Sampling biases of space-based observations of XCO_2 associated with South American biomass burning events

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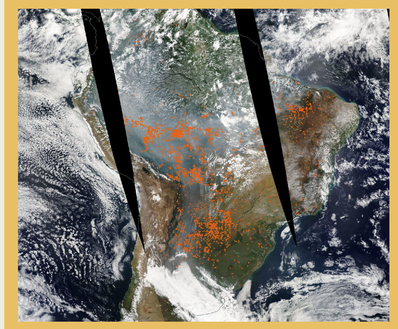
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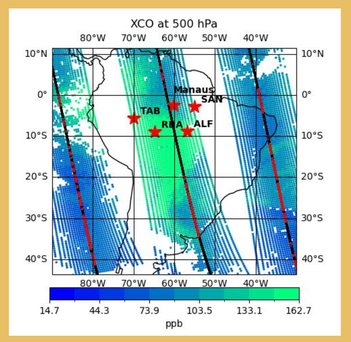
Summary

- We take an initial approach to examine 2017-2020 time series of OCO-2 xCO_2 observations coincident with other remotely sensed and in-situ observations to better understand external sampling effects associated with Amazonian biomass burning events.
- Future: GIM to quantify seasonal and IAV of CO_2 fluxes across tropics band.

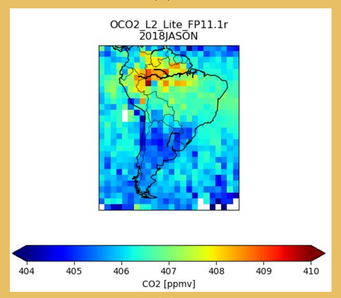
Selection Near Fires



(a)



(b)



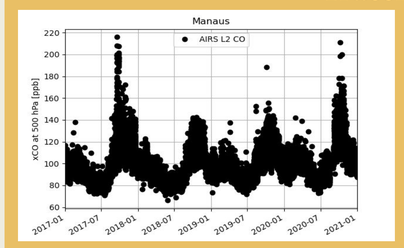
(c)

Figure 1(a-c).
(a) MODIS reflectance from 2017-09-20 with MODIS/Aqua Thermal Anomalies/Fire overlayed shows seasonal Amazonian fires.

(b) AIRS Carbon Monoxide mixing ratio at 500 hPa with OCO-2 total (black) and quality filtered (red) XCO_2 retrievals overlayed. None of the OCO-2 observations over the region of enhanced CO due to biomass burning passed the quality filter. Locations of correlative ground-based or in-situ measurements from Dubey et al. 2017, Gatti et al. 2021, and Miller et al. 2021 are indicated on the figure.

(c) OCO-2 L2 v11.1r retrievals over South America aggregated in 2.5° x 2.5° grid cells showing enhancement within 100 km of Manaus. Time period is the average of peak Brazilian fire season months: July-November.

Tracers of Fires



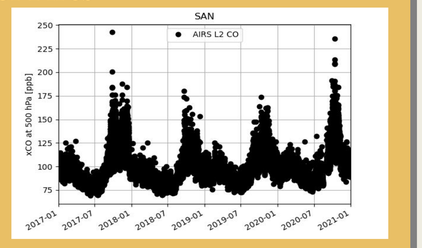


Figure 2. Time series of AIRS CO observations within 100 km of Manaus and Santarem both show the seasonal increase in CO associated with fires.

Comparison with validation datasets

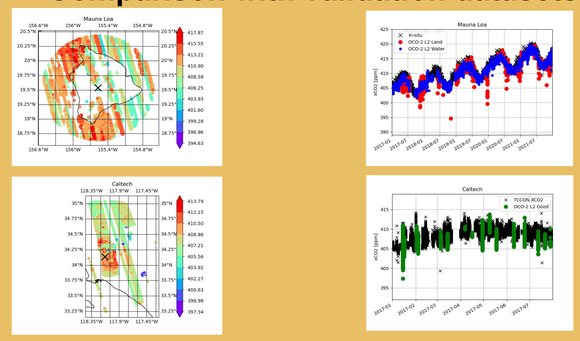


Figure 3. The above figures show comparisons of OCO-2 XCO2 measurements with other validation datasets. The GES DISC is developing tutorials to help users perform similar types of analyses.

Comparison of OCO-2,3 Level 2 and Level 3 products

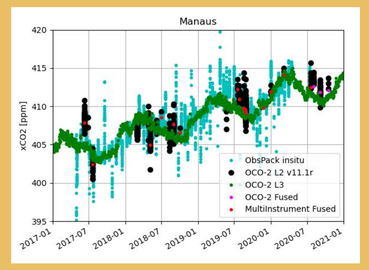


Figure 4. Various OCO-2/3 products over Manaus show the differences in seasonality and amplitude between the Level 2 and Level 3 products. The Level 3 assimilated product effectively fills gaps in the OCO-2 record but the Level 2 observations are more sparse during the biomass burning season.

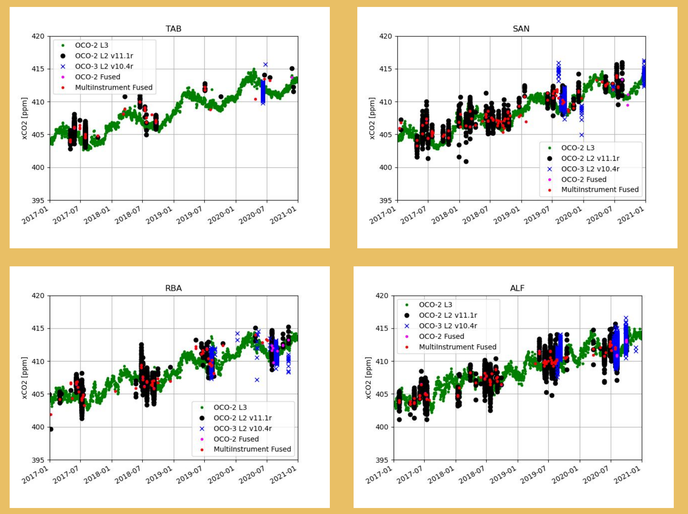


Figure 5. Time series of various OCO-2 and OCO-3 XCO_2 products over 4 other regions in the Amazon shows that the Level 3 observations suggest that there are differences in the seasonal cycles in these regions. There is also a general paucity of Level 2 observations during the buring seasons.

Comparison of OCO-2/3 with aircraft datasets in the Amazon

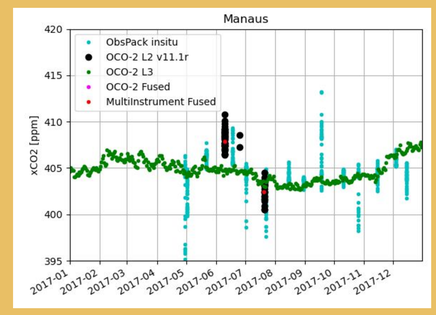


Figure 6. There were no successful OCO-2 xCO_2 Level 2 measurements in September over Manaus. The ObsPack data has a larger xCO_2 than the OCO-2 Level 3 assimilated data on 2017-09-17. The OCO-2 Level 2, Fused Data, and ObsPack data are all larger than the OCO-2 Level 3 around June 2017 and they are all less than the Level 3 around July 2017.

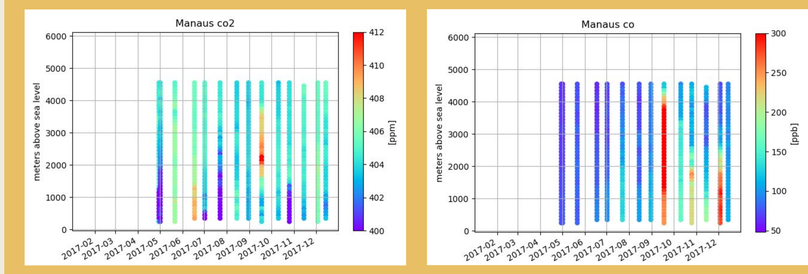


Figure 7. Aircraft profiles over Manaus during the 2017 dry season depict a biomass burning anomaly in September where intense fire plumes were captured in the mid-column of CO_2 and CO.

Current and Future Work

- See GES DISC How-To and Tutorials for how to aggregate OCO Level 2 data.
- Objective to better understand when, where, and to what extent OCO-2/3 can reduce uncertainties in tropical (17.5° N-17.5° S) CO_2 fluxes relative to ensemble models.
- Compare the spread of TRENDY models and OCO-2 MIP models to understand the function of spatial and temporal scale.
- Nested geostatistical inverse model (GIM) simulations to quantify relationships between net biosphere exchange (NBE) via OCO-2/3 observations and environmental drivers (MERRA-2) such as temperature and soil moisture (SMAP) across different seasons and ENSO phases (2014-2016, 2023/2024)..
- Investigate the extent to which biomass burning and LU/LC could yield seasonal or IAV in tropical fluxes.

Acknowledgements

- We acknowledge the use of imagery from the NASA Worldview application (https://worldview.earthdata.nasa.gov/), part of the NASA Earth Observing System Data and Information System (EOSDIS).
- The latest OCO-2, OCO-3 data accessed via the NASA Goddard Earth Services (GES) Data and Information Center (DISC) online archive.