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Interactive comment on "Water Vapour and Methane Coupling in the Stratosphere observed with SCIAMACHY Solar Occultation Measurements" *by* Stefan Noël et al.

Anonymous Referee #2

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This paper describes a water vapor data set derived from SCIAMACHY solar occultation measurements. It covers the altitude region from 17-45 km and the latitude region from 50-70N over the time period Aug 2002 to Apr 2012. The authors describe the method, the data set and then attempt trend analysis and describe the co-relationship between their CH4 and H2O data. I think a new data set is a valuable contribution, and the validation comparing to ACE and MLS is also valuable. The analysis of variations related to the QBO and discussion of the BDC is repeating work that has already been done, much going back to studies from measurements taken by UARS or LIMS/SAM. I think the paper could be significantly shortened into a data description/validation paper and much of the QBO and total hydrogen (or potential water) discussion eliminated.

General comment: please have the native English speaking co-author edit the text when revised.

Specific comments: Abstract, line 13-15, I would think that at lower altitude, water vapor is largely impacted by the stratospheric input value (so tropical tropopause temperatures). The "balance" hasn't had time to be established with young lower stratospheric air.

Page 1, Introduction, L17-18, the climate of the planet is determined by many factors, not just greenhouse gases. Please rewrite this sentence.

Page 2, line 3, the sentence "Most of the water vapour is of natural origin and located in the troposphere."and then change "It enters" to "Water vapor enters"

Page 2, line 8, I don't think this is an entirely accurate statement, in particular that the BDC controls the freeze drying process. The BDC is a zonally averaged construct, and freeze drying (and the associated microphysics) is a local process.

Page 5, figure 2; (and related text). Some descriptions as to what the improvements made in the algorithm between the 2010 product 2.0.2 and the current one is warranted (rather than simply referring to the 2016 methane paper).

Page 8, line 3&4..i think you mean biennial not bi-annual

Page 8, discussion of the "inverted behavior" (or anti-correlation) between water and methane. This is well known behavior and probably doesn't need the extensive following discussion regarding the QBO.

Page 11: line 14….you don't have a long enough time series to talk about 5-6 year oscillations, just delete that comment.

Page 12: trend discussion: the data set under consideration is just 10 years. That is not long enough to talk about trends. The so called trend noted on line 8 (Urban et al 2014) is really a step function like feature, not a trend. With 10 years, you can look at

interannual variability, and perhaps should stick to just that. Show a time series, not a linear trend.

Page 12, line 13 "an estimate" is duplicated

Page 12, line 14. It is not true to say that if potential water is conserved, the trend should be zero. You could have a trend in water vapor entry value, thereby allowing a potential water trend. You could also have a trend in the input of methane, again allowing a potential water trend.

Page 12: I really don't understand the point of this sentence "Considering this error, the combined trend above about 20 km is in a statistical sense not significant, meaning that the assumption that all water vapour is produced from methane via the net reaction (R2) is not disproved by the measurements." One should keep in mind that all water vapor is not produced from methane (ie, the average entry value is on the order of 3.5 ppmv, current methane is ~1.8 ppmv, so if all were oxidized you could get a contributions of 3.6 ppmv, so at most you could get half of water vapor from methane. It may be that here the authors are trying to assess contribution to the trend. Rohs et al, 2006, JGR, determined for the 78-03 trend in stratospheric water vapor, only 25% can be due to a trend in methane. A similar analysis could be done here, for the SCIAMACHY period.

Page 14, line 26-30: this description of the processes going on is in error. In the upper altitudes, water vapor changes are anti correlated with methane, and simply reflect age of air variations; the QBO signal is not "carried by methane".

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