Geoscientific
Model Development
Discussions

[GMDD]

Interactive
comment

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.

Anonymous Referee #1

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This study introduces a heuristic idea to extend the mixing scheme in CLaMS down into the troposphere. Konopka et al. parametrised an additional mixing process using the dry Richardson number and added it to the existing CLaMS mixing scheme. Moreover, convective uplift in the troposphere is represented by using the moist Richardson number to calculate an additional vertical displacement to the trajectory. Konopka et al. evaluate their new parametrisations by comparison of Age-of-Air for the stratosphere, propagation of CO_2 from the planetary boundary layer to the lower stratosphere, and CO_2 variability with observations.

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Discussion paper

C1

The paper is well written and clear structured and is suitable for publication in GMD after revision.

General Comments:

1. Title: The term "parametrisation of convection" suggests, that you describe a more or less comprehensive convection parametrisation with up- and downdrafts and compensation motion. But what you actually show (you mentioned it in the abstract) is "convective uplift and mixing". Please, modify the title accordingly.

2. The citation of other publications describing Lagrangian models, which already use Lagrangian convection is missing. Please, cite other work introducing Lagrangian convection or convective mixing, e.g. Collins et. al. (2002) Q.J.R.M., Erukhimova and Bowman (2006), J. Geophys. Res., Forster et al. (2007), J. Appl. Meteorol. Clim.

3. I would suggest to select the word " simulations" instead of "runs".

4. Vaisala or Väisälä? Decide for one notation.

Specific comments:

Page 2, line 18: Ri_c: omit the subscript here.

Page 2, line 28: "considered" instead of "detected"

Page 2, line 30: Instead of "roughly" just say "above"

Page 2, line 32: heuristic (not heurestic)

Page 3, line 34: reasonable

Page 3, line 35: Please specify here, at what height your lowest model boundary is. From your Figures I would suggest that it is the surface layer?

Page 3, line 38: upward

Page 3, line 7: Please explain: is there a reason why you compare a one year mean of

2007 (CLaMS) with a WACCM climatology over 1955-2099? Is the WACCM simulation of AMIP type or a time-slice experiment?

Page 4, line 5-7: What did you wanted to say with this sentence?

Page 5, line 3: The point at the end of the sentence is missing.

Page 5, line 6: "condition"

Page 6, line 17: In Table 1 you list 2 reference simulations. Please use the same abbreviation in the text. Is REF or REF-6h meant by the reference simulation?

Page 6, line 22: You refer to a period between 2005-2008 of the reference simulation. Please explain, how do you calculate Age-of-Air from such a short simulation? I would expect that at least a 20-year model simulation had to be performed to calculate Age-of-Air.

Page 7, line 11: Vertical boundaries of layers on the left side? What do the tics on the right side of Figure 7 mean?

Page 11, line 12: Instead of "validate" please say "evaluate".

Page 12, line 2: You refer to a relatively short period of the control simulation (2005-2008). Please explain, how you calculate Age-of-Air from such a short simulation.(Figure 7 and 11)

Page 13, Fig.7: Please use a colour bar, which better shows the differences of Age-of-Air in the troposphere, because your modifications in CLaMS have only less influence on the stratospheric distribution of Age-of-Air. Moreover, the influence of the reference pressure on the results in the troposphere should be better visible for a discussion. Alternatively, you might also present the difference of the (control-300hPa) minus (control-700hPa) simulation. In Table 1 you list the simulations TROP_MIX and UNRES_CONV, representing simulations with either tropospheric mixing or convective uplift. Could you please show the result of Age-of-Air for these simulations, also? This

would provide more information on the spacial impact of different mixing attempts on the troposphere.

Page 14, Figure 8: Please describe the simulations you analysed in the Figure caption. 8a-d. 8cd) seems to be the reference simulation, but it is not clear, if it is REF or REF-6h.

Page 15, line 22-25: Please explain, why it is plausible, that you find a faster upward propagation in the CLaMS control simulations compared to REF. Why is the interhemispheric transport weaker in the sigma=0.7 simulation?

Page 16, Figure 9: The date in the Figure caption should be 25.9.

Page 19, Figure 11: 11c) shows a simulation not described in Table 1. I found 3 simulations with the same name (FULL_EXT), but with different set-ups. Are 11b+c) simulations with the reference pressure at 300hPa or 700hPa?

Page 18, 10-10: Please use the abbreviations for the simulations TROP_MIX and UN-RES_CONV also in the text. So far they can only be found in Figure 10 and Table 1.

Page 18, line 5: "Although there" instead of "Also there"?

Page 18, line 1-5: If you mention simulations, please refer to the notations in Table 1. All control simulations should be described in section 4.1 and summarised in Table 1.

Page 20, line 3-5: The last part of the sentence "especially the effects on the stratospheric water vapour" makes no sense.

Page 20, line 26: temperature

Page 21, Figure caption A1: removed,

Page 24, line 7: air parcel

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2018.