Geophysical Research Abstracts
Vol. 17, EGU2015-5479, 2015
EGU General Assembly 2015

Effects of lateral boundary condition resolution and update frequency on regional climate model predictions

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The work presented is part of the joint project “DecReg” (“Regional decadal predictability”) which is in turn part of the project “MiKlip” (“Decadal predictions”), an effort funded by the German Federal Ministry of Education and Research to improve decadal predictions on a global and regional scale.

In MiKlip, one big question is if regional climate modeling shows “added value”, i.e. to evaluate, if regional climate models (RCM) produce better results than the driving models. However, the scope of this study is to look more closely at the setup specific details of regional climate modeling. As regional models only simulate a small domain, they have to inherit information about the state of the atmosphere at their lateral boundaries from external data sets. There are many unresolved questions concerning the setup of lateral boundary conditions (LBC).

External data sets come from global models or from global reanalysis data-sets. A temporal resolution of six hours is common for this kind of data. This is mainly due to the fact, that storage space is a limiting factor, especially for climate simulations. However, theoretically, the coupling frequency could be as high as the time step of the driving model. Meanwhile, it is unclear if a more frequent update of the LBCs has a significant effect on the climate in the domain of the RCM.

The first study examines how the RCM reacts to a higher update frequency. The study is based on a 30 year time slice experiment for three update frequencies of the LBC, namely six hours, one hour and six minutes. The evaluation of means, standard deviations and statistics of the climate in the regional domain shows only small deviations, some statistically significant though, of 2m temperature, sea level pressure and precipitation. The second part of the first study assesses parameters linked to cyclone activity, which is affected by the LBC update frequency. Differences in track density and strength are found when comparing the simulations.

Theoretically, regional down-scaling should act like a magnifying glass. It should reveal details on small scales which a global model cannot resolve, but it should not affect the large scale flow. As the development of the small scale features takes some time, it is important that the air stays long enough within the regional domain. The spin-up time of the small scale features is, of course, dependent on the resolution of the LBC and the resolution of the RCM.

The second study examines the quality of decadal hind-casts over Europe of the decade 2001-2010 when the horizontal resolution of the driving model, namely 2.8°, 1.8°, 1.4°, 1.1°, from which the LBC are calculated, is altered. The study shows, that a smaller resolution gap between LBC resolution and RCM resolution might be beneficial.