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PSC and cirrus cloud detection over the high latitudes using thermal infrared spectra observed by TANSO-FTS/GOSAT

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Greenhouse gases observation SATellite (GOSAT) was launched in 2009 and has been operating normally. However, the areas where the greenhouse gases can be retrieved are still limited in low and mid-latitudes. That is mainly because Cloud and Aerosol Imager (CAI) onboard GOSAT, which is used for cloud screening, covers only reflected sun light ranged from ultraviolet to near infrared, and has relatively low sensitivity to optically thin clouds such as cirrus clouds. On the other hand, Thermal And Near infrared Sensor for carbon Observation - Fourier Transform Spectrometer (TANSO-FTS) which is the main sensor of GOSAT has a thermal infrared band and expected to have ability to detect optically thin clouds. However, the cloud detection in high latitudes is not easy even thermal infrared band data are combined to CAI images because of lower surface and atmospheric temperature in this region. Furthermore, the situation is more complicated if the stratospheric clouds (PSCs), whose optical thickness is thinner than cirrus clouds, exist in lower stratosphere. In this study, we modified CO_2 slicing method to detect optically thin clouds more stably by optimizing the pseudo-spectral channels which are defined as sets of actual spectral channels which have weighting function peaks in a same height range. This optimization is based on simulation studies using a multi-scattering radiative transfer code, Polarized radiance System for Transfer of Atmospheric Radiation (Pstar), for six types of atmospheric model profiles, i.e. tropical, mid-latitude summer, mid-latitude winter, high latitude summer, high latitude winter and Antarctic winter. The spectral range used are from 710cm-1 through 750cm-1, and cloud height, geometric thickness, optical thickness assumed in the simulations are 6-24km, 1km, 0.01-5.0, respectively. As a consequence, we found the best combination of pseudo-channels for each atmospheric condition, and the score on the cloud detection exceeds 90 % for all combinations. This method has been applied to GOSAT data obtained mainly in 2010, and its performance is evaluated by comparing the results with other satellite data and climatology.