Atmos. Meas. Tech. Discuss., 3, C2556–C2559, 2011
www.atmos-meas-tech-discuss.net/3/C2556/2011/

Atmospheric Measurement Techniques Discussions

Interactive comment on "Fast NO_2 retrievals from Odin-OSIRIS limb scatter measurements" *by* A. E. Bourassa et al.

Anonymous Referee #2

Received and published: 28 January 2011

The manuscript introduces a new method for NO_2 profile retrieval from ODIN measurements. The measurement vector is constrained by a modified triplet technique involving 4 spectral pixels around the NO_2 absorption band at 448 nm, and the MART technique is used to iteratively find the profile. The algorithm seems feasible and the manuscript provides new interesting results. I generally support its publication in AMT. However, in my opinion, there are some deficiencies which should be addressed beforehand:

1. It is not possible to fully appreciate the new method due to lacking error analysis and corresponding discussion. The reader does not get information with what decrease in retrieval precision one should pay for the increase in the calculation speed.

2. I see that the daily average determines the zonal variation rather well, is it the

case also for individual orbits? The analysed data set (only one day) is very small. What would be standard deviation for profiles retrieved for a longer time period? How it compares with retrieval precision, i.e. can a substantial part of this variability be explained by natural variation? Also results for different seasons could be investigated. Is the discrepancy at high latitudes appearing then also?

3. In introduction, abstract and conclusions, the authors state that the much faster approach (comparing with the standard retrieval) could be used for tomographic retrievals. This is especially enhanced in the conclusions where one of the only two sentences states this, although such an application is not presented and discussed in the main text of the manuscript at all. Although it is meant as an outlook, reading only the abstract and/or conclusions, one can get impression that a major part of the paper is about a new tomographic approach. I think that these statements in their current form and proportion give wrong impression about the work actually performed.

4. Also the statement (which is even meant as a main conclusion of the study) about the reducing for "the computational cost by almost an order of magnitude" is mentioned only in the abstract and conclusions as a conclusion of the study. It is not discussed and proved in the main text, in which steps of the retrieval and how the improvement is get, and how time consuming are each of these steps comparing with the nominal retrieval.

5. The algorithm description is not complete. Standard method uses a number of spectral corrections. Are there corrections for error sources necessary to worry about, e.g. Ring effect, straylight...? Is it necessary to account for them in the new retrieval? If yes, mentioning this and a short description would be nice.
What cross-sections are used, at which temperature? Dou you use the same slit function for your retrieval as for the standard method to convolute the cross-sections to actual resolution? Cross-sections generally vary with temperature; how this is accounted for in the new approach comparing with the standard retrieval?

6. The discussion of the results is much too short. What are the strengths/weaknesses of the retrieval without that it is now much faster? What is the impact of different retrieval settings (see also the comment before)?

7. With respect to the conclusions section: Two very general and partly speculative sentences is too less for conclusions. Please summarize some key facts from the results and discussion. Which is the essential retrieval step where you get the improvement? Besides the statement about the calculation time, it would be nice to see some measures about the differences in accuracy and precision between both compared retrievals.

Specific comments:

Abstract: Second last sentence, second part (also similar statement in the introduction and conclusions): I think these statements are too speculative and I am sceptic about them. Arguments and discussion for them are needed in the main text of the manuscript. Two-step algorithms suffer not much from increase in the computational burden (comparing with direct retrievals) when moving from 1D to 2D because the spectral part of the retrieval stays the same and RTM should be done for one or two spectral points per one geometry only. Also total number of geometries per orbit is not very large, so inversion is not a problem for a modern PC. Is it then reasonable to degrade the retrieval precision few times as a cost for higher speed? Do you need now to do RTM for each of 4 points to get y^{modelled}?

Abstract: last sentence: Do you have some estimate for optimal spectral resolution requirements for your retrieval? Although one could gain on signal to noise ratio, reducing spectral resolution will also smooth out the narrow absorption bands, so the measurement vector will reduce. Can you provide arguments for that in the main text of the manuscript? What instrument would be capable to satisfy at best your requirements?

Page 5502, line 2: I would suggest adding SCIAMACHY, to read: “current instruments, such as OSIRIS or SCIAMACHY”.

Page 5505, line 12: A decrease in random noise when adding additional spectral point is just mentioned without providing any error bars in the plots later. What is the improvement? Please definitively add statistical error bars in some figure along with some sample profiles for the different retrieval methods in order to allow quantitative comparison.

Page 5507, lines 9-10: This sentence has some grammatical mistakes.

Page 5508, Sect. 3, 2nd line: Please add reference for the “official OSIRIS version 3.0 NO_2 retrievals” or indicate already in the introduction which of the retrievals mentioned there is the official one.

Page 5509, last paragraph of Sect. 3: could you add percent difference plots between the new and the standard retrievals for Fig. 5.

Conclusions: first line: “technique outlined here”: please name the method.

Interactive comment on Atmos. Meas. Tech. Discuss., 3, 5499, 2010.