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Atmospheric Measurement Techniques Discussions

Interactive comment on "Vertical profile of δ^{18}OOO from middle stratosphere to lower mesosphere derived by retrieval algorithm developed for SMILES spectra" *by* T. O. Sato et al.

Anonymous Referee #1

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General Comments

This short paper introduces a new algorithm for the retrieval of ozone isotopic enrichments vertical profiles from the Superconducting Submillimiter Wave Limb Emission Sounder (SMILES). First, the retrieval, forward model and errors are explained. Then a comparison is performed. Followed by a brief discussion.

Although the overall material is publishable, I believe there are a number of points which need to be address before the paper can get into AMT. In particular, the title, the introduction and some of the retrieval intricacies could be explained better.

Furthermore, one major concern is the use of English, there are many sentence that could be rewritten for a more enjoyable reading, the manuscript needs to be thoroughly re-checked, and proof read to improve its readability before the paper is re-submitted.

Please find below my specific comments.

Change title to: Vertical Profile of delta18OOO from Middle Stratosphere to Lower Mesosphere from SMILES Spectra

Introduction comments

Please start by mentioning that there is a heavy ozone anomaly (ie. the measured magnitude of the ozone enrichments are large compared to the expected values).

Perhaps give a bit of history (ie. Cicerone and McCrumb [1980]; Mauersberger [1981]) to give the reader a historical perspective.

Break equation 1 into 2 and add the 100 factor since all the results are given in percentage. (i.e. deltaˆm O = (ˆm R_obs / ˆm R_std -1) * 100. where ˆm R_obs is .... and ˆm R_std ...)

Then explain previous measurements clearly (although briefly), detailing their finding and their measurements caveats rather than quoting Mauresberg, (1981) and then giving the Krankowsky (2007) results (as in p8891 line 5 through 7).

Overall, the SMILES section of the introduction is fine, just some minor comments (that can be found in the minor comments section)

Specific comments

p8895 line 19: If window b0 is the same as b1, why did you retrieved O3 plus other molecules using a fix pressure and temperature profile if later you were going to retrieved temperature. Please clarify, wouldn't be better to retrieve O3 and temperature from b0 (b1) at the same time.

p8897 eq2: You don't need ny or nx to increase the contribution of the apriori you just need to decrease the apriori noise, which is essentially what you are doing with ny and nx. Please delete nx and ny and report the corresponding apriori error .

p8898 line 16: include a brief explanation of eq 21 in Worden (2006) or give the full description in the explanation.

p8899 eq7 and 8: These two equations will be better after eq 4. So when eq6 refers to e_z the reader already know what it is.

For instance change line 9 in p8898 to: The weighting function Kx in the linear scale was projected onto the log scale by (no period) K_z = dy / dz ... as well as, the apriori error (e_x) by(again no period) followed by eq7 and 8. (rearranging the rest of the text appropriately)

eq10: Why did you need this normalization? Please explain the advantages/disadvantages of doing this.

p8900 eq13: please define how did you map Kz (equation 4) to K (in eta space) I understand that the a priori section of the chi2 (eq2) in eta space becomes zero but please clarify for the reader.

Also, in the last iteration the levenberg-marquadt parameter needs to become zero otherwise is introducing a regularization effect that needs to be taken into account for the computation of the averaging kernels and the error covariance matrix. For a description of this effect see Raspollini et al 2013 – Ten years of MIPAS measurements with ESA level 2 processor V6- part 1: Retrieval algorithm and diagnostics of the products.

p8901 line3: Please explain the methodology described in Sato (2012) briefly. Line15: Why did you not include the xtrue – xref error? This error give you an approximation of the retrieval error in itself.

p8902 line 12: Define the contribution matrix D. Is this the same D as in Baron et al 2011 or in Sato (2012). Please clarify.

Line17: Define A (the averaging kernel matrix) ie. A = dˆx / dx = DK

p8903 line 3: Sato et al 2012 refers the reader to Baron et al 2002 for a detail explanation of the measurement response. Please summarize here or add the description in the appendix. line 6: what does the m = 0.9 implies? Is this just the integrated area under each kernel? If it is just say: values near unity indicate that most information was provided by the measurements while lower values indicate that the retrieval was influenced by the apriori.

Line25: Please explain why for 18OOO in window b2 the gamma_air error increased compared to V215, particularly around 30km. Is this also due to the fix vertical grid that helped reduced the gamma_air error in O3. Please clarify.

p8904 line1: The smoothing error drops from 55 to 57 and then sharply increases. Why were the values of Sx multiplied by two above 55km. Did you try not multiplying by two to verify your hypothesis.

line7: The information in figure 3 looks just like the information in figure 2. Is this suppose to be the case?

line8: Is the consistency you are talking about the similarities between total b2 and c1 errors. Because if that's the case, please clarify what you mean until line 11. line16: The minimum value is 5%.

p8906 line23: From 45 to 50 km V215 also shows a decrease please comment.

Minor comments

p8892 line 12: Change "instrument to observe atmospheric" to "instrument that observes atmospheric"

line13: remove "quite"

line15: Change "The signal to noise ratios. . .." to "For a single scan, the signal-to-noise ratios. . ."

p8893 line 13: Change "vertical profile observations of delta18 000. . ." to "a vertical profile of delta18 000. . ."

p8894 line 5: Consider changing "We used the tangent height after correcting it by a bias offset in TOROROS. The bias offset was estimated by . . ." to " A tangent height offset was estimated by. . ."

p8895 line 13, 14 and 15 change "The VMR of X" to "X VMR"

p8896:

line 1: Change "We employed the forward model . . ." to "We employed the v215 forward model (F) with the following improvements."

line 22: change "which was half that of the . . ." to "which is half of the . . ."

p8897: line 11: Change "Sy is the diagonal matrix with the diagonal elements. . ." to "Sy is a diagonal matrix with elements (0.5K)ˆ2".

line 22: Change "The apriori profiles of pressure and temperature were taken from. . ." to "The pressure and temperature apriori profiles were taken . . ."

p8898

line 20: instead of having (m=16,18) in the line above and then: i and j in square brackets ... just say: where m is either 16 or 18, i and j indicate vector or matrix indices, h is the altitude vector, and h_c is the correlation length set to 6 km.

p8902 line25-27: change “The same retrieval grid was employed for all retrieval windows for obtaining the isotopic ratio without any vertical interpolation in TOROROS, while that of V215 was adjusted to optimize each molecule (see Fig. A1).” to: “The same retrieval grid was employed for all retrieval windows to obtained the isotopic ratio without any vertical interpolation in TOROROS, while V215 adjusted the retrieval grid to optimize each molecule (see Fig. A1).”

p8903 line7: The total systematic o3 is more between 2% and 3% than around 2%. line22: change: “in window b2 was 5-15%” to “in window b2 varied from 5 to 15%”

p8904 line27: change: “is essential for error in remote sensing...” to “is essential to reduce erros in remote sensing ...”

p8905 line 3: Just say performed using a profile by profile comparison. No need to quote other paper that did the same thing.

Line21: are 1145 the number of profiles for b1 and 1377 the number of profiles for c1? If thats the case please change “The numbers of profiles of 18OOO calculated from the b1 O3 and the c1 18OOO with “good quality” were 1145–1377 in an altitude range between 28 and 57 km.”

to

“The numbers of profiles of 18OOO selected for b1 O3 and the c1 18OOO with “good quality” in an altitude range between 28 and 57 km were 1145 and 1377, respectively.”

otherwise clarify.

In figure 4 in the VMR difference add the values for the systematic errors, individually and then added, to see if the difference is between those lines (ie. Two blue lines on either side of zero, two red lines and two total).

p8906 line27: Change “This was in good...” to “This is in good...” line29: please add reference for the atmos observation.

p8907 line16: Change “(the reaction R1)” to “(reaction R1)” line17: Change “the temperature dependence.” to “a temperature dependence.” line 20: Remove “the” from “Only the nighttime date ...” line 21: change “excepting” to “except at” line 22,23: change: “the positive correlation between the delta 18OOO and the temperature was clearly obtained that the ozone isotopic enrichment is increased as the temperature increases. ” to: “Clearly, there is a positive correlation between delta18OOO and

temperature strongly suggesting the ozone isotopic enrichment increases with temperature."

p8908 line14: either define the wall effect or just say "due to an apparatus artifact."

p8909 line:13: are this results for c1 18OOO? Table 6 says 16% at 32km.

P8910 line5: change: "to the mesosphere" to "to the lower mesosphere"

Interactive comment on Atmos. Meas. Tech. Discuss., 6, 8889, 2013.