



Plans for the GGG2020.1 data product

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GGG2020 update: input met change

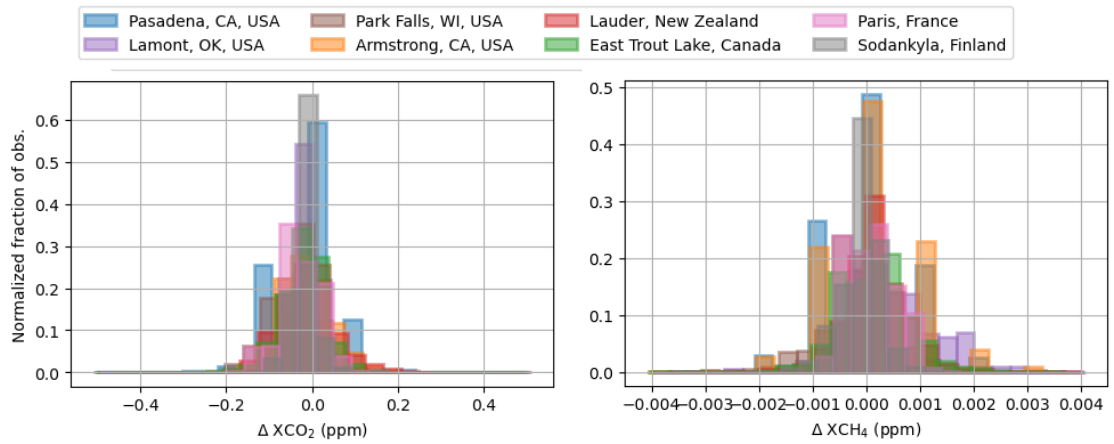


- GGG2020 uses GEOS as our meteorological priors and as input for CO₂, N₂O, CH₄, HF, CO, H₂O, HDO, and O₃ a priori profiles.
- As GEOS FP-IT is being replaced by GEOS IT, we elected to change at the same time as OCO-2/3 (as close as possible).
- Any TCCON data with a *prior_time* value before 00:00 UTC 1 Apr 2024 uses GEOS FP-IT priors; data with *prior_time* equal to or greater than this uses GEOS IT
- **Note:** this affects any data (incl. EM27s) that obtains GGG2020 priors from Caltech

GGG2020 update: input met change

- Most Xgas products have little or no change in mean
- XCO is the exception, as we use GEOS CO fields as the basis for our priors

Gas	Mean change
XCO ₂	-0.021 ppm
XwCO ₂	-0.0034 ppm
XICO ₂	0.039 ppm
XCH ₄	0.064 ppb
XCO	-2.9 ppb
XN ₂ O	0.0047 ppb
XH ₂ O	-0.78 ppm
XHDO	-1.8 ppm



Report: Laughner, J. L., Roehl, C. M., Wunch, D., Pollard, D. F., Jeseck, P., Té, Y., Kivi, R., & Heikkinen, P. (2024). Report: TCCON GGG2020 switch to GEOS IT met products. CaltechDATA. doi: 10.14291/tccon.ggg2020.report.geosit-change

(just search “geos it” on data.caltech.edu)

Planned, potential, and delayed changes

Delayed change

- Bias correction of CO₂ products based on comparison to *in situ* data

Potential change

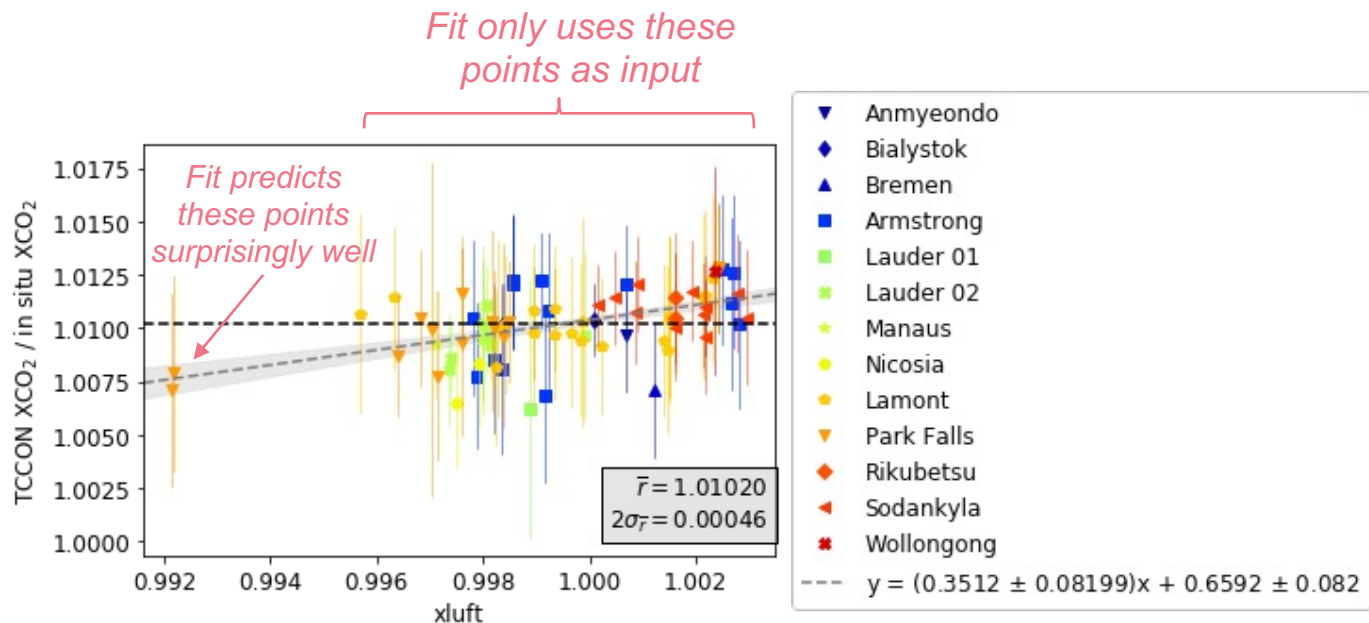
- Update all Xgas variables to account for trend in O₂ mole fraction

Planned changes

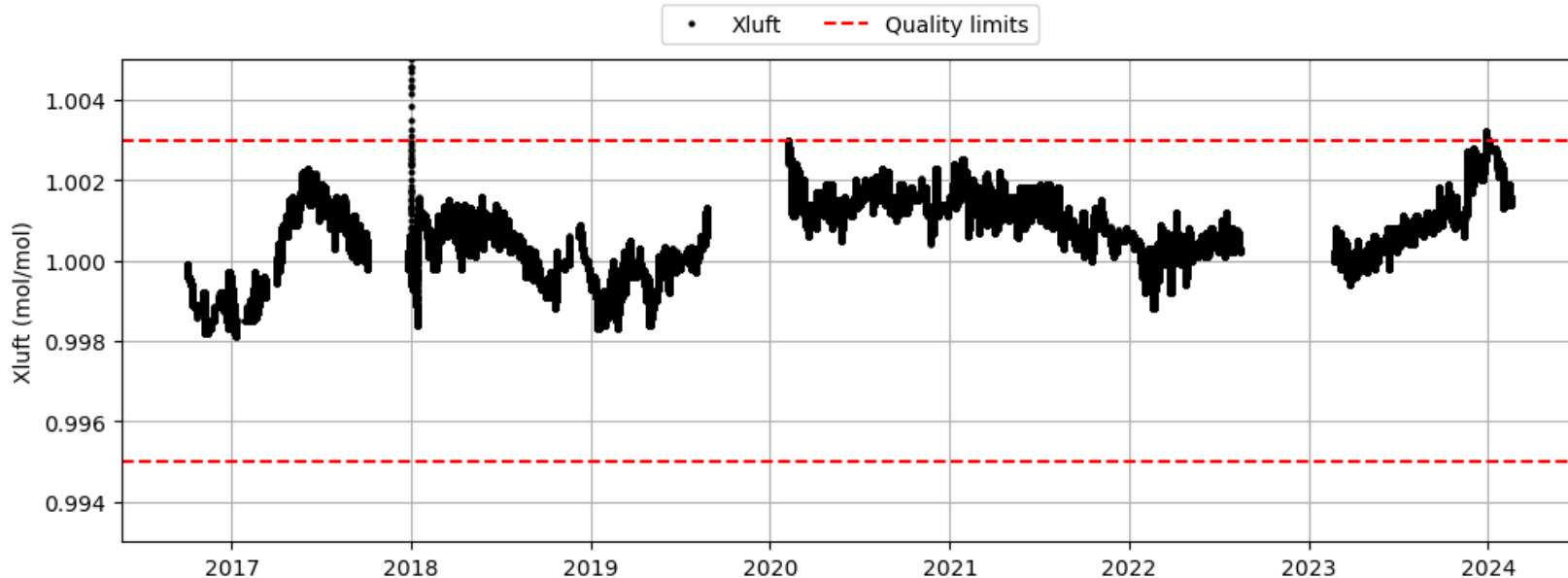
- Temperature-driven bias correction to XN₂O
- Partial reprocessing with CO priors from GEOS IT

Delayed: bias correction of CO₂ products

- Comparison with in situ data suggests a variable bias in XCO₂
- Have not been able to find a plausible physical reason supported by evidence
- Without that, cannot be sure this will be a reasonable bias correction for all sites.



Delayed: bias correction of CO₂ products



- GGG2020.* data will continue to be quality controlled to flag and remove periods with Xluft outside predetermined limits
- Any CO₂ bias correction will be delayed until we are confident it does not introduce a new bias

Potential: account for O₂ mole fraction trend in all variables

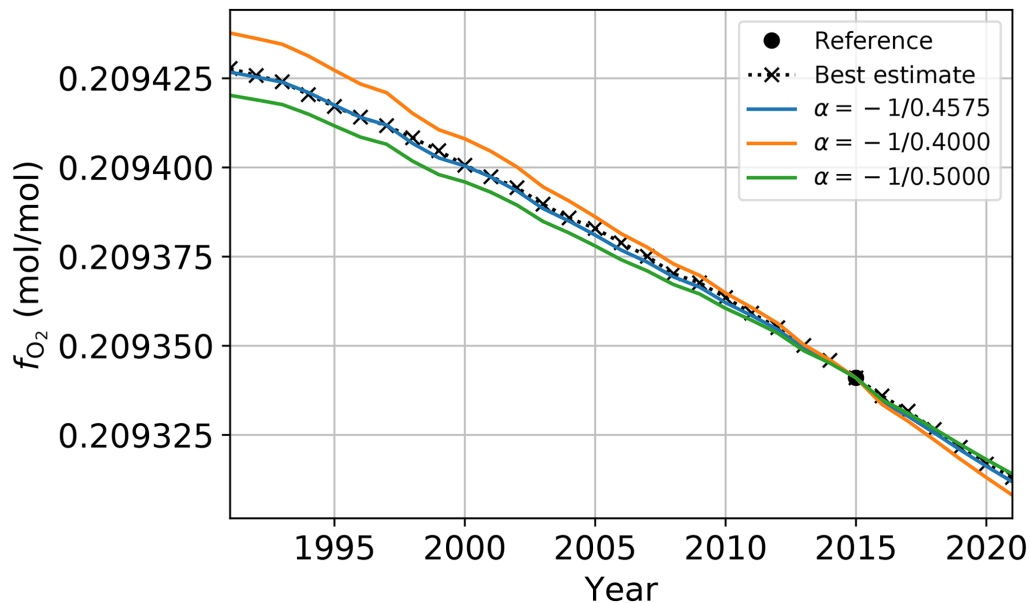
GGG Xgas definition:

$$X_{\text{gas}} = \frac{V_{\text{gas}}}{V_{\text{O}_2} / f_{\text{O}_2}}$$

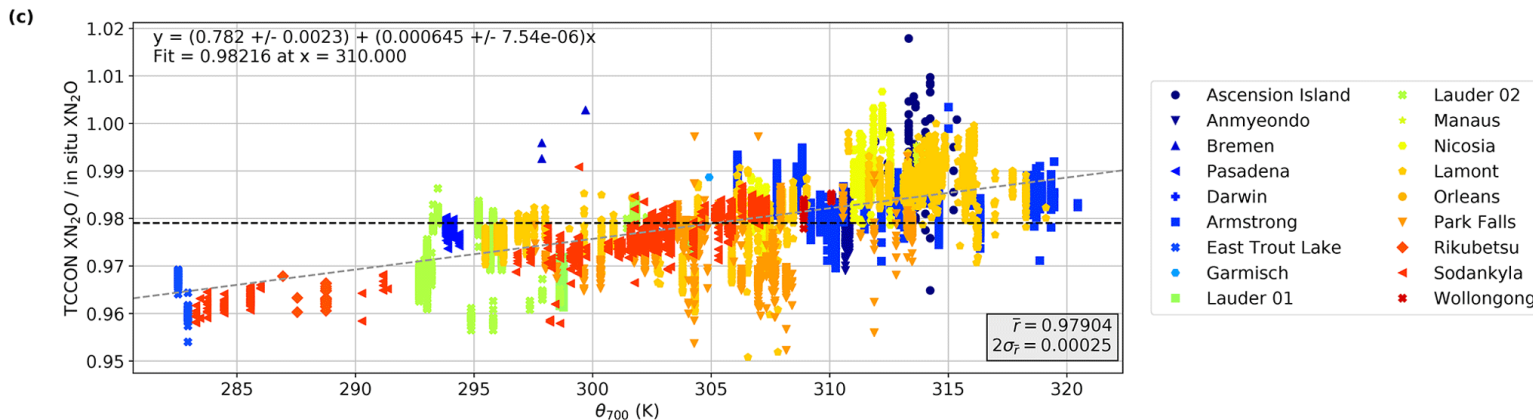
TCCON Variable	O ₂ mole fraction
xco2_x2019	Varies as function of raw XCO ₂
xwco2_experimental_x2019	
xlco2_experimental_x2019	
All other Xgas variables	Fixed at 0.2095

Potential: account for O₂ mole fraction trend in all variables

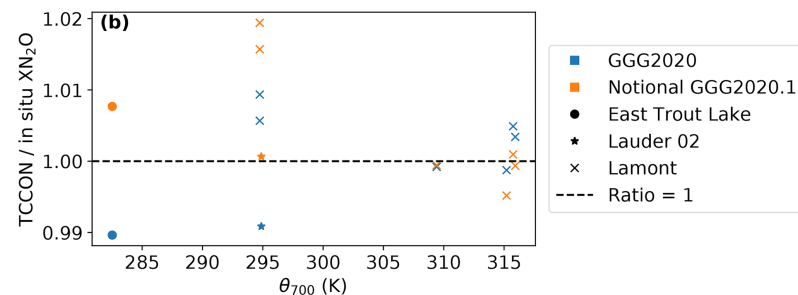
- Change in O₂ ≈ 40 ppm per decade (out of ~210,000 ppm ≈ 0.02%)
- Impact to XCO₂ ≈ 0.08 ppm/decade
- Small, but matters for long term TCCON datasets.
- Current approach for _x2019 variables assumes O₂ varies inversely with CO₂ and uses the “raw” XCO₂ to infer O₂.
- Want to revisit if this is the best approach before applying to all variables.



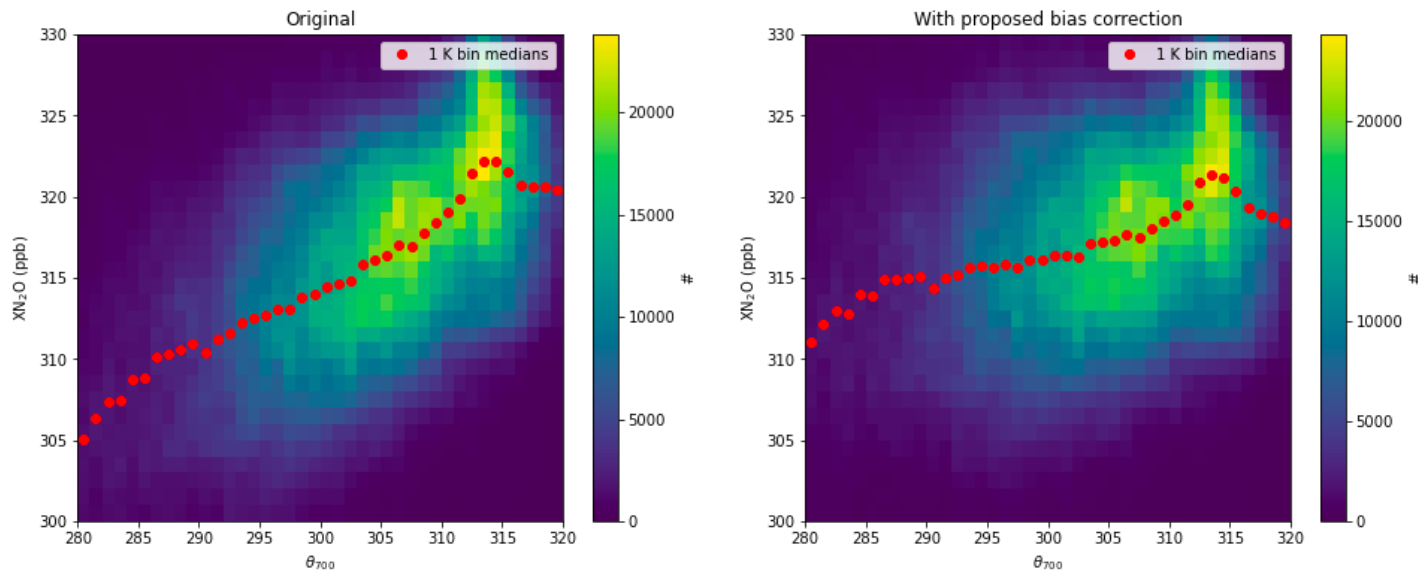
Planned #1: XN₂O bias correction



- Comparison of TCCON XN₂O with hemispheric-average N₂O concentration shows a temperature-dependent bias (top)
- Comparison to aircraft with and without bias correction (right) is unclear due to limited profiles



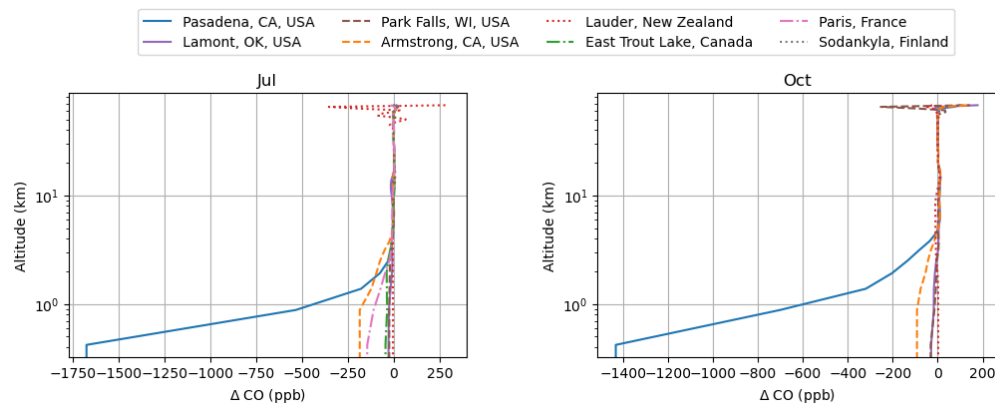
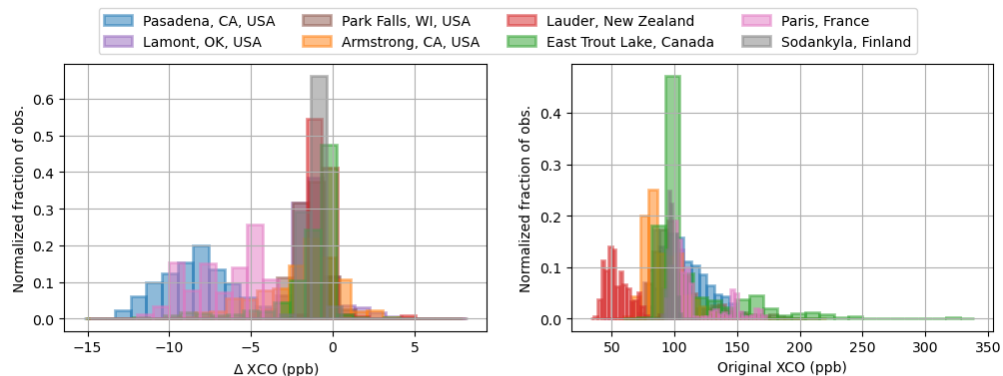
Planned #1: XN_2O bias correction



- Because we chose the XN_2O scaling factor to normalize the mean TCCON/in situ ratio to 1, this change will affect data away from the network mean temperature, $\theta_{700} \approx 310$ K

Planned #2: Partial reprocessing with GEOS IT

- GEOS FP-IT to GEOS IT change had most significant and consistent changes in urban sites' XCO
- Working on making new GEOS IT-derived CO priors available at least from the launch of TROPOMI, possibly earlier depending on available effort and disk space
- Urban sites are encouraged but not required to rerun the relevant years.



Summary

- GGG2020
 - Data for dates on or after 1 Apr 2024 use GEOS IT as prior input
 - XCO_2 , $XwCO_2$, $XICO_2$, XCH_4 , and XN_2O show no shift in mean with the change
 - XCO will have a mean shift at polluted sites.
- GGG2020.1:
 - Currently planned to include XN_2O bias correction and some reprocessing of polluted sites with new CO priors
 - Likely will also include trend in O_2 mole fraction for all Xgas variables
 - Release date: this year barring unforeseen complications.



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