Atmos. Chem. Phys. Discuss., 12, C13347–C13349, 2013
www.atmos-chem-phys-discuss.net/12/C13347/2013/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "A compressed super-parameterization: test of NAM-SCA under single-column GCM configurations" *by* J.-I. Yano et al.

Anonymous Referee #2

Received and published: 12 March 2013

The manuscript discusses the implementation of the NAM-SCA model into two global atmospheric models in single column configuration. Results from two well-known single column test cases are presented in stand-alone mode (NAM-SCA driven by observations) and coupled mode (NAM-SCA driven by and coupled to a single column atmospheric model).

The manuscript is poorly written which makes reading and understanding difficult. The manuscript contains well over 100 plots distributed over 28 figures. Many of these plots look alike and need to be improved. If published the number of figures would need to be reduced significantly.

The main problem of the presented work is that it is in my opinion conceptually and methodologically flawed.

NAM-SCA is introduced and used as a cloud resolving model (CRM) that is supposed to replace parametrisations of convection in global atmospheric models. However, NAM-SCA is conceptually not a cloud resolving model in its presented form. The included physics is incomplete and not suitable for the purpose of simulating convection. There is no treatment of subgrid scale mixing which is crucial for the evolution of convective clouds. Since the advection scheme is only first order upwind the numerical scheme is highly diffusive. However, this entrainment is entirely driven by the numerics and not by the physics of the problem. Results will be strongly resolution dependent. A key motivation of any super-parametrisation is a more realistic treatment of physical processes. The only physics included here is a very simple cloud scheme which is warm phase only. (Using a smaller fall velocity for precipitation at sub-zero temperatures doesn't change much.) However, ice processes are crucial in deep convection. In addition, the cloud microphysics in NAM-SCA is much simpler than the large scale cloud schemes used in the host models. In the case of the ECHAM model even for convective clouds a two-moment microphysics has already been used (Lohmann, 2008). Thus, in its presented form NAM-SCA does not accurately represent relevant dynamical processes nor does it improve the cloud microphysical schemes that are already in use in the host models ECHAM and ACCESS.

The use of CRMs is restricted to spatial resolutions that correspond to the size of individual clouds. Using 1km spatial resolution is already pushing this limit for boundary layer clouds. Even convection permitting models with parametrised boundary layer clouds are restricted to spatial resolutions finer than 10km. Thus, NAM-SCA has conceptually (assuming it is a true CRM) no skill for spatial resolutions coarser than about 1km. Most of the investigation focuses on coarser resolution cases that should be removed from the discussion.

The only quantitative metric used to evaluate model performance is a root-mean square

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difference between simulations and observations. This metric is not suitable since it assigns the smallest error to a physically unrealistic atmospheric state as simulated with 16km resolution in a 32km domain. As described in chapter 4.2.2 the NAM-SCA only produces drizzle in this configuration, the simulated dynamics is completely dominated by the grid. Thus, I don't agree with the author's main conclusion that a coarse resolution in NAM-SCA is as good as or even better than a fine resolution.

Before the presented material can be published as a novel contribution to super-parametrisations the representation of dynamical and cloud microphysical processes in NAM-SCA needs to be improved, investigations need to be restricted to cloud resolving scales. At the moment, NAM-SCA is not much more than a toy model that produces features that resemble convective clouds without much scientific basis.

Interactive comment on Atmos. Chem. Phys. Discuss., 12, 28237, 2012.

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