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Atmospheric Measurement Techniques Discussions

Interactive comment on "Retrieval of aerosol optical depth in vicinity of broken clouds from reflectance ratios: case study" *by* E. Kassianov et al.

Anonymous Referee #1

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1 General comments

The paper deals with the application of a 'reflectance ratio' (RR) method to perform aerosol retrievals in the vicinity of broken clouds. This is an area of interest because 3D cloud effects typically lead to aerosol optical depth (AOD) estimates in these regions being poor quality, or absent entirely. The methodology was developed in previous work by the authors. The introduction of the paper provides a good overview of the difficulties in the field.

Overall I think the paper is written well and makes a good contribution to the field, and would recommend publication in AMT following some comments as described below being addressed.

2 Specific comments

Page 1898 and the authors' previous works discuss that the RR method works when the isolines provided by the ratios are orthogonal and lead to unique solutions for alpha and beta. This has previously been established to be the case for the wavelengths chosen. As the MAS measures at 50 wavelengths, and there are corroborating ground-based spectral AOD measurements, this is a good opportunity to examine the consistency of RR retrievals from other possible combinations of wavelengths (perhaps 550 nm and 1.6 μm, although it may be that the aerosol signal is often too weak at the latter wavelength). This would be useful when considering the possible adoption of this scheme for satellite radiometers which lack some of these channels. AVHRR, MISR and ATSR have no 470 nm measurement (although MISR has a nearby blue band). I would strongly suggest but not require that the authors add this; if not added here, then when the scheme is tested with MODIS data in the future (as mentioned on page 1906), then I would suggest this is explored there.

The figures showing RR AODs do not have error bars. What is the precision on MAS reflectances and therefore the precision in the RR AODs? I realise the previous paper by the authors, and the introductory section here, mention that for fully correlated measurement error the RR will be unaffected; I don't know how well-characterised the MAS measurements are so some statement about this would be welcome. Some statement about MAS uncertainty should be added.

Figure 6. This shows the domain-averaged AOD as a function of assumed surface albedo at 870 nm. It would be useful to add the domain-averaged AOD for other wavelengths (not just 660 nm) to see how the spectral shape of AOD changes as a function of albedo. This may also depend on the assumed albedo at other wavelengths too, so perhaps some additional figure or brief mention in the text of this should be added.

I would also suggest adding a figure or text describing the PDF of the AODs as a function of assumed surface albedo. This would provide information as to, when the albedo is changed, whether the domain-average AOD changes because of a shift in the centre of the PDF, or the bulk of the PDF stays the same but outliers change. This could alternatively be examined by plotting the standard deviation of domain AOD on Figure 6 as an error bar on the AOD line (if the AOD PDF is Gaussian).

Figure 9. The centre of the colour scale consists of different shades of green, which are hard to distinguish between. This is also the 'interesting' range of AOD (0.2-0.3) where the majority of the data lies. I would suggest redrawing this with a different data range (perhaps something like 0.1-0.4?) or colour scale (greater range of colours between 0.2 and 0.3) so that this important region of AOD is easier to resolve.

Figure 10. The spectral dependence of the difference between the RR and MFRSR AODs is of the opposite sign to the error from simulated results from Figure 4(c) in Kassianov and Ovtchinnikov (2008). Do you have any additional comment on this?

3 Technical corrections

I have no technical corrections to suggest for this paper.

Interactive comment on Atmos. Meas. Tech. Discuss., 3, 1889, 2010.