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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Consistent circulation differences in the Southern Hemisphere caused by ozone changes: a chemistry-climate model and observational study" *by* P. Braesicke et al.

Anonymous Referee #2

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This manuscript investigates through idealised model experiments the complex chemistry-radiation-dynamics coupling and how a chemical change can impact the BDC branches in the SH in different ways also affecting composition.

I consider this work interesting and worth to be published in ACP, moreover it is well-written and clear. I am sorry for taking much time in the review dealying its possible publication. These mechanisms have to be investigated expecially in the view of interpreting climate projections performed with models do not including an interactive chemistry scheme.

My major concern is the lack of a few more diagnostics related to the circulation changes such as zonal mean zonal winds, meridional circulation, resolved waves acceleration and deceleration of the mean flow, wave fluxes, streamfunction. I am not suggesting to add extra 10 figures, but maybe one more figure could render the interpretation of results stronger (even if shown into an appendix). Specific suggestions are inlcuded below.

Introduction: could you also refer at the Birner et al papers (J CLim 2010 and/or ACP 2011)?

Method: which are the known biases of this model w.r.t the other ccmval models (they are just briefly mentioned in section 5.2 and just concerning the breakout time of the vortex in the model)?

Figure3: have you seen if there are more SSWs in the activated PSC in Pair A? This could be consistent with + ozone anomaly. A curiosity, what would it happen to the wbester relatinship in the PairA simulations? it would be nice to repeat that figure for this experiment, what do you think? (see webster et al grl, 2003 and weber et al, ACP, 2011)

The positive anomaly in PairB is less than 1std, clearly not significant, it is not given that the polar vortex really shows n earlier breakup in this case. Howevere in general 1-std for a gaussian distribution does correspond to the 66%, 2-std to 95%. In this case a t-test would be more adequate. Howevere I agree to also show regions of lower significances if they are properly commented (see Nicholls et al BAMS 2001)

Figure 4: the strongest signal is in DJF SH, this is consistent with Son et al 2010 interpretation of SH O3 long term changes and changes in the tropopause height, is it possible to discuss the chain of mechanisms here more clearly here? (Is this figure really necessary?)

No stippling in this figure, why?

Figure5: why December only? maybe the DJF average would be more clear?

Figure 6:

In order to interpret the positive signal above the cooling in the polar region, have you also looked at the changes in the winds? I would expect that the cooling is consistent with stronger westerlies that imply an increase of the wind shear at and below the jet core; at the stratopause, the net momentum flux gravity waves could therefore become more negative (filtering), this implies in the mesosphere a deceleration of the westerlies leading to an increased circulation.

Looking at the three months separately would also be interesting: Dec, Jan, Feb. How is the evolution within the season for the T (and possibly U winds)?

page 8465, lines 10-15. Why not referring here at contours of the streamfunction within the model itself?

page 8467, line 8, would it be possible to look at w* if available? Is it possible to link any change of the circulation (unfortunately U is not shown) to changes in the EP flux convergence, this could nicely confirms where (at which alt and lat) acceleration anomalies drive the trends in the circulation?

Case 2006/2007: I think this section (comparison with MIPAS) is very important, however instead of choosing one single year, why not an average of "similar" years? you have chosen one specific year where the anomalies in the N2O were similar to the case A anomalies. Would it be possible to fine more "special" years and then multi-average these cases insetad than one only year? Especially because this specific MIPAS year may have different T and O3 values. Moreover, even if the anomalies are similar to the model, is it also true for the mean values? For example, if the n2o anomaly for the observations in 2006/2007 were identical to the anomaly in the model case, but the mean value of the n2o in the model were say 50% larger than in the observations I don't think these two cases could be really compared and this is not immediately evident to me

when comparing Fig 10 and Fig 7.

Figure 9: is the 70S too close to the vortex edge? why not averaging over two regions one 70-80 and one 60-70 or even southern? however it is interesting to see such a difference in the observations (not published before, that is correct?)

I liked the summary section and mostly appreciated the implication section

As a final suggestion, I would simplify the title: 'Circulation anomalies in the Southern Hemisphere caused by ozone perturbations'

Interactive comment on Atmos. Chem. Phys. Discuss., 13, 8455, 2013.