Project: **1031**

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

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*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.*

*The first simulations of the project were conducted in order to set-up the best experimental design for obtaining high resolution climate information suitable for comparison against proxy-data.*

*In a first step we performed several simulations with the atmosphere-only Global Circulation Model (GCM) ECHAM6, testing the computational costs of different model resolutions. In this way we wanted to test whether it could be possible to use the model at a resolution of approximately 50 km for the planned paleoclimate experiments. Results showed that, willing to perform an ensemble of at least 3 simulations for each possible Holocene time-slice, the highest resolution configuration (T255) of the ECHAM6 is not really suitable. Indeed, we opted for a combined use of ECHAM6 at T63L47 (to produce 6-hour outputs) and the regional climate model COSMO-CLM at a final spatial resolution of 0.22° lon.*

*Successively, we conducted a series of present-day simulations with both the models, in order to test their performances and, only concerning the COSMO-CLM, propose a robust model tuning configuration for the selected area of study.*

*After conducting in a first place a 30-year long ECHAM6 simulation, from the year 1976 to the year 2005, we mainly focused our attention on the COSMO-CLM.*

*As model domain we used the CORDEX Central Asia domain at 0.22° lon resolution.*

*At this scale, the model grid is composed by 306x200 points.*

*The main research question we tried to answer was: can we determine a reliable and robust model configuration for the area? 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.*

*The model tuning experiments consist of two parts.*

*As a first step, after considering main climatic and physical characteristics of the region, we conducted a set of 15-year long simulations (7x15 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 Tibetian plateau. From this default configuration, we changed at each time some parameters relative to specific physical processes, 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 an ERA-Interim driven 15-year long simulation that will additionally serve in order to investigate the effects of the use of different drivers.*

*Analysis of the first results are on-going and are partly presented here (Fig.1 and Fig.2). Based on them, an additional short-term simulation will be performed with the „best-performing“ parameters turned on. Then, two additionall tests will be considered, changing the height of the model top layer and the soil depth. Additionally, an ensemble of 4 short-term simulations (4x15 years) will be performed in order to estimate the model variablity for the region, relative to changes in the initial conditions. We aim at finishing these simulations within the year 2017.*

*The remaining computational time allocated for this year, together with part of the newly requested computational time for the year 2018, will be employed for the tuning of other model parameters (mainly the parameters in the TUNING and DYNAMICS CCLM namelist categories) according to an „optimal parameterization“ method such as the one proposed for Europe by Belprat et al. 2012.*

*An additional long-term simulation (30 years) is also planned for this year, for testing the response of the CCLM when driven by the outputs of the ECHAM6 simulation.*

*Our project started later than expected, so that the largest part of the simulations has been conducted only in the last months. Nevertheless, in total, more than 100 years have been simulated with the ECHAM6 and more than 200 years with the CCLM, considering also „erroneous“ model runs and additional model tests .*

*Preliminary results show, in a first place, the importance of the tuning process in order to minimize the bias emerging from the comparison of model results and observations. The model, in particular, seemed to be particularly sensitive to some of the tested parameterizations. As said, more complex and robust analyses of the first results are still on-going and no absolute conclusion may be drawn at the moment. Nevertheless, we feel quite confident regarding the value of the preliminary outcomes of the conducted work.*

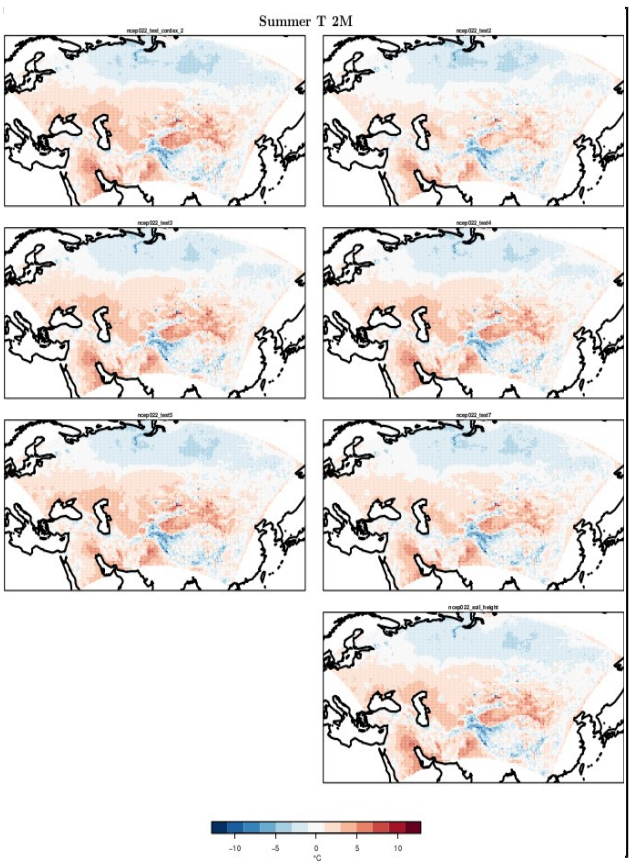


*Abbildung 2: Bias of summer near surface temperature of the different Parameterization test experiments against the CRU dataset. The figure on the top-left box represents the reference simulation with the same setup of the CORDEX east Asia simulation.*

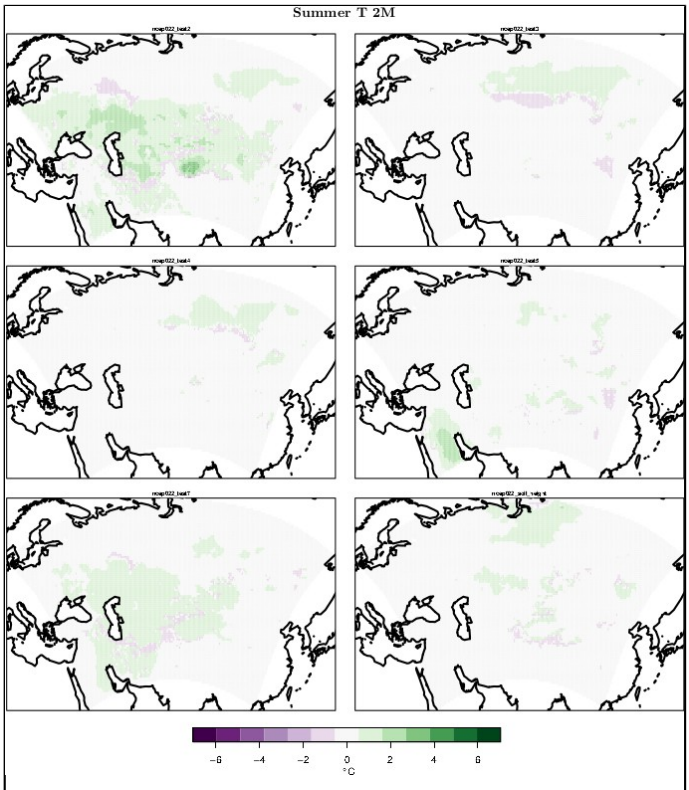


*Abbildung 1: Differences in the absolute bias calculated with respect to the CRU observations between the different parameterization tests and the one using the setup of the CORDEX east Asia reference simulation. Green color indicates an improvement of the results with respect to the reference simulation, while purple color indicates worse results.*