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Atmospheric Measurement Techniques Discussions

Interactive comment on "CRISTA-NF measurements with unprecedented vertical resolution during the RECONCILE aircraft campaign" *by* J. Ungermann et al.

Anonymous Referee #2

Received and published: 8 March 2012

General comments:
The paper describes the application of a modified retrieval approach to measurements with the airborne CRISTA-NF during the arctic RECONCILE campaign. The retrieval approach is presented together with various analytics considering, among others, error budget, vertical and horizontal resolution and line of sight uncertainties. Retrieval results for one flight during the campaign are presented and the results are compared to simultaneous observations from other instruments on board Geophysika during the same flight. I think the paper is interesting and worth being published in AMT. However, there are some sections which are unclear and could need some revision before

publication.

Specific Comments:

Page 6925, Line 16 ff.:
You describe the forward model approximation using a look up table. For me it is not quite clear, what the “EGA” and the “CGA” are used for. To my knowledge, CGA is used to determine weighted means, e.g. layer mean values for discrete profiles. CGA is also applied within line-by-line models for the RT calculation. Additionally, I assume that the Look-up tables are based on line-by-line models. Unfortunately this part is not clear from *Weigel et al, 2010* either. So here one or two sentences could help to make this part clearer.

Page 6926, Line 3 ff:
Why can the FOV of CRISTA-NF be approximated by a Gaussian? Is this an assumption? Or from observation? If the latter is the case, provide a reference.

Page 6927, Line 13 ff:
You write that spectra from upward looking scans are used. If they are used for the retrieval, how are these spectra attributed to any altitude? There is no “tangent point” information available. This should be clarified.

Page 6930 Line 17 ff and 6937 Line 20 ff:
I agree with reviewer number 1 that the description of the horizontal resolution along the line of sight is unclear and misleading. To which extend does the horizontal resolution agree with the length of the partial column (let’s call it actual footprint) through the layer at the tangent point? Is it better or worse than the actual footprint? Especially for the lowest tangent altitudes this discussion is not possible, as the path along the line of sight before and after the tangent layer is not covering the tangent layer anymore but the layers above. So you cannot get any information on the field at this altitude outside the footprint as this is observing other altitudes. Here you should rethink the use of

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horizontal resolution and use other argumentation.

Page 6931, Line 19 to Page 6932, Line 6:
The description of the pointing error assessment is difficult to follow. It could be improved.

Page 6933, Line 11/12:
What do you mean by "quiet" time. Is this the plane standing before and after the flight? If yes this should be mentioned. The use of the expression "quiet time" is unlucky.

Page 6934, Line 27:
What do you mean by a ^{2} fit. This is the first and only time you mention this. Please clarify this.

Page 6935, Line 14 ff:
The description of the observed distributions of the various trace gases could be improved. When reading this section I had difficulties to distinguish with statements related to individual species and statements applicable to all gases:

- Discussing CFC-11: How do you define the location of air masses inside or outside the polar vortex?
- CFC-11 and $ClONO_2$: What are typical distributions/profiles and why do you expect the two species to be anti correlated?
- The color scale is consistent top the error bars: Is this valid for water vapour only or for all species described?

Page 6936, Line 3 ff, Figure 6:
Where does the horizontal structure in the error distributions for $ClONO_2$ and H_2O come from? It appears to be related to the a priori profiles?

Page 6936, Line 18 ff:

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The discussion of the measurement distributions is unclear: Why do we get values above 1 for mixing ratios below the detection limit? This should be clarified.
"It can be removed..." What can be removed?
The description of possible cut-off in the retrieval altitudes is unclear and could be improved.

Page 6936, Line 20:
"ISW": do you mean "IMW"?

Page 6939, Line 22-23:
" ... might be horizontal gradients...": Here you could use additional information (e.g. maps of pot. vorticity) to show that the vortex boundary really was affecting the LOS. The argumentation is becoming less speculative.

Page 6940, Line 9 ff:
The offset discrepancy between the ascent-profile comparison (Fig 13) and the flight altitude comparison (Fig 12) is not sufficiently treated. The statement on the horizontal averaging should be supported by some (at least rough) estimates of the influence of the horizontal inhomogeneities.

Minor/Technical Comments:

Page 6920, Line 13 ff:
"Compared to CRISTA-NF, MIPAS-STR has a reduced spatial resolution.... " Do you mean vertical or both, vertical and horizontal? If you mean vertical, why not name it explicitly.

Page 6927, Line 28 ff:
What do you mean by aggressive standard deviation?

Page 6928, Line 13 ff:
Refer S_a^{-1} to section 3 : E.g "... assemble the a priori covariance matrix S_a^{-1}".

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Page 6930:
You could flip Equ 4 and 5.

Page 6930, Line 14/15:
What do you mean by the inverse of the diagonal entries of A being a measure for vertical resolution? How is this related to the FWHM approach, which is actually used?

Page 6932, Line 11 ff: You describe the set up of S_ϵ and give reasons for the use of a diagonal matrix. this is redundant or connected to **Page 6925, line 1 ff**. You could make a reference and mention that this concerns the set up of S_ϵ, explicitly.

Page 6936, Line 10/11:
You refer to two scans (taken at 11:07 UTC and 12:30 UTC) as profiles. As you work with profiles of trace species, Temperature etc, I recommend to use the expression scan rather than profile when referring to these two scans. This is applicable to all places in the paper.

Page 6936, Line 14-18:
The discussion about the profiles of water vapour and $ClONO_2$. The direction should be consistent for both profiles, going from the surface up or down to the surface, respectively.

Page 6937, Line 5-13 ff:
"These results show... to 250 to 300m" Put this section to the end of the paragraph. Currently the discussions of the resolution are interrupted. Why are the vertical resolution profiles of water vapour and $ClONO_2$ so strange? This could be mentioned.

Page 6938, Line 8:
"... two of which..." better "... of which two..."

Page 6941, Line 3:
"The MIPAS-STR retrieval grid is generally finer ... " than what? Than the measurement grid? Here you could also mention the estimated vertical resolution of MIPAS-STR.

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Figure 14:
I think you could remove the a priori profiles and the error bars. You don't really discuss them in the text and so they are not necessary. Especially due to the large error bars the a priori dominates most of the figures and distract from the two profiles to be compared. Especially for the H_2O comparison, you should reduce the x-axis to the values covered by both instruments. You can easily reduce the range to 15 to 20 ppmv and show the good agreement.

Interactive comment on Atmos. Meas. Tech. Discuss., 4, 6915, 2011.