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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Normal mode Rossby waves and their effects onchemical composition in the late summer stratosphere" *by* D. Pendlebury et al.

Anonymous Referee #1

Received and published: 9 October 2007

ACP by Pendlebury et al.,

Date: Sep 2007

Title: Normal mode Rossby waves and their effects on chemical composition in the late summer stratosphere

Decision: Accept after revisions

General Comments:

The paper studies wave motions in the atmosphere from a coupled chemistry climate model during summer to understand dynamical variability associated with free modes.

It is an interesting paper that I believe will be of interest to both the observational community and to modeling groups who include chemistry. The paper however, can be significantly improved that will help improve the science and interest.

Major Comments:

I feel that more detail regarding the correlations can be made from the CCM. Is it not possible to compute a budget of each chemical and explicitly determine if changes are due to chemistry or transport. I understand that once you decompose the field into wave components, then we assume a linear superposition and budget calculations may not be strictly valid, but I find the inability to make stronger statements about the contribution of transport (horizontal or vertical) and chemistry strange considering the fields are calculated in the CCM. I think the paper could be improved if more attention was placed on understanding these variations or at least discussing why these calculations are so difficult to make. More comments on this theme given in ‘minor comments’ section.

Each figure needs changing. Contour labels are needed (maybe not every contour for at least a few), as it is very hard (or impossible) at times to even tell the sign. Fig 1 is a good example where it’s not possible to know the values. A bold zero line would help, and shading for positive values or even the use of color with a color label could work. Ditto for Fig 2-4 and 8. Fig 6-7 are also hard to determine the exact correlations and need changes. I’m not sure how useful Fig 8 is. Perhaps a statement describing it would be sufficient.

Other (some minor) comments:

1. P12012: L25: Other than planetary waves might also be expected. I’d generalize this to ‘other wave variability (e.g. free modes and smaller scale forced modes)’. 2. Pg. 12013, L 18: Consider rewording wave to ‘wave chacteristics’ 3. Pg 12014, L20: I suggest you add more information the quality of model simulations with CMAM. For example, I believe CMAM was used in the latest

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ozone assessment (WMO 2006) and thus compared with other CCMs. A reference to this (i.e. Eyring et. al. 2006/2007) and some comment about how CMAM compared to other models would inform the reader how well this model is compared to other state-of-the-art systems. 4. Pg 12015, L7: Consider chaning ‘strongest signal’ to ‘large variability in CMAM is seen at 60km’ or something like that. I expect you also see large variability in daily temperature at the surface too. 5. Pg 12015, L13: Can you provide some information of how large these signals are in comparison to the total. Do these signals explain 10% of the variance or 50%? 6. Pg 12015: L6: More information about the particular CMAM run is needed. What was the configuration of the simulation (what year, what forcing used). Was their spinup of the model, and what SST were used. 7. Pg 12017: L13: Please briefly explain the statistical confidence technique employed so the reader does not have to look up the paper just to get an idea. 8. Pg 12017, L17. It would be really nice to see the CH4/N2O relationship especially because it would allow comparison with other measurements (i.e. Haloe). It would also provide a nice tracer/tracer correlation where one does not have to consider chemistry at all. 9. Pg 12017, L25: Work by Nathan et. al., (GRL 2004) show that wave ozone heating affect the phase and amplitude of free modes in the summer stratosphere. I expect you are familiar with this work and that at least you should mention the relationship between free modes and ozone. I expect this is one of the reasons for the different phase relationships between the tracers (CH4/N2O) and ozone in the lower stratosphere. You didn’t mention this, but if they were all behaving purely as long lived tracers, then you would expect their phase relationships to be similar, but they are not as seen in Fig 6 and 7. 10. Pg 12019, L7. CCM models allow budget calculations of all chemistry fields to be made, and thus I would expect one should be able to know if it’s meridional or vertical transport with more certainty. Certainly, for the full field a budget calculation should be possible, although for the wave components, this may not work as well. The bottom line is to understand if the correlation is positive, then what is causing this correlation. If indeed that cannot be done in your analysis, then what type of dataset would be needed to

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answer this question?

Interactive comment on Atmos. Chem. Phys. Discuss., 7, 12011, 2007.