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Atmospheric Measurement Techniques Discussions

Interactive comment on "The Level 2 research product algorithms for the Superconducting Submillimeter-Wave Limb-Emission Sounder (SMILES)" *by* P. Baron et al.

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We would like to thank C. Sioris for reviewing the paper. Associated plots are provided in the supplement pdf file.

General/scientific comments

1) Figure 1 shows synthetic spectra with no difference in radiance between bands A and B. Real data for bands A and B have differences mainly due to radiance calibration errors. We expect the difference to be reduced with the new radiance calibration algorithm that will include the gain compression (see appendix C).

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2) Yes there is a slight undersampling of the radiance spectra according to the given values (1.4 MHz resolution for 0.8 MHz sampling). Note that these values are upper limits and the actual values depend on the AOS and vary along the spectrometers bandwidth. However high resolution is not required for the spectra inversion and the number of measurement points should be at least the same as the degrees of freedom of the forward model. For the analysis presented in the paper, the inversion is actually overconstrained by the measurement and the channels could have been binned to speed-up the calculation.

3) Simulations show that line-of-sight (LOS) angle and O3-VMR profiles are "efficiently" retrieved between 30-50 km even with a large error on the a priori O3 profile (Figure A of the uploaded file). Below 30 km, LOS angles are sensitive to a large error on the O3 a priori profile (correlations between retrieved parameters due to the a priori regularization). Figure B shows that on the other hand, errors on the a priori LOS angles and temperature profiles have small impacts on the retrieved O3 profiles above 20 km. SMILES does not observed latitude higher than 65 deg and the method has been designed assuming small errors of the O3 and temperature profiles of the GEOS-5 analysis in the lower stratosphere. An example of retrieval simulation will be added in the manuscript (see additional corrections in the last section of this document). Performances below 25 km should be improved in the future by applying the same algorithm on the full spectrometer bandwidth (see answer 4).

4) Considering only the measurement noise and the correlation between retrieved parameters (within the variability range assumed in the paper), O3 can be retrieved from process A/B-w1 (step 2) down to $\sim$18 km. However, we found significant errors below 25 km from errors on the radiance calibration and on the continuum term of the absorption coefficient. Enlarging the spectral bandwidth decreases the errors due the continuum absorption (as well as retrieved parameters correlation) but increases the errors from the calibration. In future, processes A-w8 and B-w6 (step5) will be better suited for retrieving O3 and other parameters below 25 km down to $\sim$12 km.

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5) Equation 10 shows that the retrieved profile depends on the deviation of the measurement (y) with respect to the forward model, F(x_i, p_retrieved, b). Simulated radiances are such as “y = F(x_true, p_true, b) + noise”. - To avoid confusion “y(x, p_hat, b)” will be replaced by “y” in equation 10 (note that “p_hat” should have been “p”) - the text (p3609, line 18): “In the following ... depending on x, b and p_hat” is replaced by “In the following ... depending on x, b and p” - “p_hat” will also been replaced by “p” in equations 12 and 13.

Technical errors

We agree with all modifications stated in the Technical errors session. They have been introduced in the manuscript as recommended by the referee.

For the comment “p3612L18”, we will change the text as follow: “The profiles of O3, temperature, HCl isotopomers, H2O, HOCl and OO18O are simultaneously retrieved on a sparse vertical grid of 3 km step below 30 km and 5 km above. They are considered as interfering parameters. Three O3 profiles are retrieved from the fits of the main line at 625.371 GHz and of two minor lines of the molecule, respectively. The two minor lines correspond to transitions in the first level (v=1) of the O3 vibrational states \nu=2 and \nu=(1,3).”

Additional corrections

1) We found an error in Table 4: the random pressure error is 2% and not 5%.

2) Following the recommendation from the co-editor, I will include figure C in the paper as an example of O3 retrieval. It will replace figure 13 in section 6.3 and the text “Figure 13 ... error of 0.15-0.7 ppmv” will be modified as follow: “Figure 13 shows an O3 profile retrieved from a simulated measurement vector. The measurement vector was computed using atmospheric profiles (“true” profiles) from a winter mid-latitude climatology while the a priori profiles are from a tropical climatology. In addition, the true pressure profile was multiplied by 0.95 in order to highlight errors induced by the

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non-correction of the pressure profile using the retrieved temperature. A random noise of 0.4 K (1-sigma) was added to the simulated radiances. As expected, the difference between the true and the retrieved O3 profiles is smaller if it is estimated on pressure levels (right panel) than on altitude levels (left panel). Between 30-50 km, a difference of 4-6% remains due to the large error on the a priori pressure profile (20-30%). ”

Please also note the supplement to this comment:
http://www.atmos-meas-tech-discuss.net/4/C1215/2011/amtd-4-C1215-2011-supplement.pdf

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Interactive comment on Atmos. Meas. Tech. Discuss., 4, 3593, 2011.