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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Tropical convective transport and the Walker circulation" *by* J. S. Hosking et al.

Anonymous Referee #1

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This paper uses a matrix scheme to describe vertical and horizontal transport of inert tracers, 20 days following their emission from the surface to the tropical tropopause layer (here 12.5 km) and up to cold point tropopause (16.9 km) between 20N-20S. Their synthesis nicely illustrates uniform vertical transport from the surface to the TTL at 12.5km. Above that a greater influence of zonal transport, which the authors associate with the Walker Circulation, can be seen. The seasonality of the different transport pathways is highlighted. The paper is a well-written short synthesis and is suitable for publication with a little extra analysis.

General comments: The main addition I recommend is to illustrate how the tracer transport patterns in figure 2 reflects the wind flow and the convective mass fluxes, and make use of these to affirm the findings in Figure 4.

1. Adding directional information: plotting the wind vectors on Figure 2 would be most helpful to see the flow patterns and affirm that it displays the "descending branch of the Walker circulation at the Central Pacific/East Pacific border between 8 and 12km." It would also be useful to have extra panels for the other 3 seasons to illustrate the matrix concepts.

This would provide you with the directional information to address the following key questions:

1.1 If air is descending here, then how can the transport from EP surface to EP 12.6 km in Figure 4 be so strong?

1.2 How can you be sure the transport is MC surf to MC 14.6km to WP 14.6 km (line 23). Could it not as easily be MC surf to MC 12.5 km to WP 12.5 km to WP 14.6 km or some other combination?

2. If the predominant transport from the surface to the TTL is due to vertical transport, then the tracer fields should agree well with convective mass fluxes. It would be most useful to show this (these fields were plotted in Hoskings et al. 2010 so this shouldn't be too much effort).

3. Lastly how sensitive are these results to the simulations period of 30 days? It would also be helpful to explain in this paper why the effective 20 days lifetime was chosen.

Specific comments:

3) 12230: line 10- I don't think there is enough evidence to conclude from the matrices that the "downwelling branch of the Walker circulation over the East Pacific reduces locally the upward transport of emissions from below".

4) 12230: Although it is great to see a short "to the point" paper, some outline text on the Walker circulation and its prevailing altitudes and how this varies with season and year would be useful. It would then be posible to comment on whether the authors expect their findings would exhibit substantial interannual-variability. Regarding sea-

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sonality, since ENSO events peak in November to February so it may well be that is the time of year the circulation is strongest independent of the ENSO state.

5) 12232: Line 3: If moist convection stops below 14km in all tropical regions in Hosking et al (2010). Why do the same simulations used in this study with the same model set-up show tracers reaching 16.9 km. Some clearer wording is needed.

6)12232: Line 27, although the percentage calculation is discussed in the figure captions it would be useful to state here what this percentage is relative to.

7) 12233: Line 25 why "in contrast", as Fig 2 also shows percentages?

8) 12234: 17 if a valid conclusion then here it could be stated there was no evidence of a walker circulation at this altitude.

9) 12234 line 24 seasonal variation . . .dominated by the magnitude of emission fluxes not by greater regions of convective activity" This is rather confusing since "seasonal variation in emissions" have not been discussed. Some clearer re-wording and reference/s within the sentence are needed. Line 12235 again the "In contrast" is confusing. If Levine et al (2007) show preferential altitudes of $\sim$12km how does this differ from your findings? Re-word more carefully. The sentence below doesn't really clarify the "contrast" either.

10) 12234 Line 15 explain if this seasonality found here agrees with the literature on the seasonality of the strength of the Walker circulation (e.g. point 4) above).

11) The disagreement with Liu and Zipser (2005) warrants a little more attention as the authors state this is a central difference between land and oceanic convection. Since greater daytime thermal heating and higher vertical velocities occur over land would it not be expected that convection heights would be in fact larger over these land regions (as indeed lightning is)?

12) The scale for Figure 2 is confusing: the orange colour (50-60 ppbv) are overlain by percentage values that span a wide range of the blue colours in figure 3. The colours

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scale in figure 2 should reflect this % variation better.

Technical corrections:

12) figure 1: define acronyms in the caption.

13) figure 4 should have a scale even if it is the same as in figure 3.

Interactive comment on Atmos. Chem. Phys. Discuss., 12, 12229, 2012.