

TROPOMI methane validation in the GeoCarb domain

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 GML / DOE aircraft: Colm Sweeney, Kathryn McKain, Edward J. Dlugokencky, Sebastien C. Biraud, John B. Miller
 GeoCarb: Sean Crowell

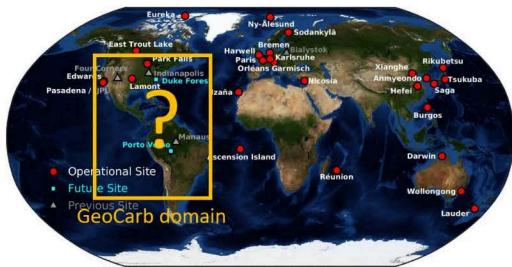
Objective: GeoCarb validation

Purpose:

Are the four TCCON sites in the GeoCarb domain adequate to characterize CH₄ satellite validation? What does the GML aircraft data add?

Method:

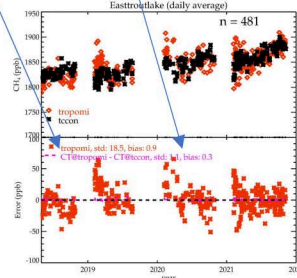
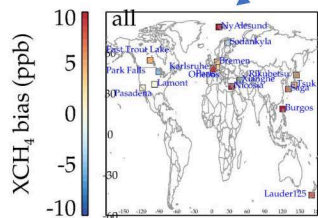
Assess the error estimates globally vs. in the GeoCarb domain
 Assess the use of GML/DOE aircraft in the GeoCarb domain



Estimate of systematic error (from Kulawik, 2016):

- + regional bias (stdev of average bias versus validation at each station)
- + correlated error (stdev of daily average versus validation)
- co-location error (above quantities for model@satellite minus model@valid)
- validation error (systematic error of validation estimates, e.g. model extension:)

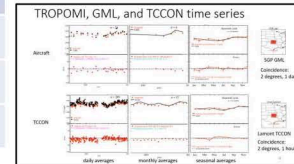
TCCON error (GGG2020): 8 ppb
 Aircraft error: 8 ppb



(1) Errors estimates for different TROPOMI versions

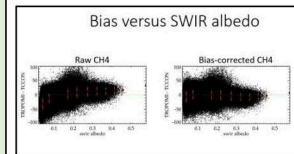
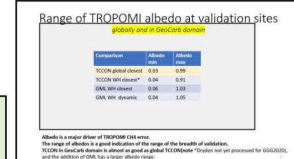
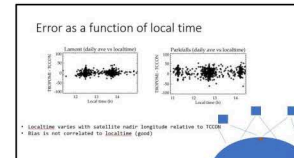
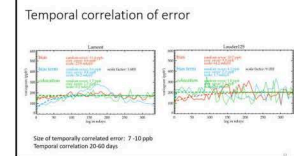
TROPOMI version	Bias (ppb)	Random error (ppb)	Stdev of daily average (ppb)	Regional bias error (ppb)	Co-location error (ppb)	Validation error (ppb)	Systematic error (ppb)
v0.1	5.8	14.7	11.1	8.3	2.6	8.0	11.7
v1.0	3.1	16.2	12.3	7.2	2.0	8.0	12.2
v2.0*	1.3*	17.0	11.5	3.3*	2.0	8.0	9.5*
All	5.5	15.8	11.9	8.5	2.2	8.0	12.6

* ½ year of overlap with validation data



(2) Error estimates for global TCCON vs. in GeoCarb domain

Comparison	Bias (ppb)	Random error (ppb)	Stdev of daily average (ppb)	Regional bias error (ppb)	Co-location error (ppb)	Validation error (ppb)	Systematic error (ppb)
TCCON global closest	5.5	15.8	11.9	8.5	2.2	8.0	12.6
TCCON WH closest	-2.0	17.9	12.6	2.7	2.1	8.0	12.8
GML WH closest	1.3	17.0	11.5	3.3	2.0	8.0	9.5
GML WH dynamic	5.5	15.8	11.9	8.5	2.2	8.0	12.6



Conclusions

- Systematic error estimates similar for global TCCON and GeoCarb-domain TCCON (12.6 vs. 12.8 ppb)
- Systematic error estimates are similar for TCCON and GML aircraft (12.8 vs. 9.5-12.6 ppb)
- The GeoCarb validation domain covers the full range of albedos (right)
- The larger location-dependent biases seen versus Lorente (2021) are because Lorente (2021) used a pre-operational product
- No bias versus local time observed for TROPOMI (right)
- v2 seems to improve significantly over v1, but the v2 time is too short to say for sure (table 1)