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Comment

# ***Interactive comment on “Retrieving aerosol height from the oxygen A band: a fast forward operator and sensitivity study concerning spectral resolution, instrumental noise, and surface inhomogeneity” by A. Hollstein and J. Fischer***

## **Anonymous Referee #1**

Received and published: 7 January 2014

The manuscript contains genuinely new information relevant to aerosol vertical information retrieval from moderate to high spectral resolution spaceborne measurements of the O<sub>2</sub> A band. The main conclusions are clear, however the writing is unclear in many instances, and several important points are hard to understand. The manuscript fits well in the scope of AMT. I recommend publication after the issues specified below have been addressed.

Main points:

C3908

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1. Please improve readability of Section 2. Please highlight more clearly which approach has been selected in the present study (as opposed to previous and alternative approaches).
2. It is stated (p. 10518 l. 14-18) that convolution of high spectral resolution radiance with an instrument response function (also taking into account spectral shifts) is numerically cheap. Accurate forward modelling of instrument responses in the O<sub>2</sub> A band requires either sophisticated spectral sampling techniques or a spectral sampling that is so high that convolution is not numerically cheap any more. Please clarify.
3. The caption to Table 2 suggests that a spectral sampling distance equal to the spectral resolution has been assumed. Please clarify upfront that this assumption has been made and justify it, in view of the fact that most spectrometers offer spectral oversampling. It is stated in abstract and conclusions that spectral sampling (next to spectral resolution) was a study parameter. How do the results depend on the spectral oversampling ratio?
4. Figure 11 suggests that the surface pressure has been retrieved. Is this really the case? Please introduce in the text upfront. It is expected that surface pressure would be very strongly correlated with aerosol layer height. Please clarify. Maybe an figure similar to Fig 6 and 7 is needed to illustrate this.

Minor:

1. The definition of ‘inversion success’ is unclear. What is meant by ‘absolute residual’? .. a residual reflectance? .. the deviation of a fitted value of a state vector element from the true value (as the caption of Fig 11 suggests)?
2. P. 10517 l. 22: please state if you are referring to the computation time needed for building the LUT
3. Typo’s: p. 10514 plan(N)ed, particulate ma(T)ter
4. ‘with respect to’ is used often where it does not seem to fit. It is assumed that ‘as a

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function of' or alike is meant.

5. P. 10516 I. 11: please clarify why it is important that the members are randomly selected.

6. P. 10516 I. 14: you state that the reconstruction accuracy is a function of the randomly selected subset of spectra. I would assume that if the subset is sufficiently large, the reconstruction accuracy is independent from the actual subset. What is the main message here?

7. P. 10517 I. 21: please report typically achieved compression factors.

8. P. 10519: The reference to k-distribution should include Kondratyev, K. Y. (1969), Radiation in the Atmosphere, Academic Press, San Diego, Calif.

9. P. 10520 I. 5: please clarify if the 4501 channels are spectral channels.

10. P. 10520 I. 6: Phrase unclear. Please rephrase.

11. P. 10519 and 10520: what is meant with 'fully simulated'?

12. P. 10521: the MODIS models have been chosen amongst others based on what can be distinguished by MODIS, which limits the variety. Please discuss if this set of models is sufficiently various.

13. P. 10521: rephrase: 'real world'

14. Please clarify what is shown in Fig 6 and 7. What is the ensemble represented by the scatter plot? (Each dot one wavelength?)

15. P. 10521: Please clarify scaling. (5000m seems not to be a power of ten. What does 'rescaled with corresponding unit' mean?)

16. P. 10522 I. 19: Can you say which prior accuracy would be needed?

17. P. 10522: please clarify definition of the SNR model: is the mean(y) the SPECTRAL average across the O2 A band?

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18. P. 10522: please justify the choice of the SNR model: the stochastic operator  $r_{-1,1}$  seems to generate data with a box-car shaped probability density distribution function (PDF). Is that correct? In practice, such a PDF shape seems unrealistic for both shot noise or readout noise.
19. P. 10522: please state clearly if iterative retrievals have been applied (using lmdr).
20. P. 10524: what is meant by 'resulting synthetic SNR'? maybe a fit residual?
21. P. 10524: please clarify what is the 'mean inversion signal to noise ratio', and what its increase with increasing spectral resolution means.
22. P. 10524: please state the SNR assumed for the calculations shown in Fig 9.
23. P. 10524: it has been stated that iterative fitting has been applied using the lmdr tool. What is meant with 'purely 'Monte Carlo like'?
24. P. 10528: 'benchmarked' sound like jargon.
25. Table 2: please clarify that computational speed is reported.

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Interactive comment on Atmos. Meas. Tech. Discuss., 6, 10511, 2013.

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