Final Preport for Project **1243** Project title: **Green CORDEX Central Asia** Principal investigator: **Bijan Fallah** Report period: **Jan. 1, 2022 - Dec. 31, 2022**

We report on our modeling efforts on Levante during the 12 months of the allocation period 2022, covering the proposed simulations with CCLM. Levante's full availability was launched on March 03, 2022. Therefore, we immediately started installing and testing the CCLM model on this machine. Unfortunately, we faced several problems in starting our simulations on time:

1- All input GCM data sets were unavailable for historical and SSP scenarios to start the CCLM simulations.

2- All the software needed was not installed on the machine.

3- We were the first group running the CCLM on the Levante.

4- Some requested storage capacities were cut in the review process, especially on the work folder.

5- The slk archiving needed to be faster when retrieving the data back from the tape.

The DKRZ support team was always available and helped us immensely in every step of our work. We are grateful for all of their support. A manuscript explaining the results is under preparation.

We have used the spatially distributed added value index¹, which calculates the differences between the probability density functions of daily total precipitation at each grid point between the CCLM simulations and the gridded observation. The index shows that the RCM has successfully reduced the bias of the GCM especially over areas with complex topography (Fig.1). The added value is higher when we used the climate hazards infrared precipitation with stations² (CHIRPS) dataset instead of Climatologies at high resolution for the earth's land surface areas³ (CHELSA). This might originate from the similar origins of GCMs and the ERA5 reanalysis (ERA5 uses a GCM as well).



Figure 1: Relative Probability differences of a) ERAInterim, b) CCLM driven by ERAInterim calculated based on CHIRPS observation and d) ERAInterim e) CCLM calculated based on CHELSA observation. c) and f) show their corresponding added values.

CHIRPS

CHELSA



Figure 2: Total yearly precipitation patterns (mm/day) for a) CHIRPS and b) CHELSA.

Figure 2 shows the climatology of the two data set used as observations. Comparing the added value patterns with figure 2, we conclude that the dynamical downscaling shows added values for regions with higher yearly precipitation, mainly located over areas with complex topographies.

The following simulations over CORDEX Central Asian (CA) domain @ 0.22° resolution were done successfully on the machine:

- CCLM run over CA driven by historical	(1985-2014)	MPI-ESM-HR
- CCLM run over CA driven by ssp585	(2019-2099)	MPI-ESM-HR
- CCLM run over CA driven by reanalysis	(2000-2010)	ERA5
- CCLM run over CA driven by ssp370	(2019-2099)	MPI-ESM-HR
- CCLM run over CA driven by ssp126	(2019-2099)	MPI-ESM-HR
- CCLM run over CA driven by reanalysis	(1979-2019)	EARInterim
- CCLM run over CA driven by ssp370	(2019-2033)	EC-Earth3-Veg
- CCLM run over CA with historical	(1984-1993)	EC-Earth3-Veg

Additionally, we conducted bias adjustment and statistical downscaling of ISIMIP3b simulations (6 GCMs and 3 scenarios) for hist-nat and historical experiments. Based on the results, we have submitted a paper entitled "Anthropogenic influence on extreme temperature and precipitation in Central Asia".

We utilized the following resources until 22.12.2022:

Levante CPU nodes (No	ode hours) : 14843 (-1886)
Levante storage (TiB) :	9 (+10)
Archive project (TiB) :	67 (-4)

References

¹ Ciarlo`, J.M., Coppola, E., Fantini, A. *et al.* A new spatially distributed added value index for regional climate models: the EURO-CORDEX and the CORDEX-CORE highest resolution ensembles. *Clim Dyn* 57, 1403–1424 (2021). <u>https://doi.org/10.1007/s00382-020-05400-5</u>.

2 Funk, C., Peterson, P., Landsfeld, M. *et al*. The climate hazards infrared precipitation with stations—a new environmental record for monitoring extremes. *Sci Data* **2**, 150066 (2015). <u>https://doi.org/10.1038/sdata.2015.66</u>.

3 Karger, D., Conrad, O., Böhner, J. *et al*. Climatologies at high resolution for the earth's land surface areas. *Sci Data* 4, 170122 (2017). <u>https://doi.org/10.1038/sdata.2017.122</u>.