Atmos. Chem. Phys. Discuss., 15, C8915–C8917, 2015
www.atmos-chem-phys-discuss.net/15/C8915/2015/

Atmospheric Chemistry and Physics Discussions
Open Access

Interactive comment on "Kinematic and diabatic vertical velocity climatologies from a chemistry climate model" *by* C. M. Hoppe et. al.

Anonymous Referee #1

Received and published: 4 November 2015

The paper examines the differences between the kinematic and diabatic vertical velocities in the EMAC model, in particular the residual circulation is compared to the diabatic ascent climatology for 10 years. Some differences are identified such as stronger upwelling in the equatorial region around 500 K and polar downwelling for the diabatic velocity. A difference in the latitudinal extension of the upwelling region is also observed.

The paper contributes to understand the different representations of the global stratospheric circulation. I consider the paper appropriate for publication in ACP after the comments below are addressed.

General comments

- I wonder why the authors show the results for the vertical velocity, which are expressed in pressure-based units (Pa/day), on isentropic coordinates. Equation 9 gives the diabatic velocity on pressure coordinates, which can be directly compared to the vertical velocity given by Eq. 3. This comparison would be simpler than then interpolating both vertical velocities to isentropic levels. A related concern is how the interpolation of the residual circulation to isentropic surfaces is done. In order to evaluate the mass transport across an isentropic surface both the meridional and vertical components of the residual circulation should be considered since pressure and isentropic surfaces are not parallel. Could you clarify how the interpolation is done and if this issue could have any effect on the comparison? Indeed, comparing the results directly on pressure surfaces could avoid having to interpolate the residual circulation.

- The age of air results should be explained more carefully. It is an important point to what extent the different vertical velocities affect the age of stratospheric air calculations. More discussion on this point is highly desirable. For instance, the hemispheric pattern appears mostly below 800 K while the latitudinal shift of the tropical pipe (in boreal summer) is mainly observed above that level.

Specific suggestions

- L11 P29944 "although their results are also affected by assimilation effects ": could you explain this?

- L11 P29945 "it shifts the pressure boundaries of the grid boxes" –> the pressure boundaries of the grid boxes are not fixed

- L27 P29945 remove "towards each other"

- L9 P29946 Planetary waves that propagate on isentropic surfaces: what do you mean?

- L19 P29946 remove TEM

- Figure 2: It would be convenient to express in the same units as the other figures

(Pa/day)

- L17 P29949 This problem can be avoided if the transformation is applied to the data on pressure instead of hybrid coordinates.

- Figure 3. Fix the figure caption. Also remove “grey”.

- Figures 4 and 5 Perhaps it could be considered to select one representative month per season and have only one figure instead of showing the 24 panels.

- Figure 6 Perhaps it would be clearer to have lines at different levels, it is not easy to compare the magnitude on a contour plot (e.g. L7-8 P29953)

- L12-13 P29953 This is only true above ∼800 K

- L22 P29953 “more dispersive” this is known from previous works but it is not a result seen here

- L25 P29953 The southward shift is only seen in summer

- L25 P29953 What about the difference in the latitudinal extension of the upwelling?

- L9-12 P29954 Could you discuss the contribution of the different velocities versus the different transport schemes in the models (ClaMS versus EMAC)?

- Figure 7 bottom: The color scheme is confusing (blue is usually used for negative values)

- L5 P29955 Add reference

- L14 P29955 Remove “In summary, the discussion above showed that” (This is discussed in this paragraph, not above)

- L4 P29956 Remove “for the example of the EMAC/CLaMS model” (redundant)

Interactive comment on Atmos. Chem. Phys. Discuss., 15, 29939, 2015.