Simultaneous estimate of surface temperature and surface emissivity from GOSAT/TANSO-FTS TIR spectra

*TOMOYUKI ITATSU[1], Naoko Saitoh[3], Ryoichi Imasu[2], Kei Shiomi[4], Akihiko Kuze[4]

1. Chiba University Graduate School of Advanced Integration Science, 2. Atmosphere and Ocean Research Institute, The University of Tokyo , 3. Center for Environmental Remote Sensing, 4. Japan Aerospace Exploration Agency

Thermal and Near-infrared Sensor for Carbon Observation Fourier Transform Spectrometer (TANSO-FTS) on board Greenhouse gases Observing SATellite (GOSAT) can observe column amounts and vertical profiles of CO_2 and CH_4 from short-wave infrared (SWIR) and thermal infrared (TIR) bands, respectively [Yoshida et al., 2011; Saitoh et al., 2009]. Uncertainties in surface parameters could affect retrieved CO_2 concentrations in the TIR retrieval [Saitoh et al., 2009]. In this study, we tried to estimate surface temperature and surface emissivity simultaneously from TIR spectra of GOSAT/TANSO-FTS, following the method proposed by Matsui and Moriyama [2008]. Their method utilized the relatively moderate wavelength dependence of surface emissivity compared to atmospheric gas absorption lines, and was applied to thermal infrared spectra with a high wavelength resolution obtained with Atmospheric Infrared Sounder (AIRS). We modified their method for the application to TANSO-FTS TIR spectra, and applied it to the spectra obtained over the oceans where the wavelength-dependence of surface emissivities is relatively known to examine the utility of the method.

We here defined wavelength channels with a transmittance above 0.95 without considering any continuum as a “smooth part” in the spectral range between 800 and 1000 cm^{-1}, and then estimated surface parameters on the basis of the “smooth part” channels. First, we applied the method to a TIR spectrum obtained over the ocean in mid-latitudes. We calculated surface emissivities by changing a surface temperature by 1 K in the range from 286 K to 310 K, and adopted the surface temperature when the calculated surface emissivities became smoothest with respect to wavelength. The estimated surface temperature was 294 K, which was close to the nearby MODIS sea surface temperature (SST) value (293.4 K). The simultaneously-estimated surface emissivity at 900 cm^{-1} was 0.97, which was also close to the sea surface emissivity of Aster Spectral Library, 0.99.

Furthermore, we applied our developed method to several TANSO-FTS TIR spectra obtained over the ocean (10–20˚N, 160–170˚E) on 1–3, January, 2013. We compared surface temperatures estimated by our method and nearby MODIS SST data. When their differences were small, the simultaneously-estimated surface emissivies were quantitatively close to the sea surface emissivities of Aster Spectral Library. However, when their differences were relatively large, the structures of the simultaneously-estimated surface emissivies were far from those of the sea surface emissivities. In the presentation, we will discuss the accuracy of our estimates of surface parameters, results of other seasons and regions, and the effect of changing several parameters in our method on estimated surface parameters.

Keywords: GOSAT, thermal infrared band, surface temperature, surface emissivity

