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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Reassessment of causes of ozone column variability following the eruption of Mount Pinatubo using a nudged CCM" *by* P. Telford et al.

Anonymous Referee #3

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This paper uses a nudged CCM, satellite column ozone data, and regression modelling with a QBO proxy to attribute causes of the column ozone changes after the Pinatubo eruption.

In fact, the role of the nudged CCM is quite small: It is really only used to derive the signature of chemical ozone depletion due to enhanced aerosol loading, but accurate calculation of this term is essential for the later attribution of other contributions. This paper gives hardly any results of the model runs and so it is not possible to judge how well the model is doing in terms of the minor species which lead to the ozone depletion. The only comparison shown is for column ozone. The authors do state

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that their calculated ozone depletion agrees with values calculated by other 2D and 3D models.

The later analysis is then based on subtracting the model calculated O3 (column) loss from observations and using a regression model with a QBO proxy. This is the part of the study which can claim to be novel, I think.

The conclusion that dynamics played a role in the low ozone in the NH midlatitudes (but not the SH) is not new. This paper argues for a link between the NH dynamical effect and 'changes in the QBO' but no strong justification is made. It is a shame that the CCM cannot be used (maybe with the free running model and its different QBO period) to investigate and support the conclusions of the coupling of the QBO and volcanic signal.

Detailed comments follow:

Abstract: Line 14. The chemical depletion cannot be observed - it can only be diagnosed from the overall column reduction using some tool (e.g. a model). You should be clear if you mean your calculated chemical loss agrees with other previous estimates, or if you really are comparing your model column with observations (chemical depletion and dynamics).

Section 2.1: The model details are brief. Is the sulfate SAD only used in the heterogeneous chemical rate calculations, or is it also used in the model's radiation scheme? The text is not clear. I don't understand the point of the sentence 'The optical depth is prescribed...'. Please explain where that comes in.

A small point: Is it really true to say the model vertical wind is a prognostic variable? I realise the model calculates it but is it not just diagnosed from the horizontal winds (and other variables which are stepped forward in time) at each model step? Are you trying to make the point the vertical wind is consistent with the nudged horizontal winds?

Section 2.3: Again, the details of the model runs are brief. What is the chlorine and

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bromine loading used for the runs? It seems that this is kept constant (based on text elsewhere) but please say at what values.

Section 3.1: The model runs in Figure 1 do appear to show good agreement with the data but to the eye this agreement is dominated by the model simply having the correct annual cycle. Can you add another panel to figure one which removes the annual cycle and therefore shows a clearer picture of the modeled long-term variability (e.g. anomaly from the monthly mean). Please give a number for the 'slight high bias'.

Section 3.2: Comment: The black curve in Figure 2 (obs - chemical signal) does appear to fit a QBO variation, which I take is a key result. This provides the authors with evidence that the model chemical signal is correct.

Section 3.3 and 3.4: The comparisons of the black and red curves in Figs 3 and 4 do show significant differences in the tropics and NH, which leads to the conclusions on the role of ENSO and dynamics. However, how confident can you be that the spatial variation of the modelled chemical signal is realistic?

Section 4: The paper ends with the sentence 'We speculate that this low ozone arises from qualitative differences in the QBO after the eruption'. This comment comes out of earlier mentions of this but in this final summary section please be clear what you are suggesting.

Interactive comment on Atmos. Chem. Phys. Discuss., 9, 5423, 2009.