

Interactive comment on “Evaluation of CLaMS, KASIMA and ECHAM5/MESSy1 simulations in the lower stratosphere using observations of Odin/SMR and ILAS/ILAS-II” by F. Khosrawi et al.

F. Khosrawi et al.

Received and published: 25 March 2009

We agree with referee 1 that an important outcome of this discussion thread is the conclusion that the discussion on the usage of tracer-tracer correlations to derive polar ozone loss should not in detail be included in discussion of our paper. However, we have to point out that we are not using tracer-tracer correlations in the classical sense. Here, we use a method which was put forward by Proffitt et al. (2003). In their study, Proffitt et al. (2003) seasonally averaged lower stratospheric distributions of ozone and nitrous oxide which were binned by potential temperature or altitude. In our study, we use monthly averages instead of seasonal averages which is possible due to the high spatial and temporal resolution of the satellite data sets. In the revised version of the paper, we have made sure that the difference between the two methods is clearly

[Full Screen / Esc](#)

[Printer-friendly Version](#)

[Interactive Discussion](#)

[Discussion Paper](#)



described so that no confusion will arise.

We are aware of the recent model-measurement comparison by Hegglin and Shepherd (2007). We already referenced this study in our previous paper (Khosrawi et al., 2008). In our previous paper we e.g. compared the 1-year data set we derived from ILAS/ILAS-II observations with the one-year data set we derived from Odin/SMR observations. The following text referring to the Hegglin and Shepherd (2007) can be found in Khosrawi et al. (2008): *Despite the spatial and temporal differences of the data sets (Odin measures every third day the entire hemisphere while ILAS/ILAS-II measures every day at a narrow latitude band) a good agreement between Odin/SMR and ILAS/ILAS-II is found in both hemispheres, demonstrating that the limited spatial sampling from solar occultation satellites does not constitute a problem for deriving a full seasonal cycle of monthly averaged N₂O and O₃. This means that mixing must be strong enough to homogenize the air masses in a way so that a limited (solar occultation) sampling is sufficient to characterize the air masses in question. This is consistent with the results of (Hegglin and Shepherd, 2007) who assess the representativeness of the Atmospheric Chemistry Experiment (ACE) satellite measurements, which is also a solar occultation instrument, by comparing these data with data from the Canadian Middle Atmosphere Model (CMAM).*

Indeed, Hegglin and Shepherd (2007) find that the correlations from ACE-FTS are not compact in the upper stratosphere. However, as already stated above we are not using tracer-tracer correlations in the classical sense and thus the results of Hegglin and Shepherd (2007) cannot be applied directly to our method. Further, most importantly, in the present paper we only consider the lower stratosphere, so that this upper stratospheric issue is less relevant here. Furthermore, the issue with the compactness of the correlations in relation to our method is already discussed in Khosrawi et al. (2006). The text there reads as follows: *In the stratosphere, compact correlations are expected between tracers for which quasi-horizontal mixing along isentropes is fast compared to their local chemical lifetime (Plumb and Ko, 1992).*

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper



Sankey and Shepherd (2003) compared correlations of various chemical species derived from the Canadian Middle Atmosphere Model (CMAM) with observations and argued that limited sampling from satellites or aircraft could possibly lead to artificially compact correlations. However, recently it has been shown by Müller et al. (2005) that there is no evidence for artificially compact correlations in HALOE observations of the Arctic vortex in winter 1991/92. Measurements from ILAS/ILAS-II (Improved Limb Atmospheric Spectrometer) provide a data set with a much higher spatial and temporal resolution of the polar regions than HALOE so that artificially compact correlations are unlikely to occur. Further, a compact correlation in the true sense is not considered here. Here, we have to point out that this statement was made concerning our application of ILAS/ILAS-II which is a solar occultation instrument. However, in the present study we mainly use data from Odin/SMR which is *not* using the solar occultation technique. Due to the review of referee 1 we now discuss the results of Hegglin and Shepherd (2007) in the revised version of the paper (see our reply to referee comments).

It is not correct that Hegglin and Shepherd (2007) use a more comprehensive satellite data set. (Hegglin and Shepherd, 2007) used data from ACE-FTS which is a solar occultation instrument and thus provides only limited sampling. Odin/SMR is a sub-millimetre radiometer which measures the thermal emission of trace gases originating from the Earth's limb globally and thus has a much better coverage than ACE-FTS. Therefore, the "sampling issue" identified by Hegglin and Shepherd (2007) is not a problem for Odin/SMR.

We agree with referee 1 that besides the references Tilmes et al. (2007) and Lemmen et al. (2006) we also should add the reference of Eyring et al. (2006).

References

Eyring, V., Butchart, N., Waugh, D. W., Akiyoshi, H., Austin, J., Bekki, S., Bodeker, G. E., Boville, B. A., Brühl, C., Chipperfield, M. P., Cordero, E., Dameris, M., Deushi, M.,

[Full Screen / Esc](#)[Printer-friendly Version](#)[Interactive Discussion](#)[Discussion Paper](#)

Fioletov, V. E., Frith, S. M., Garcia, R. R., Gettelman, A., Giorgetta, M. A., Grewe, V., Jourdain, L., Kinnison, D. E., Mancini, E., Manzini, E., Marchand, M., Marsh, D. R., Nagashima, T., Nielsen, E., Newman, P. A., Pawson, S., Pitari, G., Plummer, D. A., Rozanov, E., Schraner, M., Shepherd, T. G., Shibata, K., Stolarski, R. S., Struthers, H., Tian, W., and Yoshiki, M., Assessment of temperature, trace species and ozone in chemistry-climate simulations of the recent past, *J. Geophys. Res.*, 111, D22308, 10.1029/2006JD007327, 2006.

Hegglin, M. I. and Shepherd, T. G., O₃-N₂O correlations from Atmospheric Chemistry Experiment: Revisiting a diagnostic of transport and chemistry in the stratosphere, *J. Geophys. Res.*, 112, D19301, doi:10.1029/2006JD008281, 2007.

Khosrawi, F., Müller, R., Proffitt, M. H., and Nakajima, H., Monthly averages of nitrous oxide and ozone for the northern and southern hemisphere high latitudes: A "1-year climatology" derived from ILAS/ILAS-II observations, *J. Geophys. Res.*, 111, D11S11, doi:10.1029/2005JD006384, 2006.

Khosrawi, F., Müller, R., Proffitt, M. H., Urban, J., Murtagh, D. P., Ruhnke, R., Grooß, J.-U., and Nakajima, H., The seasonal cycle of averages of nitrous oxide and ozone in the Northern and Southern Hemisphere polar, midlatitude and tropical regions derived from ILAS/ILAS-II and Odin/SMR observations, *J. Geophys. Res.*, 113, D18305, doi:10.1029/2007JD009556, 2008.

Lemmen, C., Müller, R., Konopka, P., and Dameris, M., Critique of the tracer-tracer correlation technique and its potential to analyse polar ozone loss in chemistry-climate models, *J. Geophys. Res.*, 111, D18307, 10.1029/2006JD007298, 2006.

Müller, R., Tilmes, S., Konopka, P., Grooß, J.-U., and Jost, H.-J., Impact of mixing and chemical change on ozone-tracer relations in the polar vortex, *Atmos. Chem.*

[Full Screen / Esc](#)[Printer-friendly Version](#)[Interactive Discussion](#)[Discussion Paper](#)

Phys., 5, 3139-3151, 2005.

Plumb, R. A. and Ko, M. K. W., Interrelationships between mixing ratios of long-lived stratospheric constituents, *J. Geophys. Res.*, 97, 10145-10156, 1992.

Proffitt, M. H., Aikin, K., Tuck, A. F., Margitan, J. J., Webster, C. R., Toon, G. C., and Elkins, J. W., Seasonally averaged ozone and nitrous oxide in the Northern Hemisphere lower stratosphere, *J. Geophys. Res.*, 108(D3), 4110, doi:10.1029/2002JD002657, 2003.

Sankey, D. and Shepherd, T. G., Correlation of long-lived chemical species in a middle atmosphere general circulation model, *J. Geophys. Res.*, 108, 4494, doi:10.1029/2002JD002799, 2003.

Tilmes, S., Kinnison, D., Müller, R., Sassi, F., Marsh, D. R., Boville, B. A., and Garcia, R., Evaluation of heterogeneous processes in the polar lower stratosphere in WACCM3, *J. Geophys. Res.*, 112, D24302, doi:10.1029/2006JD008334, 2007.

Interactive comment on *Atmos. Chem. Phys. Discuss.*, 9, 1977, 2009.

ACPD

9, S1037–S1041, 2009

Interactive
Comment

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper

