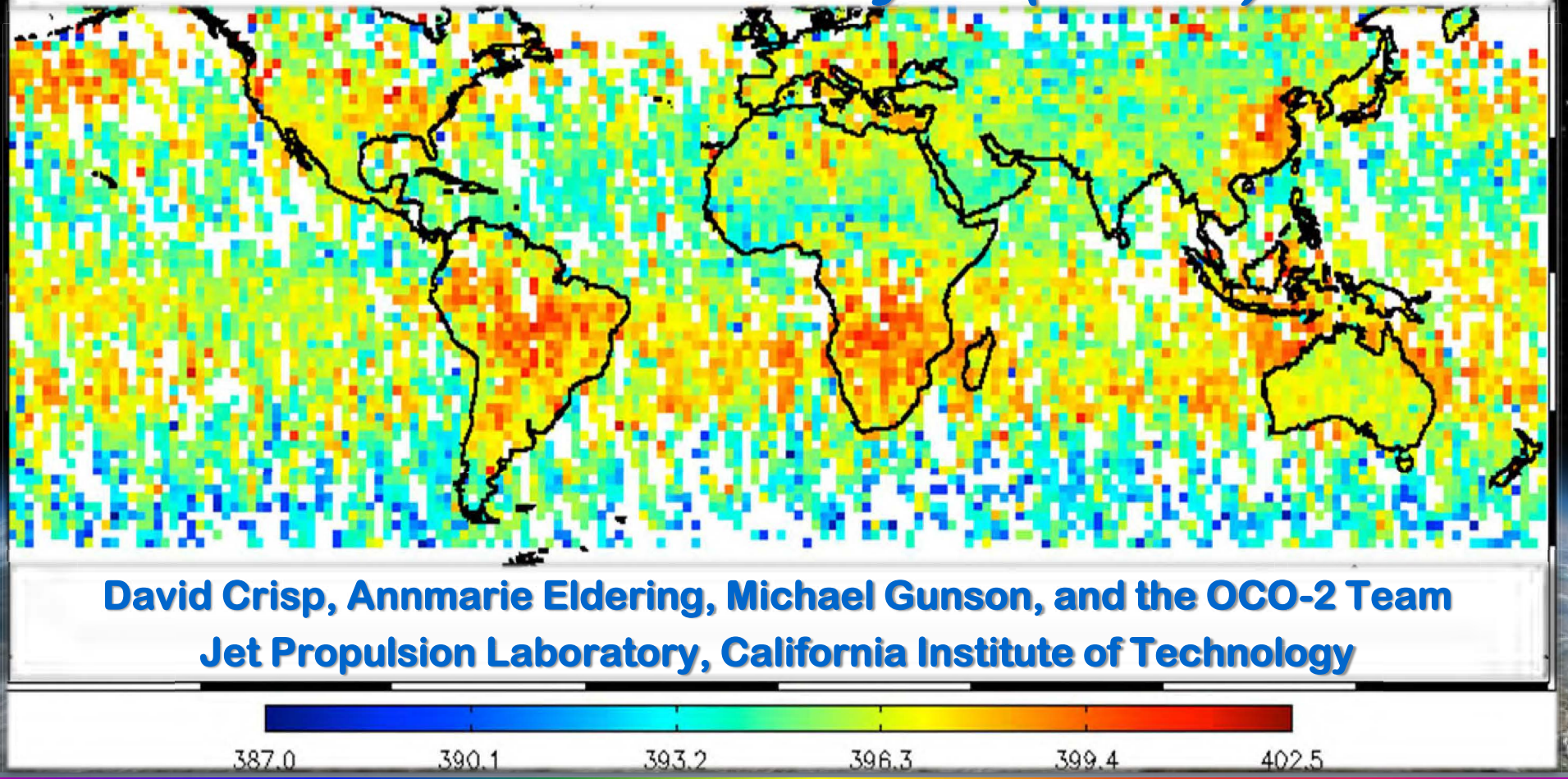
Preliminary Results from the NASA Orbiting Carbon Observatory – 2 (OCO-2)



David Crisp, Annmarie Eldering, Michael Gunson, and the OCO-2 Team

Jet Propulsion Laboratory, California Institute of Technology

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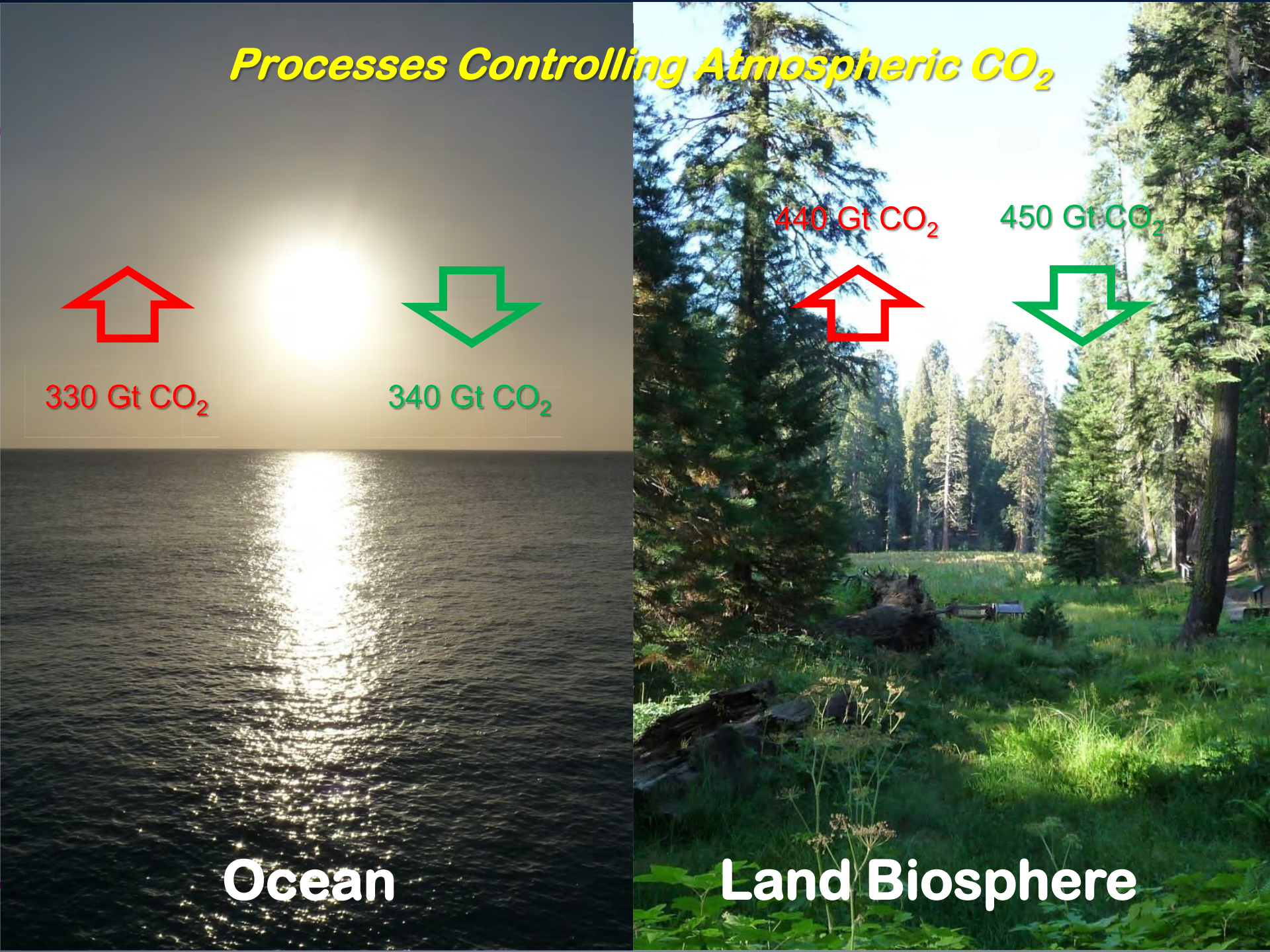
Government sponsorship acknowledged.

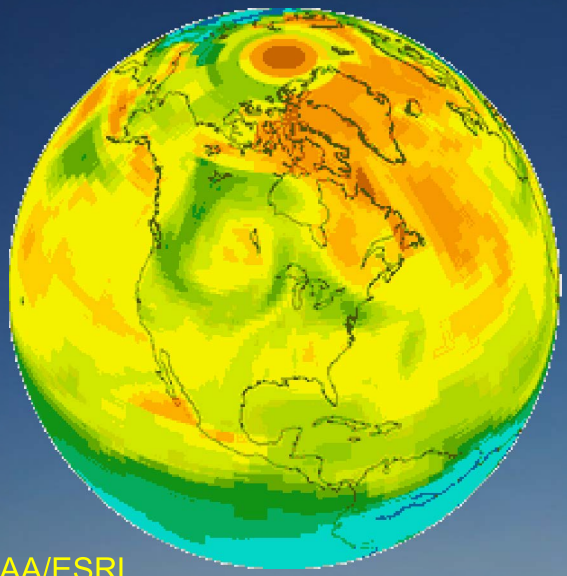

Processes Controlling Atmospheric CO_2
330 Gt CO_2
340 Gt CO_2
440 Gt CO_2
450 Gt CO_2
Ocean
Land Biosphere

Processes Controlling Atmospheric CO_2

Global Measurements from Space are Essential for Understanding the Carbon Cycle

To understand the processes controlling CO_2, we must

- Monitor human activities that add CO_2 to the atmosphere
- Understand how the carbon cycle will respond to climate change



NOAA/ESRL

Ground based measurements have the precision & accuracy needed to track global trends in CO_2 and other greenhouse gases

Space-based measurements of CO_2 and other greenhouse gases complement data from the ground based network with improved resolution and coverage

OCO-2 is the next step in space based CO_2 observations

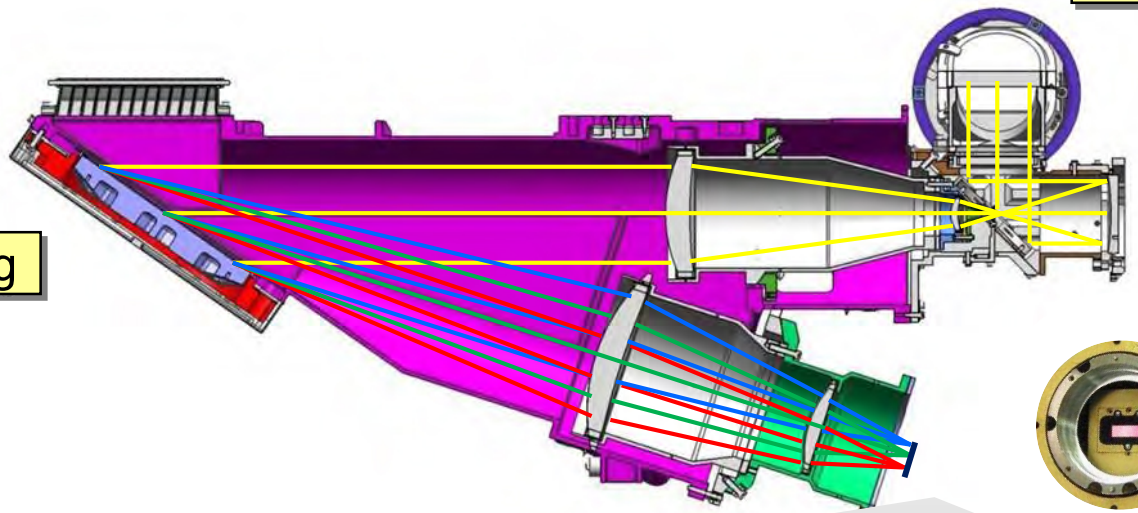
A Perfect Ride into Space

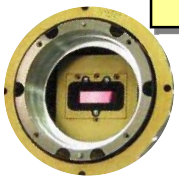
Lift-off at 2:56 am PDT, 02 July 2014

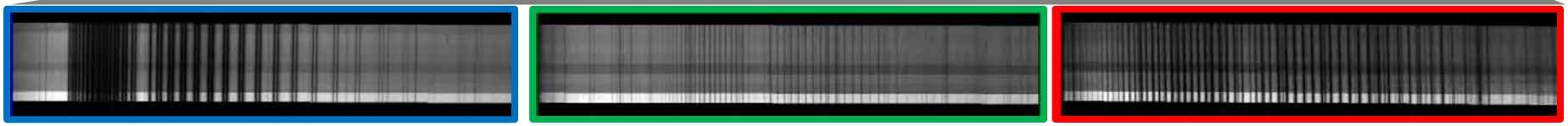
Separation!

Joining the A-Train
3 August 2014

The OCO Instrument – Optimized for Sensitivity



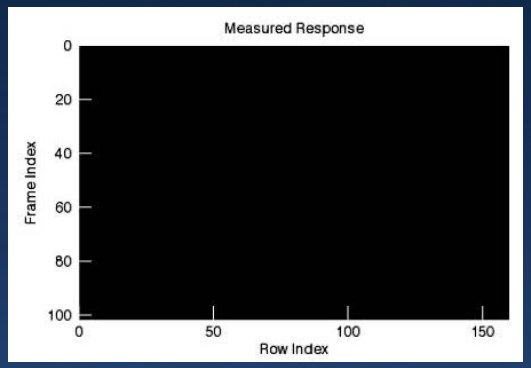


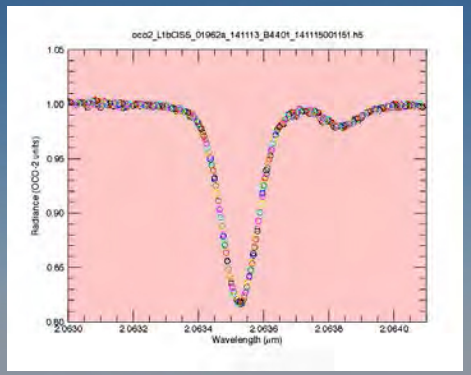


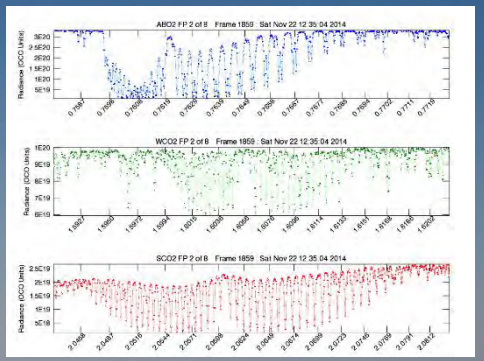
0.765µm O_2 A-Band | CO_2 1.61µm Band | CO_2 2.06 µm Band

Current Focus: Calibration

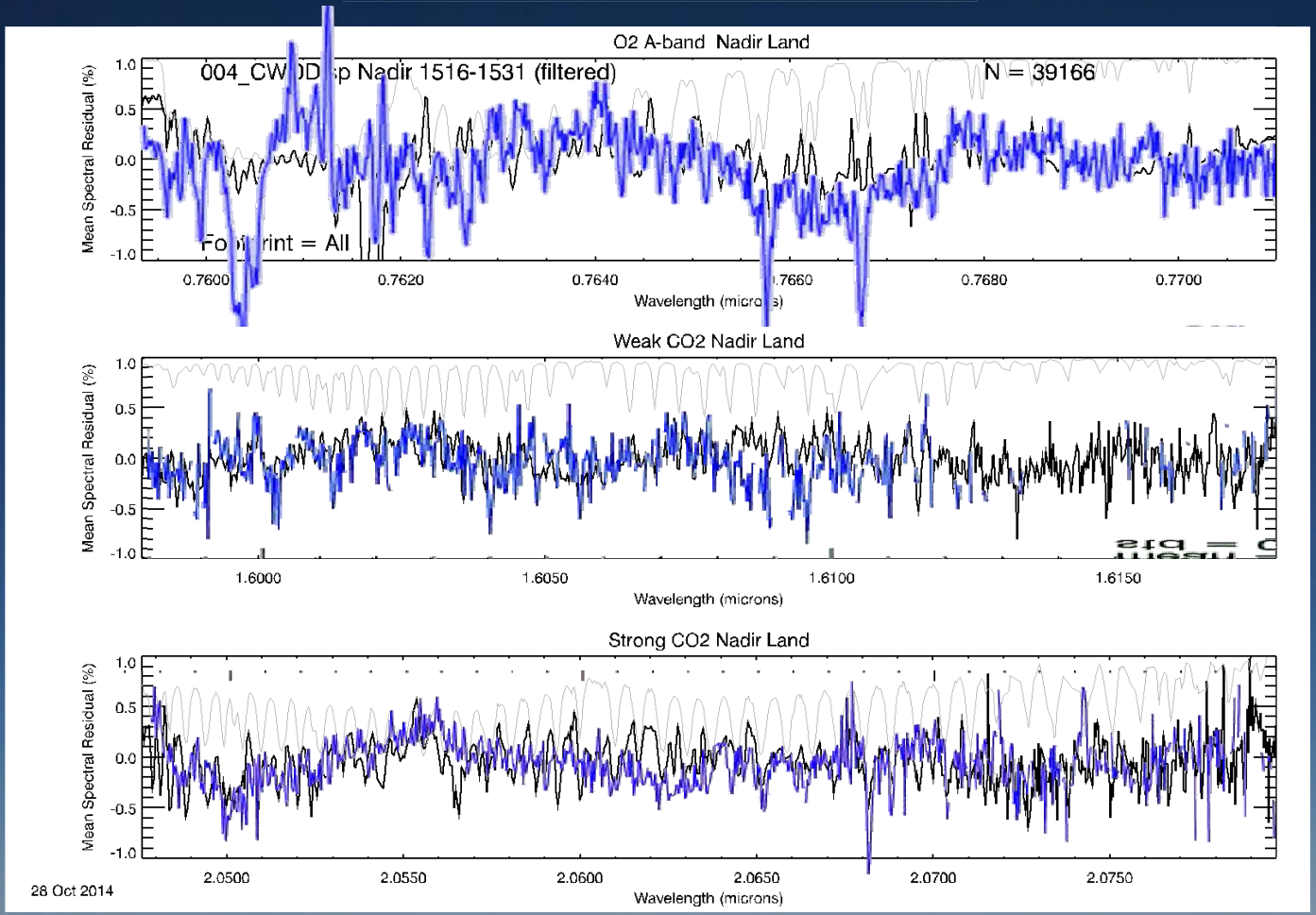
- Geometric Calibration
  - Lunar Calibration:
  - Observations of coastlines
- Radiometric Calibration
  - Identifying Bad Pixels
  - Quantifying the relative and absolute radiometry
- Spectral Calibration
  - Dispersion
  - Instrument Line Shape
- See Pollock et al: Next presentation





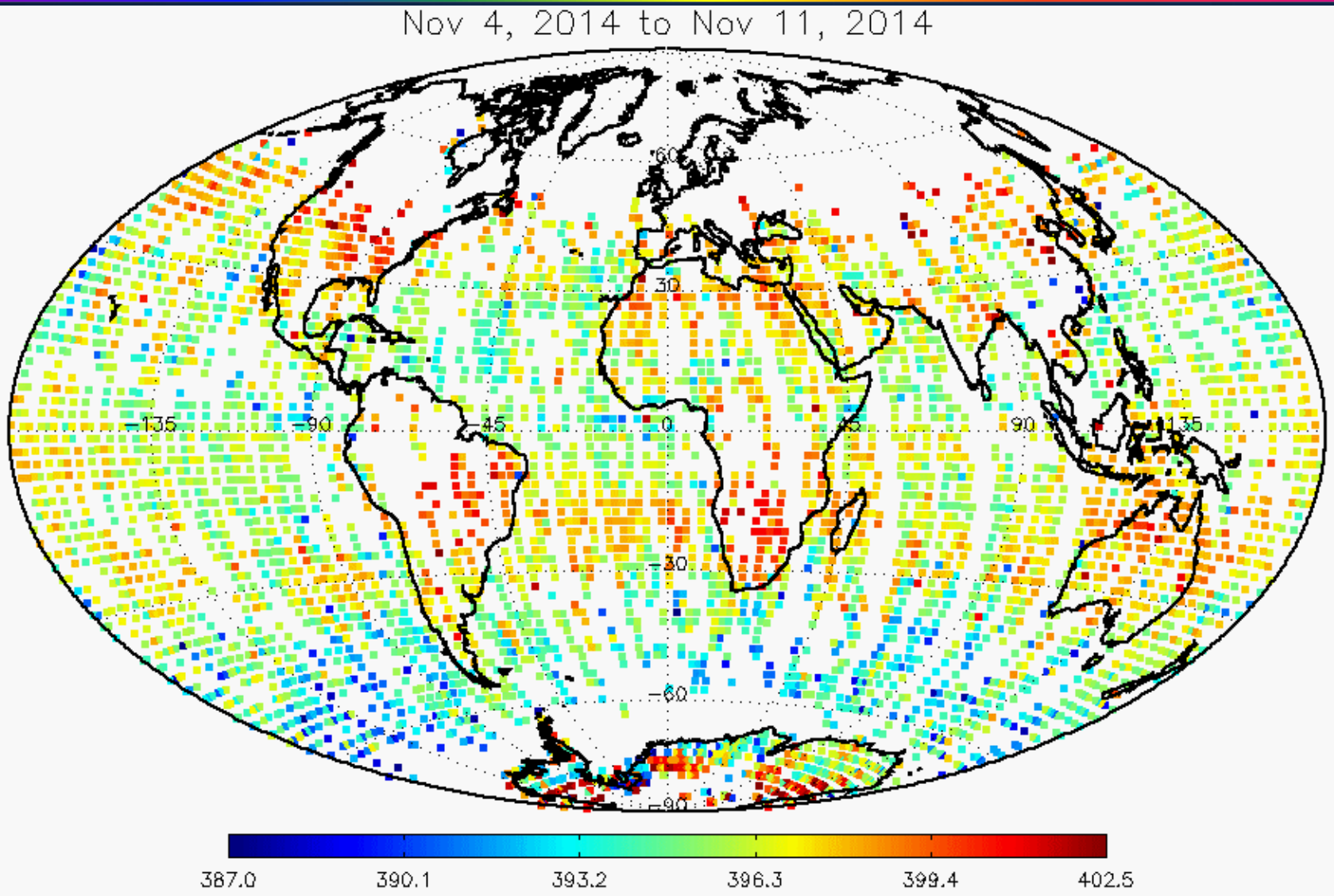


Identifying Contributions to Persistent Spectral Residuals

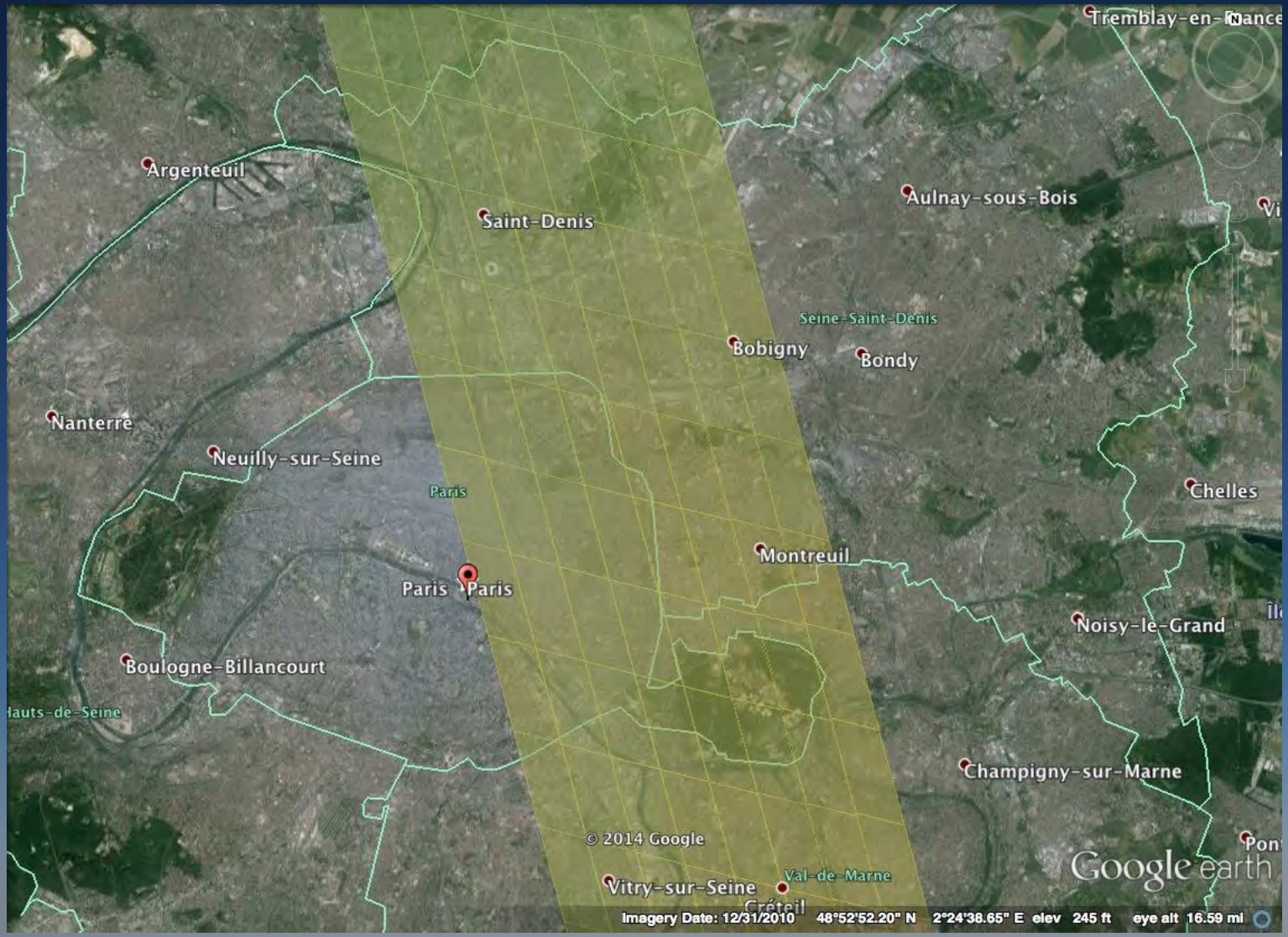


Here, the solar Doppler residuals have been scaled, inverted, and then superimposed on the atmospheric spectral residuals.

Preliminary XCO_2 Retrievals

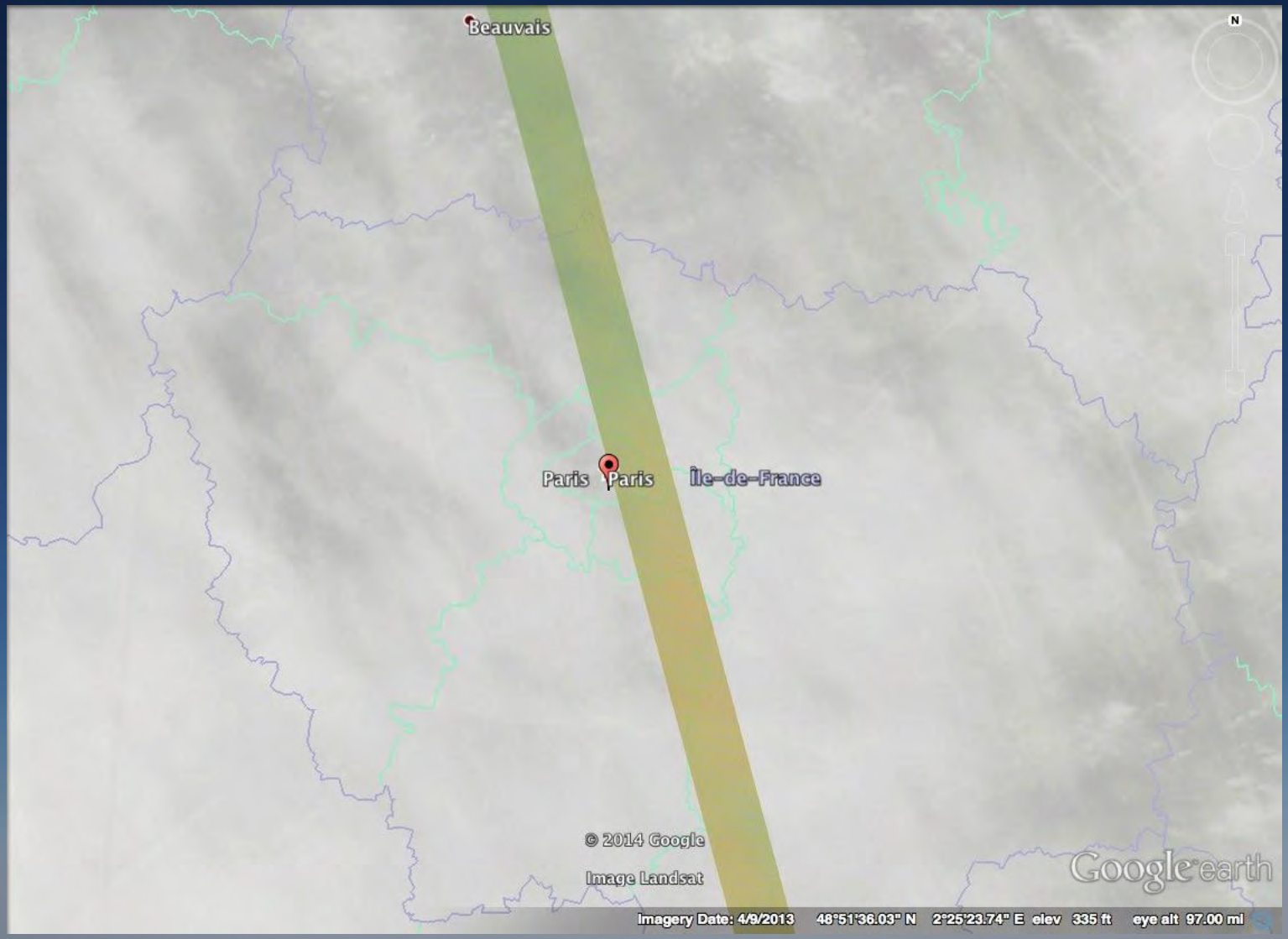


Coming Attractions – Mega City Emissions

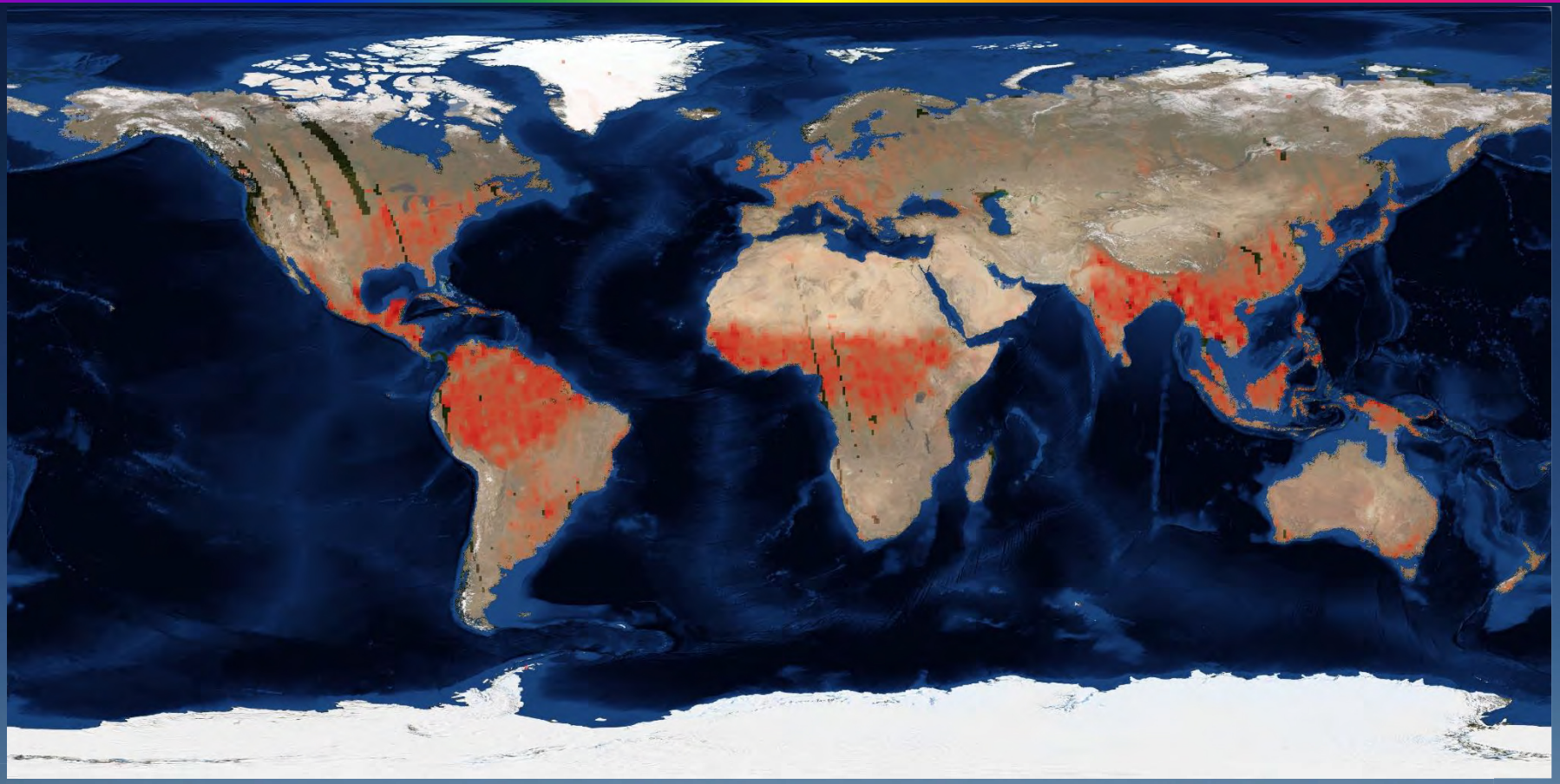


Coming Attractions – Mega City Emissions

Coming Attractions – Mega City Emissions

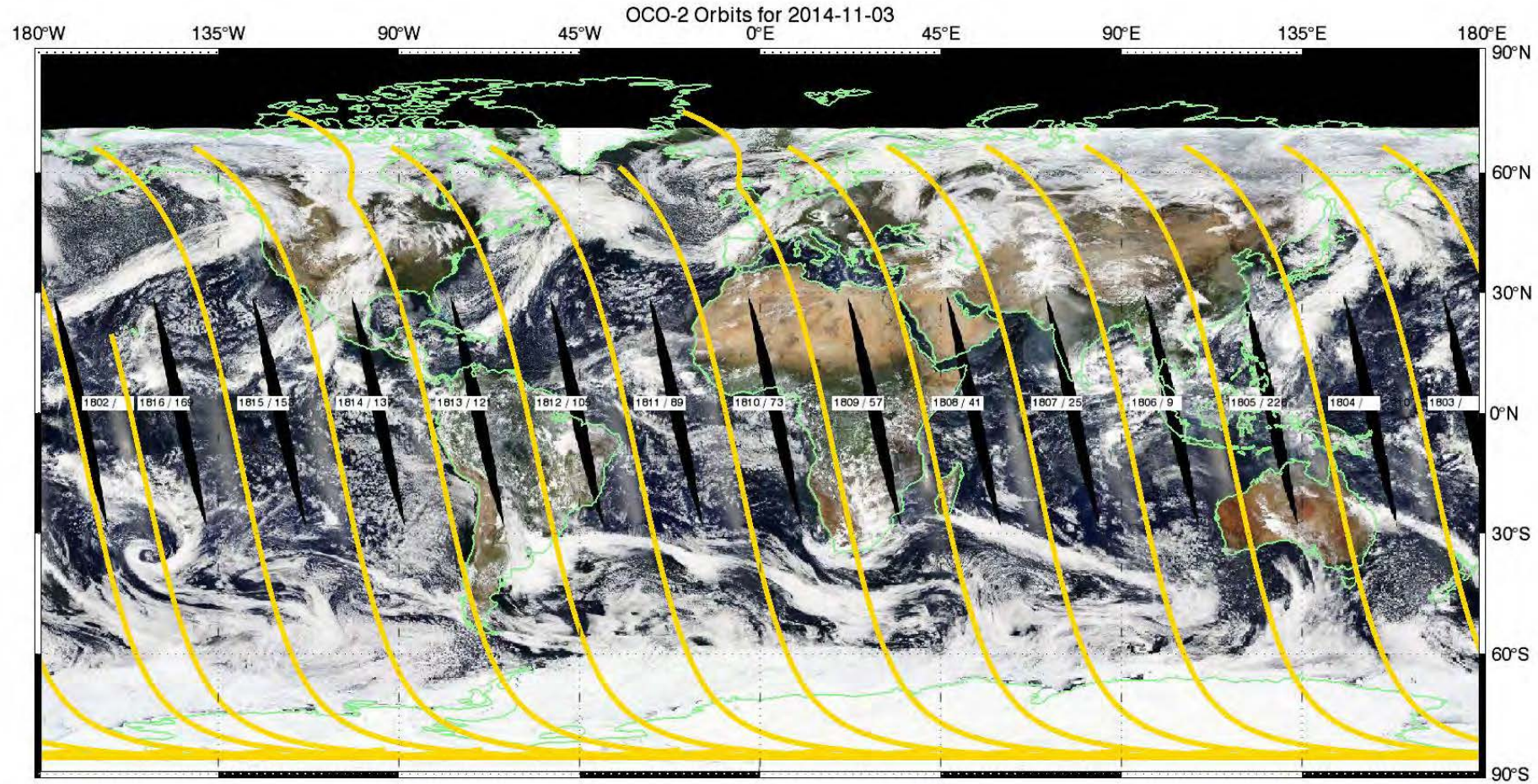


New Products: Chlorophyll Fluorescence



Christian Frankenberg has been leading the effort to retrieve chlorophyll fluorescence from OCO-2 Observations to assess CO_2 uptake by the land biosphere (see Frankenberg et al. First glimpse of solar induced chlorophyll fluorescence (SIF) from the Orbiting Carbon Observatory-2 (A53R-01)

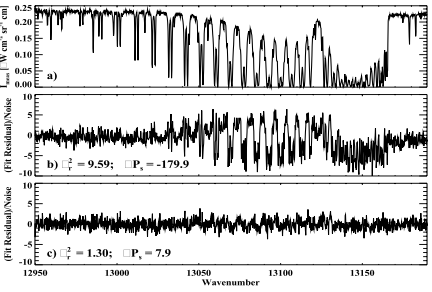
Developing Screening Tools: Screening for Optically-Thick Clouds and Aerosols



Optically thick clouds and aerosols limit the spatial coverage. Here, OCO-2 tracks are superimposed on Aqua MODIS images

Developing Screening Tools: Screening for Optically-Thick Clouds and Aerosols

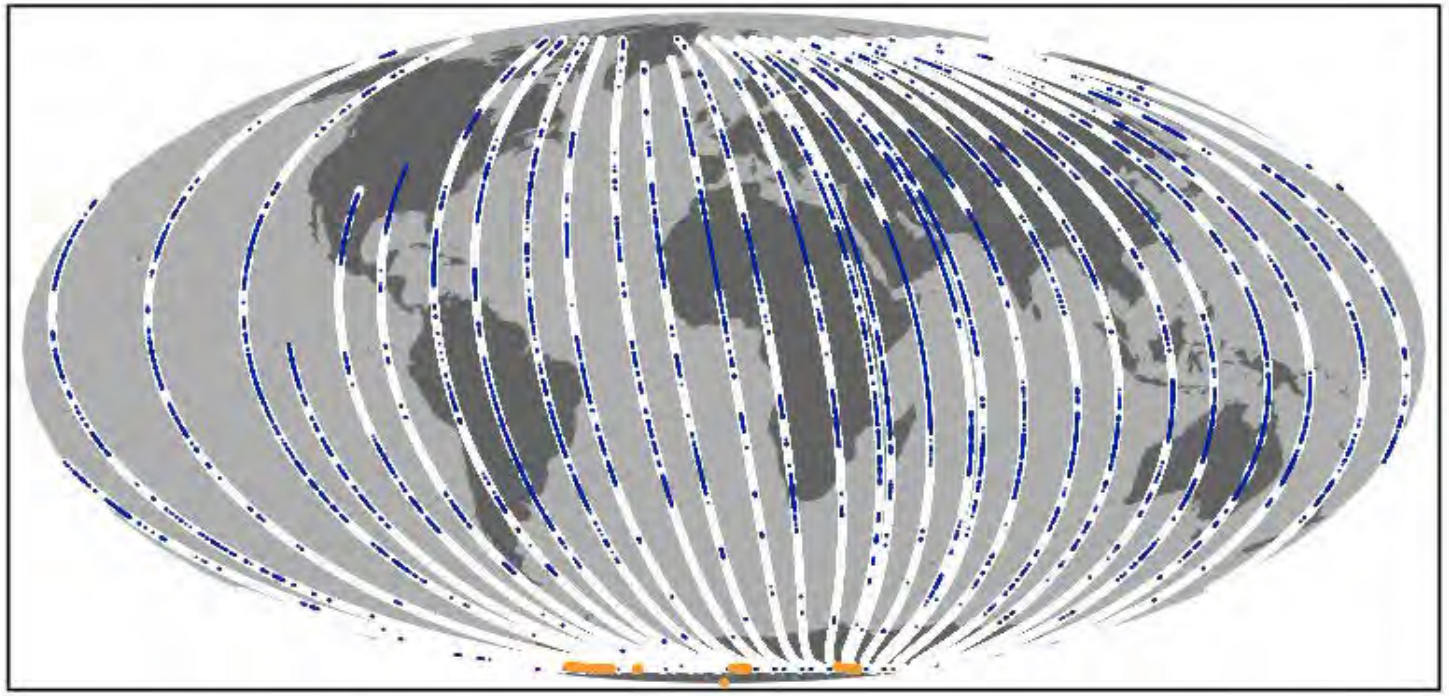
Taylor et al. have adapted methods pioneered with GOSAT data for use with OCO-2.



These methods are now being validated against MODIS Aqua data.

(See Taylor et al. OCO-2 Aerosol and Cloud Screening; Validation Against Collocated MODIS Data).

MODIS search radius=2.00 km Avg num MODIS pixels=11
MODIS cirrus reflectance threshold=0.010
OCO−2 footprint=4



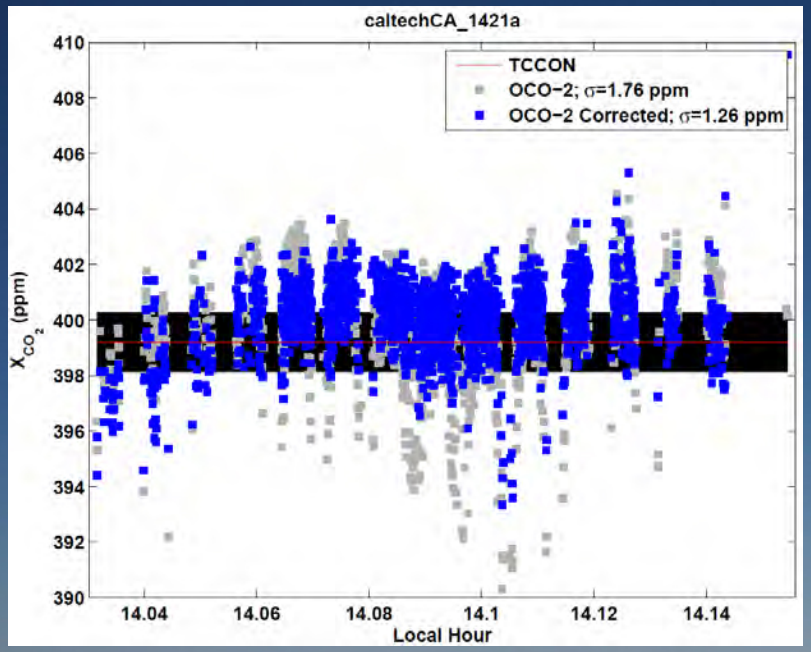
NFrames=233018 NSound=233018
%Clear= 18.4 %Cloud= 81.3 %Undet= 0.2

Validation: Target Observations of TCCON

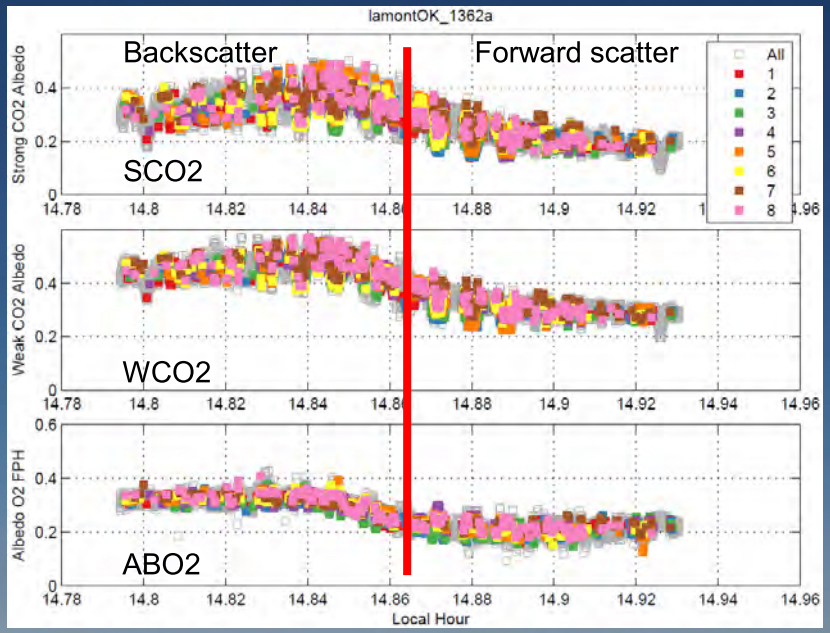
See: Natraj et al., A First Look at Target Mode Retrievals of CO_2 from the Orbiting Carbon Observatory-2 (OCO-2), A41I-3185.
Wennberg et al. Preliminary Assessment of Orbiting Carbon Observatory-2 (OCO-2) Measurements Using TCCON Data: This session

Recent Results from Target Observations

- Started yielding insights into biases and screening techniques
- Show a significant differences in the retrieved albedo from backscattering to forward scattering geometry over land)
  - May have implication s for glint signals over land.



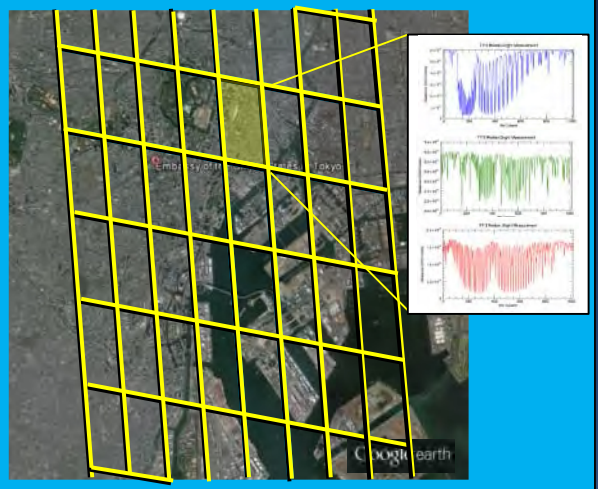
X_{CO_2} estimates over Los Angeles before (grey) and after (blue) bias correction.



Albedo estimates for the 3 channels during a target observations over Lamont

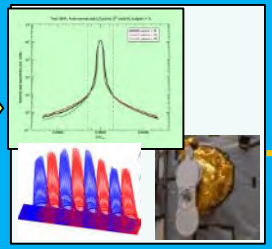
OCO-2 Data Product Delivery

L1B: Spectra



Downlink

Calibration



L2: X_{CO2} Retrievals

Initial State

Generate synthetic spectrum

Instrument Model

Inverse Model

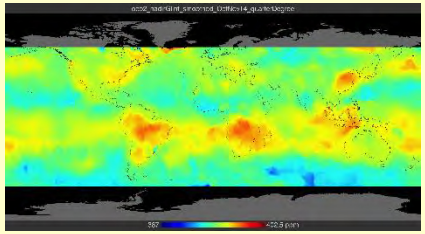
X_{CO2}

New State

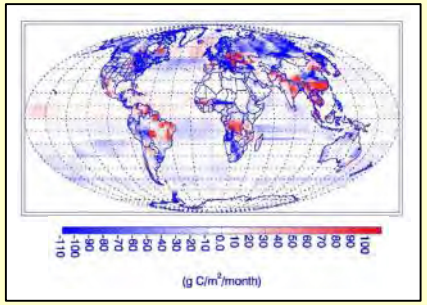
Validation

Mapped Products

L3: X_{CO2} Maps



L4: Fluxes



December 2014 — March 2015 — As Available