Project: **871**
Project title: **EWATEC-COAST (BMBF)**
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In the project 871 (EWATEC-COAST), funded under the BMBF CLIENT program, an implementation of management tools and environmental technologies for the strongly polluted Thi Vai river estuary in southern Vietnam is developed. The main management tool is a hydrologic-hydraulic model system to simulate river discharge, coastal tides, and mass transport in the river. Atmospheric boundary conditions are necessary to run the hydrological model (eg. temperature, precipitation, sea level pressure and humidity). Our role in the project is to provide these boundary conditions and analyze the physical processes associated with precipitation variability in South Vietnam. The reporting period deals with two main subjects. Firstly with a sensitivity study, which is very important since only few regional climate studies have been performed for southern Vietnam. Secondly, a long time control-run was performed with COSMO-CLM (version 4.8) on a 0.44° horizontal resolution with ERA-Interim Reanalysis as boundary conditions. The long time control-run will be used for a so called **S**tatistical **D**ynamical **D**ownscaling approach (SDD; Fuentes and Heimann, 2000) since nesting files have been written and stored for further analysis. The ultimate aim is to provide the boundary conditions for the hydrological modeling under recent and future climate conditions.

The main focus of the sensitivity studies was to set up the physical and dynamical parameterization for COSMO-CLM in South East Asia. It was analyzed how different tuning factors (like scaling factor for heat over sea) and dynamical parameters for specifying the boundary conditions (like the height of the Rayleigh damping layer) have an effect on the simulation of precipitation and monsoon circulation in the target region. Because of the complex topography of the study area, different model domains for the COSMO-CLM grid were tested. In a final step it was analyzed if the results of the COSMO-CLM runs improve when using the spectral nudging technique. The results of the sensitivity studies have been compared with the tropical rainfall measuring mission (TRMM; Huffmann et. al, 2007), focusing both on the pattern and magnitude of precipitation. Fig. 1 shows an example of this validation for experiments using the Tiedtke convection scheme and spectral nudging, which had shown promising results in the early tests.

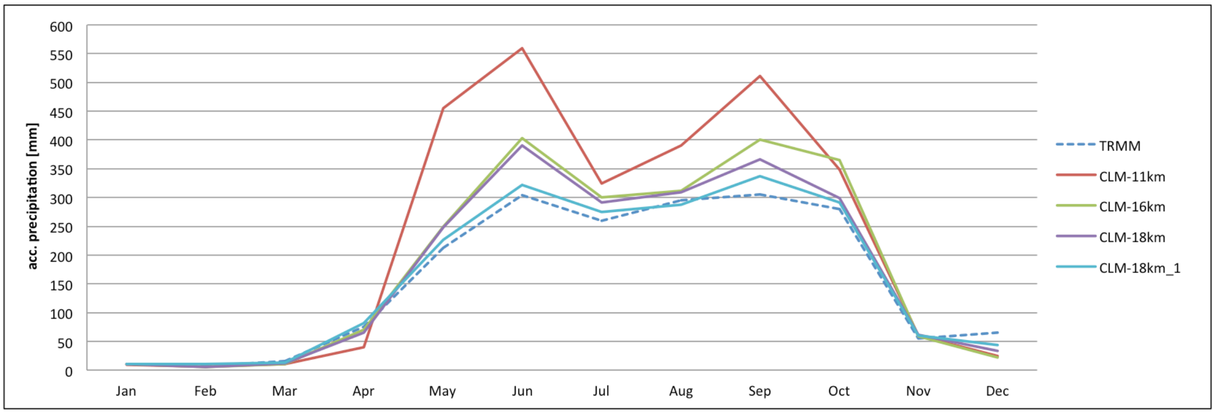


Fig. 1 Annual cycle for the year 2006 of area averaged precipitation between lon (102° - 109°) and lat (8° - 12°). Dotted blue line is the TRMM dataset. The red line is the COSMO-CLM simulation with all setting on default. The other lines show the results of the main sensitivity experiment (see text).

The Rayleigh damping layer was increased from 11 km to 16 km in the first experiment (green line). The purple line represent the results when increasing the Rayleigh damping layer to 18km. This did not have noticeable improvements. Clear improvements were found when increasing the model top layer to 30 km (blue line). All annual cycles exhibit two maxima first in June and second in September. While all simulations overestimated the precipitation, the best results are found when increasing the Rayleigh bottom layer and increasing the model top layer to 30 km.

After the sensitivity tests, a long-term control run was performed with COSMO-CLM, with the optimized configuration, using ERA-Interim Reanalysis as boundary conditions. Hourly nesting files were written and stored. Those nesting files are elementary for the **S**tatistical-**D**ynamical **D**ownscaling approach (SDD) to obtain high resolution climate data to analyze climate variability and change. This approach combines two substantial elements. Firstly the statistical part which is a cluster analysis to determine the relevant weather types. The cluster analysis is based on the zonal wind component in 850 hPa and 200 hPa. Secondly the dynamical part which will downscale the results of the cluster analysis to a 0.0625° horizontal resolution using the nesting files of the long time control run.

In the last months we have focused on the determination of appropriate weather types to characterize the weather and climate variability in Vietnam. Using a k-means cluster analysis, on the zonal wind component in 850 hPa and 200 hPa, six weather types were found and the frequency of occurrence were calculated (see Fig. 2).

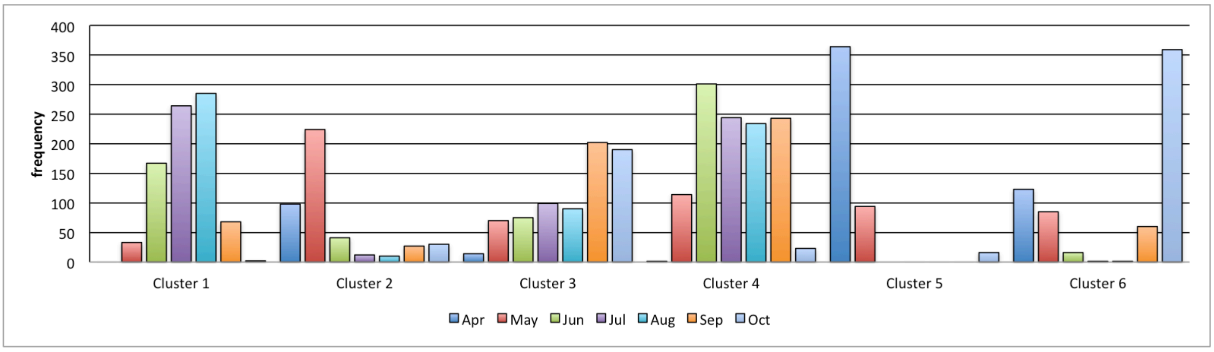


Fig. 2 Frequency of the six weather types (cluster) during the wet period (April – October).

Cluster 1 + 4 represent the main monsoonal period, and are characterized with strong southwesterly winds. Cluster 2 + 5 are characterized with northwesterly winds (before the monsoon onset). Cluster 6 is a weather type for the start of the taifun season that begins in october. The last cluster (2) is a hybrid.

Representative dates that have been simulated with COSMO-CLM in the long time control-run of each weather types were selected and were recombined (weighting with the frequency of each cluster) to a climatology for the recent climate (e.g. Pinto et al. 2010). For the whole spectrum 280 representatives have been considered. The recombined climatology, valid for 1986 – 2005, have been compared with the long time control-run for the same period (see Fig. 3).

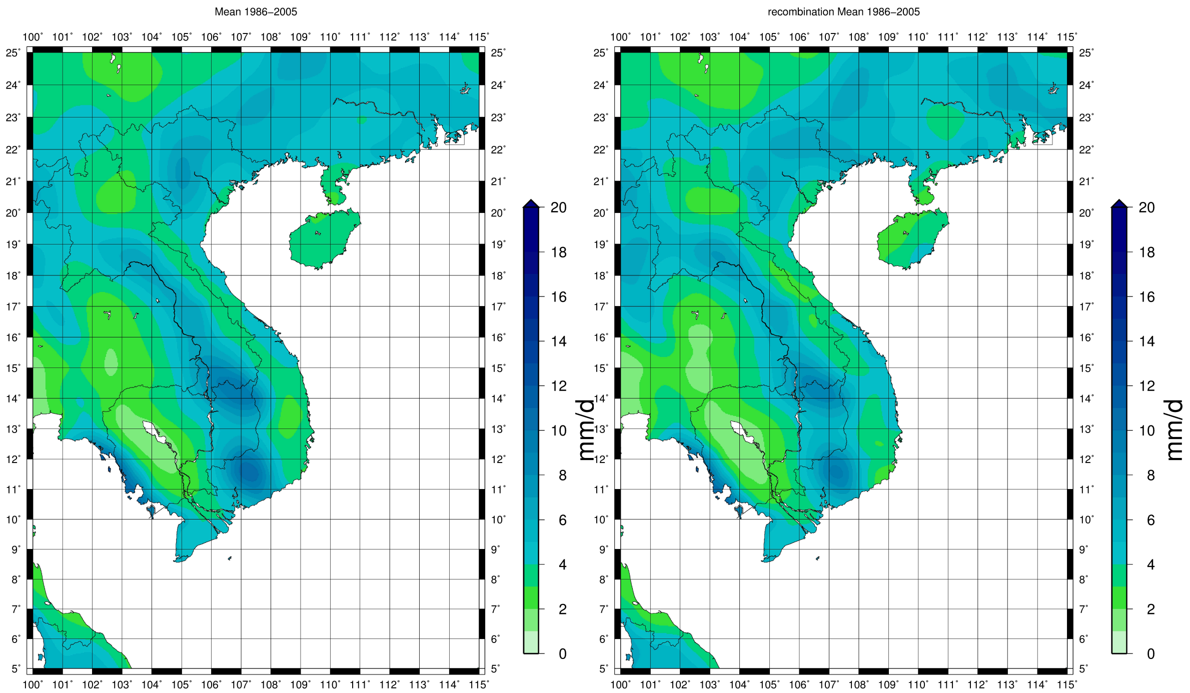

Fig. 3 Climatology for the wet period (1986 – 2005) of the long term control-run with COSMO-CLM (left) and recombined climatology (1986 – 2005) with the 280 representatives of the 6 weather types

It emphasized that the cluster analysis worked well and in a further step the selected representatives will be dynamical downscaled on a 0.0625° horizontal grid resolution to take account the very complex topography over Vietnam. The simulation on the smaller scale have to be simulated with the COSMO-CLM version 4.8, since the nesting files of the control run, have been simulated with the same model version.

Given the positive validation of the SDD method for southern Vietnam, the SDD approach can now be applied to climate change simulations for recent and future climate conditions. With this aim, selected General Circulation Models (GCMs) of the Coupled Model Intercomparison Project Phase 5 (CMIP5) will be used to construct high resolution projections for the RCP4.5 and RCP8.5 scenarios at a regional scale, by using the frequencies of the weather types in those models. The final result are high resolution scenarios of precipitation for Vietnam and boundary conditions for the hydrological modeling.

Literature:

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