Project: 946

Project title: NHCM-2

Long title: The Non-Hydrostatic Climate Modelling, Part II Towards Convection-Resolving Climate Simulations in the Alpine Region

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Report period: 01.01.2016 – 31.12.2016

As stated in the previous application period, 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" or the Highend:Extremes Project, 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 (GAR).

Within the reporting period, we continued to prepare the REMO-NH model for very high resolutions. We mainly tested the model by simulating idealized test cases such as the warm and the cold bubble test, and the mountain wave test. An example of these test simulations is shown in Figure 1. In the course of these tests, we have implemented several new numerical schemes such as a Rayleigh damping as upper boundary condition, which help to increase the numerical stability of the simulations. We also had to overcome the REMO-specific limit of at most 49 vertical levels in order to keep a reasonable ratio of the vertical and horizontal resolution.

During the rest of this accounting period we will be able to conduct two of the planned case studies (Table 1) on the Greater Alpine Region domain, namely the reference case with 49 vertical levels and the convection scheme being switched off as standard configuration (Case 1). Additionally we conduct the simulation with the convections scheme being switched on (Case 4).

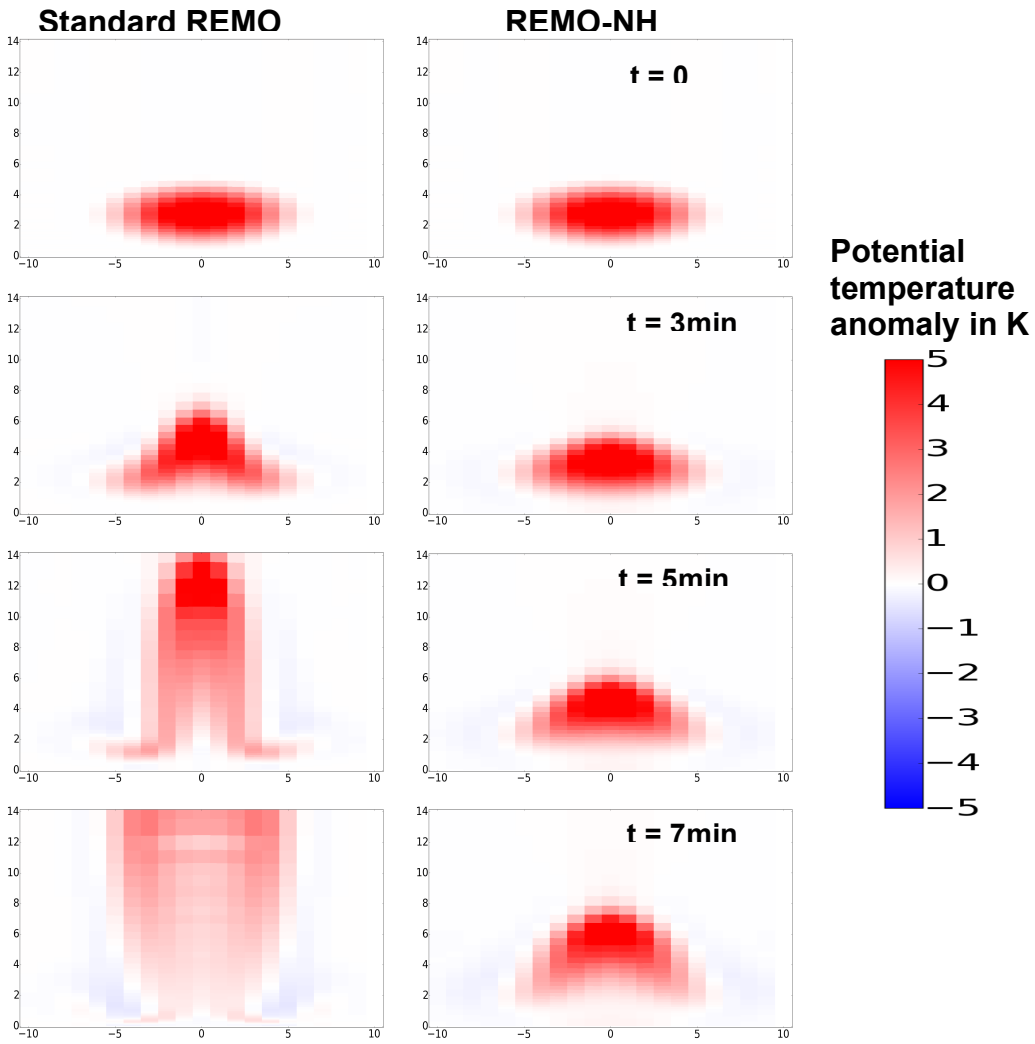

Figure 1. Results from the warm bubble test case with 1km horizontal resolution.

Table 1. Experiment List for the period January - December 2017.

Experiment ID	Description	Status	Period
REMOnh-0.027-C1	Case 1: GAR at 3 km using REMO-nh driven by REMO-0.11 driven by REMO-0.11	Ongoing	2006-2010, 5 years
REMOnh-0.027-C2	Case 2: Increasing the number of vertical levels from 49 to 98 levels, driven by REMO-0.11	**Planned**	2006-2010, 5 years
REMOnh-0.027-C3	Case 3: Changing the soil properties driven by REMO-0.11	**Planned**	2006-2010, 5 years
REMOnh-0.027-C4	Case 4: Switching on the convection scheme driven by REMO-0.11	Ongoing	2006-2010, 5 years
REMOnh-0.027-REF	Reference simulation for GAR at 3km using REMO-nh driven by REMO-0.11	**Planned**	1989-2010, 22 years