**Atmospheric
Measurement
Techniques
Discussions**

Interactive
Comment

Interactive comment on "HCl and ClO in activated Arctic air; first retrieved vertical profiles from TELIS submillimetre limb spectra" *by* A. de Lange et al.

Anonymous Referee #2

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This is a nice paper which describes the first results from the TELIS submillimetre atmospheric emission sounder. The instrument was equipped onto a balloon which took a flight within the chlorine activated air at Arctic polar vortex. Vertical profiles of HCl and ClO were successfully retrieved from the TELIS measurements, by solving the ill-posed inversion problem with Tikhonov regularization method. The authors discussed the error sources of their retrievals, and compared their results to the EOS Aura/MLS products.

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Interactive Discussion

Discussion Paper

In my point of view, this manuscript fits well with the scope of AMT.
The method of retrieving the atmospheric physical parameters from the measurements
is clearly described, and validated with the error analyses. I think this manuscript
can be published in AMT with consideration to the following specific comments to the
authors:

1. The way you calculated the systematic error due to the detectors' non-linearity
   was a bit unclear for me. You calculated the systematic errors due to non-linearity
   by comparing the retrieved profiles between two cases: using non-linearity gain
   compression factors of 10% and 25%, respectively. Is this correct? Or, is it a
   difference between the cased of 10% (or 25%) and 17.5% gain compressions?
   Perhaps, you can add a plain explanation for your calculation.

2. For the error analysis on the spectroscopic parameters, I suggest includ-
   ing an additional uncertainty due to the temperature dependence of the
   broadening coefficient. Also it may be useful for future works to compare the
   HCl spectroscopic parameters between yours and those in MLS data processing.

3. I recommend adding a bit more detail description about your forward model. For
   example, do you calculate only targeted HCl and O_3 lines with some continuum
   absorption coefficients? Or do you apply any line selection procedures? What
   kind of atmospheric refraction model do you use? etc.

And, please find some technical comments/questions below.

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Interactive Discussion

Discussion Paper

Abstract:

- 6498, L10–11. The increase of ClO . . . "has" been recorded. . .

- 6498, L17–20. I would prefer to put comma before "and for HCl" at this sentence.

1. Introduction

- 6498, L23. I would spell "protocol" starting with the capital letter P.

- 6498, L25. Do we need comma after "Although"?

- 6500, L29. "for precise measurements" is more appropriate compared to the current "accurate".

2. TELIS

- 6503, L22. Maybe you don't need to abbreviate the sideband ratio as "SBR" since there is no more appearance of this abbreviation within the manuscript.

3. Inversion

- 6507, L25. Eq(3) "xγ" seems to be a typo of "$||x\gamma||^2$".

- 6508, L13–19. I think that how you select the regularization parameter is one of the most important (and interesting for readers) points of this paper. I would suggest showing one figure of actual L-curve, just for an example to readers, from your HCl or ClO retrievals.

4. Retrievals

- 6510, L1–. Did you try a frequency-dependent offset for the retrieval parameter (I mean, not a constant offset but with slopes, or n-th order polynomial functions with respect to frequency)? It might be interesting to check whether fitting quality improves or not with introducing a slope-like brightness offset (in particular, for the ClO window).

- 6510, L25–29. Temperature/Pressure profiles are one of the most important factors in the retrieval analysis. I would suggest comparing your temperature a priori (i.e., MIPAS product) to the ones from MLS measurements, or to the reanalysis model data such as ECMWF or GEOS5, in order to confirm if the assumption of 1 K systematic error is appropriate. And, I think it is also possible to retrieve the temperature profile from the O_3 line measured by TELIS. This can be another interesting future work.

- 6511, L1. The error of 1 K is assumed for the temperature profile. Is this a systematic error? Or including the random errors coming from the measurement noise of MIPAS instrument?

- 6511, L6. Comment: If I remember correctly, the broadening parameter of ClO 501 GHz on the HITRAN 2008 is based on the laboratory measurements by Bauer et al. (1998, within a frame work of an ESTEC study for the MASTER database). As described in the MASTER introduction paper by Perrin et al. (2005, J. Atmos. Chem. 51, p 161–205), their measured broadening parameter was significantly larger than the gammas for other ClO transitions measured by different groups. For this paper, I think the currently assumed 5% uncertainty on ClO gamma is a reasonable value, but just I would like to point out that gammas are still a kind of highly caution-needed parameters.

- 6512, L7–11. Considering the closeness of the vertical resolutions of MLS and TELIS, I think you can directly compare both profiles without applying vertical smoothing. This comment is also applied to the ClO comparison.

- 6512, L29. If I see the Table 2 of Froidevaux et al. (2008), I would select 0.2 ppbv rather than 0.1 ppbv.

- 6517, L20 (Fig. 10). I would like to see the corresponding solar zenith angles within this plot (for example, putting ticks of solar zenith angles at the upper horizontal axis). And I would prefer to use different symbols, not only different colors, for the better visibility.

Finally, just a question for future works:

Do you have any plan to perform further comparison studies with other satellite measurements, such as SMILES, ACE/FTS or Odin/SMR? In particular, I expect interesting/useful works can be done with SMILES and Odin/SMR since they observe exactly the same HCl and O_3 625 GHz transitions (SMILES), and ClO 501 GHz (SMR), if these instruments were luckily observing at close locations with TELIS at this day/time...

Interactive comment on Atmos. Meas. Tech. Discuss., 4, 6497, 2011.