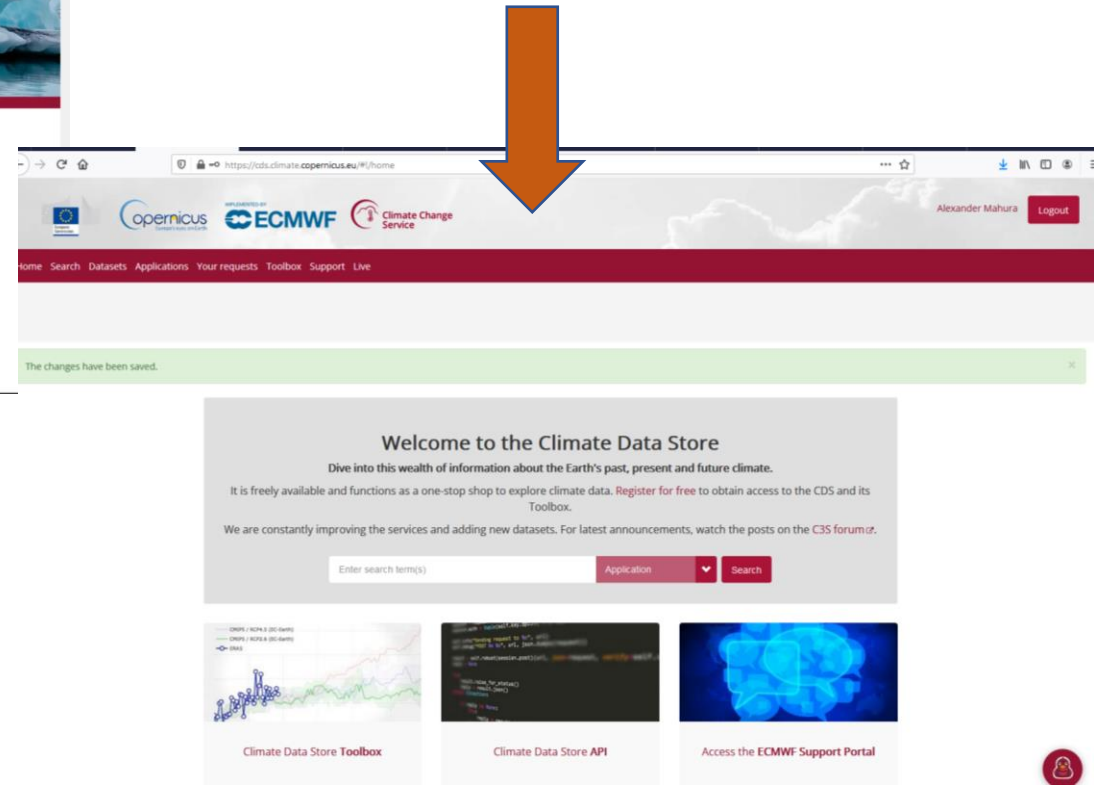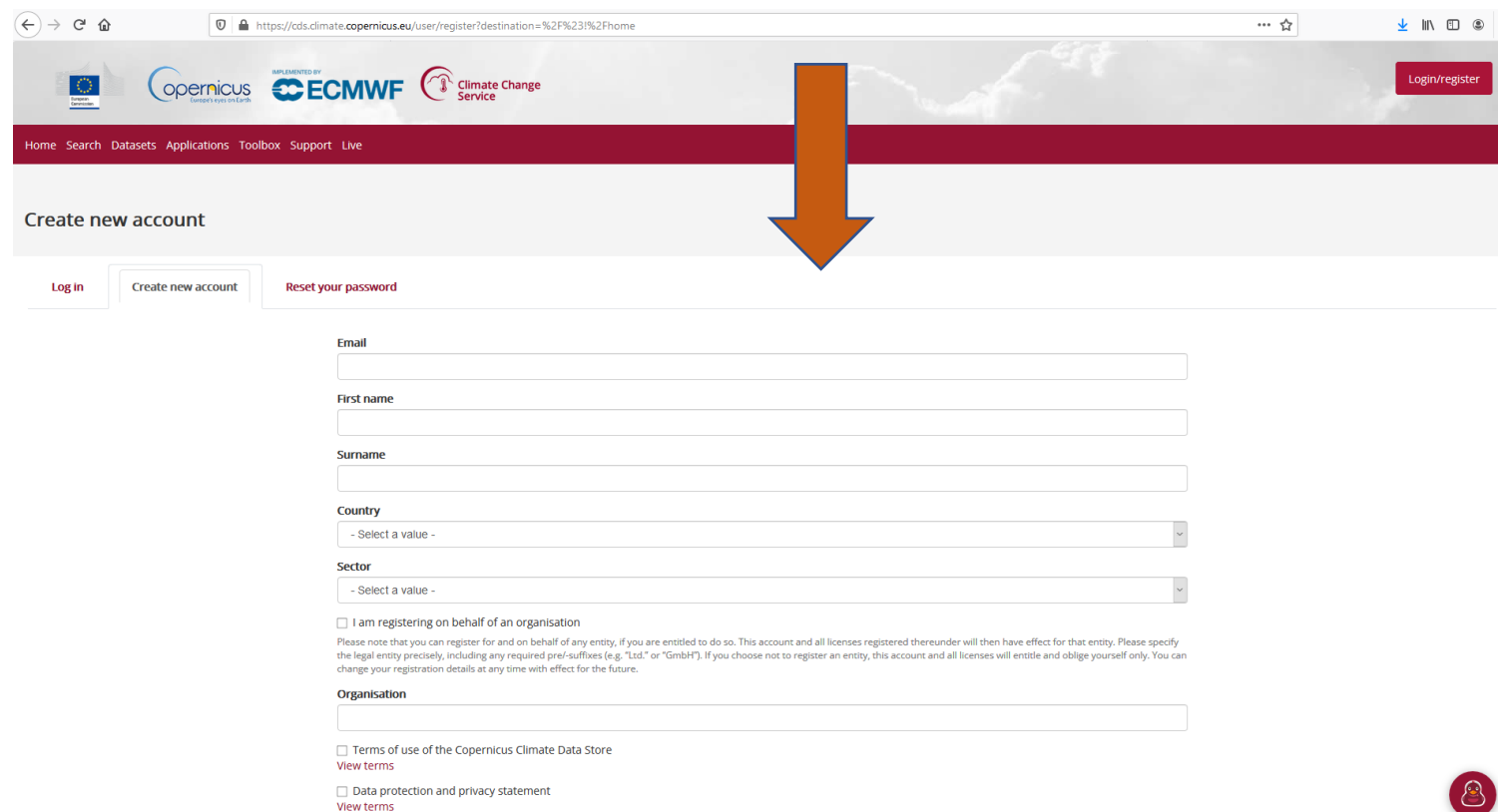
Group HWAs: Step 2 – Register for CDS

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

CDS – Climate Data Store

Group HWAs: Step 2 – Install CDS API

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

Group HWAs: Step 2 – Install CDS API On Windows

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

Prerequisites

Step-by-step guide

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

Group HWAs: Step 3 – Install Anaconda

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

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

https://docs.anaconda.com/anaconda/install
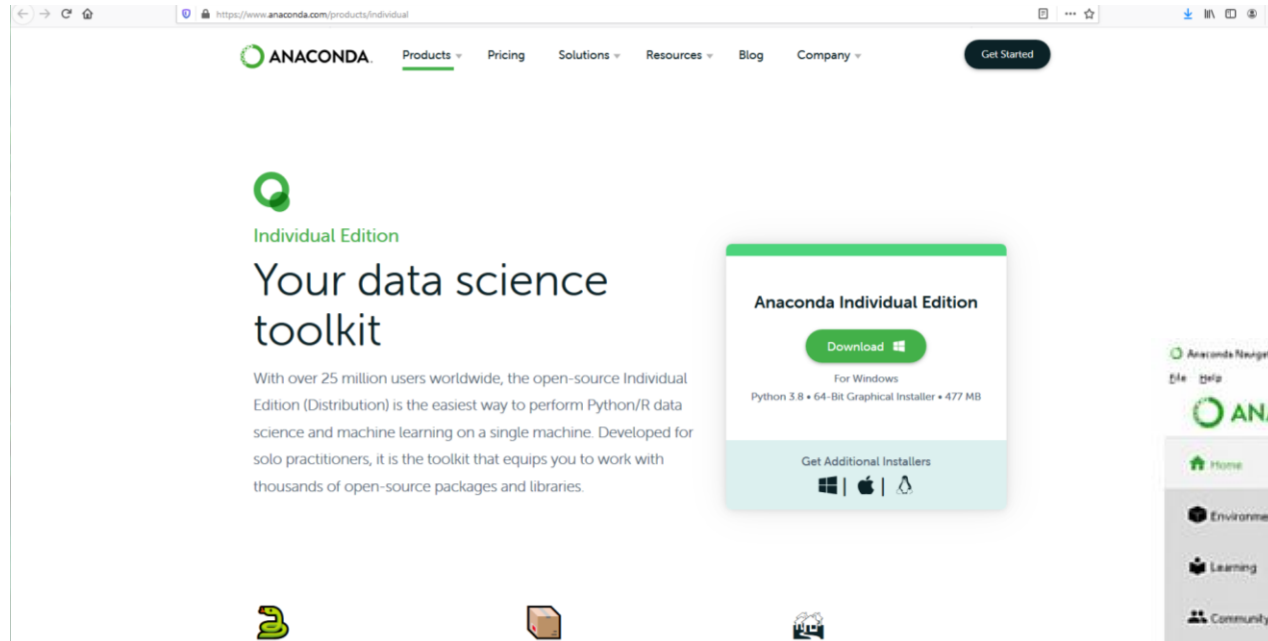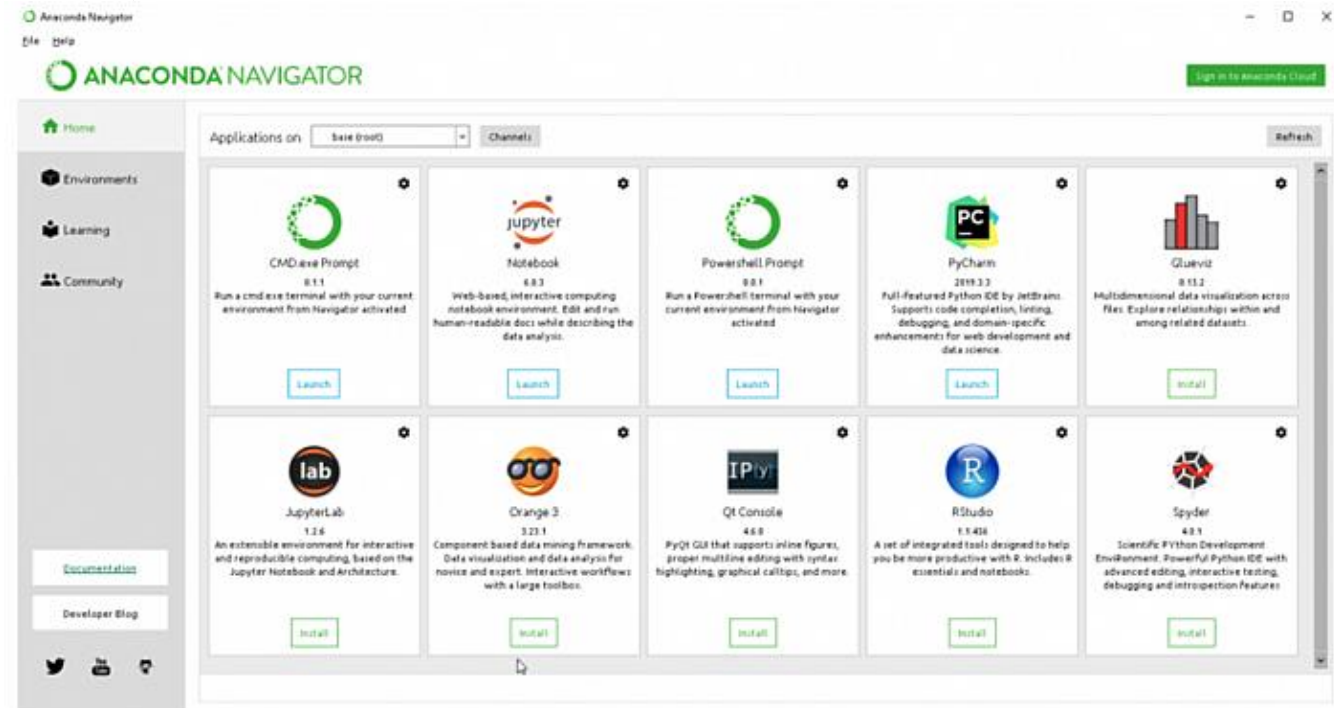
Group HWAs: Step 4.1 – Goto Toolbox
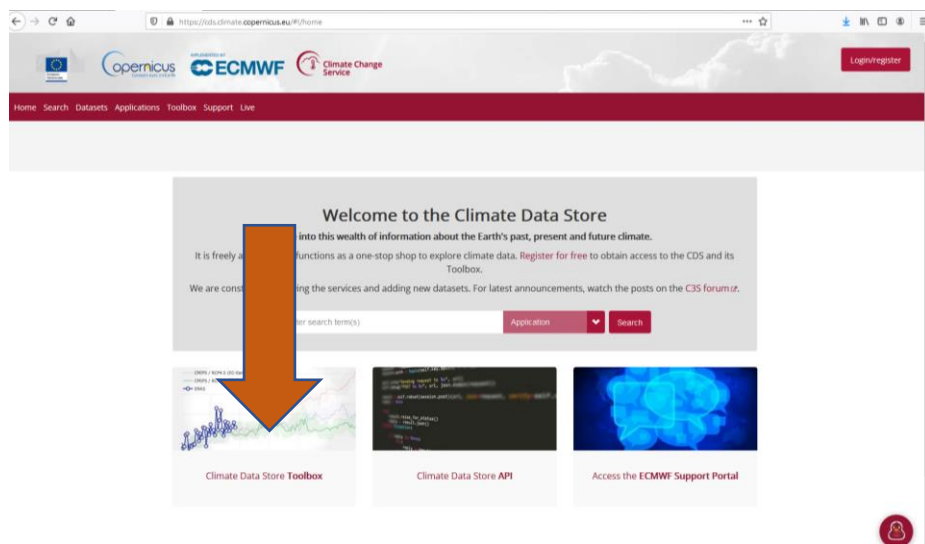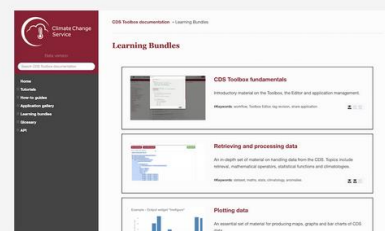
https://cds.climate.copernicus.eu/#!/home
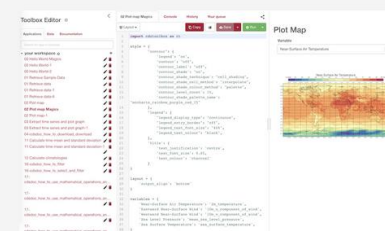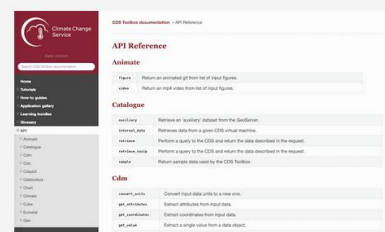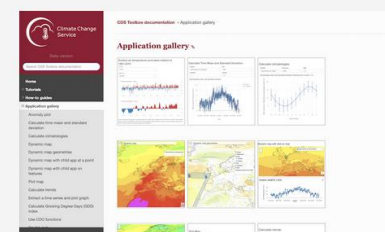
Group HWAs: Step 4.2 – Goto Toolbox
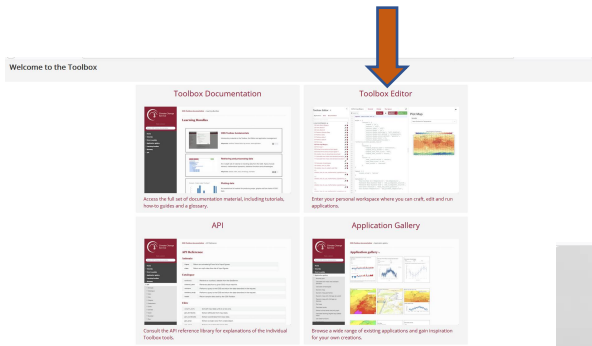
Group HWAs: Step 4.3 – Goto Toolbox
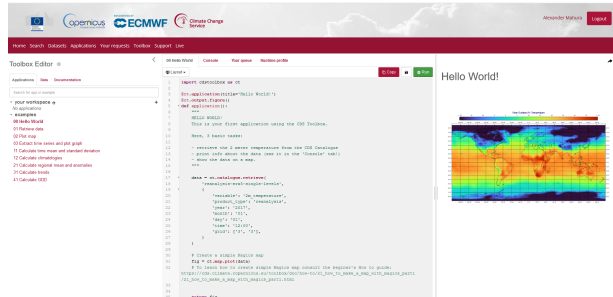
your workspace

No applications

examples

00 Hello World

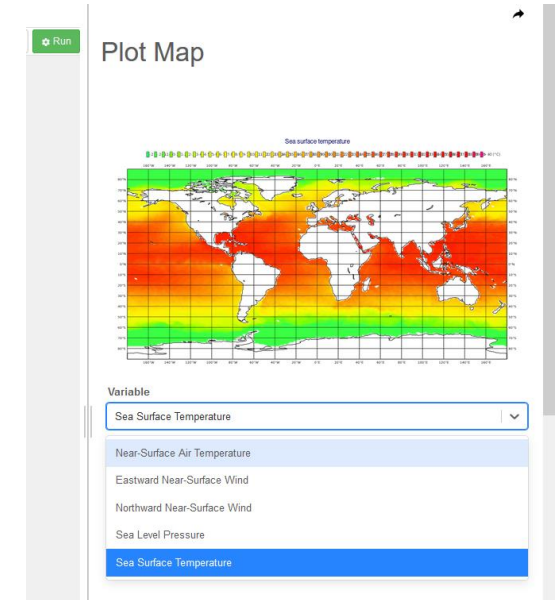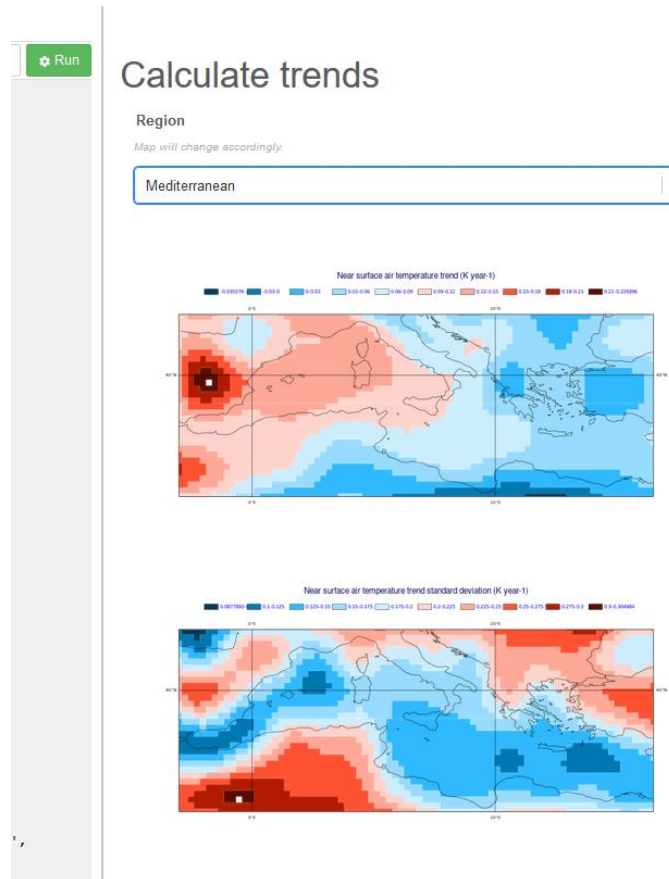01 Retrieve data

02 Plot map

03 Extract time series and plot graph

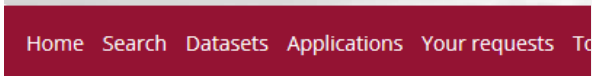11 Calculate time mean and standard deviation
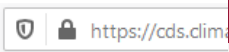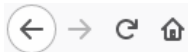
12 Calculate climatologies

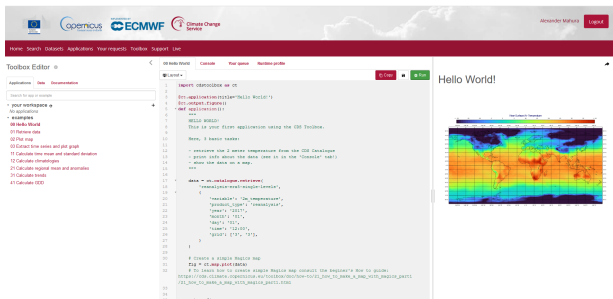21 Calculate regional mean and anomalies

31 Calculate trends

41 Calculate GDD

Group HWAs: Datasets

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

Group HWAs: Documentation
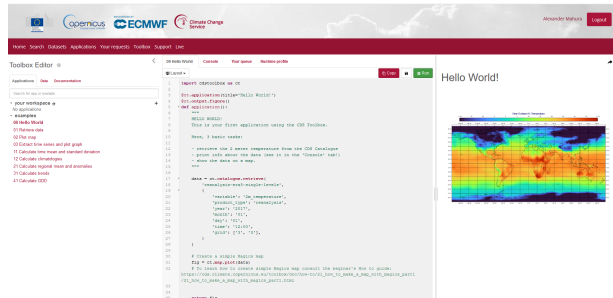
Towards Climate Services

The World Meteorological Organization's perspective on climate services

Wilfran MOUFOUMA-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

LONG RANGE FORECASTS
- Interpret and assess LRF
- Generate tailored Products
- Perform verification of LRF
- Provide on-line access to RCC products/services
- Assess use of RCC products
- Generate consensus statement on sub-regional forecasts

CLIMATE MONITORING
- Perform climate diagnostics
- Hstorical reference climatology
- Regional climate watch

HIGHLY RECOMMENDED
- Climate prediction and projection
- Research and development
- Non-operational data services
- Coordination functions

TRAINING - RCC PRODUCTS
- Provide information on methodologies and product specifications
- Coordinate training for RCC users

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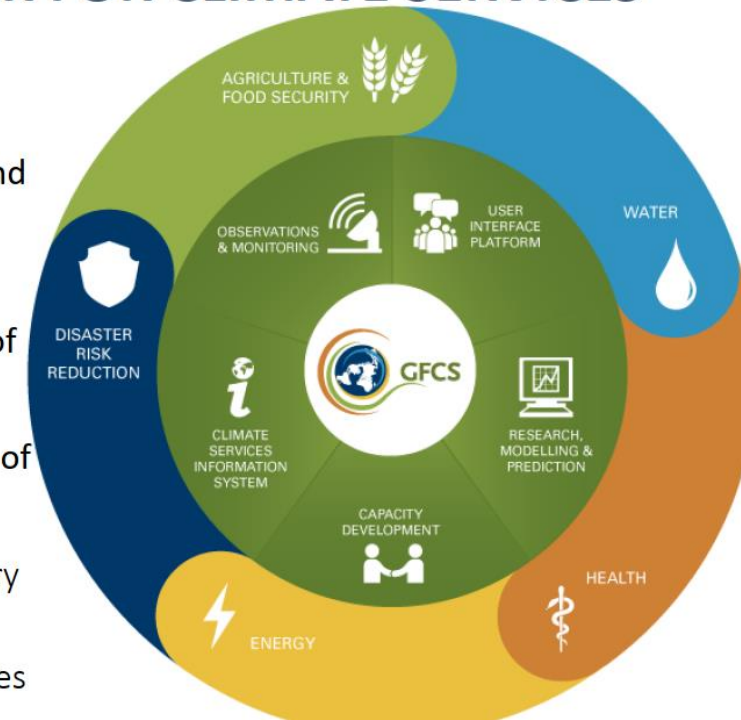
**New Jobs
linked to "Big Data" Analysis
based on results of
Observations/ Modelling/ Assessment**

IPCC WGI Interactive Atlas

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

https://interactive-atlas.ipcc.ch

Courtesy – Svitlana Krakovska, UHMI

Climate Explore

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

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)
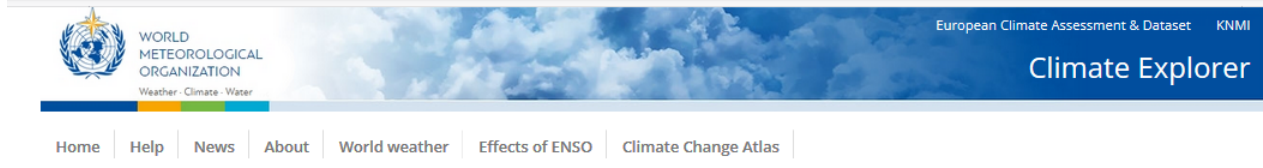*Igor Esau (NERSC)*

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

ILMATIETEEN LAITOS
METEOROLOGISKA INSTITUTET
FINNISH METEOROLOGICAL INSTITUTE

Antti Mäkelä

Finnish Meteorological Institute (FMI)

Global scale climate modelling ...

Earth System Models (ESMs)

INAR

Heavens et al., 2013, Nature Education Knowledge

- 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.ezau@nersc.no

Remote sensing/Satellite observations

ESA CCI products

Land cover

CCI BIOMASS - AGB, 2017 [Mg/ha]

Snow extent

Soil moisture 2019-01

Aerosol Optical Depth (AOD)
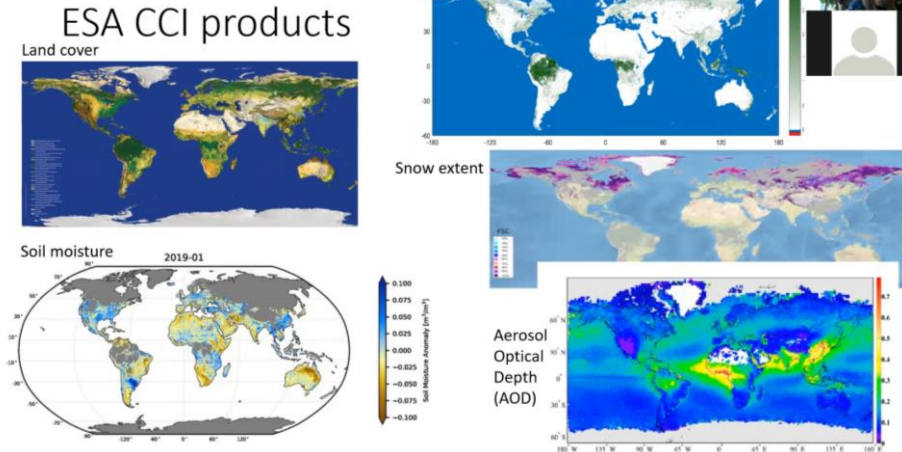
Regional scale climate modelling ...

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?)

Leung et al., Clim. Change, 2003

tomas.halenka@mff.cuni.cz
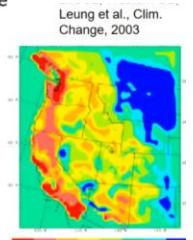
Remote Sensing Data

Courtesy – Larisa Sogacheva (FMI)

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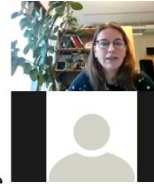
Earth Observation data can be acquired through different channels. Free of cost data is generally provided by public agencies, under potential conditions linked to the application envisaged and the nationality of the entity requiring access.

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

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

he Copernicus Open Access Hub provides free and open access to a rolling repository of Sentinel user products. A ple and fast registration is required to create an account, before getting free access to the Sentinel data. The a 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.
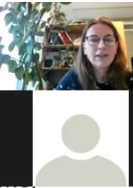
Climate Modelling Data

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

Emission Databases

- **EDGAR** (The Emission Database for Global Atmospheric Research)
  - https://edgar.jrc.ec.europa.eu/
  - CH4, CO2, N2O, BC, CO, NMVOC, NOx, SO2, …
- **ECLIPSE** (**E**valuating the **CL**imate and Air Quality **ImP**acts of **S**hort-liv**E**d Pollutants)
  - http://eclipse.nilu.no/
  - SO2, NOx, NH3, NMVOC, BC, OC, OM, PM2.5, 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, NOx, 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/

Node information

You can search by using global attributes and CMIP6 CVs

Climate Related Datasets/ Tools

Courtesy – Antti Mäkelä (FMI)

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 & ClimEd

➤ 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

➢ Prefferably: 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