

A greenhouse gas retrieval algorithm for GOSAT TANSO-FTS SWIR using polarization information

KIKUCHI, Nobuhiro^{1*} ; YOSHIDA, Yukio¹ ; UCHINO, Osamu¹ ; MORINO, Isamu¹ ; YOKOTA, Tatsuya¹

¹National Institute for Environmental Studies

TANSO FTS is a Fourier transform spectrometer onboard the Greenhouse Gases Observing Satellite (GOSAT), which is in orbit after the launch in January 2009. TANSO-FTS measures two orthogonal polarizations of solar backscattered spectra at three narrow bands in the short wave infrared (SWIR). It is expected that by using the polarization information, undesirable effects of cloud and aerosols on greenhouse gas retrievals are corrected more effectively, and the accuracy of the retrievals is improved. So far, no retrieval algorithm has been realized which uses polarization information of TANSO-FTS. In this study, for the first time, we present retrieval results of column-averaged concentrations of carbon dioxide (XCO_2) from polarized TANSO-FTS SWIR spectra.

Accurate radiometric calibration of the two polarized spectra is one of the most crucial factors for successful retrievals from TANSO-FTS spectra. With a simulation study conducted under the idealized situation that there is no calibration error in calibration coefficients of TANSO-FTS, we showed that the polarization information increases the information content of the aerosols and reduces retrieval errors in XCO_2 . In fact, degradation of the sensor is not avoidable. Unless the calibration coefficients are evaluated after the launch with sufficient accuracy, polarization information of TANSO-FTS will not improve the XCO_2 retrievals.

In this study, retrievals of XCO_2 were compared using several calibration coefficients evaluated in different methods. The figure shows XCO_2 retrievals from TANSO-FTS measurements over land in June 2011. Blue dots in the figure are results obtained with calibration coefficients evaluated from vicarious calibration reported by Kuze et al. (TGRS, 2014). We also tried to evaluate calibration coefficients from the solar calibration data by analyzing polarization properties of the solar diffuser panel. Retrievals of XCO_2 with the solar diffuser calibration are plotted by red dots in the same figure. Comparing these results obtained with two different calibration coefficients, we found that the values of XCO_2 with the vicarious calibration tend to scatter toward a low concentration in the Sahara desert. On the other hand, this tendency is hardly seen in XCO_2 retrievals with the solar diffuser calibration. Also, some high XCO_2 regions are observed in South America and Southern Africa in the retrievals with the vicarious calibration, which are not seen in the retrievals with the solar diffuser calibration.

Our result indicates that the calibration coefficients make a marked difference in retrieved XCO_2 if the polarization information is used. We plan to analyze more observations, and to try another calibration technique, such as ocean glint observations.

Keywords: satellite observation, carbon dioxide, GOSAT

