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Poster
Ongoing space missions like OCO-2, OCO-3, GOSAT-1 and GOSAT-2 use passive spectrometers that measure Earth-reflected sunlight to retrieve XCO2. Their measurements work well under clear-sky conditions and at moderate to high sun angles. However, there continue to be large measurement gaps in important carbon rich areas including the tropics and Arctic that are caused by low sun angles, darkness, aerosols, thin and broken clouds, and mixed water/land surfaces. These observational gaps lead to major uncertainties in the carbon balance of these regions.

In contrast lidar measurements work well under these conditions and in sunlight because they carry their own pulsed light source, a time gated receiver and operate in a consistent nadir viewing glint mode. The airborne CO2 Sounder is a multi-wavelength Integrated Path Differential Absorption lidar was developed by NASA Goddard as an airborne demonstrator for XCO2 measurements. It retrieves XCO2 in the nadir path from the aircraft to the scattering surface by measuring its range and the shape of the 1572.33 nm CO2 absorption line. The CO2 Sounder team participated in the 2017 ASCENDS/ABoVE airborne campaign, which was flown on the NASA DC-8 in July and early August. Eight flights were conducted with 55 hours of XCO2 measurements from the lidar along with in-situ CO2 measurements made at the aircraft. Forty-seven spiral-down maneuvers were conducted in locations over California, the Northwest Territories Canada, the Arctic Ocean and Alaska, along with the long transit flights from California to Alaska and return. Each spiral maneuver allowed comparing the XCO2 retrievals from the lidar against those computed from in situ measured CO2.

This campaign produced an unpreceded set of lidar XCO2 measurements made under a diverse set of atmospheric and surface conditions. The lidar results show better than 1-ppm agreement between most lidar and in situ measurements in the spirals. The airborne XCO2 measurements showed both north-south and east-west gradients, drawdown caused by growing cropland, changes caused by different wind directions, measurements to cloud tops, and local features in XCO2, including two caused by wildfires. The presentation will show highlights from the campaign’s lidar measurements and discuss their benefits for a future space mission.
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