Investigation of the sensitivity of GOSAT TIR observations to CH4 in the near-surface layer

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Poster

In this study, we investigated the sensitivity of thermal infrared (TIR) band methane (CH4) observations from the Thermal And Near-Infrared Sensor for Carbon Observation-Fourier Transform Spectrometer (TANSO-FTS) onboard the Greenhouse Gases Observation Satellite (GOSAT) in the lower troposphere, specifically at the 950-850 hPa level. To achieve this, we compared GOSAT-TIR CH4 data with ground observations from the World Data Centre for Greenhouse Gases (WDCGG) and the MIROC4.0-based Atmospheric Chemistry Tracer Model (MIROC4-ACTM) for the period 2009-2014. Our analysis included a comparison of monthly, daily, and hourly measurements to assess the ability of GOSAT-TIR observations to capture CH4 variability over different time scales.

We investigated the effect of a simple collocation method, where observations are selected within different radius sizes (3, 5, 7, 10, or 15 degrees) to match the footprint of the WDCGG observations. Results showed that for monthly datasets, larger radii (7-10 degrees) improved correlation due to larger footprints, whereas for short-term observations (daily, hourly), smaller footprints resulted in better performance, suggesting that larger radii worsen the correction. Optimal values for Root Mean Square Error (RMSE) and Standard Deviation (SD) were obtained with a sample of several hundred GOSAT observations. As a result, the ideal collocation radius varied with observation frequency and location. The study highlighted the importance of GOSAT sensitivity at key sites such as AMY, RYO, YON, and BKR in the Asian region, which are crucial for understanding the CH4 balance. Positive feedback was received from American and European sites, emphasizing the importance of monitoring CH4 emissions in these regions for global CH4 budgets. In addition, the study demonstrated the sensitivity of GOSAT data even on sub-daily timescales at sites with high concentration and flux uncertainties. The agreement with WDCGG observations increases confidence in the global distribution of GOSAT-TIR CH4 and

supports its potential for validating three-dimensional methane products.

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