

The impact on CH₄ retrieval of GOSAT/TANSO-FTS TIR band from the uncertainty of the continuum absorption

*Yamada Akinori¹, Naoko Saitoh¹, Ryoichi Imasu², Akihiko Kuze³, Kei Shiomi³

1.Center for Environmental Remote Sensing, Chiba University, 2.Atmosphere and Ocean Research Institute, University of Tokyo, 3.Japan Aerospace Exploration Agency

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 CH₄ profile at wavenumber range from 1210 cm⁻¹ to 1360 cm⁻¹ including CH₄ ν₄ 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 CH₄ retrieval band compared to that of BPS continuum model (Paynter and Ramaswamy, 2011). We study the impact on CH₄ 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 CO₂ profile, there is a potential for bias in CH₄ profile. There exist H₂O self continuum, H₂O foreign continuum, CO₂ continuum, and O₂ continuum in this band. The wavenumber dependencies of H₂O self continuum and CO₂ continuum are small in this band, while that of H₂O foreign continuum and O₂ 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 CO₂ continuum absorption and 10% larger H₂O self continuum absorption, respectively. The differences on brightness temperature were much smaller than the averaged residual. We are trying comparing GOSAT-TIR CH₄ profile retrieved using 10% bias continuum absorption and other continuum model with HIPPO profile. References:

Mlawer, E. J., et al. (2012) Philosophical Transactions of the Royal Society of London A: Mathematical, Physical and Engineering Sciences 370, 2520-2556.

Paynter, D. and Ramaswamy, V. (2011) JGR 116, D20302.

Saitoh, N., et al. (2009) JGR 114, D17305.

Wofsy, S. C., et al. (2012) http://dx.doi.org/10.3334/CDIAC/hippo_010.