**Atmospheric
Measurement
Techniques**
Discussions

Open Access

Interactive comment on "HCl and ClO profiles inside the Antarctic vortex as observed by SMILES in November 2009: comparisons with MLS and ACE-FTS instruments" *by* T. Sugita et al.

Anonymous Referee #2

Received and published: 9 September 2013

General Comments

Sugita et al. present a comparison of HCl and ClO measurements of the SMILES experiment on board the ISS with ACE-FTS and MLS satellite observations. The focus of the comparison is on measurements made in the Antarctic vortex in November 2009. The data are of particular interest for the study of Cly partitioning in the stratosphere. For SMILES the results of two different data sets are presented (JAXA retrieval and NICT retrieval). Both data sets show reasonable agreement with the ACE-FTS and MLS observations (about 20% for HCl and +/-0.05 ppb for ClO).

One general question which came to my mind is, if the authors have considered other satellite data sets for their comparison as well? In particular, I was wondering if Envisat MIPAS data are available for the time period considered in this study? Such additional data may be helpful regarding a more thorough analysis of the Cly partitioning.

I found the paper interesting to read, concise, and mostly well written. I would recommend it for publication in AMT once the comments and questions listed below are properly addressed.

Specific Comments

p6732, l23-29: At this point it might not be clear to the reader how low ozone values relate to the Cl+CH4 or ClO+NO2+M reactions. This is explained in section 4.3 in more detail and a forward reference might be okay to clarify this.

p6733, l4-12: What is causing the differences in Cly partitioning in the Arctic and the Antarctic?

p6733, l23-25: Could you explain a bit more in detail which changes in the ISS observation geometry have to occured that facilitated measurements at southern high latitudes? Was the time period 19-24 November the only one where measurements at southern high latitudes are available?

p6734, l5...: I would suggest to add a paragraph to section 2 that describes the observation geometry of SMILES and the ISS in more detail. The information can be found in different sections of the paper, but it might be more clear to have it in one place. The paragraph at p6734, l15-22 describes the spectral measurements and ends with just one sentence on vertical resolution. I did not found any information on the vertical range of the measurements. The ISS orbit is first explained in the method section (at p6740); I think this should also be introduced much earlier.

p6736, l26: The optimal estimation retrieval is based on an a priori mean state x_a and a corresponding covariance matrix S_a. How was S_a chosen in the two retrieval

schemes? Is a diagonal matrix used or are there smoothing constraints included?

p6736, l13-22: I have no idea how these differences in line frequency, air broadening, and temperature dependence would affect the simulated spectra. Are these differences in forward modelling causing significant retrieval errors?

p6737, l8-9: The NICT precision is 1-2% which seems much smaller than the JAXA error ("less than 10%")? What is the reason for this, if measurements are the same?

p6738, l5-7: It is stated that NICT profiles with a chi-square value larger than 0.6 are discarded. However, a chi-square of one would be expected on average (Rodgers, 2000). This could mean that there is a problem with the errors or the a priori uncertainties in the retrieval or that you are over-pessimistic and throwing away good measurements? Please clarify.

p6738, l15-21: It is difficult to keep all the different precision, accuracy, and resolution estimates for ACE-FTS, MLS, and SMILES in mind, which are found in different parts of the paper. It might be helpful to include a summary table.

p6741, l25: I think it would be more accurate to say that the differences are due to different forward models (and retrievals schemes) rather than "retrieval approaches" only? (In fact you mention in the same paragraph that you found no significant differences due to the a priori used in the retrievals, but that the differences in modelling of continuum absorption are a possible source of differences.)

p6744, l6: Negative ClO volume mixing ratios in the MLS data may be a mathematically correct solution of the inverse problem, but they are physically unrealistic. I am always curious how these negative values are treated in the forward model?

p6745, l13-15: Here you mention a case where observations in 2004/2005 contradict the hypothesis of "low ozone leads to large HCl". What is the meaning of this for your study? Is this an unusual, random event or part of inter-annual variability? Are there any problems with the observations?

p6746, l10-12: It is stated that ClONO2 values for the local solar times of the SMILES and MLS observations would be needed for a precise calculation of Cly. How large are the errors quantitatively when using ACE-FTS data as a proxy?

p6747, l17: I think you do not need to mention again in the summary that measurements are made with a 4-K mechanical cooler and SIS mixers.

p6747, l25: It seems 15-20% would be a more appropriate value for the NICT HCl errors rather than 10% (looking at Fig. 2 and 3)?

Appendix: It seems there is no link to the appendix in the main text of the paper. Perhaps add a reference to the appendix in section 4.3?

Fig. 2: Do the precision curves show the mean of the precision values of the individual measurements or are these scaled by 1/sqrt(n)?

Fig. 2: What do the vertical lines at each square indicate? Do they illustrate the bin width? Perhaps better remove these to make the plot less busy?

Fig. 2: There are only few data points for MLS at the 500K and 650K levels, resp. Is the 3.4 ppb maximum value for MLS at 500K realiable or is it just cause by the small number of data points (6 in this case)?

Fig. 3: You may consider showing the differences between ACE-FTS and MLS in this plot as well. There seems to be very good agreement above 550-600K, while both SMILES retrievals are about 20% lower?

Fig. 4: The x-axis label in the middle panel should be replaced by "(X1 - X2) (ppbv)" for consistency with the right panel.

Fig. 5: "SMILES-JAXA ClO" and "ACE-FTS ClONO2" should have different line styles.

Technical Corrections

p6732, l1: as the sum of _the volume mixing ratios_ of Cl,...

p6732, l18: from _t_he Atmospheric

p6732, l19: Space Shuttle _were_ conducted

p6733, l2: remove "At that time" (?)

p6740, l2-3: change "grid" -> "grid point"

p6740, l3: remove "above"

Fig. A1, caption: deduced _from_ the N2O values

———————————————

Interactive comment on Atmos. Meas. Tech. Discuss., 6, 6729, 2013.

C2449