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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Stratosphere-troposphere ozone exchange from high resolution MLS ozone analyses" *by* J. Barré et al.

Anonymous Referee #1

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This work examines the impact of MLS ozone analyses and horizontal resolution of the model on the simulated ozone in the troposphere and lower stratosphere in the MOCAGE CTM. Emphasis is placed on the simulation of two tropospheric intrusion events and the associated STE. Improvement in the representation of UTLS ozone and STE is a current relevant scientific issue within the scope of ACP. Although there does not appear to be many novel concepts, tools, etc. introduced here, the work is likely of interest to readers of the journal. Before I can recommend publication, I feel that several issues and interpretations need to be addressed by the authors.

Specific Major Issues:

Of primary concern is the "disconnect" between the dynamics/transport and analysis ozone fields and the interpretation in the context of the Wei STE diagnostic. The parenthesized term in Eqn. 1 represents the total mass flux through the tropopause. For a given model resolution, this term does not change in the CTM. I don't believe it should change much for the different resolutions either since the ARPEGE meteorological fields from which this term is ultimately calculated are the same and simply interpolated to the CTM resolution. The transport fields remain the same between the various simulations. The difference in the calculated ozone flux must be solely due to the change in the ozone mixing ratio on the tropopause due to the assimilation. The authors show that the ozone mixing ratio is too small in the lower stratosphere in the free running model. This must be from either too much chemical loss in the CTM, the net extratropical downward transport is too weak from the driving meteorological fields, or from the boundary conditions at the model top. Given the results in Figure 1, I would hazard a guess that it is due to the downward transport. This suggests that the total mass transport across the tropopause is also possibly too weak, and if so, also suggests that the ozone flux estimates are biased low. In the free running experiments, the ozone fields remain "connected" or consistent with the transport fields. The increments added in analysis produce ozone fields that are not truly consistent with the driving fields. I understand that this is the "nature of the beast" when using assimilation in these CTM experiments. However, any increase in ozone flux within the assimilation domain can arise from the analysis increments and not "transport". The authors need to be careful to address these topics in their descriptions and interpretations rather than simply discussing differences in "transport".

I also did not follow the authors' reasoning of why the ozone analyses produced a positive bias throughout the troposphere in the vicinity of the filaments. The assimilation adds increments down to 215 hPa and I can see how the gradients can get smoothed when the resolution of the model is insufficient compared to the scale of the features at these levels. Yet, these features will not get "smoothed" from the analysis below the assimilation domain. A better description of the reasoning needs to be presented on

this subject.

Specific Minor Issues:

P33427 L5-7, Not all STE is a result of irreversible isentropic processes. The authors even acknowledge this in the last sentence of section 4.1.

Figures 3-6 and related text, I assume the horizontal plots are on a theta surface. What surface is this?

P33430 L18-19, The filament IS visible in ozone in the LR case. However, it is more clearly defined with sharper gradients and is defined by the 2 PVU contour in the HR case.

P33431 L3-5, How is this conclusion reached? The authors do not give any evidence here for this statement.

P33438 Section 5.1, This appears contradictory to the statements above where the HR run results in less STE. A comment on this is needed.

Technical Corrections (I list a few corrections needed here, a careful proofreading is needed to correct other typos and English use):

P33431 L22, I assume the authors intend "5° [E]"?

P33437 L9-11, Forgot the "10" in the exponents.

P33438, L1, should be "greater" not "increasing" which implies getting larger over time.

P33438, L14-16, The English usage should be corrected.

P33440, L20-21, ". . .represent [the] strong gradients. . ."

Interactive comment on Atmos. Chem. Phys. Discuss., 11, 33419, 2011.