The authors would like to thank the reviewer for the careful evaluation of the manuscript and constructive comments. Our responses to the specific comments are below.

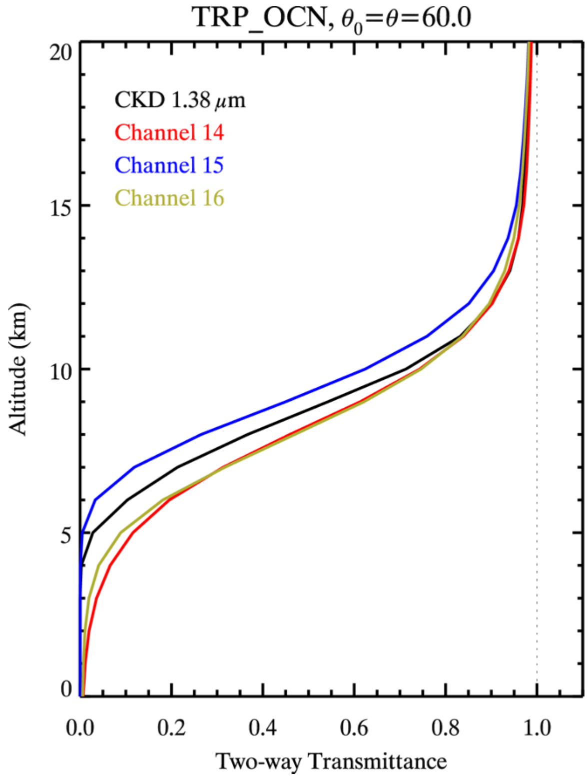
1. As explained in the manuscript, it is critical to account for the absorption of the water vapor above cirrus clouds when implementing the 1.83 μm/1.93 μm bi-spectral retrieval algorithm. Further, the correlated k-distribution (CKD) method was used in the forward model to correct the water vapor absorption. 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.

   > **Response:** This is an excellent comment. Kratz indeed did not consider the spectral response function (SRF) in his CKD approach, but instead selected uniformly weighted spectral widths that yielded band-averaged transmittance roughly equivalent to more accurate line-by-line calculations that do consider the SRF. Moreover, for the present investigation, we have adopted Kratz's MODIS-specific 1.38μm CKD routine for the above-cloud atmospheric absorption correction in both the 1.83 and 1.93μm eMAS channels. We concede that at first glance this appears to be an incompatible application of this specific CKD routine. However, comparisons with more exact line-by-line calculations using LBLRTM (Clough et al., 1992; Clough and Iacono, 1995; Clough et al., 2005), in which we do explicitly account for the eMAS SRFs when calculating band-averaged transmittance, show that the MODIS 1.38μm CKD compares well with the line-by-line 1.83 and 1.93μm band-averaged two-way transmittances from TOA down to roughly 10-11km altitude (note that the case studies shown in the paper have CPL-retrieved cloud top altitudes of roughly 12km). This is evident in the plot below, which shows two-way transmittance calculated from the 1.38μm CKD (black line), as well as that calculated from LBLRTM (accounting for the exact SRF) at 1.83μm (red line), 1.88μm (blue line), and 1.93μm (gold line). All calculations shown here assume a tropical ocean atmosphere and solar and sensor zenith angles of 60°.
   >
   > For on-line atmospheric absorption/transmittance calculations within a retrieval algorithm that must account for pixel-level changes in atmospheric profiles, cloud altitudes, etc., the CKD approach is preferable because it is significantly more efficient than the computationally expensive line-by-line calculations. However, because we were not aware of existing CKD routines (or other efficient techniques) specific to the eMAS channels within the 1.88μm water vapor absorption band, and because the 1.38μm CKD appears to sufficiently account for the absorption above typical cirrus cloud altitudes, we therefore opted for the Kratz 1.38μm CKD, and feel that it is adequate for the present proof-of-concept investigation. We do note, however, that work is ongoing, specifically by the research group of colleague P. Yang at Texas A&M, to develop an efficient atmospheric transmittance approach

that is capable of accounting for instrument-specific SRFs; we hope to implement this technique within the present cirrus retrieval algorithm in the future, though it is unfortunately not available to us at this time.

Regarding the reviewer's suggested paragraph addition, we think it is unnecessary to go into that level of detail. In fact, we fear it may confuse the issue for the reader to add a discussion of the selection and use of the MODIS 1.38μm CKD and comparisons with LBLRTM. While we readily admit the fact that this CKD routine works for the present application is quite fortuitous, the ultimate goal of this paper is to introduce the retrieval concept and show that it is viable. Finally, we would like to alert the reviewer that we have, at the request of the editor, provided additional details in Section 3 regarding how the CKD is used here to estimate the above-cloud water vapor transmittance (see p. 10, lines 218-230).



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?

    Response: Another excellent question. We actually did attempt to develop an empirical approach similar to the 1.38μm *Meyer and Platnick* (2010) approach that couples 1.24μm with 1.38μm for estimating above-cloud water vapor absorption. This was during our initial attempts to modify the *Meyer and Platnick* cirrus optical thickness retrieval for use with the eMAS 1.88μm channel. We found, however, that eMAS does not have a solar window channel that can be coupled with 1.88µm that is analogous to the 1.24/1.38µm combination; note that ice crystal absorption is stronger at 1.88µm compared to that at 1.38µm (see the plot of single-scattering albedo in Fig. 2 in the text), thus 1.24µm, even if available on eMAS (it isn't), is not an appropriate partner for such an approach, nor are the visible channels used by *Gao et al.* (2002) that we believe the reviewer is referring to. In fact, it was during these attempts to implement the *Meyer and Platnick* technique that we discovered the utility of the 1.83/1.93µm channel pair for COT/CER retrievals.

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.

   Response: This is a very good question that we believe can be asked of all imager-based size retrievals using either solar or IR channels, as there is often little agreement amongst them (e.g., Figs. 5b and 7b in the text). Moreover, there is good reason to expect these retrievals to be different, for instance due to potentially differing vertical sensitivities within the cloud (see, e.g., *Platnick*, 2000, for examples of liquid water cloud vertical weighting functions). In fact, 1.93µm may be weighted more towards the top of the cloud due to stronger ice crystal absorption than at 1.6 and 2.1µm (see Fig. 2 in the text), coupled with in-cloud water vapor absorption that further attenuates the reflected signal. That said, we believe that providing a meaningful answer to this question is well beyond the scope of the present investigation, since appropriately addressing the sensitivities of the CER-sensitive solar and IR channels will require extensive forward modeling of clouds with realistic microphysical and 3D structures. While we abstain from addressing these issues here, we nevertheless appreciate the reviewer's thought-provoking question.

   We would also like to point out that subsequent to submitting this paper, an error was found in the MAS06 ice cloud retrieval LUTs specific to the 1.6µm CER retrievals. This error has since been addressed, and we have updated Figs. 4 and 6 accordingly; note that the LUT correction results in smaller 1.6µm CER retrievals that are now "in family" with the 2.1µm CER retrievals.

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

   Response: Done.

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

   Response: Done.

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

Response: Done.

References

Clough, S. A., Iacono, M. J., and Moncet, J.-L.: Line-by-line calculation of atmospheric fluxes and cooling rates: Application to water vapor, J. Geophys. Res., 97, 15761-15785, 1992.

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