ASCENDS Lidar:
Acceleration and Demonstration of Key Space Lidar Technologies

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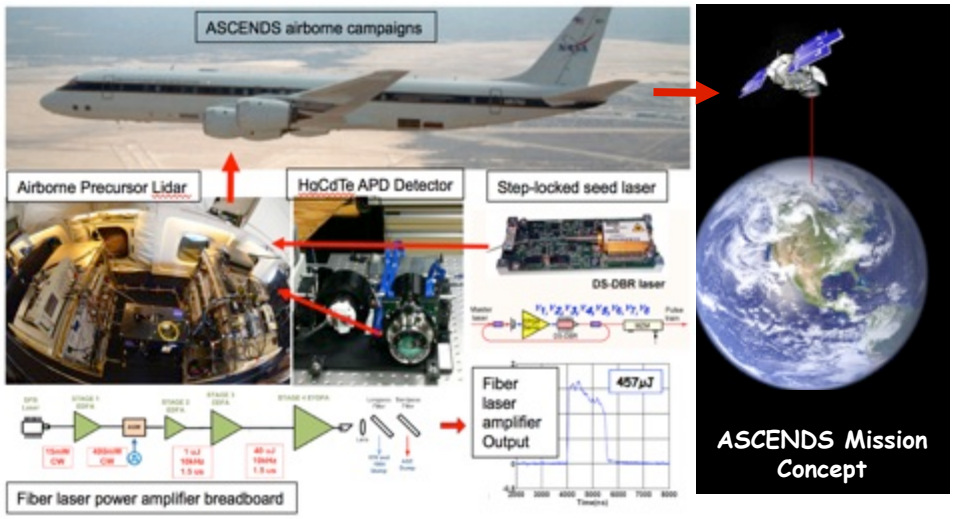
Objective

- Enable space lidar for simultaneous measurements of CO_2, O_2, and range, using lasers at 1572 and 765 nm
  - < 1 ppmv accuracy in ~100 km along track sample
  - Bias < 0.5 ppm (one year after launch)
- Demonstrate capabilities to:
  - Measure during day and night over all surfaces
  - Measure precisely through thin clouds and aerosols
  - Meet the ASCENDS science requirements
- Accelerate development of ASCENDS space lidar by developing key lidar components needed for space: step-locked laser oscillator, laser amplifier, sensitive detector
- Demonstrate space-like CO_2 measurements using new lidar components



Key lidar technologies developed to enable the space instrument

Accomplishments

- Developed technologies needed for scaling airborne CO_2 Sounder lidar to space:
  - Rapidly tuned wavelength-locked laser seed source (GSFC) (8 to 30 wavelengths/line) (TRL_{out}= 5)
  - Highly sensitive HgCdTe APD detector (DRS/RSTA): >70% QE, Gain~900, NEP ~0.1 FW/$Hz^{1/2}$ (a record), spectral response 0.4 to 4 μm, successful proton radiation test: (TRL_{out}= 5)
  - Demonstrated fiber laser power amplifier stages with space-needed power (Fibertek) (TRL_{out}= 4)
- Demonstrated improved airborne CO_2 and O_2 measurements from 3-12 km:
  - Participated in 2011, 2013, 2014 ASCENDS airborne campaigns (~40 hours flight time/campaign)
  - CO_2 measurements over all relevant surfaces (desert, forests, mountains, oceans, snow, crops). System biases were < 1.2 ppm. Most measurement precisions were < 2 ppm; precision over desert = 0.9 ppm.
  - Demonstrated 1st "cloud slicing" – using column measurements to cloud tops to enhance solving for surface fluxes
- Demonstrated airborne O_2 column lidar measurements with precision < 7 mbar

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TRL_{in}= 3 **TRL_{out}= 4**