The GSFC Integrated Path Differential Absorption (IPDA) lidar uses optical parametric technology and a sensitive detector to measure Differential Optical Depth (DOD) of CH₄ at 1651 nm. The technology can and has been used to measure CO₂, H₂O and CO in the near and mid-infrared.

Why Methane?

- Earth Science Decadal Survey (ESD, 2007): "Ideally, to close the carbon budget, methane should also be addressed, but the required technology is not yet obvious. If appropriate and cost-effective methane technology becomes available, methane capability should be added." 3.2.6
- New Earth Science Decadal Survey is expected to call for CO₂/CH₄ measurements.
- Large amounts of organic carbon are stored as CH₄ and CO₂ in the Arctic permafrost. Thawing arctic permafrost soil is a cause for concern as a rapid positive greenhouse gas climate feedback.

CH₄ Transmitter Technology - OPA

OPA: Easy to align, easy to tune, power scaling hard to achieve while maintaining narrow linewidth. OPA samples the CH₄ line at several wavelengths using a single, continuously tuned seed laser.

GSFC CH₄ Measurements

- Need: Laser transmitter technology
  - 3-4 μm for planetary
  - 1.65 μm on Earth
- Optical Parametric Generation (OPG) is the best solution currently available.

CH₄ Laser Transmitter Components

Pump: a high power, single frequency, narrow linewidth fiber or solid state laser at 1064 nm

Seed: a low power, single frequency diode laser at 1651 nm.

4 wavelength OPO

- Setup for open path measurement

2015 Airborne Demonstration

- Flight Test methane LiDAR Instruments:
  - GSFC Methane Sounder
  - GSFC Picarro
- Conduct several test flights from NASA’s Armstrong Science Aircraft Integration Facility (ASAI) in Palmdale, CA:
  - 2 Engineering flight
  - 2-3 science flights
- Approximately 12-13 hours of flight time in mostly in CA
- Assess CH₄ LiDAR measurements over Western US
- Evaluate derivation of XCH₄ from LiDAR observations and compare with in-situ and calibrations sites whenever possible.
- Evaluate OPA and OPO performance