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

General Comments:

Final publication in AMT should be obviously warranted, since just few minor changes would be needed to improve clarity also for the non-experienced reader. However, one major issue is still unclear and namely: why have land pixels been discarded in the analysis?
In Page 8 line 163 and following it is stated that: *In addition, the case studies selected here only include ocean scenes for which the surface is dark, thus the contribution of surface reflection to measured TOA cirrus reflectance is expected to be negligible*
But in the abstract the algorithm is termed to be very effective in surface screening and in delivering more accurate results. I would have expected the inclusion of a bright scene case study along with the analysis of a dark water surface. How can be the effectiveness of the algorithm be judged if the underlying surface is barely reflective?
Even if it can be clearly guessed by the experienced reader that the influence of the surface albedo is minimized, I think that it should be made explicit. Therefore I suggest to investigate the dependency of the 1.83/1.93 mkm retrieval technique also as function of surface reflectivity with an another case study and provide a table with relative errors in COT and CER among the presented algorithms and methods.

> **Response:** These are excellent comments. We would first like to state that we did not claim in the abstract that the surface is completely screened from the TOA reflectance in the 1.83µm and 1.93µm channels, only that its contribution is minimized. In fact, we explicitly state in Section 3 (p. 7-8, lines 165-173) and in the discussion (Section 5) that surface effects are not completely screened at 1.83µm and 1.93µm. The minimization of the surface contribution in these channels is of course in comparison with the heritage solar window channels used in the current MODIS and eMAS cloud optical retrievals, in which the surface can be expected to be a large contributor to TOA reflectance for optically thinner clouds such as cirrus. For the heritage window channel algorithms, surface albedo errors can not only cause increased retrieval uncertainty for optically thin cirrus cases, but can often cause the retrievals to fail outright. To eliminate any confusion, we have modified the abstract to clarify this statement (p. 2, line 37-41); we have also modified the first sentence of the introduction (p. 3, line 52).
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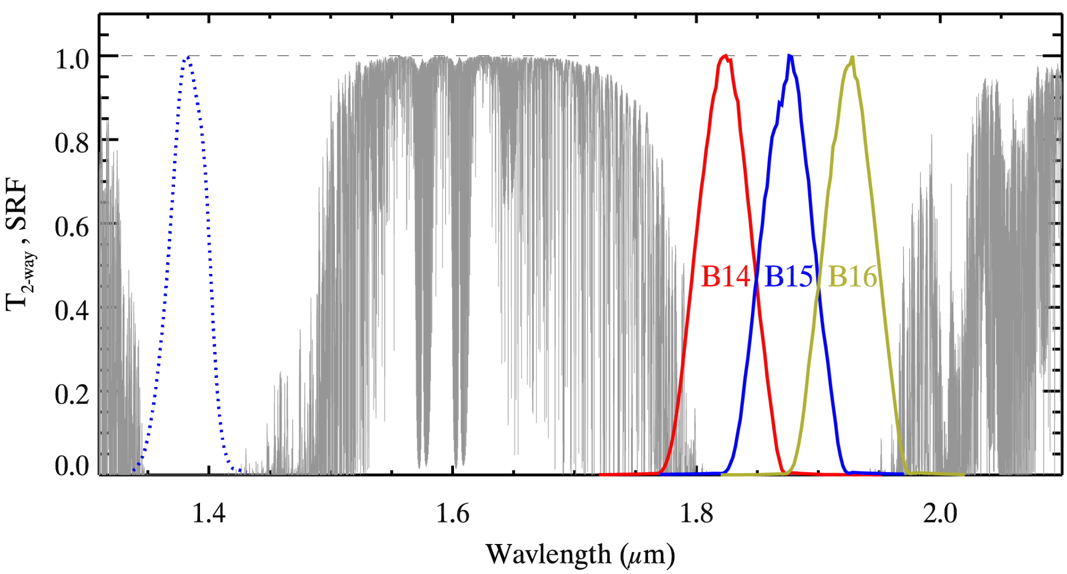
> Our reasoning for excluding land cases from the present analysis is in part due to the potentially non-negligible surface contribution to TOA reflectance at 1.83µm and 1.93µm in arid atmospheres or over some bright land surfaces. For instance, assuming a standard mid-latitude winter atmosphere over land having column water vapor amount on the order of 1.2g m^{-2}, the TOA to surface two-way transmittance at nadir solar and viewing angles, calculated using LBLRTM (Clough et al., 1992; Clough and Iacono, 1995; Clough et al., 2005) and averaged over the eMAS spectral response functions, is roughly 8% at 1.83µm and 3% at 1.93µm. Assuming a bright Lambertian surface albedo of 10%, this corresponds to a contribution to

TOA reflectance in clear sky conditions of roughly 0.008 at 1.83µm and 0.003 at 1.93µm; certainly small contributions, but potentially non-negligible for optically thin cirrus that can have TOA reflectances less than 0.03. Furthermore, while we do possess the capability to add an appropriate surface albedo to the cloud optical retrieval look-up tables, as is currently done for land surfaces in MOD06 and MAS06, we do not currently have the capability to efficiently model the below-cloud atmospheric water vapor absorption on-line within the retrieval algorithm, though we hope to add this capability in the future (see our response to the first comment of Reviewer 1). Thus these retrievals cannot at present be implemented over land unless the surface is assumed to be completely obscured. Finally, the desire to judge the present approach against the standard MAS06 algorithms, as well as the IR-based algorithms, in cases in which we believe these algorithms actually have some skill, i.e., over dark surfaces, further influenced our decision.

Specific Comments:

p7 l155: Only the range 1.83-1.93 mkm is shown in Figure 1. It would be nice to show also the 1.38 mkm for illustrative purposes.

Response: While we share the reviewer's interest in the 1.38µm channel, we have nevertheless chosen to leave Fig. 1 unchanged (with the exception of modifying the line colors) because extending it to include 1.38µm obscured the finer details of the absorption spectra. We are however including a plot of the entire spectral region here for the reviewer's benefit (below; blue dotted line denotes the MODIS 1.38µm spectral response function); the atmospheric profile and view/solar angles match those shown in Fig. 1. We also note that the effect of the details of the 1.38µm channel are in part shown by the single-scattering albedo plot in Fig. 2.



p12 l254: Notwithstanding the remarkable resemblance between image c) and d), could you please provide a justification of neglecting the error in the cloud phase discrimination? I think it is important for the reader to understand the assumption behind this choice.

Response: We should first reemphasize that the cloud phase algorithm used in the MAS06 retrievals is essentially the MOD06 C5 phase (King et al., 2006) (see p. 5, lines 108-110) that was known to have issues, e.g., identifying thin cirrus as liquid phase, etc. (see, e.g., Marchant et al., 2016). Moreover, there is no cloud phase decision filtering applied to the 1.83/1.93μm retrievals such that cases where the MAS06 phase is incorrectly liquid, or multilayer cases (thin cirrus overlying thick liquid) that are identified as liquid (in some cases correctly in a radiative sense, at least at the window channels used by MAS06), are included in the retrieval pixel population. This decision was made in order to highlight the capabilities of the water vapor absorption channels for retrieving optically thin cirrus clouds that are problematic for the window channel-based retrievals (e.g., phase discrimination errors, failed retrievals) as well as for retrieving only the overlying ice cloud in multilayer ice-over-liquid cases (which is likely the case in portions of the scene at issue here). We do note that work is ongoing to implement the MOD06 C6 phase, which has been shown to provide better phase discrimination skill compared with C5 for MODIS via comparisons with the CALIPSO lidar CALIOP (Marchant et al., 2016), within the MAS06 airborne retrievals.

That said, we acknowledge that phase discrimination errors are not part of the error budgets for either the MAS06 retrievals or the present 1.83/1.93μm retrievals. The idea we are conveying with this statement is that for the pixels that MAS06 does identify as ice phase and provides successful COT/CER retrieval pairs, the COT retrievals from the two approaches are consistent with each other. It is worth reemphasizing that the primary goal of the current investigation is to be a proof of concept, and we believe this is clearly demonstrated by the results shown.

Why aren't low-level warm clouds - in a) the brightest cumulus and in c) the red-coded at the top scans - showing up in d) too? Is it because of the discussion on the coverage of the LUT (p12 l264) or because of a suboptimal flagging?

Response: This is a good observation, and we in fact identified these clouds in the text discussion [page 14, lines 313-318]. As we stated above, we do not apply any filtering based on the MAS06-retrieved cloud phase. Instead, in addition to using the MAS06 cloud mask to identify cloudy pixels, we apply thresholds to the reflectance in the central 1.88μm channel (must be larger than 0.02) and to the 1.88/0.66μm reflectance ratio (must be larger than 0.09) (see p. 8, lines 174-178). These thresholds act to exclude clear sky pixels that are misidentified as cloudy sky, a situation that occurs primarily over bright land surfaces, and those cloudy pixels having only lower-altitude liquid phase clouds with insufficient above-cloud water vapor such that they can contribute to the TOA reflectance, in which case the clouds will be visible at 1.88μm though much brighter at 0.66μm.

p13 l294 and ff: The discussion on plot c) on CTH. It seems to me that the OE-IR mehtod delivers considerably correlated results across variables, namely CTH, CER and COT. Could you provide more details on this, even if OE-IR is not really the focus of the present manuscript?

Response: The reviewer makes a good observation that the OE-IR retrievals appear to be correlated across all variables, at least for the case studies shown here. While this is certainly an interesting result, the essential question is whether this correlation represents real physics and/or algorithm issues, the answer to which is difficult to sort out and is quite beyond the scope of the present paper. We emphasize that these these retrievals are included only as an additional point of reference for the 1.83/1.93μm approach, and thus believe that providing specific algorithm details is not necessary for the present paper, though we do note that the wavelength channels used by OE-IR are provided in Section 2 (see p. 5-6, lines 119-120). We would like to point the reviewer to the Wang et al. manuscripts for further details of the OE-IR retrievals once they are published (at the time of this writing Part II is in press, Part I remains under review).

Additional details on the cloud phase (discrimination, see above) also would be appreciated, because when looking at Fig.5-c, is difficult to see whether the green and red lines are all in ice and not mixed-phase.

Response: This is a good comment. When creating the curtain plots in Figs. 5 and 7, we do impose a cloud phase filter on the MAS06 (using the same MAS06 optical property retrieval phase used to discriminate ice and liquid clouds in Figs. 4 and 6) and OE-IR (using the IR-derived cloud phase of Baum et al. (2010)) retrievals, such that only ice phase pixels are used; the 1.83/1.93μm retrievals do not impose a cloud phase filter. The FEANOR retrieval, which is run on mean IR radiances averaged over all eMAS pixels within the CPL field-of-view, is implicitly ice phase only since it is only applied when CPL cloud top height is above 8km. We have added text clarifying these details for OE-IR (p. 6, lines 122-123) and for Fig. 5 (p. 15, lines 348-353). The criteria for FEANOR retrieval application was previously included in Section 2 (see p. 5, lines 116-118), and the pixel selection criteria for the 1.83/1.93μm retrievals was previously included in Section 3 (p. 8, lines 174-178).

References

Baum, B. A., Menzel, W. P., Frey, R. A., Tobin, D. C., Holz, R. E., Ackerman, S. A., Heidinger, A. K., and Yang, P.: MODIS cloud-top property refinements for Collection 6, J. Appl. Meteorol. Climatol., 51, 1145-1163, doi:10.1175/JAMC-D-11-0203.1.

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.

Clough, S. A., Shephard, M. W., Mlawer, E. J., Delamere, J. S., Iacono, M. J., Cady-Pereira, K., Boukabara, S., and Brown, P. D.: Atmospheric radiative transfer modeling: A summary of the AER codes, J. Quant. Spectrosc. Radiat. Transfer, 91, 233-244, 2005.