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Atmospheric Measurement Techniques Discussions

Interactive comment on "Cirrus cloud optical and microphysical property retrievals from eMAS during SEAC^{4}RS using bi-spectral reflectance measurements within the 1.88 µm water vapor absorption band" *by* K. Meyer et al.

Anonymous Referee #1

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General comments:

The well-known Nakajima-King bi-spectral algorithm for simultaneously retrieving cloud optical thickness and effective particle size is usually implemented by using a visible channel and a near-infrared channel, say, two channels centered at 0.66 μm and 2.1 μm. This study explores the applicability of two channels within a water-vapor-absorbing band. To be more specific, two channels at 1.83 μm and 1.93 μm are used. The observations made by the Enhanced MODIS Airborne Simulator (eMAS) deployed during the SEAC4RS field campaign are used in this study. The merit of using the 1.83-

and 1.93-μm channels is that the two channels are not sensitive to surface reflection because of the absorption of water vapor in the lower atmosphere below the cloud.

Overall, the manuscript is well organized and clearly written. No major technical errors were found. The manuscript is recommended for publication after some minor revisions are made.

Specific comments:

1. As explained in the manuscript, it is critical to account for the absorption of the water vapor above cirrus clouds when implementing the 1.83 μm/1.93 μm bi-spectral retrieval algorithm. Further, the correlated k-distribution (CKD) method was used in the forward model to correct the water vapor absorption. The manuscript cites the work by Kratz (1995) for the CKD simulation. But Kartz (1995) did not consider the spectral response function. A recent paper (Liu et al., 2015: A fast Visible Infrared Imaging Radiometer Suite simulator for cloudy atmospheres, J. Geophys. Res. Atmos., 120, doi:10.1002/2014JD022443) fully considers the responses function. It is suggested that the aforesaid paper be cited.

The authors are suggested to provide a paragraph to explain the incorporation of the spectral response function into the CKD simulation.

2. Can an empirical approach be used to correct water vapor absorption above ice clouds? For example, to infer cirrus reflectance using MODIS 1.375 channel, an empirical method is used to remove the effect of the water vapor above cirrus clouds. Can the aforesaid MODIS empirical approach, after some modifications, be applied to the eMAS 1.83- and 1.93-μm bands to remove the absorption of the above-cloud water vapor?

3. The cloud effective radius (CER) values corresponding to the 1.93 μm channel and the 1.6-μm or 2.1-μm channel are quite different. For downstream applications (e.g., the assessment of cloud radiative forcing), which CER value should be used

in order to obtain an optimal assessment? Note, in cloud radiation parameterization used in radiative transfer scheme involved in GCMs, the asymmetry factor and single-scattering albedo are parameterized in terms of CER. Thus, using optimal CER values in radiative transfer simulations is critical.

4. Page 7, line 6 from bottom: “all three channels are located almost wholly” to “B15 is located almost wholly”.

5. Page 8, line 2: “is more likely than” should be “is more likely larger than”

6. Page 14, line 7 from bottom: “Fig. 4 and 5” should be “Figs. 4 and 5”.

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