Geosci. Model Dev. Discuss.,
https://doi.org/10.5194/gmd-2018-165-SC2, 2018

Geoscientific
Model Development
Discussions
Open Access

Interactive comment on "Tropospheric mixing and parametrization of unresolved convection as implemented into the Chemical Lagrangian Model of the Stratosphere (CLaMS)" *by* Paul Konopka et al.

I. Wohltmann

ingo.wohltmann@awi.de

Received and published: 15 November 2018

Dear authors,

first I have to apologize for the late comment, I just stumbled over this interesting manuscript at the last minute.

Given that your method is so different from the usual method of parameterizing convective transport in Lagrangian models (e.g. Collins et al., QJRMS, 128, 991-1009, 2002, Forster et al., J. Appl. Meteorol. Clim., 46, 403-422, 2007, Rossi et al., Geosci.

Printer-friendly version

Discussion paper

Model Dev., 9, 789-797, 2016), I wonder about 2 things.

1. Do you get reasonable convective mass fluxes or detrainment and entrainment rates from your approach? The schemes cited above all take a statistical approach which uses given convective mass fluxes and entrainment and detrainment rates. E.g., typically a probability for entrainment of a Lagrangian air parcel into convection is calculated by comparing the mass of air entrained in a given time step (according to the entrainment rate in a layer) to the mass of that layer. Then, random numbers are drawn to determine if a given trajectory goes into convection. This approach implicitly makes sure that the convective mass fluxes, entrainment rates and detrainment rates from the underlying convection parameterization (e.g. Tiedtke parameterization in ERA Interim) are correctly reproduced (this requires averaging over a large enough ensemble of trajectories). It also considers that the mass associated with an air parcel in a global Lagrangian model is usually much larger than the mass transported in a single convective event. As far as I can see, you don't mention convective mass fluxes or entrainment or detrainment rates in your manuscript, and there is no constraint in your method on the convective mass fluxes. I think it would be interesting to discuss this (even considering that you can't normally compare to measurements (exceptions are few, as e.g. Kumar et al., J. Atmos. Sci., 72, 1837-1855, 2015), but maybe comparing to the convective mass fluxes and detrainment rates of ERA Interim would be nice).

2. The updraft of the air parcels in convective events needs to be balanced by subsidence in cloud free air to ensure mass conservation. Usually, Lagrangian convective transport schemes do contain an explicit parameterization for this. It seems that you don't consider subsidence explicitly, and that you rely on the CLaMS mixing scheme to handle that "automatically" ("the mixing procedure is able to adjust a certain increase or decrease in the number of air parcels", page 11, line 1). This seems to be an unrealistic approach at first glance. Wouldn't it be better to subside all air parcels outside convection by a given distance, as it is done in other schemes?

Best regards, Ingo Wohltmann

Interactive comment on Geosci. Model Dev. Discuss., https://doi.org/10.5194/gmd-2018-165, 2018.

Printer-friendly version

Discussion paper