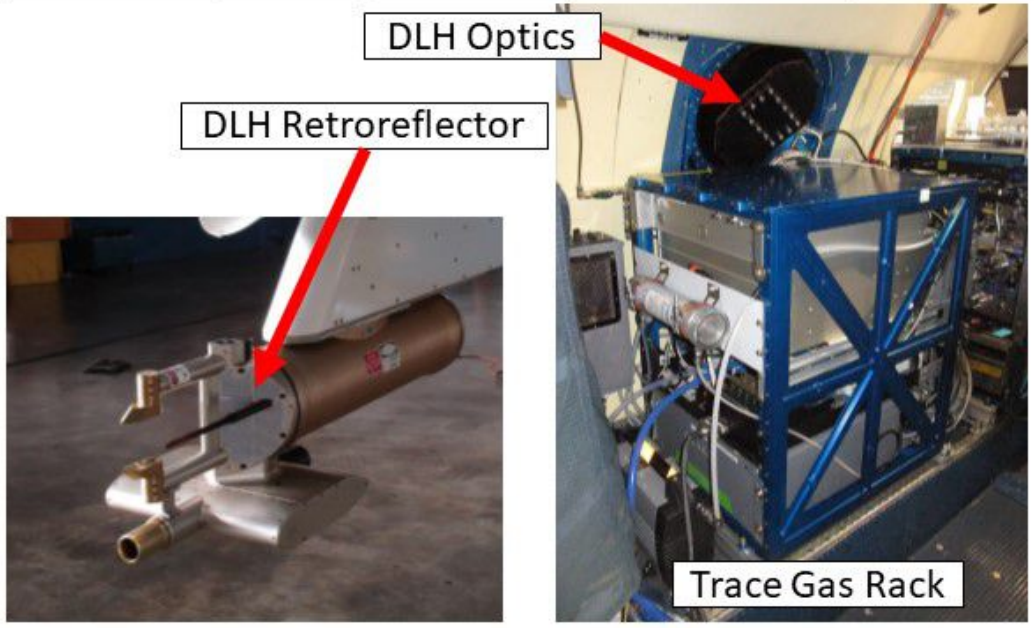
ACTIVATE Falcon Trace Gas Overview

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

ACTIVATE Science Team Meeting
11/07/2022

Payload

Instrument	Species	Data Rate	Precision (1σ)	Accuracy
DLH	$H_2O_{(v)}$	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 O_3
  - 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

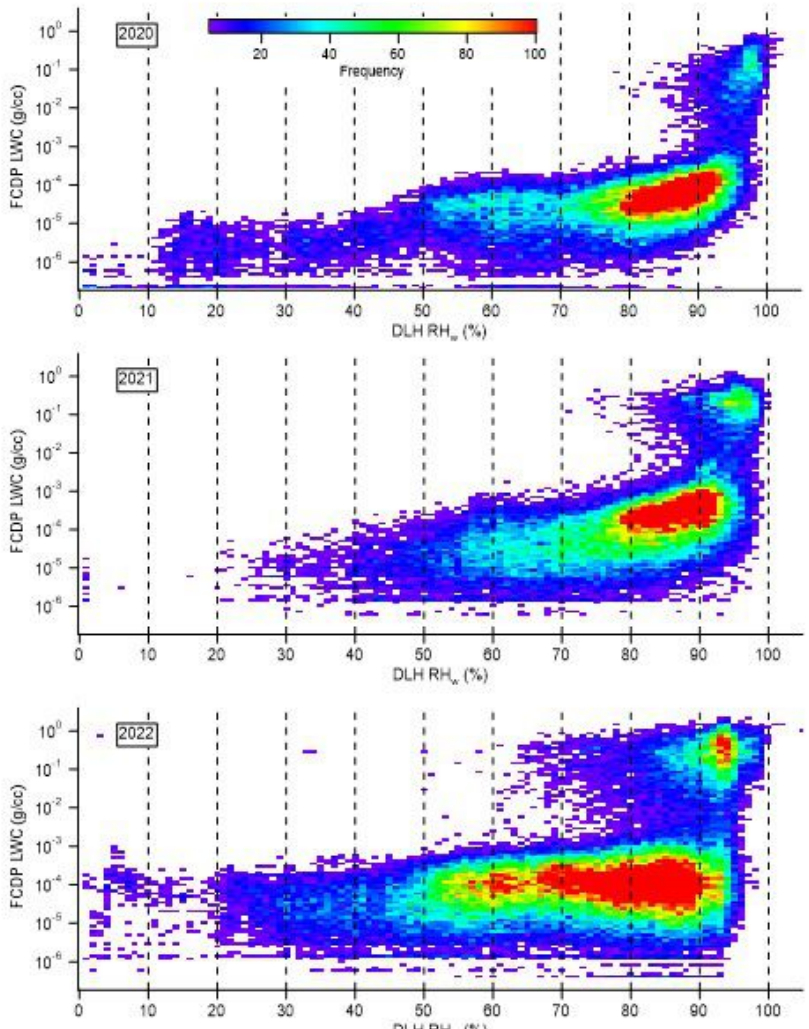
2020	Nov/Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept
H2O			94%	96%					100%	100%
CO2			51%	95%					97%	97%
CH4			51%	95%					97%	97%
CO			51%	95%					97%	97%
O3			86%	93%					94%	94%

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%			

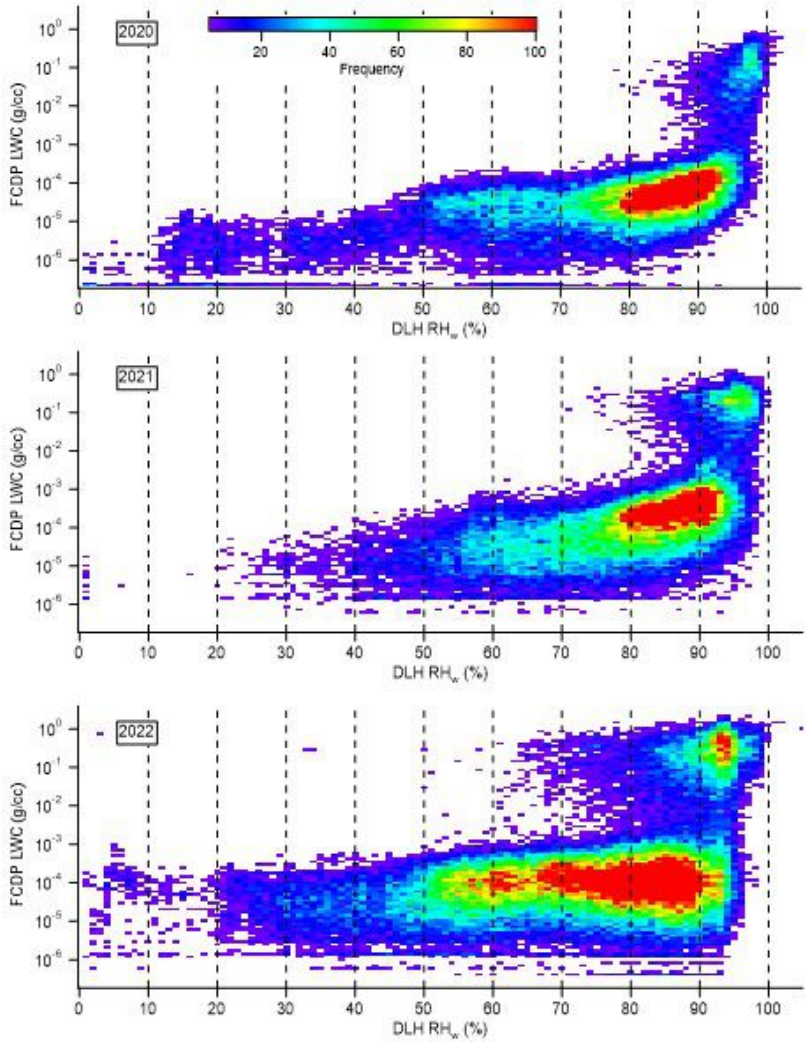
At native data rates: H_2O – 1Hz, CO_2/CH_4/CO – 0.4 Hz, O_3 – 0.5 Hz

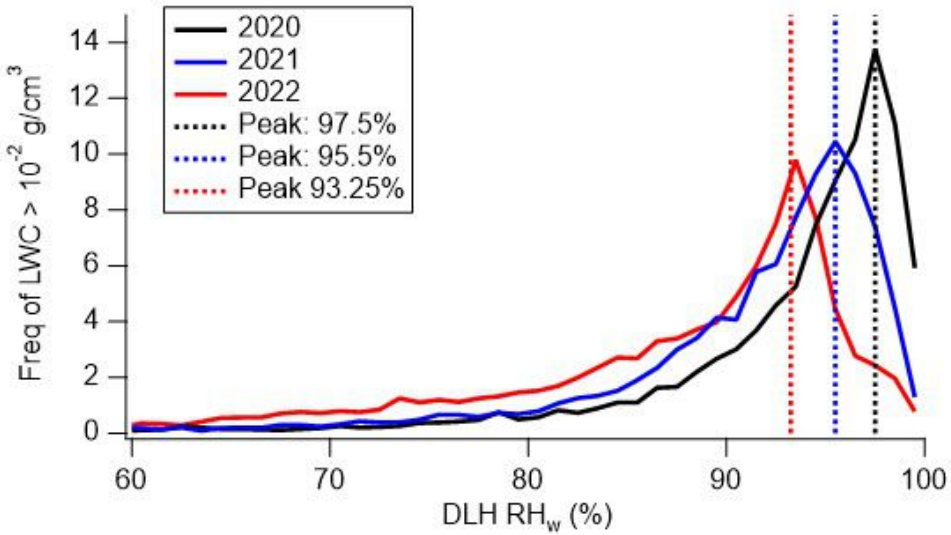
RH Product Evaluation



- 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

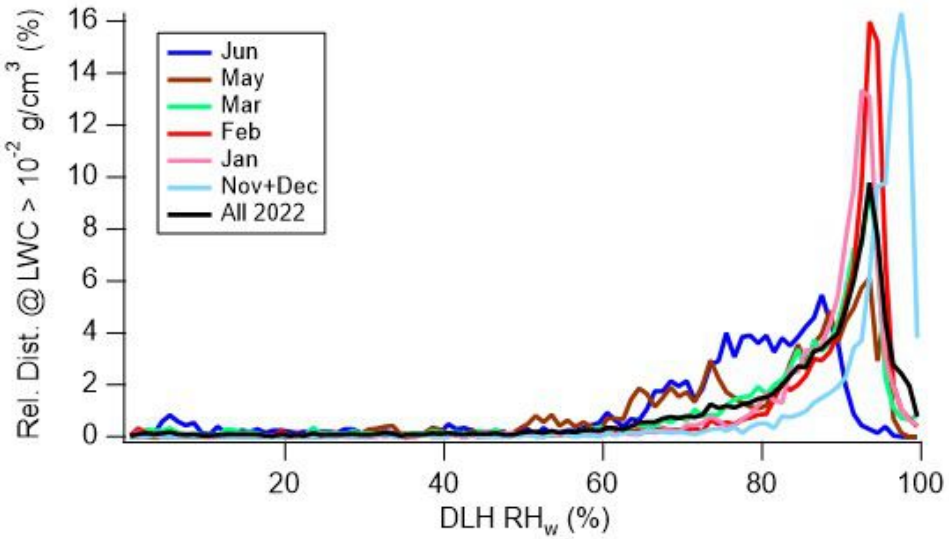
Product Evaluation

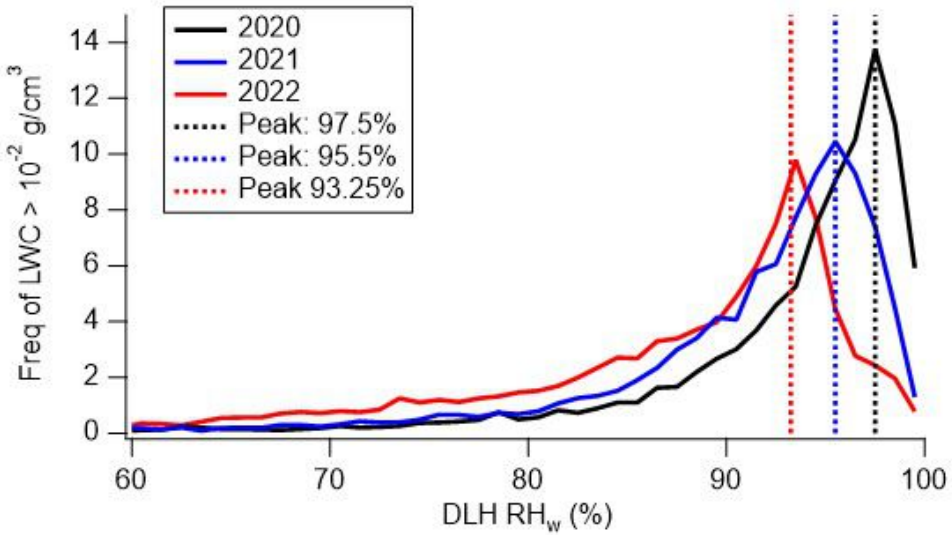




- Derived from DLH water vapor and static temperature (Thornhill)
- DLH does not always report in very dense cloud, can explain some low bias, but unlikely to statistically vary with time

Product Evaluation

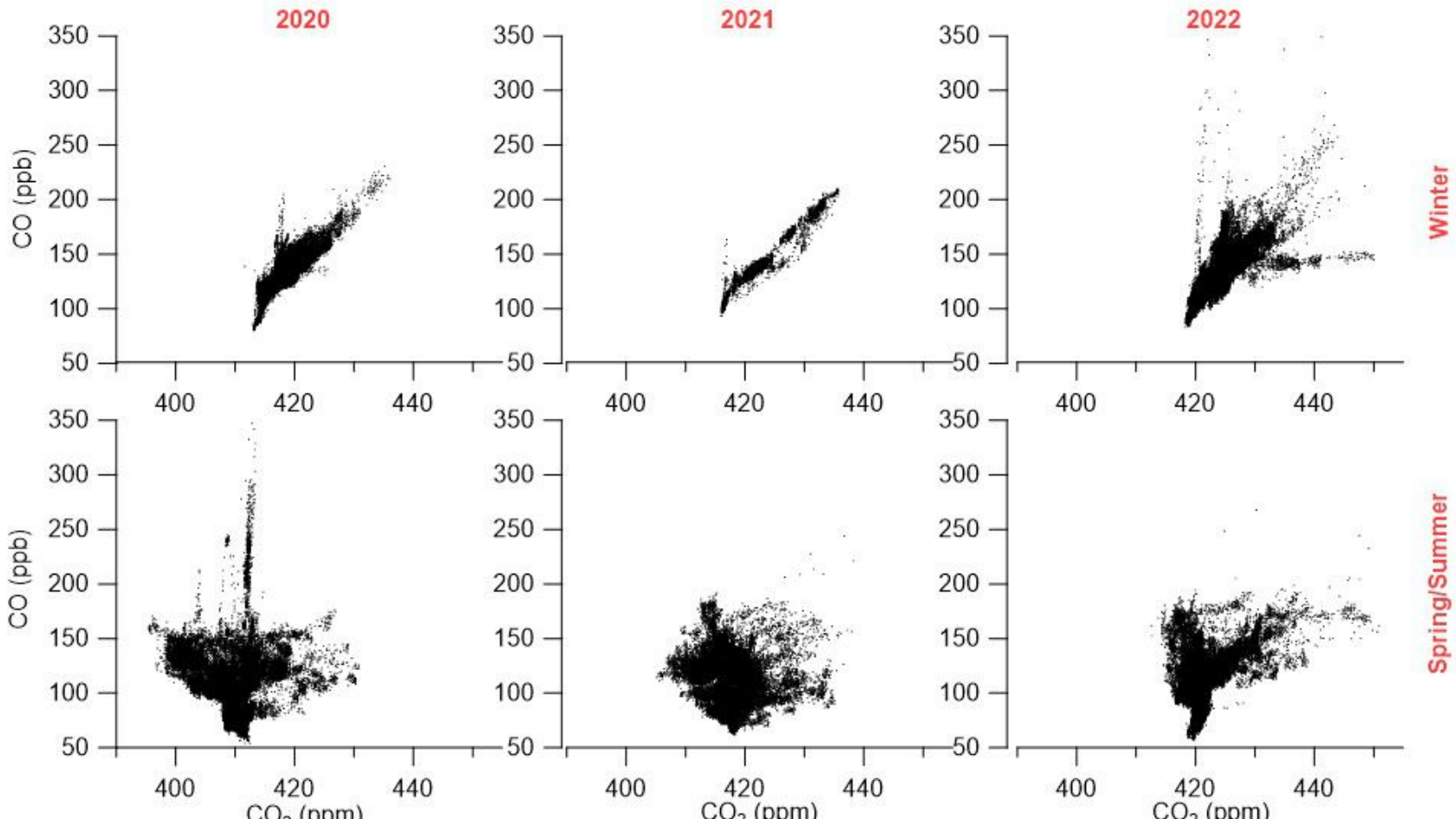




- Derived from DLH water vapor and static temperature (Thornhill)
- DLH does not always report in very dense cloud, can explain some low bias, but unlikely to statistically vary with time

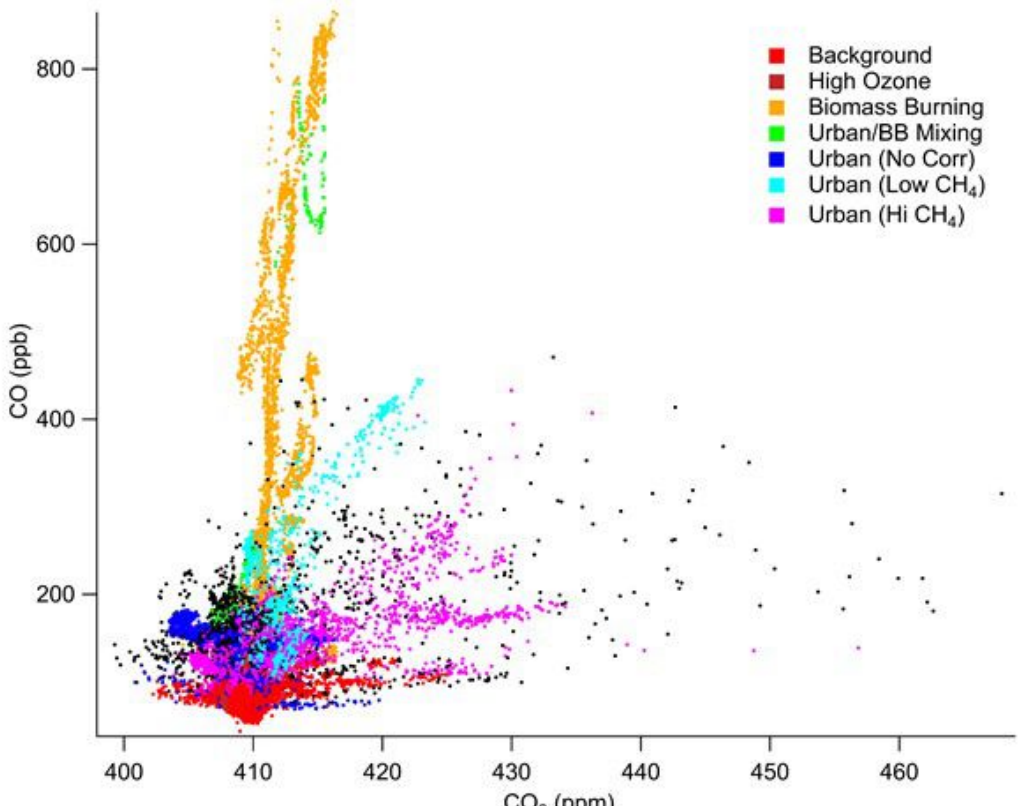
Trace Gas Enhancement Ratios

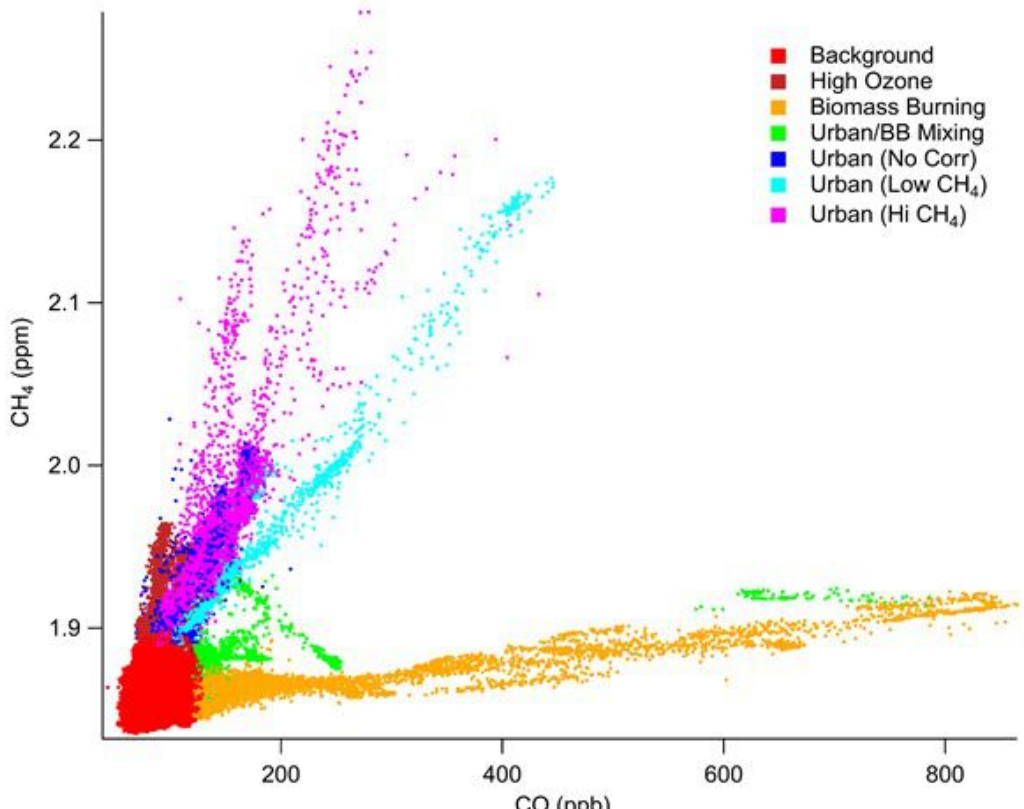
- Enhancements in CO and CO_2 conc can indicate past combustion efficiency
- Works OK in winter, CO_2 uptake complicates spring/summer analysis



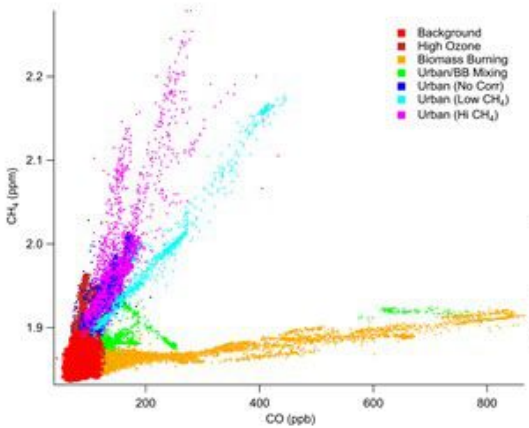
Trace Gas Enhancement Ratios

CAMP2EX 2019

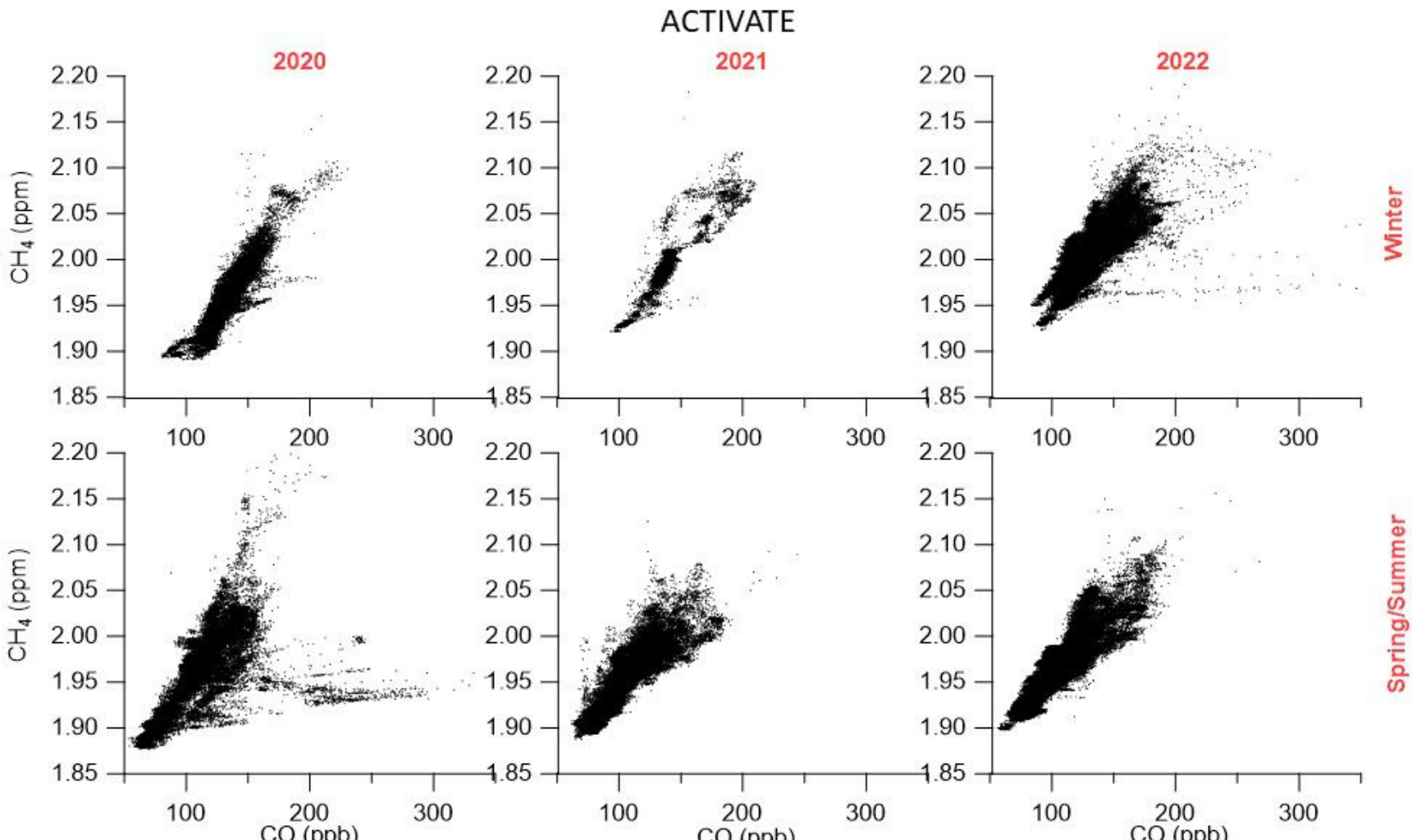




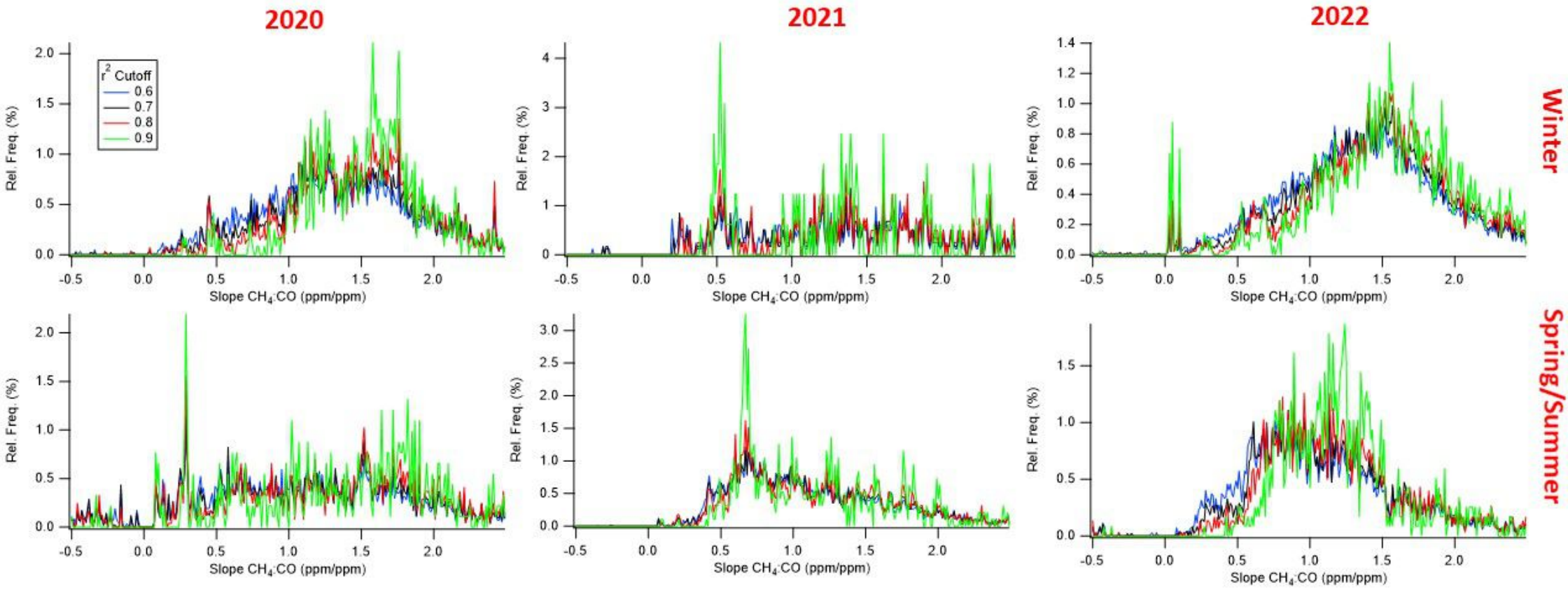
Trace Gas Enhancement Ratios



CAMP2EX 2019

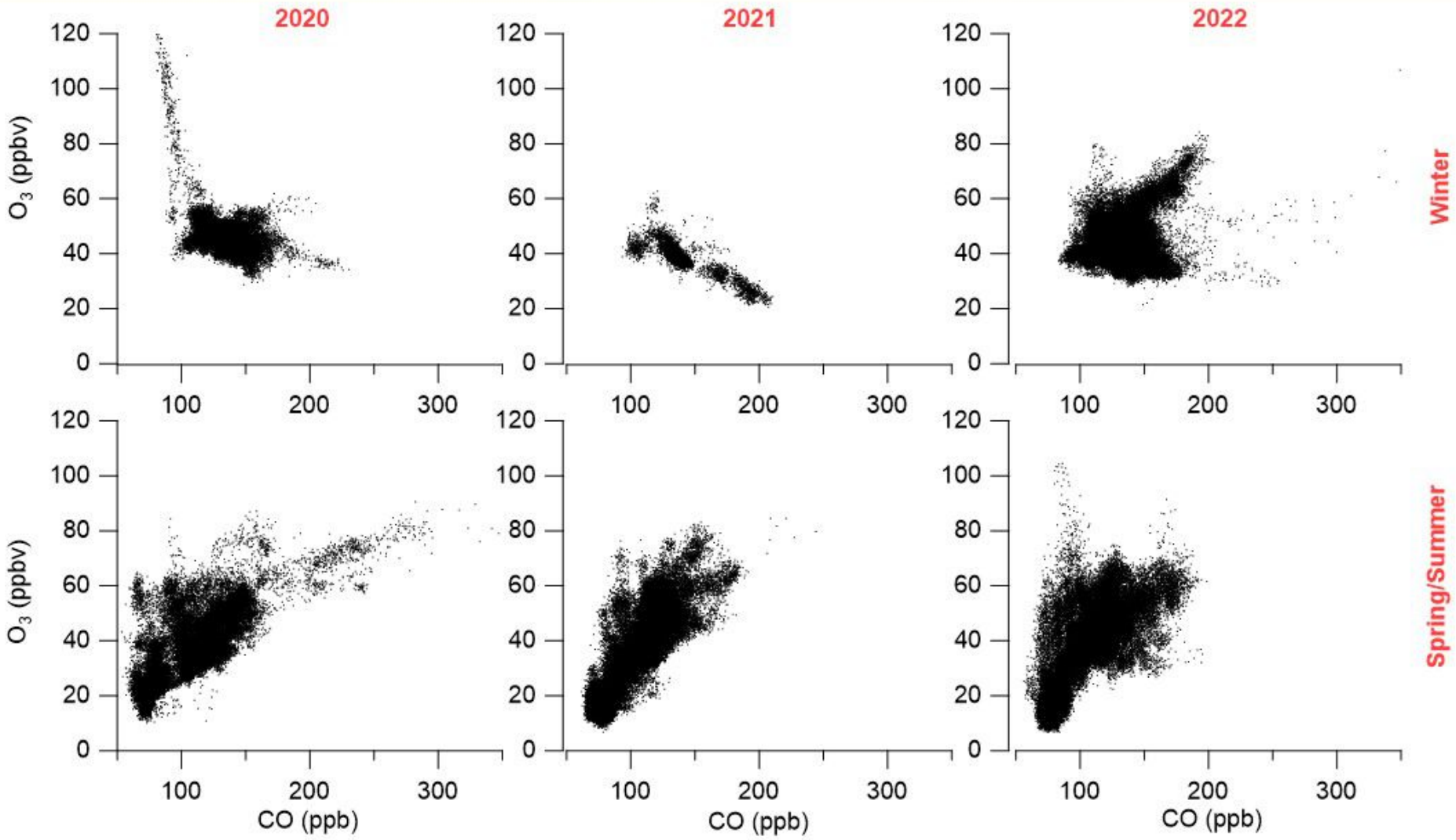


Trace Gas Enhancement Ratios – Rolling Slopes

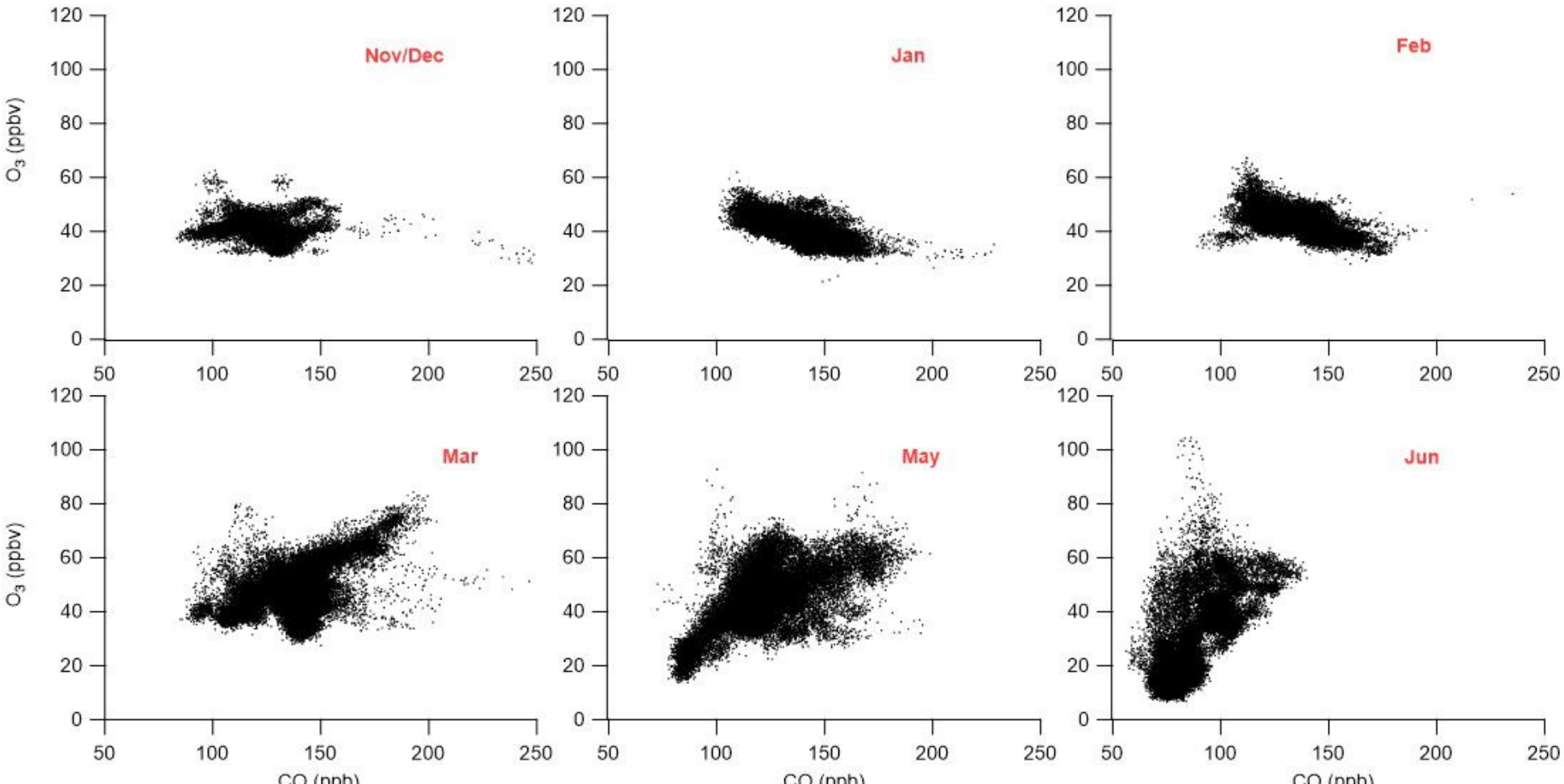


- Linear fit of 60 s rolling bins along timeseries, filter by r^2
- Needs more refinement to be a useful airmass discriminator

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

Glenn Diskin: glenn.s.diskin@nasa.gov

Josh DiGangi: joshua.p.digangi@nasa.gov