



42nd Global Monitoring Annual Conference

Launch and Early Operations of the NASA Orbiting Carbon Observatory-2

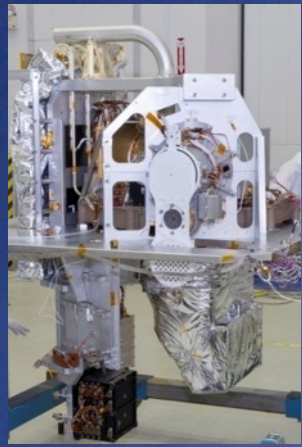
David Crisp for the OCO-2 Science Team
Jet Propulsion Laboratory, California Institute of Technology

May 2014



The OCO-2 Mission Architecture

3-Channel Grating Spectrometer



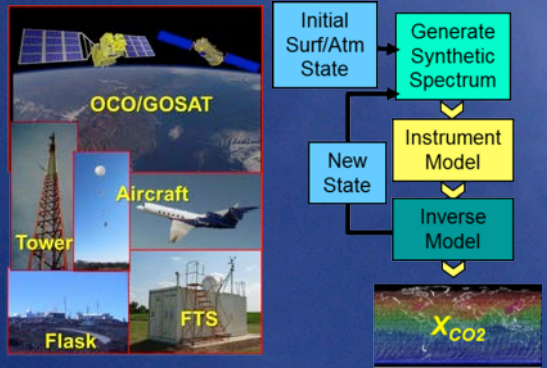
Dedicated Spacecraft Bus



Delta-II Launch Vehicle



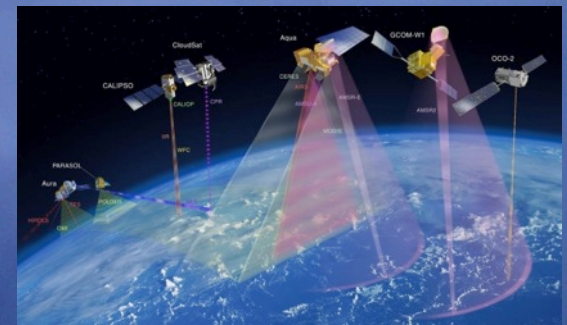
Data Product Generation



Data Transmitted to NASA NEN and SN



Formation Flying in the A-Train Constellation





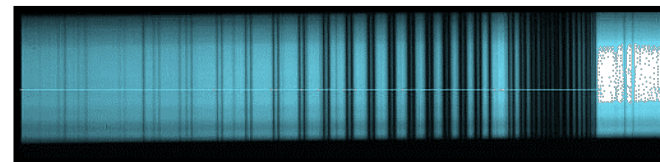
The OCO Instrument – Optimized for Sensitivity

3 imaging grating spectrometers record reflected sunlight at high spectral resolution

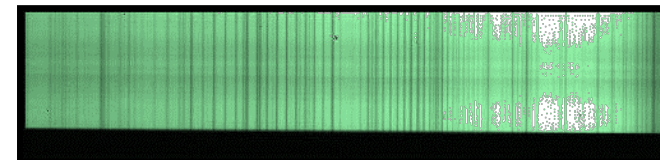
- Resolving Power: 17,000 - 20,000
- High Signal-to-Noise Ratio
- Collects 24 soundings / second
 - 1 million soundings / day



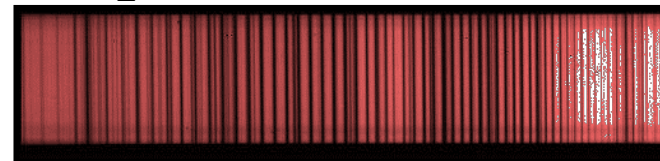
O₂ A-Band



CO₂ 1.61μm Band

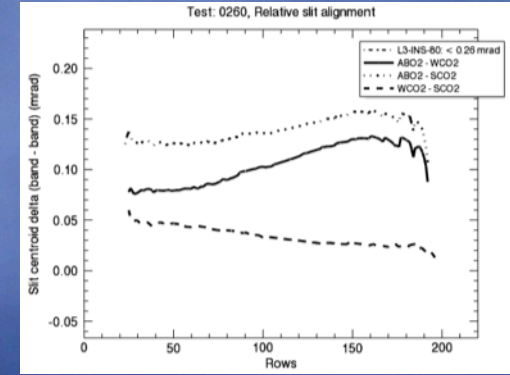
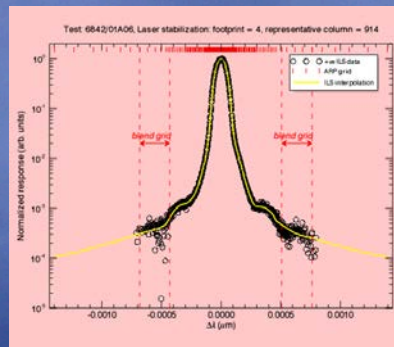
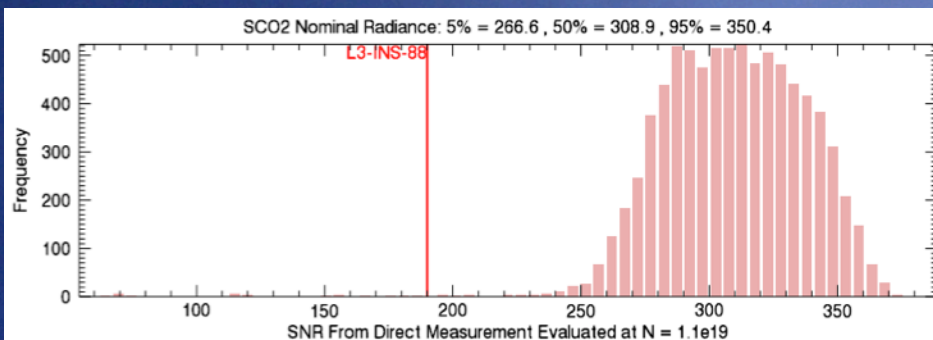
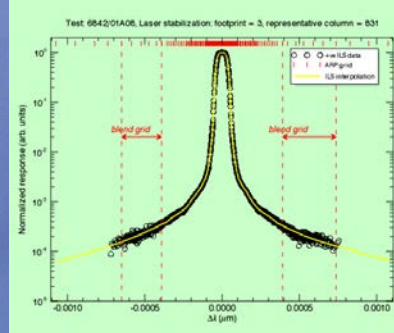
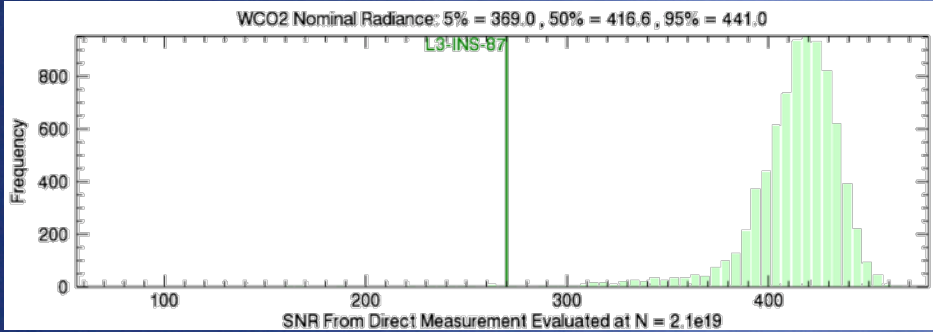
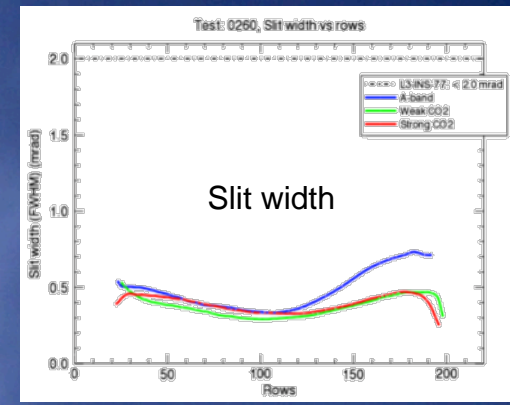
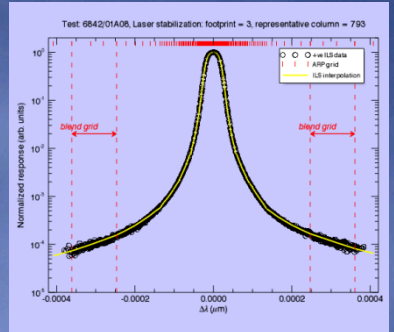
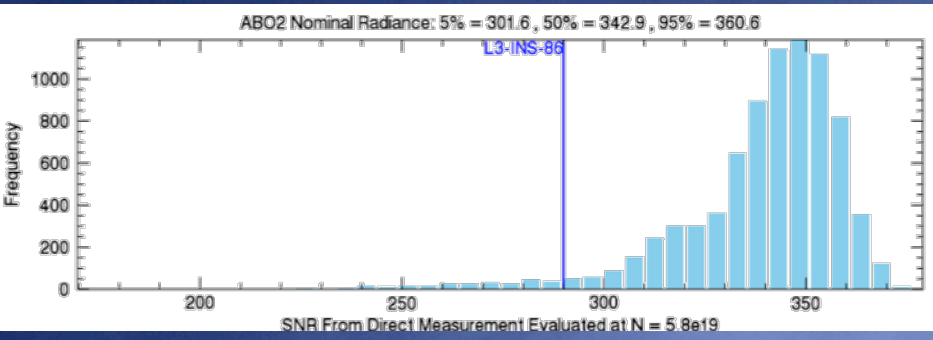


CO₂ 2.06 μm Band





Instrument Characterization and Calibration



Radiometric

Spectroscopic

Geometric



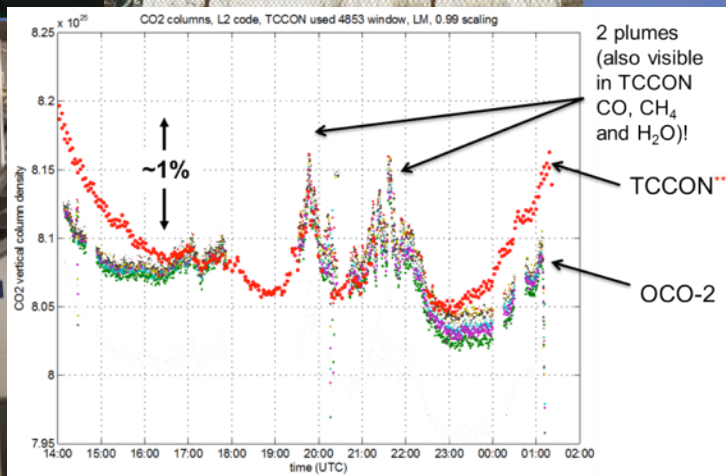
Verifying End-to-End Instrument Performance during Pre-Flight testing

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

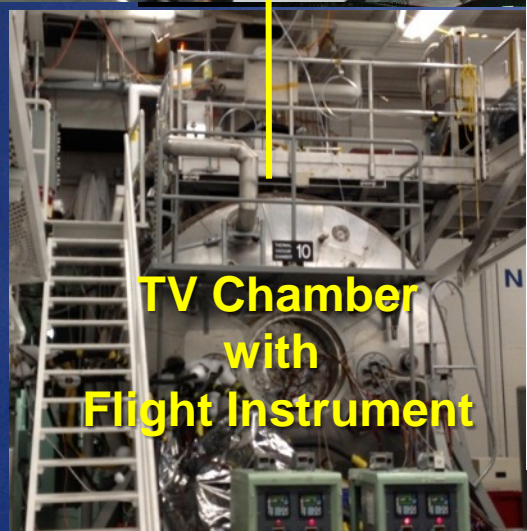
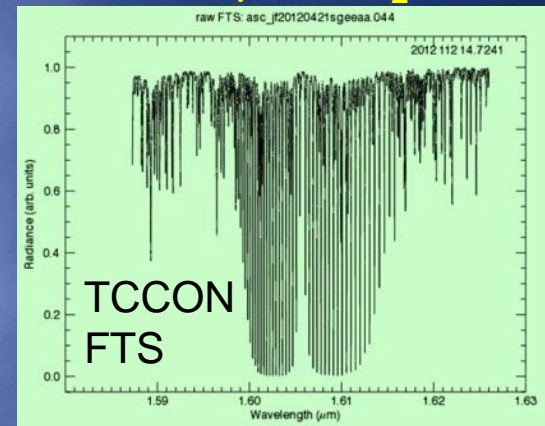


Heliostat

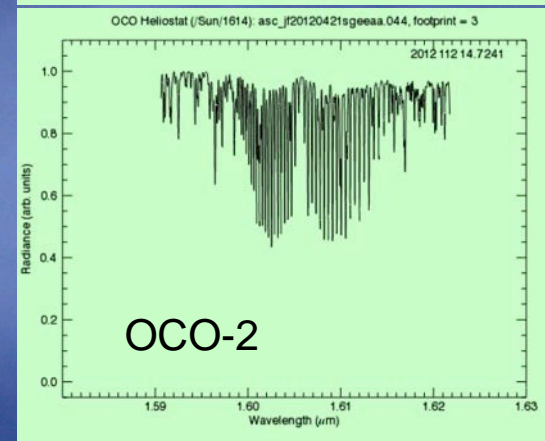
FTS



1.6 μm CO₂



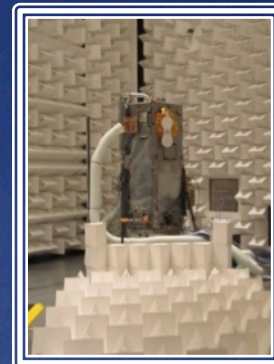
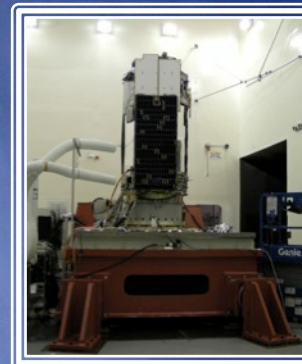
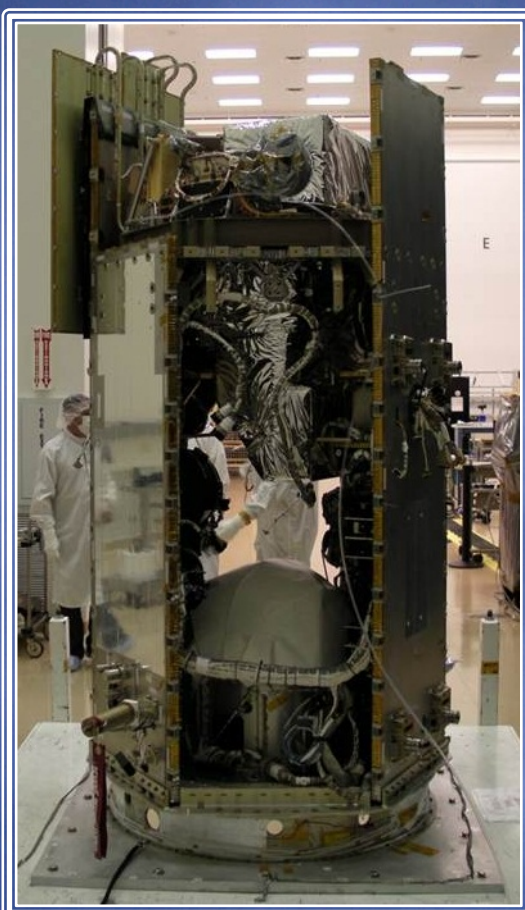
TV Chamber with Flight Instrument



21 April 2012



Observatory Integration & Test Activities





On Track for 01 July 2014 Launch



Credit: Steve Greenberg, JPL

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



Credit: NASA

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

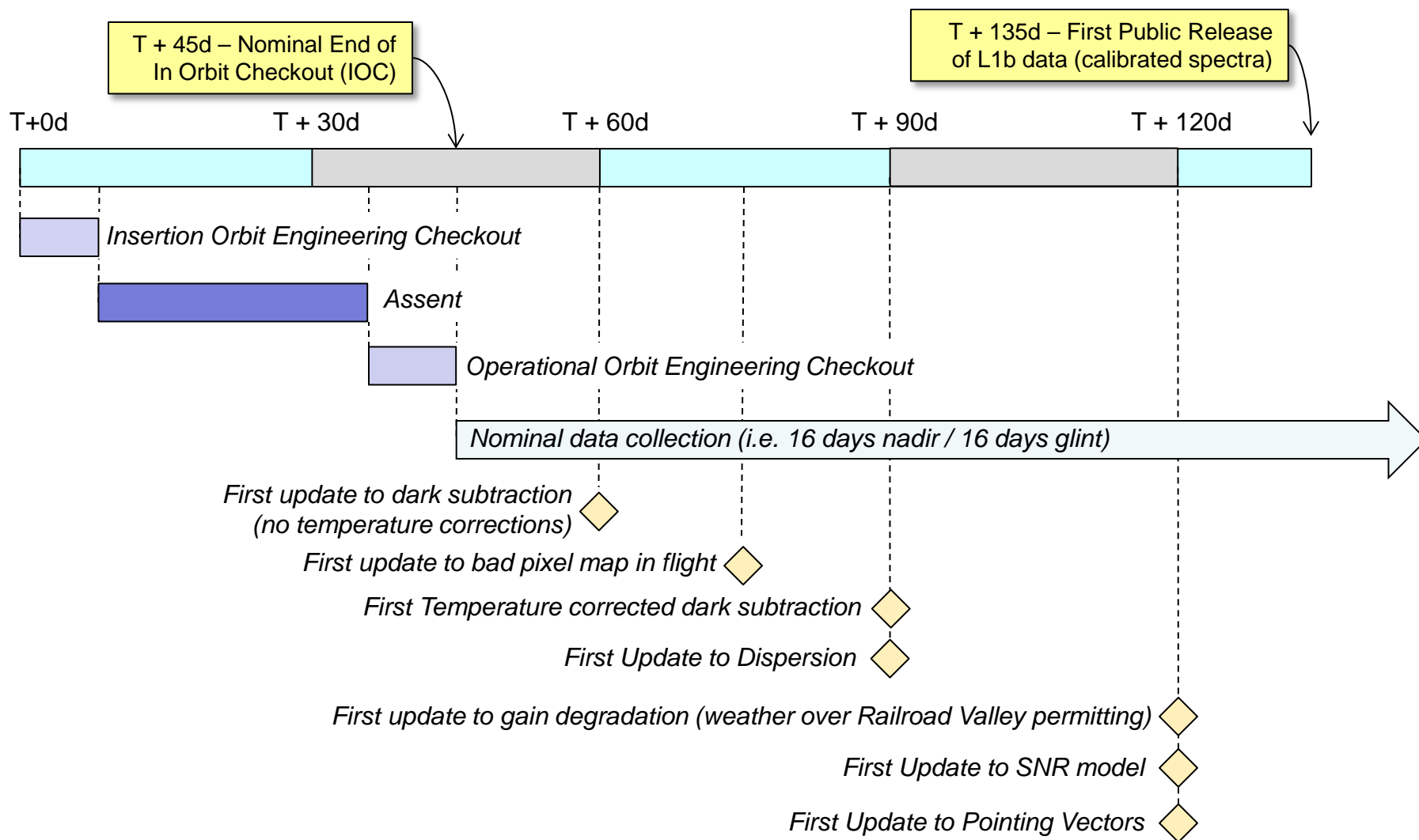


Post-Launch Critical Events



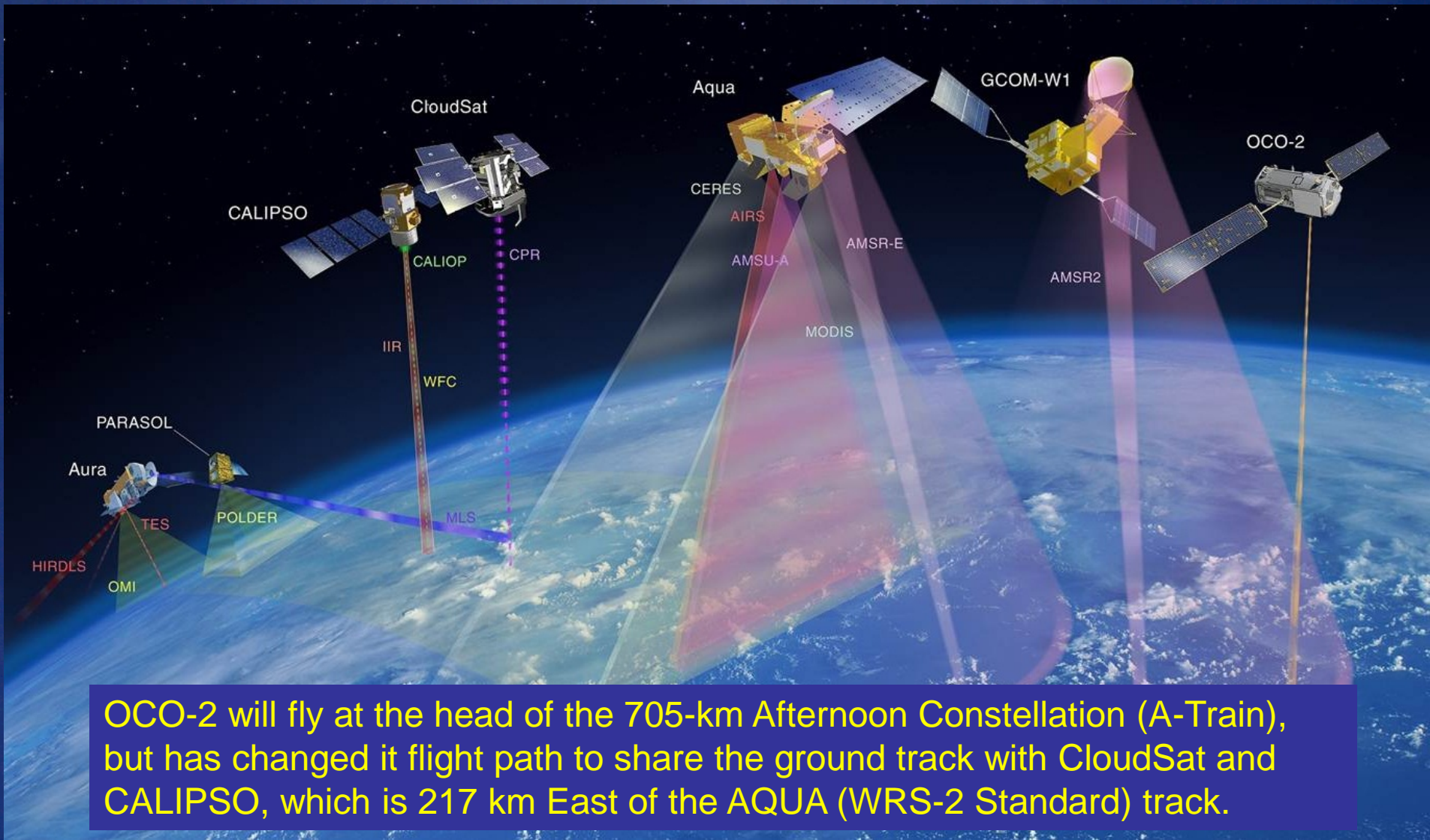


Nominal Early Operations Schedule





Inserting Into the A-Train





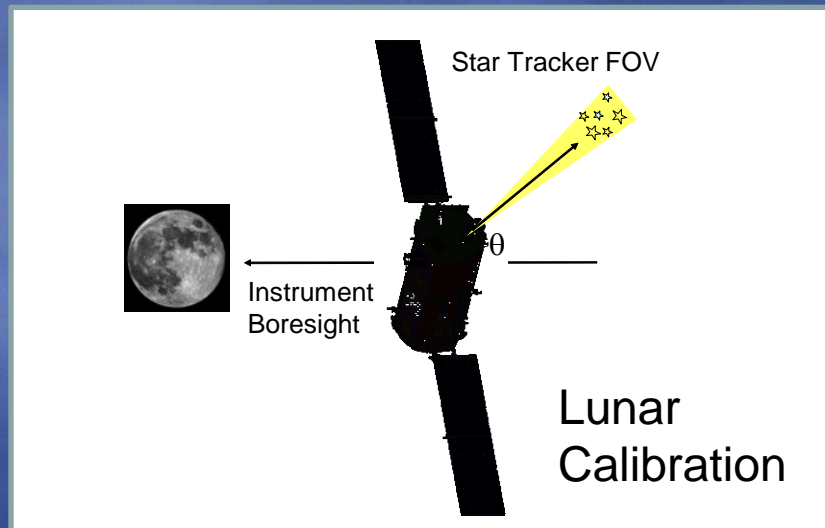
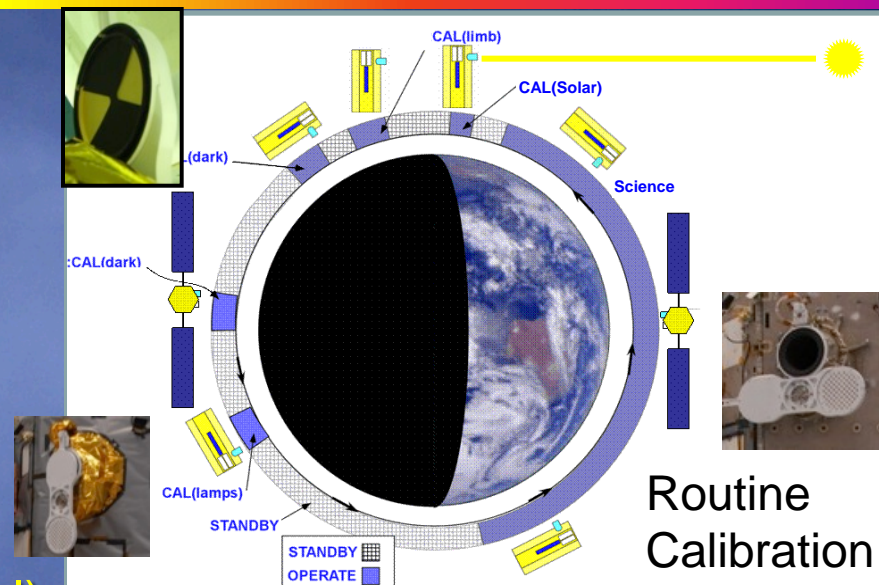
On-orbit Calibration Operations

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





Routine Operations: Sampling the Earth

The OCO-2 Orbit:

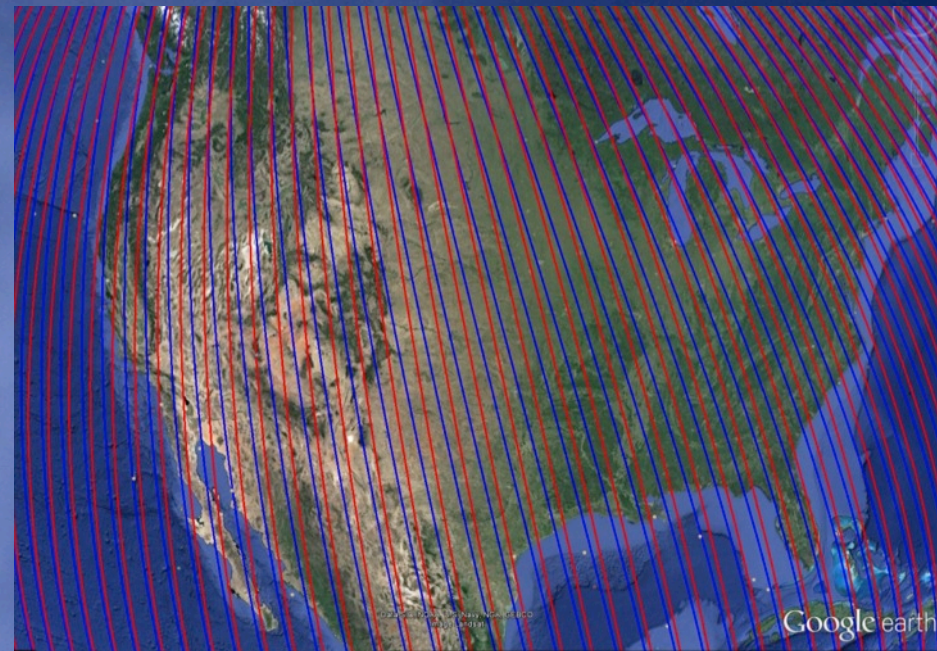
- 705 km altitude
- 98.2° inclination
- 16-day ground track repeat
- 1:30 PM Equator Crossing time
- 98.8 minute orbit period
 - 14.57 Orbits/day

Latitude Coverage

- Nadir: $\pm 85^\circ$ Solar zenith angle
- Glint: $\pm 81^\circ$ Solar zenith angle

Resolution

- $\sim 25^\circ$ longitude offset between consecutive orbits
- 1.5° longitude offset between orbit tracks after 16-days

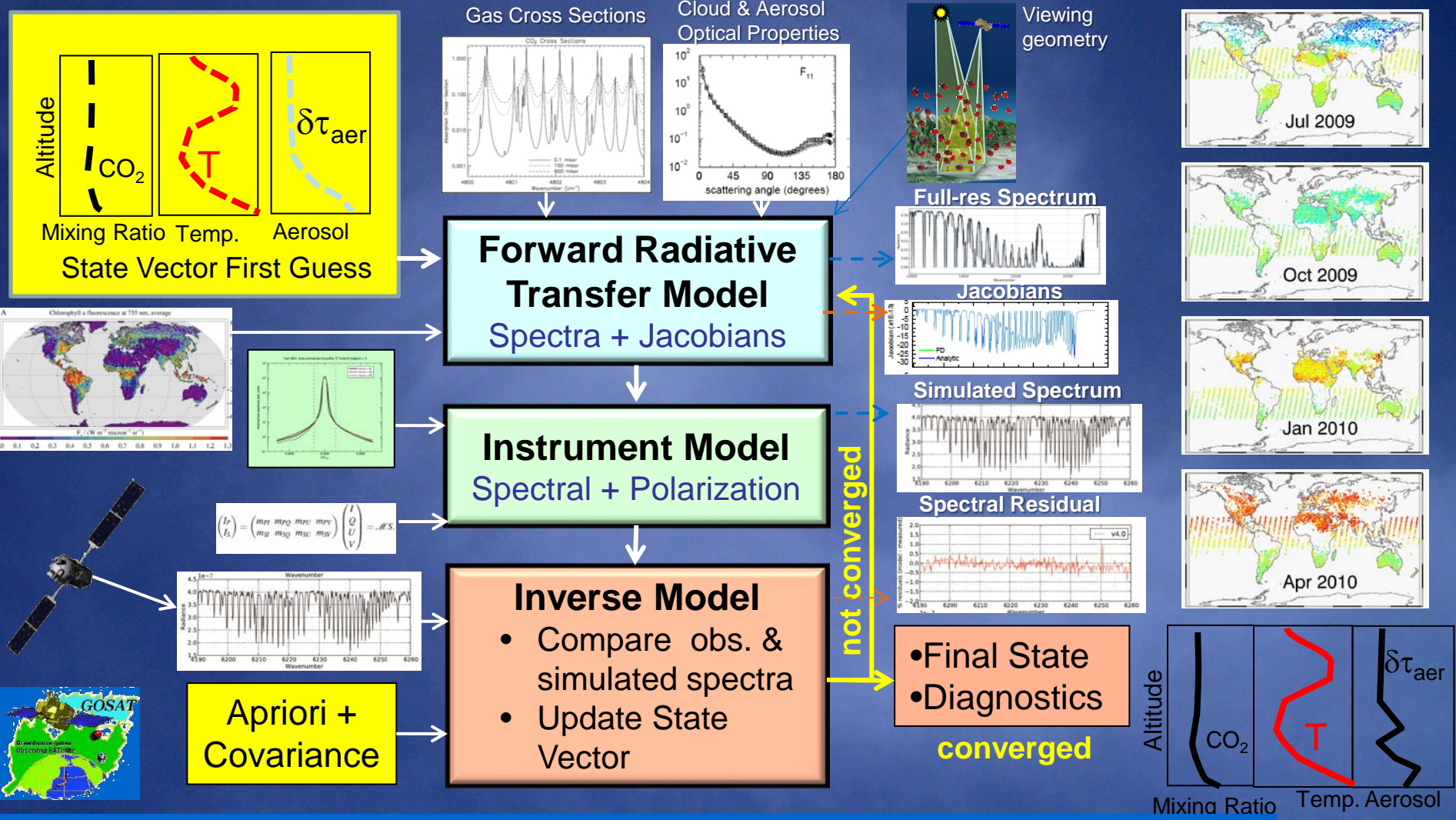


OCO-2 will collect about 1 million soundings each day along a narrow track.

**OCO-2 is a SAMPLING system,
not a MAPPING system.**

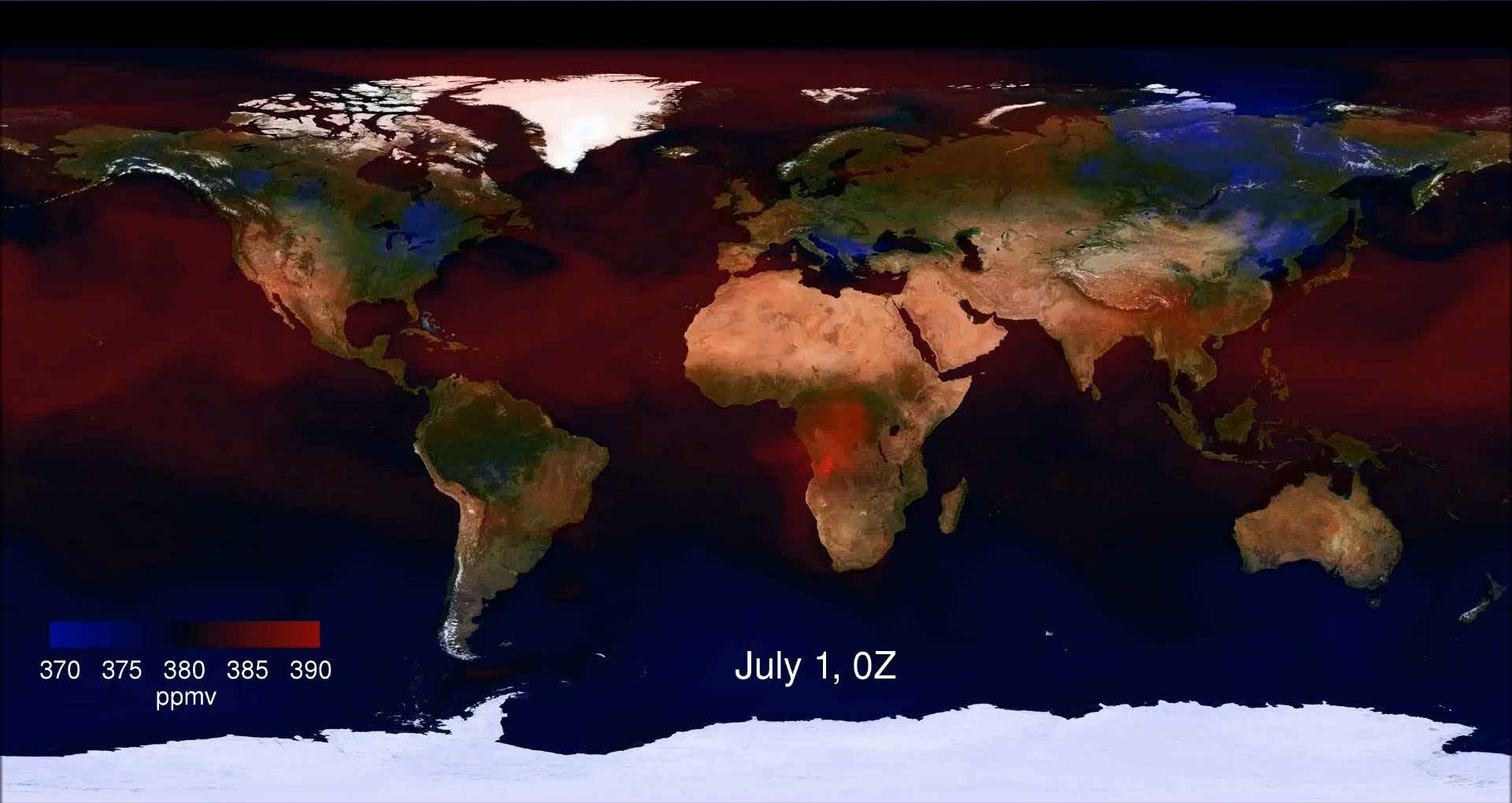


The OCO-2 Retrieval Algorithm



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







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?