Dear, Anonymous Referee #1,

The authors would like to appreciate for your careful reviews and comments to our manuscript. We response to your comments and show corrected parts of the manuscript as listed below. The referee comments are shown with Italic and the sentences with red color are added in the manuscript.

1. When talking about CO2 slicing method, the authors should carefully introduce not only its benefit, but also its limitations in applications. E.g., can it be accurate when cloud is very thin, such as optical depth smaller than ~0.3? Does background surface temperature and atmospheric temperature profile and water vapor profile result in any uncertainty to the cloud retrieval? How significantly?

As you pointed, the variables we have to assume to apply the method are large error sources. Menzel et al. (1992) had quantitatively investigated the influences to retrieved CTH and ECA from this method. Therefore, the manuscript is modified as below.

P.8, L25: ~ CTHs compared with lidar observations. In addition, uncertainty of the assumption such as surface skin temperature, temperature profile, and cloud multilayer structure are major sources of this method. Menzel et al. (1992) had quantitatively reported the influences for CTH retrievals from these assumptions.

2. For Eq (1), in remote sensing practice, how can clear-sky R be obtained? This may be the most significant drawback of this method. The authors should justify the treatment.

Clear sky radiance is calculated value from atmospheric transmittance, surface skin temperature, and surface emissivity. Transmittance is calculated using radiative transfer model, LBLRTM. Surface skin temperature and emissivity are from GSM-GPV and ASTER database noted in Sect. 2. The manuscript is modified as below.

P7. L21: ~ the spectral channel wavelength. Applying to satellite data, t is calculated using LBLRTM at each layer level and R^{clr} is calculated with the theoretical radiative transfer calculation from t, surface skin temperature, and surface emissivity based on GSM-GPV and ASTER database.

3. In Section 4.1.2. "CTH was underestimated by slicing because of very thin cirrus near ..." why?

The slicing method tends to estimate CTH as lower for optically thin clouds such as subvisible cirrus frequently occur in the Tropics and this fact was pointed in the previous researches. The pointed part is corrected as below.

P15, L12: ~~As described in Section 4.1.1, CTH was underestimated by slicing because of very thin cirrus near the tropopause or cloud multilayer structures.~~ It is reported by previous researches that CTH of high clouds near tropopause are generally underestimate by the slicing method (e.g., Wylie and Wang, 1999; Wylie et al., 2007). This is mainly because the detection error of the slicing is relatively larger for optically very thin clouds such as subvisible cirrus as mentioned in Sect. 4.1.1.

4. CALIPSO has significant errors for detecting optically thin stuff, especially during daytime, this should be discussed in the paper.

Some sentences are added as below.

P6, L15: ~ 532 and 1032 nm. The background noises of CALIPSO observations are larger during daytime than those during night time because of sunlight contaminations. However, CALIPSO is able to detect optically thin cirrus of which optical thickness of 0.01 or less even during daytime (McGill et al., 2007). Therefore, it is considered that CALIPSO data are appropriate as validation data for this study.

5. When discussing about historical background information about very thin cloud detection in Introduction, the data are not complete and updated. For references, please also cite the following 2 papers for latest developments in this important field.

(1) Wenbo Sun, Rosemary R. Baize, Gorden Videen, Yongxiang Hu, and Qiang Fu, "A method to retrieve super-thin cloud optical depth over ocean background with polarized sunlight", Atmos. Chem. Phys., 15, 11909-11918, doi: 10.5194/acp-15-11909-2015 (2015).

(2) Wenbo Sun, Gorden Videen, and Michael I. Mishchenko, "Detecting superthin clouds with polarized sunlight," Geophy. Res. Lett. 41, 688-693, doi: 10.1002/2013GL058840

(2014).

The historical background about the optically thin cloud detection from space itself is not contained in the introduction. Therefore, the suggested two papers are referred in Sect. 2 as below.

P6. L3: ~~Although~~ FTS and CAI are passive sensors using thermal or solar radiation. Although the recent studies report that optically very thin clouds are detectable with the data from passive sensors (e.g., Sun et al., 2014; Sun et al., 2015), the most accurate measurement of clouds and aerosols are using an active sensor, light detection and ranging (lidar), which emits a visible or near-infrared laser beam and receives their back-scattered components.

If you have any other additional comments, we are glad that you post them into the discussion page.

Sincerely,

Yu Someya
Atmosphere and Ocean Research Institute, the University of Tokyo
E-mail: y_someya@aori.u-tokyo.ac.jp