Digital Climate Atlas for Hungary

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HungaroMet Hungarian Meteorological Service

EMS Annual Meeting

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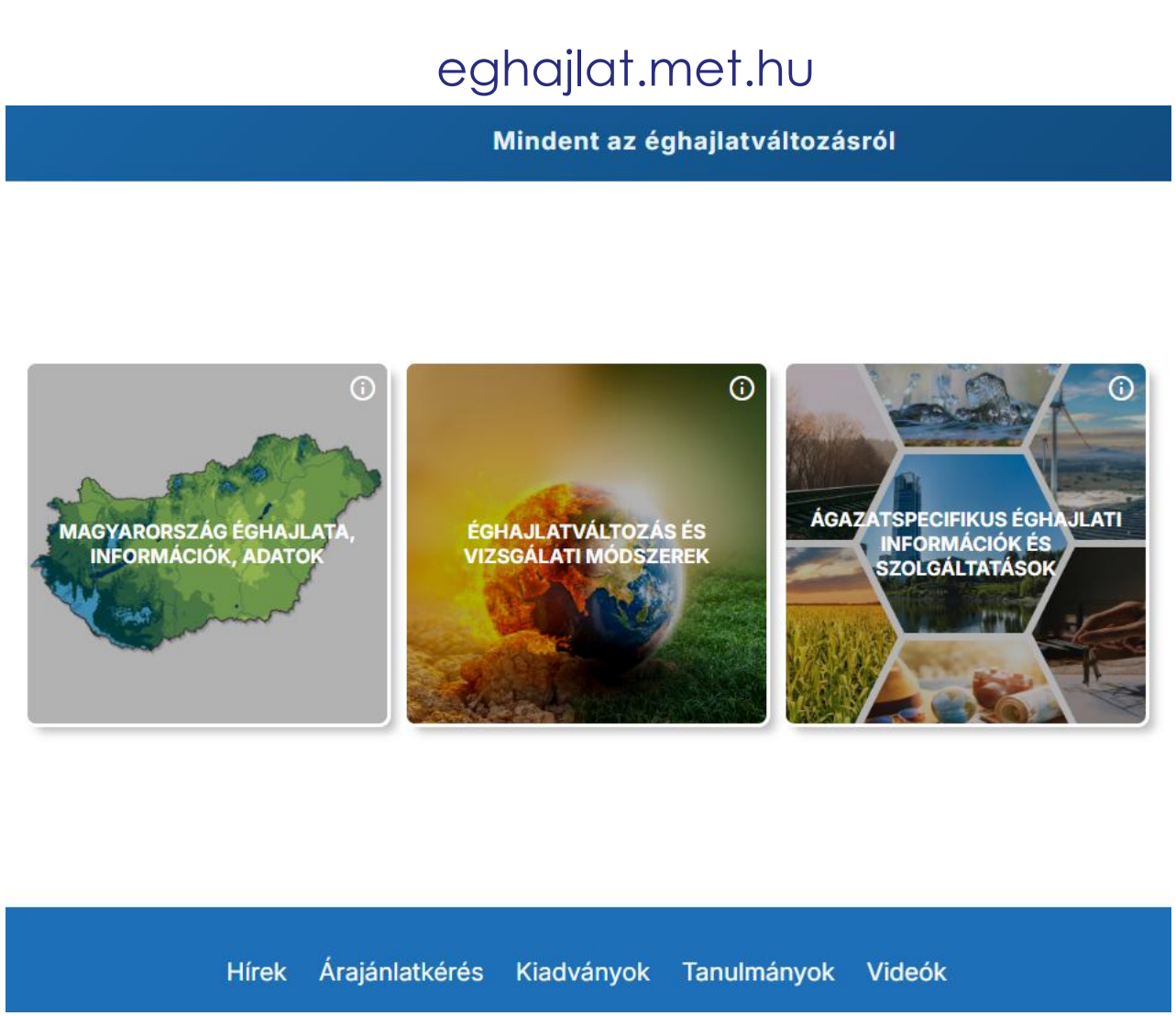
HungaroMet
Hungarian Meteorological Service

HUNGARIAN NATIONAL LABORATORY

Motivation:

- New climate portal at HungaroMet, March 2026
  - Climate of Hungary, climate data
  - Climate change background, methodologies at HungaroMet;
  - Sectoral information;



HungaroMet

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Motivation:

- Climate reports
- Digital Climate Atlas of Hungary
- Pocket Atlas
- **One-stop shop for different climate data base** of HungaroMet
  - Open data portal: ODP
  - Climate indicators (KlIMADAT)
  - National Adaptation Geo-information System (NAGiS)

Climate of Hungary – Information and Data

https://eghajlat.met.hu/magyarorszag-eghajlata-informaciok-adatok/

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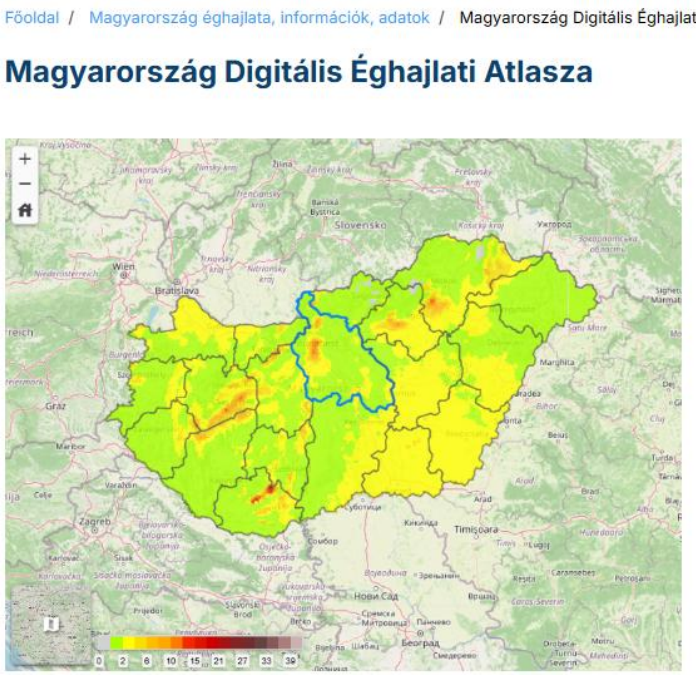
Digital Climate Atlas



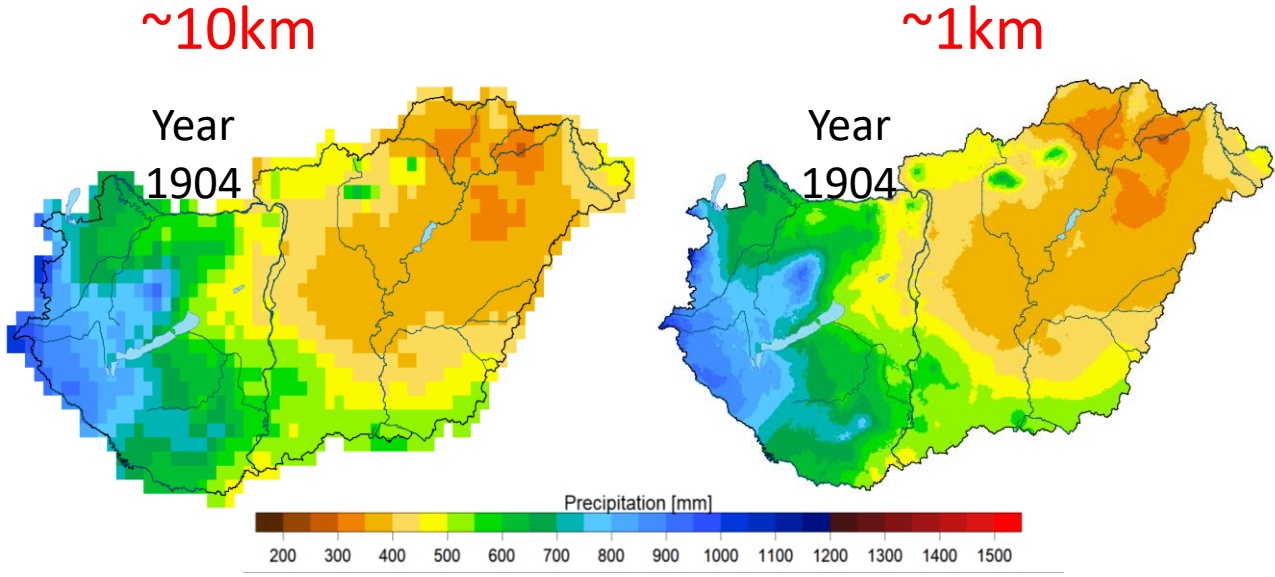
https://eghajlat.met.hu/atlasz/

Observations

Climate Projections

Digital Climate Atlas of Hungary – historical climate data

- Based primarily on the HungaroMet observation network
- Homogenized using MASH
- Gridded using MISH
- Spatial resolution: approximately ~1km (previously ~10km), for soil moisture: ~5 km)
- Sunshine duration: satellite-based EUMETSAT CM SAF data (ICDR/SARAH-2)
- Soil moisture: bucket modell, observation-based estimates for the upper 1 m of soil; plant-available water (%)



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The creation of representative climatological database with MASH and MISH software:

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

MASHv3.03

(Multiple Analysis of Series for Homogenization; *Szentimrey, T.*)

For temporal representativity (homogenization, quality control and missing value completion of station data series)

MISHv1.03

(Meteorological Interpolation based on Surface Homogenized Data Basis; *Szentimrey, T. and Bihari, Z.*)

For spatial representativity (interpolation of homogenized data series)

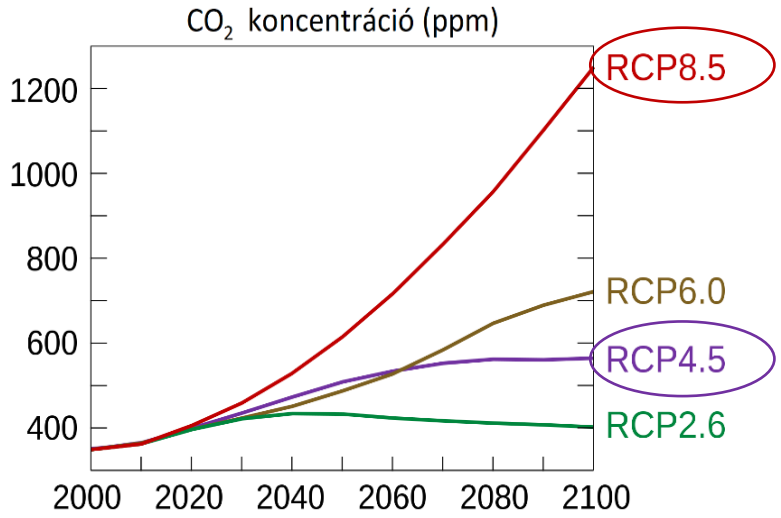
INTERPOLATION SOFTWARE: MISHv1.03

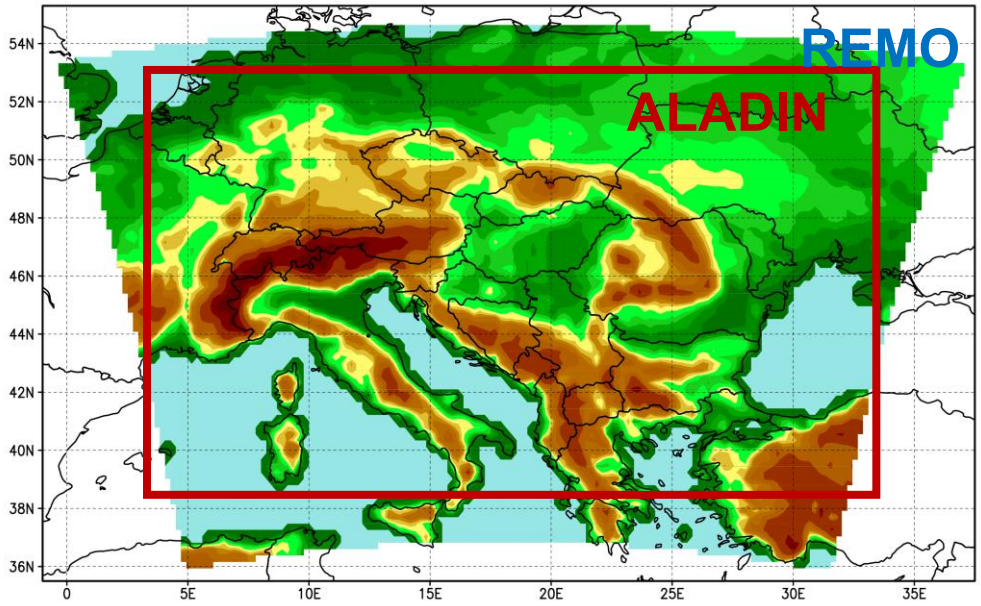
1. **The modeling subsystem for statistical (local and stochastic) climate parameters:**
   - based on long homogenized data series and supplementary deterministic model variables (height, topography, distance from the sea etc.)
   - additive (e.g. temperature) or multiplicative (e.g. precipitation) model
   - the modeling procedure must be executed only once before the interpolation applications
   - high resolution grid (e.g. 0.5'×0.5')

2. **The interpolation subsystem:**
   - Application of the modeled parameters to interpolate of the meteorological elements to any point of the grid
   - Use of background information (e.g. satellite, radar, forecast data)
   - data series gap-filling (missing value interpolation for daily or monthly station data)

Digital Climate Atlas of Hungary – future climate projections

	RCM	Resolution	period	scenario
1.	ALADIN-Climate	10 km	1971–2100	RCP4.5
2.	ALADIN-Climate	10 km	1971–2100	RCP8.5
3.	REMO	10 km	1971–2100	RCP4.5
4.	REMO	10 km	1971–2100	RCP8.5





Projection uncertainty

Models: ALADIN-Climate + REMO

Scenarios: RCP4.5 + RCP8.5

→ 4 model–scenario combinations

→ Uncertainty shown as min–max range

Digital Climate Atlas – Summary of Key Features of the climate data

Observations

- Data series period: temperature, precipitation, radiation, wind, relative humidity, air pressure, 1901–2024;
- for global radiation, wind speed and wind gusts: 2001–2024; for sunshine duration: 1986–2024.
- Map periods: 1961–1990, 1971–2000 and 1991–2020; for global radiation, wind speed, wind gusts and sunshine duration: 2001–2020, soil moisture 1991-2020
- Update: annually

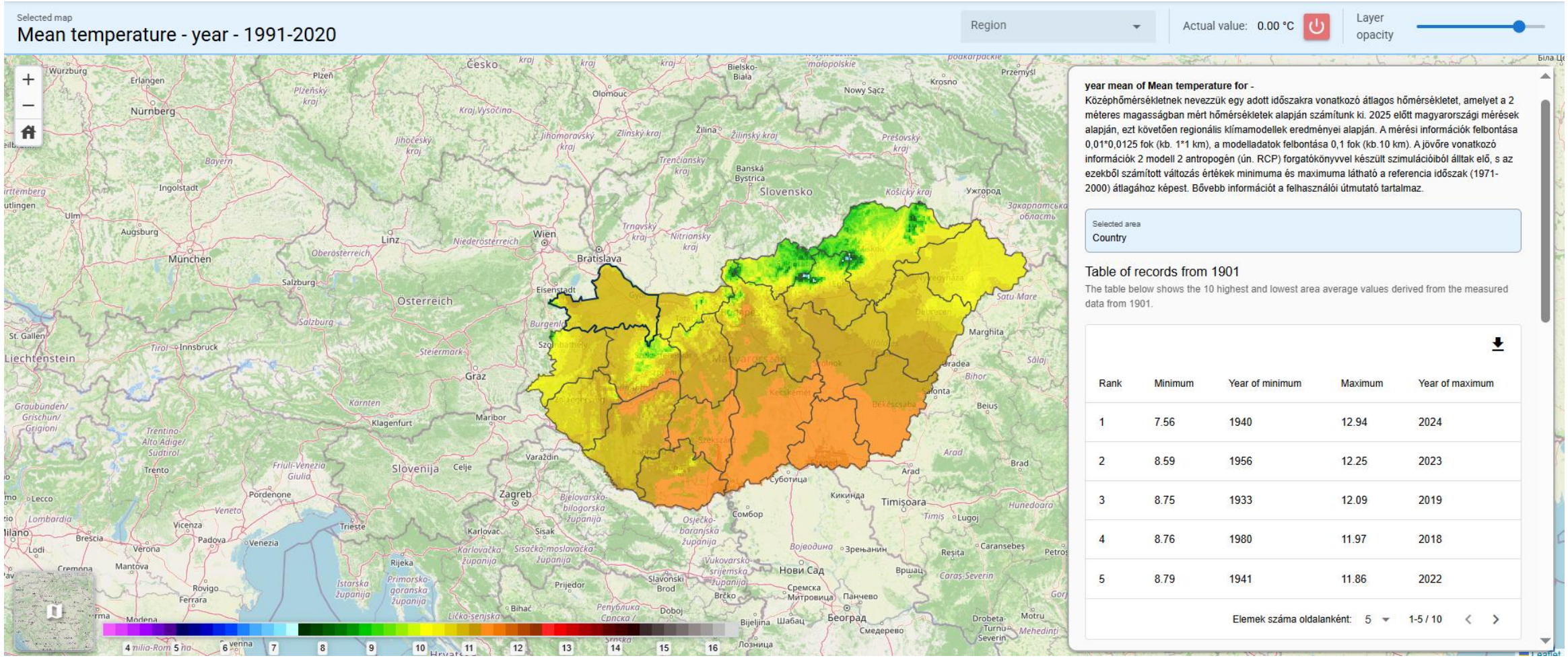
Projections

- Reference: 1971–2000; for global radiation and wind speed: 2001–2020.
- Data series: 30-year moving averages for 2021–2100, shifted annually;
- Graphs: yearly values indicate the last year of each 30-year period
- Map periods: standard climate reference periods 2041–2070 and 2071–2100.
- Update: depending on new research results

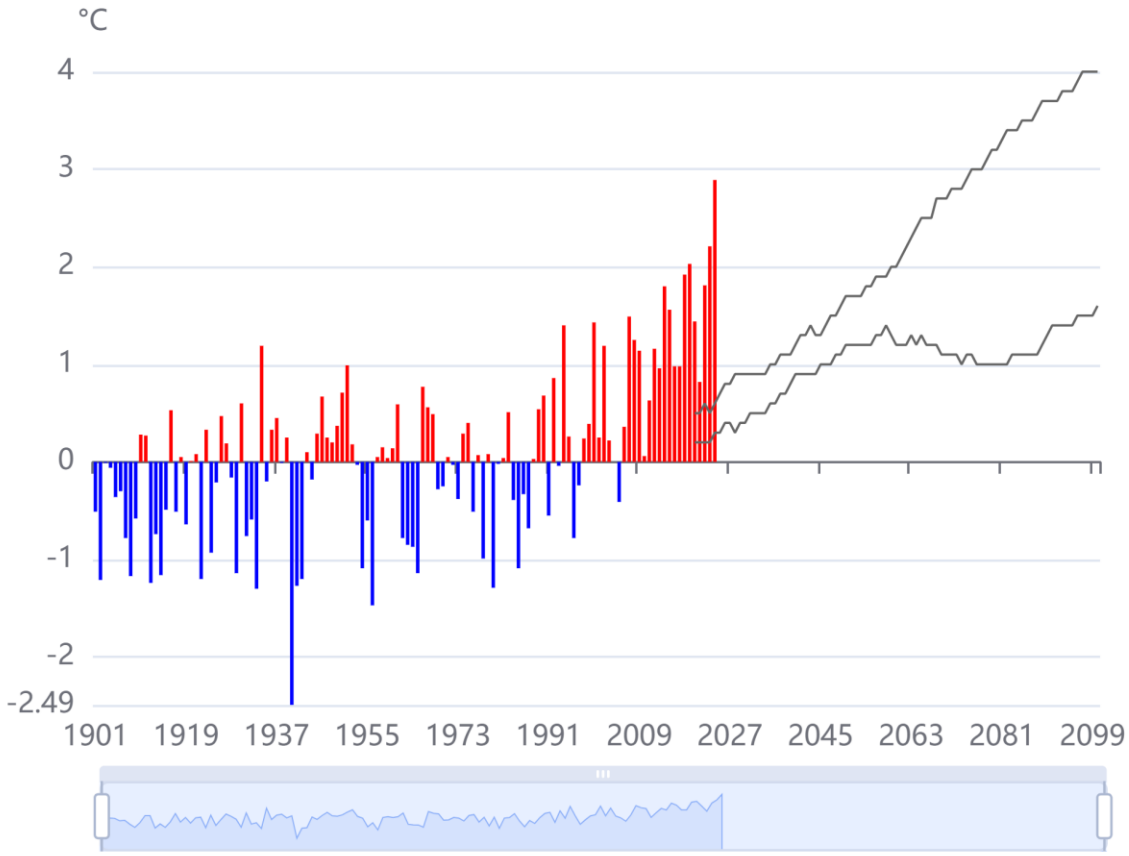
Climate indicators: most also available for future projections

Variable	Temporal Resolution	Variable	Temporal Resolution
Mean Temperature	Monthly, seasonal, annual	Precipitation Total	Monthly, seasonal, annual
Maximum Temperature	Monthly, seasonal, annual	Days with Precipitation ≥1 mm	Annual
Minimum Temperature	Monthly, seasonal, annual	Days with Precipitation ≥10 mm	Annual
Number of Frost Days	Annual	Days with Precipitation ≥20 mm	Annual
Number of Ice Days	Annual	Longest Dry Spell	Annual
Number of Summer Days	Annual	Mean Relative Humidity	Monthly, seasonal, annual
Number of Hot Days	Annual	Sea-Level Pressure	Monthly, seasonal, annual
Number of Very Hot Days	Annual	Global Radiation	Monthly, seasonal, annual
Number of Tropical Nights	Annual	Sunshine Duration	Monthly, seasonal, annual
Number of Heatwave Days	Annual	Mean Wind Speed	Monthly, seasonal, annual
Number of Severe Heatwave Days	Annual	Maximum Wind Gust	Monthly, seasonal, annual
Date of First Frost	Annual	Days with Wind Gusts ≥10 m/s	Annual
Date of Last Frost	Annual	Days with Wind Gusts ≥15 m/s	Annual
Length of Frost-Free Period	Annual	Days with Wind Gusts ≥20 m/s	Annual
Start of Growing Season	Annual	Late-Winter Soil Moisture	Annual
End of Growing Season	Annual	Late-Summer Soil Moisture	Annual
Length of Growing Season	Annual	Days with Soil Moisture <40%	Annual
		Days with Soil Moisture 60–90%	Annual
		Climate Zones	Annual

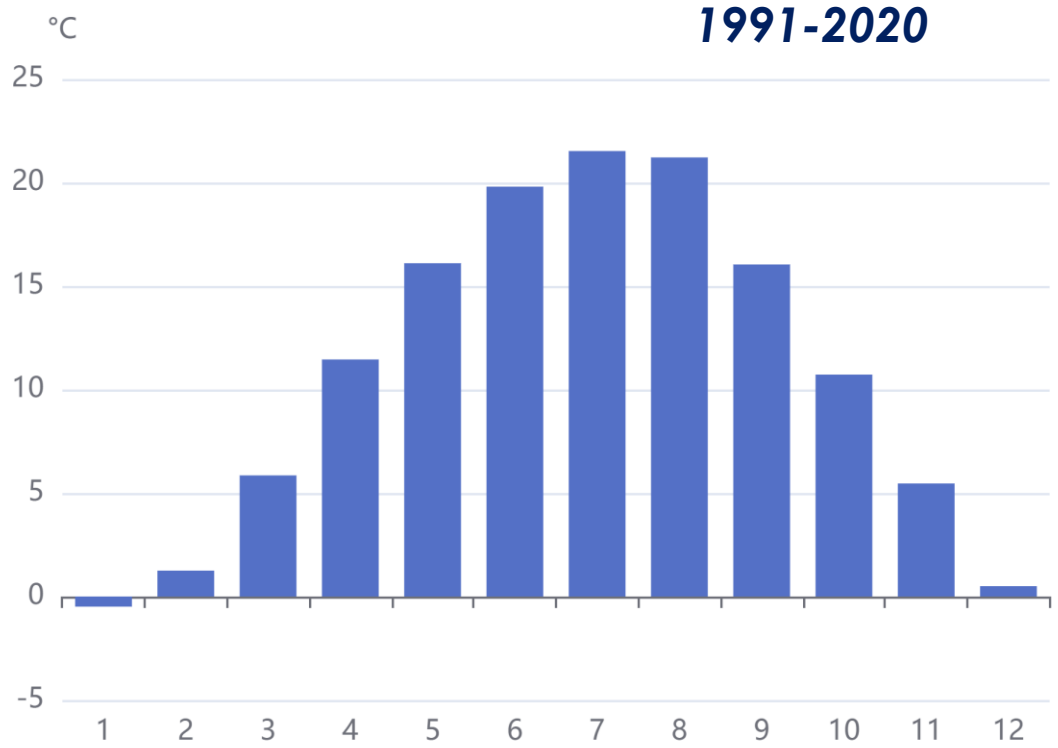
Maps, records, long-term time series on graphs at *national and county level*



Maps, records, long-term time series, annaual cycle on graphs at *national and county level*

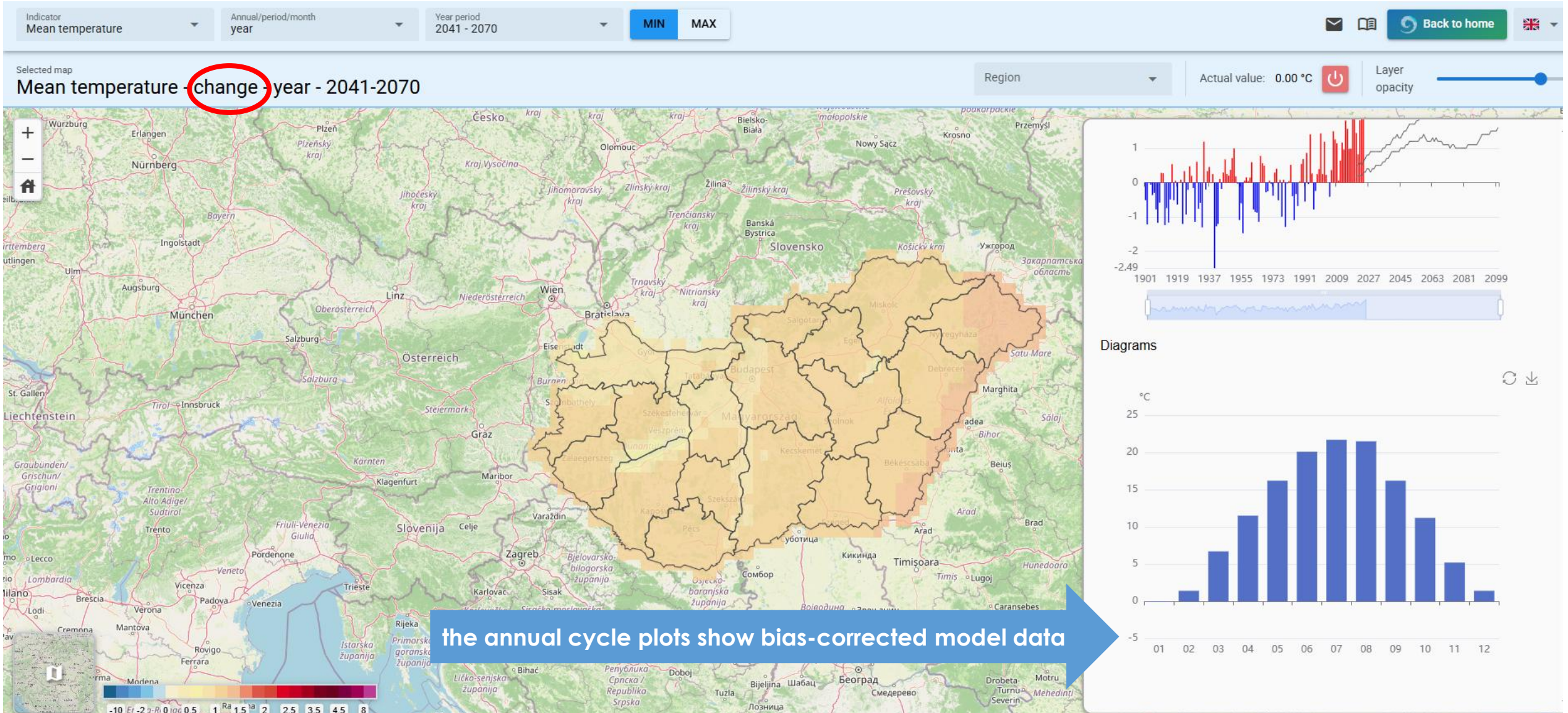


Ref: 1971-2000

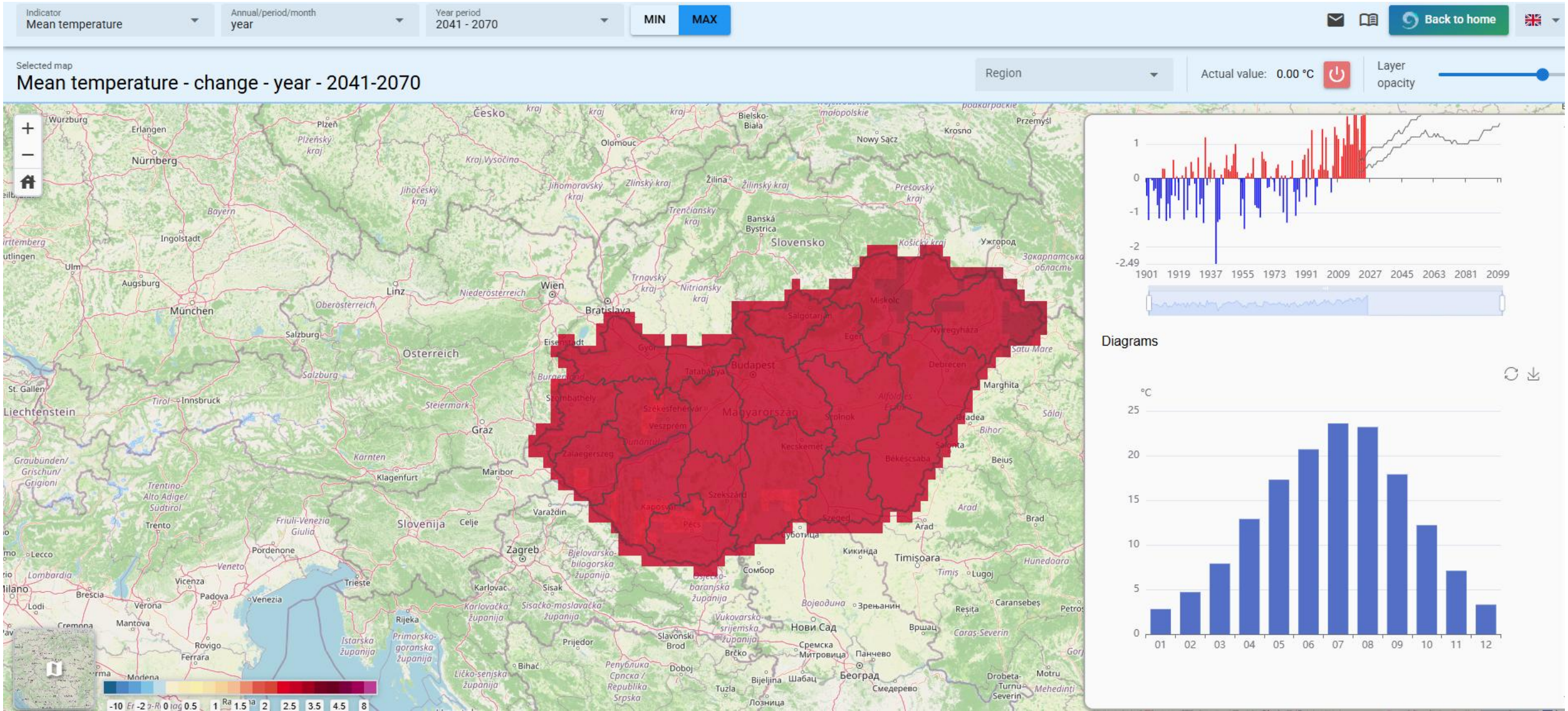


1991-2020

Country maps, records, long-term time series, annaual cycle on graphs at national and county level – future climate projection



Country maps, records, long-term time series, annaual cycle on graphs at national and county level – future climate projection



Key features and plans

- The system uses static, pre-calculated data
- Maps cannot be downloaded at present, screenshots can be taken
- Tables and charts can be downloaded/exported
- We plan to make the maps available as map imagery via a WMTS service
- We also plan to expand the functionality of the English-language version
- The developer is Telekom
- Sector specific service: Health, Energy Sector, Tourism, Risk Management, Transportation, Agriculture, Engineering Design, Water Management

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Thank you for your attention!

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