The impact on CH$_4$ retrieval of GOSAT/TANSO-FTS TIR band from the uncertainty of the continuum absorption

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The thermal infrared (TIR) band of Thermal and Near-infrared Sensor for Carbon Observation Fourier Transform Spectrometer (TANSO-FTS) onboard Greenhouse Gases Observing Satellite (GOSAT) observes CH$_4$ profile at wavenumber range from 1210 cm$^{-1}$ to 1360 cm$^{-1}$ including CH$_4$ $\nu_4$ band. The current retrieval algorithm (V1.0) uses MT CKD continuum model (Mlawer et al., 2012) to calculate optical depth of continuum absorption for forward spectrum. The temperature coefficient of the water self continuum of MT CKD model overestimated about 30% at the CH$_4$ retrieval band compared to that of BPS continuum model (Paynter and Ramaswamy, 2011). We study the impact on CH$_4$ retrieval from the uncertainty of the continuum absorption.

We used 713 spectra observed by GOSAT/TANSO-FTS TIR band from March 2010 to September 2011. These observations satisfy following criteria. The coincidence criteria of distance and time between GOSAT-TIR observations and HIPPO aircraft observations (Wofsy et al., 2012) are 300 km and 72 hours, respectively, and the degrees of freedom for signal are greater than 0.7. We calculated forward spectrum using retrieved profile by LBLRTM V12.2 (Clough et al., 2005) and convolution of the forward spectrum and sinc function as an instrumental line shape function to set to low wavenumber resolution.

The spectral residual (forward spectrum - GOSAT-TIR observation spectrum) had fine structure from -20 K to 20 K, which was made from line absorption. We calculated moving average with window width of 11 channels to separate continuum from line absorption. The average of the moving-averaged residual were -2.0 K. According to Saitoh et al. (2009), 1 K difference of surface temperature make 5% bias at the altitude of 400 mbar in CO$_2$ profile, there is a potential for bias in CH$_4$ profile. There exist H$_2$O self continuum, H$_2$O foreign continuum, CO$_2$ continuum, and O$_2$ continuum in this band. The wavenumber dependencies of H$_2$O self continuum and CO$_2$ continuum are small in this band, while that of H$_2$O foreign continuum and O$_2$ continuum are large.

We calculated forward spectra using 10% larger continuum absorption coefficient than MT CKD model to know the impact on brightness temperature spectrum from continuum absorption. The brightness temperature changed about -0.00001 K and 0.01 K when we used 10% larger CO$_2$ continuum absorption and 10% larger H$_2$O self continuum absorption, respectively. The differences on brightness temperature were much smaller than the averaged residual. We are trying comparing GOSAT-TIR CH$_4$ profile retrieved using 10% bias continuum absorption and other continuum model with HIPPO profile.

References: