Atmos. Chem. Phys. Discuss., 10, C10395–C10397, 2010
www.atmos-chem-phys-discuss.net/10/C10395/2010/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Evaluation of cloud convection and tracer transport in a three-dimensional chemical transport model" *by* W. Feng et al.

Anonymous Referee #3

Received and published: 29 November 2010

The objective of this paper is to estimate the sensitivity of simulated cloud convection in the TOMCAT model to the model grid resolution, surface evaporation fluxes (strength and resolution), type and resolution of large-scale forcing (from ECMWF). The results are presented in a pedagogical order. The figures are clear. The paper, however, would gain a more deeper analysis of the results and detailed explanations on specific points (see below). These clarifications and analysis are essential to give the paper a broader scientific impact.

Surface evaporation fluxes appear to be a key variable in this study. It is not clear in the present version of the paper how the high resolution evaporation fluxes (1x1) are

mapped in the lower resolution model grid (2.8 x 2.8). Are the fluxes simply averaged over the coarser grid ? How do these new fluxes compared with the default UGCM fluxes in terms of time evolution, location of maxima, etc ... ?

What is the methodology of the (re)construction of convective mass fluxes or winds when the meteorological analysis have higher resolution than the TOMCAT model ? How the chosen methodology impact on the differences between the TOMCAT model and ERA40 or ERA-Interim analysis ?

In section 4.3, why does the model underestimate the convective mass fluxes and the precipitation at latitudes higher than 30° ? Could it be due to the boundary layer moisture convergence criteria used by the Tiedke scheme ?

Could the authors explain how the convective precipitation are calculated in the model ?

In section 4.4, it would be worth adding a transport equation for the radon in the model, plus an explanation of the convective transport scheme applied to the tracer. The reader might not be fully aware of how the model works.

In Figure 12, all the versions of the model underestimate the observations around 8 km in summer. Is the convective scheme systematically underestimating the detrainment in this layer ?

The authors conclude that the model is not sensitive to the model grid horizontal or vertical resolution. This conclusion is to some extent in contradiction with previous works and would deserved a dedicated discussion. Why is the model unsensitive to changes in resolutions ? Is there a buffering effect in the model or convective parameterization which lessen this impact ? For example, the authors may want to discuss their results in the light of the following references:

The impact of horizontal resolution on moist processes in the ECMWF model, Phillips JT, Corsetti LC, Grotch SL, Climate Dynamics, 11 (2): 85-102, 1995.

Effects of resolution and model physics on tracer transports in the NASA Goddard Institute for Space Studies general circulation models, Rind D, Lerner J, Jonas J, et al., JOURNAL OF GEOPHYSICAL RESEARCH-ATMOSPHERES, 112, D9, D09315, 2007

The processes governing horizontal resolution sensitivity in a climate model, Pope VD, Stratton RA, CLIMATE DYNAMICS, 19, 3-4, 211-236, 2002

Impact of horizontal resolution on seasonal integrations, Brankovic T, Gregory D., CLIMATE DYNAMICS, 18, 1-2, 123-143, 2001

Sensitivity of equatorial convection to horizontal resolution in aquaplanet simulations with a variable-resolution GCM, Lorant V, Royer JF, MONTHLY WEATHER REVIEW, 129, 1; 2730-2745, 2001

Interactive comment on Atmos. Chem. Phys. Discuss., 10, 22953, 2010.