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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Characteristics of lower stratospheric transport as inferred from the age of air spectrum" *by* F. Ploeger and T. Birner

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This paper uses trajectories from the CLaMS transport model driven by ERA-Interim meteorology to analyze stratospheric age of air spectra. This work provides unique and revealing insights into the stratospheric transport on various time scales and latitude regions. The authors have recently done nice work on explaining various aspects of the stratospheric mean age of air and how the residual mean circulation and isentropic mixing contribute to the observed mean age distributions. But as they mention here, the age spectra provide another level of information, in particular how the transport variability imprints on the age spectra for years afterward.

The analysis is excellent and I highly recommend publication with consideration of the minor comments below. The paper is a bit long, 16 figures is quite a lot but I don't

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have any specific suggestions on what could be left out. Perhaps with fewer figures a bit more time could be spent explaining some of the new and unique features of the remaining plots.

Minor comments:

Page 2, line 14: awkward sentence, change to something like “comes with the benefit of allowing one to separate. . .”

Page 2, line 35: “. . .and allows one to calculate the. . .”

Page 2: Just a comment that in my Ray et al. [2014] paper figure 4 shows age spectra from the TLP model with multiple peaks with clear seasonal and QBO influence. We didn’t explain what caused the peaks beyond the known variability in the MERRA transport input to the model but thought you might want to include a mention of this paper here.

Page 7, line 13: “. . .allows one to quantify air. . .”

Page 8, lines 13-15: The younger tropical spectrum peak in DJF in Figure 6 is hard to see. I’ll take your word for it but this figure doesn’t seem to back up that statement unless I’m missing something.

Page 10, lines 1-8: Figure 9 is really nice and has so many features it takes some time to appreciate them all and what they mean. The propagation of the signals to older parts of the age spectra with time is reminiscent of the tropical tape recorder signal but has a different physical meaning. It’s actually difficult to interpret physically what’s going on with these signals because it’s in a different phase space than we’re used to thinking about. For instance, in Figure 9c-f there are anomalous peaks and troughs in the spectra that appear to propagate from the time when an event like a QBO easterly phase occurred at ages from 1-2 years for the following 4 years out to ages of 6 years. The actual air masses that were influenced by the QBO transport anomaly move around the stratosphere and many of them actually leave the stratosphere over

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the following 4 years and yet at this theta level and latitude range there is a signal that remains. It's as though the air influenced by the particular QBO event circulates around and enough of it comes back through this theta and latitude region to maintain an anomalous signal. That's actually remarkable! It might be worth spending a bit more time explaining the physical meaning of this plot and the features since I don't think it's obvious and I'm not even sure I'm getting the full picture.

Figure 5: in the caption the hemispheres are switched for (b) and (c).

Figure 6: in the caption should be "show"

Figure 7: In the interest of shortening the paper could be one to consider removing.

Figure 9: Really interesting as mentioned above and a lot going on here. My suggestion to be able to see the features more clearly on b,d and f primarily is to separate out the delta age, mode and RCTT that are on the right axis into their own plots. It's hard to see their oscillation around the zero line as it is and it obscures somewhat the propagation of the pdf anomalies.

Figure 14: Is each of the 3 lines of each color an individual month within DJF?

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