Representation of monsoon systems in a regional climate model

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COSMO-CLM

INTRODUCTION

Climate simulations of the Indian summer monsoon (ISM) and the West Africa monsoon (WAM) in the current climate
- using the regional climate model COSMO-CLM
- driven by ERA40/ERAInterim reanalysis or ECHAM5/MPIOM

Representation of the monsoon systems:
- Monsoon rainfall
- Vertical wind shear from 850/925 hPa to 200 hPa
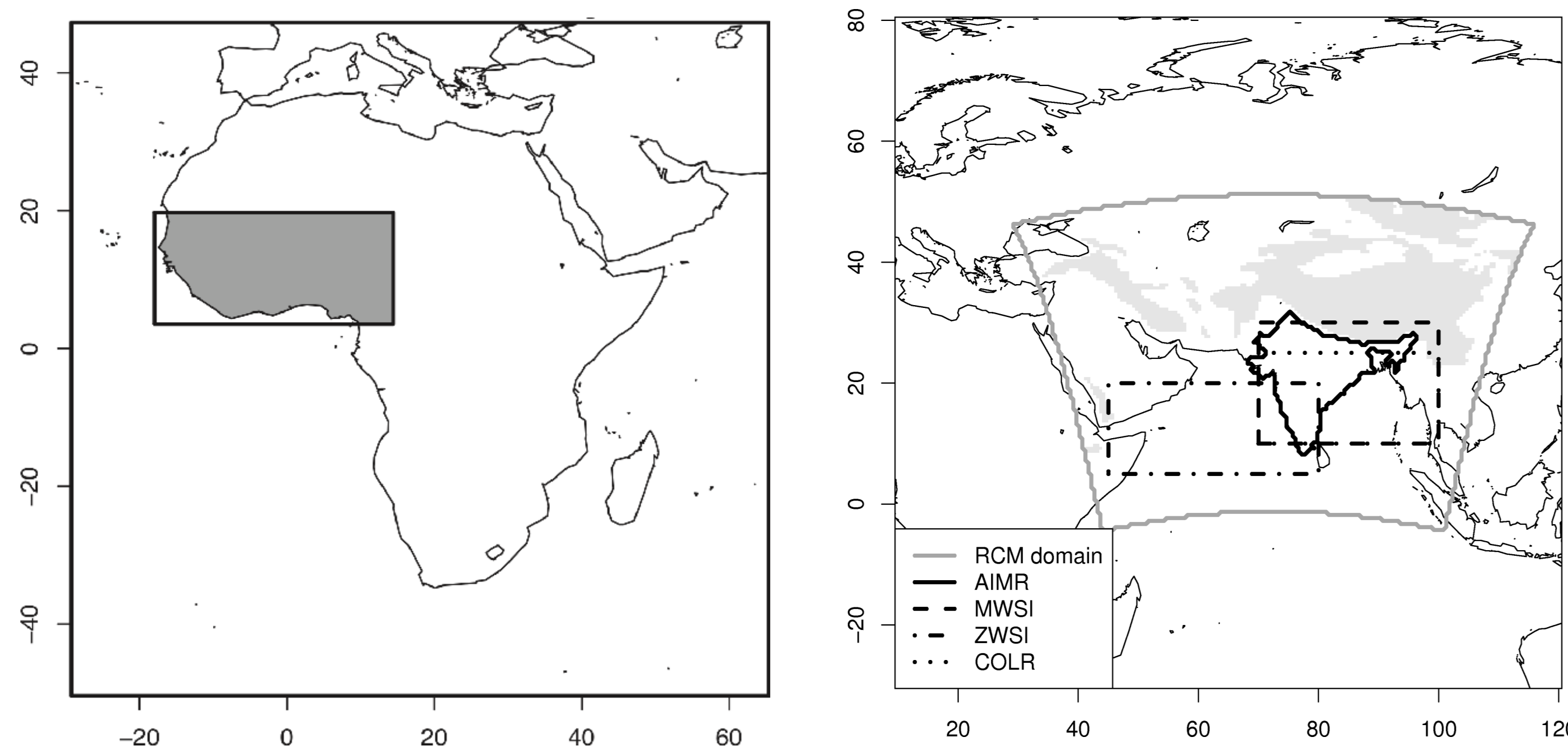- Outgoing longwave radiation
- Monsoon season: June to September

Fig. 1: Simulation domains and index areas for the WAM and ISM.

RESULTS

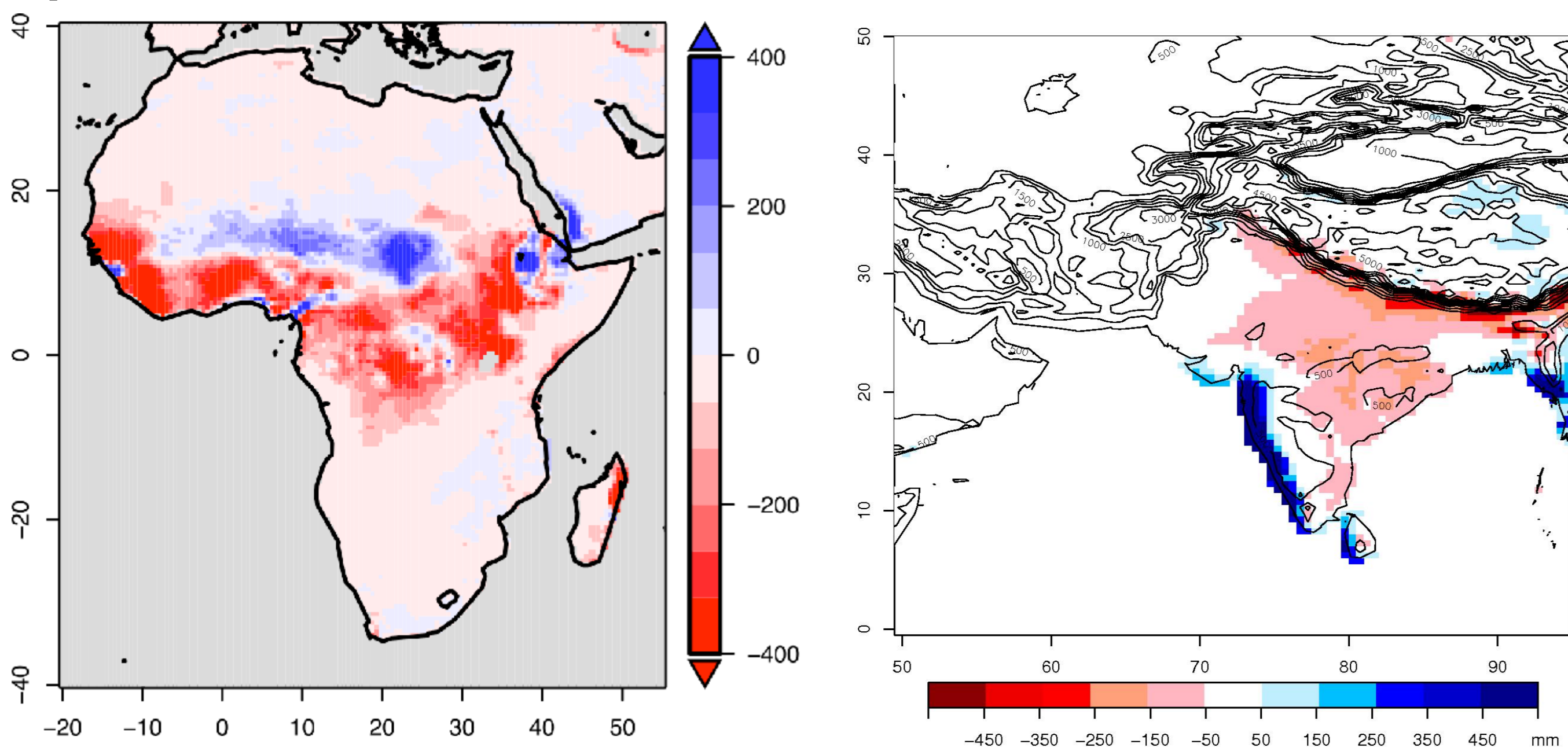### Spatial distributions of monsoon rainfall

Fig. 2: Monsoon precipitation bias of the COSMO-CLM driven by reanalysis data w.r.t. to the GPCC observation data set.
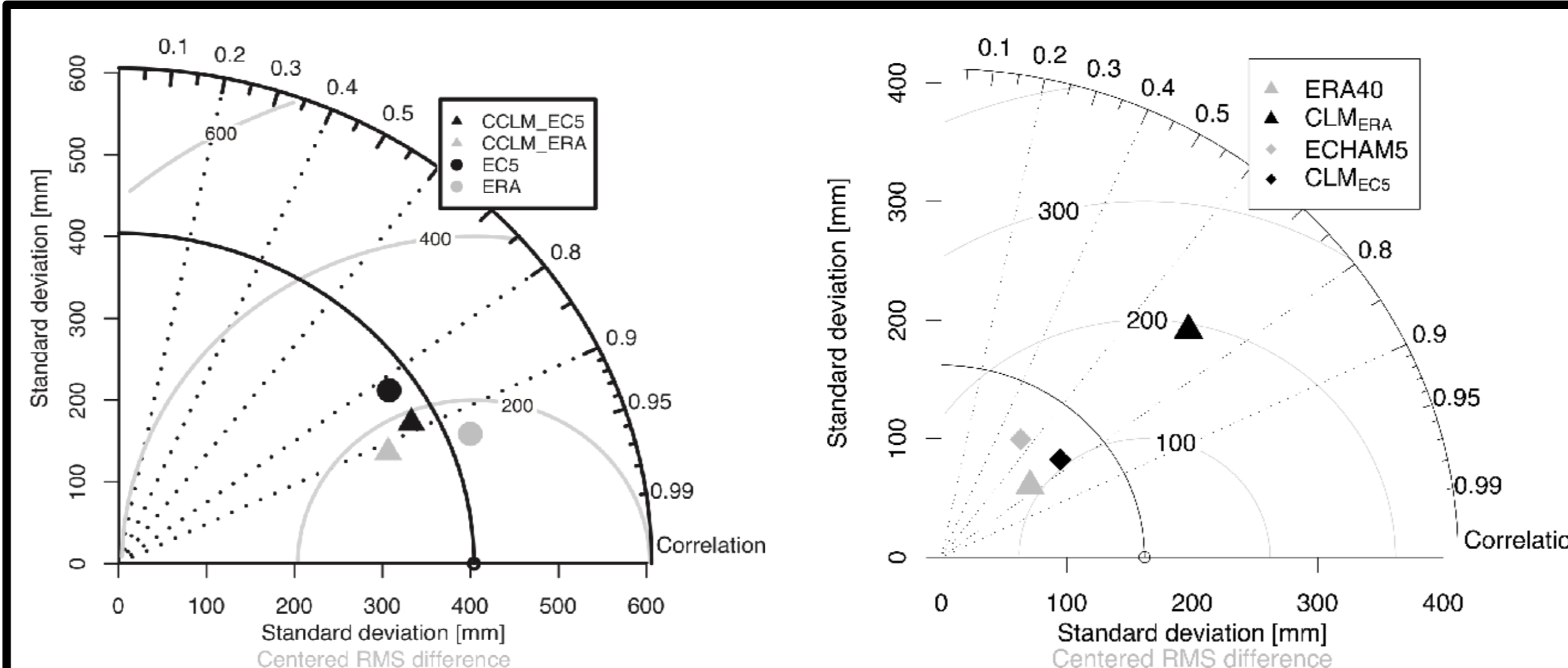

Fig. 3: Taylor-diagram for WAM (left) and ISM (right) precipitation fields compared to the GPCC data set.

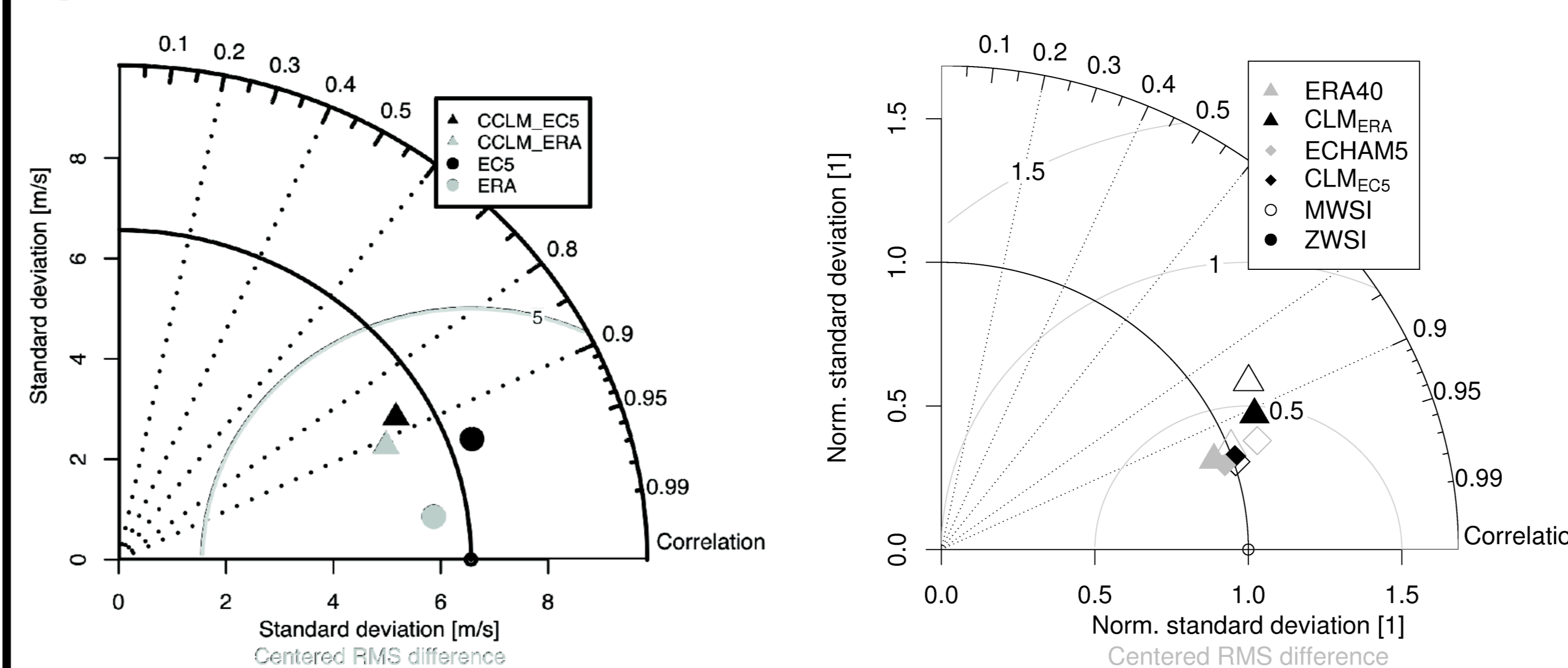### Spatial distributions of wind shear

Fig. 4: As Fig. 3, but for the wind shear fields compared to NCEP reanalysis 1 data.

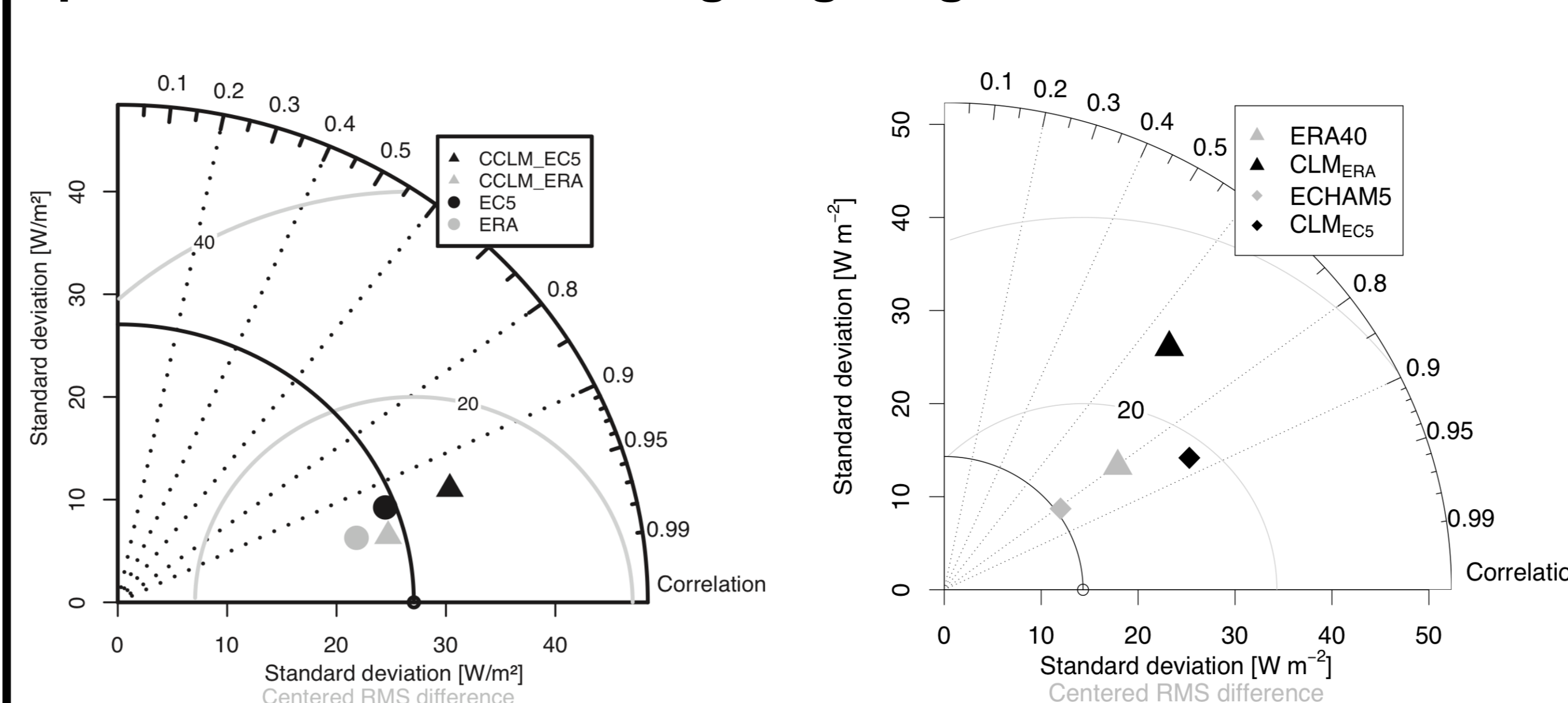### Spatial distributions of outgoing longwave radiation

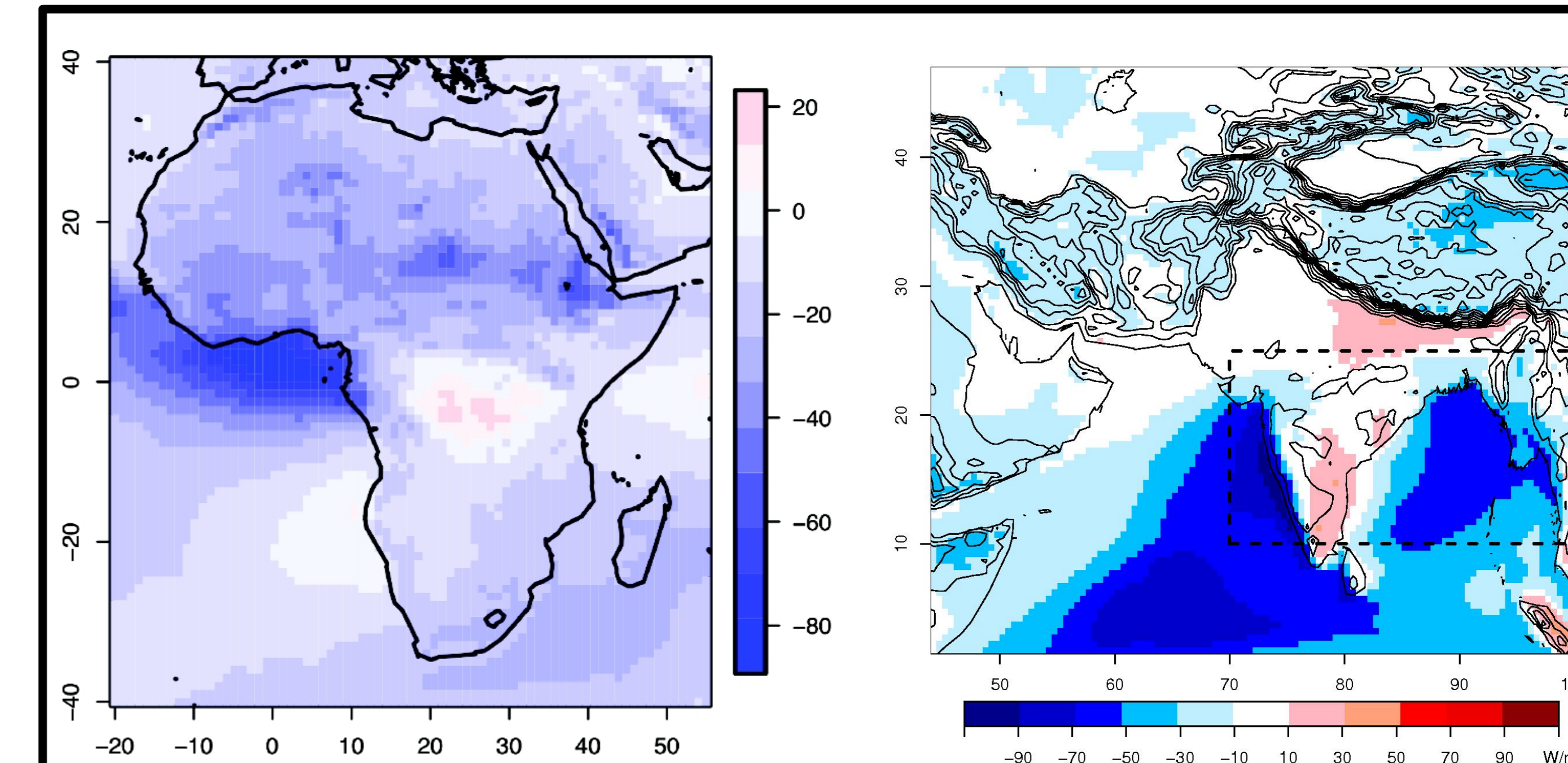*Fig. 5: As Fig. 3, but for outgoing longwave radiation compared to the GEWEX/SRB observation data set.*

Fig. 6: OLR bias of the COSMO-CLM driven by ECHAM5 (WAM) or reanalysis (ISM) data w.r.t. to the GEWEX/SRB data set.

SUMMARY

COSMO-CLM is able to represent the monsoon systems, but:
- Too high precipitation in the Sahel and South-Asian west coasts
- Underestimation of precipitation along the African west coast, Central Africa and at the Himalayan foothills
→ Only an added value compared to ECHAM5/MPIOM precip.

- COSMO-CLM shows too much convection, especially over the Indian Ocean and the Gulf of Guinea

- Wind shear is partly improved by the COSMO-CLM compared to the ECHAM5/MPIOM

CONCLUSIONS

- Difficult for the regional model to add value at the large monsoon system scale, especially compared to reanalysis data
- Monsoon representation depends strongly on the driving GCM due to the relatively small RCM domains
- Improvements in COSMO-CLM possible in e.g., convection, surface albedo
- However, the simulation of sub-GCM processes like orographic precipitation adds value important to regional impact studies.

More detailed evaluation studies:

Kothe, S. and B. Ahrens, 2010 : On the radiation budget in regional climate simulations for West Africa. J. Geophys. Res., 115, D23120

Kothe, S., A. Dobler, A. Beck and B. Ahrens, 2010: The radiation budget in a regional climate model. Climate Dynamics, 36 (5-6). 1023-1036

Dobler, A. and B. Ahrens, 2010: Analysis of the Indian summer monsoon system in the regional climate model COSMO-CLM. J. Geophys. Res., 115, D16101

Dobler, A. and B. Ahrens, 2008: Precipitation by a regional climate model and bias correction in Europe and South Asia. Meteorol. Zeitschrift, 17(4): 499-509