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Atmospheric Chemistry and Physics Discussions



# *Interactive comment on* "Evolution of stratospheric ozone and water vapour time series studied with satellite measurements" *by* A. Jones et al.

**A. Jones et al.**

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R: The authors have put together and impressive amount of data, and used this combined data to estimate trends in ozone and water vapor. There is a lot of interesting material here, but perhaps inevitably, incorporating so much data into one paper has led to the neglect of some important details related to individual datasets. Such points are particularly important in undertaking a trend analysis. The authors should address these points before the paper is accepted.

Major points: Unless there is some new thinking about SAGE II water vapor data, the inclusion of this data on Figure 7 is enough to warrant rejection of this paper, since it might otherwise cause great confusion in the water vapor community. The authors

even reference Taha et al. [2004], which states: 8220;However, using SAGE II long-term water vapor record in trend analysis is not recommended until further assessment of the effect of channel drift corrections.8221; As far as I can tell (please correct me if I8217;m wrong) there is no author on this paper with SAGE expertise, nor is there any newer paper on SAGE II water vapor which suggests that anything has changed, nor is there any particular discussion here which suggests that the authors are even aware of this issue.

A: This is a valid point. The SAGE II data is known to have issues with aerosol contamination, especially during the period post the Pinatubo (1991). For this reason we do not include water vapour data between 1991 and 1994. The other issue with SAGE II data prior to 1991 is that there is no other satellite instrument that measures water vapour. It thus makes it difficult to trust the SAGE II data during this period as no robust validation has been made. Due to this we also have decided to not include the SAGE II data prior to 1991. However, we feel (as do those responsible for the SAGE II data) that SAGE II data is usable after 1994 as we show there is a reasonably good comparisons with overlapping instruments when applying the necessary flags, such as HALOE.

R: A second major criticism is based on the statement: "We then create a weighted all instrument average where each instrument residual time series is weighted dependingon the total number of profiles that contribute to create each monthly average." If this is really what the authors are doing, they are making a very poor choice of instruments to determine trends. Instruments with many profiles (e.g. SBUV) will dominate the trends. Yet the instruments which provide many profiles are very often not the best instruments for long-term trends. HALOE trends are almost certainly much more reliable.

A: We agree with this statement and thus have decided to create a simple numerical mean where there is an equal weighting between all instrument time series when creating the all instrument mean.



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R: The authors need to clarify exactly what they're doing with respect to the seasonal variations. On the one hand it seems they have removed the seasonal cycle. Yet then they still try to fit an SAO. Why is there still an SAO left after fitting the seasonal cycle?

A: This is an overlook in the processing of the manuscript. We have corrected this. When removing the seasonal cycle using the method we have used, one also removes the lesser seasonal cycles, such as those regarding the SAO.

R: The short-term variation in the monthly HALOE residuals is much larger than I would have expected, both for the ozone and the water vapor, especially given a 30 degree latitude band (60 degrees for water vapor) and a 10 km averaging for the bin. 10.

A: We don't think that there is anything strange about this. Both SAGE and HALOE are on board satellites that have drifting orbits, while both utilise occultation viewing geometry. It means that the number of measurements during each month will vary, especially in the tropics. Months with fewer data are vulnerable to the possibility of slightly larger variance.

R: Minor suggestions and typos:

This is an awfully long sentence: As studies to date only present time series until 2005, we extend both stratospheric ozone and water vapour time series until April 2008 by using a combination of various satellite data sets, many of which have been used in previous studies, especially the historically longer and older times series such as from SAGE, HALOE, SBUV/2, and POAM III, but we also use shorter and newer time series from Odin/SMR (2001-present), Odin/OSIRIS (2001-present), Envisat/ SCIAMACHY (2002-present), and Aura/MLS (2004-present).

A: This has been addressed

R: "Each satellite had a low temporal and spatial coverage" I dont think you can use the word "low " in this sense.

A: This has been addressed



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R: "Furthermore, analysis above 45km would mean extra care would need to be taken to account for large non negligible diurnal variability in ozone and water vapour" The diurnal variability of water vapor is small until well into the upper mesosphere.

A: This has been addressed

R: Figure 1 8211; There seem to be large differences in the amplitudes of the seasonal variations between different instruments, with the SBUV measurements generally showing much smaller seasonal variations. Why is this?

A: "The differences in amplitudes between each instrument is partially explained by the level of noise between measurements, but also by the level of variability determined by the number of samples during each month”

R: "We see a good phase fit in the tropics as there is typically no time lag since the QBO is a tropical phenomenon". Im not sure that I would necessarily expect the phases to line up, but since the authors bring up this point for water vapor then why dont they line up for ozone?

A: The ozone fits to the QBO are modelled in Figure3 for the mid latitudes, while the water vapour fit in figure 4 is for the tropics. There will be a delay or lag, (such that the phase will be essentially opposite) in the mid-latitudes as it takes time for ozone rich/poor air to travel from the tropics.

R: Table 1 In the last 7 columns the change in trend is simply the difference between the pre and post 1997 trends, but in the first 2 columns they dont add up.

A: This has been updated.

R: This is a poorly written sentence: After the assumed 1997 turn around, trend values show that the reduction in ozone in the stratosphere has slowed down and in some cases has even possibly increased although the majority of trend values are not significant at the 2 sigma level.



**ACPD**

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Interactive Comment



A: This has been amended.

Interactive comment on Atmos. Chem. Phys. Discuss., 9, 1157, 2009.



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Interactive Comment