This paper carries out a detailed theoretical analysis on the use of spectral measurements in the Oxygen-A band to retrieve the vertical distribution of the atmospheric aerosol load. The authors have simulated the expected performance of currently deployed, soon-to-be deployed or planned sensors with Oxygen-A band observing capability, and evaluated obtainable levels of accuracy by four different sensors in terms of their spectral resolution and signal-to-noise ratios. The paper is generally well written and suitable for publication in AMT after the issues identified below are addressed.

My main criticism of this work is the lack of detail regarding the aerosol simulation component of the analysis. The authors used 13 aerosol mixtures reported in the literature [Kahn at al., 2001], but fail to provide enough information on the relevant aerosol properties (effective particle size distribution and effective single scattering albedo) of the mixtures to adequately interpret the reported results. The discussion in section 6.4 on the aerosol assumptions in the retrieval states that simulation retrievals were carried out for the 13 aerosol mixtures of Kahn et al [2001], and quotes in Table 4 the obtained maximum and minimum biases in retrieved AOD and aerosol height. There is no discussion, however, on which of the 13 aerosol mixtures and their corresponding fundamental properties are associated with the largest biases. In terms of aerosol particle size, the aerosol mixtures of Kahn et al [2001] go from predominantly small particles (1a) to coarse dust particles (4c). In terms of absorption the mixtures go from negligible absorption (1a) to significant absorption (5b). Characterizing the retrieval capability of the vertical distribution of absorbing aerosols layers by Oxygen-A band observations is of great importance since smoke layers are often observed in the free troposphere and UTLS. The AOD/Height bias results presented in the bottom section of Table 4 should be expanded to include the associated values of effective particle size distribution and single scattering albedo.

Other comments (identified by page and line number):

6022-5 In the statement that includes the expression '…with high coverage…' it is not clear what kind of 'coverage' the authors referring to. Is it spatial coverage?

6022-16 Suggestion: 'but the accuracy of the required priori knowledge is very high'

6024-5 The literature review fails to mention documented applications to retrieve aerosol layer height from passive stereo-viewing MiSR observations (Kahn, et al., 2007), from POLDER observations (Dubuisson et al., 2009), and from OMI near UV observations (Sathheesh et al., 2009). These applications have been successfully demonstrated under certain conditions.

6024-11 The Martin et al (2010) does not appear in the list of references.

6025-20 In the context of this manuscript the expression 'aerosol type' is ambiguous. I suggest using 'aerosol mixtures' that specifically refers to well defined aerosol properties: particle size distribution, particle shape and refractive index of the components of the mixtures [Kahn et al., 2001].

6029-17 Type 2b in Table 2 of Kahn et al (2001) does not represent an aerosol model but an air mass mixture containing four aerosol types (sulfate, sea salt, accumulation mode dust, and coarse dust). The actual aerosol models associated with each type are given in Table 3 of Kahn et al. (2001). A more detailed description of the computational handling of the resulting aerosol mixture is required. Are these four aerosol components internally or externally mixed? What are the resulting effective aerosol particle size distribution, shape and single scattering albedo?

6032-8 There is a typo in last sentence of Fig. 3 caption.

6033-5 The discussion of AOD errors is carried out in terms of absolute errors. For a purely theoretical analysis as the one presented here, relative errors are often more meaningful. I suggest adding in parentheses the relative errors associated with the reported absolute errors. Figures should also be modified to reflect the relative error.

6042-5 The AOD/Height biases associated with aerosol type (reported in Table 4) are interpreted by the authors only in the context of particle size. As shown in Table 3 of Kahn et al (2001), the single scattering albedo of the constituents of the possible 13 aerosol mixtures varies between 0.1 and 1.0. Thus, the authors' interpretation of the results is incomplete. As suggested above in this review, it would be useful to list the effective particle size and single scattering albedo associated with the aerosol mixtures used in this analysis. This is important, because aerosols in the free troposphere are predominantly either desert dust or carbonaceous aerosol layers. Carbonaceous aerosols are very absorbing in this spectral range with reported single scattering albedos of 0.84 or lower (Dubovik et al., 2002).

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