EURO-CORDEX data in the climate services of the Hungarian Meteorological Service: Validation of a EURO-CORDEX ensemble over Hungary

Sára Bordi, Otília A. Megyeri-Korotaj (megyeri.o@met.hu), **Beatrix Bán** and **Gabriella Szépszó**
Regional Climate Modelling Group, Modelling Unit
Hungarian Meteorological Service (OMSZ), Budapest, Hungary

OMSZ

Introduction

The Hungarian Meteorological Service has been providing climate services for stakeholders and impact modelers for several years based on EURO-CORDEX simulations and own model results as well. Due to changes in simulations and lack of RCP2.6 scenario in our ensemble we decided to update our EURO-CORDEX selection in order to supply the best possible quality of climate projection data. The aim is to extend our KLIMADAT[1] information system currently based on in-house climate projections with the selected EURO-CORDEX simulations and with more indicators requested by the users. As a first step we have validated the ensemble (Table 1) with the HUCLIM[2,3] observational database for 1971–2000 over Hungary.

Table 1.The GCM-RCM matrix used for validation

	CNRM-CM5	EC-EARTH	HadGEM2-ES	MPI-ESM-LR	NorESM1-M
ALADIN6.3	x				
CCLM-4-8-17		x		x	
HIRHAM5		x	x		
RACMO22E	x	x	x		
RCA4		x	x	x	x
REMO2009				x	
REMO2015			x		x

Temperature and Precipitation

- Well-described annual temperature cycle (Fig. 1)
- 11 out of 15 simulations overestimate summer mean temperature
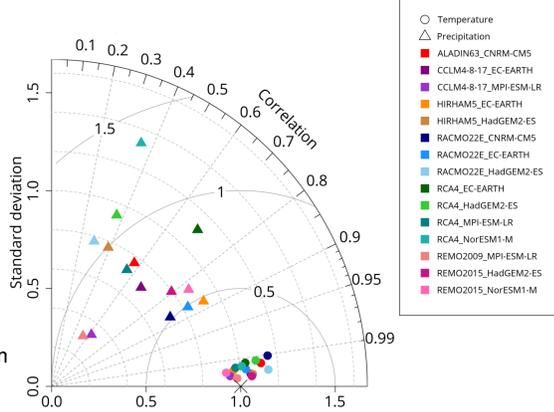- REMO overestimates temperature throughout the year; RACMO22 shows underestimation

Fig. 1. Taylor diagran

- Difficulties with representing the annual precipitation cycle (Fig.1)
- Shifted annual maximum from June to May (Fig.2)
- Mostly underestimation in summer precipitation and overestimation in spring and winter precipitation
- CCLM4-8-17 – MPI-ESM-LR, HIRHAM5–HadGEM2, REMO2009–MPI-ESM-LR, RACMO22–HadGEM2, RCA4–HadGEM2 and RCA4-NorESM2 were unable to reproduce the annual cycle.
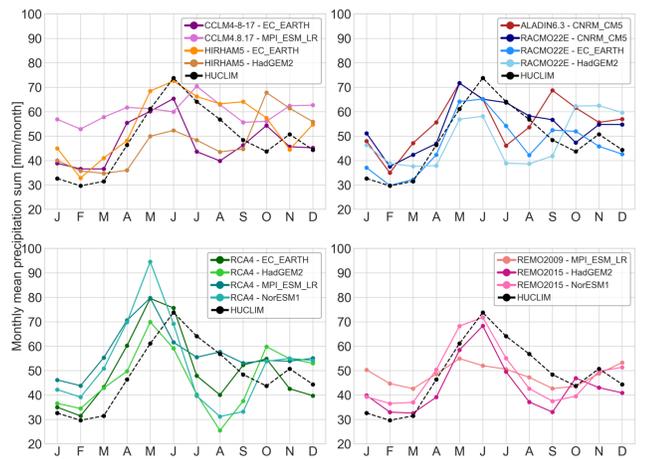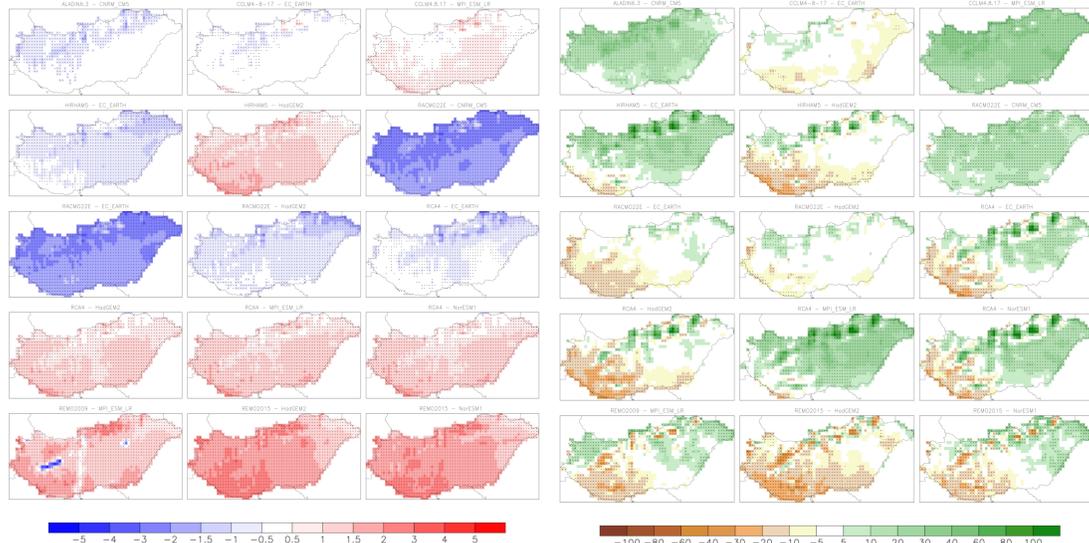

Fig. 2. Monthly precipitation sum

- Spatial differences are shown in Fig. 3
- Areas with temperature overestimation often relate with precipitation underestimation: mostly in south and southwestern areas of Hungary
- Areas with higher elevation emerge in most simulations
- The smallest temperature bias is with CCLM4-8-17 –EC-EARTH, CCLM4-8-17–MPI-ESM, ALADIN6.3, HIRHAM–EC-EARTH, RCA4–EC-EARTH simulations
- The smallest precipitation bias is with CCLM4-8-17–EC-EARTH and RACMO22–HadGEM2

Fig. 3. Annual (a) temperature bias map and (b) precipitation sum bias map

Minimum temperature

- Well represented annual cycle (Fig. 4)
- Generally small biases
- Mostly overestimations throughout the year, except in RACMO and ALADIN, where underestimation is more typical, especially during winter
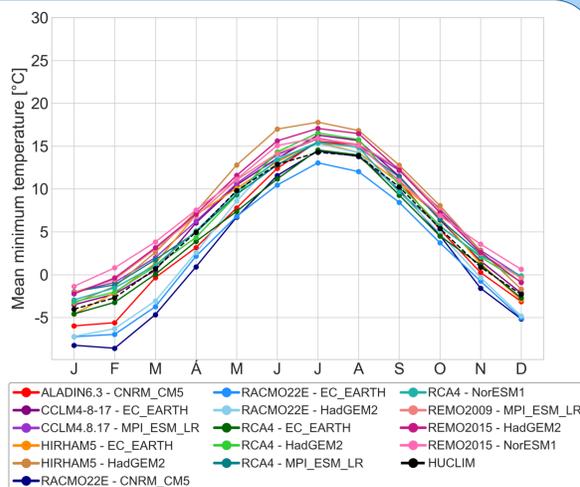

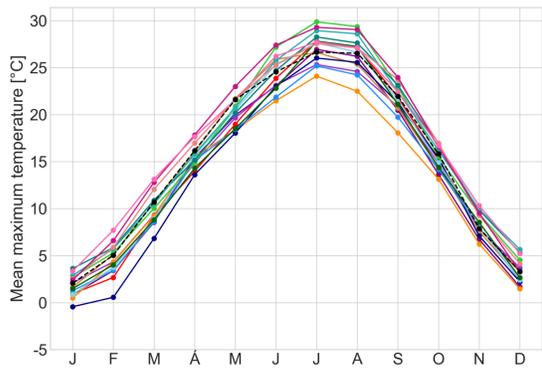Fig. 4. Monthly mean minimum temperature

Fig. 5. Monthly mean maximum temperature

Maximum temperature

- Small biases (Fig.5)
- Summer overestimation in REMO and RCA4
- CCLM, HIRHAM and RACMO simulations generally have underestimation
- ALADIN underestimates in winter and spring, overestimates in summer

Climate indices

- TR, HWDI1, HWDI2 are highly overestimated by most of the simulations
- HD, FD and SU have wide range bias within the ensemble.
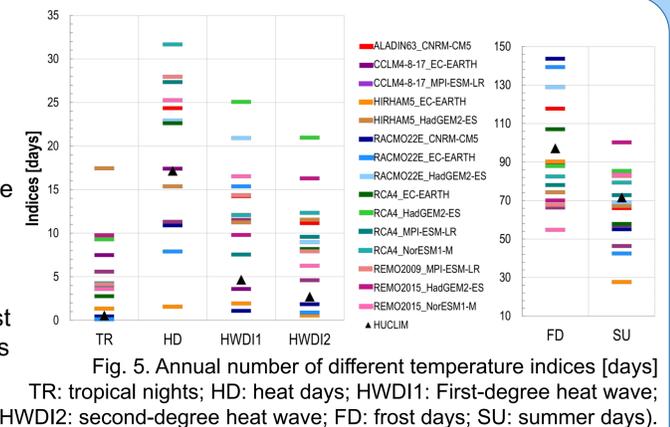- REMO2015-HadGEM2 highly overestimated most of the temperature indices

Fig. 5. Annual number of different temperature indices [days]
TR: tropical nights; HD: heat days; HWDI1: First-degree heat wave; HWDI2: second-degree heat wave; FD: frost days; SU: summer days).
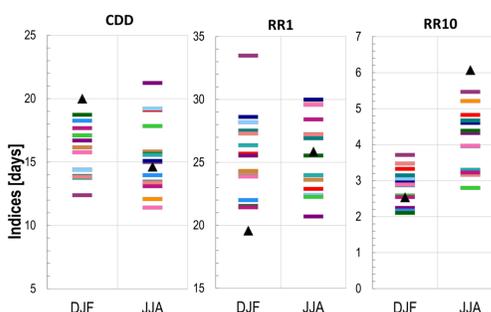

- CDD is underestimated in winter, while RR1 index is overestimated.
- RR10 is underestimated in summer by all models, as a result of summer precipitation shift in annual cycle. Winter values are too high.

Fig. 6. Same as Fig.5, but for winter and summer precipitation.
(CDD: consecutive dry days; RR1: rainy days; RR10: heavy precipitation days)

Summary and Plans

- RCA4-HadGEM2 has high bias at most of the parameter and a low correlation coefficient with HUCLIM in case of precipitation.
- For precipitation, 4 and 7 GCM-RCM model pairs have correlation lower than 0.4 and 0.6, respectively.
- In order to make a more objective decision about the final selection we are planning to make further investigation and statistical test on the ensemble.

References

[1] Allaga-Zsebeházi, G., Bán, B., Kovácsné Izsák, B., Szépszó, G., 2022: Assessment of climate change impacts in Hungary with regional climate model simulations and development of a representative climate database. Layman's report of the KlimAdat (KEHOP-1.1.0) project, 20 p.
[2] Izsák B., Szentimrey T., Lakatos M., Pongracz R., and Szentes, O., 2022: Creation of a representative climatological database for Hungary from 1870 to 2020. Időjárás 126, 1–26. https://doi.org/10.28974/idojaras.2022.1.1
[3] Izsák B., Bihari Z., Szentes O., 2021: Climate change: should I use homogenized or raw observational data? Légkör, 66(3), 11-15. (in Hungarian).