CO_2 Measurements from Space: The Japanese GOSAT and NASA OCO-2 Missions

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The Japanese Greenhouse Gases Observing SATellite (GOSAT) and the NASA Orbiting Carbon Observatory (OCO) were the first two satellites designed specifically to collect high resolution spectra of reflected sunlight in shortwave infrared CO_2 and O_2 bands. These observations can be analyzed to retrieve surface-weighted estimates of the column averaged CO_2 dry air mole fraction, X_{CO2}. Once validated against surface *in situ* and remote sensing measurements, these X_{CO2} estimates can be combined with the ground based CO_2 measurements and assimilated by chemical tracer transport models to quantify CO_2 surface fluxes on regional scales over the globe. GOSAT was successfully launched in January 2009 and has been routinely collecting CO_2 and CH_4 observations over the sunlit hemisphere since April 2009. OCO was lost in February 2009 when its launch vehicle malfunctioned and failed to reach orbit. A replacement, called OCO-2, is under development, in preparation for a late 2014 launch.

Soon after the loss of OCO, its science team began working with the GOSAT Project Team to analyze the observations collected by the GOSAT Thermal and Near-infrared Sensor for carbon Observations-Fourier Transform Spectrometer (TANSO-FTS). Recent X_{CO2} products from this collaboration show little or no bias and random errors that are typically less than 0.5% on regional scales over much of the Earth. Global maps of X_{CO2} for July 2009, October 2009, January 2010, and April 2010 are shown in Fig. 1. These results have been screened for clouds and optically-thick aerosols, and have passed a series of additional data quality filters. The spatial coverage each month is limited by low-solar illumination, persistent cloud cover, and the low reflectance of ocean- and ice-covered surfaces. These GOSAT data products are now being distributed by the NASA Goddard Earth Sciences Data and Information Services Center and tested in flux inversion models.

The OCO-2 instrument and spacecraft development are proceeding rapidly. Once it is successfully launched and inserted into orbit, its data are expected to complement the GOSAT X_{CO2} measurements by providing improvements in coverage, resolution, and sensitivity.

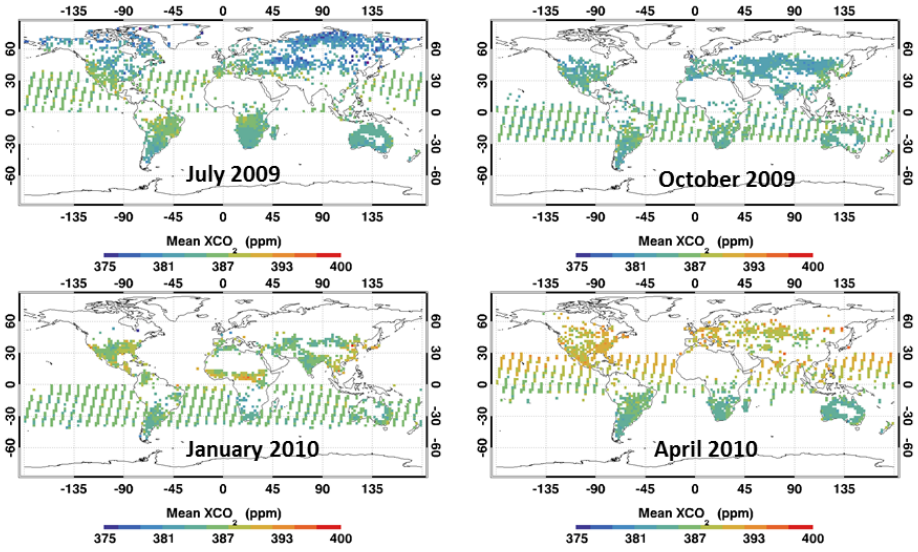

Figure 1. Monthly maps of X_{CO2} retrieved from GOSAT observations by the OCO-2 team. Each data point shows the average value for a 2° by 2° box for the month.