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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Inter-comparison of stratospheric mean-meridional circulation and eddy mixing among six reanalysis datasets" *by* K. Miyazaki et al.

Anonymous Referee #2

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General:
Starting from the well-known 2d picture decomposing the Brewer Dobson circulation (BDC) into the mean meridinal circulation (MMC) and eddy mixing (EM) the authors use the method of mass-weighted zonal means (MIM) to quantify both, the MMC and EM contributions, for six reanalysis data sets. Overall, this is an important contribution in the ongoing discussion of the uncertainties of the reanalysis data, especially in their ability to represent stratospheric trends. The paper is well-written and contains results which are worth to be published. The most novel results are related to the analysis of eddy mixing (in terms of the meridional diffusivity K_{yy}) and of the relative importance of eddy mixing in relation to mean meridional circulation. However, there are

some (partially major) critical points listed below which should be addressed before publication:

Major points:

1. The recently published paper, Abalos et al., JGR, 2015 is not included into the discussion of the results. Especially the discussion of the trends in tropical upwelling, weakening trends in MMC in the NH only for the ERA-Interim reanalysis (for the deep branch of the BDC) are some of the main results mentioned in the abstract which are not compared with the Abalos et al. publication who clearly demonstrates that ERA $(\bar{v}^*\bar{w}^*)$ is an outlier compared to the other estimates.
2. The study does not show any simulation of the Age of Air (AoA). On the other side, some speculations on the possible impact of the results on AoA are given in the abstract. Because AoA is not the focus of this paper, I would recommend to reduce such speculations to some discussion in the last chapter.
3. There are two definitions of the mean meridional circulation: by using eq (3) with $\bar{w}^*$ describing the TEM vertical velocity in the log pressure coordinate and eq (6) with the cross-isentropic PV flux $\bar{q}^*\bar{\dot{\theta}}^*$. To me both quantities are different, or if these quantities are the same you should prove that. Consequently, I expect also different streamfunctions resulting from these different definitions. This point should be clarified.

Minor points:

1. P 27751, L 9
   ...of the mean meridional circulation...
2. P 27752, L10-15
   Maybe you should include the Wright and Fueglistaler, ACP, 2013 paper discussing the large differences in diabatic heating rates for all reanalysis data

3. P 27752-3
   “may upset this balance and degrade the expression of momentum budget” - maybe you should explain it in more details

4. 2.2 Analysis framework
   In this chapter I miss some connection to the isentropic TEM formalism described in the standard text books like Andrews 1987. Your chapter makes necessary to look into all the citations. However, you should try to argue what is different in your formalism if compared with the text book formulations.

5. Mean meridional circulation
   In your paper you use 2 definitions of MMC: The first one uses the mass stream function and the mean continuity equation (Eqs. (3) and (4)). The second definition uses equation (6) to quantify MMC. Are these definitions exactly the same ? If yes, can you proof that ?

6. P 2775 L 7
   I would say, you estimate the ratio of mean eddy and mean total meridional transport fluxes and not of “mean and eddy meridional transport fluxes”.

7. P 27759 L 15
   Level 560 K is too high to be influenced by the subtropical jet stream. Please reformulate

8. Figure 6-9 contain the most novel results, especially if compared with Abalos et al, JGR, 2015. Maybe you should move these results more into the foreground.

Interactive comment on Atmos. Chem. Phys. Discuss., 15, 27749, 2015.