The OCO-2 Mission Architecture

3-Channel Grating Spectrometer

Data Product Generation
- Initial Surf/Atm State
- New State
- Generate Synthetic Spectrum
- Instrument Model
- Inverse Model
- $X_{CO2}$

Dedicated Spacecraft Bus

Data Transmitted to NASA NEN and SN

Formation Flying in the A-Train Constellation

Delta-II Launch Vehicle
The OCO Instrument – Optimized for Sensitivity

3 imaging grating spectrometers record reflected sunlight at high spectral resolution
- Resolving Power: 17,000 - 20,000
- High Signal-to-Noise Ratio
- Collects 24 soundings / second
  - 1 million soundings / day
Verifying End-to-End Instrument Performance during Pre-Flight testing

Observations of the sun with the flight instrument taken during TVAC tests provide an end-to-end verification of the instrument performance.

1.6 µm CO₂

21 April 2012

OBSERVATIONS

CO₂ columns, L2 scale, TCCON used 4853 window, UN., 0.99 scaling

2 plumes (also visible in TCCON CO₂, CH₄ and H₂O)!

- TCCON
- OCO-2

~1%
Observatory Integration & Test Activities
On Track for 01 July 2014 Launch

The business end of one of three Series 40 Graphite Epoxy Motors that will more than double the total thrust of the vehicle to 0.5M lbf at launch

The Mobile Service Tower [left] and Fixed Umbilical Tower [right] at SLC-2W (Space Launch Complex 2 West), Vandenberg Air Force Base, CA
Post-Launched Critical Events

- Fairing Ejection
- Separation
- Solar Array Deployment
- Sun Acquisition
Nominal Early Operations Schedule

- T + 45d – Nominal End of In Orbit Checkout (IOC)
- T + 135d – First Public Release of L1b data (calibrated spectra)

**T + 0d**
- Insertion Orbit Engineering Checkout
- Assent

**T + 30d**
- Operational Orbit Engineering Checkout

**T + 60d**
- Nominal data collection (i.e. 16 days nadir / 16 days glint)

**T + 90d**
- First update to dark subtraction (no temperature corrections)
- First update to bad pixel map in flight

**T + 120d**
- First Temperature corrected dark subtraction
- First Update to Dispersion
- First update to gain degradation (weather over Railroad Valley permitting)
- First Update to SNR model
- First Update to Pointing Vectors
OCO-2 will fly at the head of the 705-km Afternoon Constellation (A-Train), but has changed its flight path to share the ground track with CloudSat and CALIPSO, which is 217 km East of the AQUA (WRS-2 Standard) track.
On-orbit Calibration Operations

Routine Calibration (every orbit)

- Solar Calibration
  - Observe sun through a solar diffuser
- Lamp Calibration
  - Observe illuminated diffuse target
- Dark/Bias calibration: Lamps off

Special Calibration Activities

- Solar Doppler calibration (semi-annual)
  - Observe sun through entire daylight orbit to calibrate ILS
- Lunar calibration required for absolute and relative pointing (monthly)
  - Verifies instrument-star tracker alignment
  - Radiometric calibration check
The OCO-2 Orbit:
- 705 km altitude
- 98.2° inclination
- 16-day ground track repeat
- 1:30 PM Equator Crossing time
- 98.8 minute orbit period
  - 14.57 Orbits/day

Latitude Coverage
- Nadir: +85° Solar zenith angle
- Glint: +81° Solar zenith angle

Resolution
- ~25° longitude offset between consecutive orbits
- 1.5° longitude offset between orbit tracks after 16-days

OCO-2 will collect about 1 million soundings each day along a narrow track.

OCO-2 is a SAMPLING system, not a MAPPING system.
The OCO-2 Retrieval Algorithm

Forward Radiative Transfer Model
- Spectra + Jacobians

Instrument Model
- Spectral + Polarization

Inverse Model
- Compare obs. & simulated spectra
- Update State Vector

Apriori + Covariance

Gas Cross Sections
- Cloud & Aerosol Optical Properties

Viewing geometry
- Full-res Spectrum
- Simulated Spectrum
- Spectral Residual

GOSAT Data have provided a critical validation of the OCO-2 Algorithm

Crisp: OCO-2 Mission
Conclusions

• The OCO-2 implementation is progressing on schedule for launch from Vandenberg Air Force Base, at 2:56:44 AM PDT on 1 July 2014
  – April 2012: The Instrument delivered for integration with spacecraft
    • At delivery, the OCO-2 instrument performance exceeded most of its stringent performance and calibration requirements
  – April 2014: Observatory delivered for integration with launch vehicle
• A launch ready version of the OCO-2 Retrieval Algorithm has been delivered and is being tested using GOSAT data
  – The ACOS/GOSAT collaboration provided valuable insight and a critical validation of the OCO-2 algorithm
• If all goes as planned, we could start delivering Level 1B products as early as late November 2014 and Level 2 products in February 2015
Thank You for Your Attention

Questions?