Project: 946
Project title: NHCM-2
Long title: The Non-Hydrostatic Climate Modelling, Part II Towards Convection-Resolving Climate Simulations in the Alpine Region
Project leader: Andreas Haensler
Report period: 01.01.2017 – 31.12.2017

As stated in the previous application periods, the main objectives of NHCM-2 are: to investigate the ability of state-of-the-art non-hydrostatic RCMs operated at convection permitting scales (≤3 km grid spacing) to capture important climate processes in the European Alpine region on regional (meso-β) scales; and to derive model configurations for next generation (i.e. convection-resolving) long-term climate simulations in the Alpine region using the regional climate models COSMO-CLM, WRF and REMO-nh. GERICS is tasked to conduct and analyse all REMO-nh simulations for common multi-model analysis and to contribute in the multi-model analyses. The next phase of the NHCM-2 is to continue long-term climate change simulations to further understand the occurrence of future climate precipitation extremes over the Alpine region. This will be done within the framework of the "The Future of Extreme Precipitation Events in the Alpine Region under High End Climate Change Conditions" (Highend:Extremes) , which is funded by the Austrian Ministry for Transport, Innovation and Technology in the frame of the Climate and Energy Fund. The Highend:Extremes Project is also an ongoing project between WEGC and GERICS and the GERICS are tasked to evaluate indices such as heavy to extreme precipitation events over the Greater Alpine Region.

Within the reporting period, we have finished two of the sensitivity simulations which we applied computing time for and have been started in the previous period, namely the reference case and the test with the convection scheme being switched on. The comparison of the two simulations revealed that the convection scheme is not adequate at these convection permitting scales of about 3km.

The simulation results also revealed that the old precipitation scheme in REMO-nh was not suitable any more at these spatial scales since it assumed that the precipitation reaches the surface within one time step. Therefore we have implemented a new prognostic precipitation scheme including advection following the method of a statistical sedimentation by Geleyn et. al. (2008) and Bouteloup et. al. (2012). For this we conducted several sensitivity experiments in order to find suitable parameters of the cloud microphysics.

During the allocation period a CORDEX flag ship pilot study (FPS) was established with the focus on convective phenomena at high resolution over Europe and the Mediterranean. Since the goals of this FPS are very close to those from NHCM-2, it has been agreed within the NHCM-2 project to shift the activities a bit so that they fit also to the FPS on convection.

The first steps of this FPS were to conduct simulations for three real test cases of heavy precipitation events. The was during one of the intense observational periods from HyMeX (IOP16) in October 2012, the second for a strong convective event in Austria in June 2006, and the third for a foehn event in November 2014. We used the Austrian event to compare the results from the two different precipitation schemes and conducted two simulations with the old and the new scheme.

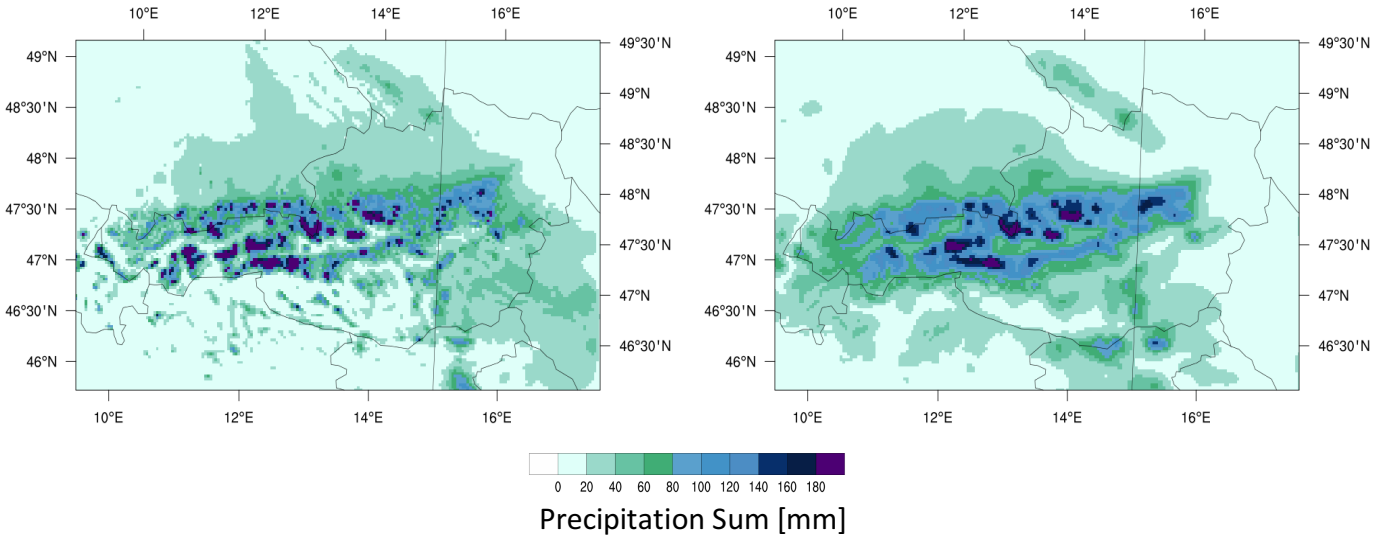

Figure 1: Precipitation sum of a heavy precipitation event during June 2006 using the old precipitation scheme (left) and the new prognostic scheme (right).

Figure 1 shows the precipitation sum of a simulation using the old precipitation scheme (left column) and the new prognostic scheme (right column). The old scheme produces patchy precipitation with too extreme peaks, whereas the new scheme produces a smoother field – which is much closer to what was observed. Therefore the new scheme was used for the other two test cases. Data of these simulations has been submitted to the joined analysis framework of the FPS.

During the rest of the allocation period we will perform a long term simulation with the new precipitation scheme in order to evaluate the model performance on a climatic time scale.

References

Geleyn, J. F., Catry, B., Bouteloup, Y., & Brožková, R. (2008). A statistical approach for sedimentation inside a microphysical precipitation scheme. Tellus, Series A: Dynamic Meteorology and Oceanography, 60 A(4), 649–662.

Bouteloup, Y., Seity, Y., & Bazile, E. (2011). Description of the sedimentation scheme used operationally in all Meteo-France NWP models. Tellus, Series A: Dynamic Meteorology and Oceanography, 63(2), 300–311.