Review of Merlin et al.

General comments

This paper reports theoretical results of retrieving cloud top height and geometrical thickness from simulated multi-angular TOA radiances in the oxygen A-band. The authors carry out a sensitivity study of the A-band radiance ratio to cloud height and thickness. Using the Shannon information content analysis they compare the information content of two future multi-angular satellite instruments: 3MI and MSPI. They conclude that the retrieval of cloud height is possible with high accuracy in almost all cases investigated while the retrieval of cloud thickness is possible for optically thick clouds above a black surface only. The paper subject is appropriate to AMT. The paper contains significant original material that can be of interest for the developers of operational cloud algorithms for 3MI and MSPI. Earlier work is adequately recognized and credited. The abstract provides a sufficiently complete summary of the paper. The paper is well organized and clearly presented. I recommend the paper for publication after the authors address to the following comments.

Specific comments

Introduction.

When the authors mention that the cloud cover vertical distribution has a significant impact on meteorological processes they may want to add the following reference that describes detection of multi-layer clouds using satellite passive instruments:

J. Joiner, A.P. Vasilkov, P.K. Bhartia, G. Wind, S. Platnick, and W.P. Menzel, Detection of multi-layer and vertically-extended clouds using A-Train sensors, *Atmospheric Measurement Techniques*, 3, 233-247, 2010.

Section 2.3.

Only a single layer model of clouds is used in the radiative transfer simulations. It is known that two layer clouds can substatially differ in terms of absorption/scattering from the single layer clouds (see e.g. Vasilkov et al., JGR, 113, D15S19, 2008 for the Raman scattering case). I strongly recommend to consider the two layer model of clouds in the future study.

Please explain why the relatively obsolete k-distribution technique is used instead of the exact line-by-line calculation and provide an estimate of errors involved with the use of the approximation.

Section 3.

Please clarify the definition of the average band ratio and the angular standard deviation. How many data points are used in the calculation of those quantities?

Section 4.1.

Please explain why the ratio noise is smaller than 1% (see Line 341-342) provided the radiance noise is of the order of 2-3%.

Section 4.3-4.6.

The degree of freedom and a posteriori error are indeed linked. However, the retrieval error is more illustrative than the degree of freedom. That is why I would recommend to provide the retrieval error in Fig. 12-18. This would give a potential reader the quick understanding of how big error (in physical units) can be in the retrieved cloud height and thickness.

Section 4.3.

It is quite desirable to provide an explanation of the finding that the information content for low and high optical depths is larger than for intermediate values of cloud optical depth.

Section 4.4.

The use of the Henyey-Greenstein phase function is not logical because (1) it does not represent either liquid droplet or ice clouds, (2) all previous simulations were already carried out with a more realistic Mie phase function.

Intuitively, variations of a scattering phase function can affect the A-band radiance ratio at least for low optical depths of cloud. Lower values of the asymmetry factor lead to a higher photon path , i.e. to more absorption, than higher values of the asymmetry factor. Fig. 14 shows results for cloud optical depth of 16 only. The authors should do the inormation content analysis for lower optical depths of cloud.

The statement that «results can be extended to ice clouds» is too ambitious. You have to support the statement by doing simulations with an ice phase function.

Section 4.6.

I doubt the statement «the retrieval of CTP over bright surfaces is feasible regardless of the COT and albedo» at least for low optical depths of cloud. Please provide physical considerations to support this uncommon statement.

Technical notes:

Line 13. Ice cloud properties are not considered in the paper.

Line 71. Typo ‘hte’

Fig. 3 caption. Typo ‘prented’

Line 248-249. Please reword to clarify.

Line 265. Remove ‘be’.

Line 501. Correct ‘account for’