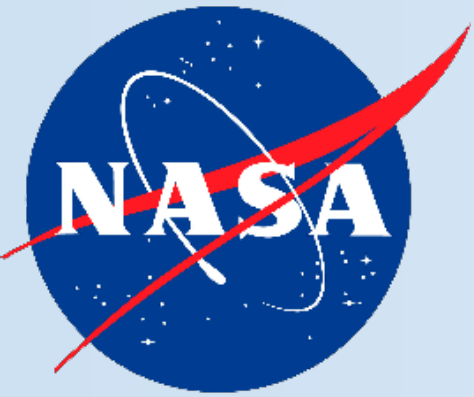


ACTIVATE Falcon Trace Gas Overview

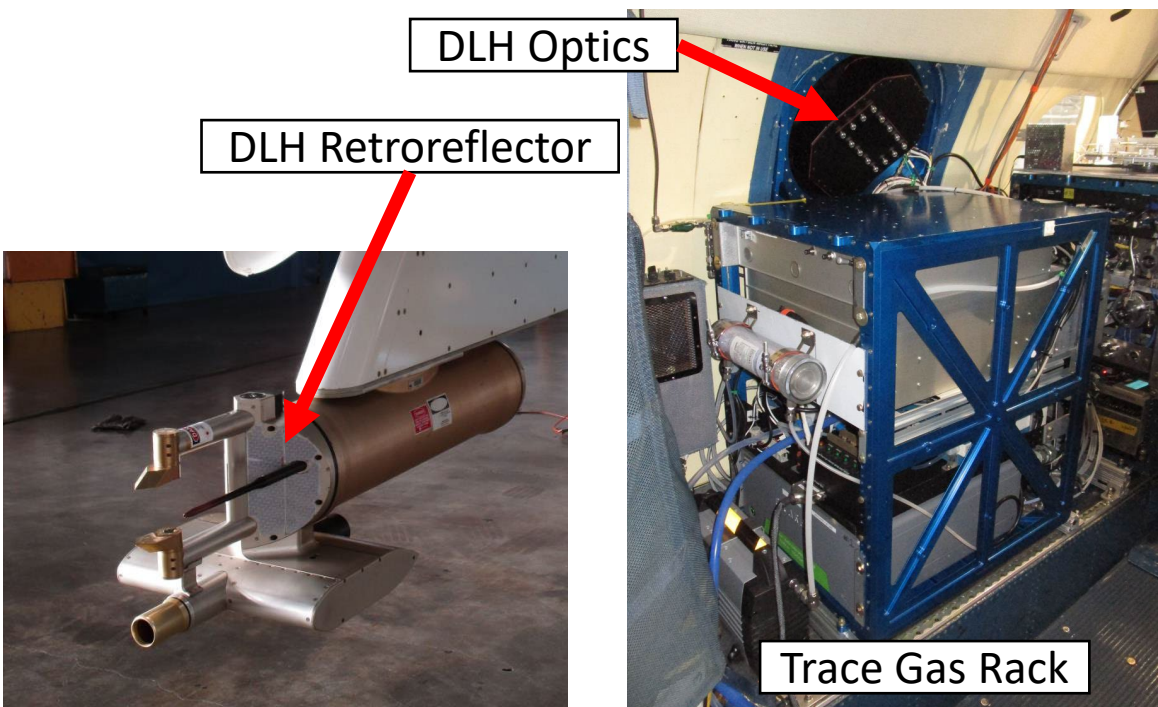
Glenn Diskin, John Nowak, Yonghoon Choi, Josh DiGangi, Mario Rana
NASA Langley Research Center

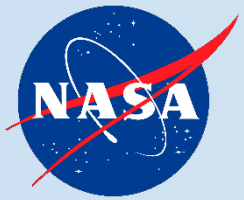
ACTIVATE Science Team Meeting
11/07/2022



Instrument	Species	Data Rate	Precision (1σ)	Accuracy
DLH	H ₂ O _(v)	1 Hz/20 Hz	0.1%/0.05 ppm _v	5%/1 ppm _v
PICARRO G2401-m	CO ₂	0.4 Hz	0.1 ppm	0.1 ppm
	CH ₄	0.4 Hz	1 ppb	1%
	CO	0.4 Hz	5 ppb	2%
2B Tech 205	O ₃	0.5 Hz	2 ppb _v	5 ppb _v (5%)

- Diode Laser Hygrometer (DLH)
 - Open path absorption spectroscopy
 - Temporal resolution limited by beam extent and aircraft velocity
 - Up to 100 Hz data available if desired
- PICARRO G2401-m
 - Cavity ringdown absorption spectroscopy
- 2B Tech O₃
 - Dual beam UV absorption measurement
- Data status
 - All R0 data submitted as of 10/31/2022





Data Coverage



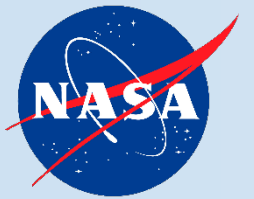
- Generally good coverage over most of the project
- PICARRO in Feb 2020 suffered a leak leading to some data loss
- DLH in Jan 2021 has a missing flight due to no static temp data
- PICARRO & Ozone missing in Mar-Apr 2021 due to HU-24 power inverter issues

2020	Nov/Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept
H2O			94%	96%					100%	100%
CO2			51%	95%					97%	97%
CH4			51%	95%					97%	97%
CO			51%	95%					97%	97%
O3			86%	93%					94%	94%

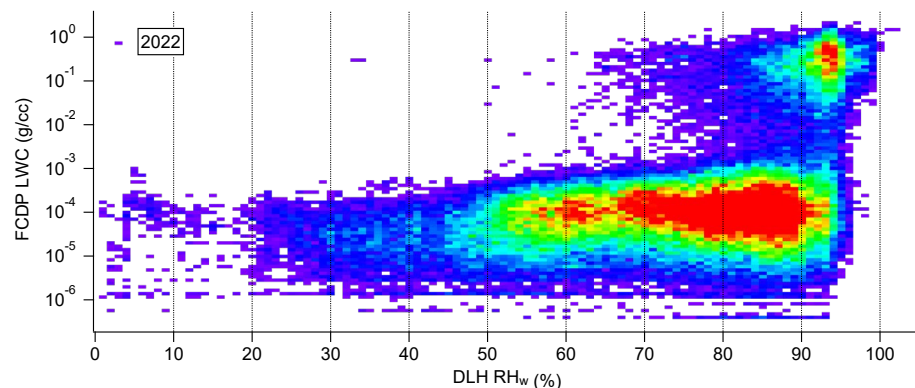
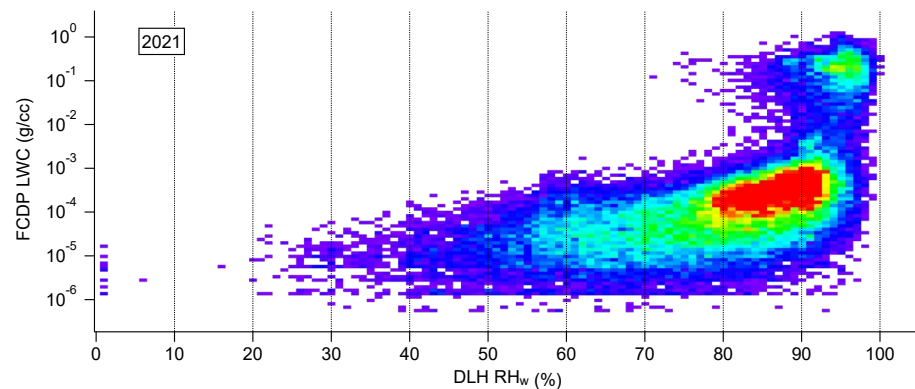
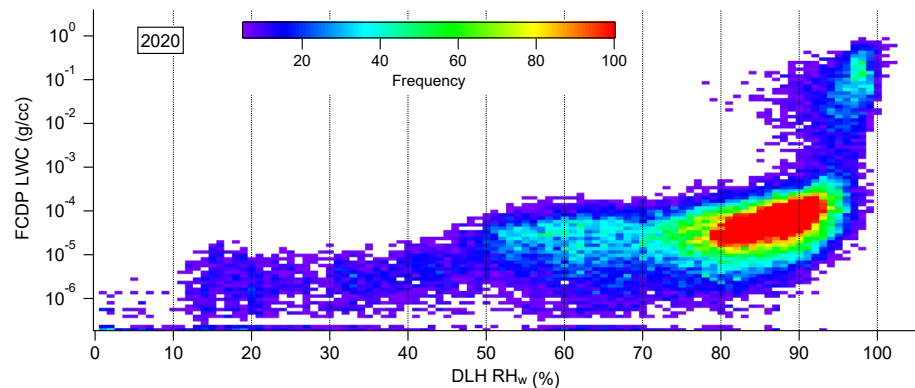
2021	Nov/Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept
H2O		48%	100%	99%	90%	100%	100%			
CO2		95%	97%	0%	0%	97%	97%			
CH4		95%	97%	0%	0%	97%	97%			
CO		95%	97%	0%	0%	97%	97%			
O3		87%	93%	0%	0%	95%	94%			

2022	Nov/Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept
H2O	100%	94%	100%	99%		98%	100%			
CO2	97%	97%	97%	95%		97%	94%			
CH4	97%	97%	97%	95%		97%	94%			
CO	97%	97%	97%	95%		97%	94%			
O3	95%	95%	95%	92%		92%	94%			

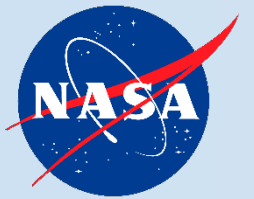
At native data rates: H₂O – 1Hz, CO₂/CH₄/CO – 0.4 Hz, O₃ – 0.5 Hz



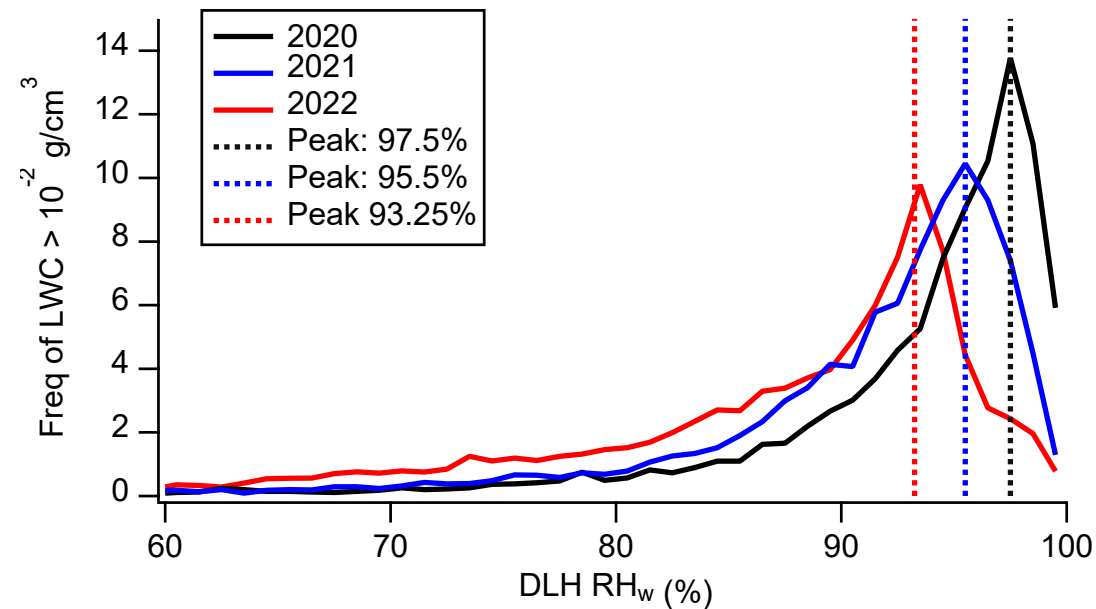
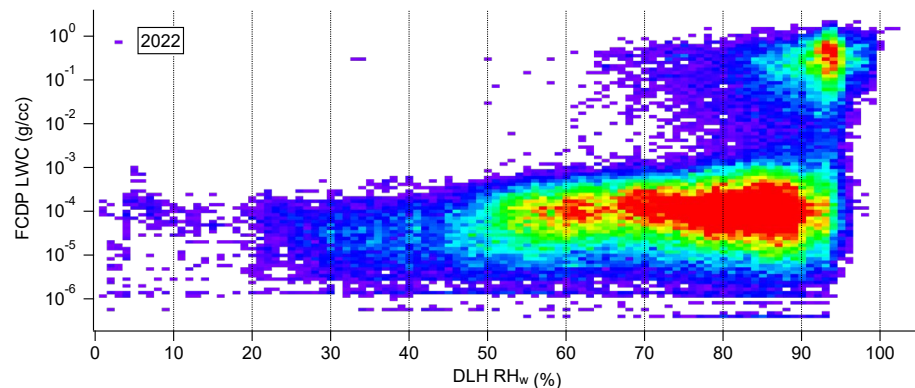
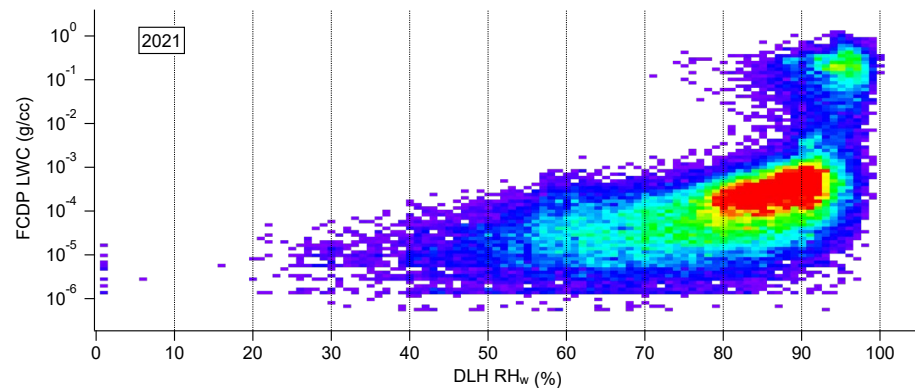
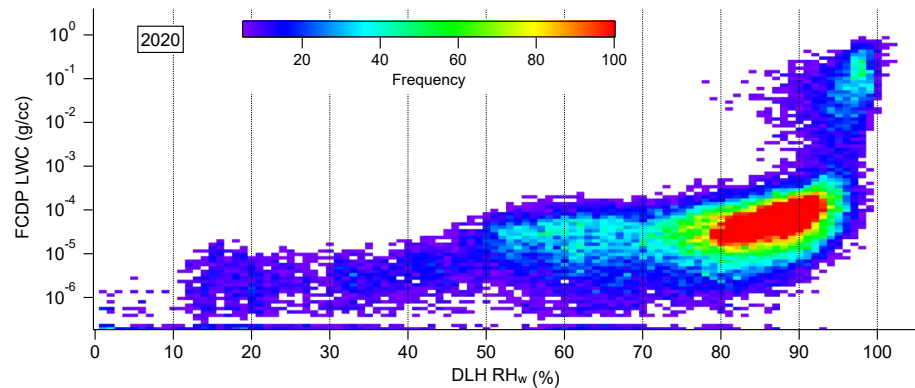
RH Product Evaluation



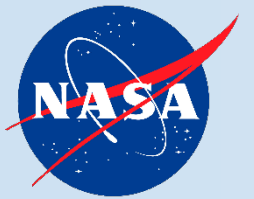
- Derived from DLH water vapor and static temperature (Thornhill)
- DLH does not always report in very dense cloud, can explain some low bias, but unlikely to statistically vary with time



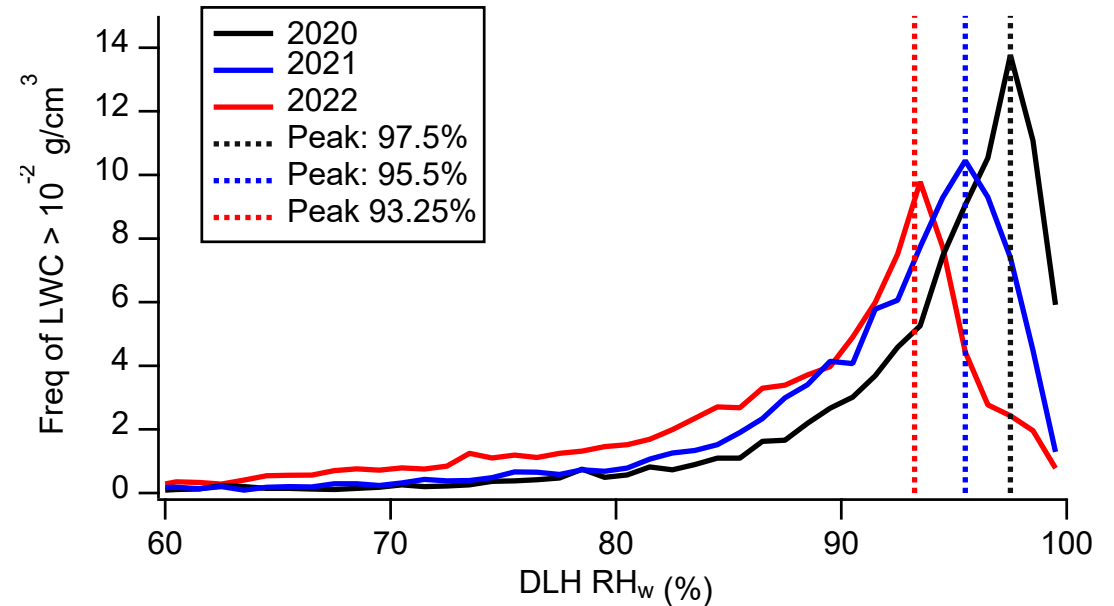
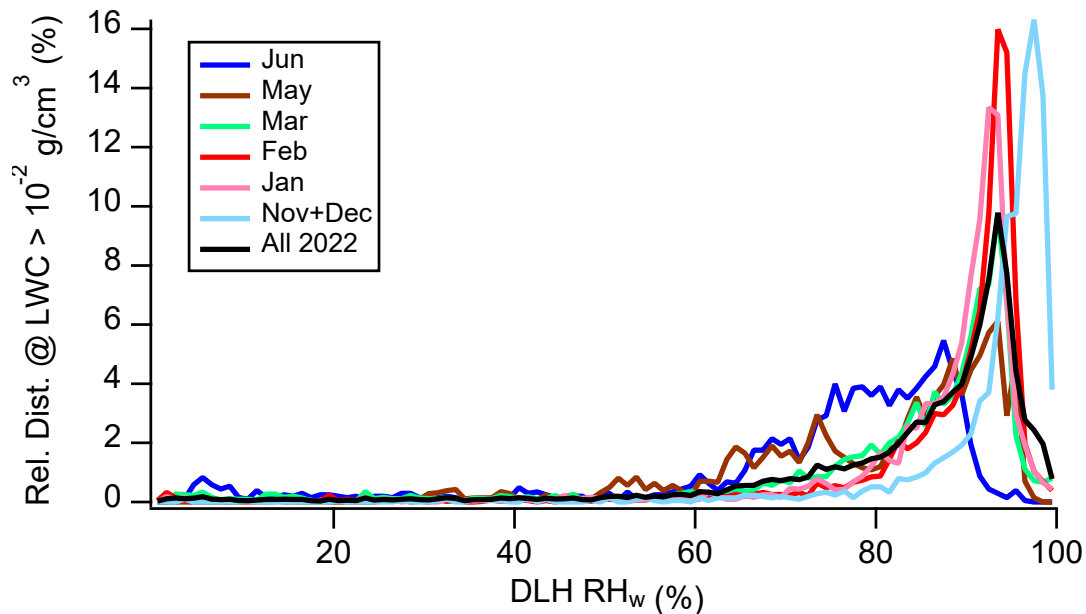
Product Evaluation



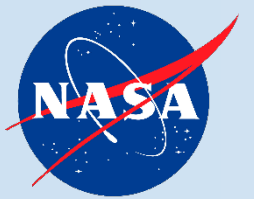
- Derived from DLH water vapor and static temperature (Thornhill)
- DLH does not always report in very dense cloud, can explain some low bias, but unlikely to statistically vary with time



Product Evaluation



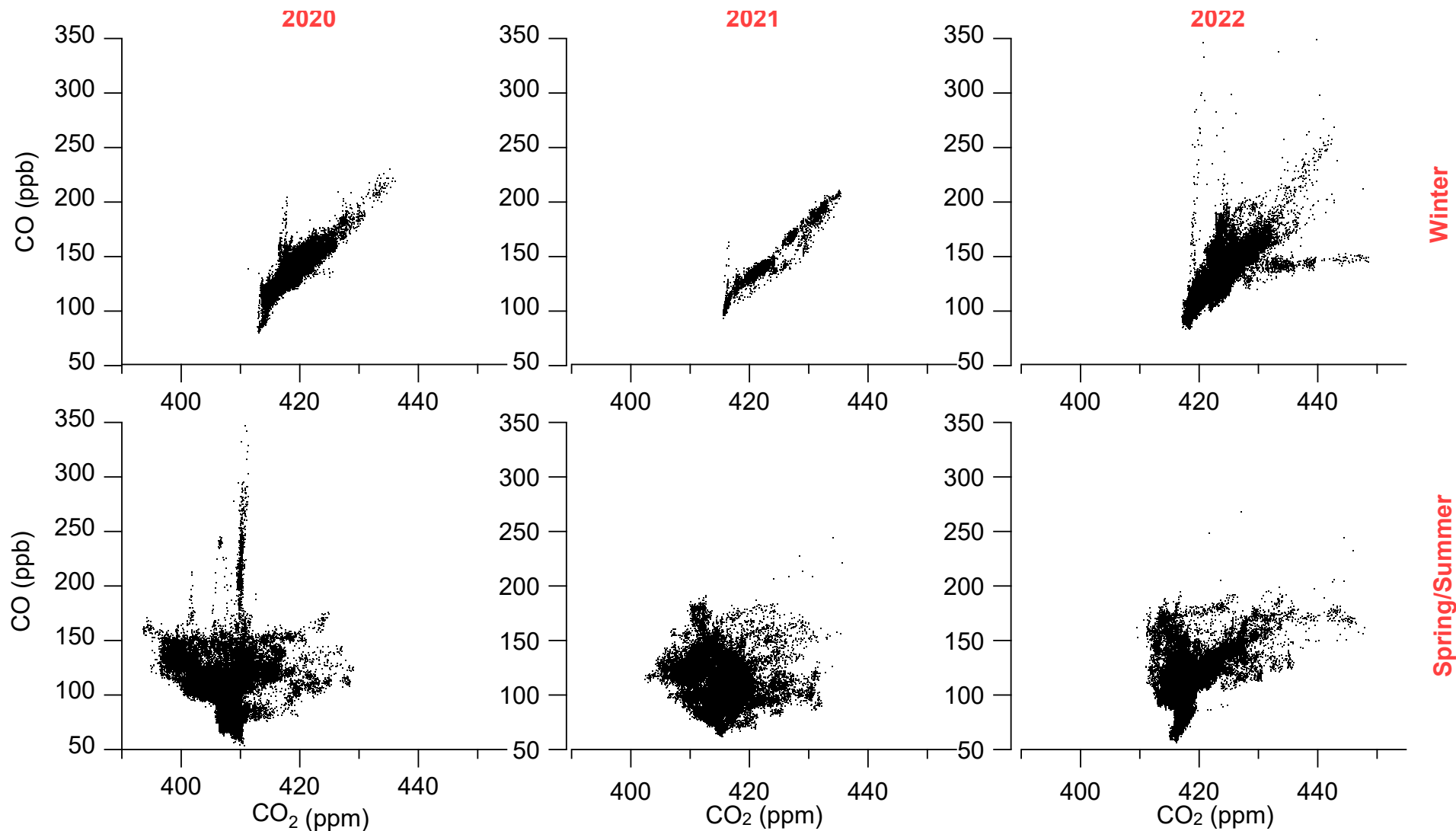
- Derived from DLH water vapor and static temperature (Thornhill)
- DLH does not always report in very dense cloud, can explain some low bias, but unlikely to statistically vary with time

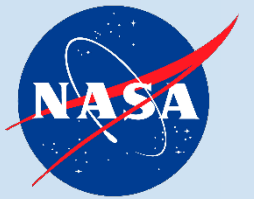


Trace Gas Enhancement Ratios



- Enhancements in CO and CO₂ conc can indicate past combustion efficiency
- Works OK in winter, CO₂ uptake complicates spring/summer analysis

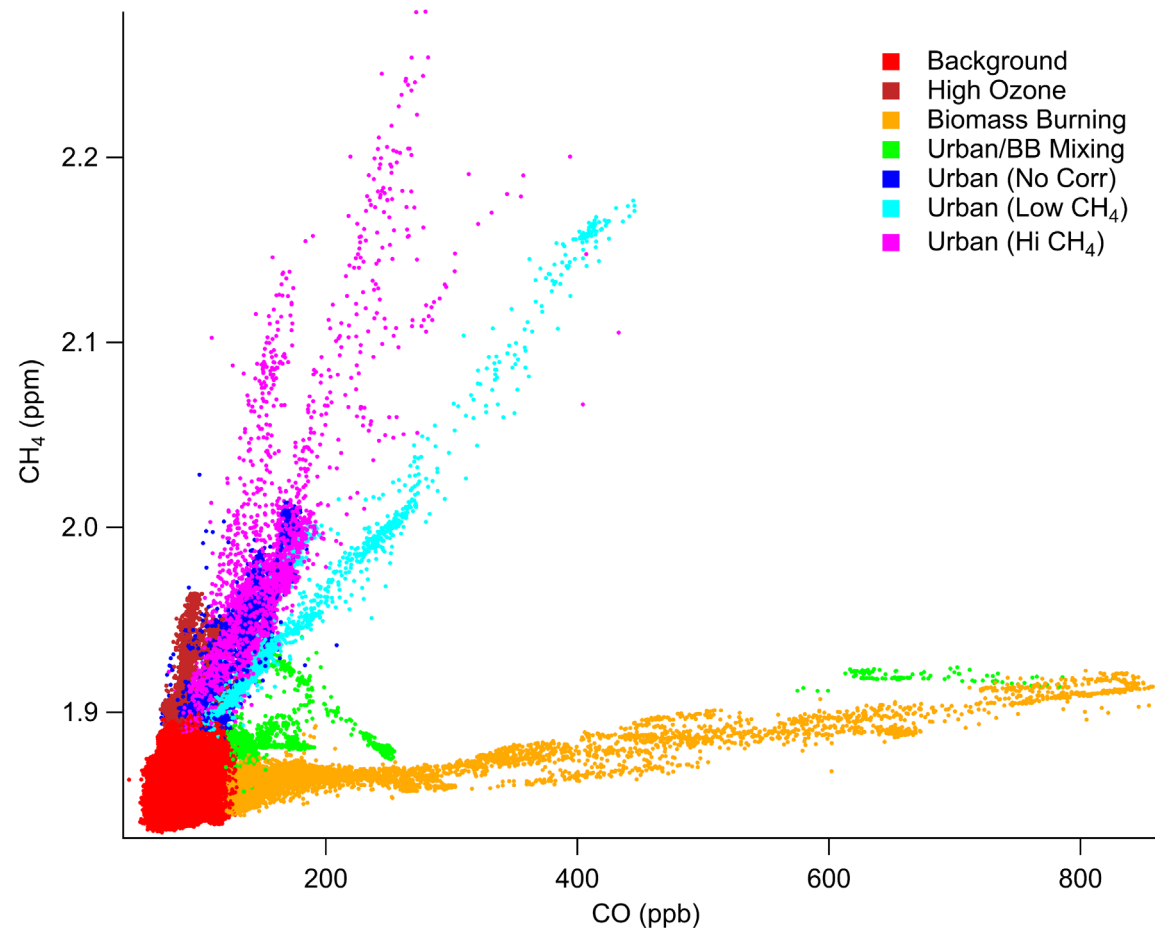
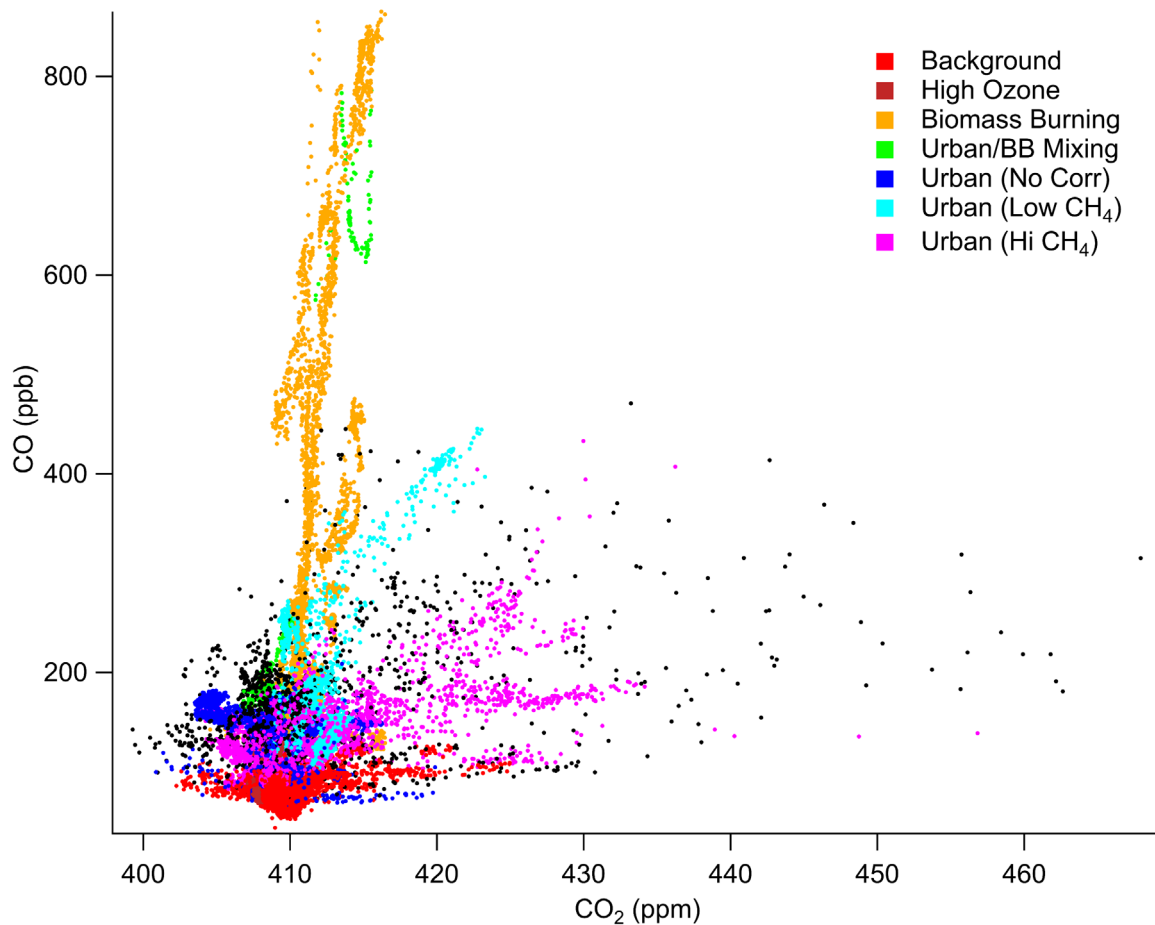


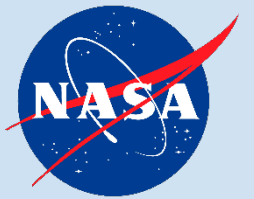


Trace Gas Enhancement Ratios

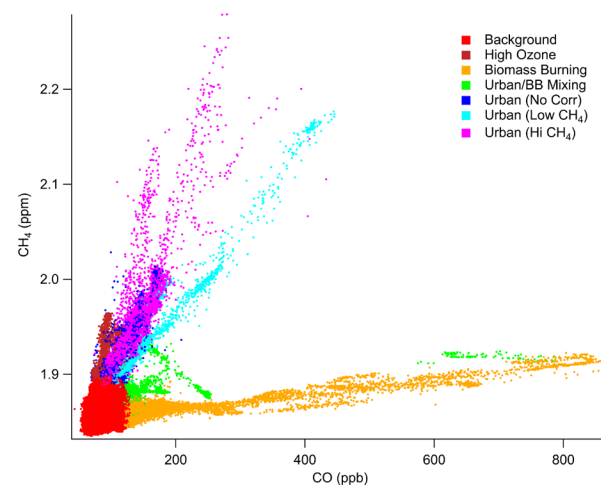


CAMP2EX 2019

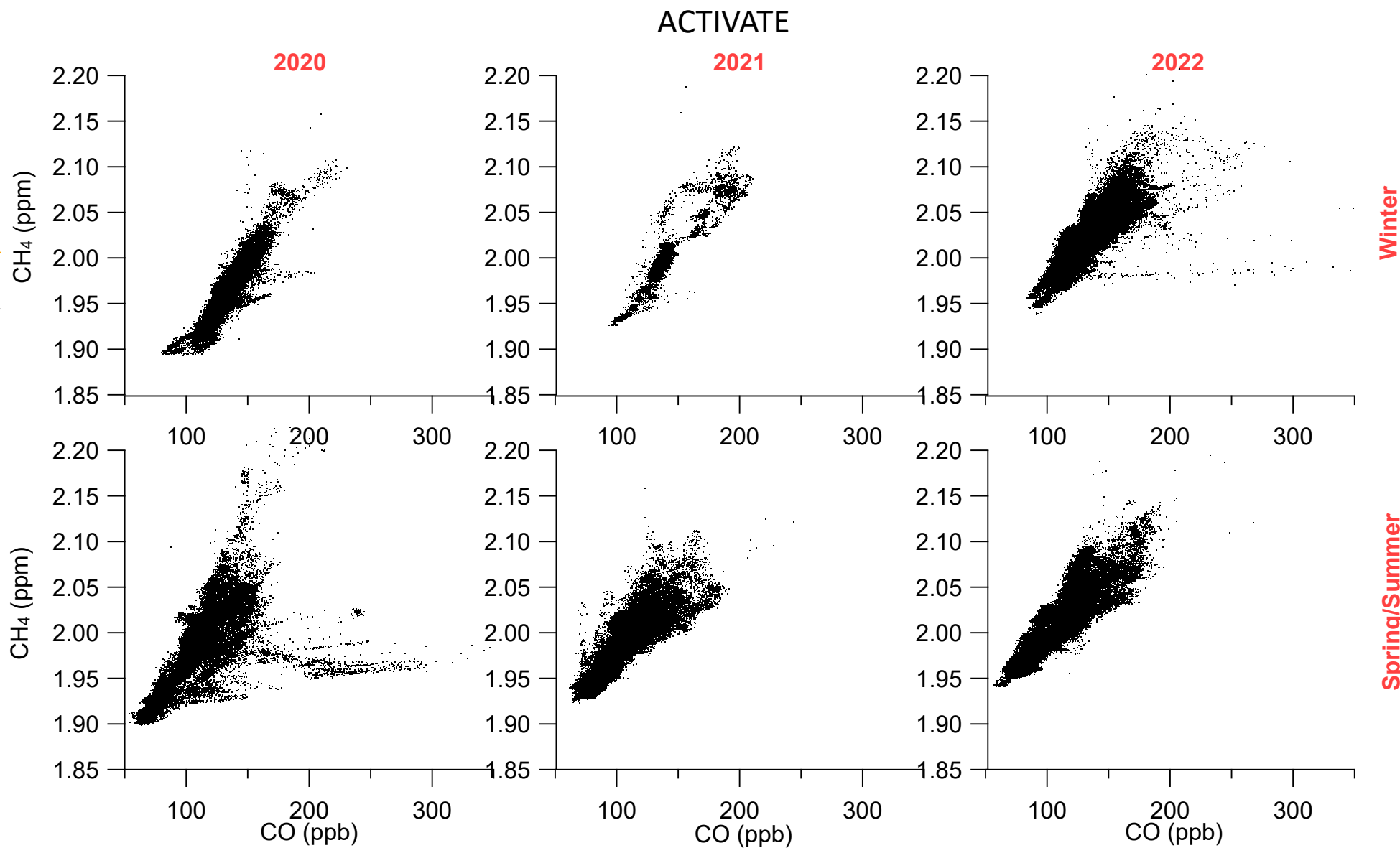


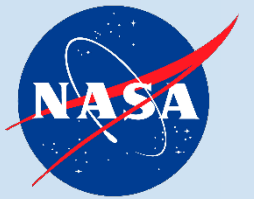


Trace Gas Enhancement Ratios

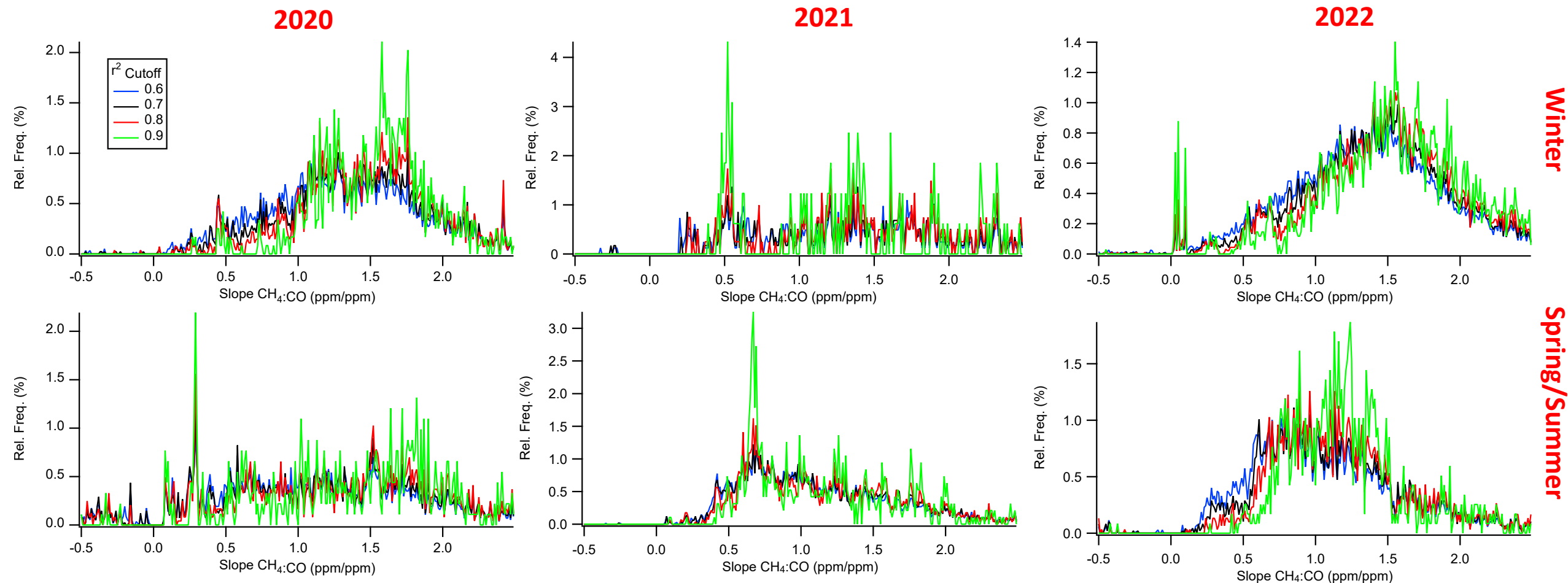


CAMP2EX 2019

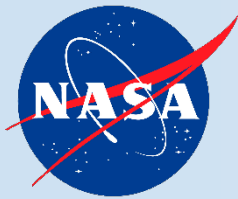




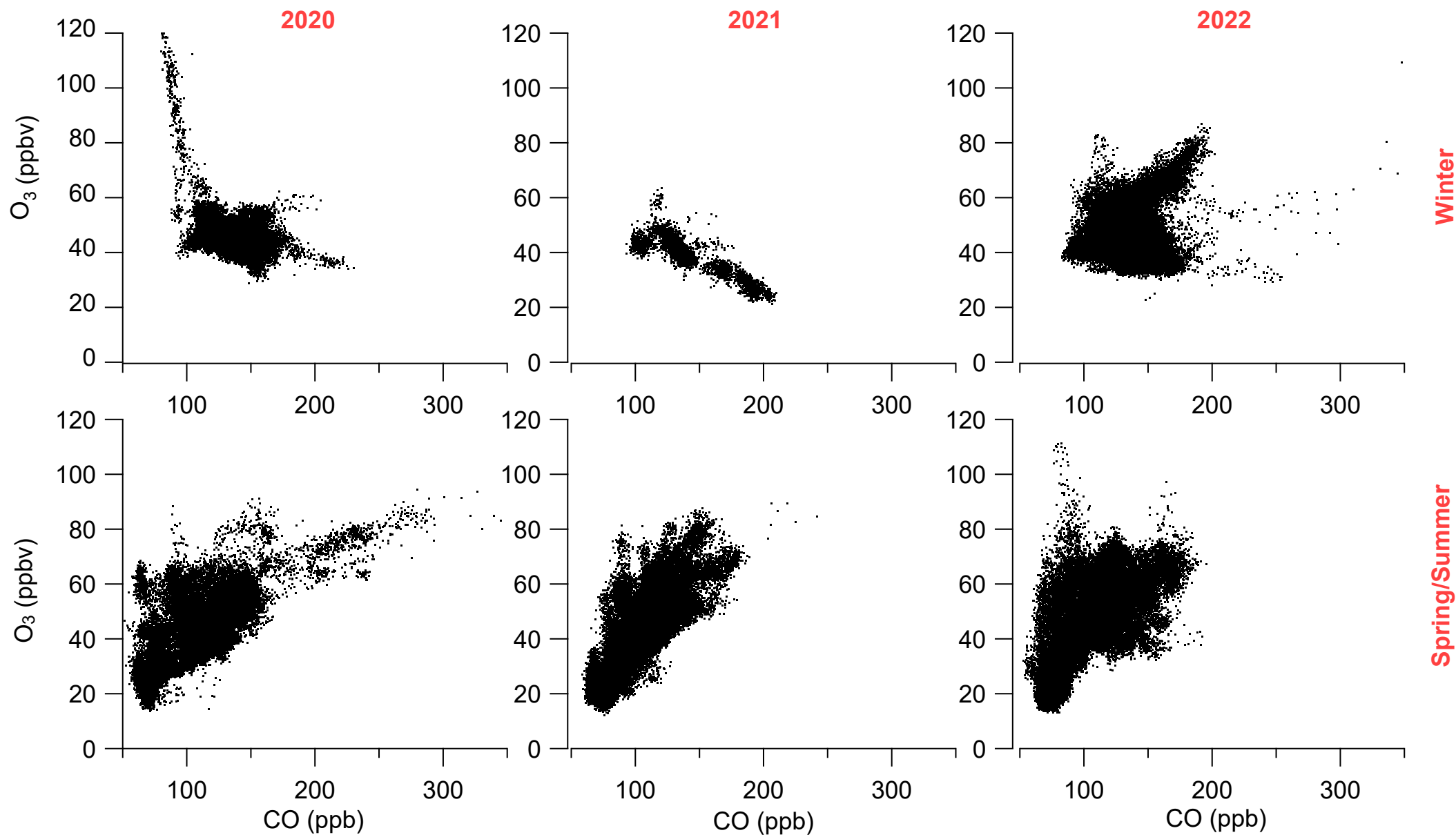
Trace Gas Enhancement Ratios – Rolling Slopes

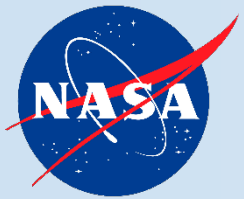


- Linear fit of 60 s rolling bins along timeseries, filter by r^2
- Needs more refinement to be a useful airmass discriminator

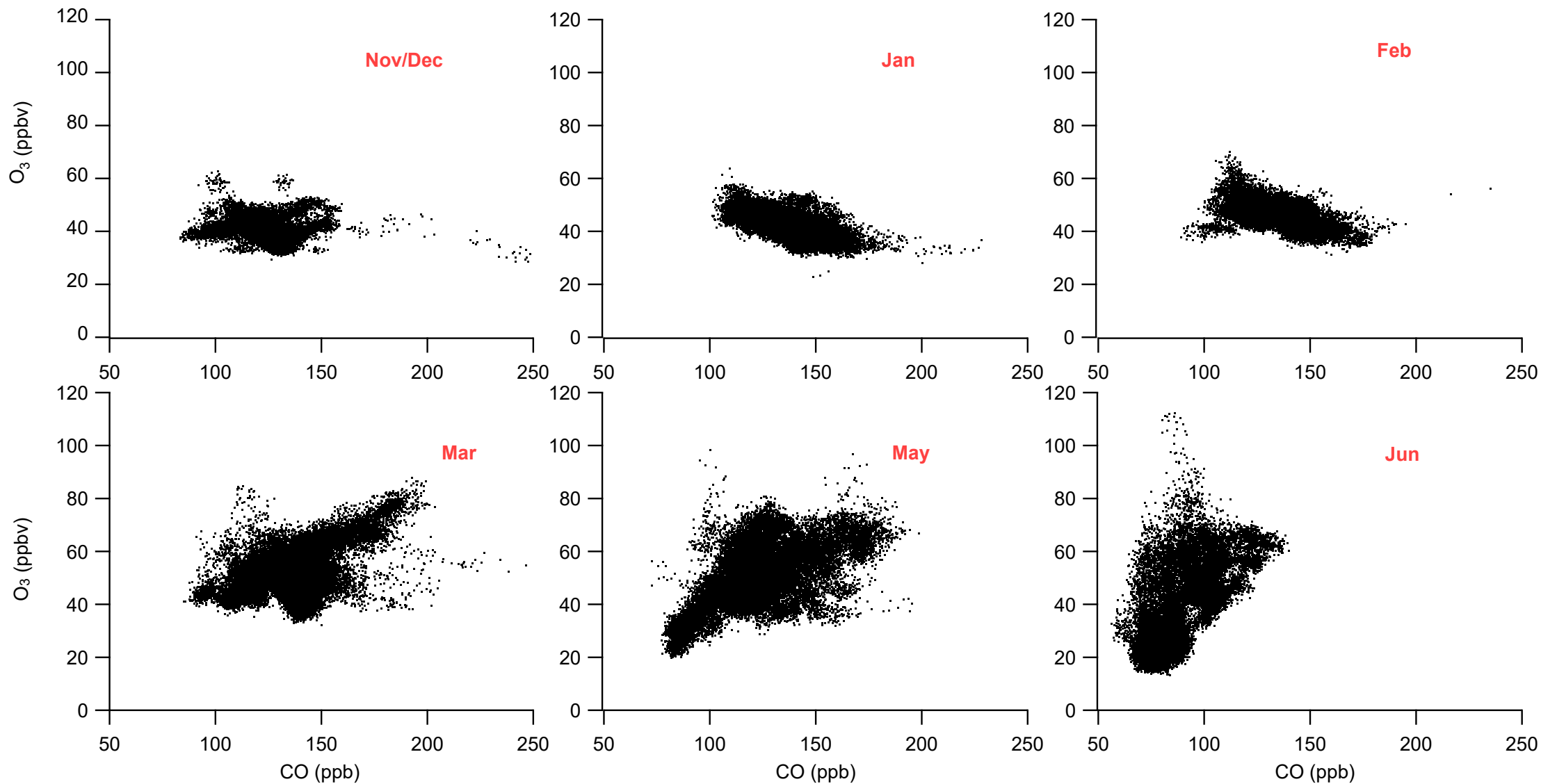


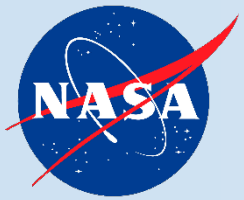
Trace Gas Enhancement Ratios





Monthly Variability in $O_3:CO$ in 2022





Continuing Work



- Generate flag for clear biomass burning/stratospheric influence events
- Compare emissions along different jetways, look for systematic difference
- Looking for analysis help
 - Grad student collaboration
 - Postdoc recruitment

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