

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

Anonymous Referee #1

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CRISTA-NF measurements with unprecedented vertical resolution during the RECONCILE aircraft campaign,

Ungermann et al

OVERVIEW

The paper outlines the calibration and retrieval algorithms used to invert spectral measurements from the airborne CRISTA-NF instrument during an arctic campaign in early 2011. It follows on from an earlier paper (Weigel et al) describing the same instrument and essentially the same algorithms but with data acquired during a different campaign

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(AMMA-SCOUT in Africa). While I have no major argument with the contents of the paper, I wonder whether there is enough new material on the "atmospheric measurement techniques" to justify a second publication. It does, however, contain a more extensive set of diagnostics and serves as a useful document for those who may wish to use the CRISTA-NF RECONCILE measurements (although perhaps a more comprehensive comparison of the entire dataset rather than a few examples would be more useful if this is the aim).

SCIENTIFIC COMMENTS/QUESTIONS

A) Although some attention is given to the question of LOS pointing accuracy, it is not explained why the standard approach used for satellite infrared limb sounders, i.e. a joint pressure-temperature retrieval, is not used to circumvent the problem by retrieving tangent pressure.

B) Horizontal resolution in the line-of-sight direction. I am surprised that Fig.9 shows figures as large as 300-400 km at low altitudes. These numbers are comparable with the resolution expected from MIPAS which has a FOV of 3-4km when projected on to the limb. One can make a crude estimate of the best horizontal resolution attainable by considering the length of the path within each vertical layer so how, for example, do these figures compare to that?

C) The importance of the demonstration of retrieving at fine vertical resolution seems overstated. Even from space, this is purely a matter of geometry and S/N, and instruments within the atmosphere itself have an obvious further advantage both in terms of integration time (S/N) and distance to the tangent point. High vertical resolution is only really useful if there is a commensurate increase in horizontal resolution in both directions, which cannot be said for this particular experiment (15km OK, but not ~100s km in the other direction).

D) It seems that most of the temperature information comes from ECMWF, which is necessarily on a relatively crude spatial grid. How is this reconciled with the claimed

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ability to resolve fine structures? Is it just assumed that the temperature has no fine structure, or is the retrieved temperature superimposed (but with an a priori temperature of 1K it is difficult to see how the ECMWF temperatures would be modified).

E) (possible) horizontal inhomogeneities along the line-of-sight are cited as a potential cause of many discrepancies with the other instruments. This should be supported by a plot of potential vorticity or some other tracers (eg from MIPAS or MLS) measurements at this time which show the likelihood of such gradients.

MINOR/TECHNICAL COMMENTS

1. Abstract: it would be helpful to state the viewing geometry (ie sideways to the flight direction)
2. p6918, top: an equally important advantage of limb-sounding for trace-gas detection is that the measurements are made against the cold, uniform background of space.
3. p6918, l12: is 'passive' necessary here? (als p6942, l7). I know of no 'active' infrared limb sounders.
4. p6918, l23: unprecedented horizontal coverage? I accept that CRISTA may have provided unprecedented resolution but, from the Space Shuttle, I would expect its latitude coverage to be quite limited compared to that obtained from contemporary polar orbiters such as Nimbus-7 and UARS.
5. p6919, l10: I assume RECONCILE is a contrived acronym so I suggest capitalising the relevant letters in the phrase in brackets to make this point (rather than it just appearing to be an explanatory phrase inserted in brackets).
6. p6920, l8: '500m diameter' - I suggest removing 'diameter' since you are only discussing the extent in the vertical direction and diameter implies a similar horizontal extent.
7. p6921, l7: what sort of S/N figures are typically obtained? In section 3 (p6925, l2) it

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is implied that a figure of 100 is assumed for the measurement covariance.

8. p6925, l12: Heading: presumably "Radiative transfer model" is meant.
9. p6926, l7-10: This information would be better in the figure caption rather than here in the text.
10. p6926, l13: Having 'temperature' as only a secondary retrieval seems surprising, since most infrared instruments would regard this as a primary retrieval, and necessary for the accurate retrieval of any other species.
11. p6929: although the paper includes some detail on the construction of the a priori covariance matrix, this presumably has little bearing on the retrieved values if the S/N is reasonable. Are there really any advantages over a simple climatological covariance with some auto-correlation length?
12. p6931, l13: some further assumption is required to construct the HNO₄ covariance matrix from the Remedios climatologies which only supply the diagonal elements of this matrix.
13. p6932, l1: replaced "shrinked" by "shrunk"
14. p6932, l14: doesn't this imply that your error covariance matrix is unrealistically large?
15. p6932, l14: remove ',' after 'solutions,'
16. p6935, l5-18: in my opinion much of this explanation would be better as part of the figure caption.
17. p6935, l20: replace 'less' with 'fewer'
18. p6936, l14: replace 'cross-talks' by 'cross-talk'
19. p6936, l20: 'ISWs' ?
20. p6938/39 comparisons with HAGAR. It would be useful to have the a priori CFC-11

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profile plotted on Fig.10 as well. For a CFC-11 measurement to be of 'useful' accuracy it should reproduce the same deviations (at least in sign) as the HAGAR measurements from the a priori values. From the information presented here it is not possible to say whether the retrieved CFC-11 profile is actually any better than the climatology.

21. p6939 - same as 20, applied to the ozone comparison with Fozan in Fig.12

22. p6941, l5: remove ',' after 'We mention,.'. Incidentally I think it unlikely that the differences between the two HNO₃ spectroscopic databases would be large enough to contribute any noticeable difference in results.

23. p6941 - HNO₃ comparisons with MIPAS-STR: rather than comparing single profiles I would have been more impressed if a 2D plot of the MIPAS-STR results resembled Fig 5(e). ———

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