

Interactive comment on “Error sources in the retrieval of aerosol information over bright surfaces from satellite measurements in the oxygen A-band” by Swadhin Nanda et al.

Anonymous Referee #2

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The manuscript deals with the very challenging retrieval of aerosol height and amount from spectrally resolved satellite observations in the O2A band. An error characterization of a specific retrieval algorithm is presented and its capability is demonstrated in a case study. The topic is very relevant for a number of satellite instruments, the results are new and of interest to the community. Publication in AMT is recommended after the issues listed below are addressed.

Main comments

1. The discussion of the mechanism leading to the near-singular regime (large retrieval uncertainties) is confusing. The authors should avoid talking about ‘correlation of in-

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formation’, ‘sign of information’, and ‘interference between light (contributions R_s and R_p)’. The discussing of the retrieval sensitivity based on the Jacobian (derivative of the top-of-atmosphere radiance R wrt z , AOT, SSA, Fig 4) and the cost function (Fig 6) is clear and instructive. It is not clear what exactly the separation into the derivatives of the contributions R_s and R_p add to this.

2. In many instances the formulations are creative (which is ok as such) but in some cases the clarity suffers. The manuscript needs to be checked and the clarity enhanced.

Minor

1. Page 1 line 22 typo: if an aerosols
2. Page 2 line 10: CALIPSO coverage area is not ‘reduced’ but maybe ‘limited’
3. Page 3 line 6: ‘non-consequential’ > ‘not affected’
4. Page 3 line 13-14: ‘the cause of these errors needs to be extended’ > ‘the concept of critical albedo needs to be extended’
5. Page 5 line 3: formulation: ‘due the wavelength band lying beyond’ > ‘since the wavelength band is located beyond’
6. Page 5 line 10: ‘instead of the Henyey-Greenstein MODEL’
7. Page 5 line 18: ‘the instrument’s platform .. has been designed as a sounder’ > ‘the instrument is a sounder’
8. Page 5 line 18: remove redundant information in ‘The NEAR INFRARED spectrometer . . . , in the NEAR INFRARED.’
9. Page 6 line 6: provide justification for diagonality Page 6 line 16: It is wrong to state that the Jacobian is the primary reason for failure. It is singularity of the generalized inverse.

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10. Page 6 line 10: estimate ... elements .. beyond boundary conditions > beyond boundaries
11. Page 6 line 19: 'reveals interference between Delta_Rp and Delta_Rs' > the increments can cancel.
12. Page 6 line 20: what is the 'relative difference'?
13. Page 8 line 26: the root cause is the cancellation of the increments Delta_Rp and Delta_Rs (same spectral shape, same amplitude, opposite sign) rather than 'anti-correlation'.
14. Page 10 line 14/15: the retrieval sensitivity is not specific to any spectral point > suggested to remove 'at that spectral point' in line 15.
15. Section 4.2. please mention which biases are discussed: bias in AOT or in z, or both?
16. Page 11 line 1 typo: a biases cause by
17. Page 12 line 12/13: Are the terms 'a-priori' and 'first guess' used synonymously? (They should not.) Please report a-priori values for both parameters, or discuss why the first guess is important in this discussion.
18. Page 13 line 4-6: it is stated that the analysis and specifically Fig 7 top left explains the low bias of the retrieved layer height. This is not understood. Please explain.
19. Page 14 line 29 (and Page 15 line 21) it is argued that there are multiple minima in the cost function, in case of high optical thickness. This finding should be presented in the body of the article before it is referred to in the discussion and in the conclusion.
20. Conclusion: please reformulate the discussion of interference and correlation of information.

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