Geophysical Research Abstracts
Vol. 17, EGU2015-4631, 2015
EGU General Assembly 2015

Sensitivity simulations of superparameterised convection in a general circulation model

Harald Rybka and Holger Tost
Johannes Gutenberg University, Institute of Atmospheric Physics, Mainz, Germany (rybkah@uni-mainz.de)

Cloud Resolving Models (CRMs) covering a horizontal grid spacing from a few hundred meters up to a few kilometers have been used to explicitly resolve small-scale and mesoscale processes. Special attention has been paid to realistically represent cloud dynamics and cloud microphysics involving cloud droplets, ice crystals, graupel and aerosols. The entire variety of physical processes on the small-scale interacts with the larger-scale circulation and has to be parameterised on the coarse grid of a general circulation model (GCM). Since more than a decade an approach to connect these two types of models which act on different scales has been developed to resolve cloud processes and their interactions with the large-scale flow. The concept is to use an ensemble of CRM grid cells in a 2D or 3D configuration in each grid cell of the GCM to explicitly represent small-scale processes avoiding the use of convection and large-scale cloud parameterisations which are a major source for uncertainties regarding clouds. The idea is commonly known as superparameterisation or cloud-resolving convection parameterisation.
This study presents different simulations of an adapted Earth System Model (ESM) connected to a CRM which acts as a superparameterisation. Simulations have been performed with the ECHAM/MESSy atmospheric chemistry (EMAC) model comparing conventional GCM runs (including convection and large-scale cloud parameterisations) with the improved superparameterised EMAC (SP-EMAC) modeling one year with prescribed sea surface temperatures and sea ice content. The sensitivity of atmospheric temperature, precipiation patterns, cloud amount and types is observed changing the embedded CRM represenation (orientation, width, no. of CRM cells, 2D vs. 3D). Additionally, we also evaluate the radiation balance with the new model configuration, and systematically analyse the impact of tunable parameters on the radiation budget and hydrological cycle. Furthermore, the subgrid variability (individual CRM cell output) is analysed in order to illustrate the importance of a highly varying atmospheric structure inside a single GCM grid box. Finally, the convective transport of Radon is observed comparing different transport procedures and their influence on the vertical tracer distribution.