

Analysis of the carbon dioxide in the upper troposphere and lower stratosphere by the data from GOSAT TANSO-FTS TIR

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Stratospheric cooling was reported, it could be caused by increasing the carbon dioxide (CO₂), which is a major greenhouse gas. While, the concentration of CO₂ in the stratosphere is not well understood, nor are the exchange processes between the upper troposphere and lower stratosphere (UT/LS ; 250-100hPa). The present study investigated the intra-seasonal, seasonal and inter-annual variations of CO₂ to understand the CO₂ concentration at UT/LS and the Stratosphere and Troposphere exchange process.

We used the vertical profile data (Level 2) of CO₂ derived from thermal infrared (TIR) region (Band 4: 5.5 - 14.3 μ m) of the Thermal And Near-infrared Sensor for carbon Observation (TANSO) - Fourier Transform spectrometer (FTS) on board Greenhouse gas Observing SATellite (GOSAT). The analysis period is four years from January 2010 to December 2013. We adapted the bias correction values derived from Saitoh et al. [AMT, 2016] which validated the TIR CO₂ profiles at UT/LS region with the Comprehensive Observation Network for TRace gases by AirLiner (CONTRAIL). For reference, the atmospheric transport model, NIES-TM (ver.5) and the Nonhydrostatic Icosahedral Atmospheric Model (NICAM)-based Transport Model (TM) were used [Niwa et al., 2011; 2017].

The growth rate of CO₂ concentration at UT/LS were approximately 2 ppmv/year, which one at southern hemisphere were relatively larger than one at northern hemisphere. The seasonal variation of CO₂ concentration, showed that the maximum peak existed after a few month with respect to the peak at the middle or lower troposphere. The inter-annual variations were affected by the ENSO cycle; the higher (lower) CO₂ concentration at UT were seen during La Nina (Normal / El Nino) period. Finally, the intra-seasonal variation CO₂ concentration at UT/LS were associated with both the vertical and horizontal transportation due to the deep convection and the Asian monsoon anticyclonic circulation, respectively. To clarify the dynamics of CO₂ concentration on the time scale within the area and season within which we could not observe by aircraft observation or balloon observation, the results are used for verification of physicochemical process of global model and also for their development can do.

Keywords: greenhouse gases, stratosphere-troposphere exchange, GOSAT satellite