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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Insight from ozone and water vapour on transport in the tropical tropopause layer (TTL)" *by* F. Ploeger et al.

Anonymous Referee #1

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Transport through the TTL and into the tropical lower stratosphere is studied using a Lagrangian chemical transport model (CLaMS). Different ways to calculate Lagrangian transport (trajectories) are contrasted: 1) using pressure coordinate vertical velocities and 2) using potential temperature coordinate vertical velocities. These transport calculations are applied to water vapour and ozone. In the case of water vapour the two different ways to calculate Lagrangian transport give similar results ($\sim$ small sensitivity to details in the transport calculation), whereas in the case of ozone substantial differences are found. The differences in transport of ozone are attributed to large sensitivity with respect to vertical (and horizontal?) dispersion. The authors conclude that ozone represents a more appropriate tracer to constrain transport in the TTL.

This study represents a nice and valuable contribution to improve our understanding

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Interactive Discussion
Discussion Paper

of a complicated atmospheric region with a couple of quite interesting results. The manuscript is well written and in most places straightforward to follow. Some of the methodology maybe hard to follow for someone without prior knowledge in trajectory calculations (see my specific comments/recommendations below). I only have a few minor comments (see below) and recommend publication of the material after these have been taken into account.

Minor Comments:

general:

1. It seems that what the authors find is that a tracer with a large vertical gradient (such as O3) in the region of interest is better suited to understand (possibly subtle) differences in transport than a tracer with a very small vertical gradient (such as H2O). If the authors agree that the above represents the main advantage of O3 with respect to H2O than this should be more clearly stated in the paper. It would also be interesting to comment on possible other tracers with the desired property (whatever that property may be).

2. I'd encourage the authors to be more careful with their wording concerning the concepts of backward trajectories, initialisation, initial values, etc. For example, in the schematic, Fig. 1, the departure point for the backward trajectories (which would correspond to a given arrival point in a forward sense) is labeled "initialization location", at the same time the final location of the trajectory ($\sim$ the departure point in a forward sense) is labeled "initial H2O, O3". This is very similar terminology for very different diagnostics, which could lead to a lot of misinterpretations on the reader side.

specific:

L = line

L126-128: is this due to the 4dVar data assimilation used in ERA interim?

L140: Why are these two flights not included?

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L153: What is the sensitivity to the 350 K value - depending on geographic location, values within ∼340-360 K would also seem to be reasonable?

L174/175: this is a good example of where the wording could lead to misinterpretations - please clarify how "end point", "forward-time" and the backward sense of the trajectories are related

L227: not clear why "differences" is highlighted, given the sentence already starts with "Differences will be discussed ..."

L243: Equivalent latitude - essentially a PV coordinate - is more of an extratropical concept - why is this concept used here, that is, in the tropics?

L364: section 3.1 - there is no section 3.2 !?

L398: "ideal" - more appropriate / better?

L401: section 4.1 - there is no section 4.2 !?

L422/3: please be more specific/explicit

L425: vertical dispersion

L465/66: "relatively small differences in transport" - my impression from your previous study (Ploeger et al., 2010) was that this difference is relatively large - please clarify

L470: what does this "maximum increase" refer to - trends / vertical gradients / ...?

L492: is -> are

L515: isentropic

L550-555: not sure I understand your point - the tape recorder is a zonal mean signal, whereas the Sherwood argument applies locally - please clarify

L565: ascent -> upward?

L589: repeating the "particular problem" here would help readability

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Interactive Comment

Fig. 2: why do you plot harmonic fits as opposed to just monthly means?

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