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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 #2

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In this manuscript authors use chemistry climate model (SOCOL) simulations to show that in future, the warmer tropical tropopause temperatures and stronger Brewer-Dobson circulation would lead to increased CH4 flux in the stratosphere. Therefore they suggest that increased stratospheric CH4 can lead to up significant enhancement in the upper stratospheric water vapour, but relatively smaller changes in the lower stratospheric water vapour. Overall, this is well written manuscript and can be published in ACP if authors can address following minor comments.

My main concern is the model's ability to simulate stratospheric water vapour correctly. Figures 1 and 2 show significant biases against observations. On Page 4 (line 32) you say that "Because the aim of this study is to analyse future changes in SWV on a multi-decadal scale, we do not anticipate that the model's shifted annual cycle in SWV will substantially bias our results"

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But I don't think only wording is enough. As far as know most of the models have great difficulty in simulating lower stratospheric water vapour correctly as this is combination of TTL as well as stratospheric process. But if model is missing some key process, how can it simulate future water vapour changes correctly? Can you show some other analysis that can confirm that your model is good enough to study stratospheric water vapour changes, especially in the lower stratosphere? For e.g. is it possible to show show decrease in tropical lower stratospheric ozone/ TTL temperatures when BD circulation is stronger (even in supplementary material would be good enough)

Technical corrections Page 1

1) Line 2: Abstract: why only 21st century. I think this was and will always be true. Delete "21st century" 2) line 4: "circulation, so that more methane" 3) line 8: "Although, methane contribution of SWV maximise in the upper stratosphere, modelled" 4) line 16: repeated "ozone depletion"; just delete second one.

Page 2 5)Line 4: Oltmans and Hofmann (Nature, 1995) is better reference for Boulder data. 6)Line 5-10: Very long (and confusing) sentence so reword it. 7)line 10:- "merged" or various satellite data sets 8) Line 13: Explain that now you are discussing modelling studies. 9) Line 23: "that controls amount of water vapour entering in the stratosphere" 10) Line 32: Forster et al., (2007) discussed reduced ozone in the tropical lower stratosphere and colder CPT. Randel et al., and Dhomse et al, discussed enhanced upwelling/ adiabatic expansion of TTL causing colder temperatures.

Page 3: 11.line 6: First, we assess 12. line 17: sits???-> lies near 100 hPa 13: Figure 1: almost 25\% negative bias compared to MIPAS. 14. line 30: (Stenke et al., 2013)

page 6 line 7: Do you mean lower mesospheric temperatures? line 14:Chemistry Climate Model used in Dessler et al., 2013

Page 7 Line 10 and 13: Repeated "because" line 30: Compared to Page 8: Line 19: or "dehydration due to PSCs?"

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