Analysis of Pulsed Lidar Measurements of \(XCO_2\) from the 2017 ASCENDS/ABoVE Airborne Campaign

Campaign flown on NASA DC-8, carrying:
- Goddard \(CO_2\) Sounder Lidar
- LaRC ACES Lidar
- Goddard Picarro, \textit{in situ}
- LaRC AVO CET, \textit{in situ}
- LaRC DLH, \textit{in situ}

Summary
- Pulsed IPDA lidar measurements of \(XCO_2\) over long flight lines
- IPDA lidar measurements of \(XCO_2\) in Arctic, for first time
- Measurements made through diverse set of atmospheric & surface conditions.
- Analysis of measurements show:
  - Gradients in \(XCO_2\): North-south, East-west & Locally
  - Local features in \(XCO_2\), including one caused by wildfires
  - Better than 1-ppm agreement between most lidar and \textit{in situ} measurements at spiral locations.
- iPoster gives highlights

- 8 flights
- July 20- Aug 8, 2017
- 55 hours of airborne measurements
- Comparison with \textit{in situ} at 47 spiral down locations
The airborne CO2 Sounder is a pulsed, multi-wavelength Integrated Path Differential Absorption lidar. It estimates the column average CO2 mixing ratio (XCO2) in the nadir path from the aircraft to the scattering surface by measuring the shape of the 1572.33 nm CO2 absorption line. The airborne lidar uses 30 fixed-wavelength samples distributed across the line and measures the range and pulse energy to ground or to cloud tops at each wavelength. For each 1-second integration the retrieval solves for scattering surface elevation and XCO2 by using radiative transfer calculations, the aircraft altitude, range to the surface, and atmospheric conditions.

The CO2 Sounder team participated in the 2017 ASCENDS airborne campaign, which was flown on the NASA DC-8 from July 20 to August 8. The flights were designed to assess the accuracy of airborne lidar measurements of XCO2, and to extend lidar measurements to the ABoVE study area in the Arctic. Eight flights were conducted with XCO2 measurements from the lidar along with in-situ CO2 measurements made at the aircraft with the AVOCET and Picarro instruments. Forty-seven spiral-down maneuvers were conducted in locations over California, the Northwest Territories Canada, the Arctic Ocean and Alaska, along with the 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 airborne campaign was quite successful:
It made IPDA lidar measurements of XCO2 over long flight lines and in the Arctic region for the first time
Lidar measurements made though a diverse set of atmospheric and surface conditions.
The analysis of lidar results show both north-south, east-west and local gradients in XCO2.
It also shows local features in XCO2, including one caused by wildfires
It shows better than 1-ppm agreement between most lidar and the in situ measurements in the spiral locations.
The presentation will show highlights from the lidar measurements during the campaign.