

Sampling of space-based observations of XCO₂ associated with biomass burning events

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Summary and XCO₂ datasets

- The OCO-2 Level 3 assimilation product fills in gaps where OCO-2 does not have observations.
- Although the Level 3 clearly shows the increased CO₂ over the Amazon associated with the September 2017 biomass burning event, the total amount of CO₂ may be underestimated because of a sampling bias.
- The TCCON observations match fairly well with the OCO-2 observations and can be used to estimate the accuracy of the OCO-2 observations and the temporal sampling bias. However, since it is a remotely sensed product, it may suffer the same sampling biases associated with biomass burning events as OCO-2.
- Although aircraft data show that there is a significant variation in xCO₂ with altitude, they suggest the OCO-2 fused products created by kriging may be better than the assimilated product at detecting large deviations from the average state on daily and regional scales.

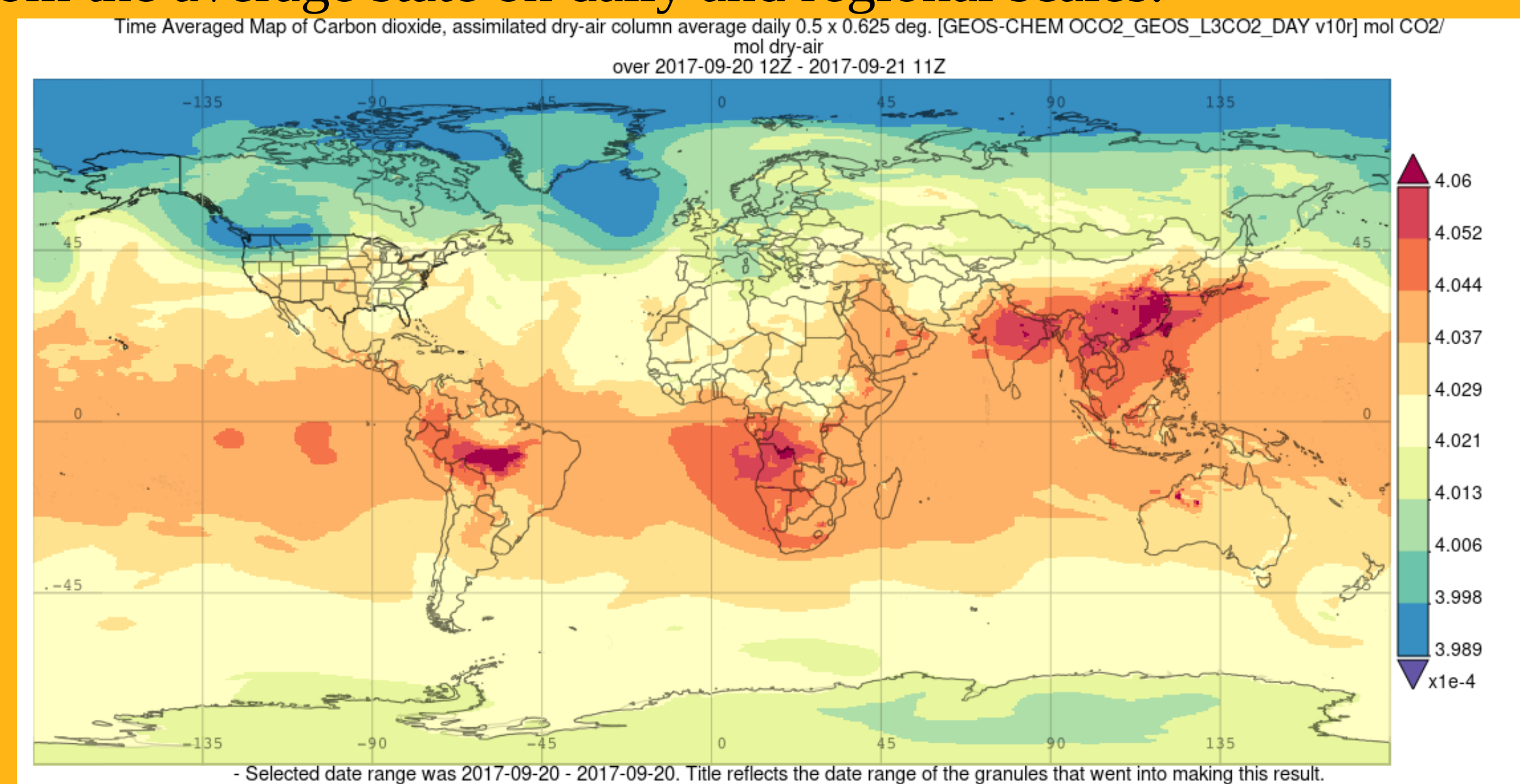


Figure 1 Shows a global map of xCO₂ from the OCO-2 GEOS Level 3 daily assimilated V10r product for 2017-09-20. This product uses the GEOS CoDAS assimilation system to fill gaps in the OCO-2 observations. See INV22C-0504 for more information on how to explore this dataset.

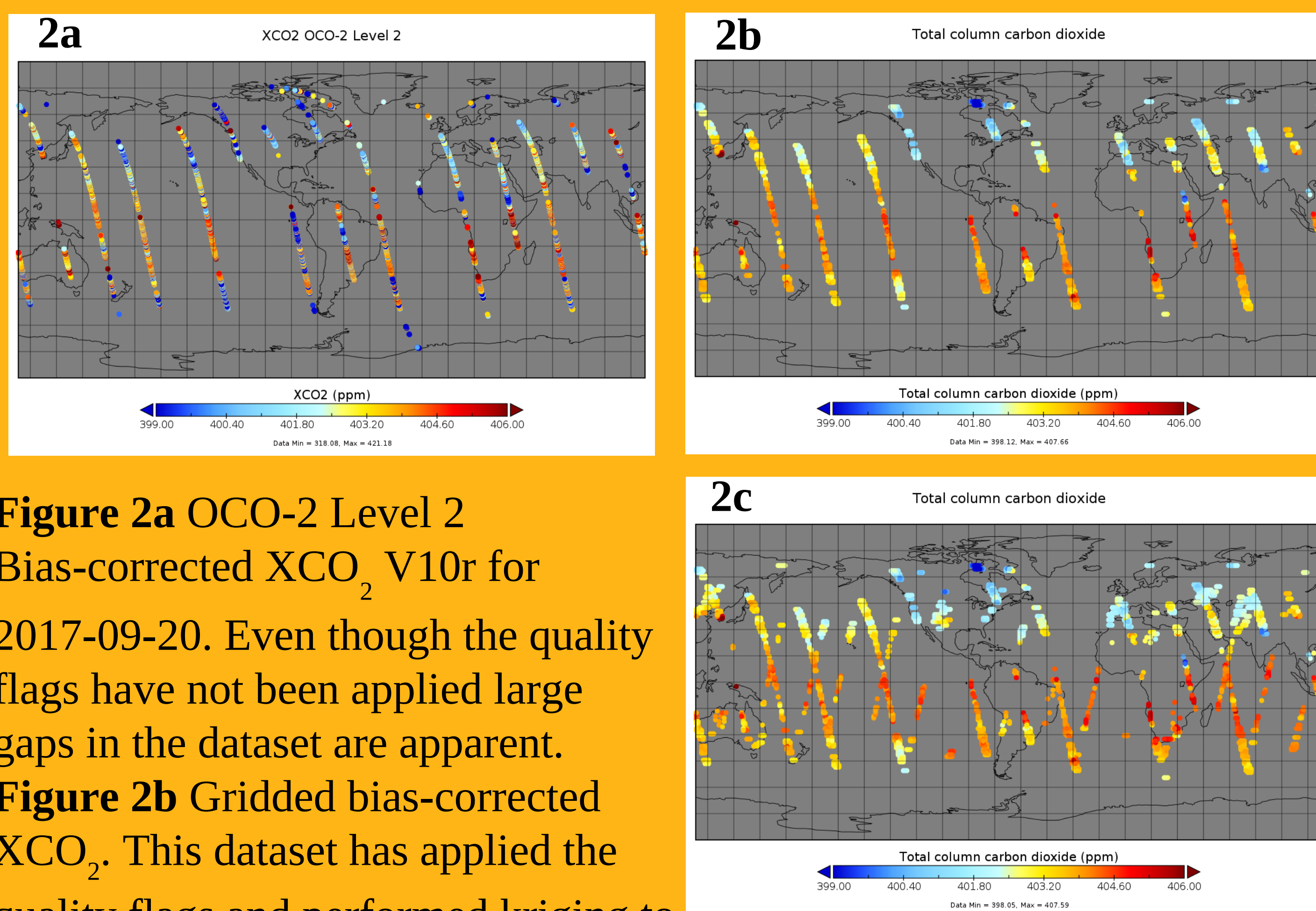


Figure 2a OCO-2 Level 2 Bias-corrected XCO₂ V10r for 2017-09-20. Even though the quality flags have not been applied large gaps in the dataset are apparent.
Figure 2b Gridded bias-corrected XCO₂. This dataset has applied the quality flags and performed kriging to put the data on a 1 degree x 1 degree grid.
Figure 2c A product similar to Figure 3 but including both OCO-2 and GOSAT observations.

Selection Effects Near Fires

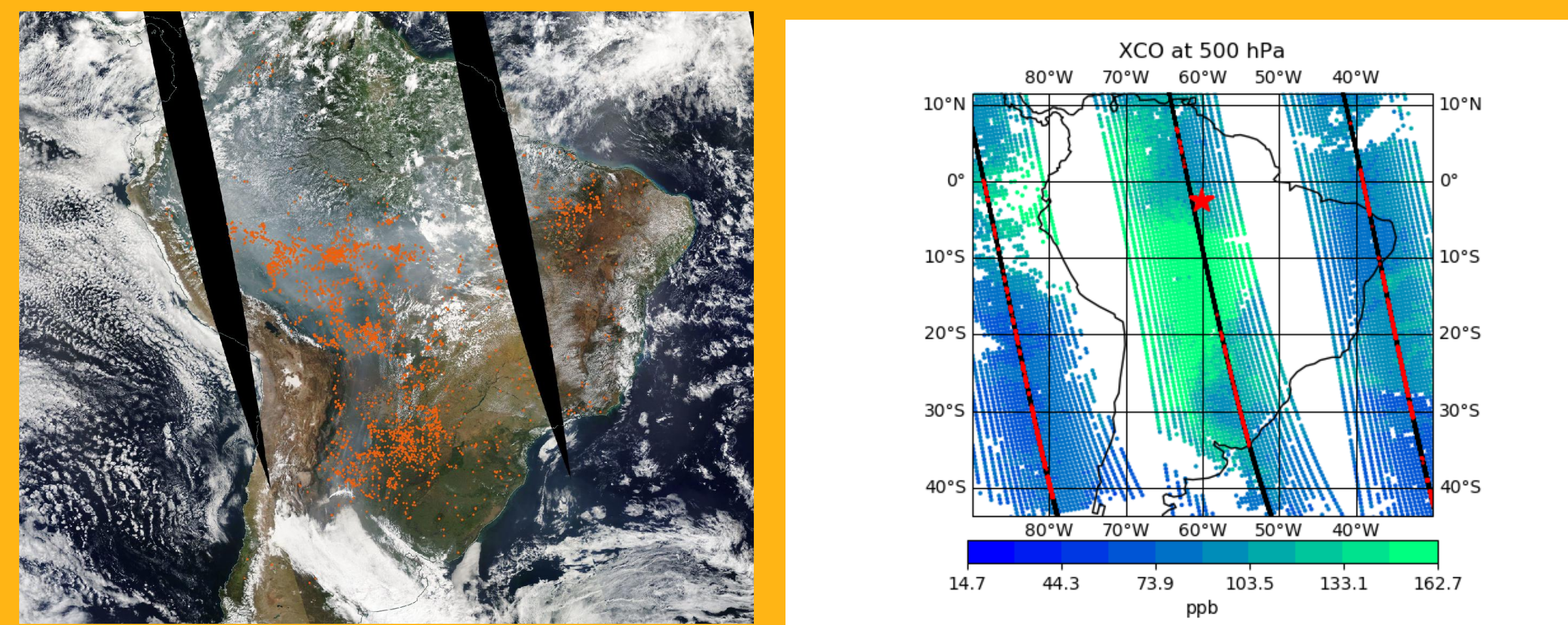


Figure 3 The left panel shows MODIS reflectance from 2017-09-20 with MODIS/Aqua Thermal Anomalies/Fire overlaid shows that there were a lot of fires in the Amazon at this time. The right panel shows AIRS Carbon Monoxide mixing ratio at 500 hPa with OCO-2 observation location overlaid. The black points show the OCO-2 footprints. The red points the OCO-2 xCO₂ data that passed the quality control. None of the OCO-2 observations over the region of enhanced CO passed the quality control.

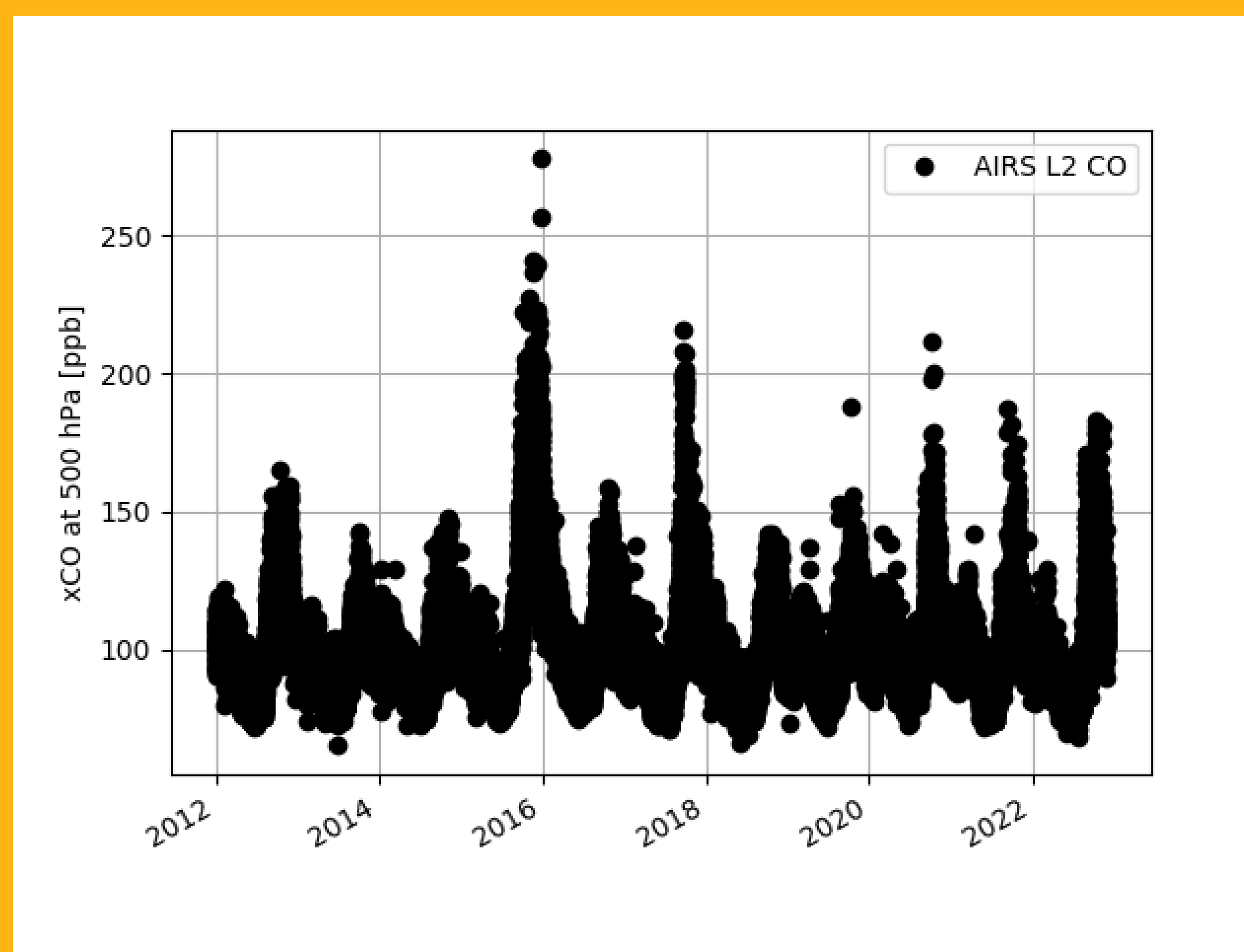


Figure 4 A time series of AIRS CO observations within 100 km of Manaus shows the seasonal increase in CO associated with fires.

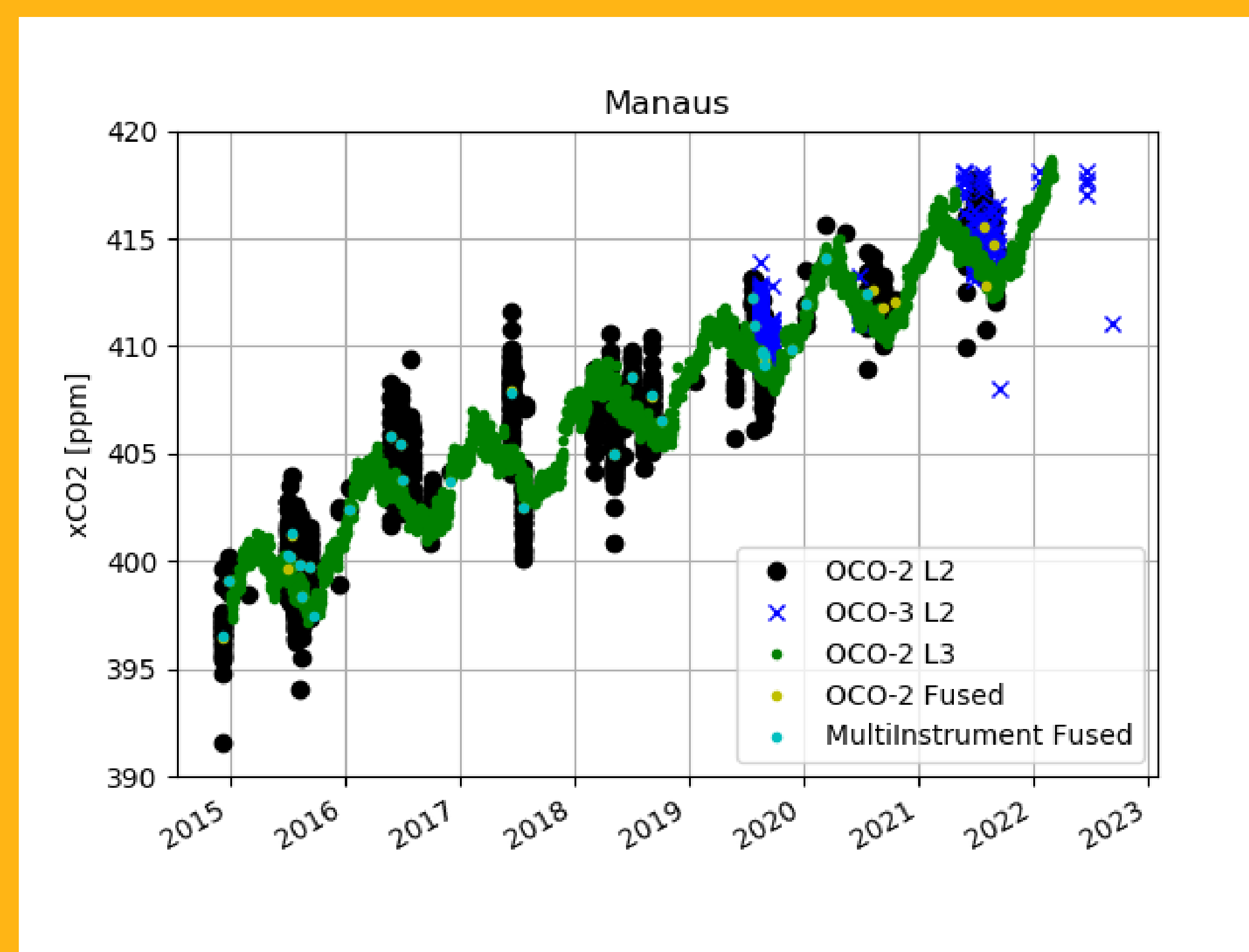


Figure 5 A time series of OCO-2 and OCO-3 products over Manaus. The Level 3 assimilated product effectively fills gaps in the OCO record but the Level 2 observations show deviations from the seasonal averages.

Comparison with TCCON and ObsPack data

Figure 6 A time series of xCO₂ from OCO-2, OCO-3, TCCON, and ObsPack within 100 km of Manaus, Brazil.

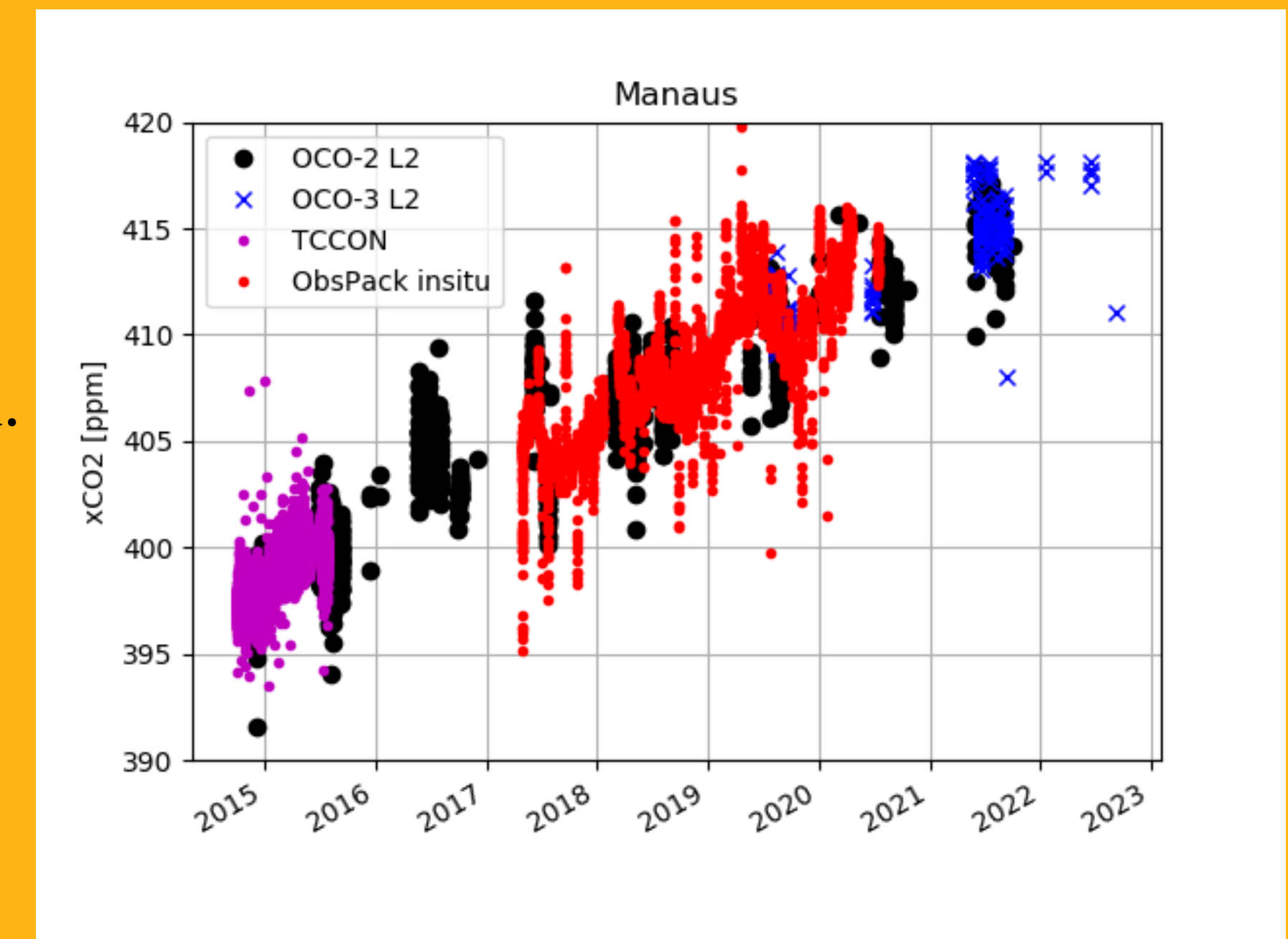


Figure 7 A time series of AIRS xCO for the Period for which we have ObsPack data over Manaus.

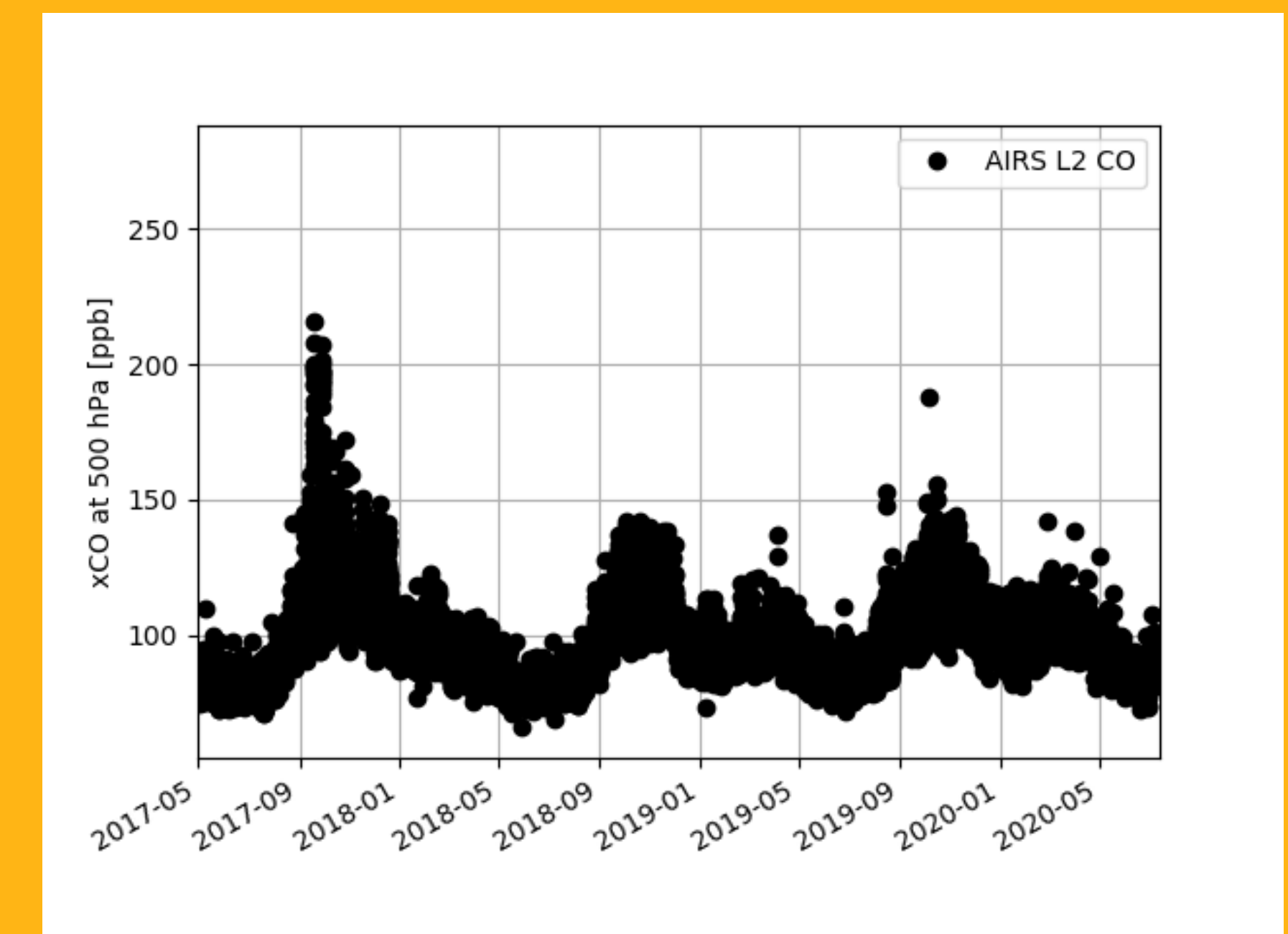


Figure 8 Comparison of Obspack xCO₂ with OCO-2 Level 2, Level 3, and Fused data over Manaus.

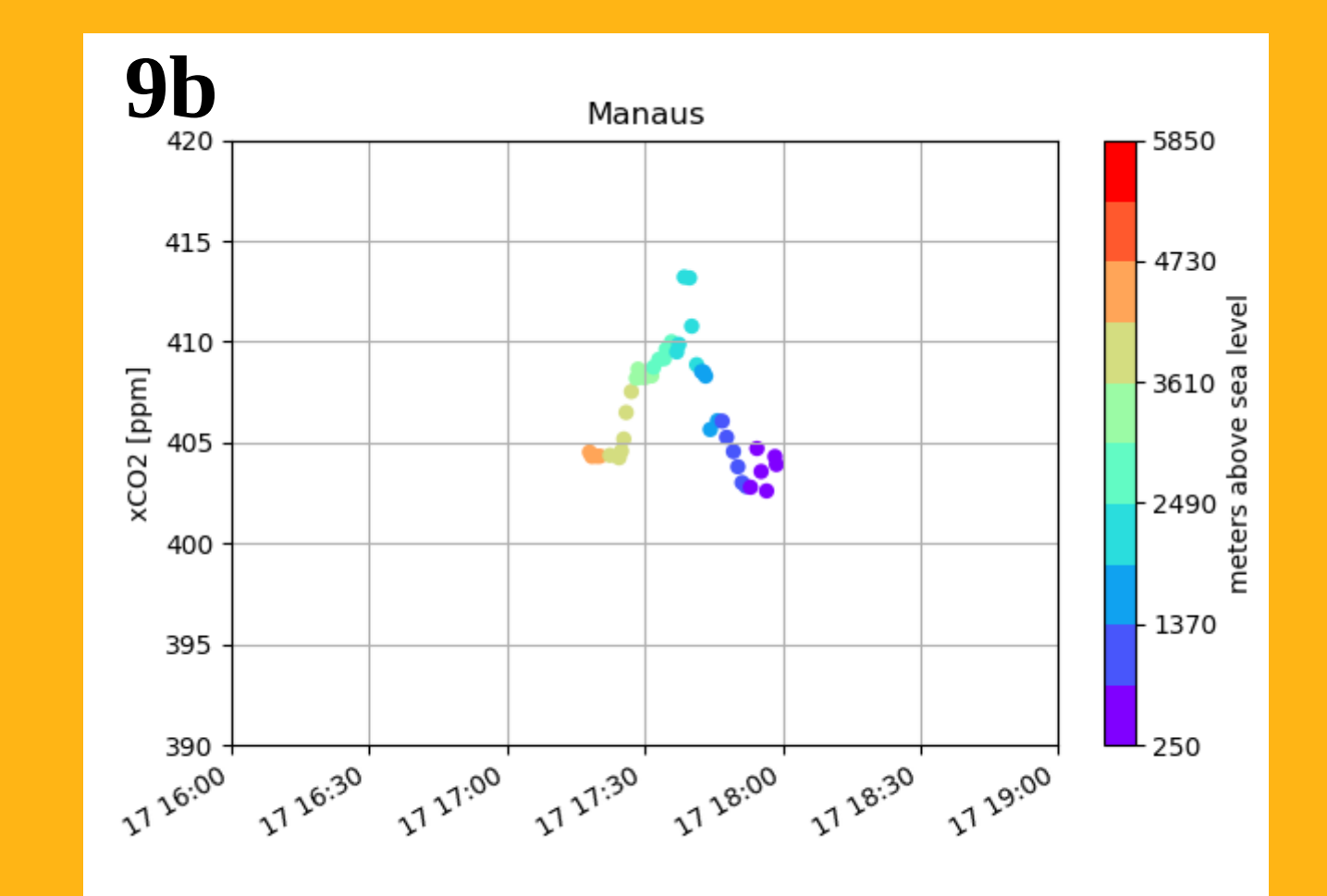
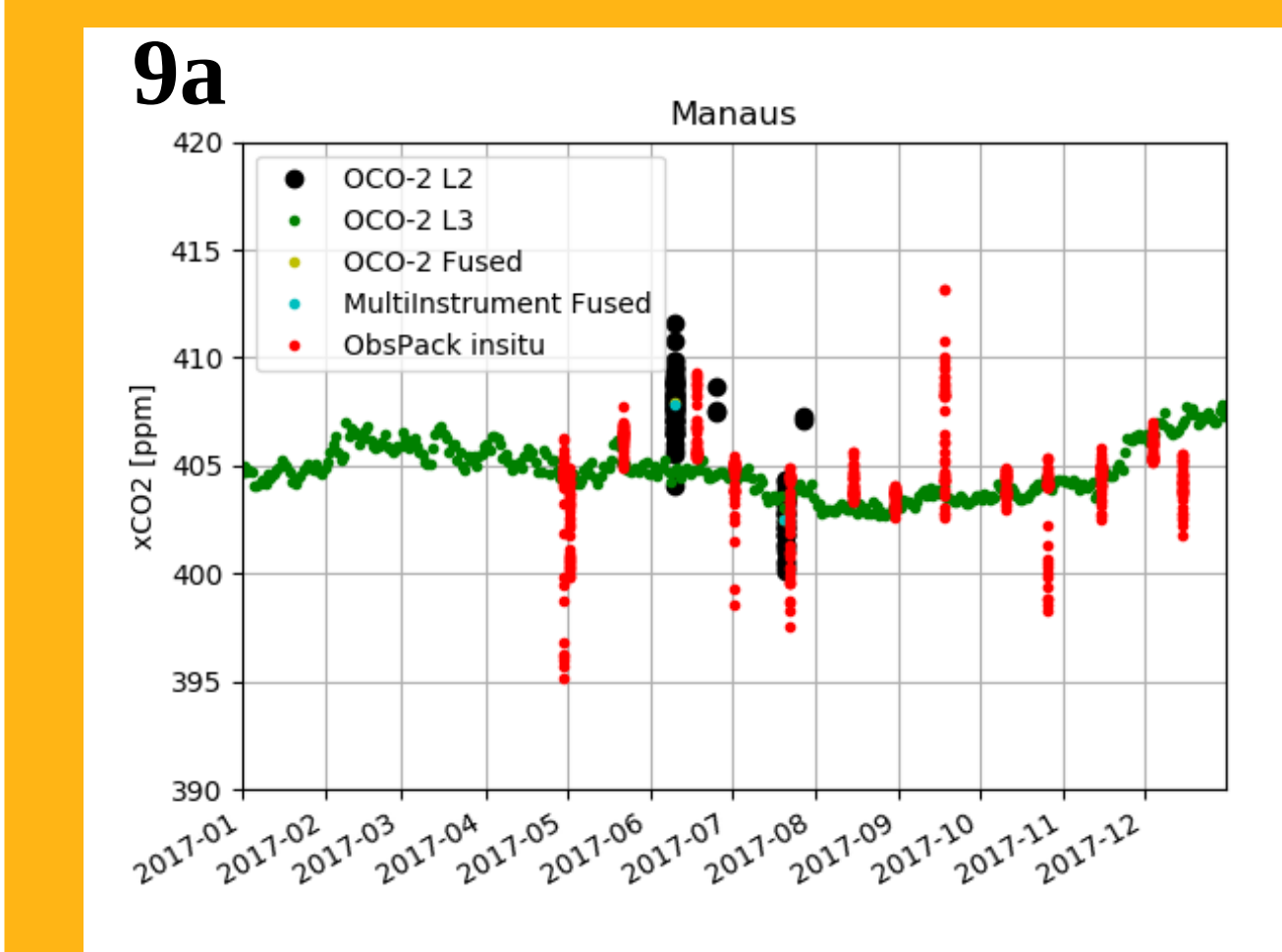
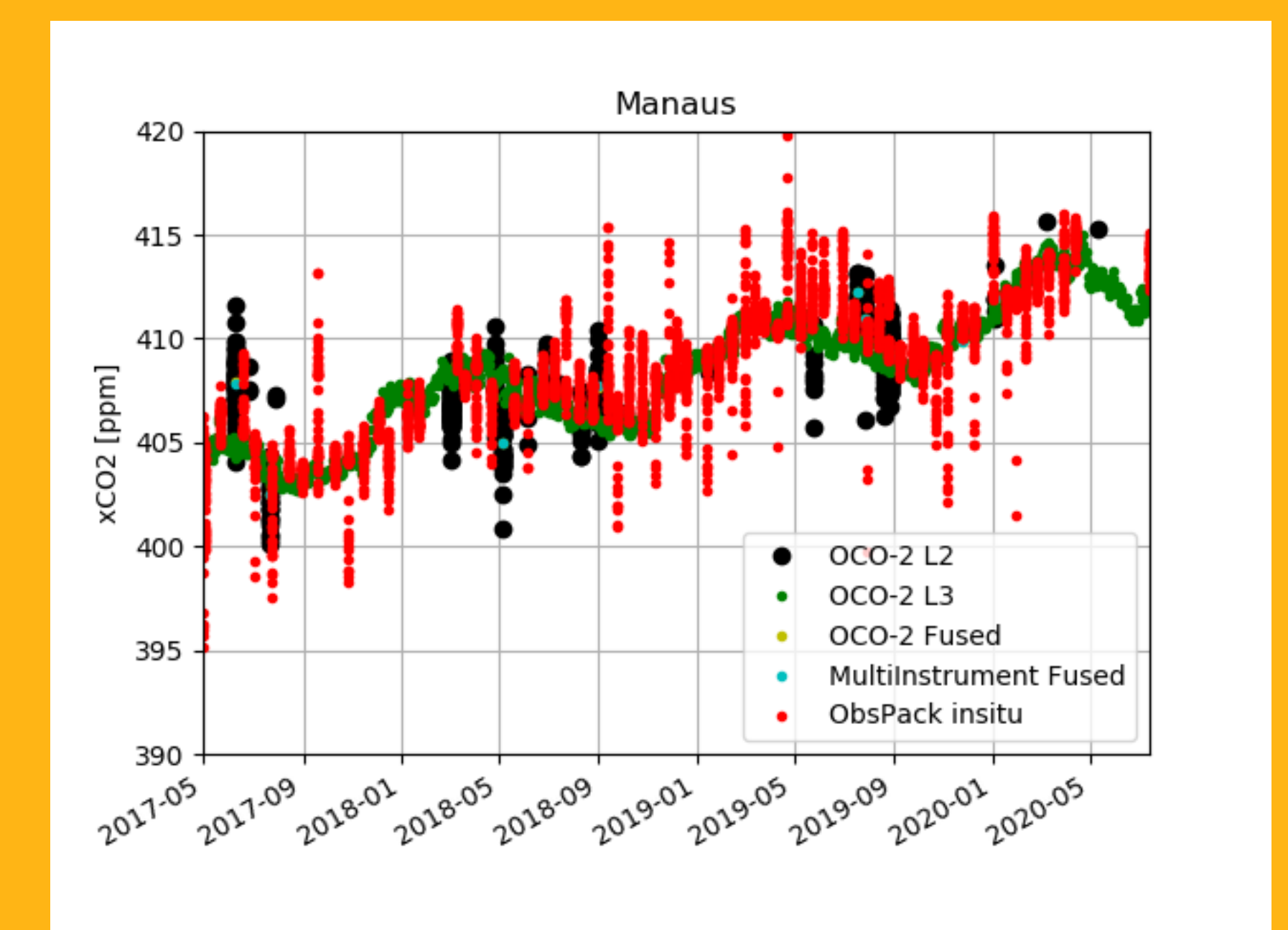


Figure 9a There were no successful OCO-2 xCO₂ Level 2 measurements in September over Manaus. The ObsPack data has a larger xCO₂ than the OCO-2 Level 3 assimilated data on 2017-09-17. The OCO-2 Level 2, Fused Data, and ObsPack data are all larger than the OCO-2 Level 3 around June 2017 and they are all less than the Level 3 around July 2017.
Figure 9b The ObsPack data can vary based on the altitude.