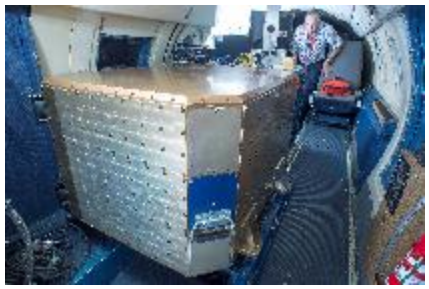
ASCENDS CarbonHawk Experiment Simulator (ACES)

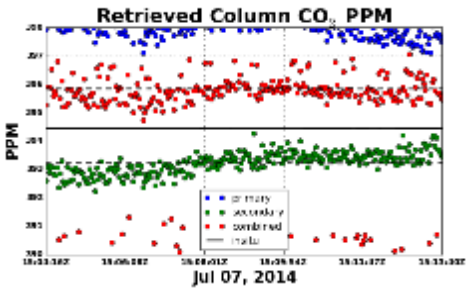
PI: Michael Obland, NASA LaRC

Objective

- Demonstrate measurements of column CO_2 mixing ratios with a high-altitude airborne instrument architecture scalable to the ASCENDS mission requirements
  - Technologies include a high bandwidth detector and trans-impedance amplifier, a multi-aperture telescope, advanced algorithms for cloud/aerosol discrimination, and high efficiency CO_2 and O_2 transmitters.
- Deploy instruments on NASA aircraft to demonstrate discrimination of surface returns from clouds and aerosols, derivation of ranging information from the continuous wave laser system, and measurements of column CO_2 mixing ratios



The ACES instrument inside the NASA HU-25



CO_2 measurements made over the Atlantic ocean

Accomplishments

- Built airborne lidar measuring atmospheric column-averaged CO_2 number densities and mounted in a Global Hawk-compatible environmental enclosure (2.1'x2.8'x3.7').
- Increased transmit power by 6x compared with previous instrument (to 30 watts), yielding 14x increase in power aperture product consistent with simulated returns over ocean and vegetated surfaces. Increased transmit power produced high signal-to-noise ratio measurements over challenging surfaces (e.g. ocean) with demonstrated differential optical depth measurement precisions of <0.5%.
- Increased bandwidth of HgCdTe detector and electronics from 500 KHz to 4.9 MHz allowing the use of advanced laser modulation waveforms.
- Flew onboard LaRC HU-25 Falcon collecting remotely-sensed CO_2 and O_2 column amounts with in situ CO_2 and meteorological measurements. Compiled 17.4 hours of data from multiple altitudes over land and ocean surfaces with and without intervening clouds.
  - Meets projected ASCENDS requirements for range retrievals; demonstrated retrievals of cloud and vegetation canopy structure.
  - Initial CO_2 mixing ratio retrievals show reasonable agreement compared with in situ measurements (~ 1 ppm over water).

Co-Is/Partners: Ed Browell, SSAI; Jeremy Dobler, ITT Exelis; Berrien Moore, Univ. of Oklahoma; Scott Zaccheo, AER

TRL_{in} = 3 TRL_{out} = 5