A VALIDATION AND INTERCOMPARISON OF SATELLITE-DERIVED CO2 PROFILES WITH AIRCRAFT OBSERVATIONS

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Although carbon dioxide is the main contributing greenhouse gas to global warming and climate change, the estimation of its source and sink has a considerable uncertainty. To investigate the movement of atmospheric carbon dioxide, many *in-situ* observation data collected over the world have been used. However, *in-situ* observations are not spatially continuous, which result in large uncertainties in spatial variation of the CO_2 concentration.

In this context, the use of satellite-based observation is much appealing. Although thermal remote sensors such as Atmospheric Infrared Sounder (AIRS) onboard Aqua and Tropospheric Emission Spectrometer (TES) onboard Aura are originally designed to investigate temperature and water vapor profiles in the atmosphere, they can be used to retrieve atmospheric carbon dioxide concentration. Greenhouse gases Observing SATellite (GOSAT), the first dedicated satellite to monitor carbon dioxide, was launched on 23 January 2009. GOSAT provides two types of carbon dioxide concentration: vertical profile of carbon dioxide using thermal remote sensing and the total column of carbon dioxide using shortwave infrared remote sensing. The vertical profiles of carbon dioxide are important to understand carbon dioxide transport in the troposphere. One of the major problems with these satellite-based carbon dioxide concentration products is its uncertainty due to the lack of calibration and validation data.

Comprehensive Observation Network for Trace gases by AIrLiners (CONTRAIL) can measure vertical carbon dioxide profile concentration with air flask measurements. It records the carbon dioxide concentration every 10 seconds during ascending and descending of an aircraft, which is approximately a 100m interval along the altitude. Since CONTRAIL data are *in situ* observations, it is more accurate than satellite data and can be used as reference data to calibrate and validate the satellite-derived carbon dioxide products.

In this research, multi-year CONTRAIL and AIRS, TES and GOSAT L2 daily data between 2005 and 2011 were used to evaluate the satellite-derived carbon dioxide products. Since AIRS peak sensitivity lies between 6km and 8km, CONTRAIL data measured only between 6km and 8km were used to evaluate AIRS products. TES data has 15 layers along the altitude and each layer was evaluated with the CONTRAIL data measure at the similar altitude. Similarly, GOSAT data has three vertical profiles—700, 500 and 300hPa—and they were compared with the CONTRAIL data at the similar altitude. A one to five degrees spatial buffer and a one to four hours temporal buffer were used to make pairs of data between satellite-derived products and CONTRAIL data. Results show that the correlation coefficients between satellite-based carbon dioxide concentration and reference data ranged from 0.5 to 0.9 and RMSE were from 1 to 3 ppm depending on the buffer size and satellite-derived products used.

Keyword: AIRS, GOSAT, TES, CONTRAIL, Carbon dioxide