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Atmospheric Measurement Techniques Discussions

Interactive comment on "Application of Oxygen A-band Equivalent Width for Cloud Optical Depth Measurement" *by* E. R. Niple et al.

Anonymous Referee #2

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The manuscript includes three major parts: 1) description of a cloud optical depth (COD) retrieval method that makes use of the zenith radiances at 440 nm, 870 nm and oxygen A-band. To do that, the authors first utilize the information from all the three bands to determine the atmospheric condition/state (clear, thin cloud or thick cloud); then retrievals are conducted using a 440nm zenith radiance look up table based on the atmospheric state; 2) Introduction to the zenith pointing radiometer developed by the authors for hyperspectral measurements that cover the bands needed for the COD retrieval; and 3) validation efforts, albeit brief, are presented. In general, the manuscript contains information and ideas that would be of interests to the community, but some of the fundamental justifications for the technique and results, as described below, is missing from the current version; hence a major revision is needed before it's publishable.

General Comments: 1. The determination of the atmospheric state, i.e. whether the atmosphere column contains thin or thick cloud, is the first and crucial step for the COD retrieval method presented. The authors used two techniques to do that 1) for ultra-thin clouds, the ratio of 440nm and 870nm zenith radiances is used and 2) for other situations the A-band equivalent width (EQW) vs 440 nm zenith radiance plot, which the authors call the "nose plot", is used. What is missing in the manuscript is the justification of both techniques. For example, why the EQW is a monotonic function of COD? How is Figure 2 generated? Is it from radiative transfer simulations? What are the inputs and which model is used? Also how was the threshold chosen for the 440nm and 870nm ratio (5 is used in the manuscript)? How does surface albedo/SZA affect the threshold? These are the physical basis of the retrieval method and a clear description would be essential. 2. As the authors pointed out, the observed zenith radiation varies drastically and it is not likely that one can determine the atmospheric state without filtering the data. The authors developed a time varying hysteresis filter for the purpose (Section 5), which seems to have solved the problem, but what is missing is the results that shows that. A figure that shows how a data sequence, e.g. the data shown in Figure 3, is transformed before and after applying the filter would be good enough.

Specific Comments: 1. P2, Line 21: " This requires an accurate determination of the zero radiance level". It is not clear to me why this is the case. Please elaborate. 2. Page 15, Figure 1 caption: the abbreviation of TWST appeared before defined. 3. Page 16-17, Figure 2 & 3: units of the axis missing. 4. Figure 10: description of each part missing in the caption.

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