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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Comparison and synergy of stratospheric ozone measurements by satellite limb sounders and the ground-based microwave radiometer SOMORA" *by* K. Hocke et al.

Anonymous Referee #1

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The paper addresses a subject of the ozone remote sensing by the ground-based microwave radiometer SOMORA and by satellite limb sounders. It focuses on a spatial and temporal distribution of ozone fields over middle latitudes. Authors assess the ozone variability in the stratosphere and lower mesosphere with respect to the temporal atmospheric noise. They also investigate a correctness of a Gaussian normal distribution assumption in the data evaluation. The paper presents a unique, detailed examination of time and distance limits for co-incident ozone measurements in the stratosphere at middle latitudes. The limitation of the SOMORA measurement technique is investigated with respect to systematic errors of the ozone retrieval. The double-referencing technique is applied to the cross-validation of satellites and ground-based stations.

Several valuable conclusions are made in this paper. Results suggest that differences between SOMORA and Aura MLS ozone data are well represented by the Gaussian distribution at altitudes between 25 and 60 km. This is a useful exercise, extremely relevant in atmospheric data comparisons, especially because the derivation of the mean differences and standard deviation are typically based on the assumption of the normal distribution of analyzed data. Therefore, it is worth of checking if the assumption is actually true.

Analyses of the Aura MLS and SOMORA coincidental dataset find consistency in temporal ozone fluctuations observed in both datasets; especially strong, planetary wave-like features observed in year 2005. The application of the Averaging Kernel (spatial smoothing) and moving averaging (temporal smoothing) methods allows for a more clear presentation of the data.

The conclusion that "The mean O3 difference profile does not depend much on the limit for spatial coincidence of the ground- and satellite based measurements" is useful for future comparisons of the ground-based and satellite data. Although, this conclusion is strongly limited to atmospheric conditions that feature no extreme horizontal ozone distributions in the vicinity of the ground station, which is typical for stratosphere at middle latitudes. In addition, the paper points out that the standard deviation of differences increases slightly with the horizontal distance.

The synergy of the ground and satellite based measurements is emphasized through the double-referencing method. The method is applicable for comparisons of satellites that are separated by an observational time and location. It is based on the assumption of a long-term stability of a ground-based station. It is also applicable for comparisons of ozone data from two remote ground-based stations. This application requires a stability of co-incidental satellite data. The method provides tools for "control of the measurement accuracy and long-term stability of ground- and space-based instruments".

The paper is written very well, in concise manner, and at the same time providing

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enough details to describe main ideas and approach of the research. However, before this study gets published, I recommend various minor changes:

1. My main concern is the unresolved bias between the SOMORA and the Aura MLS data that could be related to change of the SOMORA's frontend optics in 2005 (as suggested by authors) (results of Figs.10 and 11). The period between October and December of 2005 is used in the paper to do a cross-validation of the microwave spectrometer from the Mauna Loa station in Hawaii and SOMORA instrument in Switzerland (Fig.18). The MLS and SOMORA difference (Fig. 11) suggest that the bias became more pronounced in 2006. Thus, it would be useful to include MLO and SOMORA comparisons for the October-December period taken from measurements performed in 2006. It would be useful to see if the MLO and SOMORA bias has changed between 2005 and 2006 data.

2. The same is applicable to the comparisons of the MIPAS and Aura MLS data (Fig. 17), where the segment of the SOMORA data from 2004-2006 time-period is used for comparisons. Is it possible that the positive bias between MIPAS and MLS below 30 km might be influenced by the positive bias observed in comparisons between SOMORA and MLS data in 2006?

3. The last step in equation 5 uses an approximation where X_true (t) is replaced by X_G (t) to define a systematic error. It also uses the assumption that between time t1 and time t2 the relative systematic error e_G of the station has not changed. Please, add more explanation to the text.

4. On page 5072, the <SOMORA> profile is defined as "average of all SOMORA profiles within the selected time interval". Does it mean that you have multiple mean profiles assigned to a specific latitude and longitude location, or do you use a single profile for all geo locations as long as the data are taken within 1 hour of the MLS data? It is confusing; please provide more details regarding the lat/long field of < SOMORA> data.

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Interactive Comment

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5. The typing mistakes are found: on page 5064: should be Fig. 9 instead of Fig.10 on page 5065: should be Fig.10 instead of Fig. 11

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