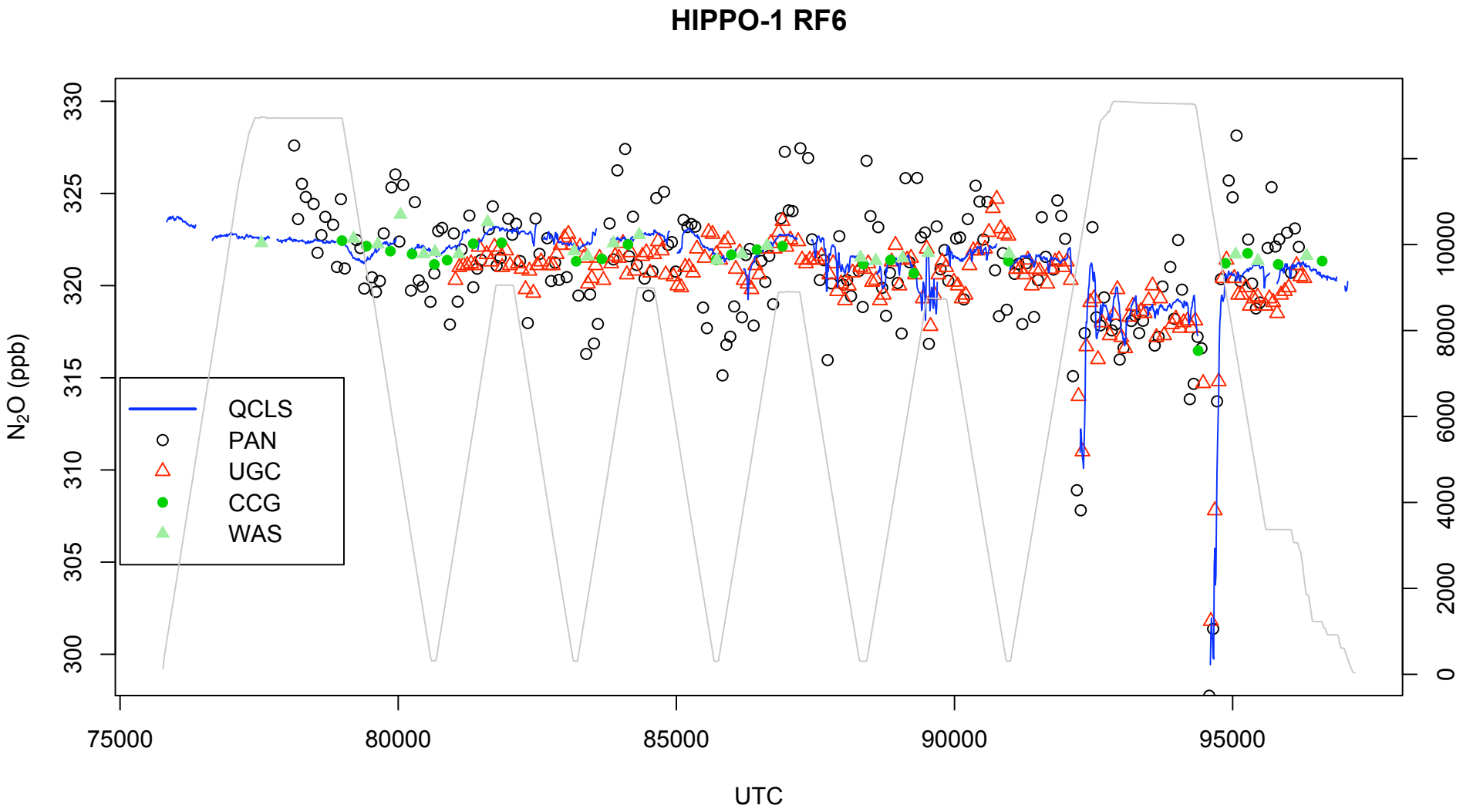
Non-CO_2 in-flight inter-comparisons

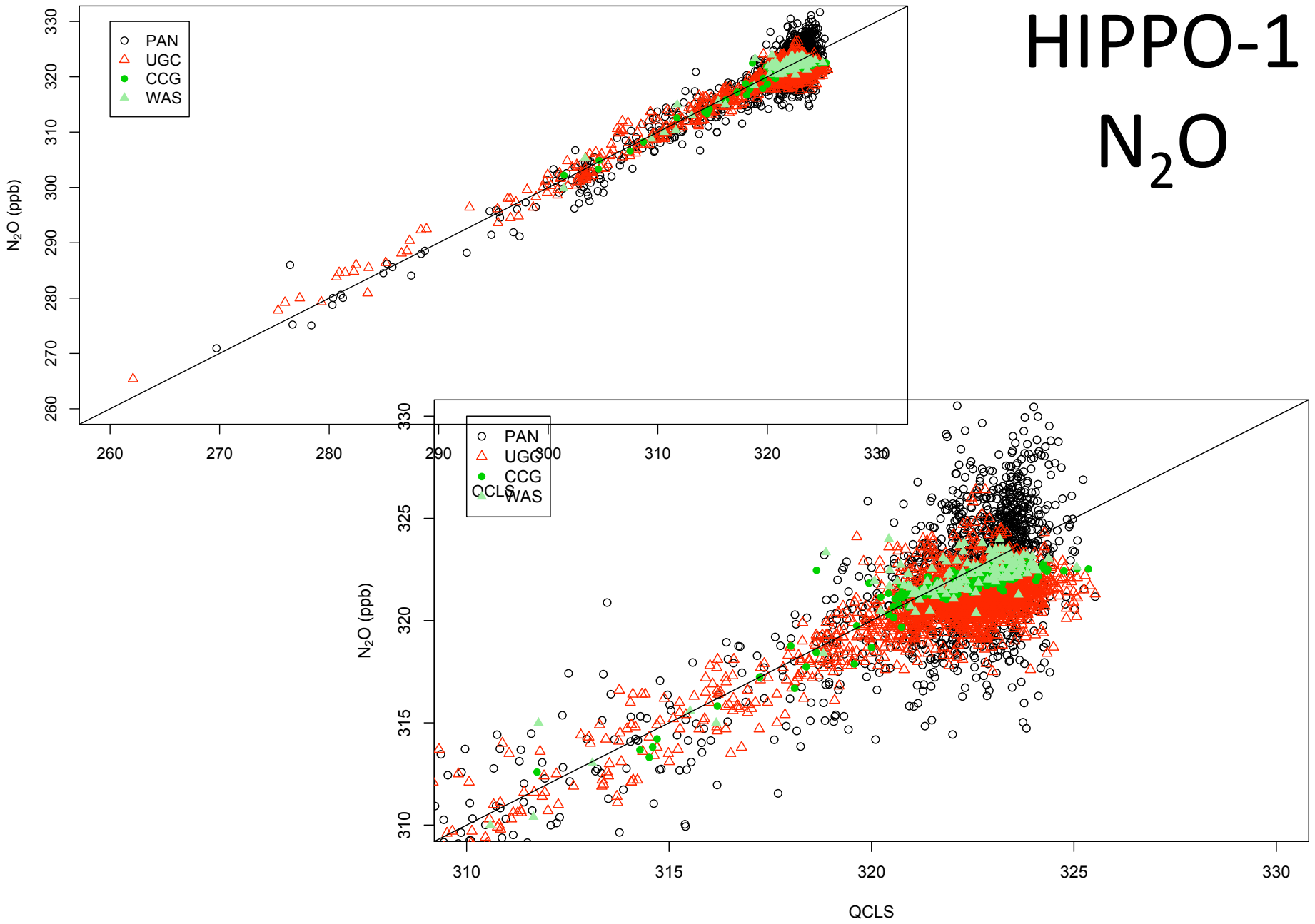
Gases compared- focus on HIPPO-1

- N_2O
  - QCLS, UCATS, PANTHER, CCG flasks, WAS flasks
- CH_4
  - QCLS, UCATS, PANTHER, CCG flasks, WAS flasks
- CO
  - QCLS, RAF, PANTHER, CCG flasks, WAS flasks
- H_2O
  - Mark Zondlo
- O_3
  - Eric Hintsa

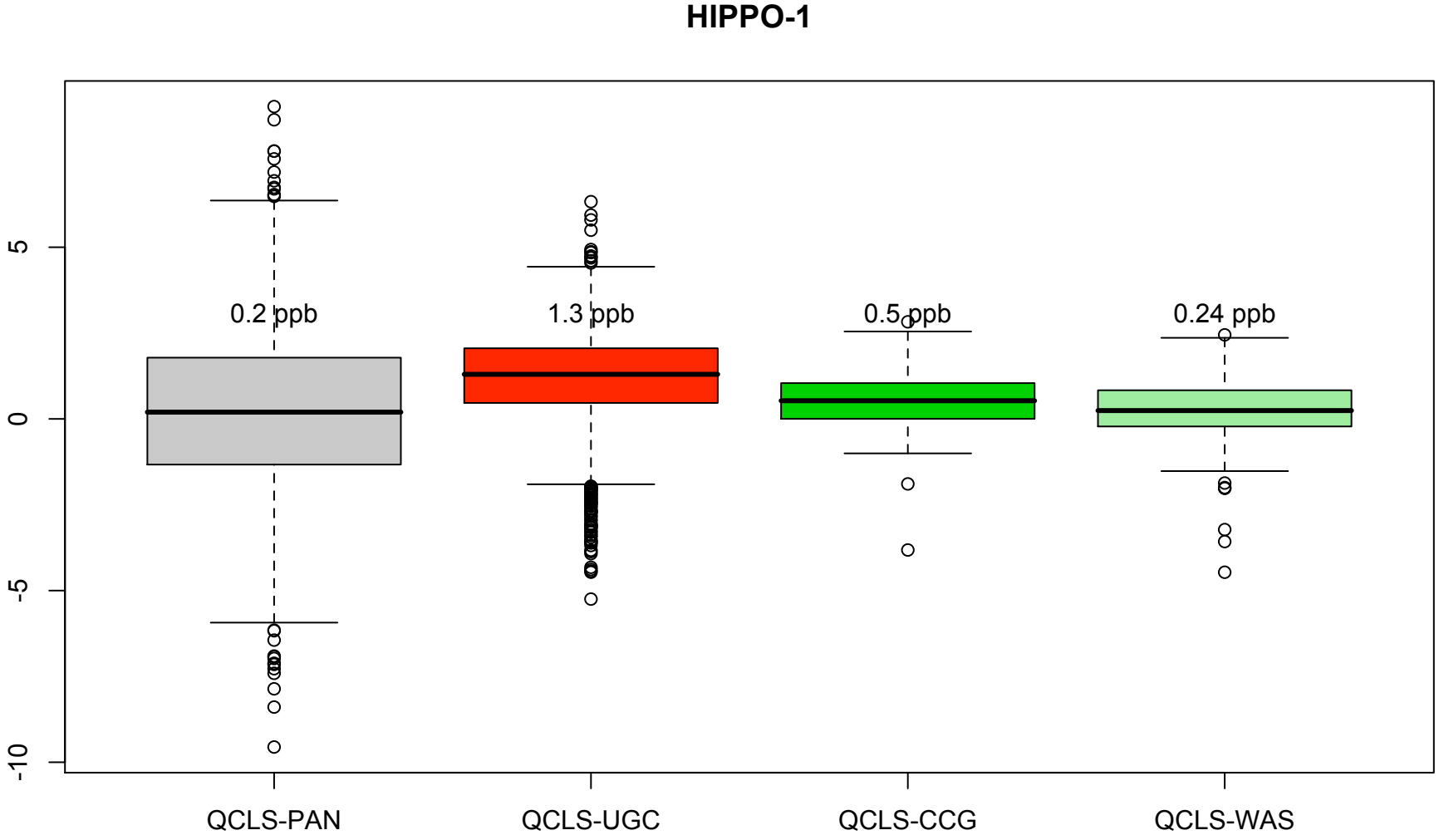
Time series from H1 w/ all measurements



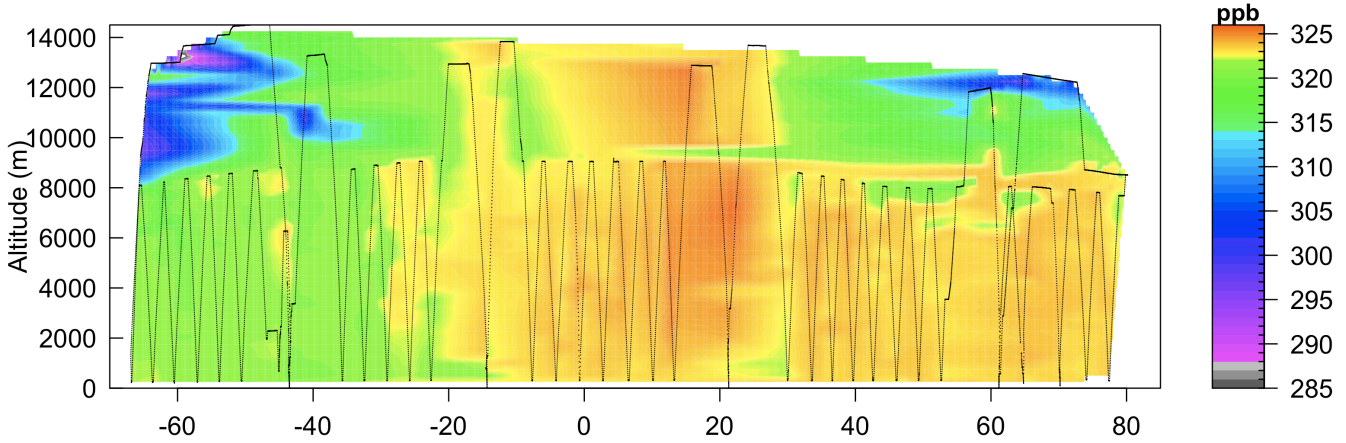
HIPPO-1
N_2O

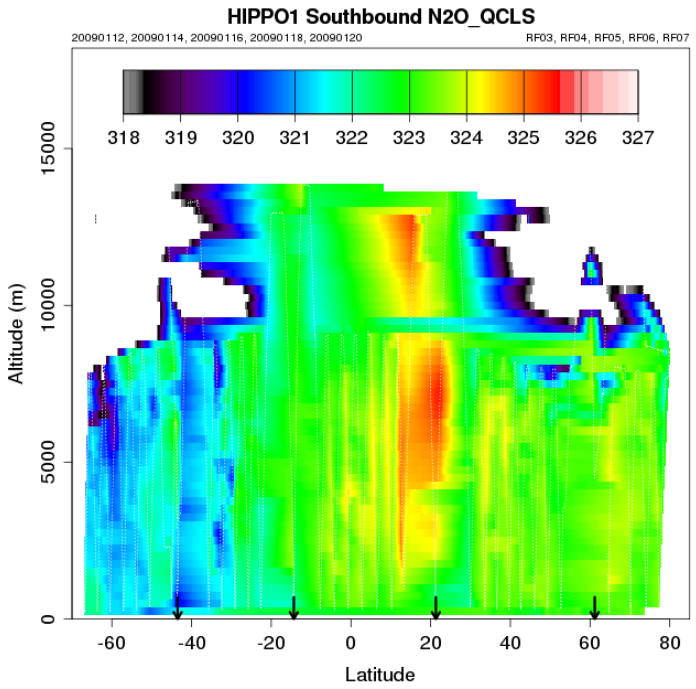

PAN
UGC
CCG
WAS
N2O (ppb)
260
270
280
290
300
310
320
330
QCLS
315
325

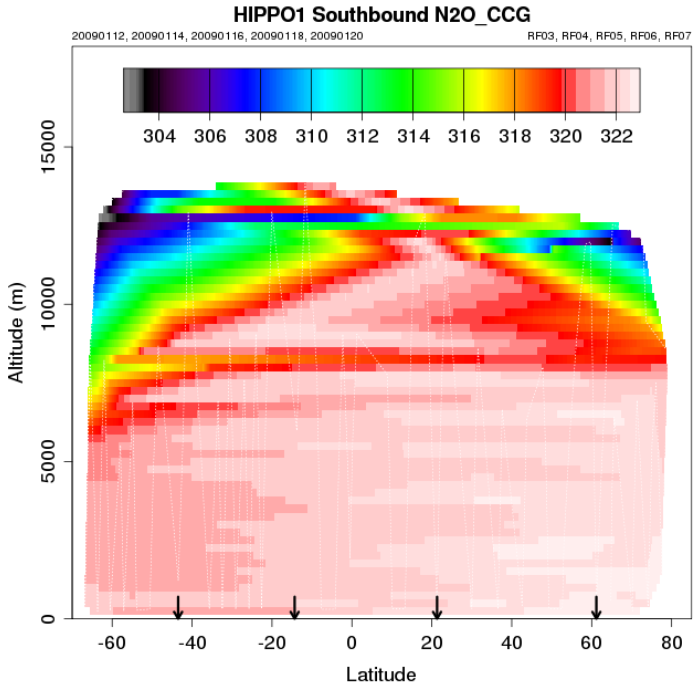
N_2O: HIPPO-1 biases

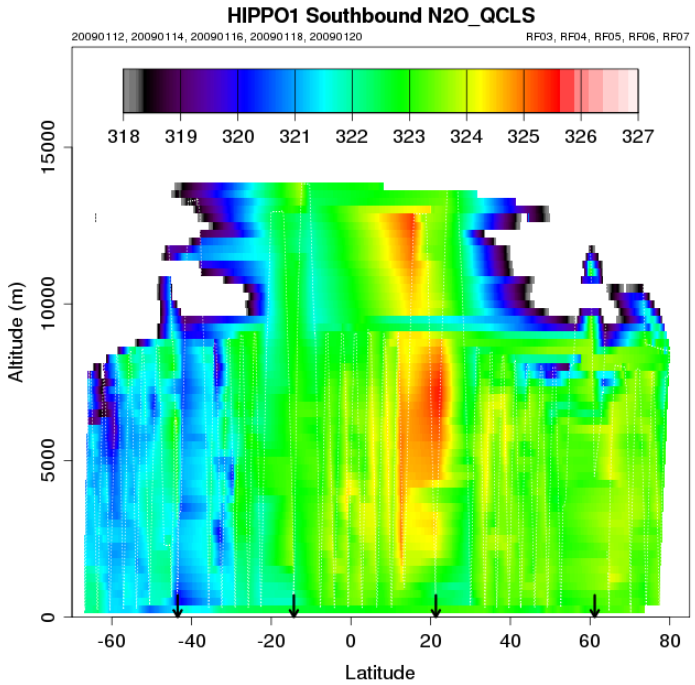


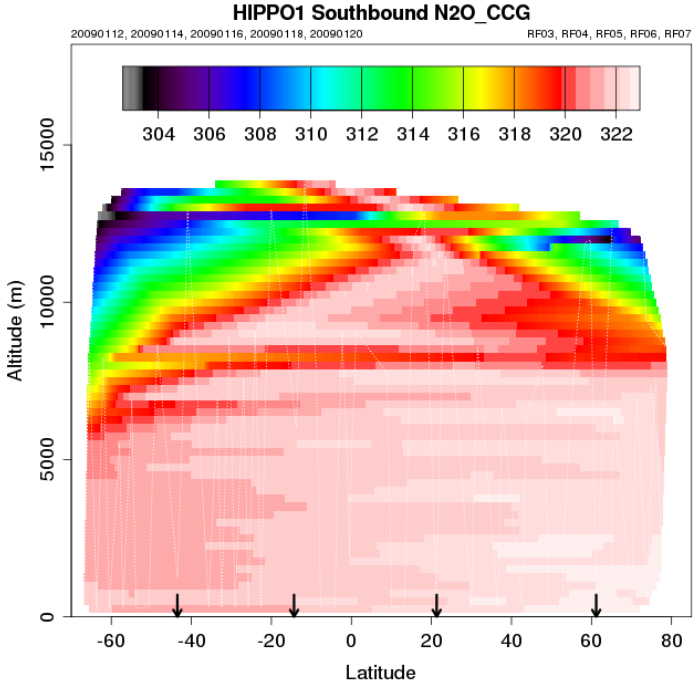
N_2O- Elevated Levels at altitude in QCLS



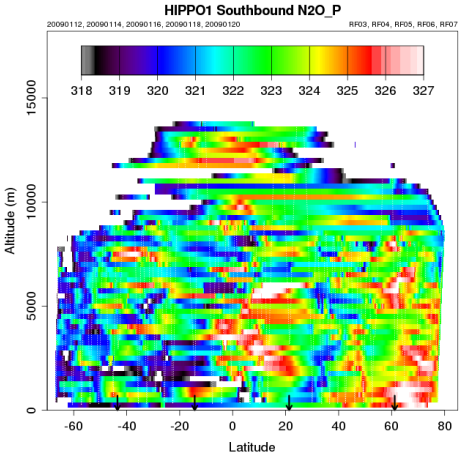




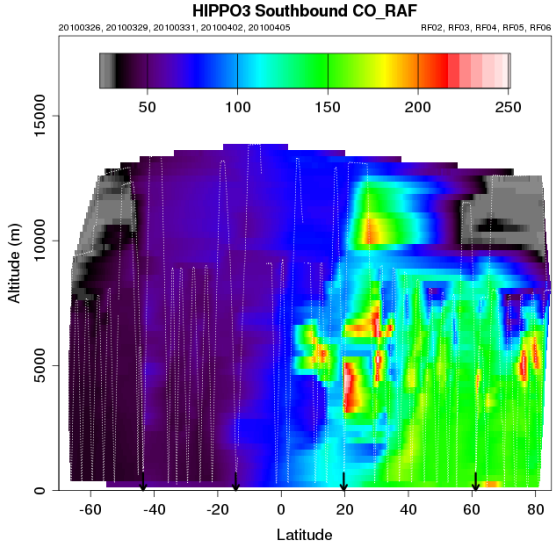


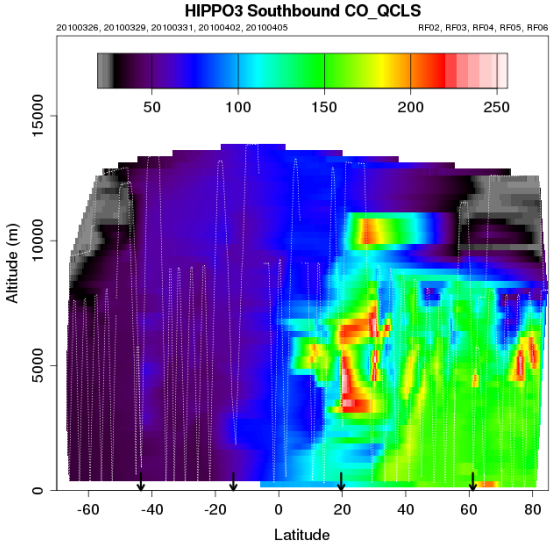


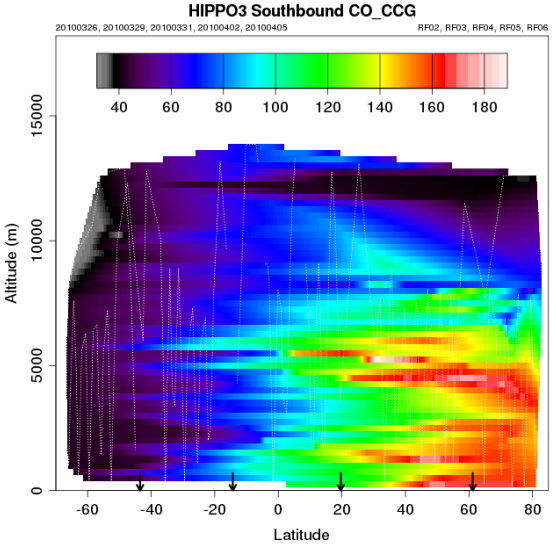
Contours plotted on Britt's website



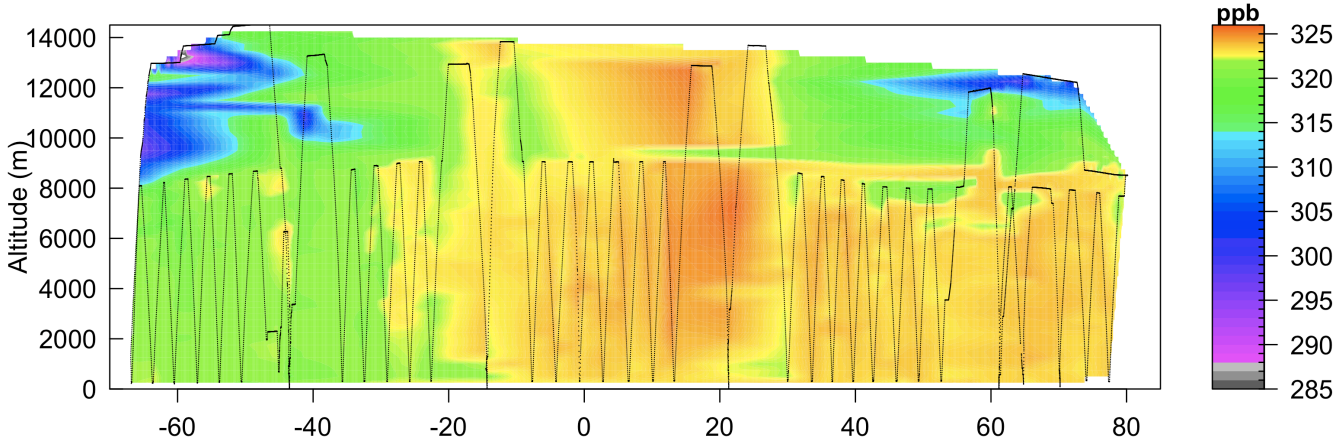
Contour plots (in this fashion) are not the way to compare 1-hz in-situ data with flask data







N_2O- Elevated Levels at altitude in QCLS

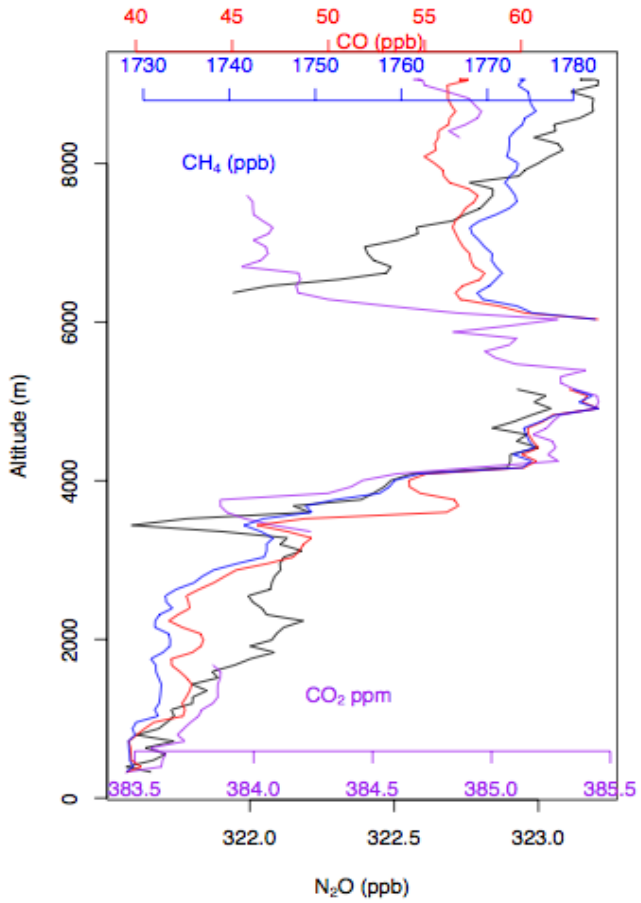


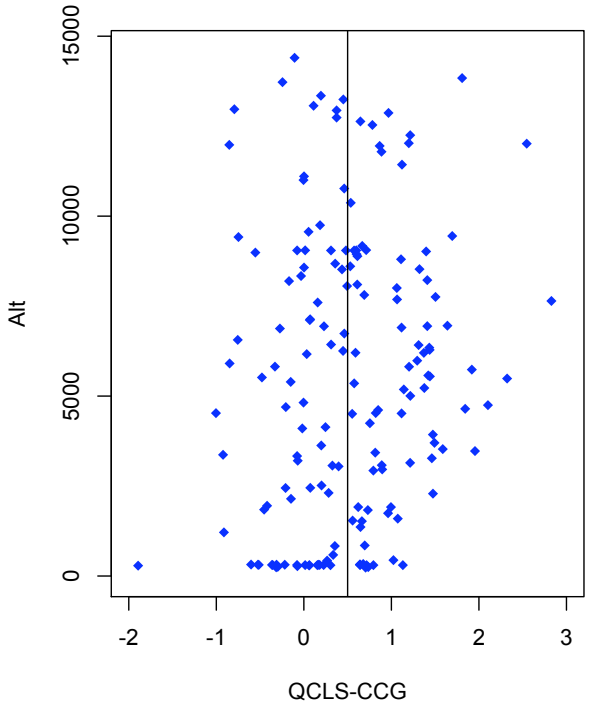
Verifiable by:
Intersection of same layer on multiple profiles

Periods of coincident enhancement with independent tracers

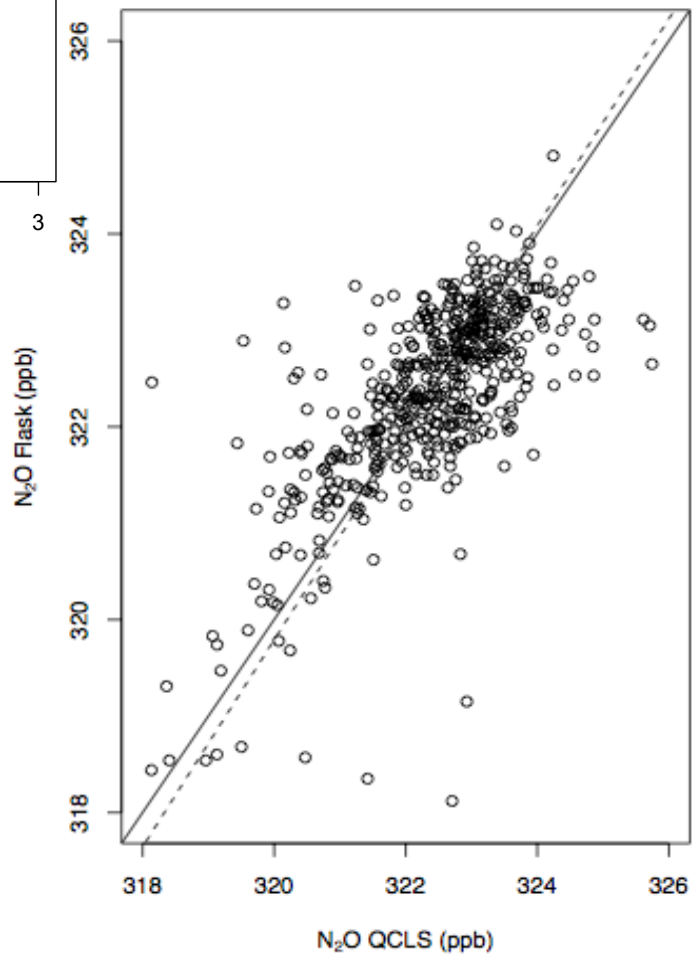
Linear relationship with NOAA flasks over HIPPO-1,2,3
-With no altitude or H2O dependence

Correlated Tracers



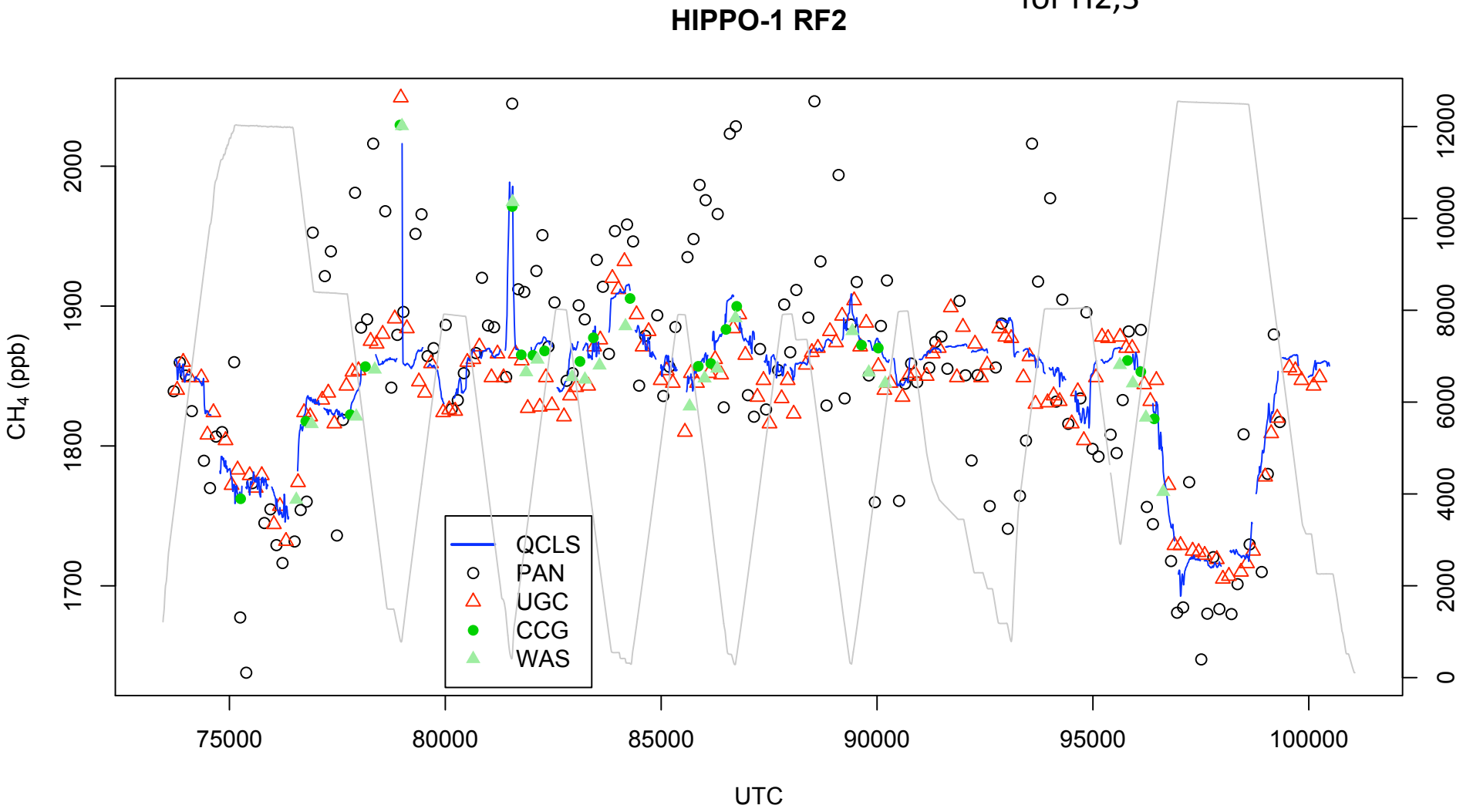


QCLS and CCG H1-3

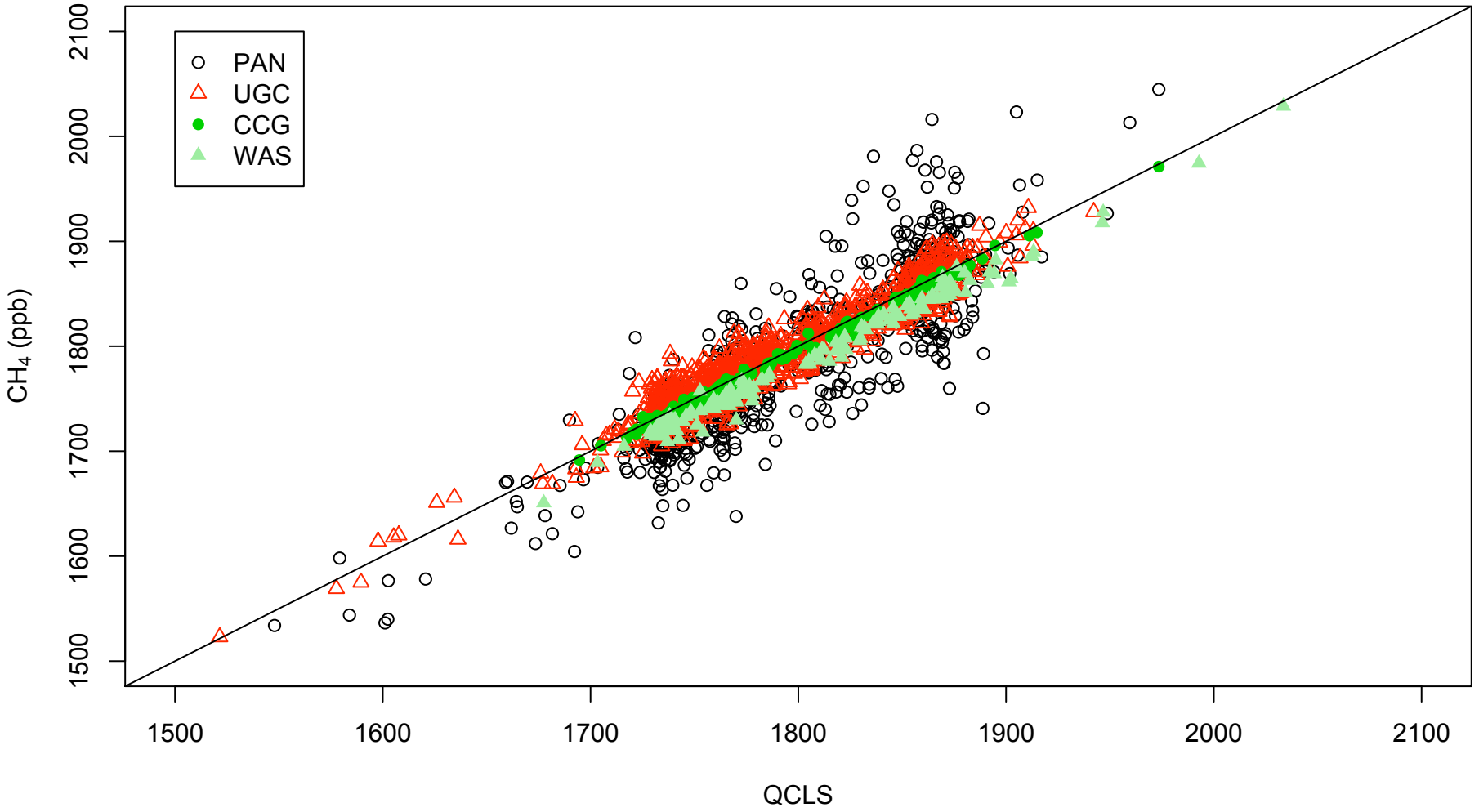


Methane

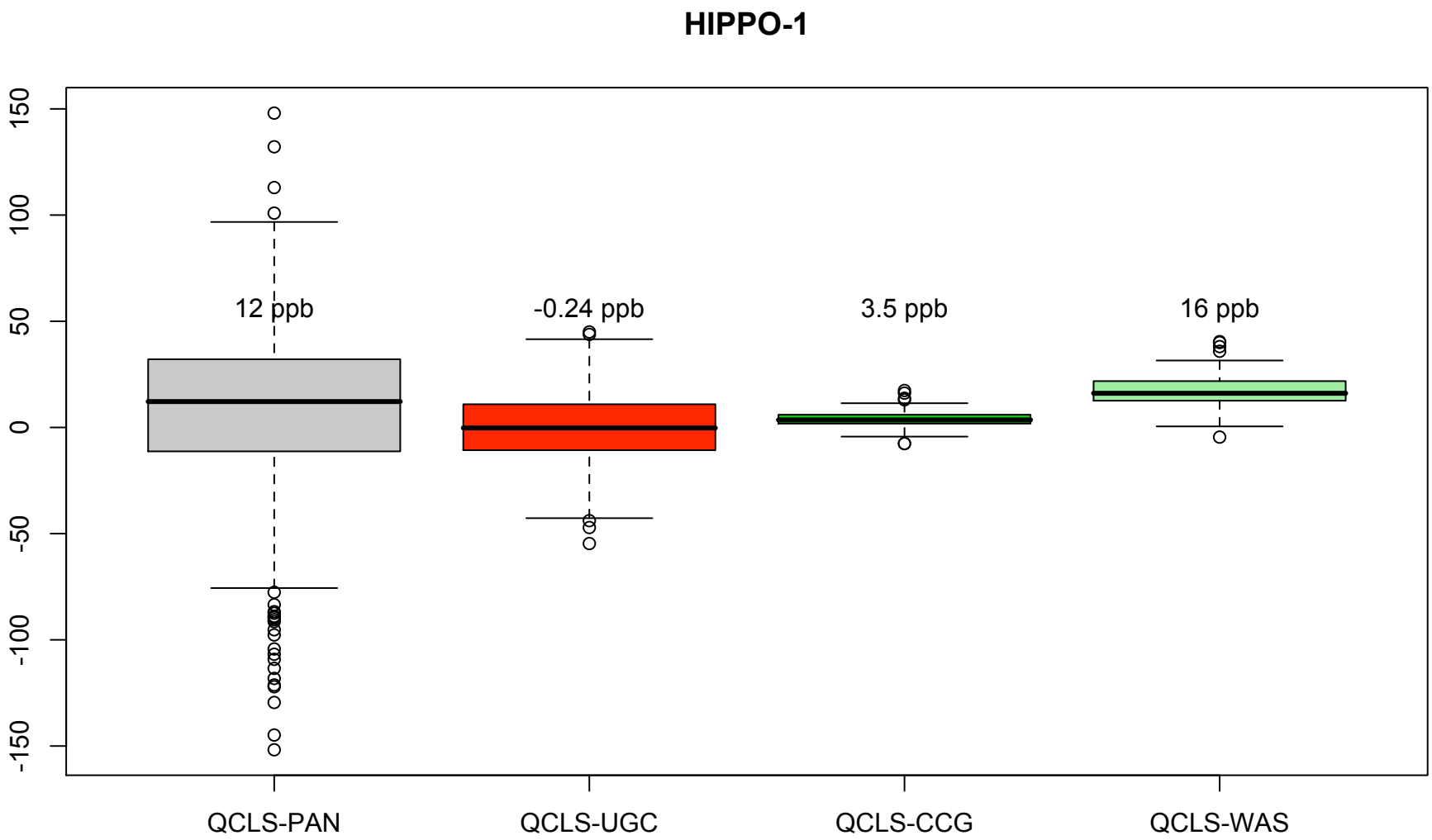
Performance on HIPPO-1 not necessarily illustrative of other HIPPOs: ie PANTHER CH4 & CO improved greatly for H2,3



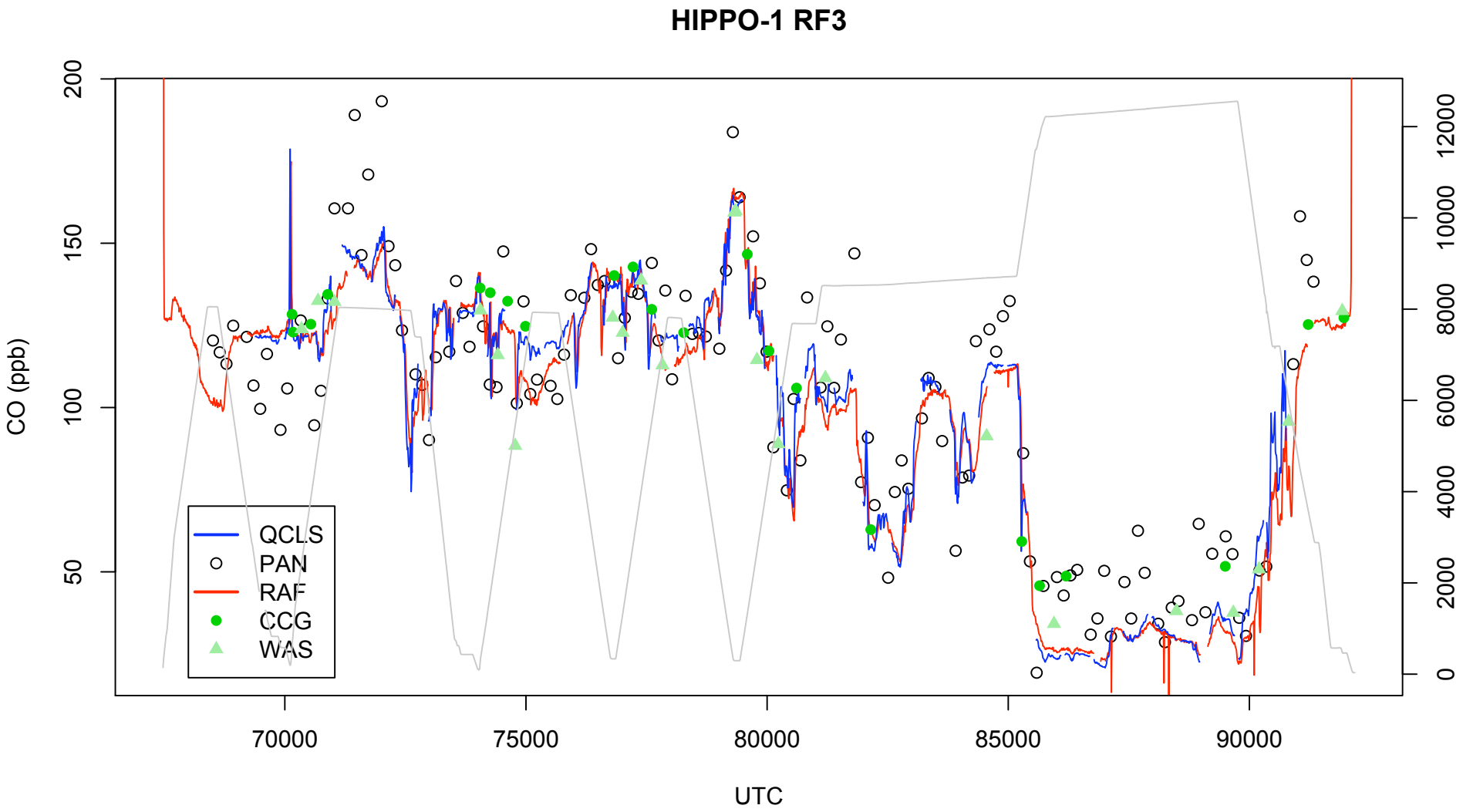
CH_4: HIPPO-1


PAN
UGC
CCG
WAS
CH4 (ppb)
1500
1600
1700
1800
1900
2000
2100
QCLS

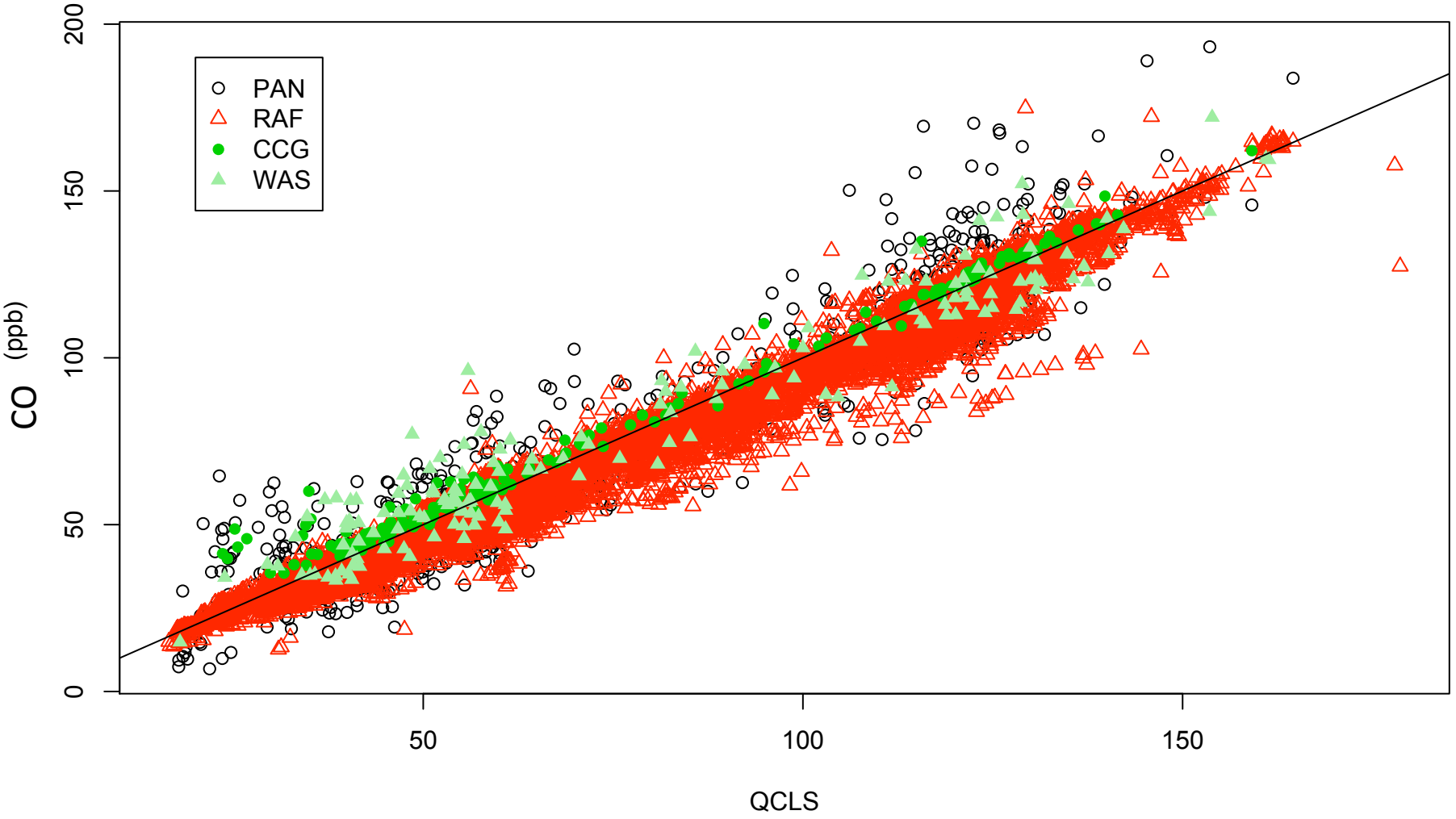
CH_4 HIPPO-1 biases



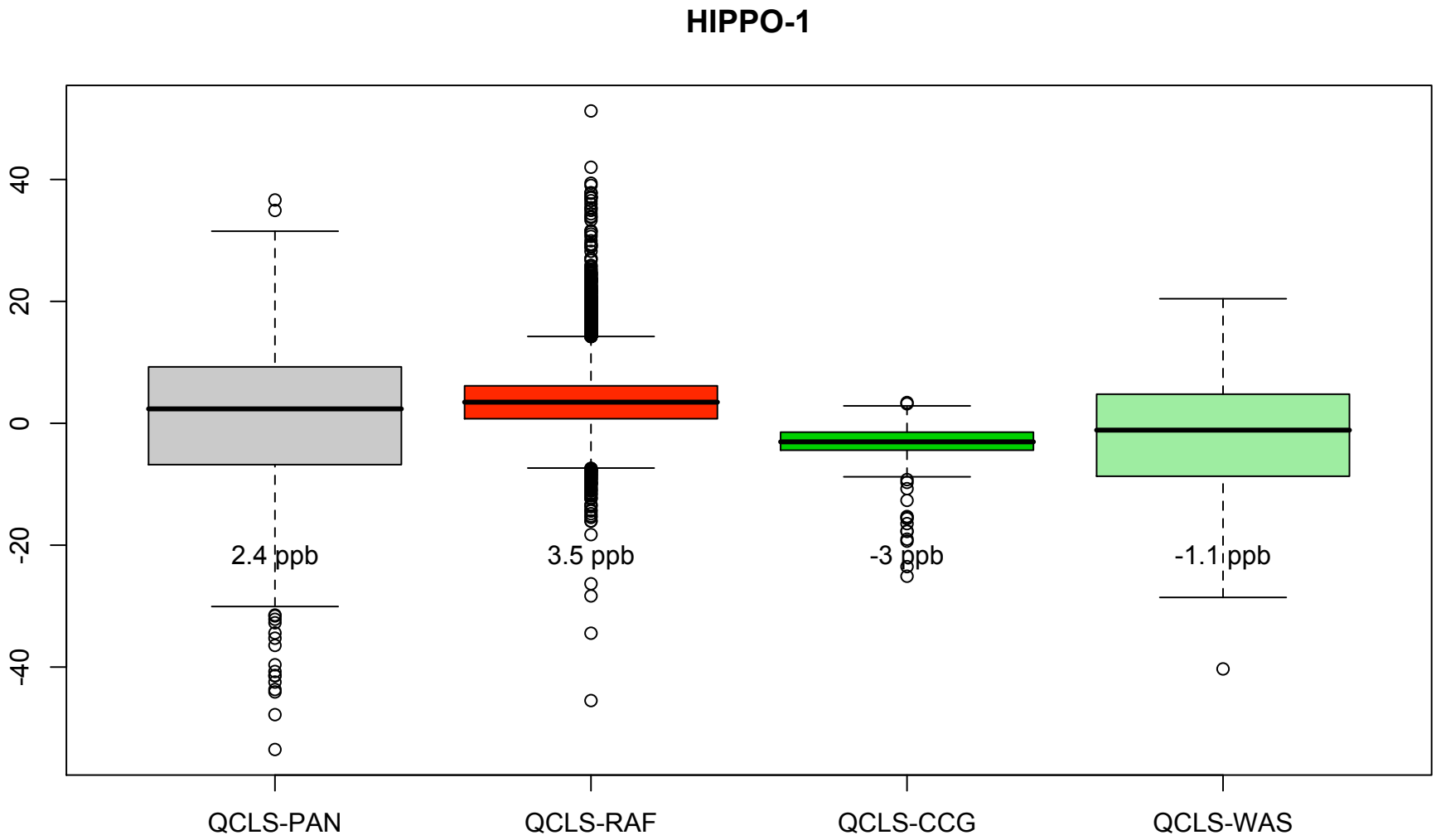
Carbon Monoxide

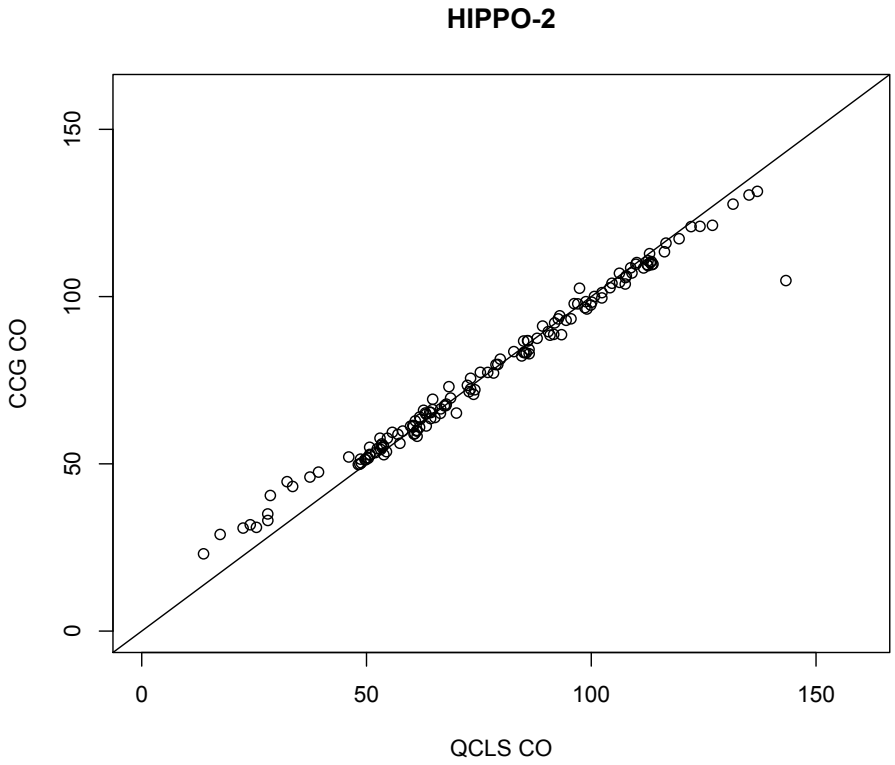


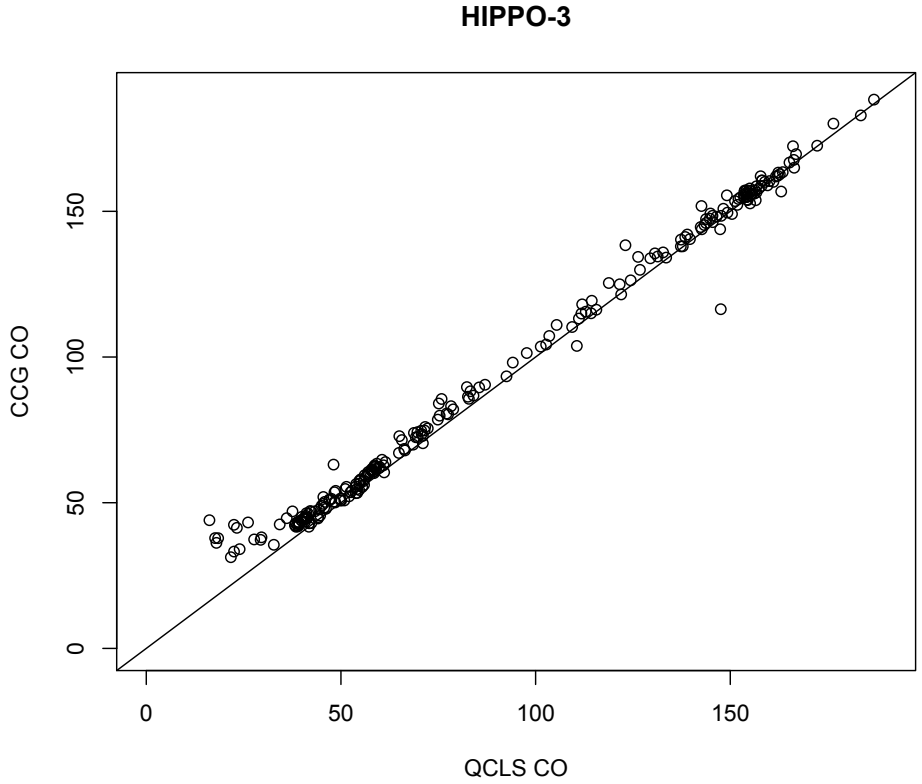
CO: HIPPO-1



CO: HIPPO-1 Biases

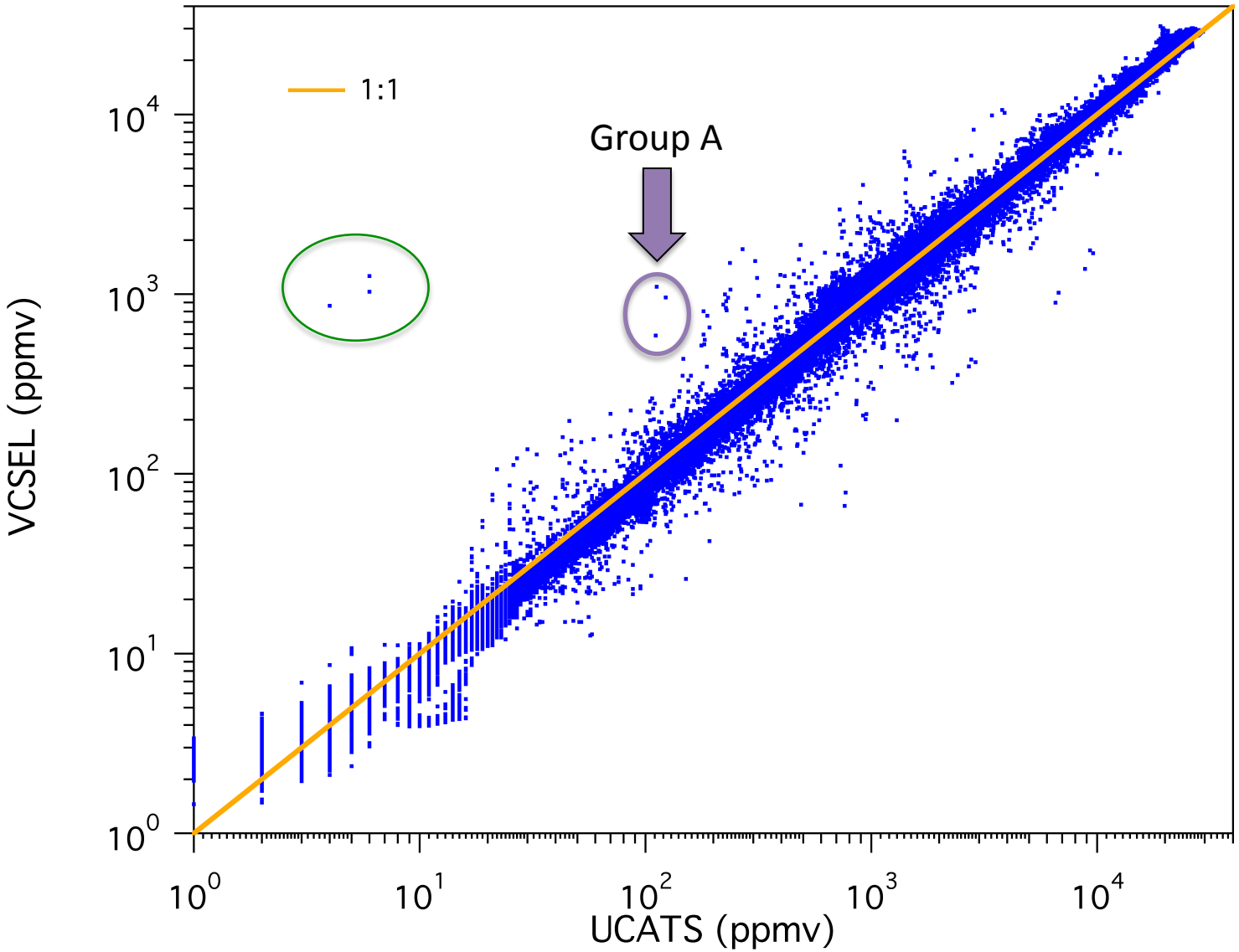



HIPPO-2
CCG CO
QCLS CO
0
50
100
150

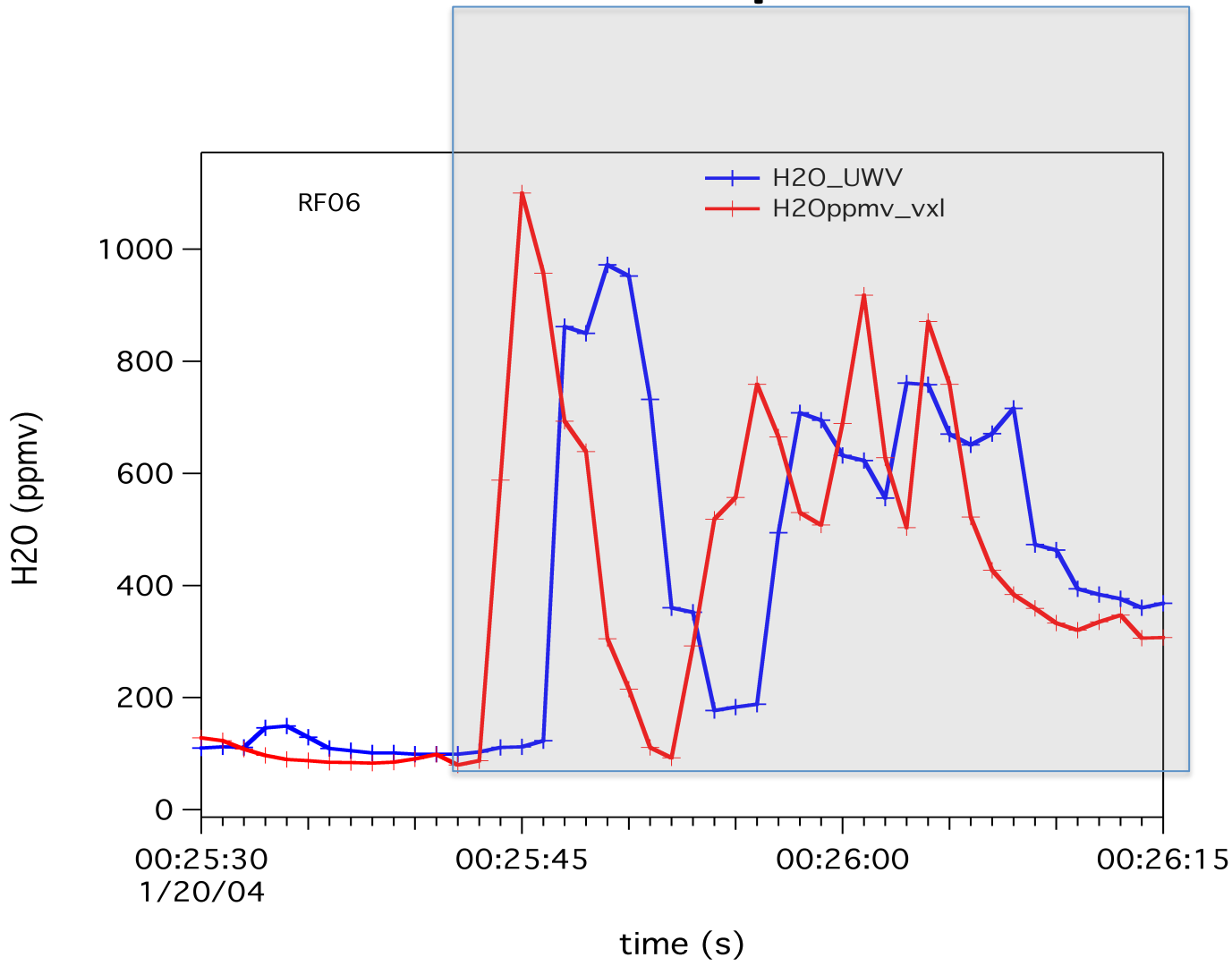

HIPPO-3
CCG CO
QCLS CO
0
50
100
150

H_2O intercomparison in HIPPO-1

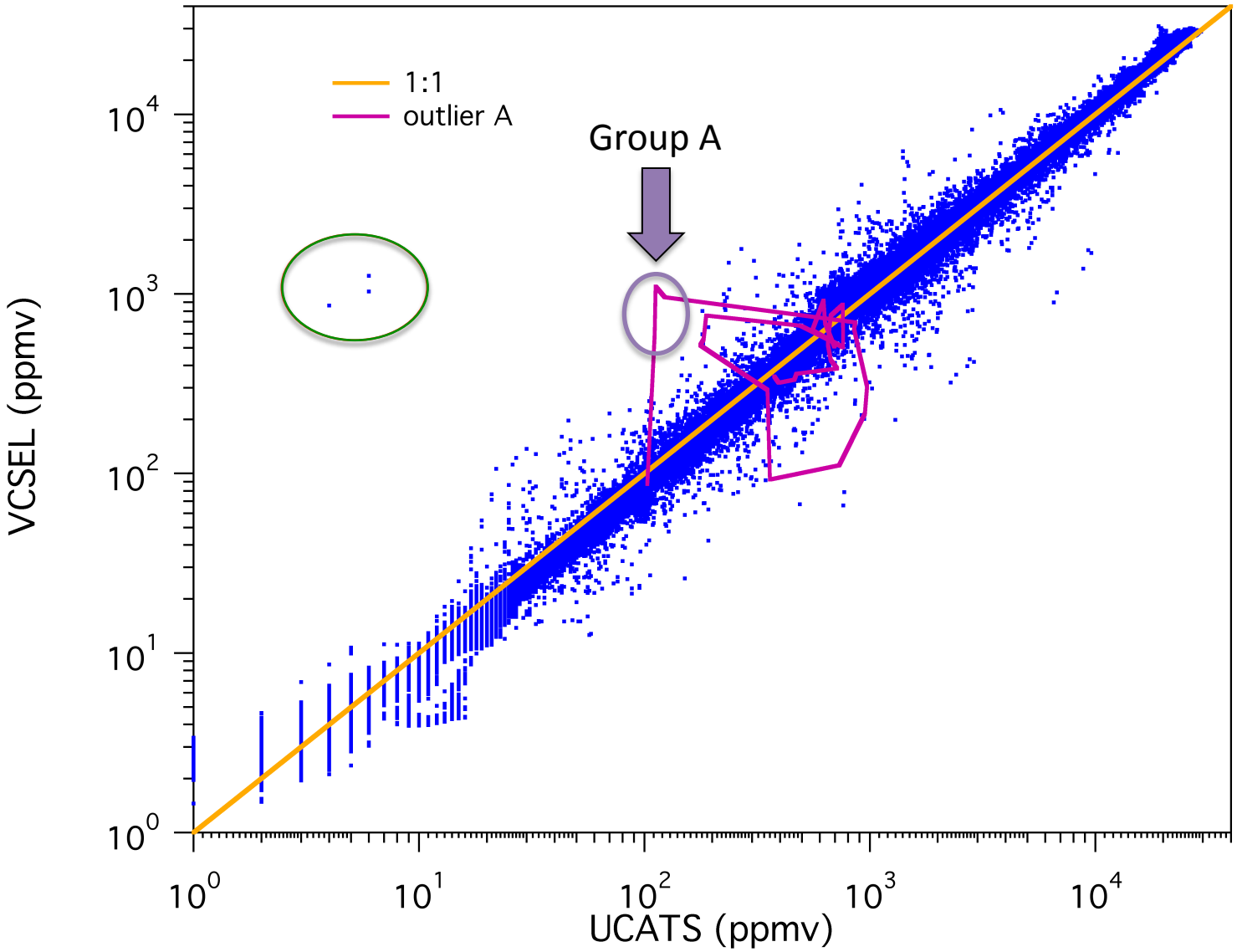
- Source: March 14, 2011 merge
- Comparison of VCSEL and UCATS water vapor
- Notes: VCSEL data only on RF01-RF07
-


1:1
Group A
VCSEL (ppmv)
UCATS (ppmv)
10^0
10^1
10^2
10^3
10^4

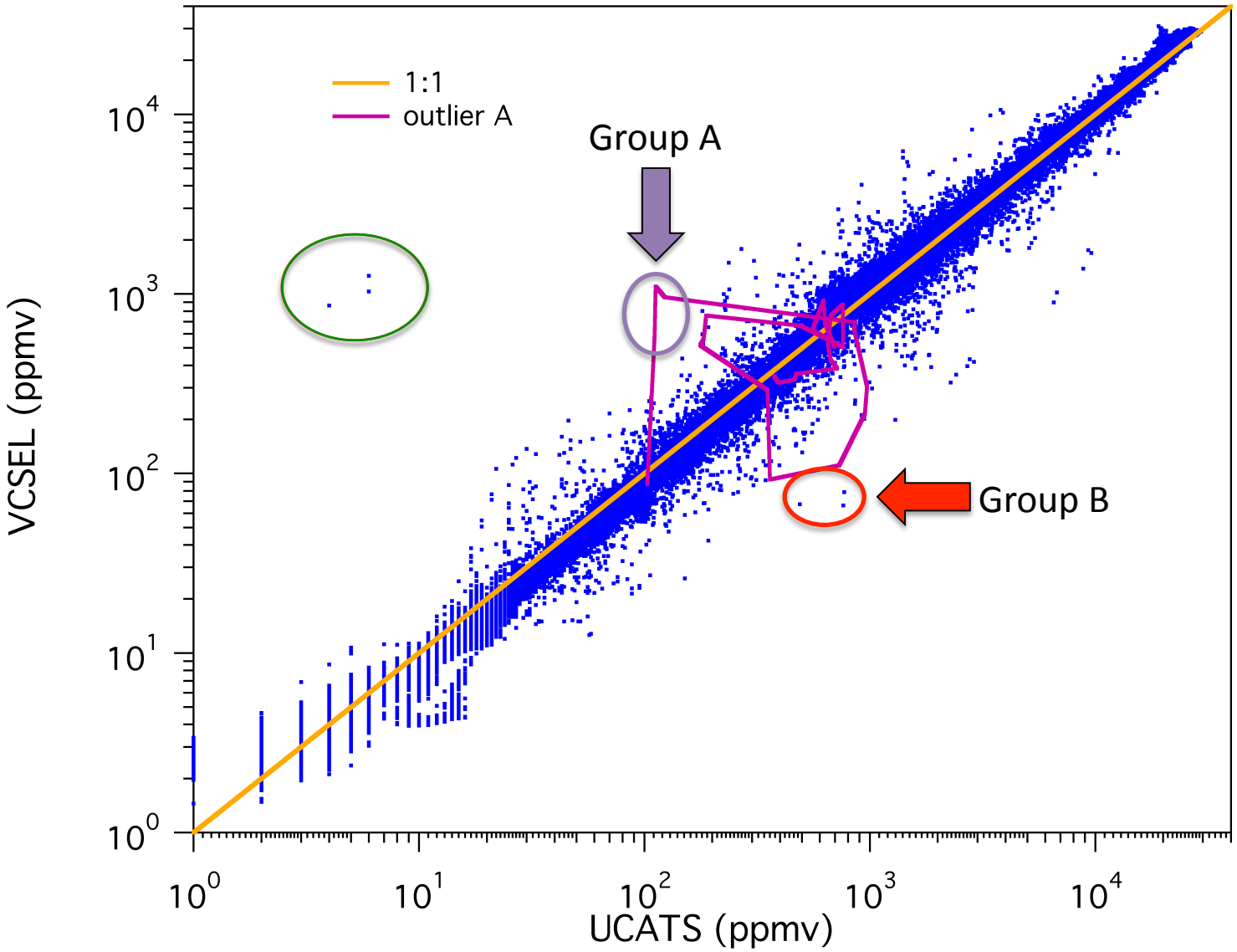
Outlier Group A

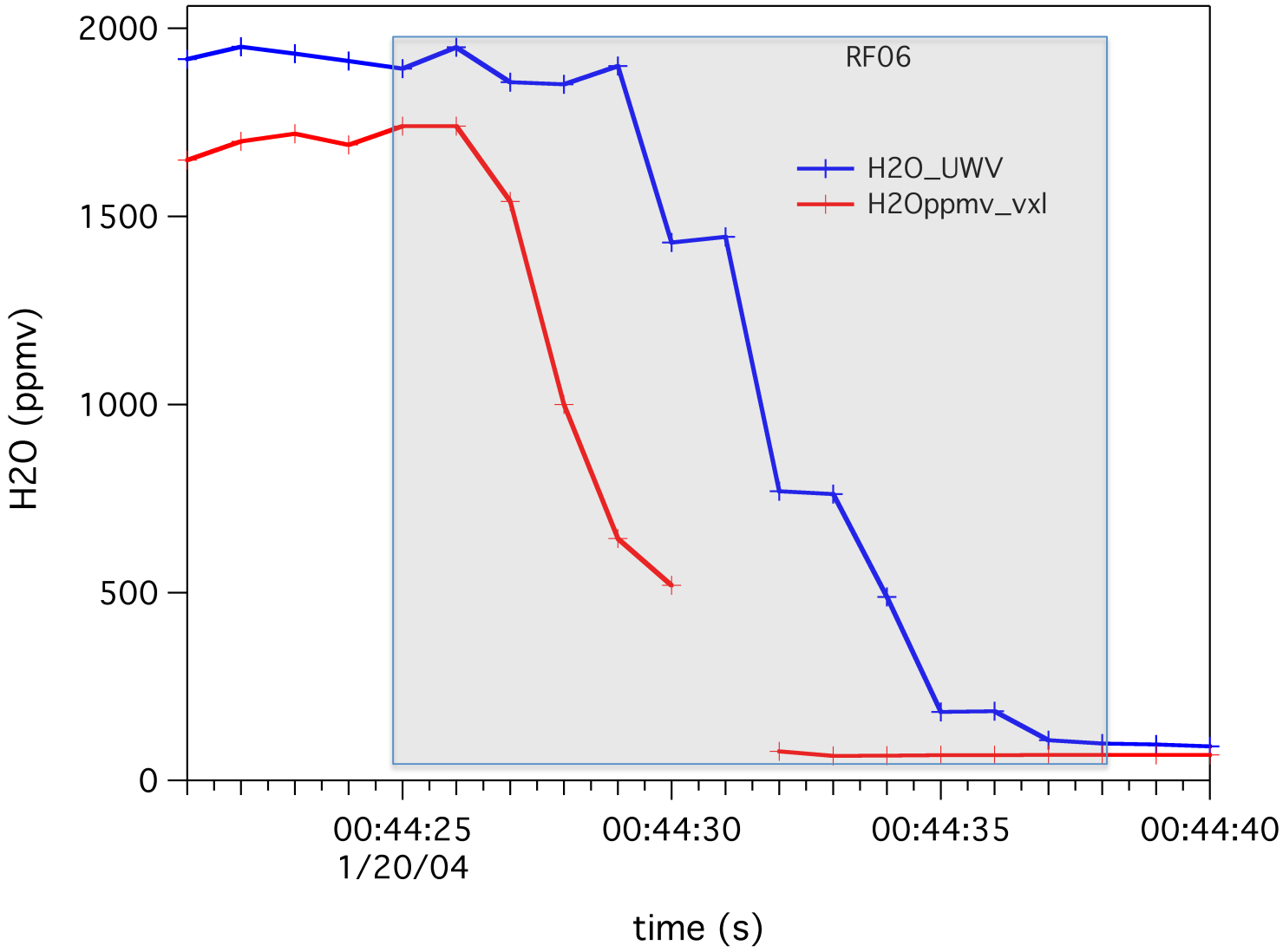


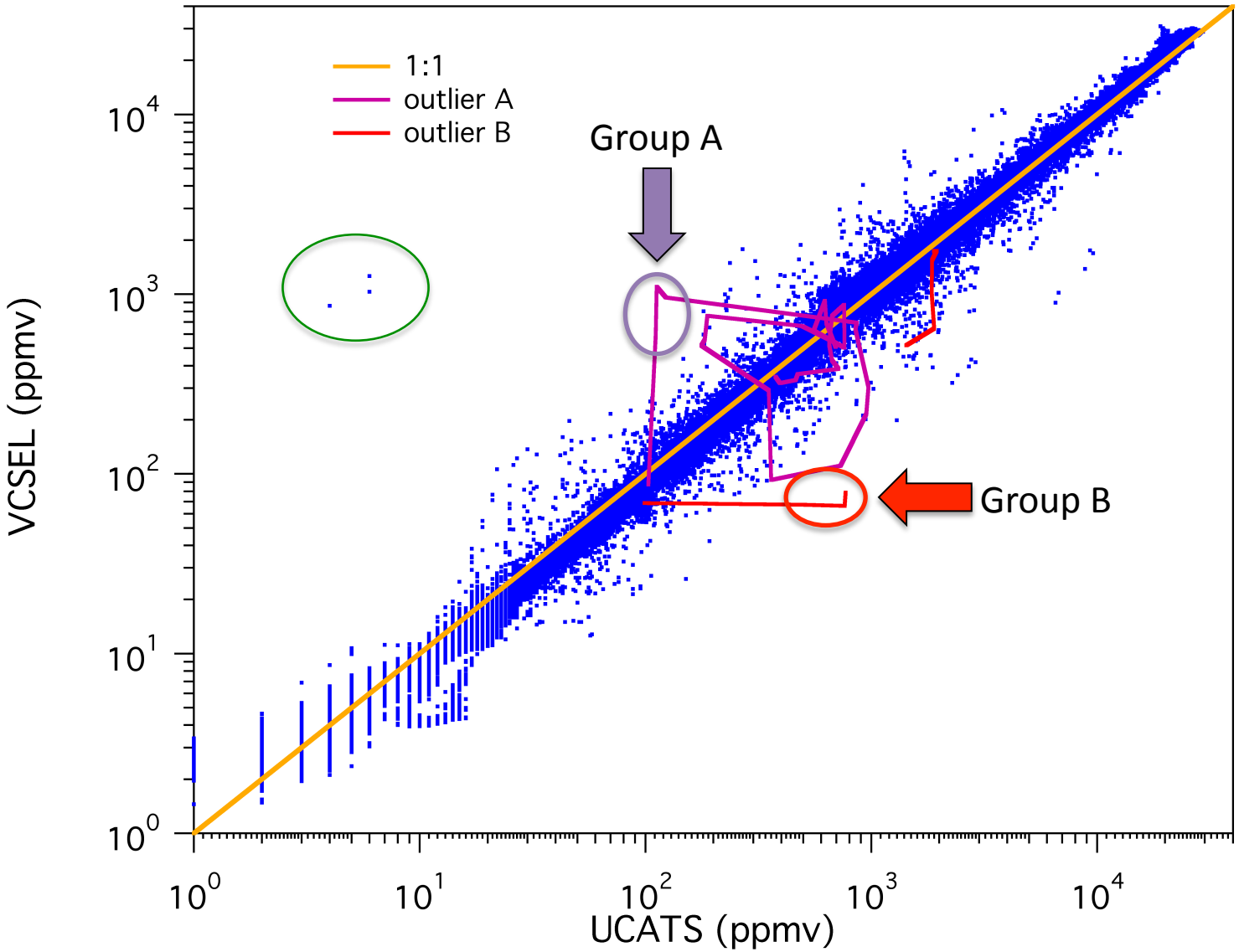
All data: VCSEL vs. UCATS



All data: VCSEL vs. UCATS

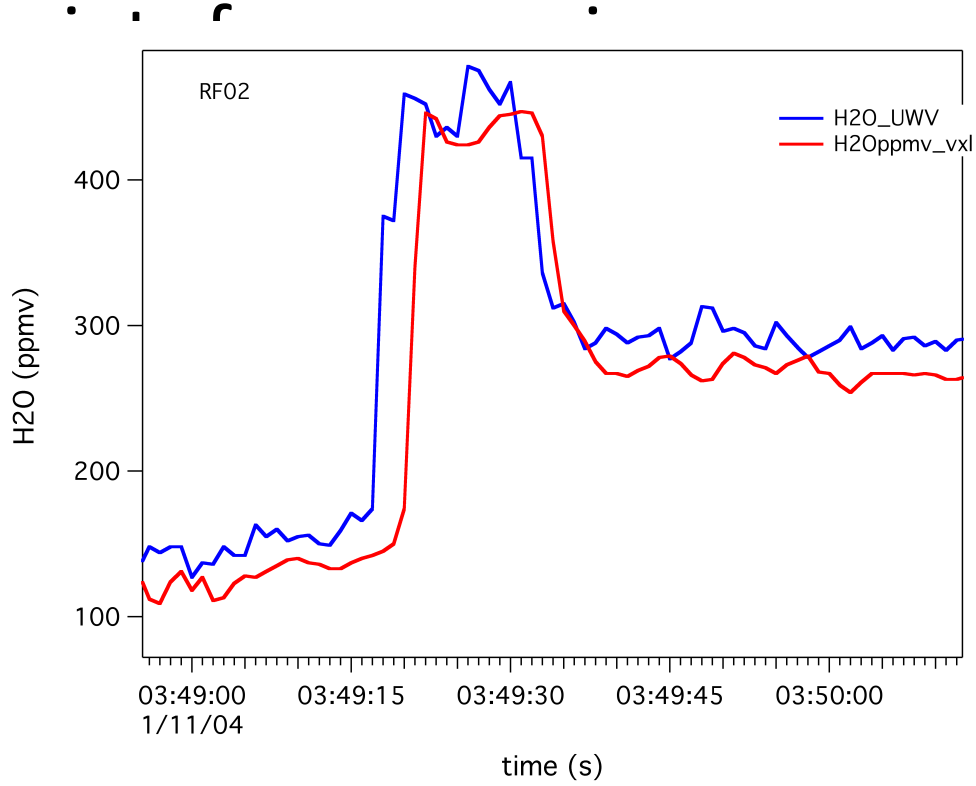



RF06
H2O_UWV
H2Oppmv_vxl
H2O (ppmv)
2000
1500
1000
500
0
00:44:25
1/20/04
00:44:30
00:44:35
00:44:40
time (s)


1:1
outlier A
outlier B
Group A
Group B
VCSEL (ppmv)
UCATS (ppmv)
10^0
10^1
10^2
10^3
10^4

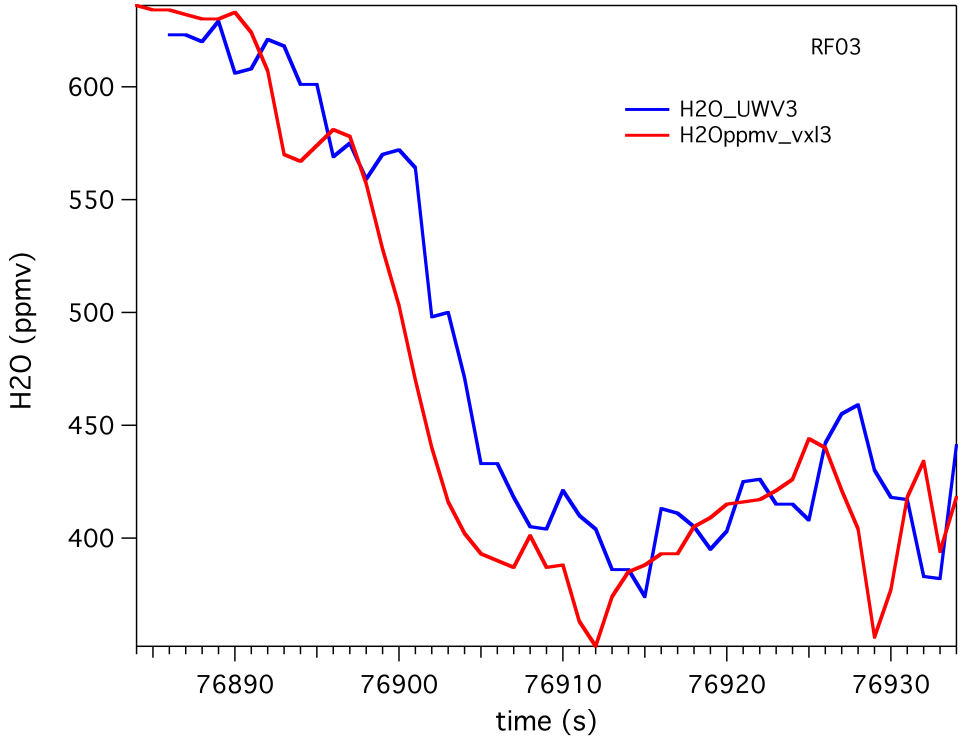
H_2O intercomparison in HIPPO-1

- Sources: March 14, 2011 merge
- N=36,471 dat
- Time differen
- Δt (:
- RF02: -:
-



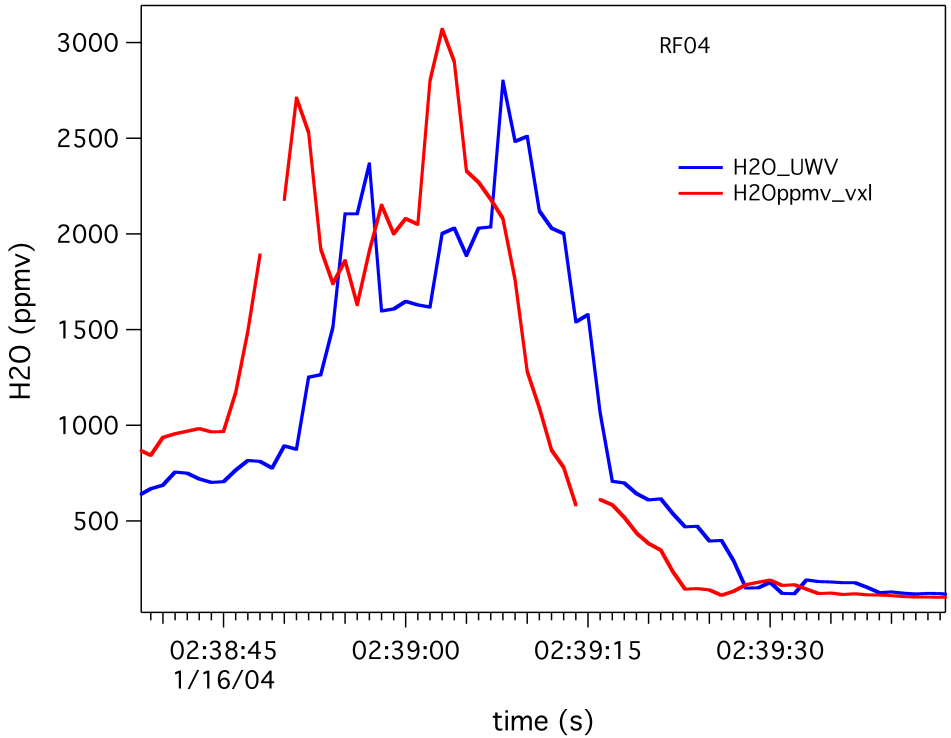
H_2O intercomparison in HIPPO-1

- Sources: March 14, 2011 merge
- N=36,471 data points for comparison
- Time differenc
- Δt (>
- RF02: -2
- RF03: 2
-



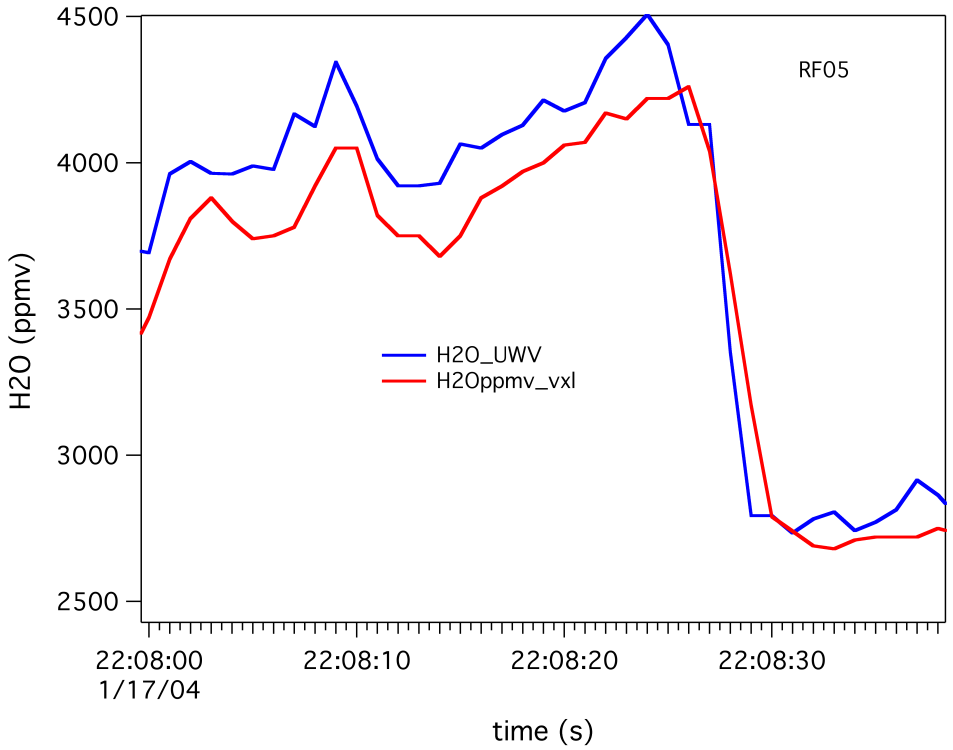
H_2O intercomparison in HIPPO-1

- Sources: March 14, 2011 merge
- N=36,471 data points for comparison
- Time difference
- Δt (>
- RF02: -2
- RF03: 2
- RF04: 5s
-



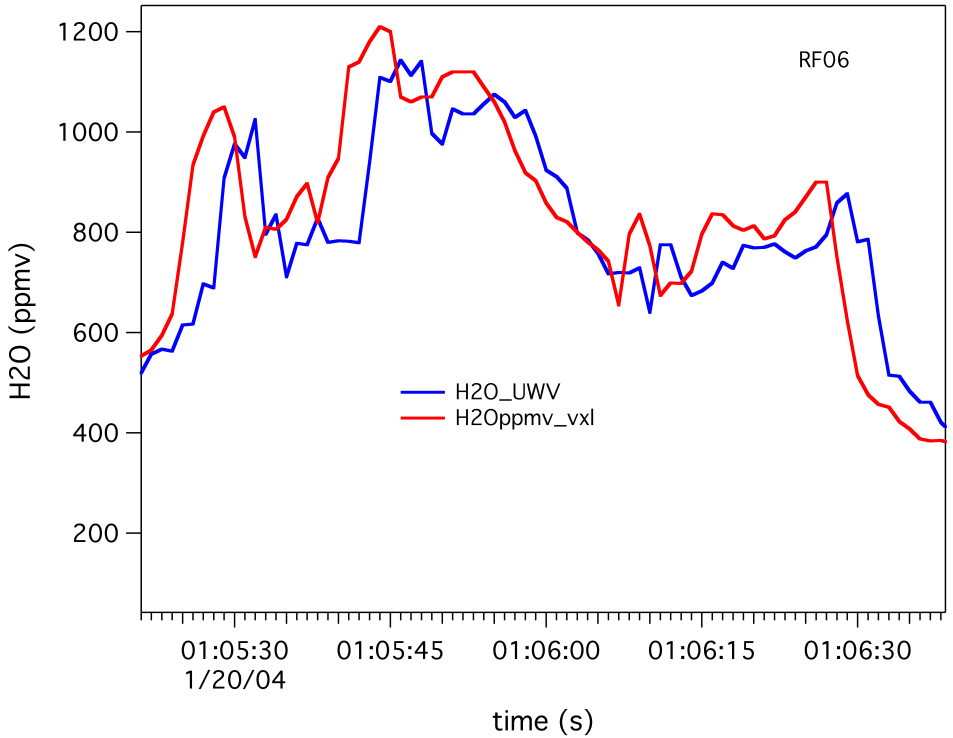
H_2O intercomparison in HIPPO-1

- Sources: March 14, 2011 merge
- N=36,471 data points for comparison
- Time differences
- Δt (>(
- RF02: -2s
- RF03: 2s
- RF04: 5s
- RF05: -2s
-



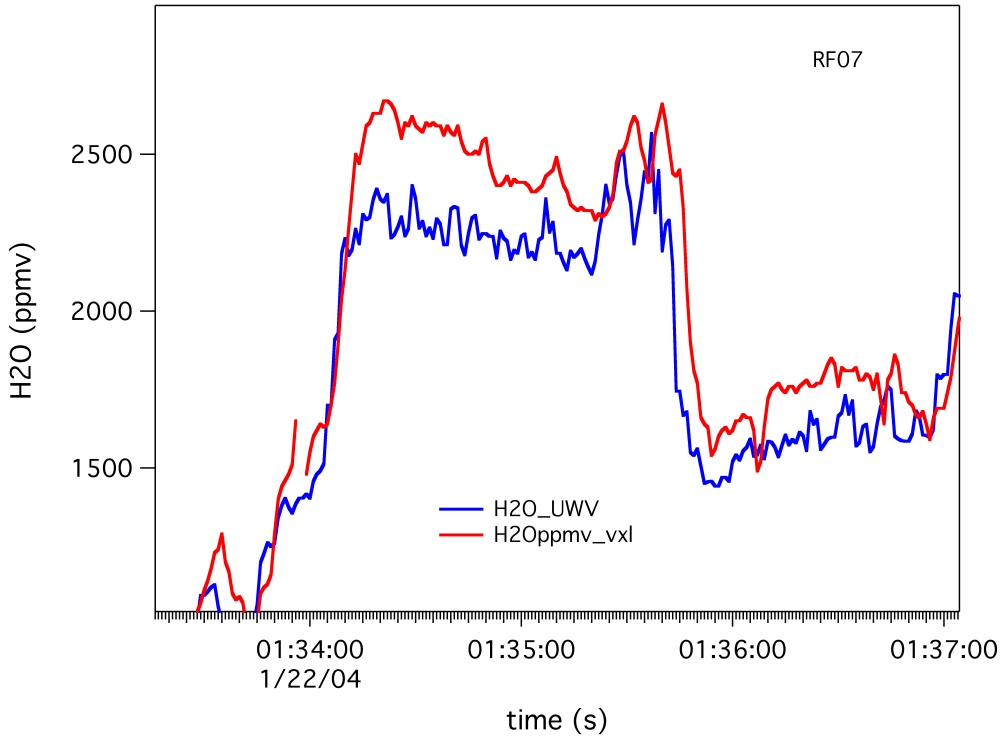
H_2O intercomparison in HIPPO-1

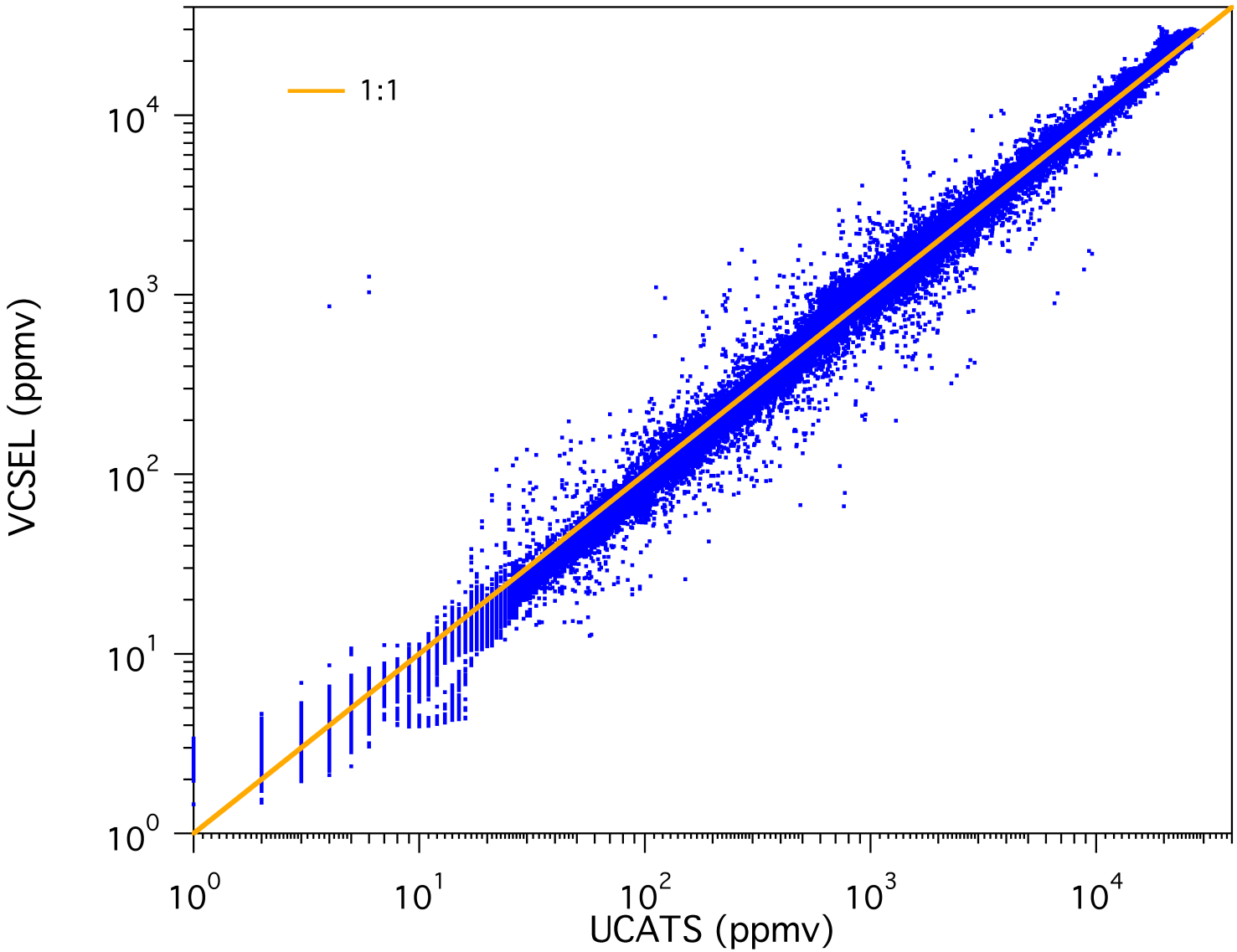
- Sources: March 14, 2011 merge
- N=36,471 data points for comparison
- Time differences ob
- Δt (>0
- RF02: -2s
- RF03: 2s
- RF04: 5s
- RF05: -2s
- RF06: 3s
-
-

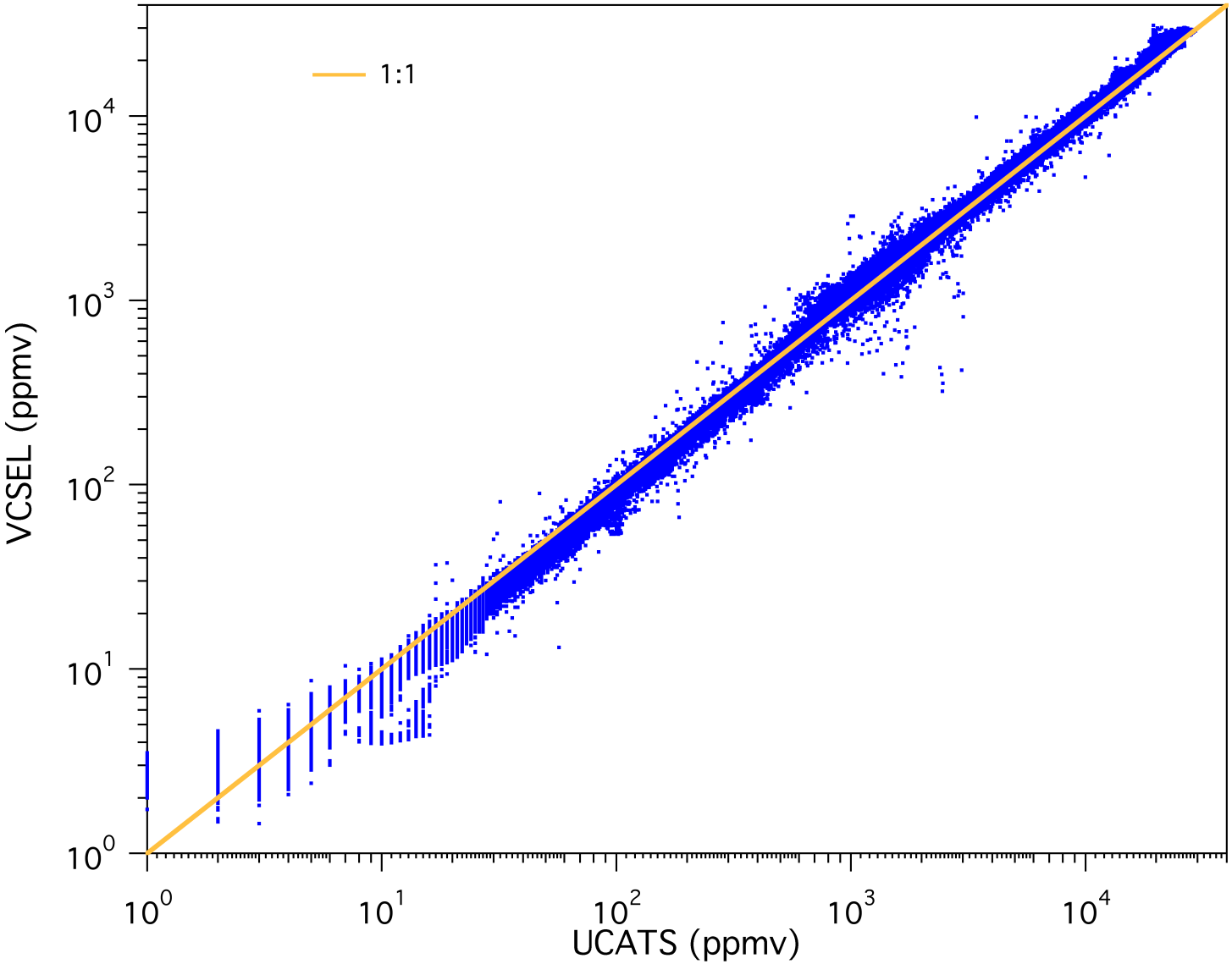


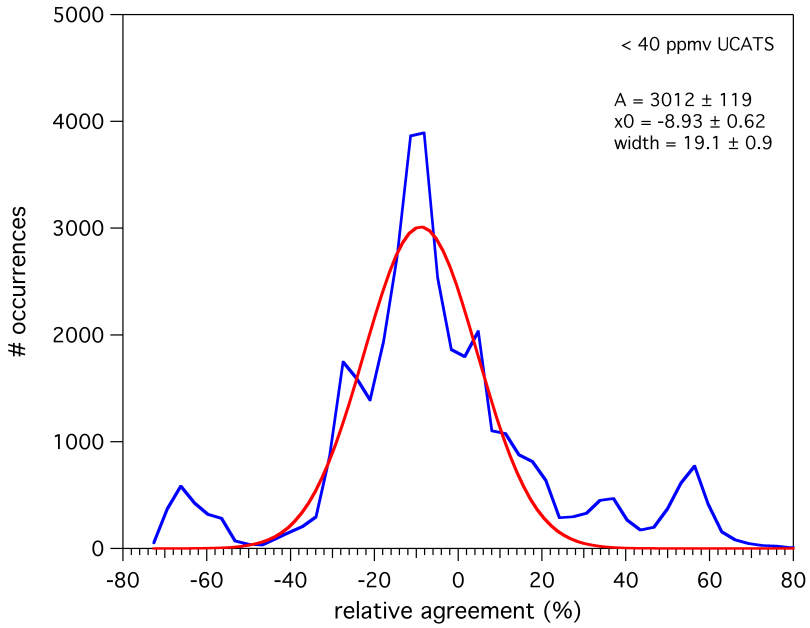
H_2O intercomparison in HIPPO-1

- Sources: March 14, 2011 merge
- N=36,471 data points for comparison
- Time differences ol
- Δt (>0
- RF02: -2s
- RF03: 2s
- RF04: 5s
- RF05: -2s
- RF06: 3s
- RF07: -3s
-

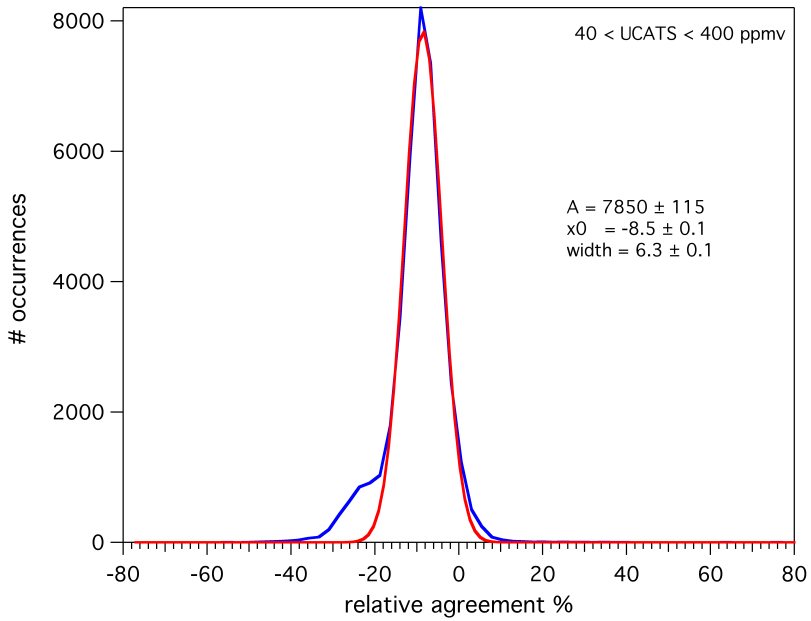


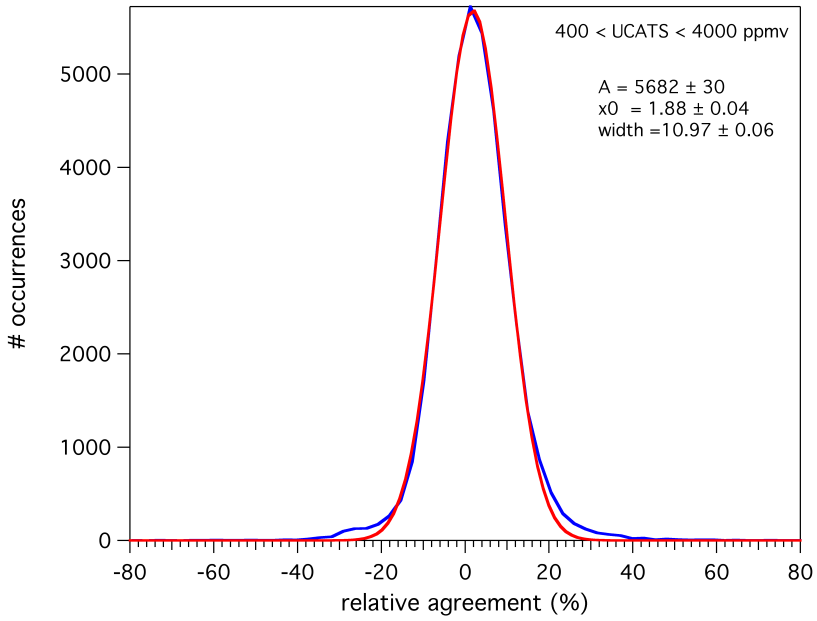

1:1
VCSEL (ppmv)
UCATS (ppmv)
10^0
10^1
10^2
10^3
10^4

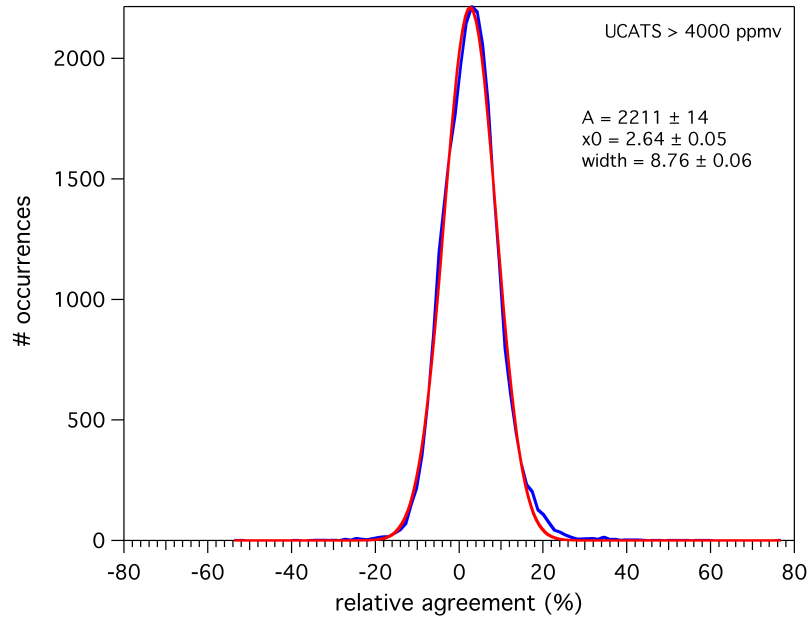

1:1
VCSEL (ppmv)
UCATS (ppmv)
10^0
10^1
10^2
10^3
10^4


< 40 ppmv UCATS
A = 3012 ± 119
x0 = -8.93 ± 0.62
width = 19.1 ± 0.9
# occurrences
relative agreement (%)

·U


40 < UCATS < 400 ppmv
A = 7850 ± 115
x0 = -8.5 ± 0.1
width = 6.3 ± 0.1
# occurrences
relative agreement %


400 < UCATS < 4000 ppmv
A = 5682 ± 30
x0 = 1.88 ± 0.04
width =10.97 ± 0.06
# occurrences
relative agreement (%)


UCATS > 4000 ppmv
A = 2211 ± 14
x0 = 2.64 ± 0.05
width = 8.76 ± 0.06
# occurrences
relative agreement (%)

Notes

- UCATS and VCSEL agree to within 10% for most of HIPPO-1, except during rapid changes (UCATS outgassing).
- Timing between datasets inconsistent – needs further examination
- Integrated water vapor dataset should be possible with careful analyses
- Still a few anomalous VCSEL points need to be removed

HIPPO Ozone Intercomparison

Eric Hintsa, Fred Moore, Jim Elkins, Dale Hurst, Laura Patrick, Sam Oltmans, Ru-Shan Gao, Ryan Spackman, and David Fahey

NOAA ESRL and U. of Colorado, CIRES

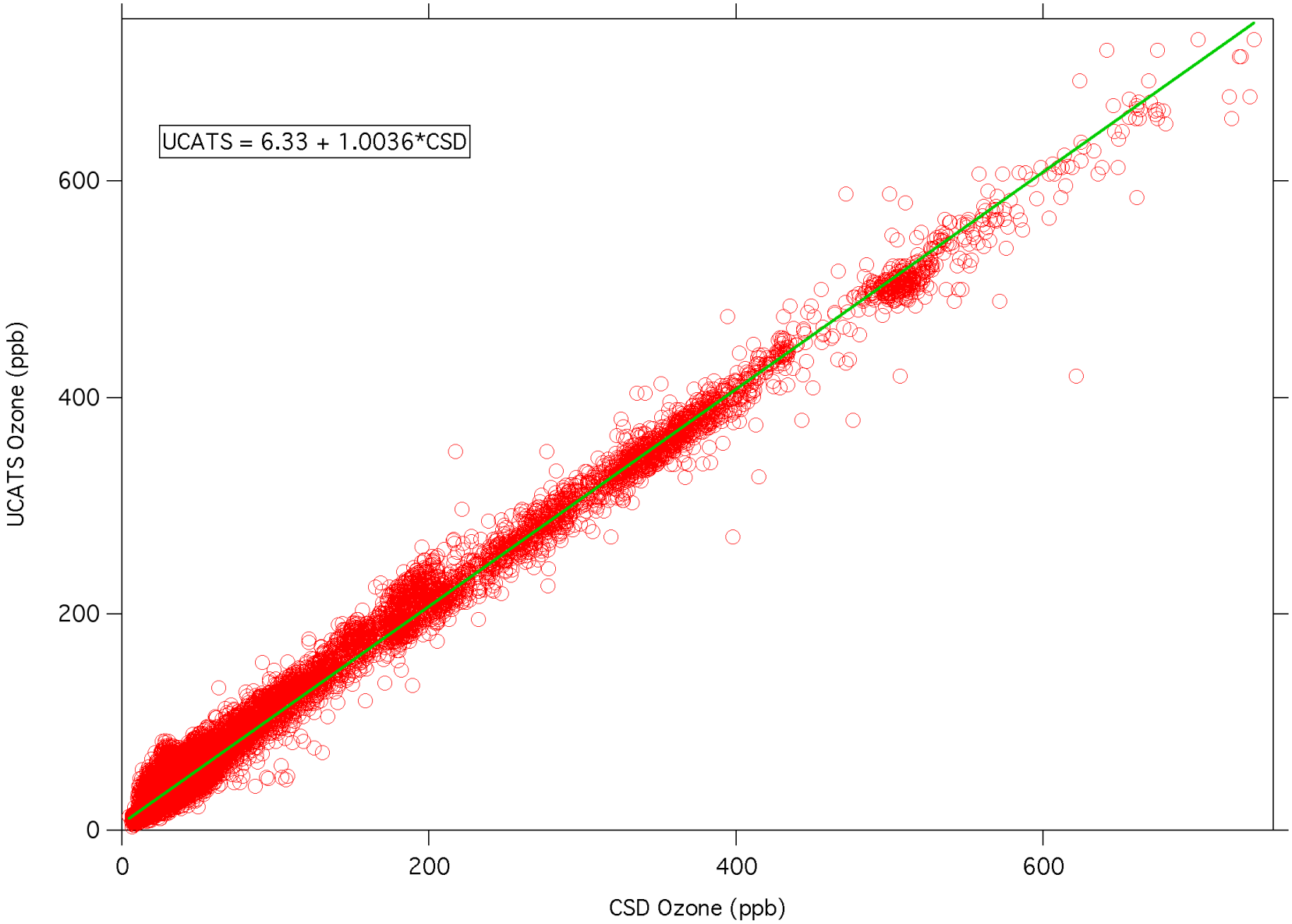
Background:
Both the CSD and UCATS 2B instruments are dual-beam UV photometers. Flow rate is ~5 faster in CSD.

The CSD and NCAR chemiluminescence O_3 instruments agreed well in START-08, as did the UCATS instrument in dry conditions. The UCATS ozone scrubber did not work properly in wet conditions during START-08; it was replaced June 2008 (MnO_2-coated screens, similar to CSD).

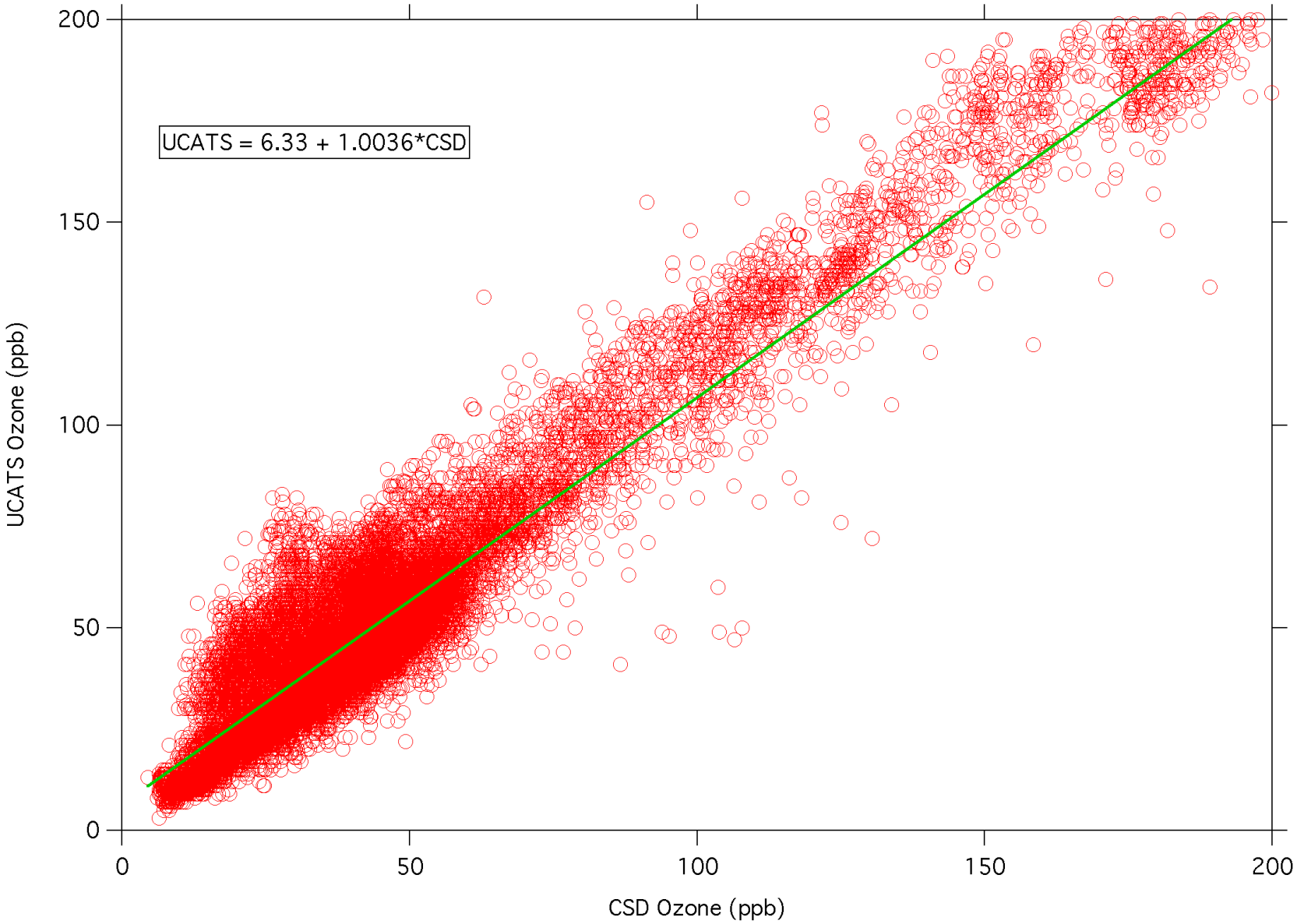
Pre-HIPPO: UCATS ozone higher than CSD after passing through wet regions; good agreement in high water regions and when always dry.

This was even more obvious in HIPPO-1.

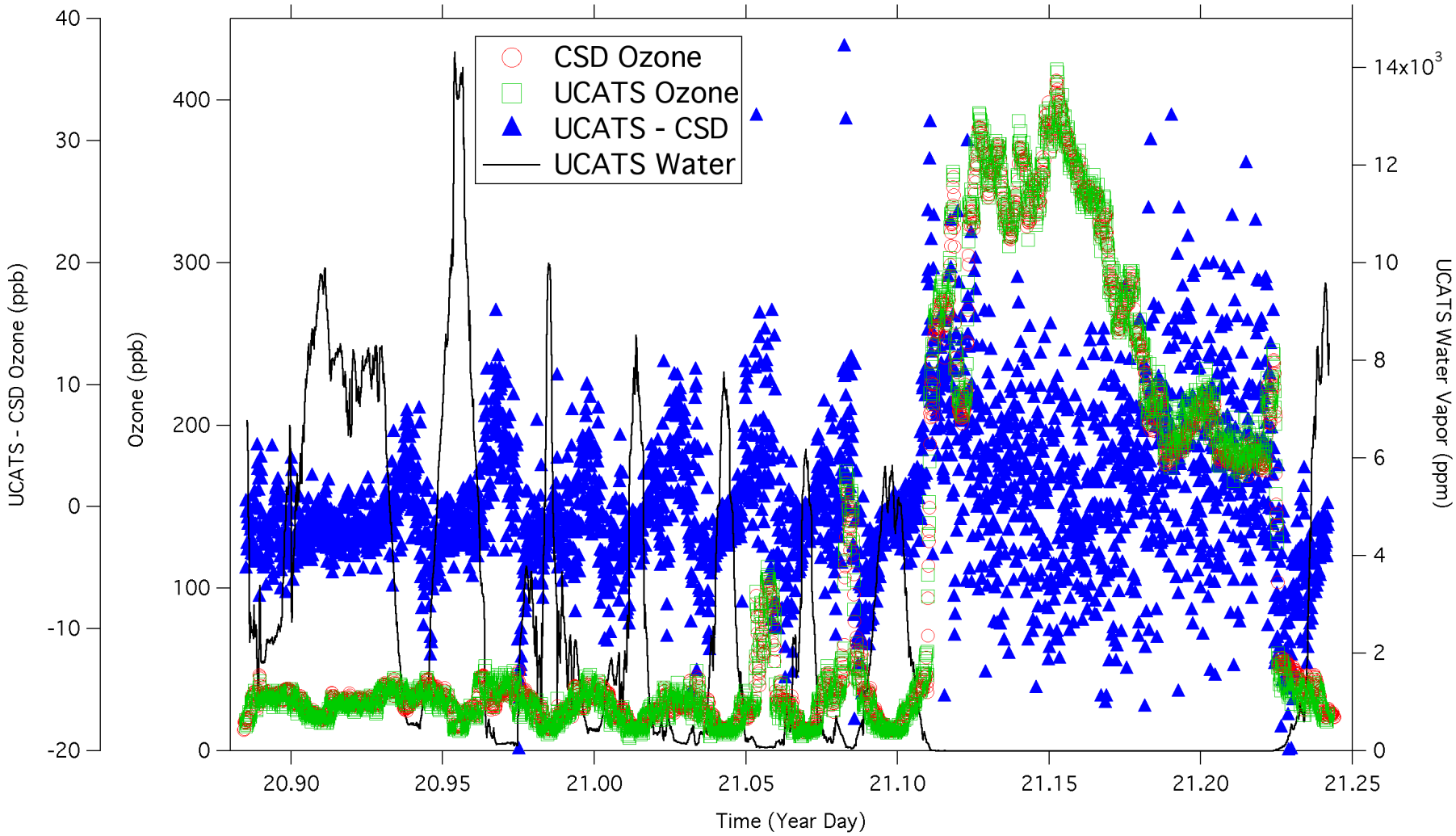
HIPPO-1, all data from RF02-RF11



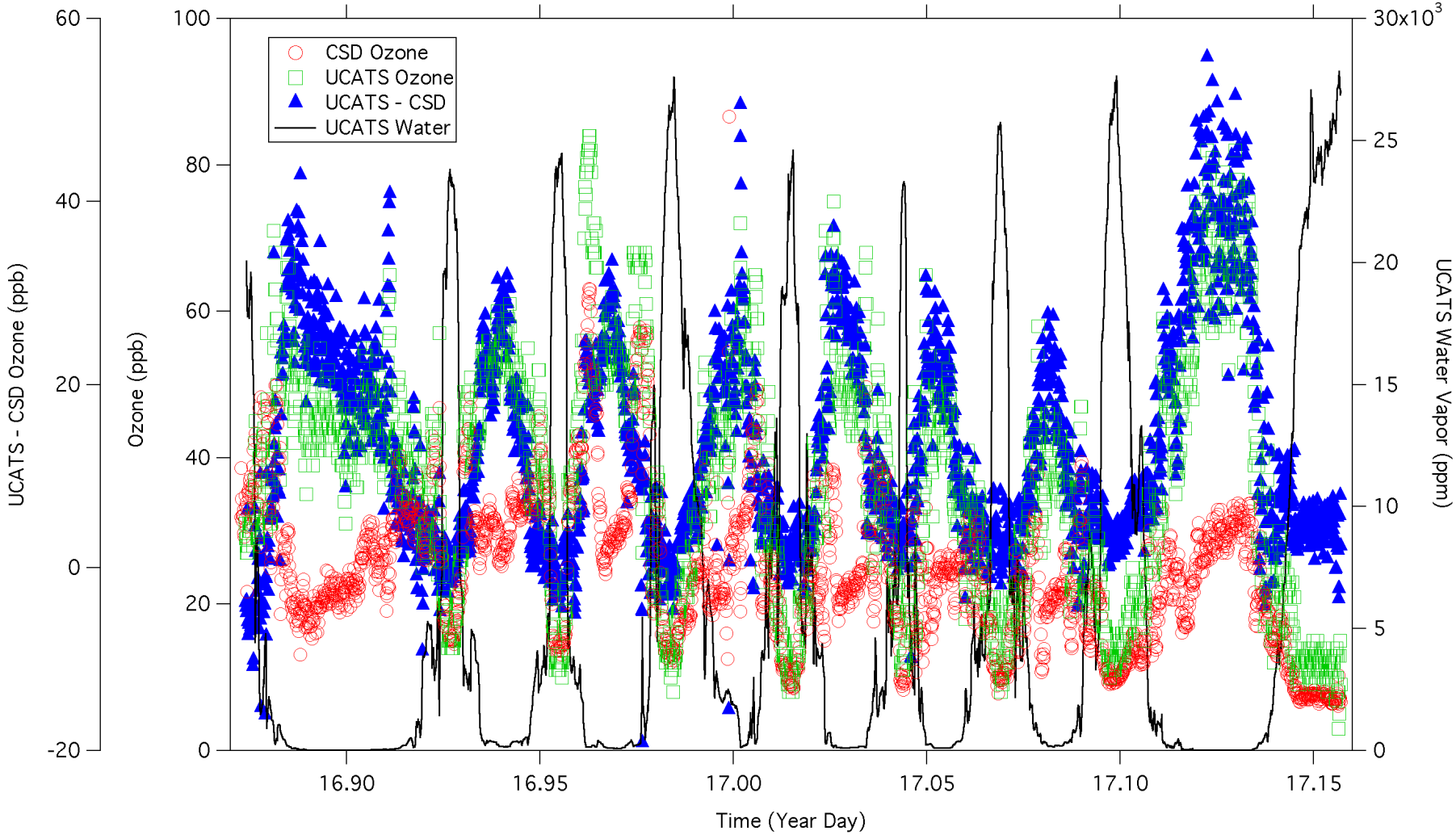
HIPPO 1, RF02-RF11

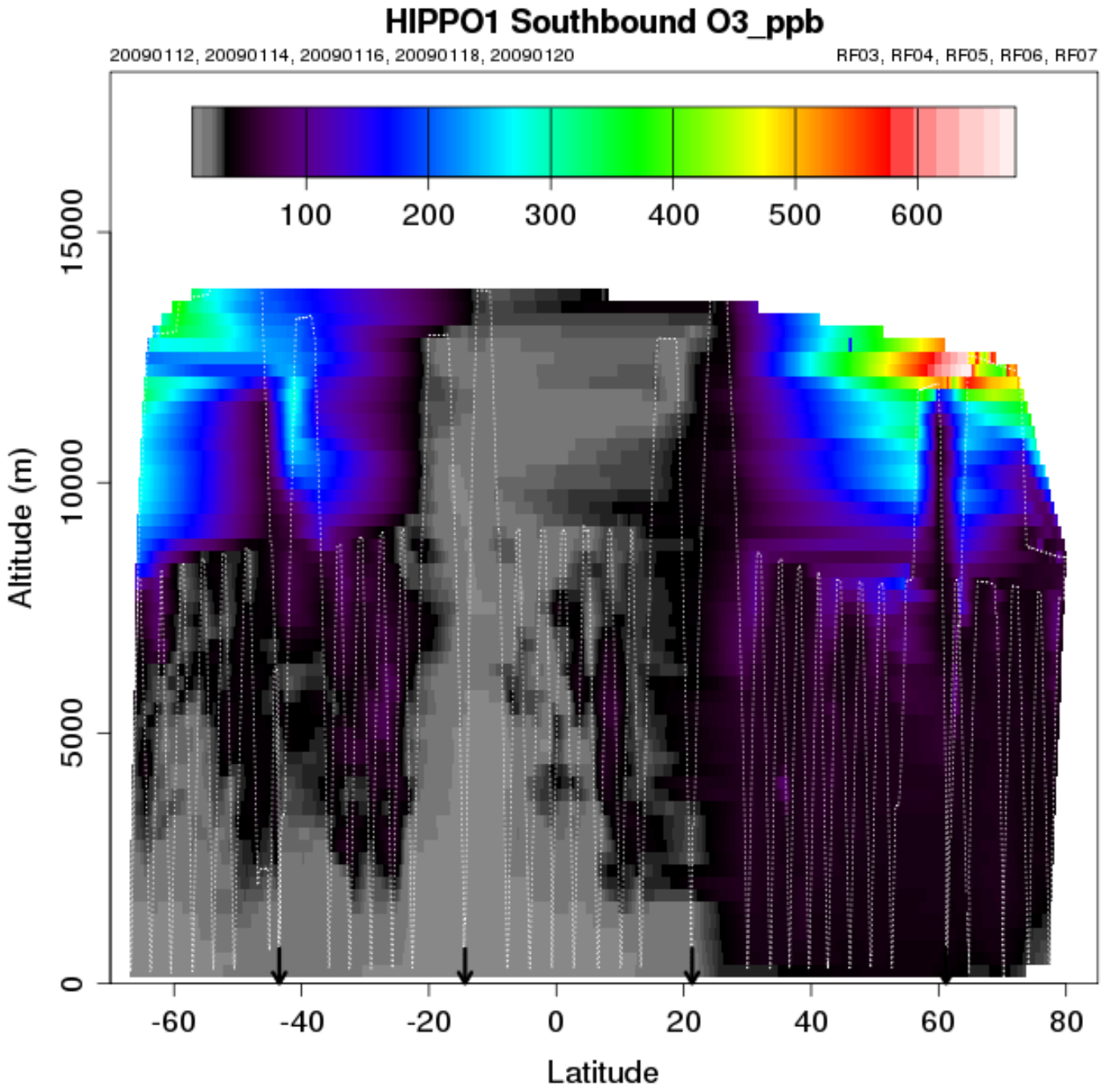


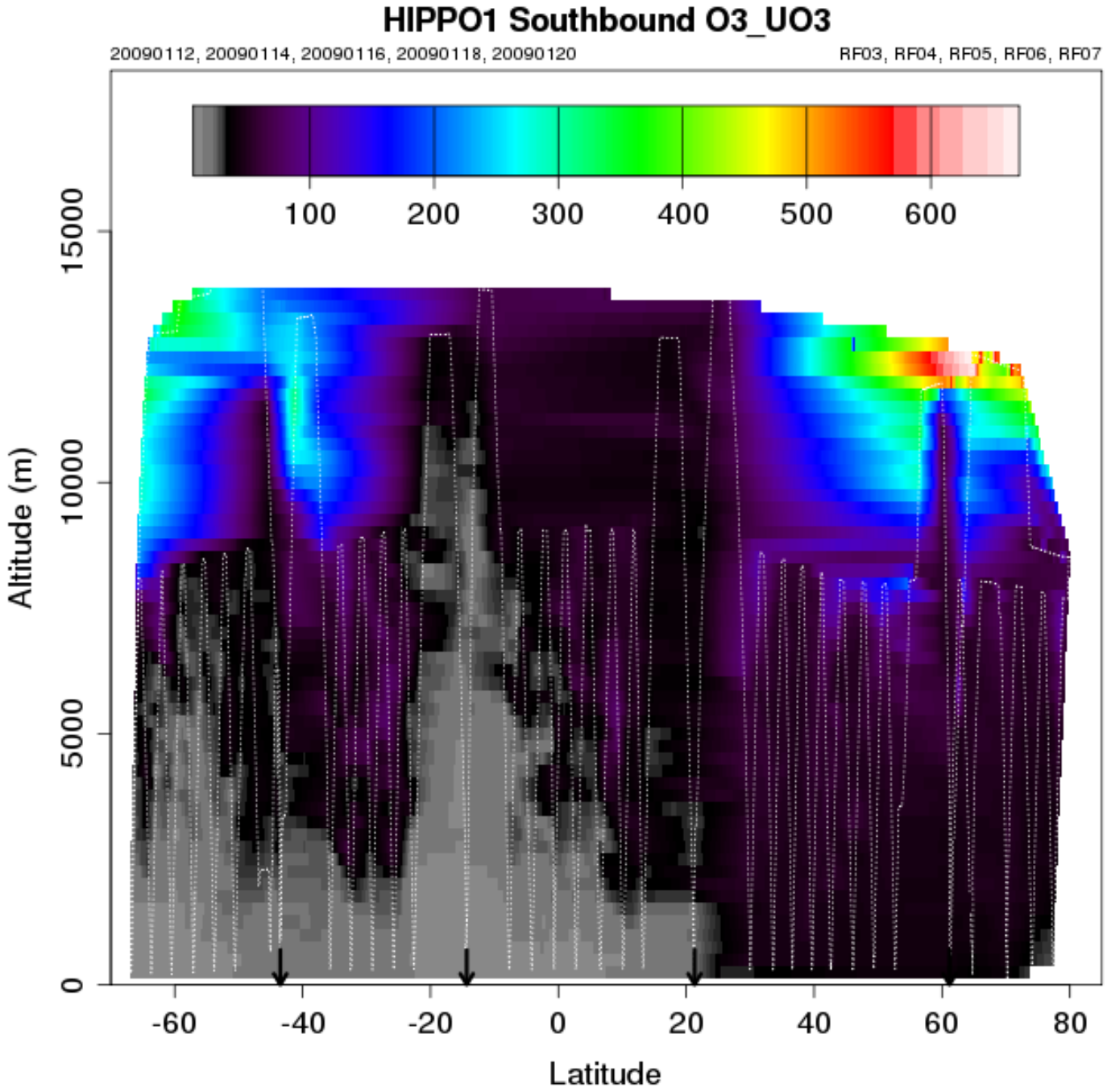
HIPPO-1, RF07 (South Polar flight)



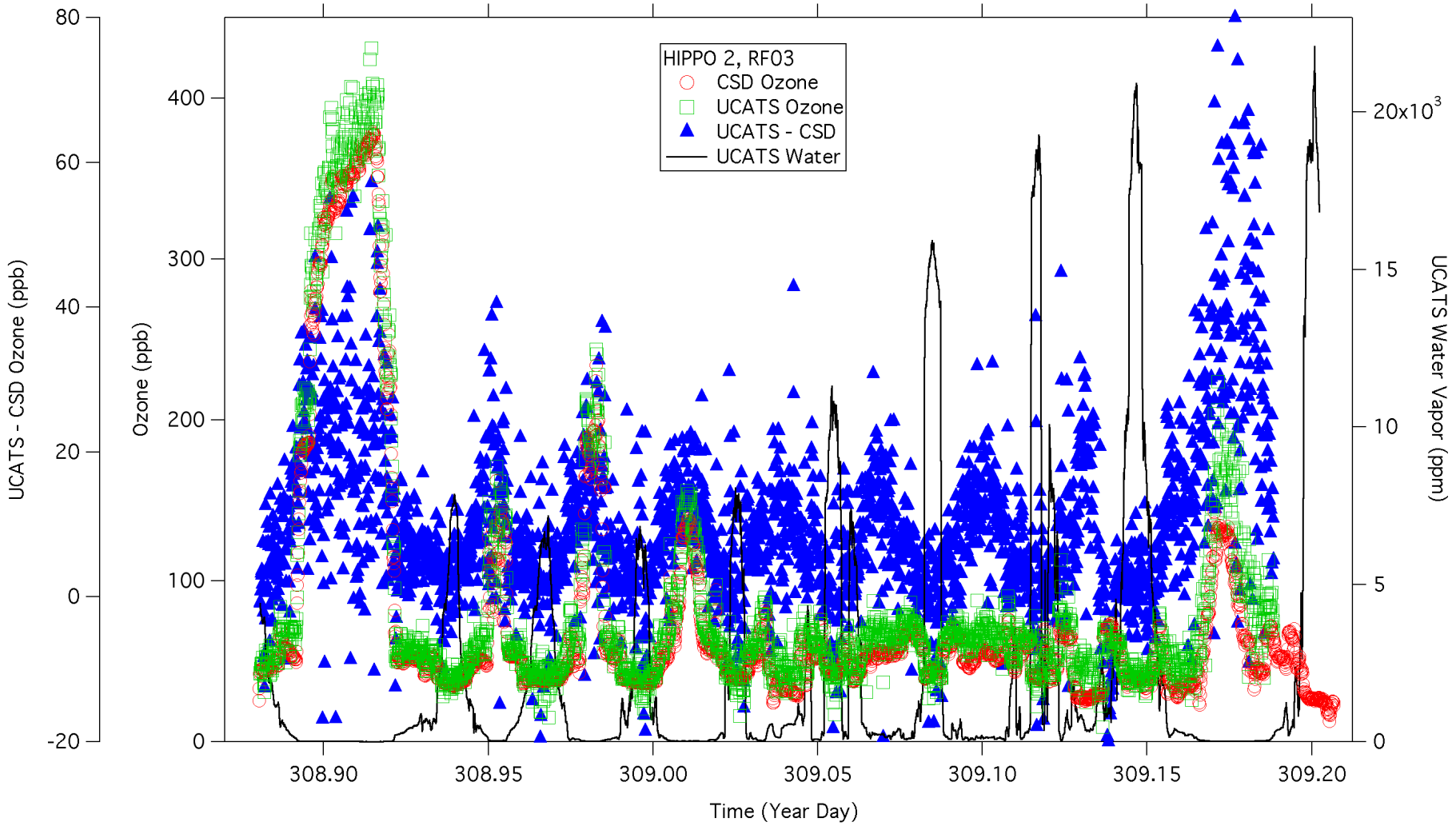
HIPPO-1, RF05 (Southbound tropical)




HIPPO1 Southbound O3_ppb
20090112, 20090114, 20090116, 20090118, 20090120
RF03, RF04, RF05, RF06, RF07
100
200
300
400
500
600
Altitude (m)
0
5000
10000
15000
-60
-40
-20
0
20
40
60
80
Latitude


HIPPO1 Southbound O3_UO3
20090112, 20090114, 20090116, 20090118, 20090120
RF03, RF04, RF05, RF06, RF07
100
200
300
400
500
600
Altitude (m)
0
5000
10000
15000
-60
-40
-20
0
20
40
60
80
Latitude

HIPPO-2, ANC to Kona



Summary

HIPPO-1 and first part of HIPPO-2: UCATS ozone usually higher than CSD ozone by 10-40 ppb after passing through wet air masses. Agreement quite good otherwise.

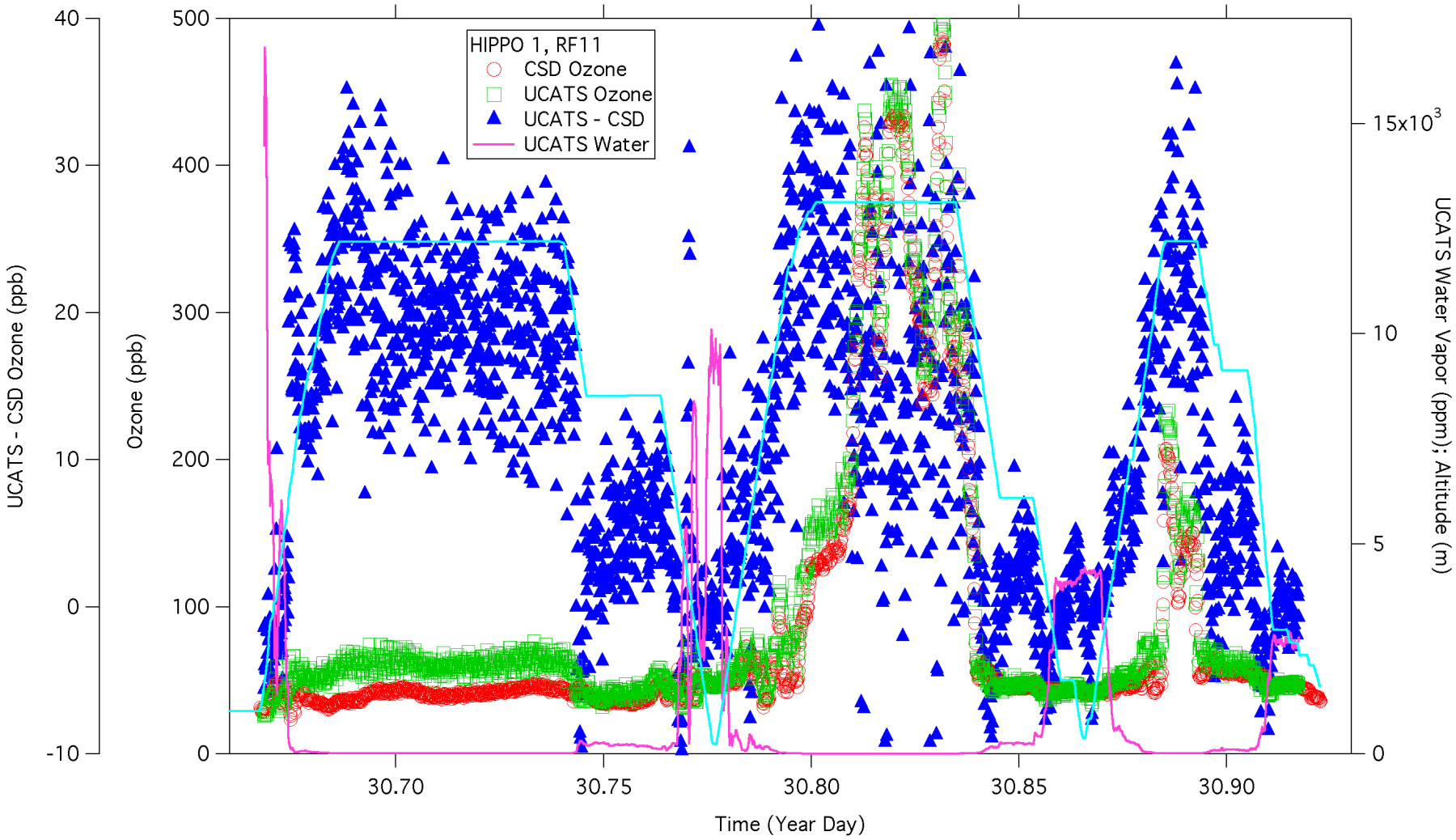
Deviations between UCATS and CSD typically after water >10,000 ppm. However, RF07 (S. Pole) on HIPPO-1 showed good agreement despite water vapor up to 15,000 ppm.

Differences sometimes persisted for over an hour at cruise altitude. Not consistent with a leak in either instrument.

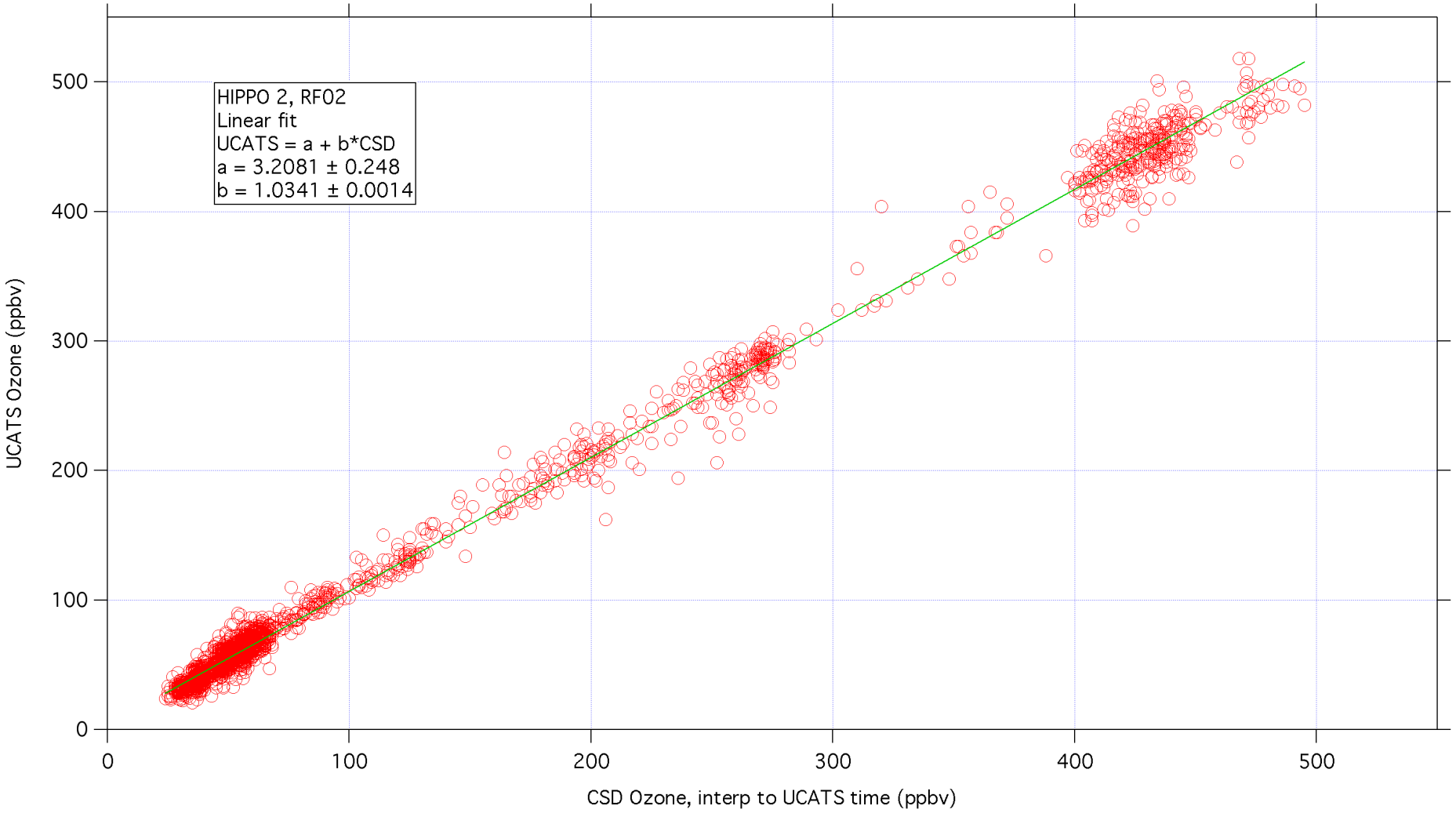
After HIPPO-2, RF03 (lamp replacement and reassembly) and RF04 (leaks fixed): apparent UCATS calibration changed. UCATS < CSD following wet air. However, UCATS instrument not internally secure and alignment could have changed.

After HIPPO-2, the mechanical problems with UCATS ozone were fixed and a tight correlation was observed between UCATS and CSD in the stratosphere. No UCATS HIPPO-3 data because of GloPac.

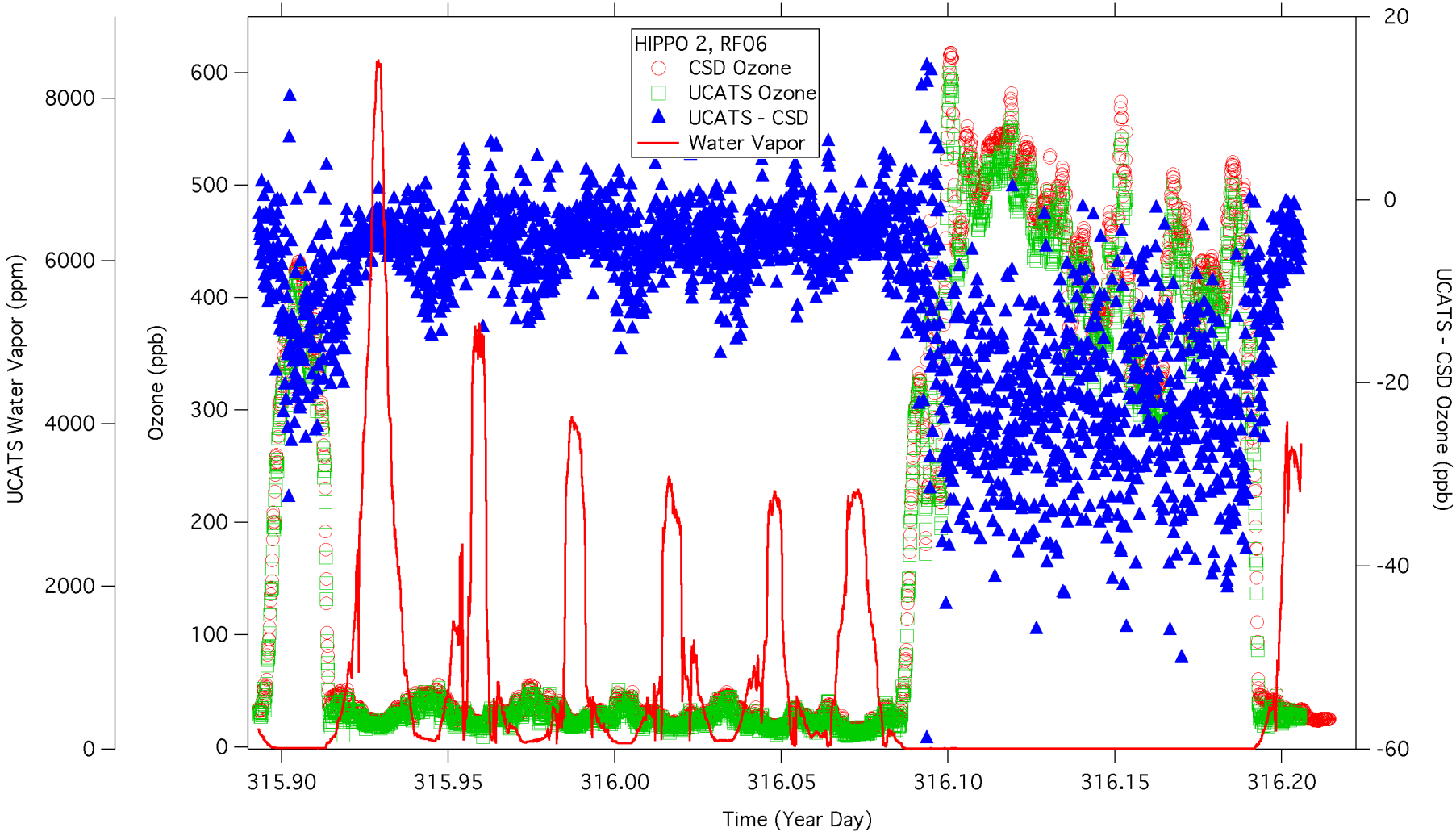
HIPPO-1, RF11, Costa Rico to JeffCo



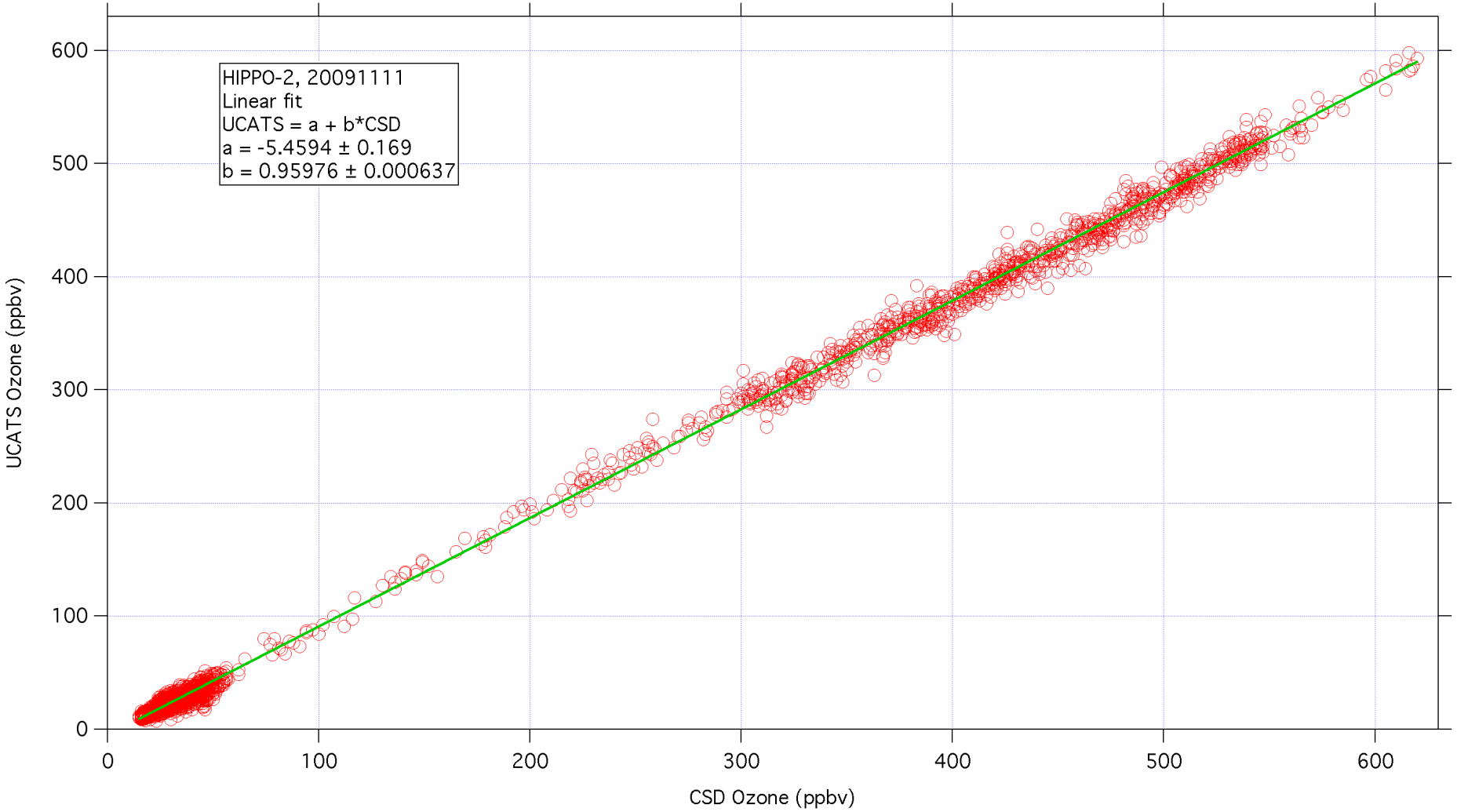
HIPPO-2, First N. Polar flight



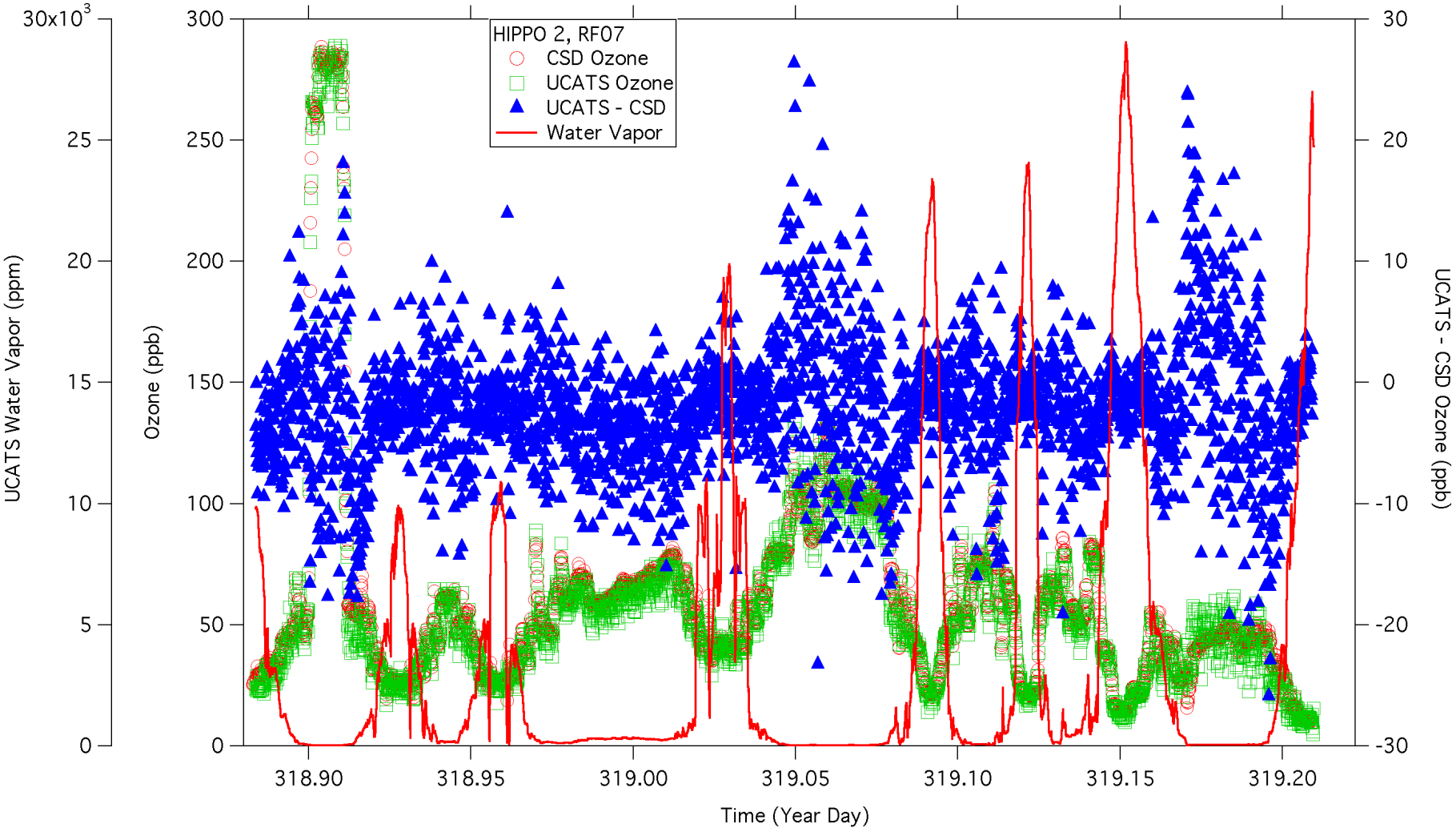
HIPPO-2, South Polar flight



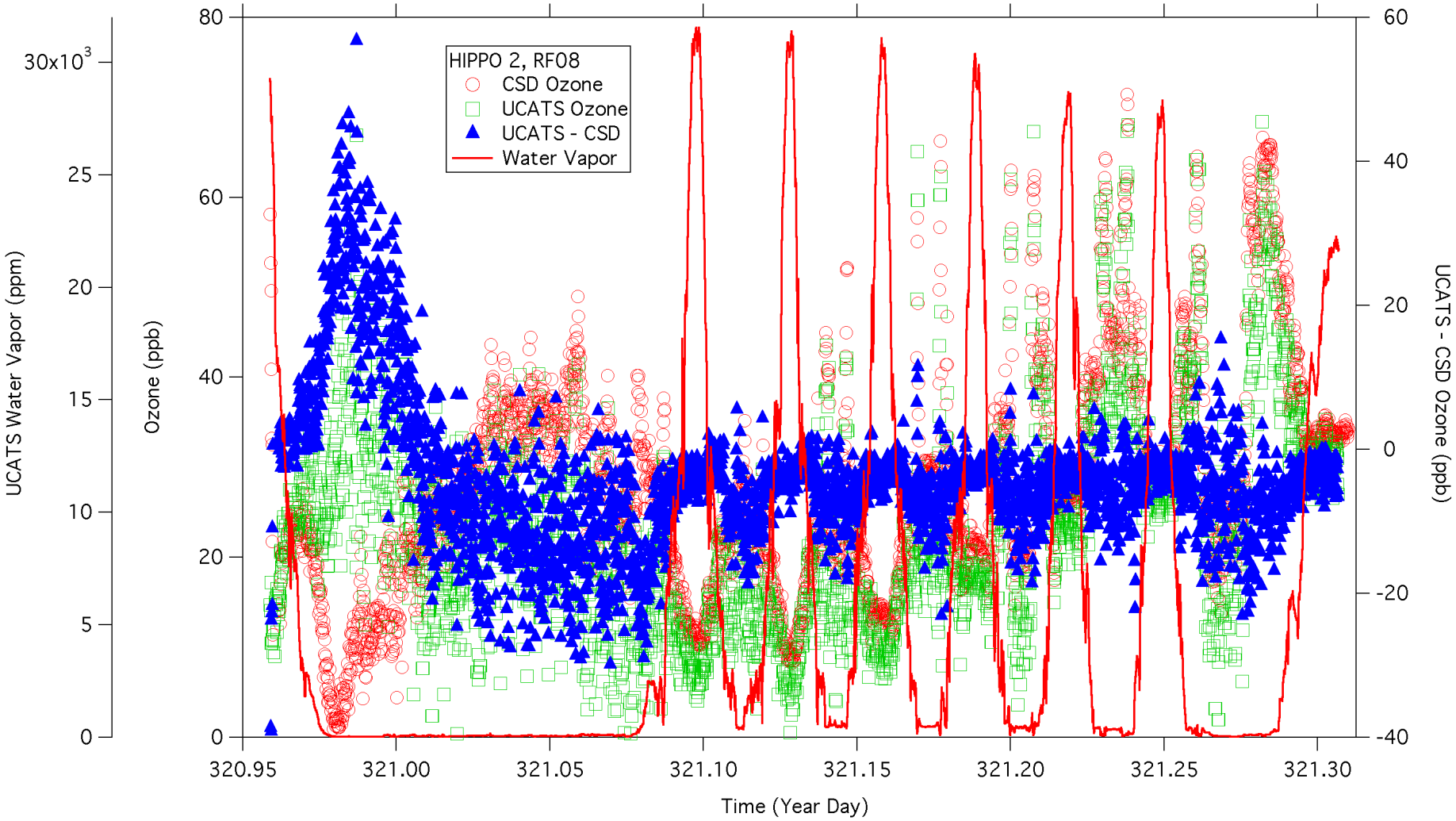
RF06, South Polar flight



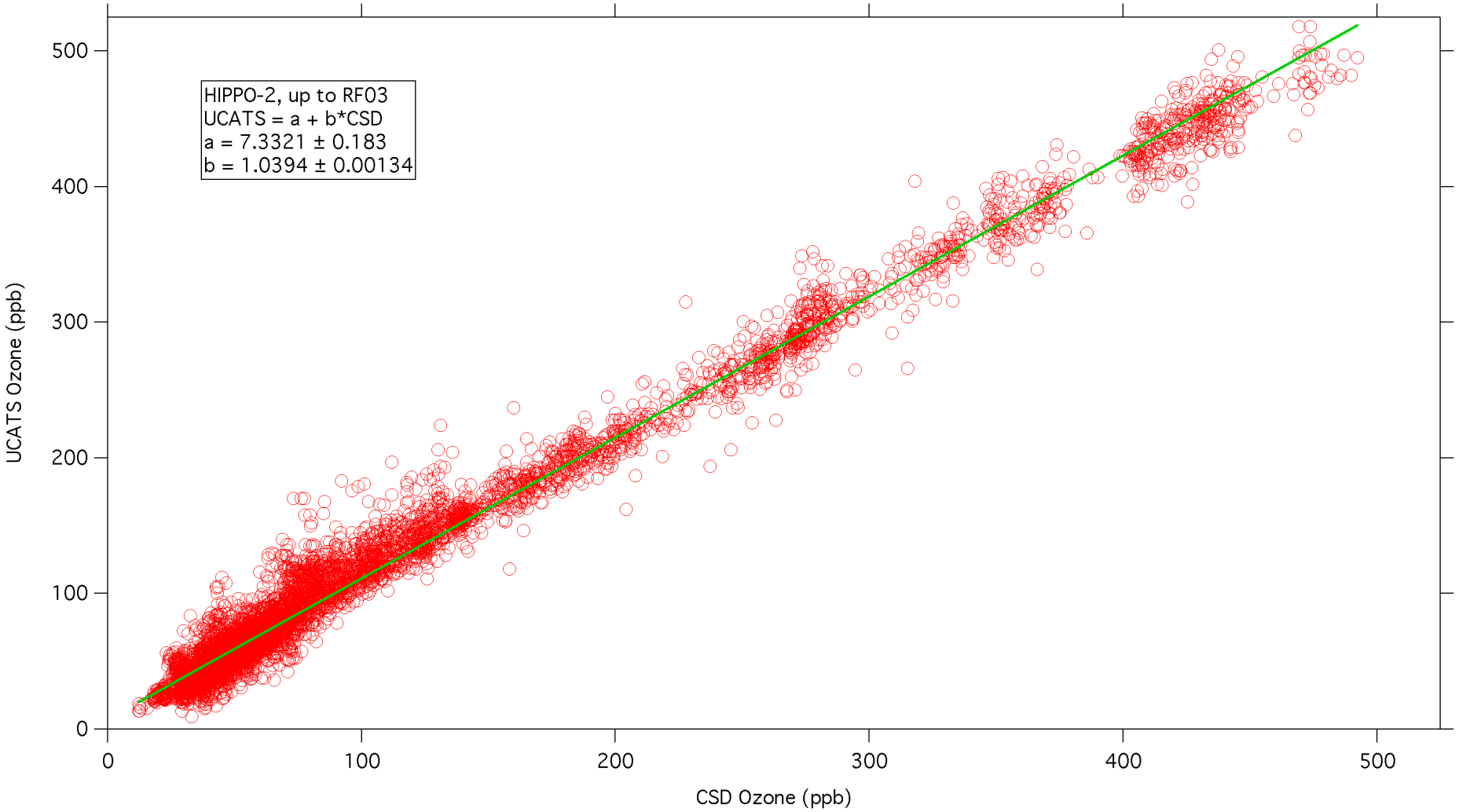
HIPPO-2, Christchurch to north



HIPPO-2, northbound tropical



HIPPO-2 data, prior to lamp switch



Same, but expanded scale