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Atmospheric Chemistry and Physics Discussions

Interactive comment on "The role of methane in projections of 21st century stratospheric water vapour" *by* Laura Revell et al.

Anonymous Referee #1

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Further to my initial review I have the following specific comments.

1) There is occasional confusion (e.g. line 8 of the abstract) about the role of the changing BDC in this paper. Increasing BDC will of course creat more methane flux into the stratosphere but it will not necessarily cause an increase in SWV directly through increased advection because it cools the tropopause cold point. Please make this clear.

2) p2 Line 29 is also unclear about the role of the BDC increase. Is this not simply an increase in methane flux entering the stratosphere. Please reword this sentence for clarity.

3) There is a problem with the uncertainty envelopes in Figure 1. The authors show the interannual standard deviations if I understand correctly. However, this is not the

uncertainty on the multiannual means plotted in the solid lines. The envelopes should be narrowed by a factor equal to the square root of the number of years included to give the uncertainty in the means.

4) Line 26 argues that the too moist stratosphere can not be due to the tropopause cold point temperature bias as this is too cold in the model. However, as the authors state elsewhere, the SWV is dependent on the minimum temperature that air parcels experience on their transit - this is more related to the coldest regional temperatures at the tropopause, e.g. in the west pacific. So is the model cold bias everywhere? we need more than the zonal mean here.

5) p4 Line 33 argues that the results will not be biassed by the incorrect seasonal phasing of water vapour entry into the stratosphere. This may not be quite right as the BDC increases most in winter under climate change. The authors should at least acknowledge this.

6) p5 line 15: most or all CC models?

7) p8 Line 22: Joshi et al, GRL, 2006 were the first to point out circulation changes due to stratospheric water vapor.

8) p9 line 3: can the authors give any estimate of the relative size of surface climate warming due to stratospheric water vapor compared to say greenhouse gases?

9) Figure 4 panel c shows an apparently decreasing trend in cold point temperature variance. This could be important given the non-linearity of saturated water vapor pressure with temperature. Is it due to changing tropospheric variability in ENSO for example? Scaife et al 2003 and Garfinkel et al 2013 discuss the effects of tropospheric variability on SWV which ought to be considered here.

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