



CLUVEX  
CLIMATE UNIVERSITY FOR VIRTUAL EXCHANGES

# **CLimate University for Virtual EXchanges – C L U V E X –**

***Web-based tools for climate related data  
& lessons learnt***

***Alexander Mahura, Stefen Fronzek, Risto Makkonen***

***16 Jun 2026, CLUVEX e-Final-meeting***



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



# Outline of Presentation:

- **Communication + Collaboration + Education (Platforms)**
- **Virtual Exchange (VE) Weeks for students – main activity with tools**
- **VE Week programme and tools**
- **Web-based tools in VE Weeks**
- **ERA5 Past Climate Explorer**
- **Shared Socioeconomic Pathways**
- **IPCC Interactive Atlas**
- **After introducing tools**
- **Extras to visualize, analyze and interpret climate-related data**
- **CLUVEX lessons learnt**
- **Earned bonuses for students**

# VE Week – Work in Groups on Climate Horizon

## Learning + Communication + Collaboration Platforms (★)

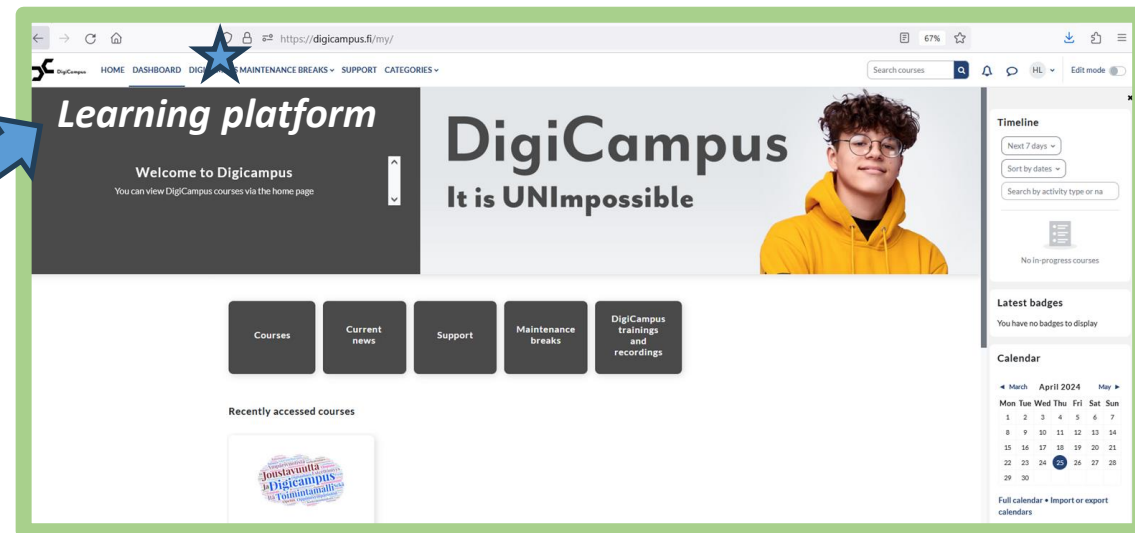


Communication platform

zoom



Collaboration platform



## DigiCampus for sharing materials for students & moderators:

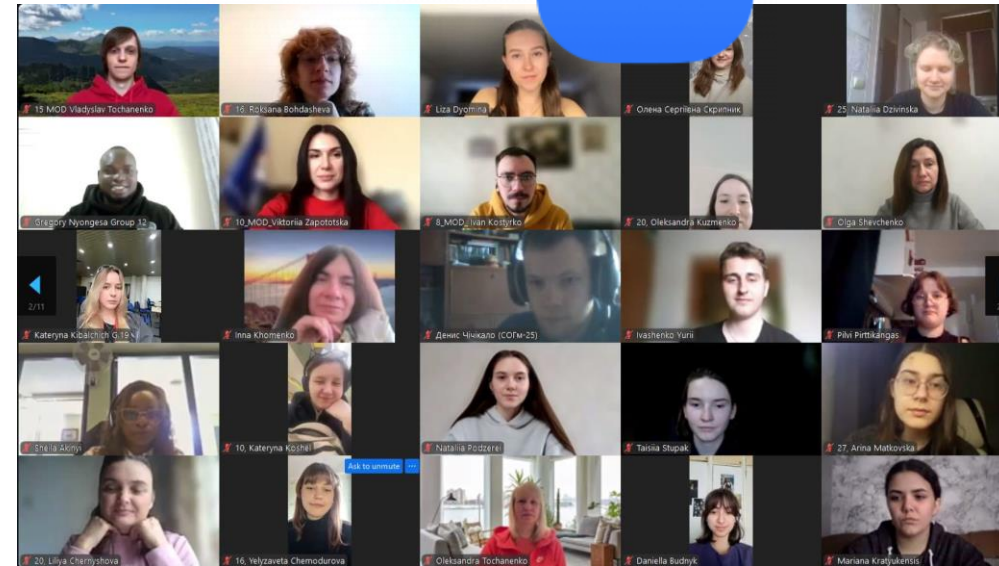
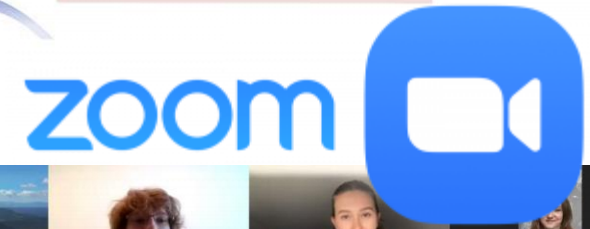
- VEG – Virtual Exchange Guidebook
- CLG – Climate Literacy Guidebook
- CMC – Climate Messenger Code of Conduct
- Videos+slides of 8 lectures &
- **3 web-based tools for climate-related data analysis**
- Group Exercise "Climate Horizon" & linking to SDGs
- Questionnaires



# CLUVEX: VE Weeks for Students

## Main Activity

- 5 VE Calls & organize interactive online trainings called “VE Weeks-for-students” (1 ECTS credit point) in Oct 2024, May 2025, Oct 2025, Feb 2026, Apr 2026
- VE Weeks online in Zoom with plenary sessions (lectures, introductory talks and demonstration of web-based tools for visualization, analysis and interpretation of climate related data) + work in small groups of students discussing specific topics of climate change, working/practicing with tools and working with Individual and Collaborative “Climate Horizon” exercises.
- Small groups in Zoom break-out-rooms are guided by educated CLUVEX moderators & questions/help on tools in the room “HelpDesk”



# VE Week for Students – Programme / Tools

## Programme of the Virtual Exchange Week

All times are given in EET (i.e., in Finnish time)

### ❖ 1<sup>st</sup> Day: 20 April 2026 (14:00 – 17:00, 3h online)

**14:00** – Welcoming words from the Hosts

Introduction into CLUVEX project & Virtual Exchange (*Hanna K. Lappalainen, UH*)

L8: Towards Sustainable Future Utopia (*Antti Rajala, UH*)

L5: Impacts of Climate Change and Future Outlook (*Hasmik Movsesyan, YSU*)

L2: Climate Change, Disasters, Carbon Neutrality and UN SDGs (*Alexander Baklanov, UCPH*)

L7: Artistic Res. & Critical Thinking at Intersection of Art, Science & Society (*Yvonne Billimore, BioArt*)

Introduction into Climate Horizon exercise (*Julia Karhumaa, Laura Riuttanen, UH*)

**15:45** – Breaking students into groups & Introduction round in groups & pre-task sharing (**1+ hour**)

**17:00** – End of the day

### ❖ 2<sup>nd</sup> Day: 21 April 2026 (14:00 – 17:00, 3h online)

**14:00** – L1: Navigating Planetary Boundaries: Blueprint for Sustainable Future (*Inna Khomenko, ONU*)

L3: Climate Change Impact on Water Resources (*Sergiy Snizhko & Olga Shevchenko, TSNUK*)

L4: Nature Hazards – Floods (*Valeriya Ovcharuk, ONU*)

Tool for Environment and Data Visualization | Past & Present | (*Alexander Mahura, UH*)

Detailed Introduction into Climate Horizon exercise (*Julia Karhumaa, Laura Riuttanen, UH*)

**15:30** – Breaking into same groups & working with tool and individual Climate Horizon (**1.5 hour**)

**17:00** – End of the day

### ❖ 3<sup>rd</sup> Day: 22 April 2026 (14:00 – 17:00, 3h online)

**14:00** – L6: Climate Change: Mitigation and Adaptation Strategies (*Hasmik Movsesyan, YSU*)

Tool for Socio-Economic Drivers of Climate Change | Past & Future | (*Stefan Fronzek, SYKE*)

Detailed Introduction into Climate Horizon exercise (*Julia Karhumaa, Laura Riuttanen, UH*)

**14:30** – Breaking into same small groups & working with tool and individual Climate Horizon (**2.5 hour**)

**17:00** – End of the day

### ❖ 4<sup>th</sup> Day: 23 April 2026 (14:00 – 17:00, 3h online)

**14:00** – Tool for Climate Scenarios | Future | (*Risto Makkonen, FMI/UH*)

Detailed Introduction into Climate Horizon exercise (*Julia Karhumaa, Laura Riuttanen, UH*)

**14:30** – Breaking into same groups & working with tool and individual Climate Horizon & discussing and drafting collaborative Climate Horizon (**2.5 hour**)

**17:00** – End of the day

### ❖ 5<sup>th</sup> Day: 24 April 2026 (14:00 – 17:00, 3h online)

**14:00** – Breaking into same small groups & working/ finalizing collaborative Climate Horizon (**2 hour**)

**16:00** – Summary by Hosts, demonstration for all groups the collaborative Climate Horizon exercises

Questionnaire with feedback about VE Week

Reminders about Climate University online courses & reports in DigiCampus & ECTS credits

Wrap up & closing the VE Week

**17:00** – End of the day | End of the Virtual Exchange Week for students



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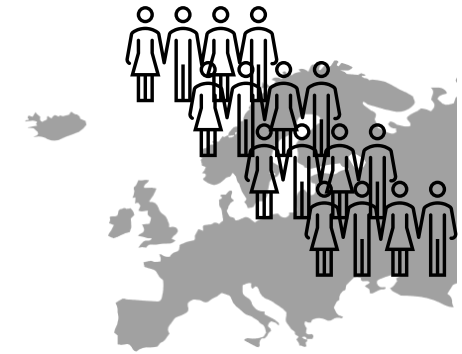
# Virtual Exchange Call for Students

Up to 450 students



## Virtual Exchange Week

Up to 450 students + up to 50 moderators + tech. support staff



*students*

*Plenary session*

**Monday**

*students*

*Plenary session*

**Tuesday**

Introducing tool new tool

*work in groups  
(1 moderator  
& 10 students)  
on e-platform  
on groups' projects*

**Wednesday**

Introducing tool new tool

*work in groups  
(1 moderator  
& 10 students)  
on e-platform  
on groups' projects*

**Thursday**

Introducing tool new tool

*Group's projects/ presentations & discussions*

**Friday**

*Group's projects/ presentations & discussions*

# VE Week – Web-based Tools

User-friendly tools to examine regions from local to global scales

## Tue, Tool #1 | Past & Present | Environment and Data Visualization

*Lecturer: Alexander Mahura, University of Helsinki, Finland*

ERA-5 Past Climate Explorer (PCE) tool: <https://era5.lobelia.earth>

- *Questions for environment/ climate conditions/ society/ pollution ...*



## Wed, Tool #2 | Past & Future | Socio-Economic Drivers of Climate Change

*Lecturer: Stefan Fronzek, Finnish Environment Institute, Finland*

Shared Socioeconomic Pathways (SSP) Database: <https://tntcat.iiasa.ac.at/SspDb>

Historic Time-Series of Socio-Economic Indicators: <https://data.worldbank.org/indicator>

- *Questions for historical/ political/ social/ natural causes that lead into current situation ...*

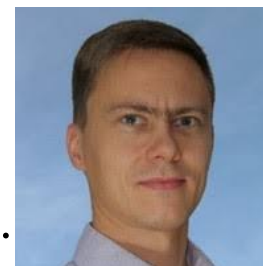


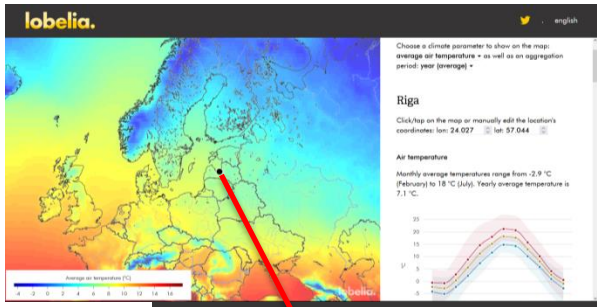
## Thu, Tool #3 | Future | Climate Scenarios

*Lecturer: Risto Makkonen, Finnish Meteorological Institute, Finland*

IPCC Interactive Atlas: <https://interactive-atlas.ipcc.ch>

- *Questions for historical/ political/ social/ natural causes that lead into current situation ...*





# Tool #1 | Past & Present | ERA5 PCE

english

## Past Climate Explorer

Source: ERA5 dataset, 1981-2010

Choose a climate parameter to show on the map:  
**average air temperature** as well as an aggregation  
 period: **January**

**Riga**

Click/tap on the map or manually edit the location's  
 coordinates: lon: 24.027 lat: 57.044

**Air temperature**

Monthly average temperatures range from -2.9 °C  
 (February) to 18 °C (July). Yearly average temperature is  
 7.1 °C.

english

## Past Climate Explorer

Source: ERA5 dataset, 1981-2010

Choose a climate parameter to show on the map:  
**average air temperature** as well as an aggregation

- Average air temperature
- Maximum air temperature
- Minimum air temperature
- Frost days
- Warm nights
- Precipitation
- Rainy days (≥ 0.5 mm)
- Heavy rainy days (≥ 10 mm)
- Very heavy rainy days (≥ 20 mm)
- Relative humidity
- Average wind speed
- Wind gusts
- Cloud cover

english

## Past Climate Explorer

Source: ERA5 dataset, 1981-2010

Choose a climate parameter to show on the map:  
**average air temperature** as well as an aggregation  
 period: **January**

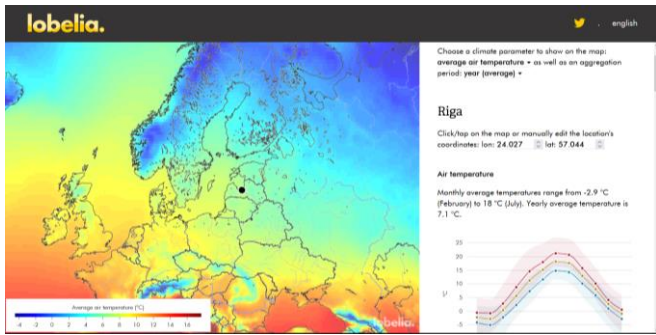
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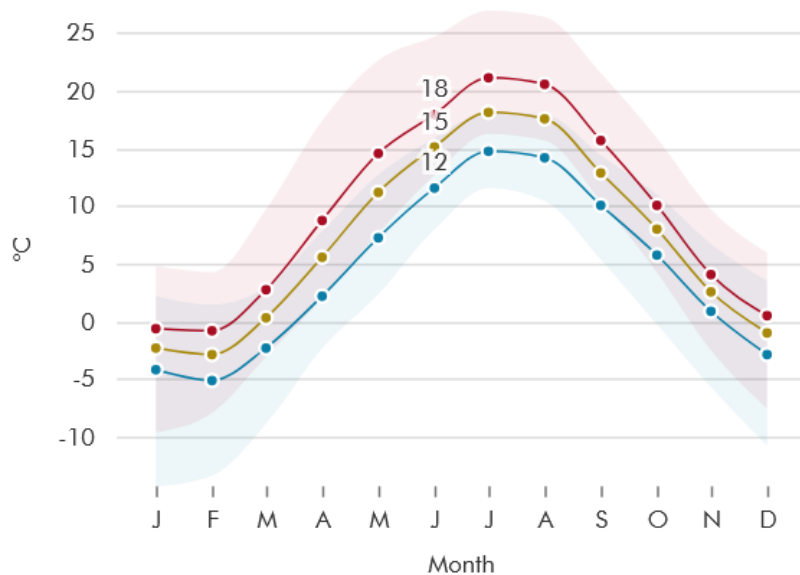
- year (average)
- January
- February
- March
- April
- May
- June
- July
- August
- September
- October
- November
- December



# Tool #1 | Application | Riga

## Air temperature & Warming stripes

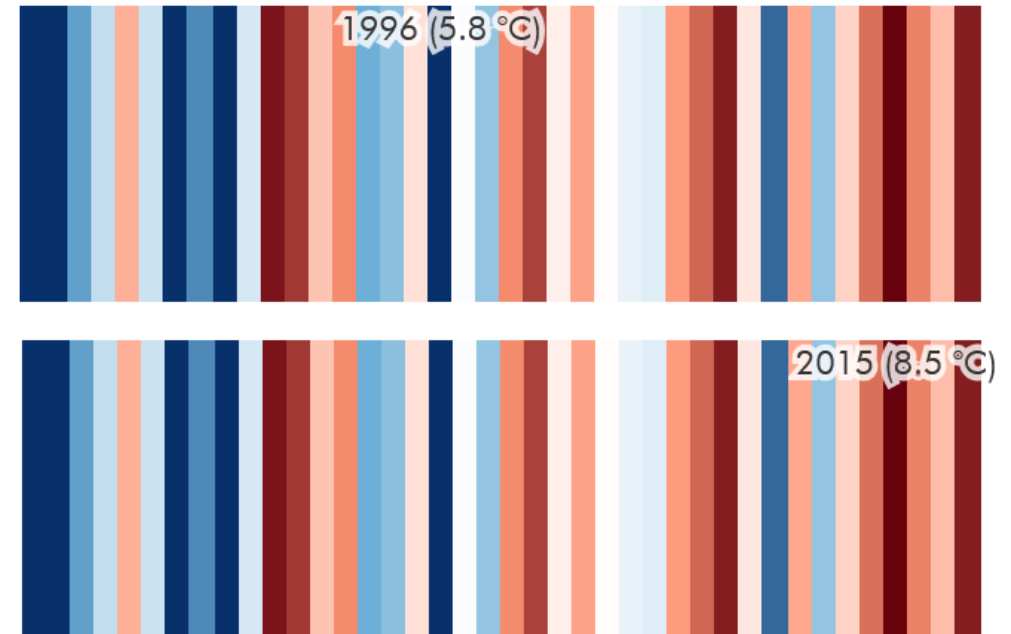
Monthly average temperatures range from -2.9 °C (February) to 18 °C (July). Yearly average temperature is 7.1 °C.



- Monthly average of daily maximum
- Monthly min/max of daily maximum
- Monthly average of daily average
- Monthly average of daily minimum
- Monthly min/max of daily minimum

**Warming stripes** (sometimes referred to as **climate stripes**, **climate timelines**) are data visualization graphics that use a series of coloured stripes chronologically ordered to visually portray long-term temperature trends

Warming stripes for the extended period 1979-2018 (what's this?):



*progression from blue (cooler) to red (warmer) stripes portrays annual increases of global average temperature intuitively convey global warming trends to non-scientists.*



# Tool #2 | Past & Future | Socio-Economic Drivers of Climate Change

<https://tntcat.iiasa.ac.at/SspDb>

**New release (V 2.0) SSP Database (Shared Socioeconomic Pathways) - Version 2.0**

**NEW RELEASE, (Version 2.0, December 2018):** The new release includes four important updates and extensions of the SSP IAM scenarios:

1. extended reporting of existing SSP scenarios, covering additional new variables,
2. a set of new
3. some scenari
4. the projection projections w

Select region(s), scenario(s), and variable to define your query

(1.) Regions: World, 5 Regions, OECD, Reforming Economies, Asia, Middle East and Africa, Latin America, 32 Regions, Urban, Countries

(2.) Model/Scenarios: Basic Elements, POP, IASIA-WIC Population, SSP1, SSP2, SSP3, SSP4, SSP5, NCAR Urbanization, GDP, OECD GDP, IASIA GDP, PIK GDP, History, World Bank (WDI), WPP2010, WUP2009

(3.) Variable: data, data

Query Results - Chart Preview:

For a citation of th  
Changes since Rel

IAM Model  
AIM  
IMAGE

**Introduction**  
The SSP database at  
Information about th  
matrix that combine  
describe situations in  
The SSP quantificati  
The narrative  
of SSP elements. A r

© IIASA Energy Program 2012 - 2018

Output Options:  
Microsoft Excel, Portable Network Graphics, Scalable Vector Graphics

Select region(s), scenario(s), and variable to define your query

(1.) Regions: World, 5 Regions, OECD, Reforming Economies, Asia, Middle East and Africa, Latin America

(2.) Model/Scenarios: MARKER, SSP1 (IMAGE), Baseline, 4.5, 3.4, 2.6, 1.9, SSP2 (MESSAGE-GLOBIOM), Baseline, 6.0, 4.5, 3.4, 2.6, 1.9, SSP3 (AIM/CGE), Baseline, 6.0, 4.5, 3.4, SSP4 (GCAM4), Baseline, 6.0, 4.5

(3.) Variable: data, data

Query Results - Chart Preview:

For a citation of th  
Changes since Rel

IAM Model  
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**Introduction**  
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of SSP elements. A r

© IIASA Energy Program 2012 - 2018

Output Options:  
Microsoft Excel, Portable Network Graphics, Scalable Vector Graphics

# Tool #2 | Shared Socioeconomic Pathways

## Basic Elements

## IAM Scenarios

The screenshot displays the SSP Public Database interface, version 2.0. The top navigation bar includes 'About', 'Welcome', 'Basic Elements', 'IAM Scenarios', 'CMIP6 Emissions', 'Download', and 'Citation'. The main interface is divided into several sections:

- (1.) Regions:** A tree view showing 'World' and '5 Regions' (OECD, Reforming Economies, Asia, Middle East and Africa, Latin America).
- (2.) Model/Scenarios:** A tree view showing 'MARKER' and 'SSP1 (IMAGE)', 'SSP2 (MESSAGE-GLOBIOM)', 'SSP3 (AIM/CGE)', and 'SSP4 (GCAM4)'. Each scenario has sub-options for 'Baseline' and '4.5'.
- (3.) Variable:** A dropdown menu set to 'data', with a tree view showing 'GDP', 'PPP', 'Population', 'Total', 'Male', 'Female', and 'Urban'.
- Query Results - Chart Preview:** Two line charts are shown. The first is 'Population' (y-axis 0-14000, x-axis 1950-2100) and the second is 'Primary Energy/Wind' (y-axis 0-100 EJ/yr, x-axis 2000-2100). Both charts show multiple lines representing different scenarios, with a red circle highlighting the data series.
- Query Results - Table:** A table with columns for Region, Model - Scenario, Variable, Unit, and years from 2005 to 2100. The table contains data for various scenarios and variables.

At the bottom, there are 'Output Options' for Microsoft Excel, Portable Network Graphics, and Scalable Vector Graphics. The footer includes '© IIASA Enerov Program 2012 - 2018' and 'current user: guest | logout'.

Source: <https://tntcat.iiasa.ac.at/SspDb>

# Tool #3 | Future | IPCC Interactive Atlas



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

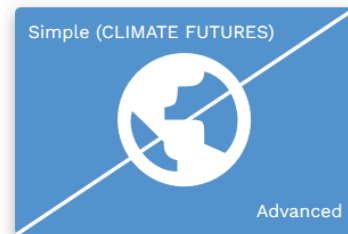
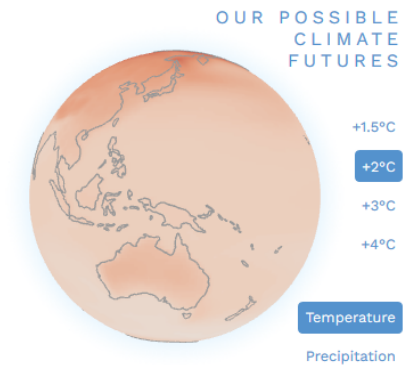
IPCC Working Group I (WGI): Sixth Assessment Report

## IPCC WGI Interactive Atlas

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).

[Participate in the user testing survey](#)

[Errata and problem reporting](#)



REGIONAL INFORMATION



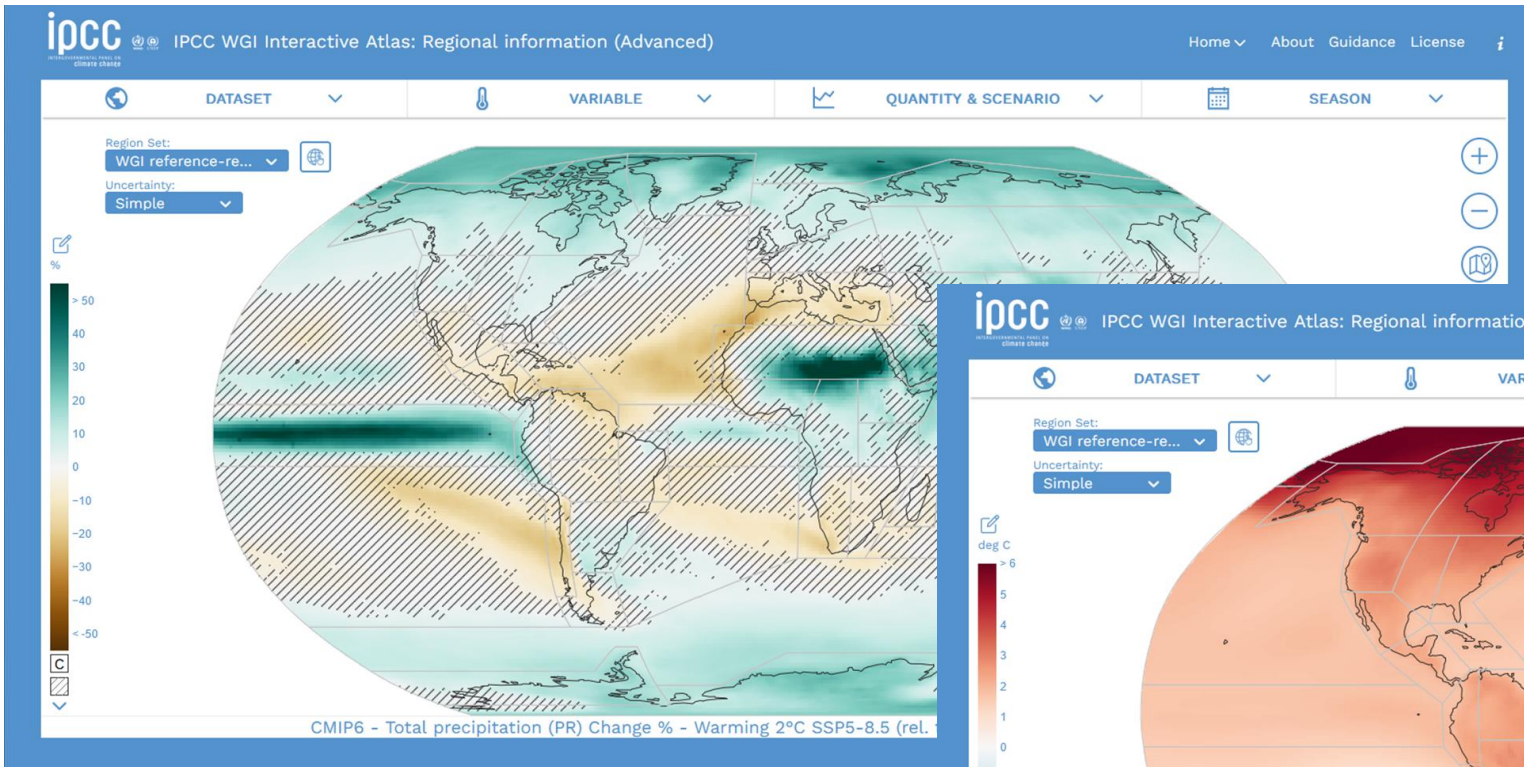
REGIONAL SYNTHESIS



DOCUMENTATION

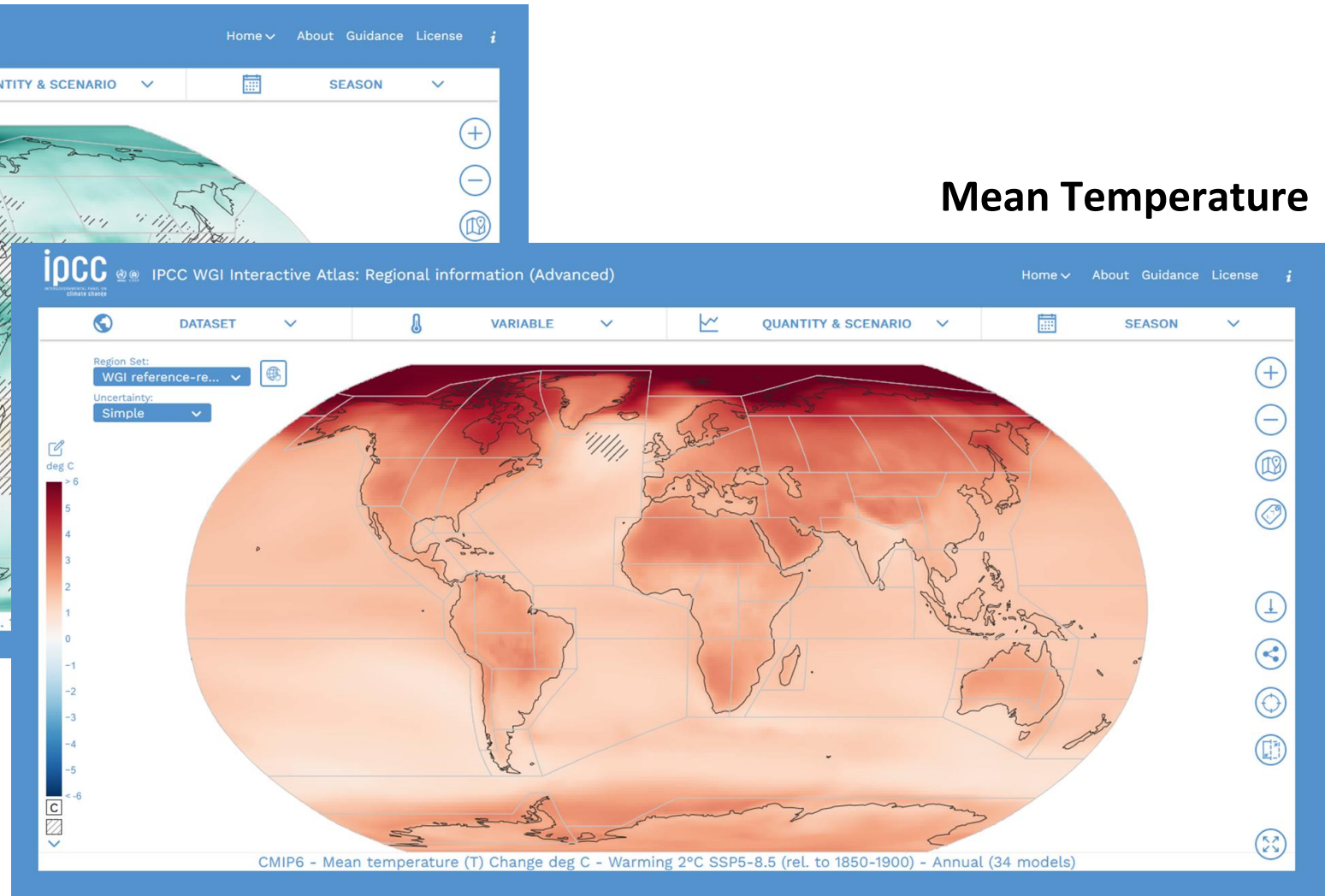


# Tool #3 | Future | IPCC Interactive Atlas



**Total Precipitation**

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



**Mean Temperature**



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# After Introducing the Tool:



**Individual work & group work/ discussions, some guiding questions (examples for ERA5 PCE tool):**

- What are the mean air temperature, precipitation, etc. in your own city/environment?
  - Changes in temperature (see warming stripes) in your city?
  - How do you observe climate change in your location?
  - How do you think climate change will affect your location?
- &**
- What do you dream about in life, in general?
  - How would you like to see your life in 2050?
  - Find similarities or differences between your and others' dreams

**Other examples of questions are given in the booklet/ instructions for the Climate Horizon exercises**

# Extras to Visualize, Analyze and Interpret Climate Data



- **Climate Explorer** - tool to investigate the climate related data:  
<https://climexp.knmi.nl/start.cgi> & [https://climexp.knmi.nl/plot\\_atlas\\_form.py](https://climexp.knmi.nl/plot_atlas_form.py))
- **CDO** (Climate Data Operators) - tool set for working on climate and NWP model data:  
<https://code.mpimet.mpg.de/projects/cdo>
- **IDV** (Integrated Data Viewer) - 3D geoscience visualization and analysis tool:  
<https://www.unidata.ucar.edu/software/idv>
- **Metview** – application incl. powerful data access, processing, visualization:  
<https://confluence.ecmwf.int/display/METV>
- **Visualization with Python:**  
<https://matplotlib.org> & [matplotlib.org/stable/gallery/index.html](https://matplotlib.org/stable/gallery/index.html)



Webpage source: **Climate Explorer at KNMI/ WMO**

Help us improve the Climate Explorer by filling out this survey. Thank you!

Home — Starting point

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 CMIP scenario runs
- > CMIP3+ scenarios
- > CMIP5 scenarios
- > CMIP5 EUI44 CORDEX scenarios
- > CMIP6 scenarios
- > KNMI2023 NL Scenarios
- > Annual CMIP5 extremes
- > Attribution runs
- > View, upload your field

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's (Select a time series or Select a field). After you have selected the climate data 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 yr 2023 (source: GPCP, More under "World weather")

News

Plot source: *Metview at ECWMF*

```

11 import metview as mv
12
13 # read grib forecasts fields
14 g = mv.read("joachim_surf.grib")
15
16 # define isoline shading for windgust
17 wgust_shade = mv.mcontour(
18     legend
19     contour
20     contour_level_selection_type
21     contour_level_list
22     contour_label
    
```

Plot source: *IDV at UniData*

Unidata IDV - Map View - One Pane

File Edit Displays Data Tools Help — Main Menu Bar

1998-06-29 12:00:00Z

View Projections Main Toolbar

Viewpoint Toolbar

Navigation Toolbar

Viewpoint Undo/Redo

Display List

Time Animation Widget

Clipping Box

Side Legend

Cursor Readout

18:28:39 GMT Latitude: 65.4 Longitude: -17.0 Altitude: 9152.5 m

# CLUVEX Lessons Learnt

Importance of online work and be a part of international teams and **manage work with tools through processing of climate-related data by contributing** to elaborating individual and collaborative Climate Horizon exercises

**On a poll question “*What has been the most rewarding part of CLUVEX VE Week?*”** participants chose (single choice): ... option “**working with different tools**” ...

Oct 2024 – **28%**; May 2025 – **22%**, Oct 2025 – **16%**, Feb 2026 – **14%**, Apr 2026 – **15%**

**On an extra poll “*How easy it was to understand, practice and use the demonstrated web-based tools in the Climate Horizon exercise*”**

The scale included options (1-5): not at all | slightly | somewhat/to some extent | mostly agree | fully agree. Majority participants “mostly” & “fully” agreed that it was easy to understand, practice and use the tools.

<b>VE Week</b>	<b>ERA-5 PCE,</b>	<b>SPPs,</b>	<b>IPCC Atlas</b>
Apr 2026 –	77	78	77%
Feb 2026 –	74	57	79%
Oct 2025 –	75	59	75%

# CLUVEX Lessons Learnt

## *(1) Introduction to the tools used in VE Weeks*

*It was noted that not all were practiced enough, leaving both moderators and students less confident in usage of tools.*

To address this issue, **more time** including **self-education** was devoted to **practice-practice-practice** with web-based tools for climate-related data visualisation, analysis, and interpretation (slides and demonstrations /video-recording/ of tools - available in the DigiCampus areas for moderators and students)

& **HelpDesk** break-out-room in Zoom was used **in case of questions for tools** (& join break-out-rooms of groups)

## *(2) Force-majour situation with the tool*

*It was noted by moderators before the 1<sup>st</sup> VE Week (Oct 2024) that the web-based tool (ERA-5 Explorer, hosted by ECWMF) was disconnected from the public service by end of Sep 2024.*

To address this issue, **finding suitable replacement** (e.g., ERA-5 PCE) **with free/open public access** instead of previously used tool and redoing presentation and demonstration /video-recording/ was implemented (slides and demonstration /video-recording/ of new tool - available in the DigiCampus areas for moderators and students)

## *(3) Because all tools are web-based, stable internet connection is required (situation in Ukraine)*

*(4) If the tool presenter is not available in some VE Weeks, prepared in advance video-recording can be played online*

# VE Week – Earned Bonuses for Students



## Students awarded the following:

- **1 ECTS credit by University of Helsinki**
- **CLUVEX Certificate**
- **Status of Climate Messenger**
- **Welcome to Climate University Online Courses**



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**Thank you!**



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