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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Quantifying tracer transport in the tropical lower stratosphere using WACCM" *by* M. Abalos et al.

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We acknowledge the careful review by Anonymous referee #1 and answer the specific comments below.

Specific comments:

Pg. 13250, lines 8-10: Any idea how significant the remapping from Lagrangian to Eulerian framework is to the tracer budgets?

» Although we do not have a quantitative estimate of the uncertainty introduced by the remapping process, it is a minor effect (consistently with the small residuals in our budgets). We have specified this in the manuscript.

Pg. 13251, line 12: Any significance to the offset in CO above 70 hPa to the analysis that follows?

» The MLS observations have large relative uncertainties at these levels, where CO concentrations are very small (<30 ppbv). Hence it is not straightforward to know if the larger differences between the model and the observations at these levels are due to misrepresentation in the model or to uncertainties in the observations.

Pg. 13251, line 22: Sawblade shape to the CO seasonal cycle in MLS isn't captured in the model. Any explanation, significance?

» A saw blade shape is observed in the time series of MLS CO observations at 68 hPa, because the decrease in boreal summer is slower than the increase in winter, due to the long timescales of CO photochemical loss (∼3-5 months). The time series of CO from WACCM in Figure 2 also show these different increase/decrease rates. This becomes more evident in Figure 3, where the variability in CO is directly contrasted with temperature and ozone. The minimum concentrations in CO are reached ∼1-2 months after the maxima in ozone and temperature, similarly to the observations. On the other hand, we note that exact correspondence between WACCM and MLS CO is not expected in this free-running simulation. Possible sources of uncertainty for CO concentrations in the model are the emissions and the representation of detailed transport processes (e.g. convection).

Pg. 13251, line 25: It doesn't seem like Figure 3 belongs in this section, or maybe the section needs to be renamed. There is no "comparison of WACCM with observations" in this figure, it's only WACCM output. This figure is also somewhat redundant with Figure 2, at least the WACCM part.

» Figure 3 is included in this section named "Comparison of WACCM with observations" because it is the model's equivalent of Figure 1 in Abalos et al. (2012), which represents the same time series but for the observations, and should be compared to it. In this sense, Figure 3 belongs in this section, and we have added a few words to

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clarify this. This figure provides additional information respect to Figure 2, because it demonstrates that the model captures the common variability between temperature and tracers found in the observations.

Pg. 13254, line 20: Figure 7 is really nice. Lots of details in there that could be described further, but only if room to do so.

» We agree that there are many interesting details to analyze in this figure, but focusing the attention on them would perhaps distract the reader from the main points of the paper. We have decided to remove tropospheric levels from this figure in order to help the reader focus on the relevant region and facilitate identifying the key features described in the manuscript.

Pg. 13259, lines 10-13: How do you think the shift in peak vertical level of the annual cycle in ozone shown in Figure 4 might affect the profiles in Figure 11? If the peak annual cycle amplitude shifted down from 70 to 80 hPa as in the observations there might not be as clear a separation in the horizontal vs. vertical contributions to the annual cycle. Might be worth mentioning here.

» We agree, and we added a comment on this in the new version of the manuscript.

Pg. 13262, line 1: Replace “Eddy transports are” with “Eddy transport is” and replace “have” with “has”.

» It has been changed.

Pg. 13262, line 9: An extra “in” should be removed.

» It has been removed.

Pg. 13262, line 26: Add “to” between “close” and “the”.

» It has been added.

Pg. 13263, line 5: Switch the order of the words “also” and “be”.

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» It has been changed.

Pg. 13264, line 6: Replace the first “CO” in the line with “ozone”.

» It has been changed.

Interactive comment on Atmos. Chem. Phys. Discuss., 13, 13245, 2013.