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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Variability in upwelling across the tropical tropopause and correlations with tracers in the lower stratosphere" *by* M. Abalos et al.

Anonymous Referee #2

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This paper describes an analysis of the variability in temperature, ozone and CO in the tropical lower stratosphere. The stated hypothesis is to show that the distributions of these trace gases in this part of the stratosphere are primarily controlled by upwelling. The authors use the TEM formalism to show that there are statistically significant correlations between tropical upwelling and ozone and temperature variability on time scales from 10 days or so up to seasonal. However, correlation does not prove causation. This is especially relevant because of the recent work by Ploeger et al. (2012) using a Lagrangian analysis that clearly shows the seasonal cycle of ozone in the tropical lower stratosphere is driven by mixing from the extratropics during the monsoons and is essentially independent of the variability in upwelling. The authors acknowledge

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Interactive Discussion
Discussion Paper

the Ploeger et al. paper but only briefly and do not give any suggestions as to why there is such a large difference in the interpretation of ozone variability between the two techniques and how to reconcile it.

There is nothing wrong with the analysis performed in this paper. The techniques used and results are clearly described throughout. The TEM formalism has been used for many years now and in fact the analysis done here is mostly an update and extension of Randel et al. (2007). But in light of the Ploeger et al. results it is not enough in my opinion to do the TEM analysis, find a contradictory interpretation, and not address the contradiction in a more substantial way. Ploeger et al. mention in their conclusion section that it is not straightforward to compare Lagrangian and TEM analyses. But they did show that the TEM formalism does not separate vertical advection and horizontal in-mixing as clearly as the Lagrangian formalism. Figure 6 in the current paper does show a large residual term that includes mixing and the authors acknowledge this. But since the residual term does not follow the overall tendency term it is discounted as not being relevant to the seasonal cycle.

The Ploeger et al. paper has essentially raised the bar on understanding the variability of ozone in the tropical lower stratosphere. I don't think that the current paper advances our understanding any further since the end result is essentially the same as that of Randel et al. (2007). Without some attempt to reconcile the drastically different results of the TEM and Lagrangian analysis the community is left with a confused picture of the tropical lower stratosphere. Instead, we need to know which analysis gets us closer to understanding what is actually going on in this region of the atmosphere. Does the TEM analysis effectively separate advection and mixing? What affect does the use of pressure vs. potential temperature coordinates have on the analysis? These aspects and others related to the different analyses are actually quite interesting and need to be explored further.

I recommend that the authors should address some of the above comments before the paper is published. It's certainly beyond the scope of this paper to resolve the

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discrepancy but there at least needs to be some effort put into helping the reader understand why it is there and how to move forward in understanding it. A few minor comments to also consider are included below.

Specific comments

Pg. 18826, lines 8-10: There is good agreement between wm and wq at 100 and 70 hPa, but not so much at 80 hPa. Any explanation for why this might be the case?

Pg. 18832: The correlations shown in Fig. 10b may be statistically significant but with values of 0.7 and lower this means the upwelling is explaining less than half of the tracer variance. And less than a quarter of the variance is explained at 80 hPa and below. Is this consistent with upwelling being the primary controlling mechanism of ozone variability throughout the tropical lower stratosphere?

Pg. 18833: Again in Fig. 11a the correlation may be significant but there is a lot of spread around the linear correlation. Just over a third of the variance is explained at this level by the correlation. It would be good to at least mention this.

Pg. 18834, line 18: “primarily” should be “primary”

Interactive comment on Atmos. Chem. Phys. Discuss., 12, 18817, 2012.