Project: **1374**

Project title: **TIPPing points Explained by Climate Change (TIPPECC)**

Principal investigator: **Torsten Weber**

Report period: **2023-05-01 to 2024-04-30**

Maximum of 2 pages including figures. 9 pt minimum font size.

Project Overview

The TIPPing points Explained by Climate Change (TIPPECC) project over southern Africa is a three-year project and funded by the BMBF SASSCAL 2.0 (FKZ01LG2049B). TIPPECC is a direct response to the South African Development Community (SADC) Grand Challenge (SGC) call, which emphasizes that the southern African region faces major risks in the form of climate change induced tipping points. In GERICS, we are leading a work package on regional projections of future climate change (WP1). GERICS will be contributing to a new set of high-resolution regional climate change projections covering southern Africa using the ROM (GERICS-AWI) driven by the CMIP6 GCMs as forcing.

Planned work, performed simulations, summary of preliminary result

As part of the work package 1, GERICS will provide a high-resolution regional climate projection using a GCM from the CMIP6 ensemble as the driving model. In the previous plan, GERICS will use the coupled system ROM[1] currently maintained in AWI, which contains REMO as the atmospheric component and the Max Planck Institute Ocean Model (MPIOM) as the global oceanic component. The modelling domain at a horizontal resolution of 0.22 degree x 0.22 degree for REMO is shown in Fig. 1.

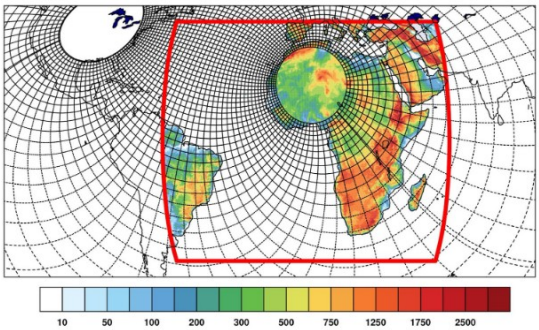

Fig. 1 Model domain and orography [m] for REMO and ROM with a spatial resolution of 0.22 degrees (red box) and for MPIOM with a TR04 grid (black grid). Source: Weber et al, 2023[2].

A new preprocessor was programmed during the reporting period due to the different format of the CMIP6 boundary conditions. Short sensitivity simulations were carried out to test the stability of the model. To contribute to the high resolution simulations that were planned in this project, the resolution of REMO was also increased to 0.11 degree x 0.11 degree. With the new high resolution design, the planned simulations were revised. Due to project timeline constraints, the simulations for the evaluation and historical time period are running simultaneously.

The revised plan and current status of the simulations are listed in Table 1.

[1] Projected climate change signals for hotspot regions in southern Africa using regional climate change simulations - Armelle Remedio, Torsten Weber, et al., Poster, Session B, International Conference on Regional Climate-CORDEX 2023 (ICRC-CORDEX 2023), abdus salam International Centre for Theoretical Physics, Trieste, Italy, September 25-29, 2023.

[2] Remedio, A., Weber, T., Engelbrecht, F., Biskop, S., Steinkopf, J., Padvatan, J., van der Waal, C., Wassenaar, T., Banda, K., Tlhalerwa, K., and Perkins, J.: Projected climate change signals for selected hotspot regions using regional climate simulations in southern Africa, EGU General Assembly 2024, Vienna, Austria, 14–19 Apr 2024, EGU24-16077, https://doi.org/10.5194/egusphere-egu24-16077, 2024.

Table 1. Revised planned simulations at 0.11 x 0.11 degree simulation for the atmospheric domain.

Experiment ID	Description	Simulation years	Status
REMO_uncoupled_REAN	ROM driven by ERA5	1981 to 2010 (30)	In preparation
REMO_uncoupled_HIST	REMO driven by CMIP6	1950 to 2014 (65)	20 years done, running 1979
ROM_coupled_HIST	ROM driven by CMIP6	1950 to 2014 (65)	20 years done, running 1979
ROM_coupled_SCEN	ROM driven by CMIP6	2015 to 2100 (86)	Planned

As preliminary results, the following figures show the mean annual temperature and precipitation results for a decade of simulation (1961 to 1970) for the REMO_uncoupled_HIST (Fig. 2) and ROM_coupled_HIST (Fig. 3) experiments. The simulations were driven using the AWI-CM HighResMIP[3] boundary forcing.

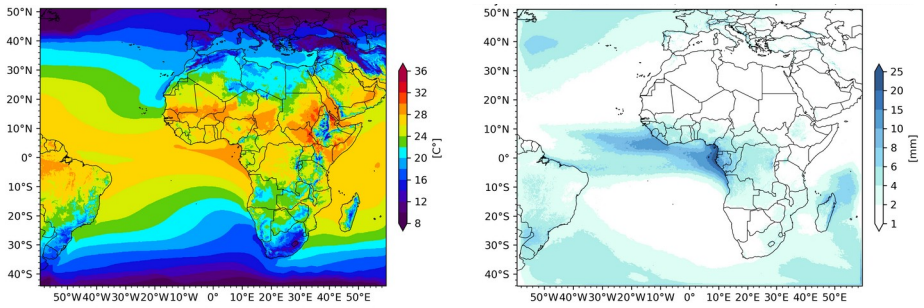

Fig. 2. Mean annual temperature (in Celsius, left) and daily precipitation sum (in mm/day, right) for the REMO_uncoupled_HIST simulation for the 1961 to 1970 period.

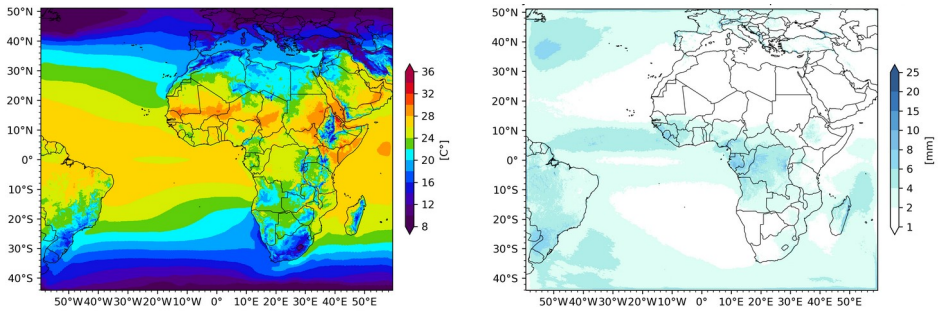

Fig. 3. Mean annual temperature (in Celsius, left) and daily precipitation sum (in mm/day, right) for the ROM_coupled_HIST simulation for the 1961 to 1970 period.

The next steps will be a transient, high-resolution projection using the ssp585 scenario with a GCM from the CMIP6 ensemble as forcing. Details of computing resource requests are being applied for in the accompanying DKRZ Computing Request Form for 7/2024 to 6/2025.

In addition, during the reporting period, GERICS performed analysis on existing regional climate projections over southern Africa using the CORDEX-CORE simulations. The climate change over selected hotspot regions were analyzed and assessed. The results were presented as a poster[4] during the ICRC-CORDEX Conference 2023 in Trieste, Italy and an oral presentation[5] during the EGU2024 Conference in Vienna. We acknowledge the use of the computing resources in DKRZ.

The resources used in levante during the reporting period was 28,918 Node-hours (luv.dkrz.de).

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[3] Semmler, Tido; Danilov, Sergey; Rackow, Thomas; Sidorenko, Dmitry; Hegewald, Jan; Sein, Dmitri; Wang, Qiang; Jung, Thomas (2017). AWI AWI-CM 1.1 HR model output prepared for CMIP6 HighResMIP. Version YYYYMMDD[1].Earth System Grid Federation. https://doi.org/10.22033/ESGF/CMIP6.1202

[4] Sein DV, Mikolajewicz U, Gröger M, Fast I, Cabos W, Pinto JG, Hagemann S, Semmler T, Izquierdo A, Jacob D (2015) Regionally coupled atmosphere–ocean–sea ice–marine biogeochemistry model ROM: 1. Description and validation. J Adv Model Earth Syst 7:268–304. https://doi.org/10.1002/2014MS000357.

[5] Weber, T., Cabos, W., Sein, D.V. et al. Benefits of simulating precipitation characteristics over Africa with a regionally-coupled atmosphere–ocean model. Clim Dyn 60, 1079–1102 (2023). https://doi.org/10.1007/s00382-022-06329-7.