EMI R&D PROJECT PROGRESS REPORT

All the following mandatory information needs to be provided. The length should *reflect the complexity and duration* of the project.

Reporting year 2026……

Project Title: Analysing climate variability and change based on various types of climate simulations……

Computer Project Account: sre……

Principal Investigator(s): Wilhelm May……

Affiliation: Department for Earth and Environmental Sciences, Lund University……

Name of ECMWF scientist(s) collaborating to the project (if applicable) Not applicable……

Start date of the project: 1.1.2026……

Expected end date: 31.12.2028……

Computer resources allocated/used for the current year and the previous one

(if applicable)

Please answer for all project resources

		Previous year		Current year	
		Allocated	Used	Allocated	Used
High Performance Computing Facility	(units)	0	0	200,000	0
Data storage capacity	(Gbytes)	160,000	52,000	100,000	52,000

Summary of project objectives (10 lines max)

The purpose of the project is to facilitate different research activities, partly related to international research projects in the Horizon programmes by the EU. These are, for instance, to analyse the impacts of the projected climate changes in East Africa on agricultural practices in the region (as part of the UPSCALE project) as well as to evaluate the post-CMIP6 versions of different ESMs run at high resolution and to analyse the regional climate changes associated with certain levels of global warming (both as part of the OptimESM project). Another aspect is to continue the work with EC-Earth on the role of the land-surface atmosphere coupling in the ESM.

Summary of problems encountered (10 lines max)

The work in the OptimESM project has not proceeded as planned. Furthermore, version 4 of the EC-Earth earth system model is not finalized yet. Therefore, I have not used the assigned HPC quota.

Summary of plans for the continuation of the project (10 lines max)

I will continue with the work in the UPSCALE project, that is investigating the projected climate changes in East Africa based on the regional climate simulations from CORDEX-CORE Africa. I will start with the work in the OptimESM project, that is a) the evaluation of the high-resolution of the earth system models from OptimESM, focusing on precipitation and the surface energy fluxes, and b) the analysis of regional climate changes in the global simulations with specific degrees of global warming and different behaviour after the level of warming has been reached, e.g., stabilization or ramp-down.

List of publications/reports from the project with complete references

None yet.

Summary of results

During the first half year of the project, I have investigated the representation of the seasonal variation of rainfall in East Africa based on the regional climate simulations from CORDEX-CORE Africa. The results can be summarized like this:

Realistic representations of the seasonal variation of rainfall in regional climate simulations are crucial for assessing the potential socio-economic impacts of future climate changes in areas that strongly rely on seasonally reoccurring rainfall. Yet assessments of how well this is simulated by regional climate models (RCMs) is often lacking. Here, we investigate the extent to which regional climate simulations within the CORDEX-CORE experiment Africa realistically represent the seasonal variation of rainfall in East Africa. These are simulations for recent decades with three different RCMs, either forced with observed lateral meteorological boundary conditions or with data from global climate simulations with three different models. The simulations forced with ERA-Interim reanalyses indicate that the RegCM4 RCM best simulates the seasonal variation of rainfall (i.e., phase, shape and magnitude of the climatological annual cycle of daily rainfall) in East Africa. The simulations driven by the global climate models (GCMs) show that only the boundary conditions from the MPI-ESM GCM enable realistic simulations of the seasonal variation of rainfall in East Africa by the RCMs. For the boundary conditions from the two other GCMs, the regional climate simulations fail to capture the observed dominance of two rainy seasons over parts of the Horn of Africa and in the central tropics. Each of the RCMs is characterized by specific geographical distributions of the deviations from observations for the characteristics of the rainy seasons, (i.e., onset, cessation and length) in East Africa. These results provide guidance in choosing viable regional climate simulations for use in climate impact and adaptation research in East Africa.

These findings can be seen from the following figures, showing the Taylor diagrams (focussing on East Africa) for some of the regional climate simulations, i.e., the simulations with the three RCMs with ERA-Interim as lateral boundary forcing (Fig. 1) and the simulations with the RegCM4 RCM forced with the simulations from the three GCMs at the lateral boundaries (Fig.2).

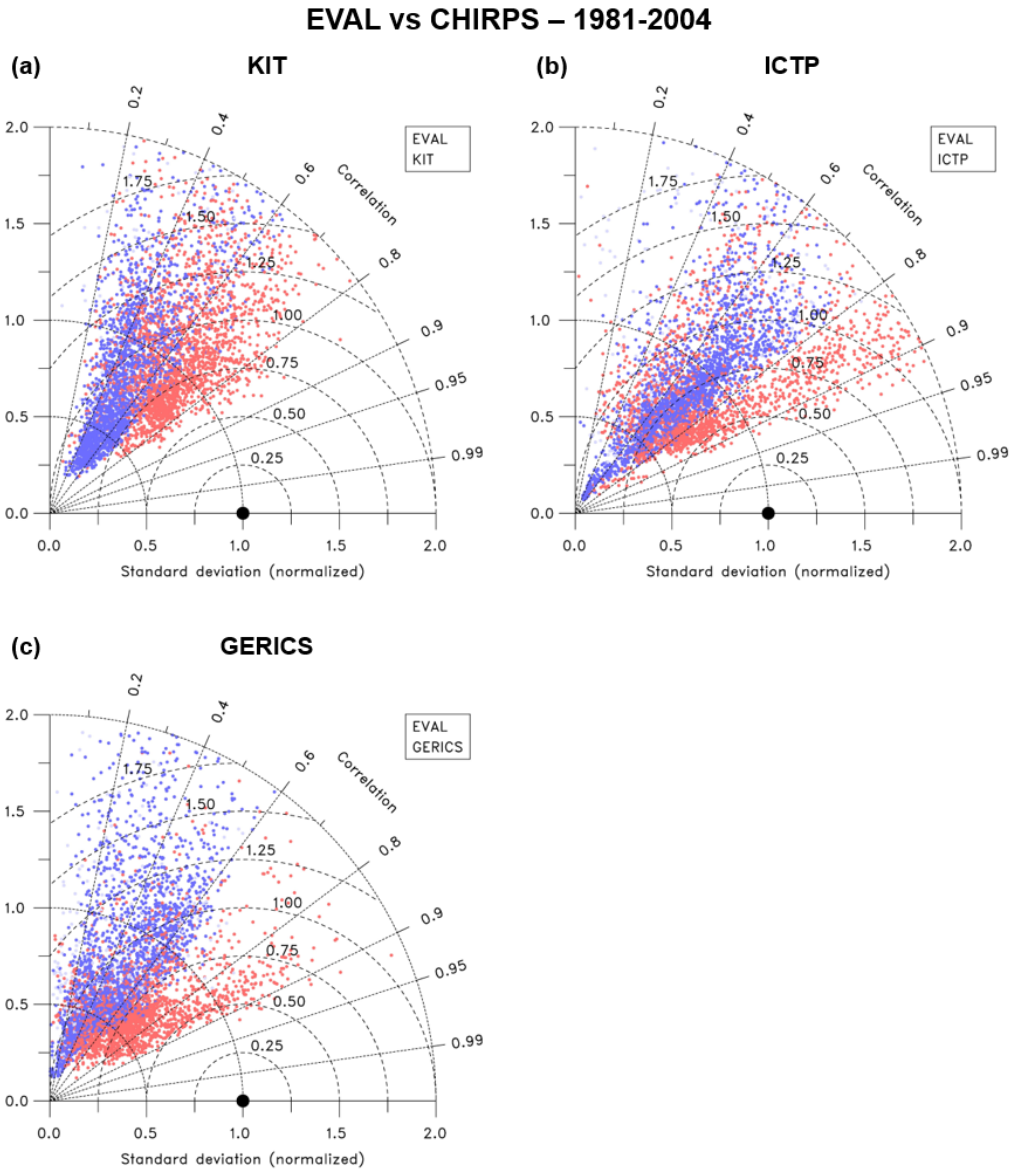

Fig. 1: Taylor diagrams for the climatological annual cycle of daily precipitation for each grid point in the study region for the RCM simulations driven by ERA-Interim (EVAL) with CHIRPS as reference data for (a) the CCLM5-0-15 RCM (KIT), (b) the RegCM4-7 RCM (ICTP) and (c) the REMO2015 RCM (GERICS). All values, i.e., the centred root-mean-square deviation and the standard deviations of the data sets, are normalized by the standard deviation of CHIRPS. The red and dark blue colour indicate the grid points where the first and the second harmonic, respectively, dominate in CHIRPS. The light blue colour indicates the grid points where neither of these two harmonics dominate in the observational data.

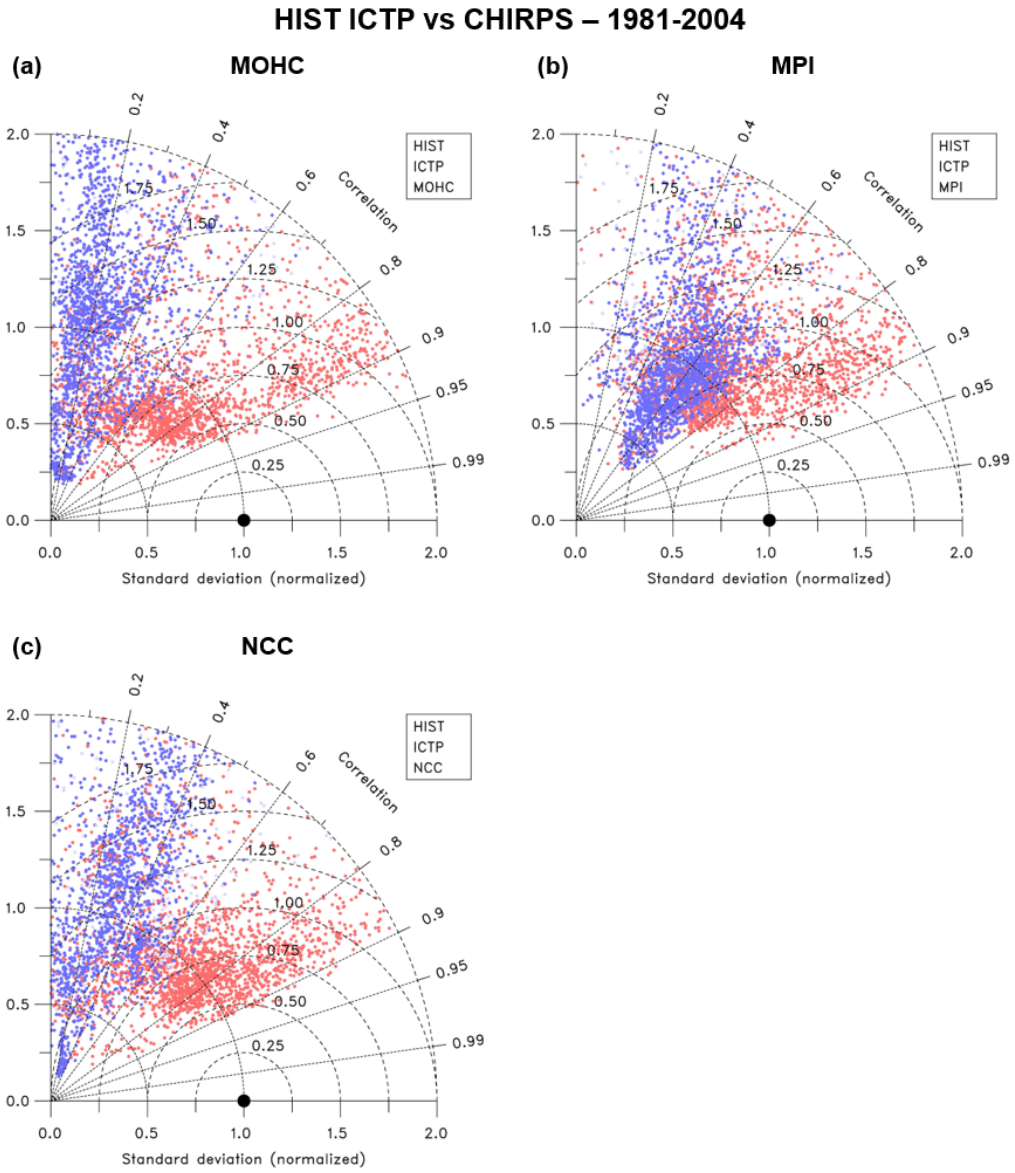

Fig. 2: Taylor diagrams for the climatological annual cycle of daily precipitation for each grid point in the study region for the simulations with the RegCM4-7 RCM (ICTP) with CHIRPS as reference data driven by (a) HadGEM2-ES (HIST; MOHC), (b) MPI-ESM-LR (MPI) and (c) NorESM1-M (NCC). All values, i.e., the centred root-mean-square deviation and the standard deviations of the data sets, are normalized by the standard deviation of CHIRPS. The red and dark blue colour indicate the grid points where the first and the second harmonic, respectively, dominate in CHIRPS. The light blue colour indicates the grid points where neither of these two harmonics dominate in the observational data.