**Atmospheric $CO_2$ Observations from Space (ACOS): Preliminary Results from Greenhouse Gas Observing Satellite (GOSAT) Data Analysis**

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The NASA Orbiting Carbon Observatory (OCO) and Japanese GOSAT teams formed a close partnership during the development phases of these two missions. The objectives of this collaboration were to cross calibrate the OCO and GOSAT Thermal and Near Infrared Sensor for Carbon Observatories (TANSO) Fourier Transform Spectrometer (FTS) measurements, and to cross validate the OCO and GOSAT $CO_2$ retrievals against common reference standards to facilitate the joint use of these two data sets in studies of the carbon cycle. After the loss of the OCO spacecraft, NASA reformulated the OCO science team as the ACOS team to (i) meet the NASA's obligations to its GOSAT partners, (ii) recover some of the science knowledge expected from OCO, and (iii) validate the OCO retrieval algorithms in a realistic operational environment. This final objective took on greater significance when the U.S. Congress authorized a restart of the OCO project and the President's 2010 budget proposal included funding to produce a "carbon copy" of OCO that could be ready for launch by February 2013.

The GOSAT and ACOS teams conducted their first joint vicarious calibration campaign in Railroad Valley, Nevada from 23 Jun – 6 Jul, 2009. Results from this experiment and the subsequent coordinated over-flights of Railroad Valley with the Airborne Visible/Infrared Imaging Spectrometer instrument on the NASA ER2 on 10/9/2010 are being used to track changes in the radiometric calibration of the GOSAT TANSO-FTS instrument. The ACOS and GOSAT teams are validating GOSAT XCO2 retrievals with near-simultaneous measurements from the Total Column Carbon Observing Network (TCCON) measurement. While these comparisons still show biases, the amplitude of these biases are decreasing steadily over time as the retrieval algorithms improve. The standard deviations of the ACOS XCO2 estimates are now approaching the GOSAT accuracy requirement of 1% (~4 ppm) on regional scales. Ongoing investigations of spatially invariant spectroscopic residuals in the GOSAT retrievals are providing insights into the systematic errors that must be addressed to meet the much more stringent 0.3% (1ppm) regional scale uncertainties for OCO-2.

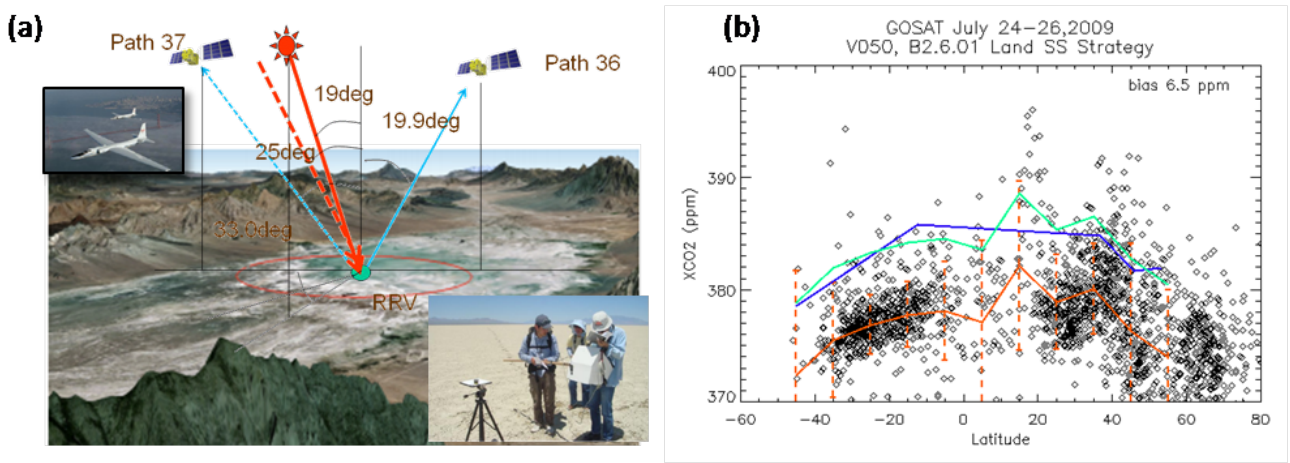


**Figure 1.** (a) Major components of the vicarious calibration campaign shown over a Google Map of Railroad Valley, Nevada, including satellite overpasses, ground-based observers and aircraft overflights. The next vicarious calibration campaign is scheduled for June 2010. (b) Pole to pole retrievals of XCO2 by the ACOS team for GOSAT 3-day repeat cycle in July 2009. There is currently a 6.5 ppm bias between the ACOS and TCCON retrievals, but the latitude distribution of XCO2 is clearly reproduced, with regional scale standard deviations of 2.5 to 4 ppm.