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Interactive comment on "Can sampling biases explain the discrepancies between lower stratospheric water vapour trend estimates derived from the FPH observations at Boulder and a merged zonal mean satellite data set?" *by* Stefan Lossow et al.

Anonymous Referee #2

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This is a very good paper and answers (negatively) the important question posed in the title, although given that the question is posed in the title, I do think the answer is surprisingly difficult to find in the text.

My primary concern with this manuscript is that I don't understand exactly how Figure 8, which is an extremely important figure, is produced. In response to a question in the quick review the authors now state: "One caveat is that the time periods for

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[Discussion paper]

the de-seasonalisation inevitably vary among the satellite data sets and are different from that used for the FPH observations (and model simulations). While this affects the absolute differences, tests show that this has no decisive influence on the overall spread estimate nor the consistency of the temporal development of the differences shown in Fig. 8." This seems to imply that they have set the average difference equal to zero for each dataset. But if that is the case then, given that Figure 1 shows a trend of ∼0.28 ppmv/decade between satellite and FPH, I do not see how the authors can make the statement that neglecting the fact that the satellite to FPH comparison changes with respect to time period "has no decisive influence on the ... temporal development of the differences shown". Based on that trend the difference between, e.g., the SAGE vs. FPH differences (average date ∼1996) and the MLS vs. FPH differences (average date ∼2010) must be ∼0.4 ppmv, which is certainly not negligible on Figure 8. On the other hand, my interpretation that the average difference is equal to zero for each dataset is probably wrong (the MIPAS offset appears to be distinctly positive). In any case, the authors should explain how the offsets are calculated and not (absent a much better explanation) say that it doesn't matter.

Abstract page 2 lines 2-4 "Overall, both the simulations and observations exhibit trend differences between Boulder and the zonal mean. The differences are dependent on altitude and the time period considered." I'm not sure what information these lines add (of course there will be some differences) other than to confuse the reader, especially since the next 2 sentences then say that the differences are "not sufficient to explain the discrepancies".

Figure 1 – The error bars for the merged satellite dataset are very hard to see, but, more importantly, on the positive side they all seem to lie exactly on the zero line. Please check to make sure that this is indeed correct, and if it is, please explain why.

Page 7 – Here it says explicitly that: "observations before March 1992 were discarded", yet in several plots data points are shown in 1991. Since what is shown are annual averages this might be mathematically okay, but I would strongly discourage showing

anything before the first data included in the timeseries (at the earliest).

Page 11 – "We focus on the altitude range between 100 hPa and 20 hPa that is typically covered by the FPH observations and in almost all cases completely entirely in the stratosphere (Kunz et al., 2013)." Either "completely" or "entirely" will do, but not both.

Figure 8 – It seems to me that it would helpful to the reader, and would seemingly nicely summarize the main point of the paper, if the authors would add to this figure a line showing Boulder minus zonal mean for any one of the models taken from Figure 2 or 6.