Summary of OCO-2 Status and AGU Plans from December 6, 2016 Telecon

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

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Government sponsorship acknowledged.

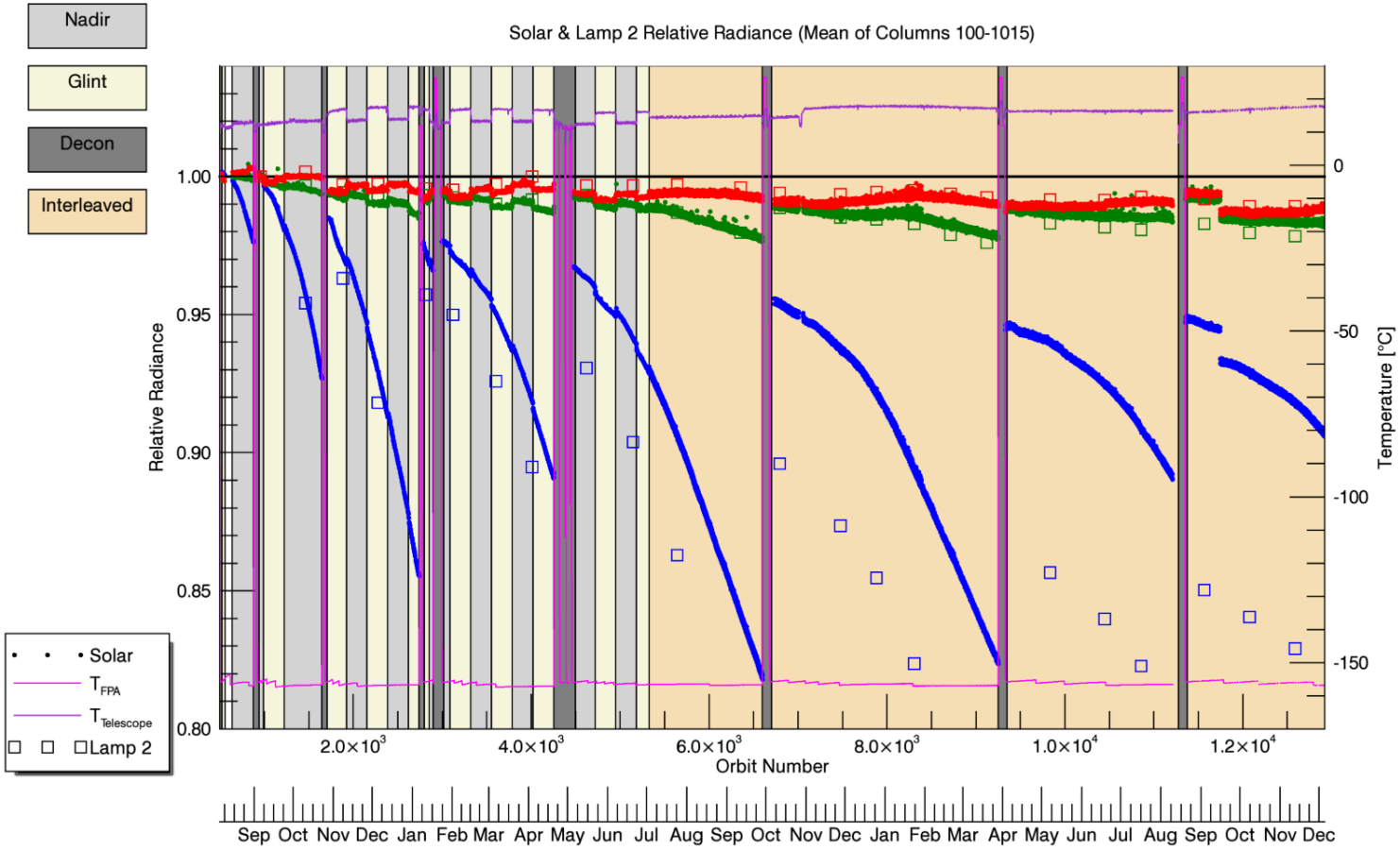
OCO-2 Status

- Observatory Status
  - All Subsystems Nominal
  - Propellant Available Until 2037
  - Last avoidance RMM on 04/12/16
  - Last DMUM on 10/06/16
  - Next scheduled DMUM – 01/07/2017

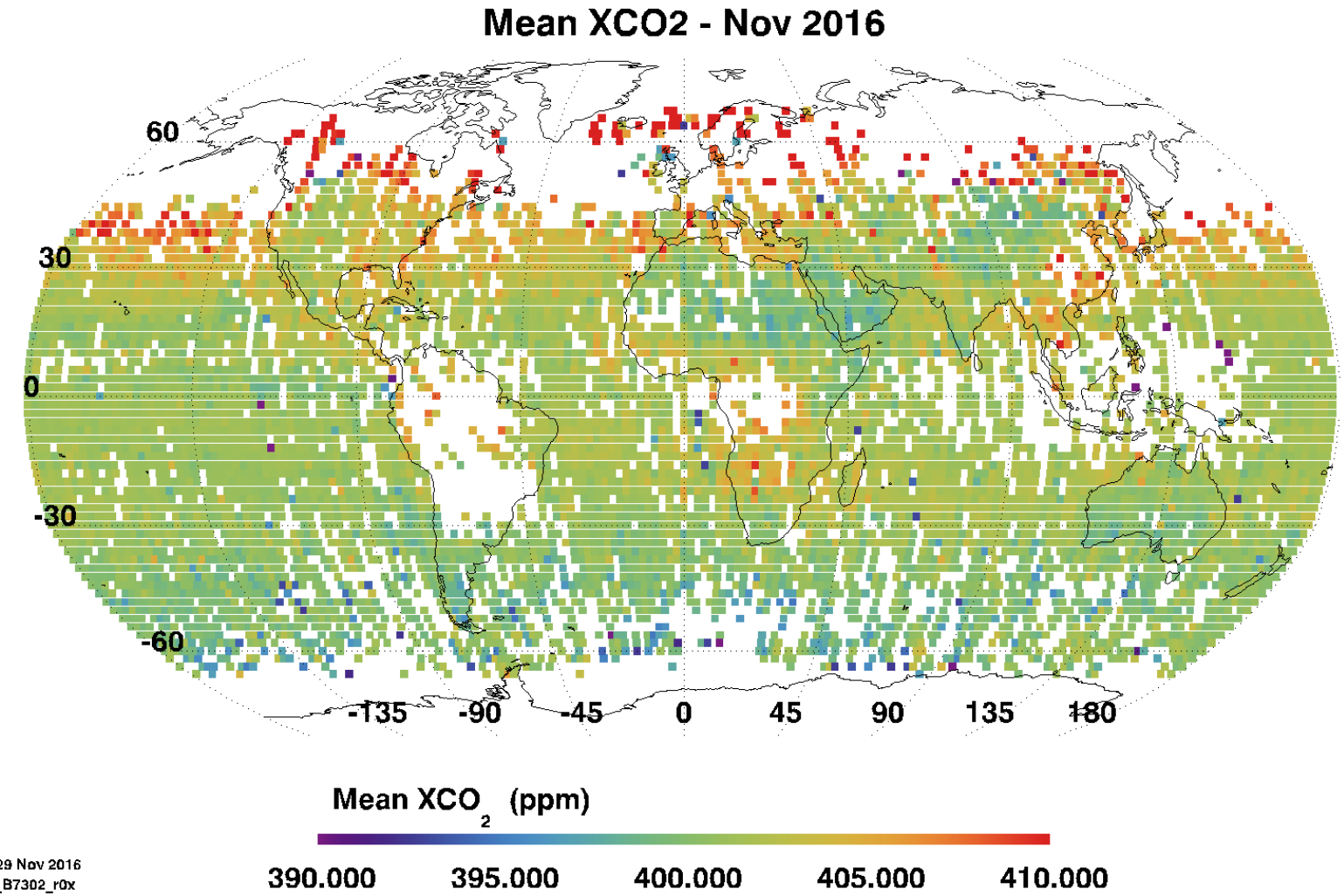
- Instrument Status
  - Operations Are Nominal
  - Next Decon planned for February 21 – March 1, 2017

- Science and Validation
  - Collected observations for 26+ months (Nadir, Glint, Target modes)
  - Continued testing of Version 8 build
  - Preliminary test suite completed
  - Additional improvements ongoing
  - ACOS B7.3 production and documentation in process

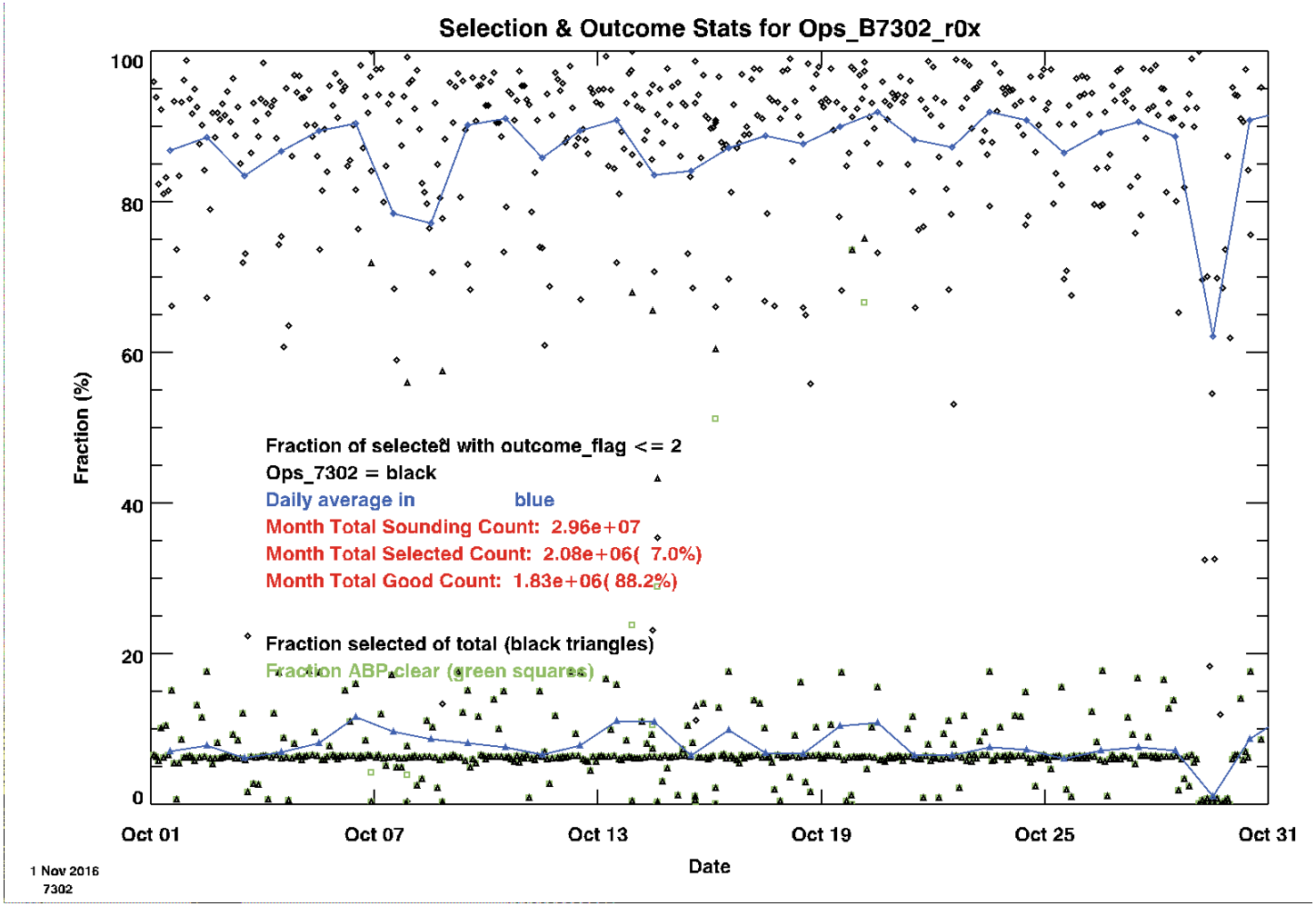
Contamination Trending



Latest XCO2 Data (forward stream)

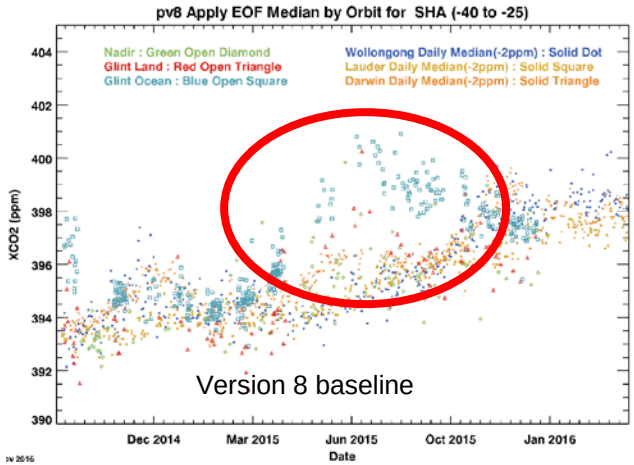


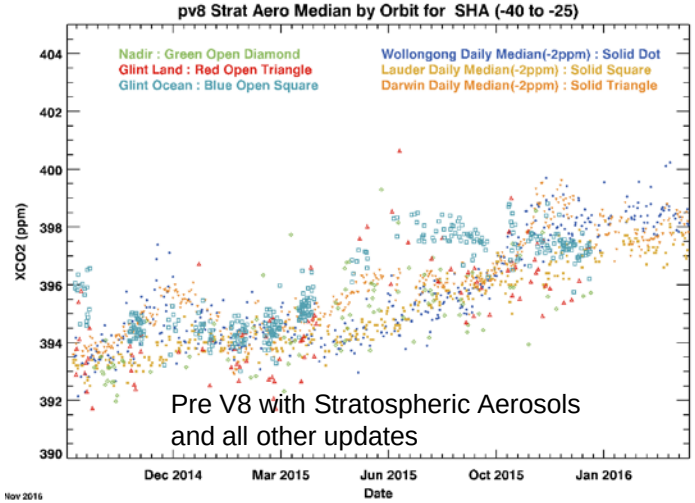
OCO-2 Data Yield – ~7%



Science Highlights

- Pre-Version 8 Test sequence
  - Pre-V8 baseline: Revised L1B + gas absorption coefficients (ABSCO 5.0)
  - Add updated surface bi-directional reflection distribution function (BRDF)
  - Add TCCON CO_2 prior
  - Add updated cirrus cloud prior
  - Add Stratospheric aerosols
- Preliminary results
  - Results from this series of tests are generally better than those from the current data product (v7)
  - Biggest improvements seen at high latitudes in the southern hemisphere during the winter, where large biases substantially removed
  - Additional improvements ongoing

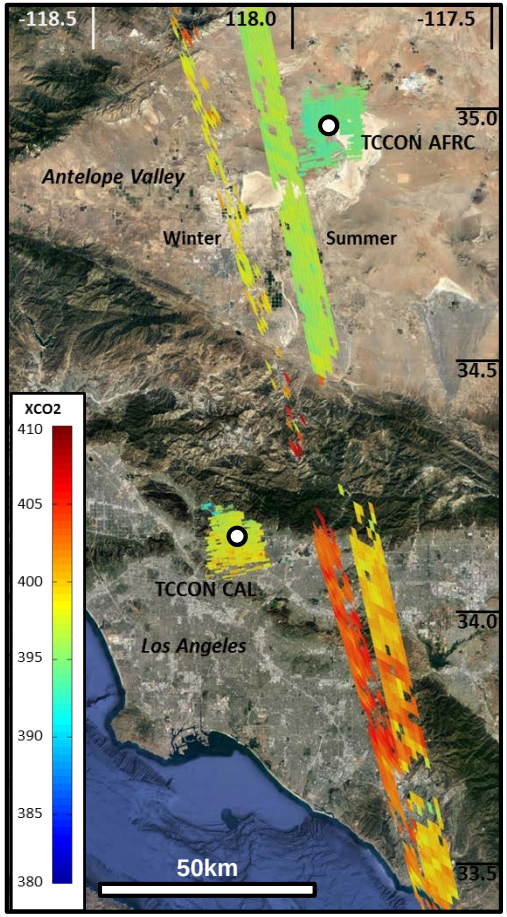




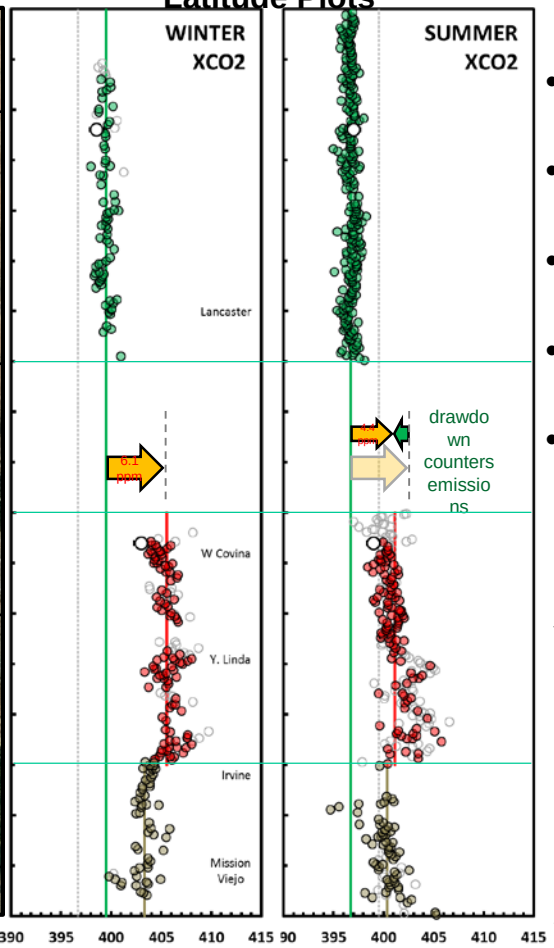
Carbon Cycle Science Highlights at AGU

- Sunday 4-6 PM: 2017 Senior Review Kick-off Meeting
- Tuesday:
  - 10:20-12:20 Data assimilation, inverse methods, OSSEs (MW 3010)
  - In situ CO2, GeoCARB, ACT America, Flux Inversion Posters
  - 13:40-15:40 Active remote sensing (MW 3012), SOCCR2 (MW 3007)
- Wednesday
  - 8:00 – 15:40: Greenhouse gas remote Sensing oral sessions (MW 3004)
  - 10:20-12:20: stratospheric aerosols – Pinatubo (MS 104)
- Thursday
  - 8:00 – 12:00: Greenhouse gas remote sensing posters
  - 14:40-15:40: Earth from Space: the Power of Perspective (MW 2022/2024)
  - 1400-1700: GOSAT/OCO-2 TIM - Marriott Marquis (TBC).
- Friday
  - 8:00 – 1700: Hot spots, cities, SIF/GPP posters
  - 10:20-10:35: Sampling a Pinatubo-like volcanic plume (MW 3004)
  - 13:40-1540: SIF as a proxy for Photosynthesis (MW 2008)
  - 1340-1540: GHG from urban systems and hot spots (MW 3004)

Science Stories at AGU
- Urban Sources -

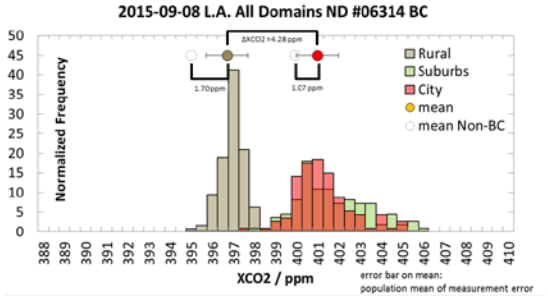


Latitude Plots



- **Urban-rural ΔXCO2** is ubiquitous
- **Intra-urban contrast** (urban vs. suburban) strong in winter, less in summer.
- **Winter ΔXCO2 5.8 ppm, consistent with GOSAT** (Kort et al 2012) (Jan. 13)
- **Summer ΔXCO2 depressed to ~3ppm** (drawdown counters emissions) (Sept. 8)
- Summer ΔXCO2 and mean XCO2 **consistent between nadir & target**
- Target & nadir mean XCO2 is **consistent with concurrent TCCON data** (early Oct.)
- Bias correction makes city & rural populations more Gaussian, and shifts the mean XCO2.

Effect of bias correction



Florian Schwandner et al.

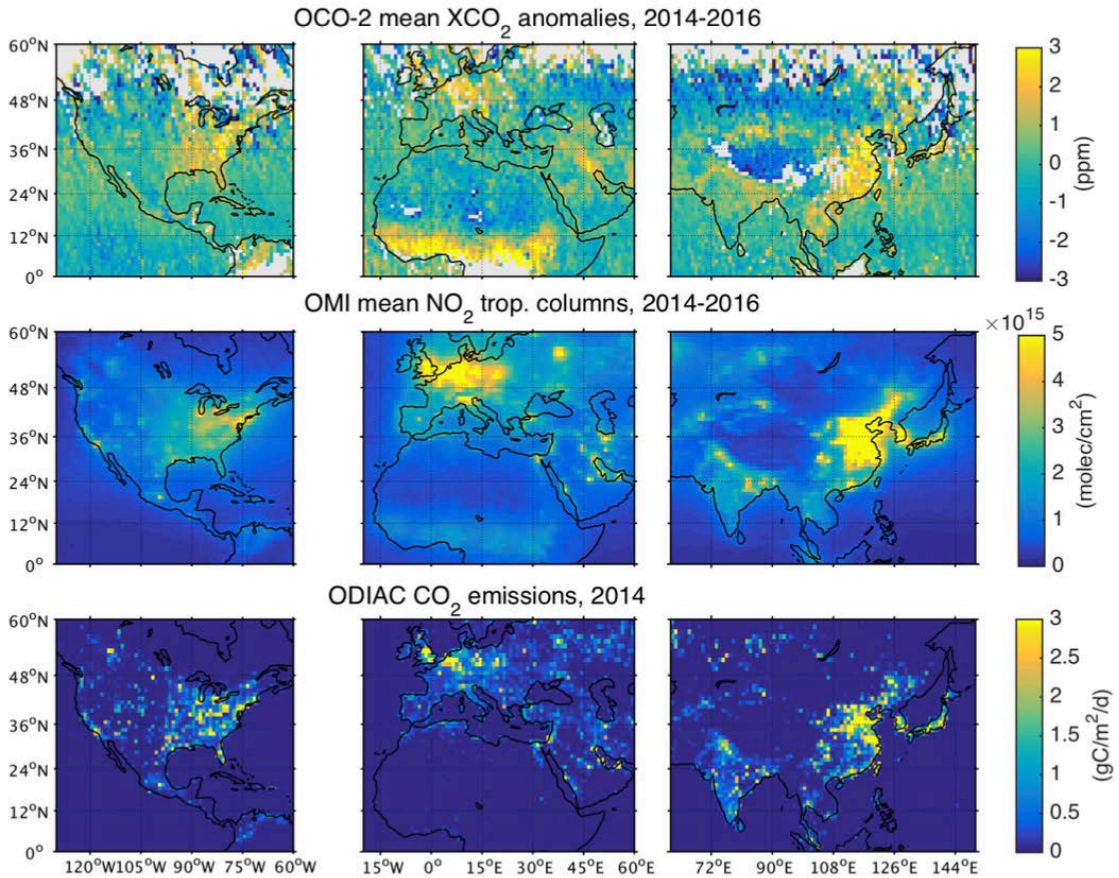
Science Stories at AGU
- Anthropogenic Emissions -

Issue: Can spaceborne observations discriminate anthropogenic emissions of CO_2?

Results: OCO-2 X_{CO2} & OMI NO_2 combined to produce global maps of anthropogenic CO_2 emissions

- High CO_2 over eastern USA, central Europe, and China consistent with fossil fuel use inferred from OMI NO_2 and fossil fuel emission inventories.
- CO_2 emissions from fossil fuel extraction activities in the Middle East clearly seen in OCO-2 maps, but not tracked in inventories.
- High CO_2 emissions over central Africa and Southeast Asia are due to intense biomass burning rather than fossil fuel combustion.

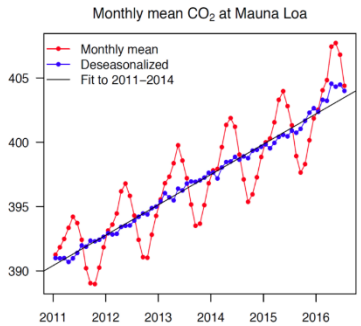
Significance: These results demonstrate the power of spaceborne data for monitoring anthropogenic CO_2 emissions.

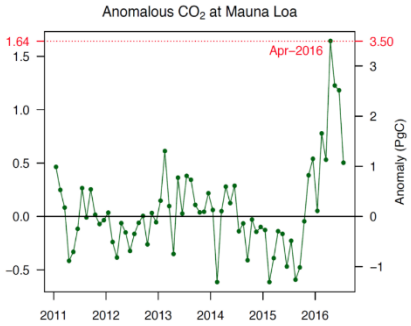


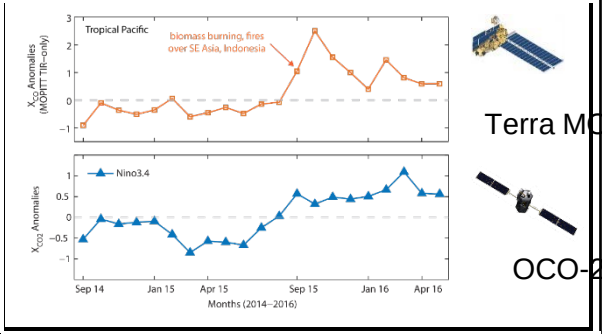
OCO-2 CO_2 anomaly data (top row), OMI NO_2 data (middle row) and an emission inventory (bottom row) were used in a cluster analysis to discriminate CO_2 emissions from fossil fuel use (northeast USA, Europe, China) fossil fuel extraction (Middle East), and biomass burning (Africa)

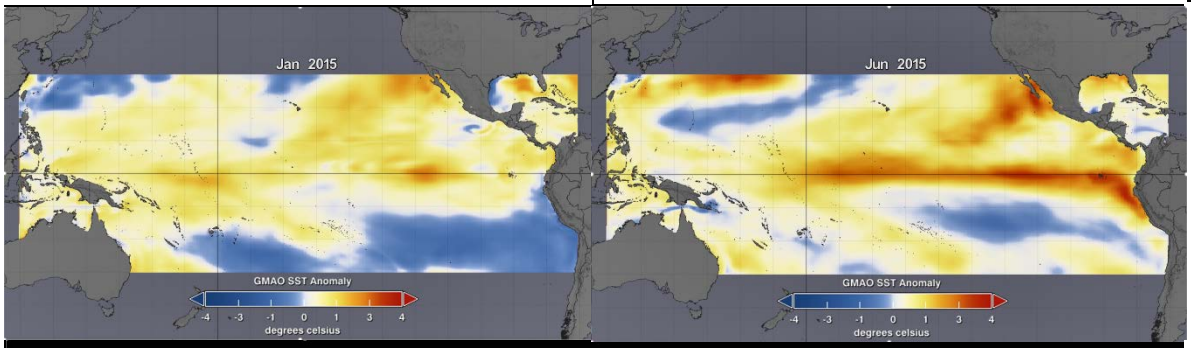
Janne Hakkarainen et al.

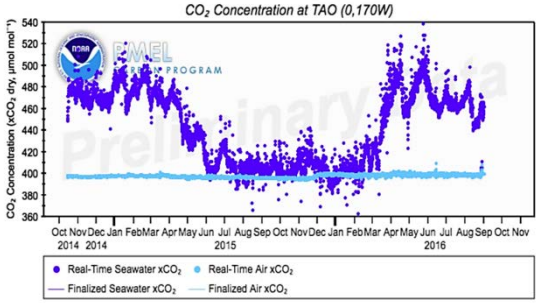
Science Stories at AGU
- El Niño Ocean Response -

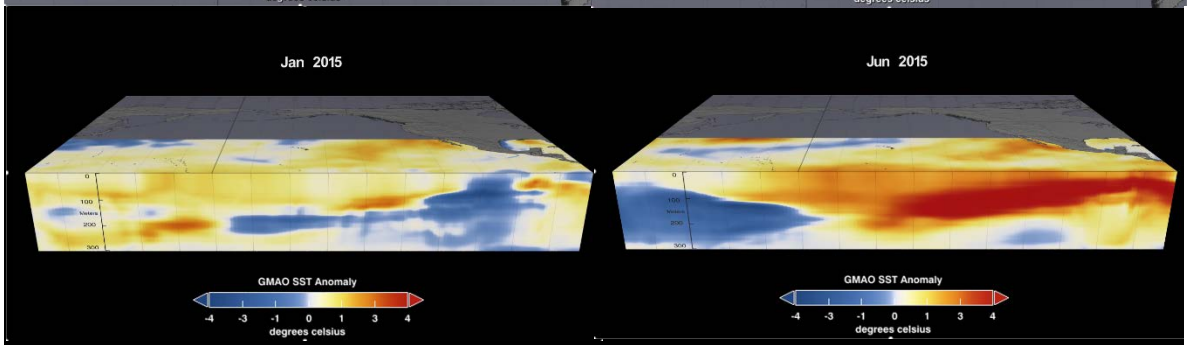


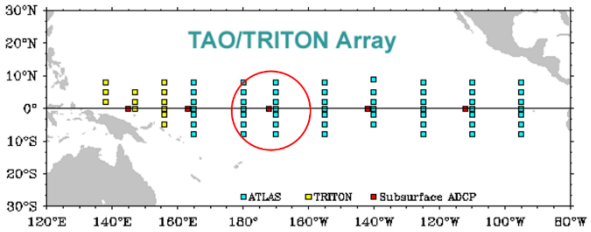






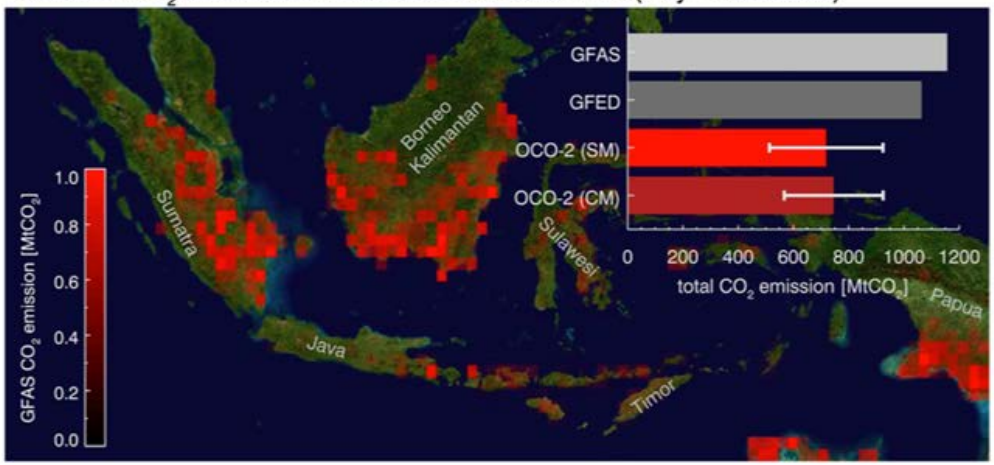






Science Stories at AGU
- Fires in Indonesia and Africa -

Estimated CO_2 emission for the 2015 Indonesian fires (July - November)

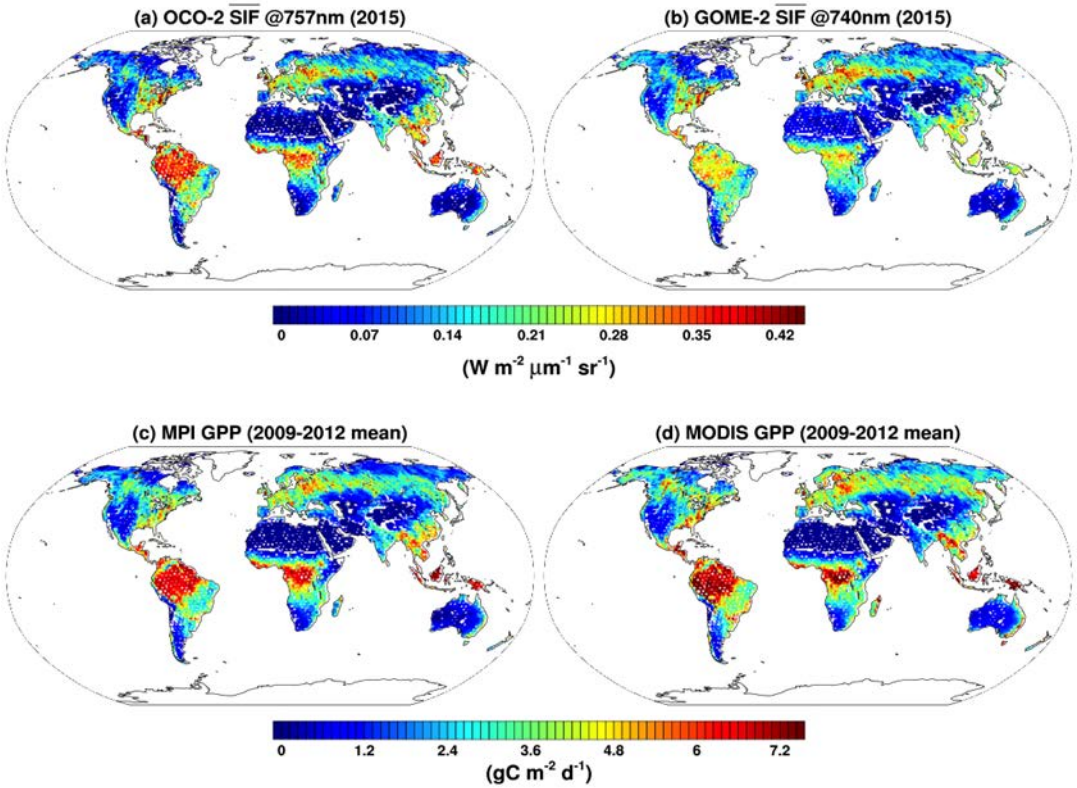


Map of Indonesia, comparing fire emissions estimates from the GFAS and GFED inventories to emission estimates obtained from OCO-2 data, using two analysis approaches. The OCO-2 estimates are less than 70% as large as those in the inventories.

Jenns Heymann et al.

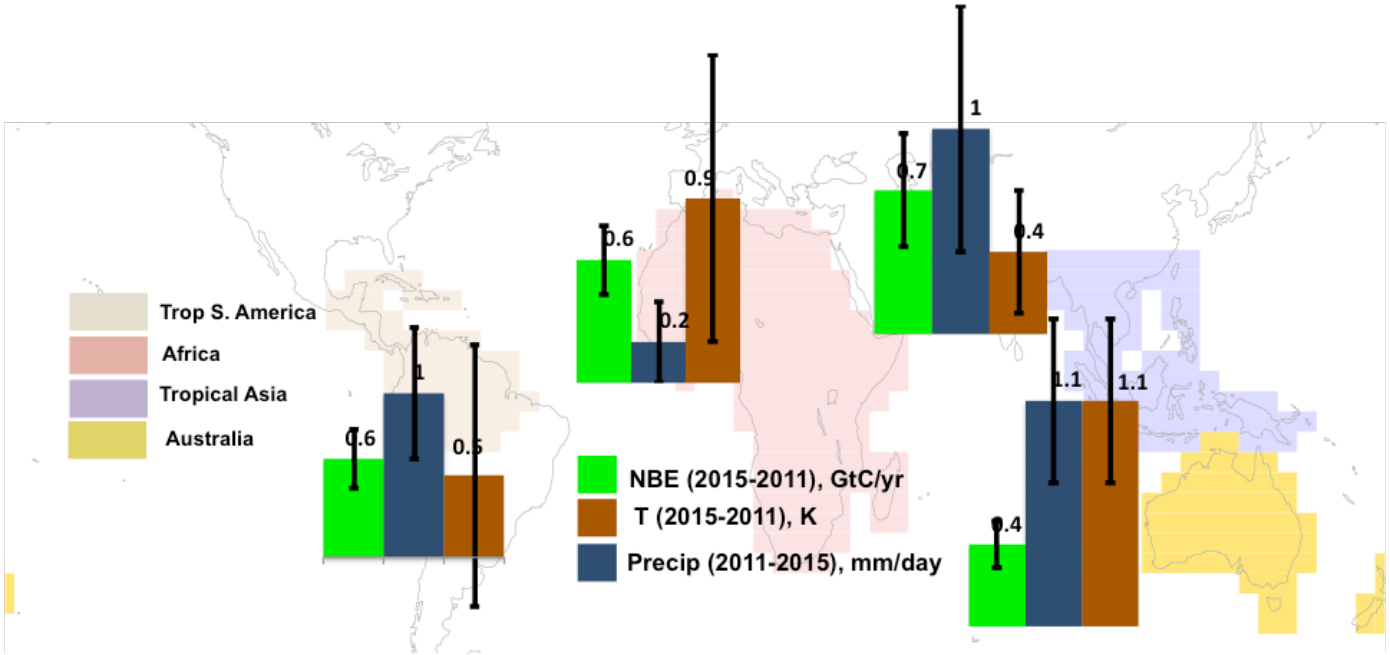
Anthony Bloom et al.

SIF as a Proxy for GPP and CO2 Uptake



The spatial pattern of daily mean SIF and GPP on grid. (a) and (b) show the annual average (January to December 2015) of OCO-2 at 757nm and GOME-2 at 740nm respectively. SIF is a valuable complement to XCO2 for identifying and quantifying land CO2 sinks

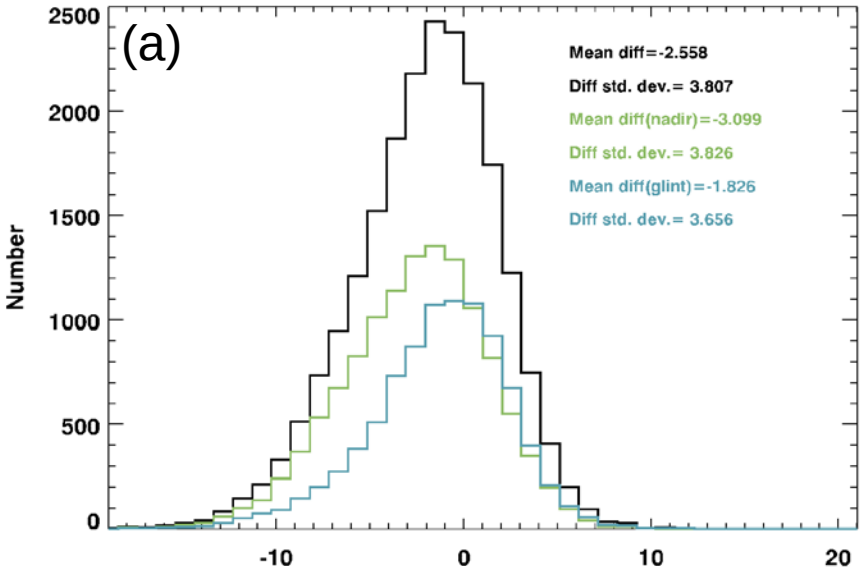
Science Stories at AGU
- El Niño – 3 Continents, 3 Stories -



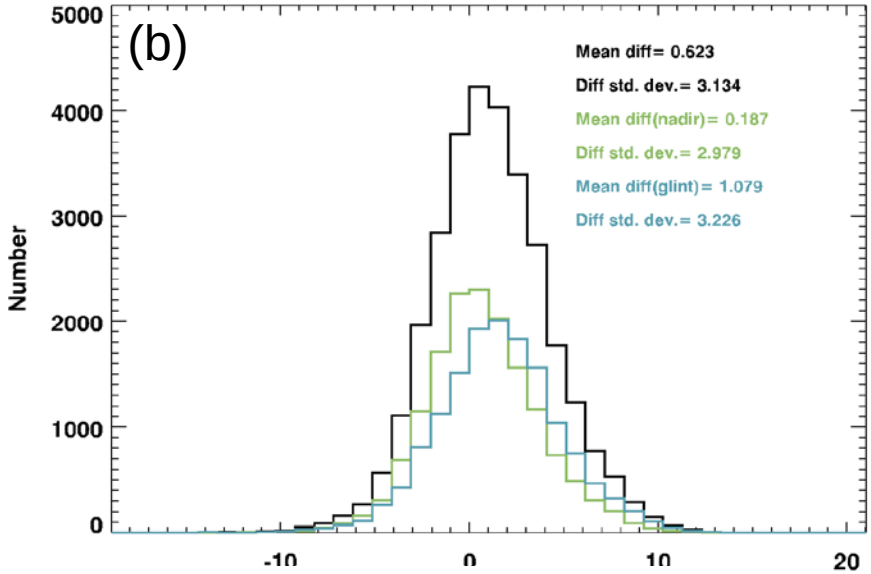
Regional scale CO_2 fluxes (excluding fossil fuel) inferred from OCO-2 and GOSAT X_{CO2} estimates. In all regions, the net biogenic exchange difference between 2015 and 2011 is positive (more carbon released in 2015), but in Australia and South America, the increase is driven by high temperatures in 2015, while in other regions, it is driven by reduced precipitation in 2015.

Junjie Liu et al.

Science Stories at AGU
- Improvements in Absorption Coefficients-



P_s(retrieved) – P_s(prior), hPa



P_s(retrieved) – P_s(prior), hPa

Examples of bias reductions from improved gas absorption coefficients. (a) Histogram of differences between the retrieved surface pressure, Ps(retrieved), and the ECMWF value Ps(prior) for the version 7 product. For land, the bias is ~3 hPa (green), while for water it is ~1.8 hPa (blue). If uncorrected, these surface pressure biases would introduce a 0.7 to 1 ppm bias in the XCO2 product. (b) The improved O2 A-band cross sections used in the version 8 product reduce the overall bias to ~1 hPa as well as the bias between land and ocean.

And Much More!

Other Carbon Cycle Highlights at AGU

- **AGU will be a big week with a wide range of NASA Carbon Cycle related activities outside of the formal talks and posters**
- Tuesday December 13
  - 10:45 - 11:00 AM, NASA Global Climate Observations: Discover How Satellites See Climate Change, Jack Kaye
  - 11:00 - 11:15 AM, El Niño 2015-16, David Halpern
  - 3:00 - 3:15 PM, NASA's Earth Observation Capabilities: Meeting The Challenges of Climate and Environmental Change Michael Freilich
  - 4:00 - 4:15 PM, Measuring CO2 with OCO during the 2015-16 El Niño, David Crisp
- Wednesday December 14
  - 3:00 - 3:15 PM, NASA's Earth Observation Capabilities: Meeting The Challenges of Climate and Environmental Change, Michael Freilich (repeat performance)
- Thursday December 15
  - 10:45 - 11:00 AM, Global Atmospheric CO2 from Satellite Data and Models, Steven Pawson
  - 11:15 - 11:30 AM, Counting Trees and Bushes from Space Using Cloud Computing, Compton Tucker/Daniel Duffy
  - 11:30 - 11:45 AM, High-Resolution Forest Biomass/Carbon Sequestration Potential, George Hurtt
  - 12:30 - 12:45 PM, 10 Years of the A-Train Constellation: Scientific Achievements Worth Celebrating, Lazaros Oreopoulos
  - 3:30 - 3:45 PM, The Role of Methane on Climate Change, Daniel Jacob
  - 3:45 - 4:00 PM, 3D Changes in Amazon Forests, Douglas Morton
  - 4:00 - 4:15 PM, Cloud Observations from Space: CALIPSO, Chip Trepte
  - 4:30 - 4:45 PM, Observing Earth from Space: The Fires in Northern Iraq, Ralph Kahn
- Friday December 16
  - 10:15 - 10:30 AM, Global Atmospheric Flux of CO2, Lesley Ott