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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Radiative and dynamical contributions to past and future Arctic stratospheric temperature trends" *by* P. Bohlinger et al.

S. Solomon

ssolomon@frii.com

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Review of the paper by Bohlinger et al.

The paper uses ERA interim reanalysis and a suite of models to probe Arctic temperature trends for the past and future. The subject is timely especially given the cold arctic winter of 2011. I think the paper should merit publication after a revision, but have several significant concerns as well as minor issues that should be addressed In revision.

1. Despite the interesting paper by Thompson that is referenced, I still feel that using

reanalysis for trends is subject to question. Particularly since the paper attempts to deduce dynamical and radiative contributions by difference, absolute accuracy needs to be very high for this method to work well. A section should be added on how large the uncertainties in eddy heat flux are estimated to be, and how these propagate into the rest of the calculations.

2. How do ERA interim temperature trends compare to MERRA? I am concerned about the error estimates, but a check with another reanalysis would help.

3. How sensitive are the results to the assumed 45 day window? What if it were 30 or 60? Is the radiative damping time temperature/season dependent?

4. Why were radiative terms described as a linear regression? If as seems likely much of the radiative cooling to date is due to ozone loss (especially in spring), then a fit to EESC may describe it better than a linear trend alone. How much difference would an EESC fit make to your estimates?

5. It is curious that the summer season radiative model values are so far off of the observations. This seems difficult to understand unless the ozone depletion is wrong, or there is another kind of shortcoming. Please compare the models' ozone losses to the ozone observations of Randel and Wu, and please discuss implications of both ozone loss and temperature discrepancies.

6. I assume you analyzed the models in the same manner as you did the observations. Please state this. Also, what about looking at the modeled change in the residual mean vertical velocity, as a consistency check on the dynamical contribution?

7. What is the definition of 'arctic' used? I assume 65N to 90N throughout, although I think this is only stated in the conclusion section. Do you think you might get better agreement by defining a vortex edge using PV, and averaging over the vortex?

8. Is a general conclusion of this paper that radiative cooling will offset about 15% of the ozone recovery in coming decades? If so, please state this; if not, what is the

bottom line?

9. Why is the EMAC radiative cooling so strong in SON (seen in both figs 4 and 5). I can't think of a reason this would occur radiatively, and it seems strange that this occurs in both past and future. Please explain.

10. Are water vapor changes playing any role in EMAC? What about the other models?

11. I would expect the radiative tests in figure 5 to be linearly additive, except for ODS. I don't understand why the different EMAC tests show such widely varying responses by gas and season. Can you explain? Are you confident that this is not due to low S/N due to high variability in the Arctic, in which case many more runs would be needed to get meaningful answers?

Minor points

Abstract, line 23. Observations can confirm models, but not the reverse since models are not data, and can also be right for wrong reasons.

Table 2. Are these errors purely statistical? Please say so, and note the possibility of structural uncertainties in the text.

Interactive comment on Atmos. Chem. Phys. Discuss., 13, 6707, 2013.