

Project: **1031**

Project title: **Kipp-Punkte im Klimasystem und ihre Konsequenzen für Zentralasien - CAHOL-Modelling**

Principal investigator: **Emmanuele Russo, Ingo Kirchner**

Report period: **2018-01-01 to 2018-12-31**

The main goal of this project is to perform a set of high-resolution climatic simulations over Central Asia, for selected time-slices of the last 8000 years. The reference simulation is a transient run performed by the MPI of Hamburg with the coupled model MPI-ESM at a spectral resolution of T63 and 47 vertical levels.

During the year 2018, the focus of the project has mainly been on the setup of the CCLM simulations for the area of study. These simulations complement the ones already started in the year 2017. They consist in a series of present-day simulations with the COSMO-CLM with the goal of proposing a robust model tuning configuration for the selected area of study.

Most of the simulations have been conducted on the CORDEX Central Asia domain at 0.22° lon resolution. In addition to them, a series of simulations have been performed switching and changing the domain borders.

The main model grid is composed by 306x200 points.

The main research question we tried to answer were: can we determine a reliable and robust model configuration for the area? What is the uncertainty proper of the model? what's the one depending on datasets used for the boundaries. Eventually, the results would not only contribute to the goal of the project itself but could also be made available to the model community for additional research over the area, such as for example the performance of simulations for the new CORDEX-CORE phase, whose results will be included in the next IPCC report.

Complementary experiments to the ones presented here were performed within the project BB1071.

As a first step, after considering main climatic and physical characteristics of the region, we conducted a set of 15-year long simulations (>30x15 years), using different physical parameterizations. As driving data we used the NCEP2 reanalysis dataset, being its resolution close to the spectral resolution that we want to employ for the ECHAM6 Holocene simulations (T63). As a reference we took the cordex east Asia parameterization configuration, including this domain a large part of the new region of study, and in particular the Tibetan plateau. From this default configuration, we changed at each time some parameters relative to specific physical features, such as albedo, aerosol, graupel scheme as well as several parameters related to surface layer fluxes and soil. Together with these simulations we also performed a default 30-year long run, that will serve for the computation of longer-term statistics, and two ERA-Interim driven 15-year long simulation that will additionally serve in order to investigate the effects of the use of different drivers and to confirm the results evinced from NCEP2 driven simulations.

Analyses focused on three variables important for adaptation and mitigation studies: near surface temperature, precipitation and diurnal temperature ranges. Results showed that, in general, parameters relative to soil/surface features are the most relevant for the area, in particular in summer over dry and warm areas. The model configuration leading to the best results is the one where a parameterization taking into account the ratio of soil water and ice for the calculation of soil heat conductivity is used together with the treatment of the hydraulic lower boundary, considering ground water with drainage and diffusion. Interestingly, results showed that none of the parameterisation used had an

important effect on model results for winter seasons.

Having found a better performing configuration, we tested it on a different domain, sharing a large area of the CORDEX Central Asia. Improvements seem to be retrieved even with changes in the model domain. Finally, the model changing the boundaries, leads to the same improvements using the same configuration.

During this year it was still not possible to conduct the PALEO simulations for the Holocene, since the driving data were not available until recently. So the next step would be to use the results of this project and of BB1071 on CORDEX Central Asia, in order to set up the COSMO CLM for the region. Then, after retrieving the driving data, we will use the retrieved configuration to start the CCLM PALEO simulations.

Some simulations will still be conducted within the end of the year 2018 by using the MPI-ESM, doing some sensitivity tests and running the model from restart files of the transient simulation.

Changes in model Physics	
A	Reference Simulation - CORDEX South East Asia setup
B	A+Tegen Aerosol Dataset
C	A+Surface albedo determined as a weighted mean of two external fields for dry and saturated soil
D	A+Vegetation albedo modified considering forest fraction.
E	A+Type surface-atmosphere transfer based on prognostic TKE in the surface layer
F	A+Cloud representation taking into account subgrid-scale condensation; cloud cover and water content calculated according to a statistical closure.
G	A+Equal to G but cloud cover and water content calculated according to a relative-humidity criterion
H	A+Exponential root distribution
I	A+Soil heat conductivity taking into account soil moisture/soil ice
J	A+Hydraulic lower boundary considering ground water with drainage and diffusion
K	A+E+F+G
L	A+H+I+J
M	A+B+D
N	A+D+H+I+J
O	A+B+D+E+F+G+I
P	A+B+D+E+F+G+H+I+J
Q	A+D+I

Abbildung 1: List of main Configurations tested

