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Interactive comment on "Aerosol profile information from high resolution oxygen A-Band measurements from space" *by* A. Geddes and H. Bösch

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We would like to thank he reviewer for the helpful and detailed comments. We have revised the manuscript according to the suggestions and we address the reviewers comment with a point-by-point response below. Changes in the manuscript as per your comments are highlighted in green in the supplement.

This paper describes a retrieval performance of aerosol profile from O2 A band spectrum measured by the current and upcoming satellite instruments. The paper is well written and the topic is suitable for AMT. I recommend it to be published after the fol-

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lowing comments are addressed. Viewing angle: I think authors assumed the "nadir-viewing" case. Please clarify. The retrieval performance will change with the viewing angle. Please make some comments.

- The simulations are for nadir geometry only and we point out in the manuscript that the performance can change for off-nadir geometry. We decided to limit this study to nadir geometry only since off-nadir geometry is only relevant for S-5 P and to a lesser extend for CarbonSat and thus a comparisons to the nadir instrument OCO-2 and GOSAT would not be possible.

Fluorescence: In p.6030, authors said "an additive intensity offset is also included to mitigate the effects of fluorescence". It is unclear for me that whether the synthetic spectra were simulated with fluorescence or not. Please clarify.

- We do not add an explicit fluorescence component to the modelled spectra. We include an intensity offset in the state vector of the retrieval as an approximation for the effect of fluorescence so that we can investigate its effect on the aerosol retrieval. We have added an additional clarification in the text in Section 3.

In p.6031, authors said "systematic errors have then been estimated from the difference of retrieved and true values for the aerosol parameters". If I understand correctly, "an additive intensity offset" is the constant radiance offset for the reflected spectrum at the top-of-the atmosphere, while the fluorescence spectrum at the top-of-the-atmosphere has O_2 absorption structure. This difference will make bias. Please make some comments.

- The inclusion of an intensity offset in the retrieval is an approximation of the effect of fluorescence. We are here not interested in fluorescence itself but on its effect (or better of the mitigation of fluorescence in the retrieval) of the information content of the aerosol retrieval. As its effect was shown to be small, we believe that this approximation is sufficient. We have added some additional clarification in the text in Section 3.

AOD: Is AOD at 0.76 micron used in this study? If not, please make some comments about the wavelength dependency of AOD and its influence on the results. AOD is defined at 0.765 micron and this is now made clear in the text. Surface albedo: The optical path shortening effect is dominant for dark surface, while the lengthening effect is dominant for bright surface. For both cases, you can extract some aerosol information from the spectrum. Please make some comments for intermediate albedo case.

- We infer the aerosol profile from a fit to the full O2 A Band which covers a large range of absorption optical depth and intensities thus the effect of path-lengthening vs. path-shortening will be different for the different spectral pixels of a spectrum. In the example given in Figure 1 below (SZA of 30 degrees), the transition between positive and negative aerosol weighting functions is roughly at a surface albedo of 0.2 and the weighting functions become small (but still different from zero, especially for higher resolution instruments). The retrievals errors accordingly increase modestly when integrated over the range of 0-2 km or 2-5 km (see Figure 2). We have included a discussion of the effect of surface albedo in the manuscript.

Please also note the supplement to this comment:
http://www.atmos-meas-tech-discuss.net/7/C2820/2014/amtd-7-C2820-2014-supplement.pdf

Interactive comment on Atmos. Meas. Tech. Discuss., 7, 6021, 2014.

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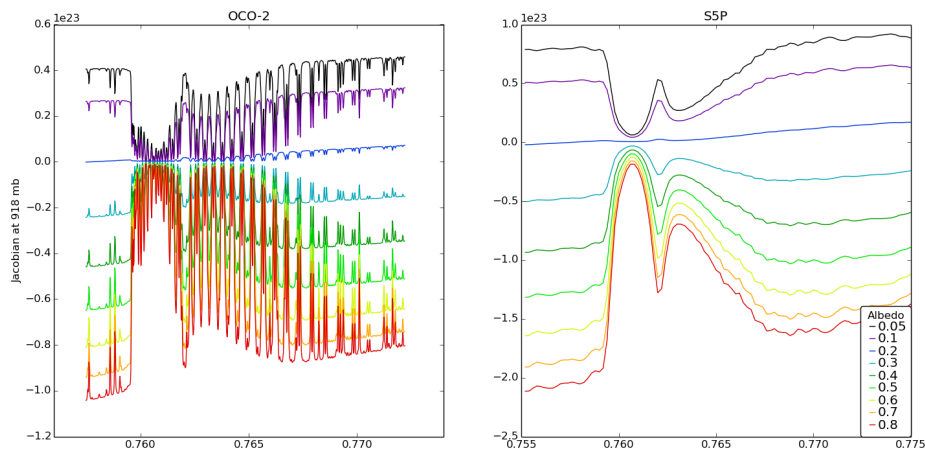
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Fig. 1. Aerosol weighting function (at 918 hPa) for OCO-2 (left) and S5-P (right) for surface albedos between 0.05 and 0.8 and a SZA of 30 degrees for scenario A
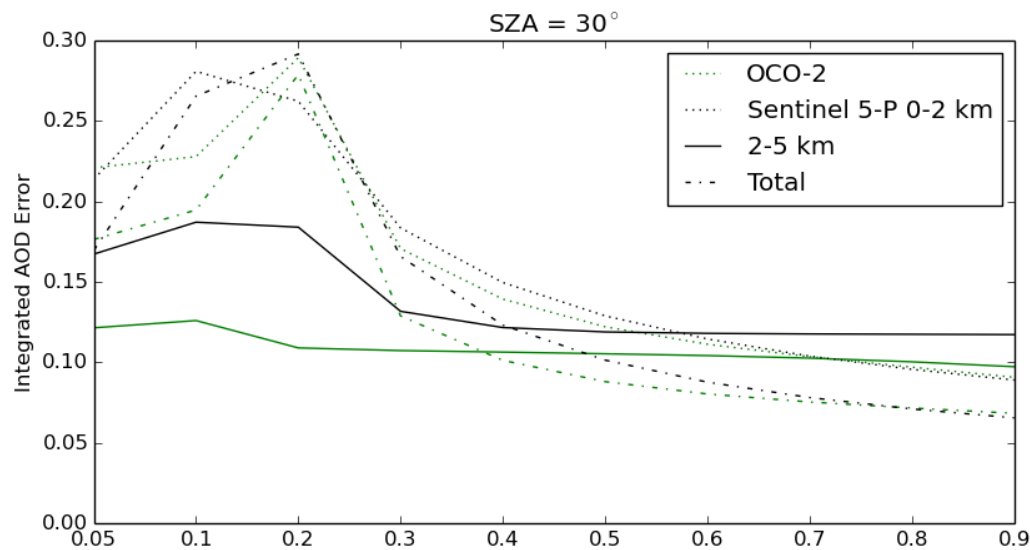
Fig. 2. AOD error as a function of surface albedo for OCO-2 and S5-P for scenario A