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Danube-ADAPT

Enhancing Climate Data Cooperation for Evidence-based Adaptation Policy Making in the Danube Region

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15th EUMETNET Data Management Workshop “Shaping Climate services for the future”

METNO, Oslo and online, 4-6 November 2025

Background, reasoning

Exposure of the Danube Region to CC impacts

- The region
  - heavily exposed to CC
  - integrates several vulnerable region types
  - and sectors
  - Either in the majority of countries or in cross border regions

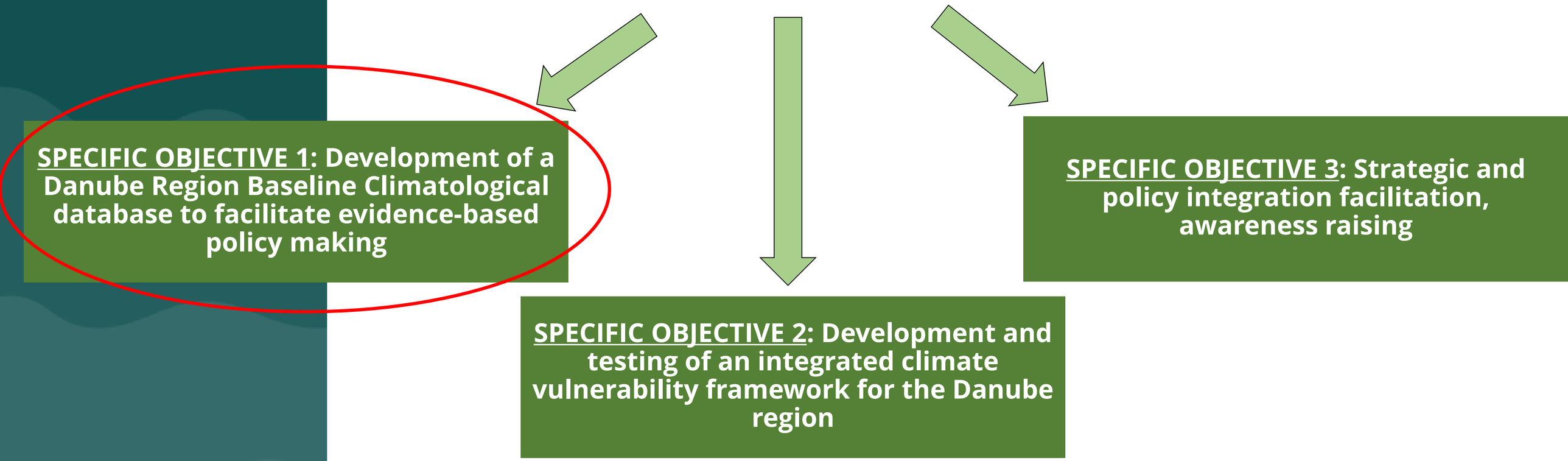
Necessity to cooperate

- Geography
- Historical background / national borders
- Common challenges need cooperative responses
- Adaptation is weakly integrated into sectoral planning

Overall aim: improving adaptive capacity of the region through evidence-based planning, CVA methodology development and facilitating policy integration

Danube-ADAPT INTERREG project
April 2025- March 2028

3 SPECIFIC OBJECTIVES with several activities and sub-activities



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Partnership

17 partners
7 ASP's

Czech Smart City Cluster
CzechGlobe

HungaroMet
Research Institute of National Strategy
Pannon University

Ukrainian Hydrometeorological Institute

Slovak Hydrometeorological Institute
Agency for the Support of Regional Development Košice

Deutscher Wetterdienst

GeoSphere Austria

Slovenian Environment Agency
ZRS BISTRA PTUJ
Municipality of Domzale

Regional Energy and Climate Agency of Northwestern Croatia
Šibenik-Knin County

National Meteorological Administration
Babes-Bolyai University
Municipality of Cluj-Napoca
Partium Christian University

CESCI Balkans
Provincial secretariat for urbanism and environmental protection (EKOVOJVODINA)
Development Fund of the Autonomous Province of Vojvodine, Department for the Management of financing for climate sustainable projects

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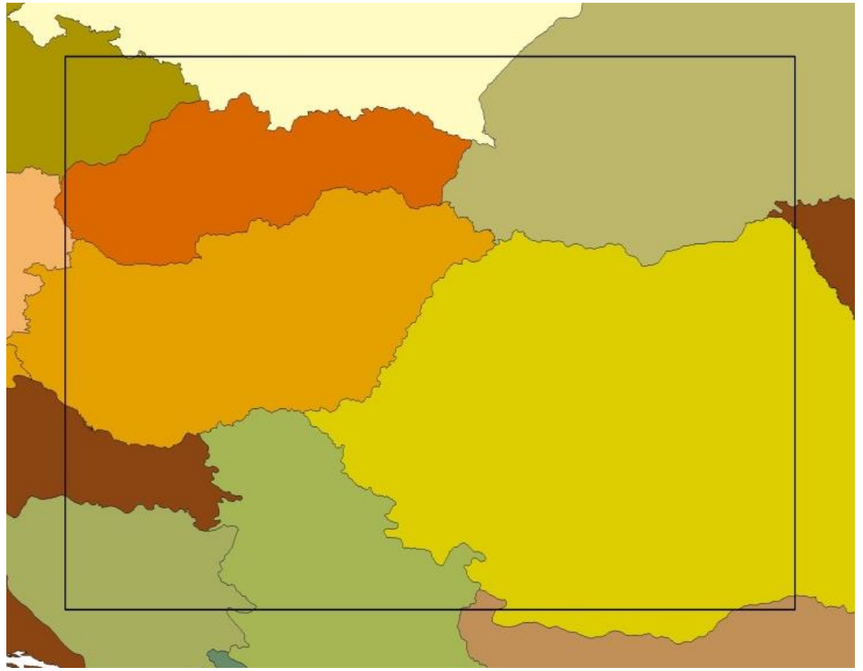
Existing experience to build on - CarpatClim project



JRC support, duration 2010-2013

Commonly used methods: MASH (Szentimrey) - MISH (Szentimrey, Bihari)

Consortium leader: OMSZ, 9 countries

Results: 13 basic meteorological variables, and 37 climate indicators

daily, 0.1 degree resolution,

1961-2010

public dataset

DanubeClim- Western Balkan region

Variable	Description	units
Ta	2 m mean daily air temperature	°C
Tmin	Minimum air temperature	°C
Tmax	Maximum air temperature	°C
p	Accumulated total precipitation	mm
DD	10 m wind direction, Degrees	0-360
VV	10 m horizontal wind speed	m/s
Sunshine	Sunshine duration	hours
cc	Cloud cover	tenths
Rglobal	Global radiation	J/cm^2
RH	Relative humidity	%
pvapour	Surface vapour pressure	hPa
pair	Surface air pressure	hPa
Snow depth	Snow depth (ZAMG model)	cm

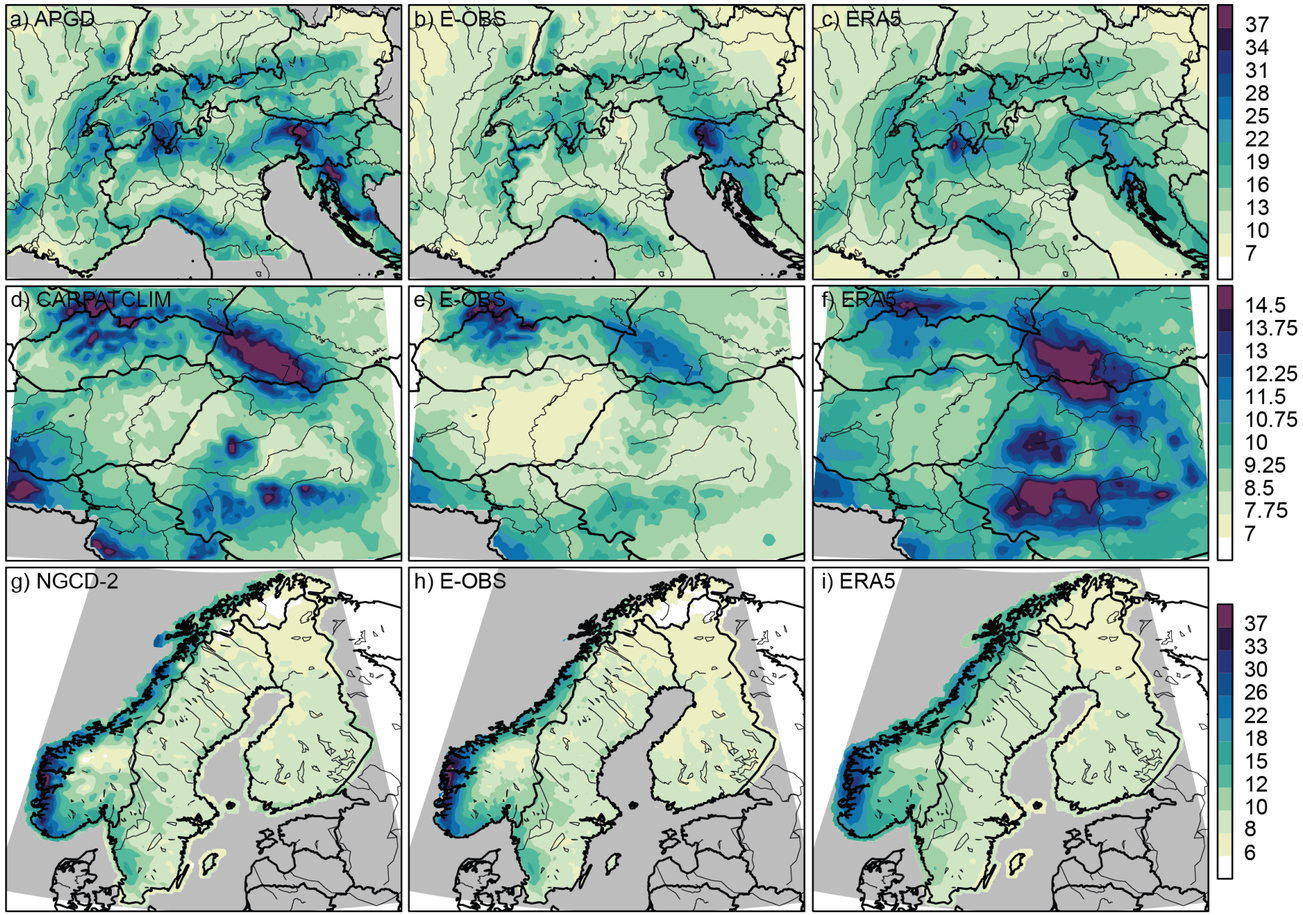
Copernicus Climate Change Service, under grant agreement C3S_D311a_Lot4. 2016–2021

Comparison of datasets

Upper row: for the period 1979-2008 in the **Alpine region** a) APGD, b) E-OBS and c) ERA5.

Middle row: for the period 1979-2010 in the **Carpathian region** d) CARPATCLIM, e) E-OBS and f) ERA5.
Lower row: for the period 1979-2018 in **Fennoscandia** g) NGCD-2, h) E-OBS and i) ERA5.

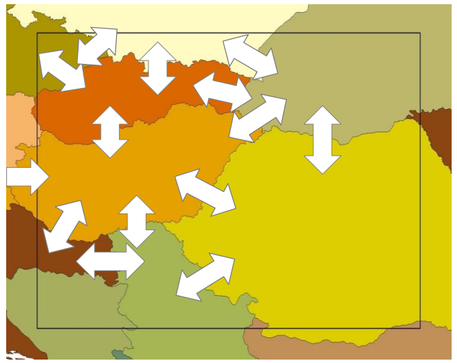
95% quantile of daily precipitation in (mm per day).



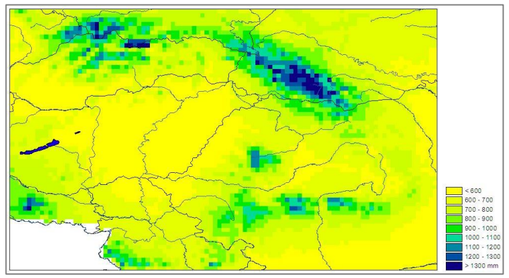
Bandhauer, M., Isotta, F., Lakatos, M., Lussana, C., Båserud, L., Izsák, B., Szentes, O., Tveito, O. E., & Frei, C. (2022). Evaluation of daily precipitation analyses in E-OBS (v19.0e) and ERA5 by comparison to regional high-resolution datasets in European regions. International Journal of Climatology, 42(2), 727–747. https://doi.org/10.1002/joc.7269

Methodology applied in the Danube-Adapt project: homogenization, harmonization, gridding

- **MASHv3.03: bilateral data exchange before and after homogenization to guarantee the harmonization**



- **MISHv1.03: the gridded daily time series**



Methods to download:
https://www.met.hu/en/rolunk/rendezvenyek/homogenization_and_interpolation/software/

Szentimrey, T.: Software MASH (Multiple Analysis of Series for Homogenization), MASH v4.01, MASH v3.03
Szentimrey, T.: Software MISH (Meteorological Interpolation based on Surface Homogenized Data Basis), MISH v1.03

A.1.1 Meteorological elements

Set of variables

Daily data 1970-2024:

- temperature (min, max, mean)
- precipitation
- daily mean relative humidity
- daily mean surface air pressure

Daily data 2000-2024:

- daily mean wind speed, maximum wind gust
- global radiation (sunshine duration)

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Activity 1.1
Building a climate observation database for the Danube Region

Homogenized data series (MASH)

Collection of raw data
Near border data exchange
Quality control, completion of missing data, homogenization (per country)

Subregional gridded data series (MISH)

Modelling of climate statistics parameters
Near border data harmonization
Interpolation for subregion (countries)

Gridded data series for Danube Region-public dataset

Harmonization of subregional gridded data series

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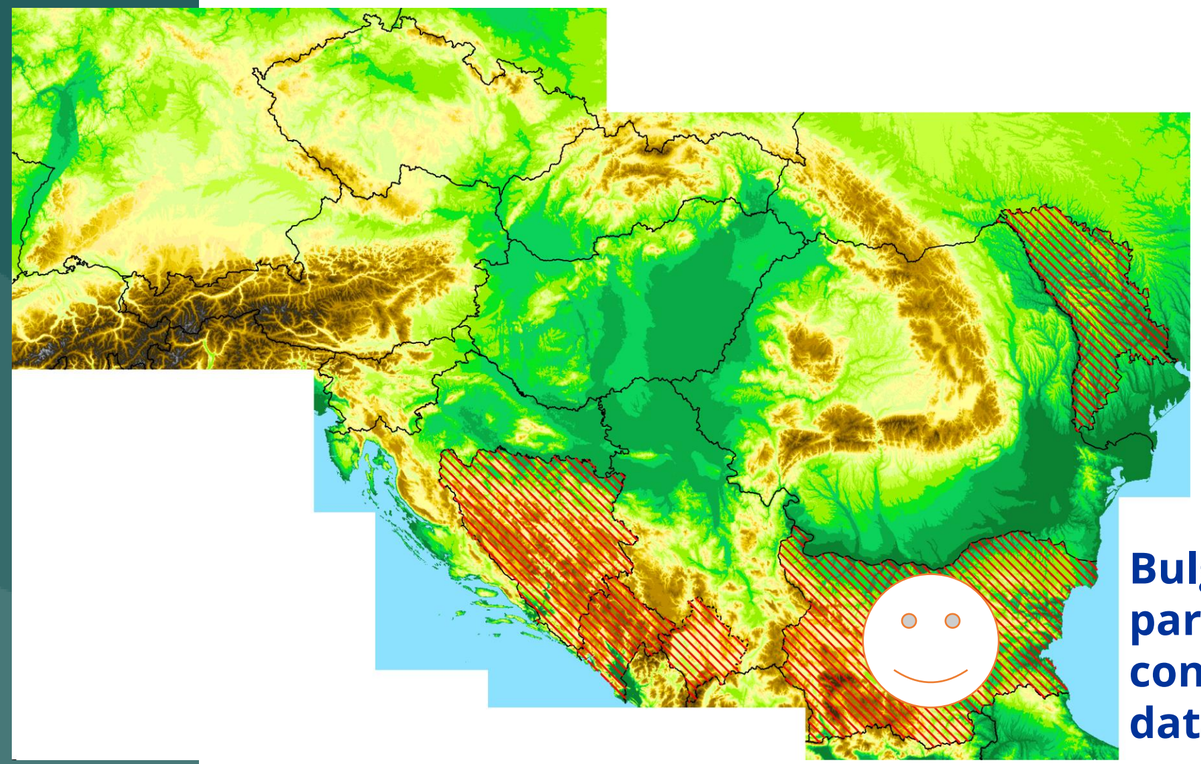
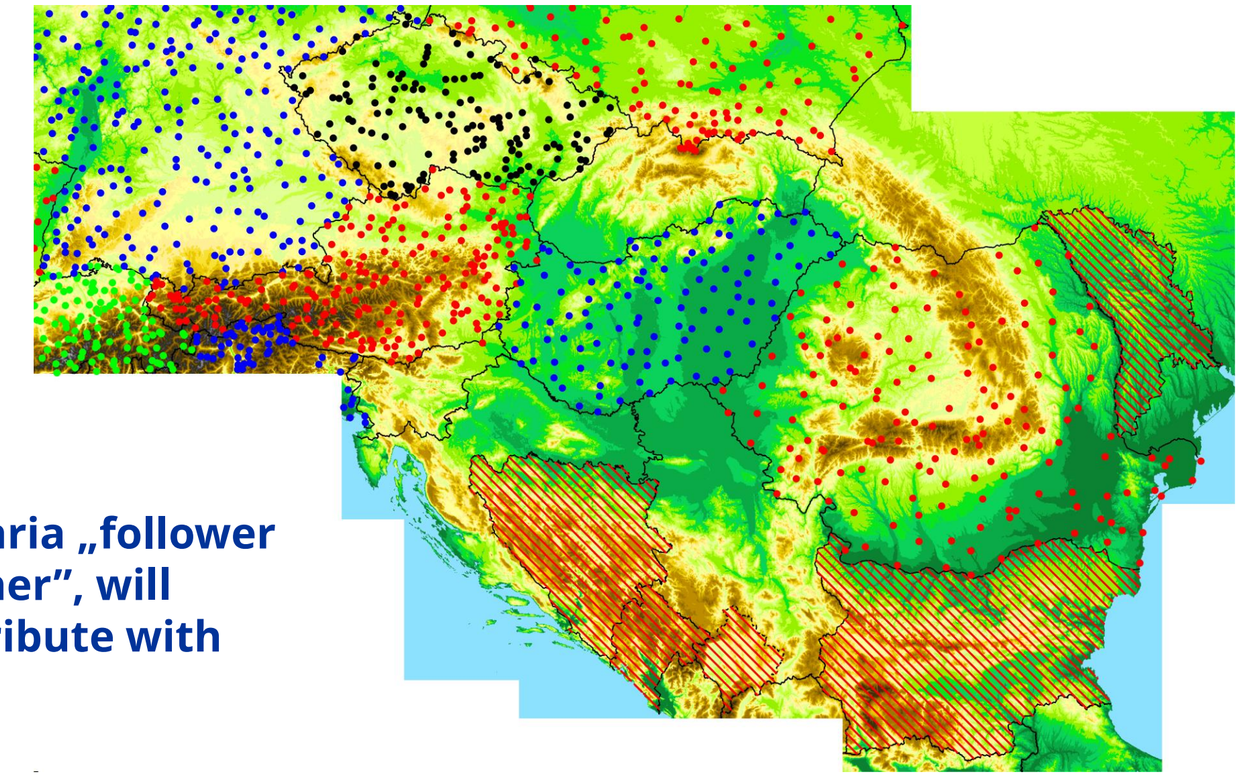
SO1

Metadata collection has started
Station density follows:
- **~50 km representativity for climate variables**
- **~25 km representativity for precipitation**

Both ensuring approximately uniform spatial coverage



Bulgaria „follower partner", will contribute with data



Lessons learned from CarpatClim: diverse national observational practices

- precipitation: 06UTC-06UTC, 18UTC-18UTC, one day shift
- temperature: computation of mean, Tmax and Tmin: which period is refer to)
- global radiation vs. sunshine duration (formula used to calculate?)
- wind: Nb. of obs per day, maximum wind gust

Activity 1.2
Creation of a database of future climate projections for the Danube Region

- **Regional Climate Model data covering the Danube Region:**
  EURO-CORDEX ensemble (CMIP5, EUR-11)
  Reference period: 1971-2000
  Target time windows: 2041-2070, 2071-2100
  Emission scenarios: RCP2.6, RCP4.5, RCP8.5

- **Variables:**
  daily mean, maximum & minimum **temperature**
  daily **precipitation**
  mean sea level **pressure**
  daily mean **wind speed** & maximum **wind gust**
  global radiation
  relative humidity

Climate Vulnerability Assessment

Downloading & preprocessing the historical RCM data

Validation

Historical model data are compared with the observational dataset using a joint methodology

Selecting the final RCM simulation ensemble

Agreement on the selection of model simulations that performed well across the Danube Region

Downloading and analyzing the projection data

Developing the projection database

Thank you

for your kind attention!

The 12th Seminar for Homogenization and Quality Control in Climatological Databases and the 7th Interpolation Conference will be organized in Budapest, at the headquarters of the HungaroMet Hungarian Meteorological Service, and online, in the week of 5 May 2026 together with the Danube-Adapt project Meeting

https://interreg-danube.eu/projects/danube-adapt

https://www.facebook.com/danubeadapt/

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