



Airborne Demonstration of Atmospheric CO2 Concentration Measurements with a Pulsed Multi-wavelength IPDA Lidar

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Multiple-wavelength approach for low-bias retrievals
Returns from elevated surfaces with accurate ranging capability and weighting functions peaking at different altitudes contain vertical information of CO2 distribution













































Lidar Measurements to Cloud Tops













Transit south flight, 8/8/2017





Significant vertical and horizontal gradients from onboard Picarro





Transit south flight, 8/8/2017









- Large, stable, rich and valuable data set !
- High precision: < 1 ppm for 1-s average and < 0.5 ppm for 10-s average
- Low bias: lidar XCO2 agrees with in-situ profiles
- Lidar XCO2 clearly shows north-south gradients and CO2 enhancement from forest fires
- CO2 Sounder is ready to participate in future airborne campaigns
 - scale up to spaceborne see poster #55 by Abshire et al
 - status and future of ASCENDS Ken Jucks talk
- Lidar XCO2 data will be released to public this summer

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Backup slides





Measurement Approach

- Pulsed laser and time-gated receiver
 - >> Height-resolved backscatter measurements
 - >> High spectral resolution, high measurement sensitivity
- Multiple-wavelength measurement cross one CO₂ absorption line
 - >> Lineshape-resolved w/ 30 wavelengths
 - >> very narrow spectral coverage (< 0.15 nm)
- Fixed nadir-pointed

Measurement Parameters

- 1-µs laser pulse width
- 10 kHz pulse rate ~ a step of 100-µs
- 300 Hz laser scan rate cross 30 wavelengths on the 1572.335 nm $\rm CO_2$ line
- 10 Hz receiver data recording rate for all wavelengths ~ 0.1 s raw data reporting interval
- 10 ns receiver bin width ~ up to 1.5 m vertical resolution











