

Interactive comment on “Testing chemistry-climate models’ regulation of tropical lower-stratospheric water vapor” by Kevin M. Smalley et al.

Anonymous Referee #2

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Smalley et al. analyse CCM model predictions of stratospheric water changes over the 21st century. A multivariate linear regression is applied to the models’ stratospheric water entry mixing ratios (“[H₂O]entry”), with the explanatory variables being a “tropospheric temperature index”, a “Brewer Dobson strength” index, and a QBO index; this analysis follows the method of Dessler et al. (2013). Overall, the analysis is straightforward, and the results are clearly described. I do not comment on the aspects of the statistical analysis brought up by the other reviewer.

However, this reviewer cannot quite see that “Our approach provides more insight into model processes than simply comparing [H₂O]entry or TTL temperatures.” (Page 7/Line 19). Rather, the paper is somewhat superficial (it certainly does not help that

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(Page 2/Line 13): "Finally, a warmer troposphere tends to increase [H₂O]entry, although whether this is through influence on TTL temperatures or some other mechanism such as convective ice lofting, is not clear.", and results are few. It would be great if the authors would work out the connection between tropopause temperatures and [H₂O]entry in the models, and the connection between "tropospheric temperature" and tropopause temperature.

The QBO results would also deserve some further analysis - for the 21st century analysis, annual mean data is analysed. This evidently removes much of the variance associated with the QBO, and it appears that the lack of influence of the QBO (as e.g. shown in Figure 2) is due to a lack of a trend in the QBO index. This evidently begs the question why the model does not have a QBO trend when it has been argued that the tropospheric expansion associated with global warming would have an impact on the lower stratospheric QBO - and as such would be reflected in the QBO index. While this may not have an impact on [H₂O]entry (because the QBO influence at the rising tropopause level main remain constant over time), it would be useful to have some more information why the QBO index (as e.g. shown in Figure 2) does not show a trend. Two additional minor comments: Please provide a reference for the statement that "Virtually all climate models ..." (page 2/Line 14); and some more information about the differences in results for models that participated in CCMI-I and CCMVal-2 would be useful.

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