Initial Validation and Bias Correction of OCO-2 Carbon Dioxide Retrievals

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In this presentation we report on results from the Atmospheric Carbon Observations from Space (ACOS) algorithm as applied to initial Orbiting Carbon Observatory-2 (OCO-2) observations. In order to obtain high-quality measurements of the column-averaged dry air mole fraction of CO_2 (XCO_2), pre- and post-filtering of OCO-2 soundings must be performed to remove cloud-contaminated data or other data likely to contain large XCO_2 errors. In addition, a post-retrieval bias correction is found to be necessary to correct for spectroscopic and calibration errors, as well as fundamental biases in the retrieval itself. Following on work from Greenhouse gases Observing SATellite (GOSAT), we use data from Total Carbon Column Observing Network (TCCON) as well as the Southern Hemisphere uniformity approximation to provide "truth proxy" data with which to derive the bias correction. For OCO-2, we can also exploit the fact that many soundings are often recorded within relatively small areas (<~ 100 km) due to its sampling strategy, and over such areas XCO_2 should be approximately uniform. We demonstrate the utility of this approach to derive bias-correction information and find that it confirms the results of the other truth proxies.

In the initial OCO-2 retrievals, we find significant bias associated with: 1) footprint across track; 2) error in the surface pressure retrieval; 3) retrieved amounts large aerosol and cloud particles; and 4) variation in the retrieved profile of CO_2. With the exception of 1), the same set of variables had been identified previously as driving bias in the ACOS GOSAT retrievals. In general, we find the algorithm is most accurate for ocean glint retrievals, consistent with the higher signal-to-noise ratio and reduced effects of aerosols over ocean, with single sounding errors of 0.5 - 1.0 ppm. However, the algorithm is found to perform well for land observations as well, albeit with higher single sounding errors of 1.3 - 2 ppm. We also find that high-quality glint observations over land do not extend to the same latitude range as for nadir observations, due to the enhanced scattering affects of aerosols or clouds in the glint geometry over land surfaces at higher solar zenith angles.
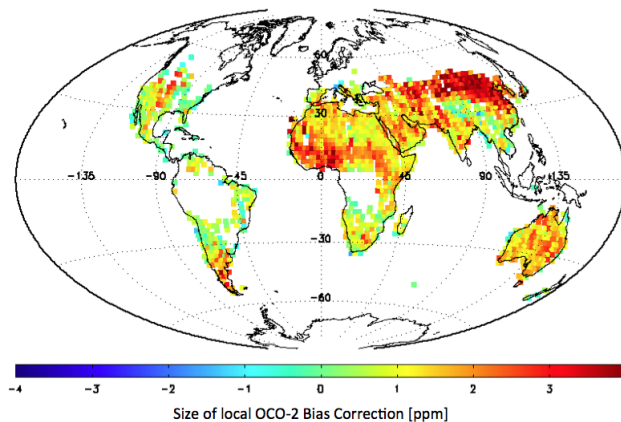

Figure 1. Local mean OCO-2 XCO_2 bias correction for filtered data acquired in nadir mode over land from December 13 - 28, 2014.