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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Residual circulation trajectories and transit times into the extratropical lowermost stratosphere" *by* T. Birner and H. Bönisch

Anonymous Referee #4

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This paper presents a study of the stratospheric residual circulation, using trajectories calculated from the residual mean (TEM) meridional and vertical velocities from CMAM and two reanalyses. The residual circulation and stratospheric age of air have been the subjects of much research activity in the last decade, especially as models and atmospheric analyses have improved markedly. In this study the attention is focused on the slow global-scale advective transport, and by separating it from the fast quasi-isentropic two-way mixing its effect on the transport into the lowermost stratosphere (LMS) is isolated. The results are important and therefore of interest to the stratospheric research community.

However, I feel some of the methods and claims in this paper are not sufficiently explained. In particular, the authors attempt to separate the residual circulation into a "deep" and "shallow" branch by picking particular values of diagnostics such as mean age and aspect ratio of vertical to horizontal extent of trajectories. While I agree on this separation of the circulation in a qualitative sense, I feel the evidence presented by the authors do not justify a quantitative measure to divide these two branches. Therefore, I recommend the article for publication after these issues are addressed.

Specific Points

Section 2:

P 16842, line 2 - The authors use monthly averaged $\overline{v}^*$ and $\overline{w}^*$ in order to obtain smoothly varying velocity fields in time. Why is this necessary? Would the results be significantly different if daily values of $\overline{v}^*$ and $\overline{w}^*$ were used?

P 16842, line 8 - How is the tropical tropopause defined here?

Section 3:

P 16843, line 14ff - The contour plot figure 3 shows that there is a latitudinal gradient in transit time in the LMS, but does not demonstrate why 1 year would be a suitable cut-off time. Would the latitudinal gradient of transit time $d\tau/d\phi$ give a clearer picture?

P 16844, line 7 - The problems with ERA-40 are well-known, but it is interesting to see it from a residual circulation perspective. It would be useful to show the comparison between ERA-40 and ERA-Interim.

P 16845, line 9 - The same issue as figure 3: why is r=1$\times 10^{-3}$ a suitable choice? Figure 5 (right top panel) show that from 30° to 90° r spans a range from 0.5 to 3. Again, would plotting the horizontal derivative of r help?

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Interactive Comment

P 16846, line 25 - “predominantly”

Section 4:

P 16848, line 9 - Again, I dispute the use of the word “clear” here.

P 16860 - Figure 9: This figure is very interesting. Is it possible to combine them in some way to give an estimate of the contribution of the two-way mixing?

Interactive comment on Atmos. Chem. Phys. Discuss., 10, 16837, 2010.