Atmospheric
Chemistry
and Physics
Discussions

Interactive comment on "An observation-based climatology of middle atmospheric meridional circulation" *by* Thomas von Clarmann et al.

Anonymous Referee #2

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An observation-based climatology of middle atmospheric meridional circulation T. von Clarmann et al.

The authors present an estimate of meridional circulation patterns in the middle atmosphere based on measurements from 2002 though 2012 by the MIPAS instrument of a range of trace gas species. The estimate is based on an inverse method that infers an effective flow field in the meridional plane from the continuity equation along with an estimate of chemical sources and sinks. The methodology is updated from previous work by the first two authors through inclusion of further chemical sources and sinks, and by inferring only an 'effective' meridional flow that includes the effects of mixing/eddy transport.

The main results shown are the month by month estimates of the decadal-averaged

meridional flow, as well as an estimate of the interannual variability of the flow. In as much as this estimate is a relatively direct observational estimate of a difficult to measure quantity, this result is of potential value to the broader community. My main concern is that if this is to be the case, enough quantitative details should be given in order to facilitate comparisons with these results; this is largely the case but there are a few ambiguities that should be addressed (see below). Beyond this I have a few questions and comments about the presentation of these results (in particular I find the presentation of the interannual variability difficult to understand), but otherwise feel this is appropriate for publication with some minor revisions.

Specific comments

1) As mentioned above there are a few points that would be helpful for making quantitative comparisons with these results. Firstly, does the inferred circulation conserve mass? If so the authors may want to consider showing a mass stream function instead of the vector plots. If not, the choice of units for Figs. 1 through 4 are a bit confusing; surely the velocities should be homogeneous in units (e.g. m/s)? The note regarding the colour scales in the

2) Figures 5 and 6 show standard deviations of the inferred effective velocities, but the visualization is not explained. One assumes that the axes of the ellipses are scaled relative to the variance of the y and z components of the velocities but it seems no account is being taken of their covariance if that is the case. How are the colors chosen? More importantly, are these estimates of the standard deviation of the mean (implied by the figure caption) or sample standard deviations? In sum the interannual variability is difficult to assess in comparison to the mean circulation from these figures and is not very satisfyingly discussed in the text.

3) In all figures, different years are included in each panel with no discussion; why?

4) The methodology used in the present work includes the role of chemical sources and sinks; this has been updated from von Clarmann and Grabowski (2016). The

value of these updates should be demonstrated. It would also be useful to make some assessment of the role of mixing, again in order to facilitate quantitative comparisons with the mean meridional flow from models, for instance.

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