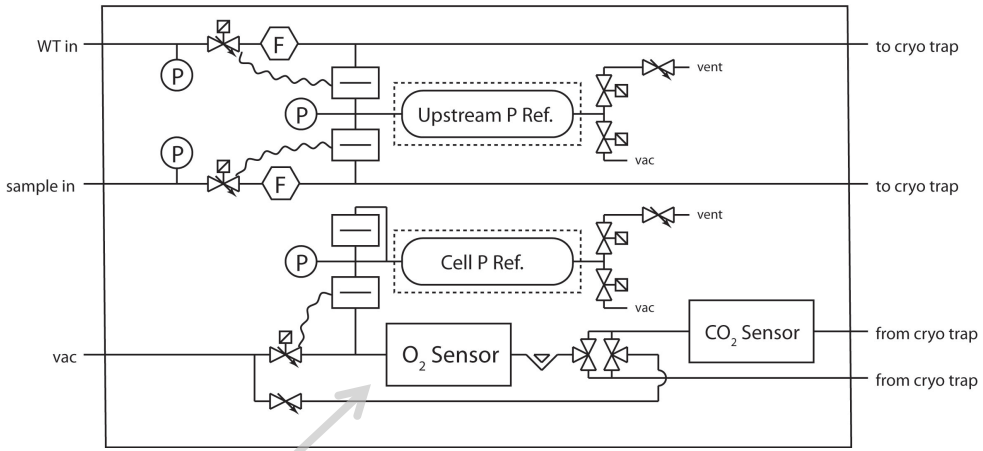
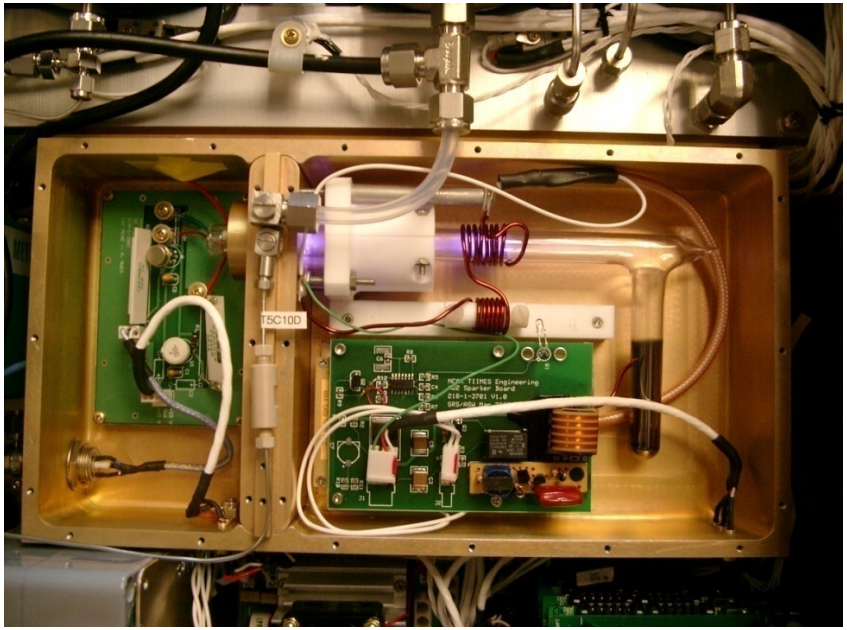
NCAR Airborne Oxygen Instrument (AO2)

Flow control:



O_2 sensor

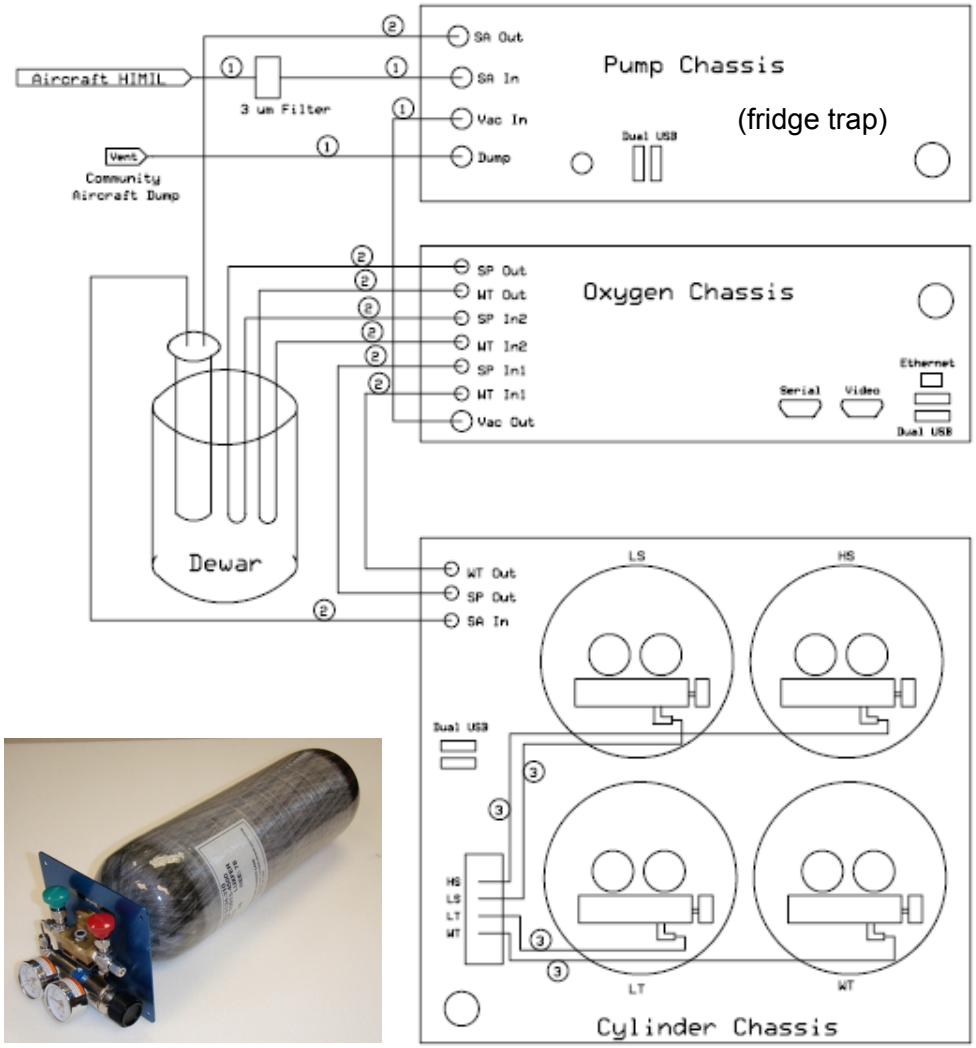


B. Stephens, A. Watt, S. Shertz (NCAR); J. Bent, R. Keeling (Scripps)

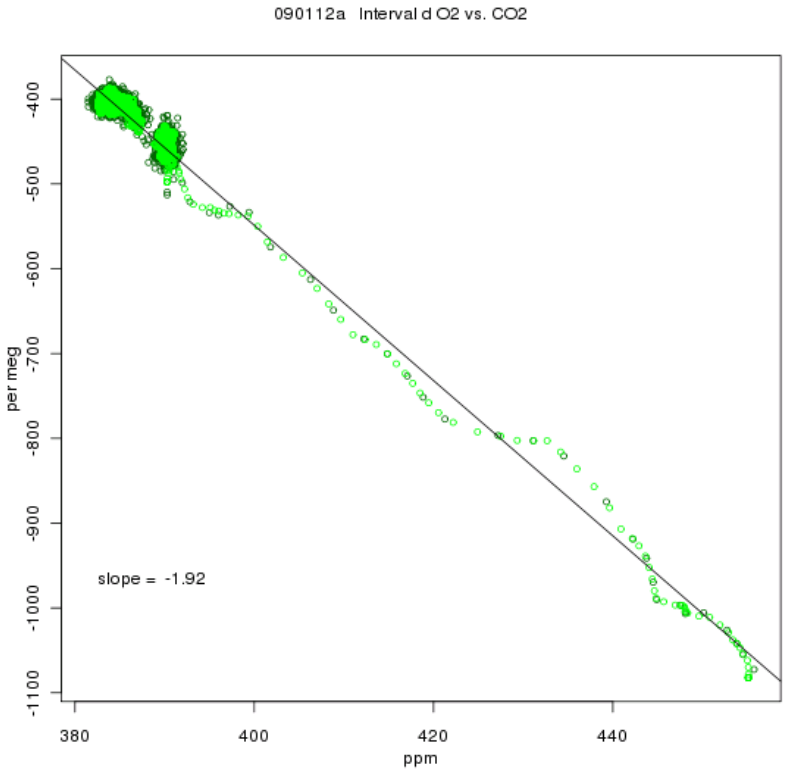
- Vacuum ultraviolet absorption technique
- Xe lamp (147 nm) and CsI detector
- Adapted from shipboard design (Stephens et al., 2003)
- Active pressure and flow control to 10^{-6}
- Switches every 2.5 seconds between sample and WT gas
- 5-second 1-sigma precision of ± 2 per meg
- Factor of 2-5 motion degradation is correctable

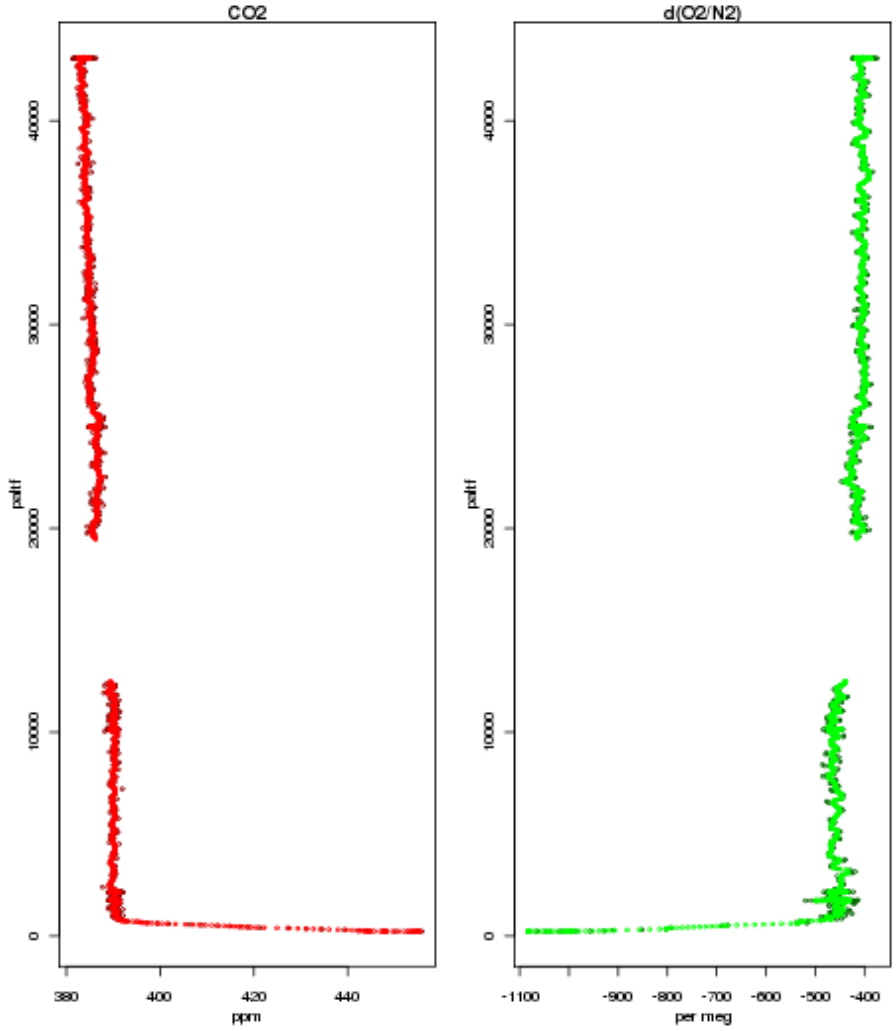
NCAR Airborne Oxygen Instrument (AO2)

System components:

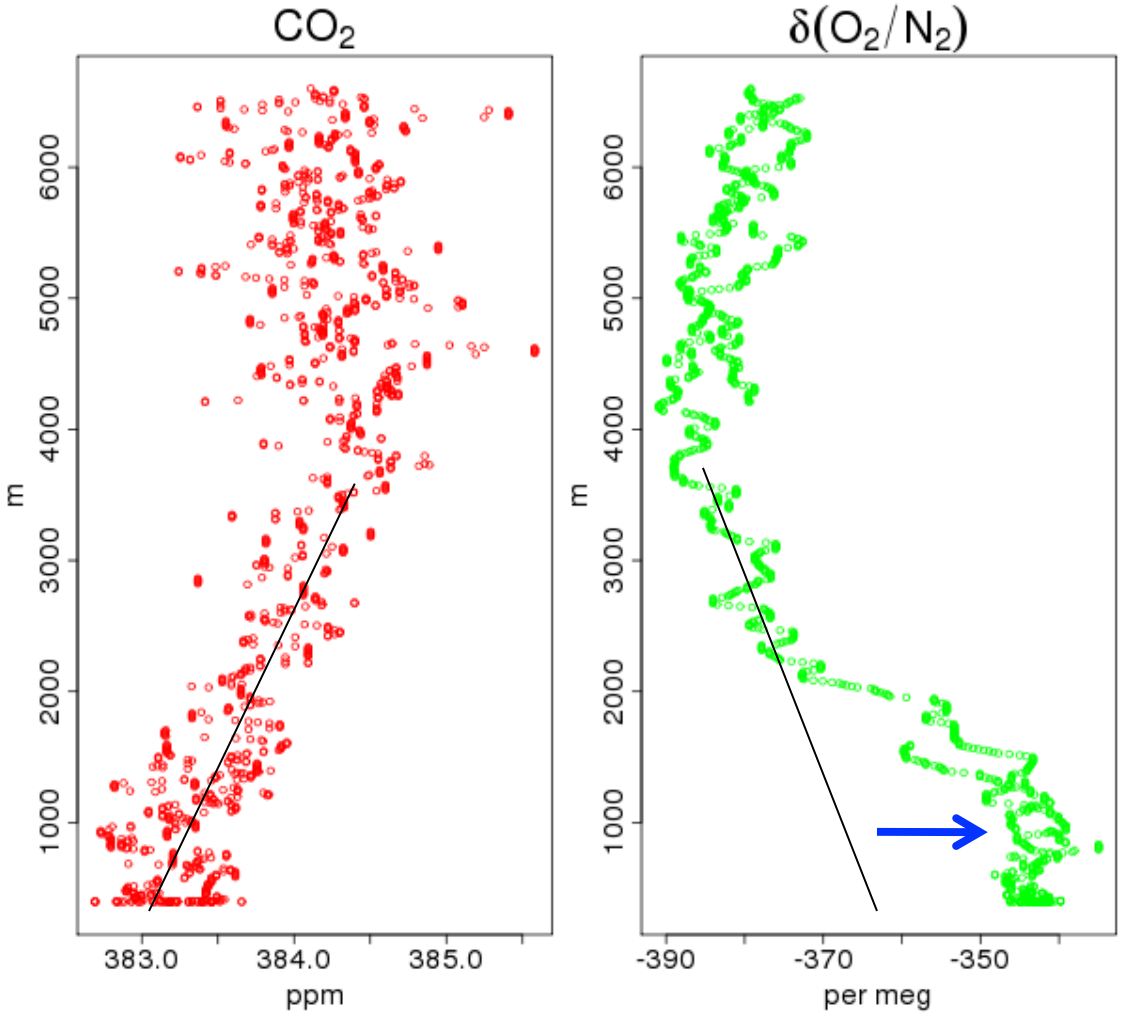


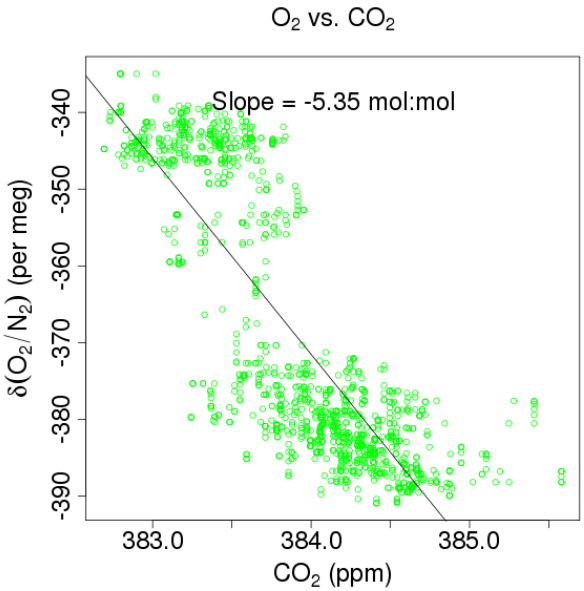
HIPPO1 descent into ANC





HIPPO1 Profile at 65 S

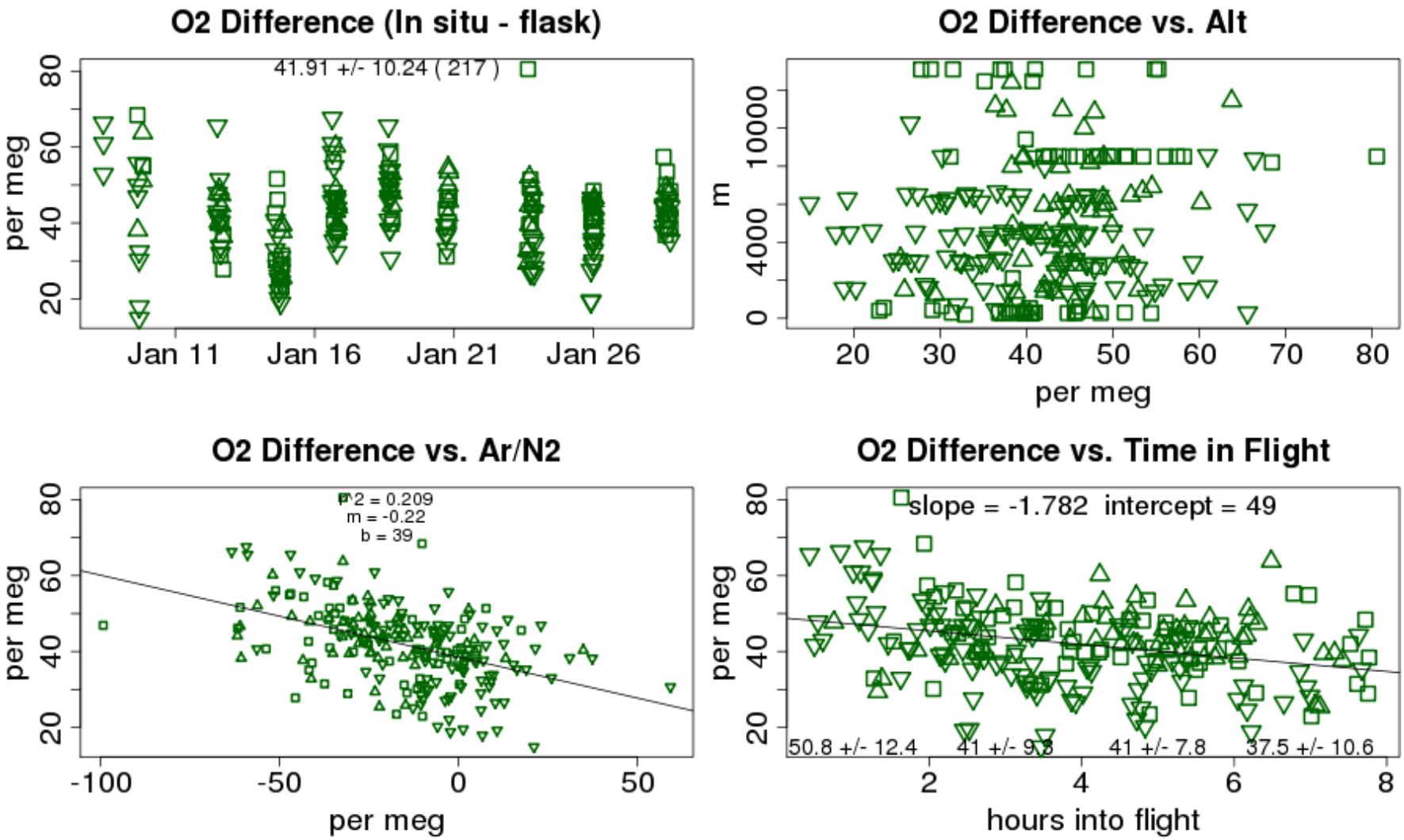




Southern Ocean
O_2 outgassing

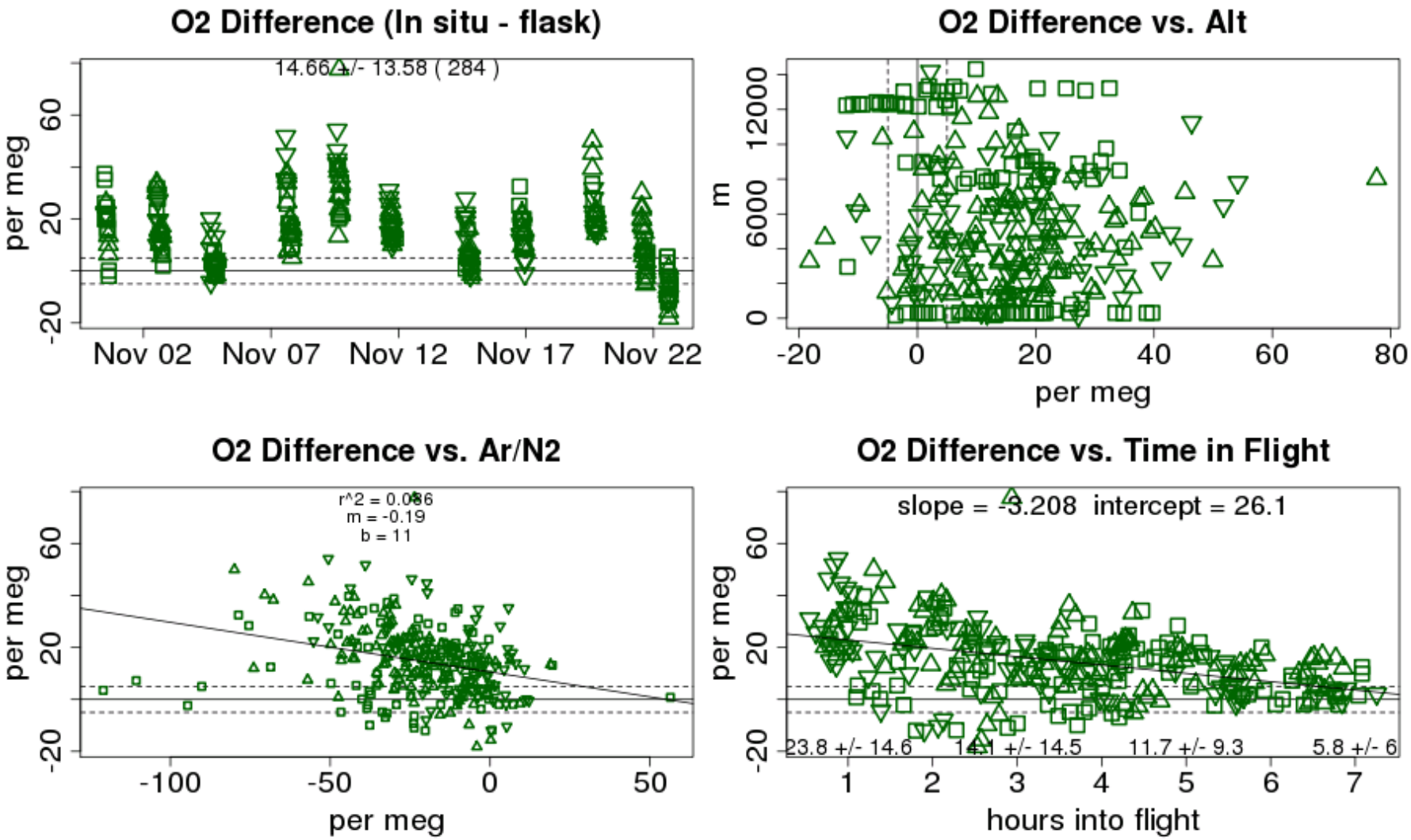
January 20, 2009

HIPPO1 ALL AO2



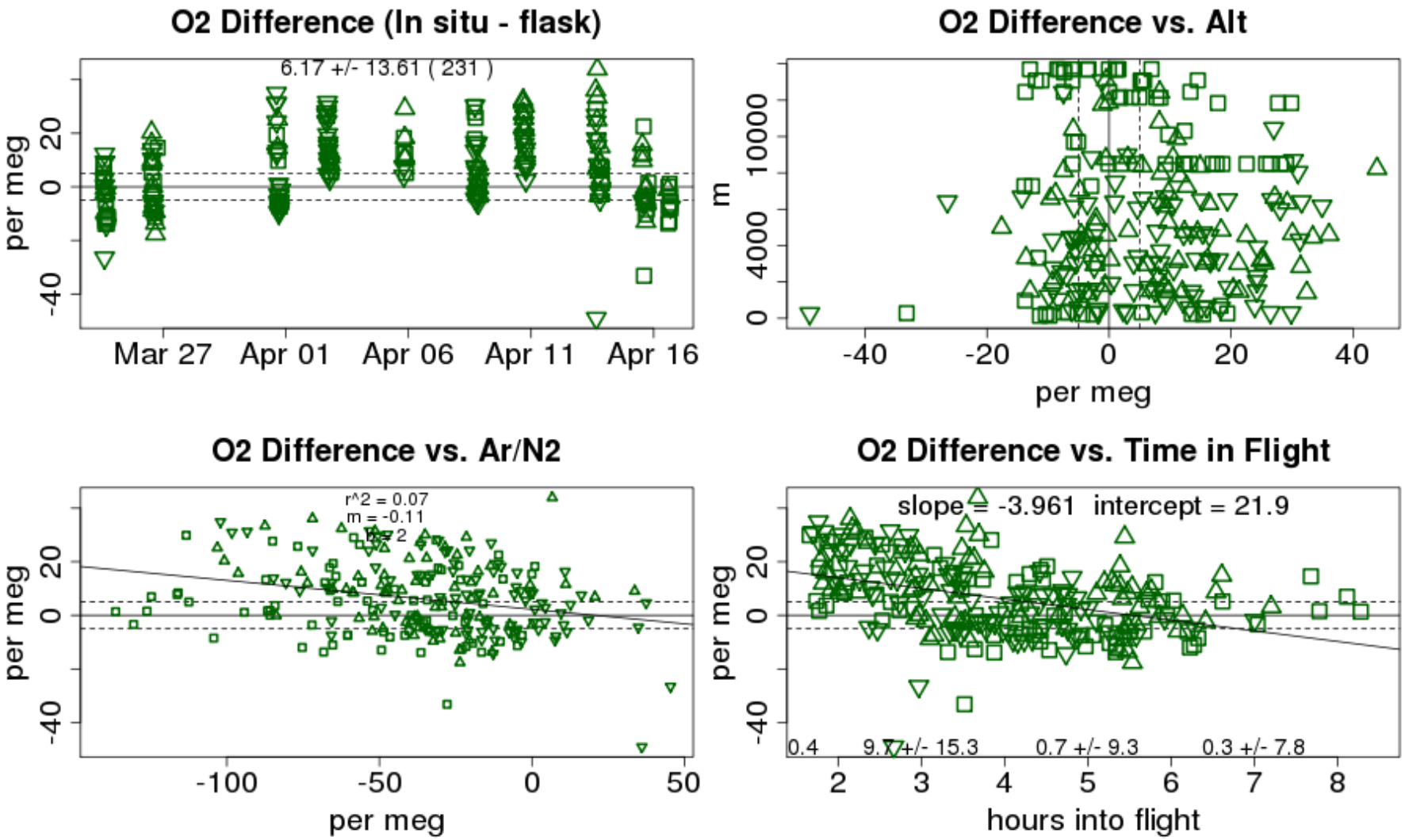
(shorter preflight flow period)

HIPPO2 ALL AO2



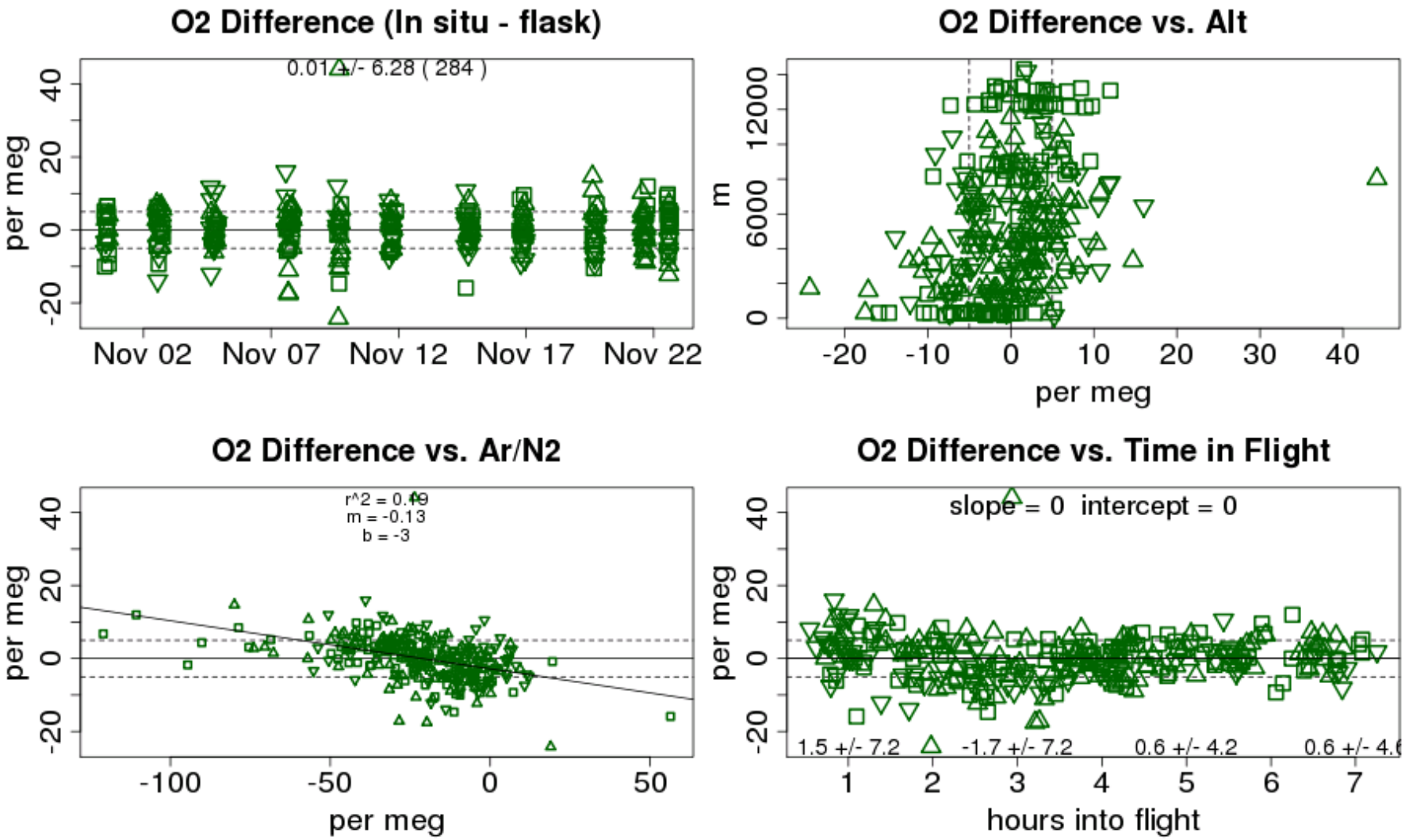
(fridge trap + pre- and post- flight dry air purge)

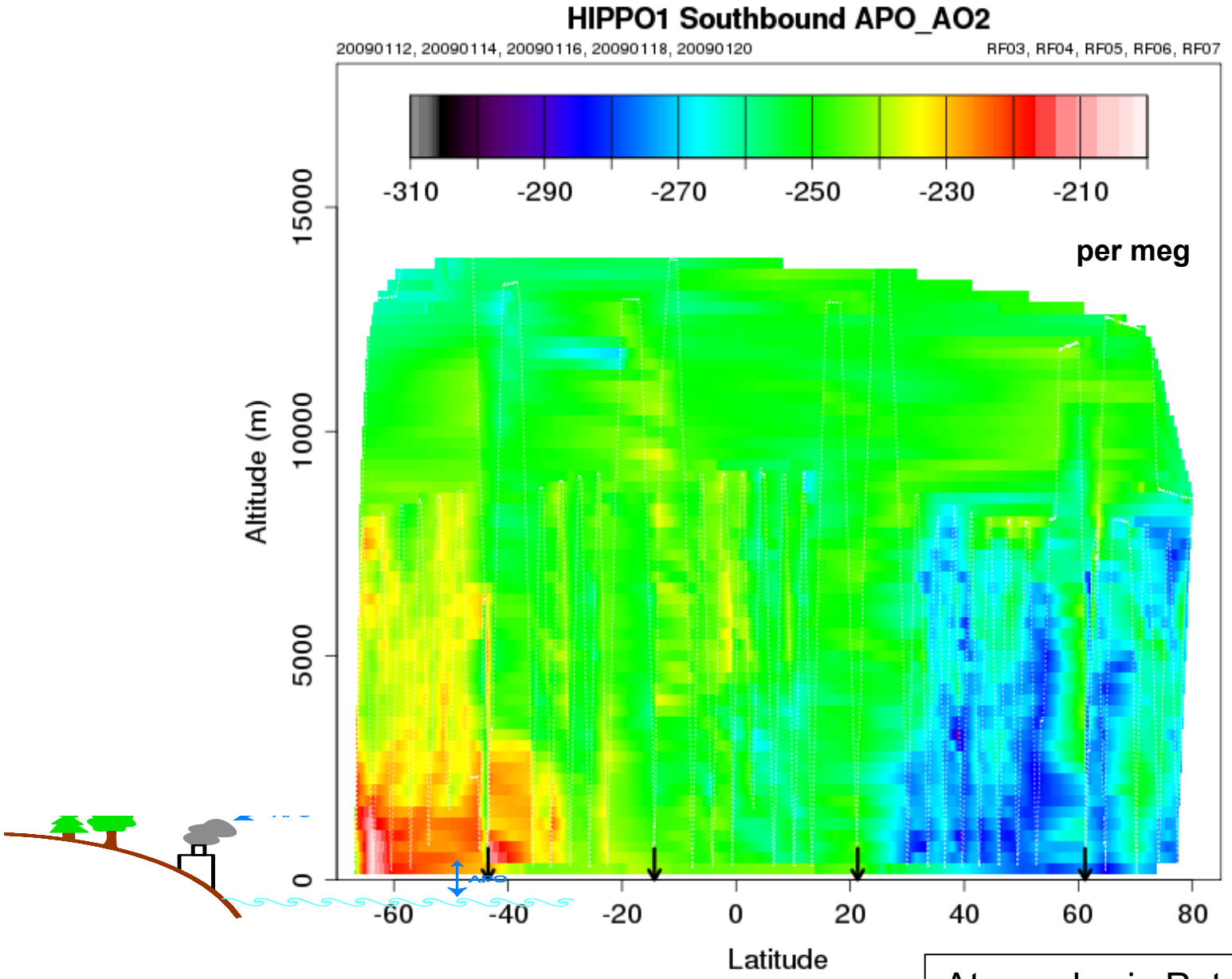
HIPPO3 ALL AO2



(after linear time-in-flight correction)

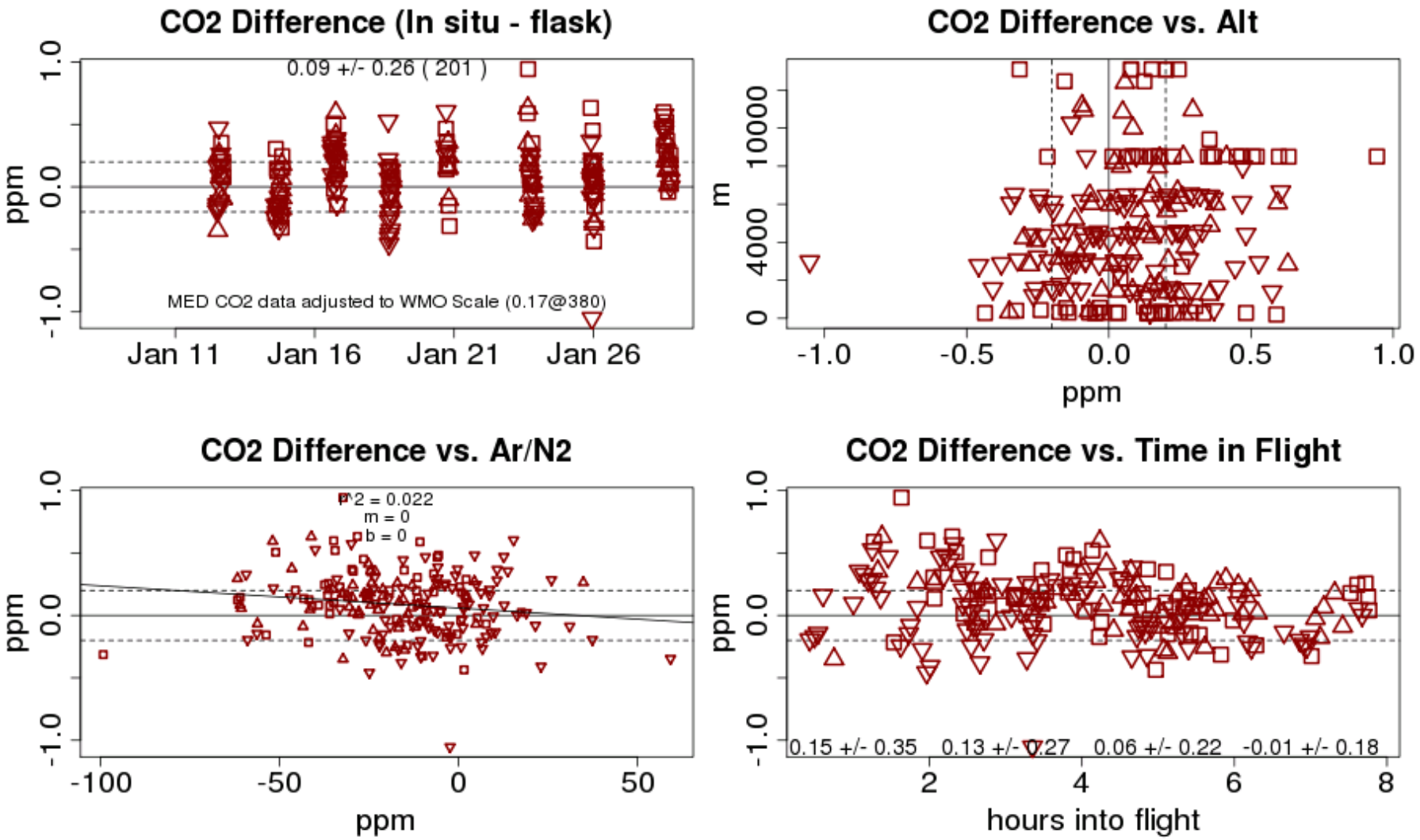
HIPPO2 ALL AO2



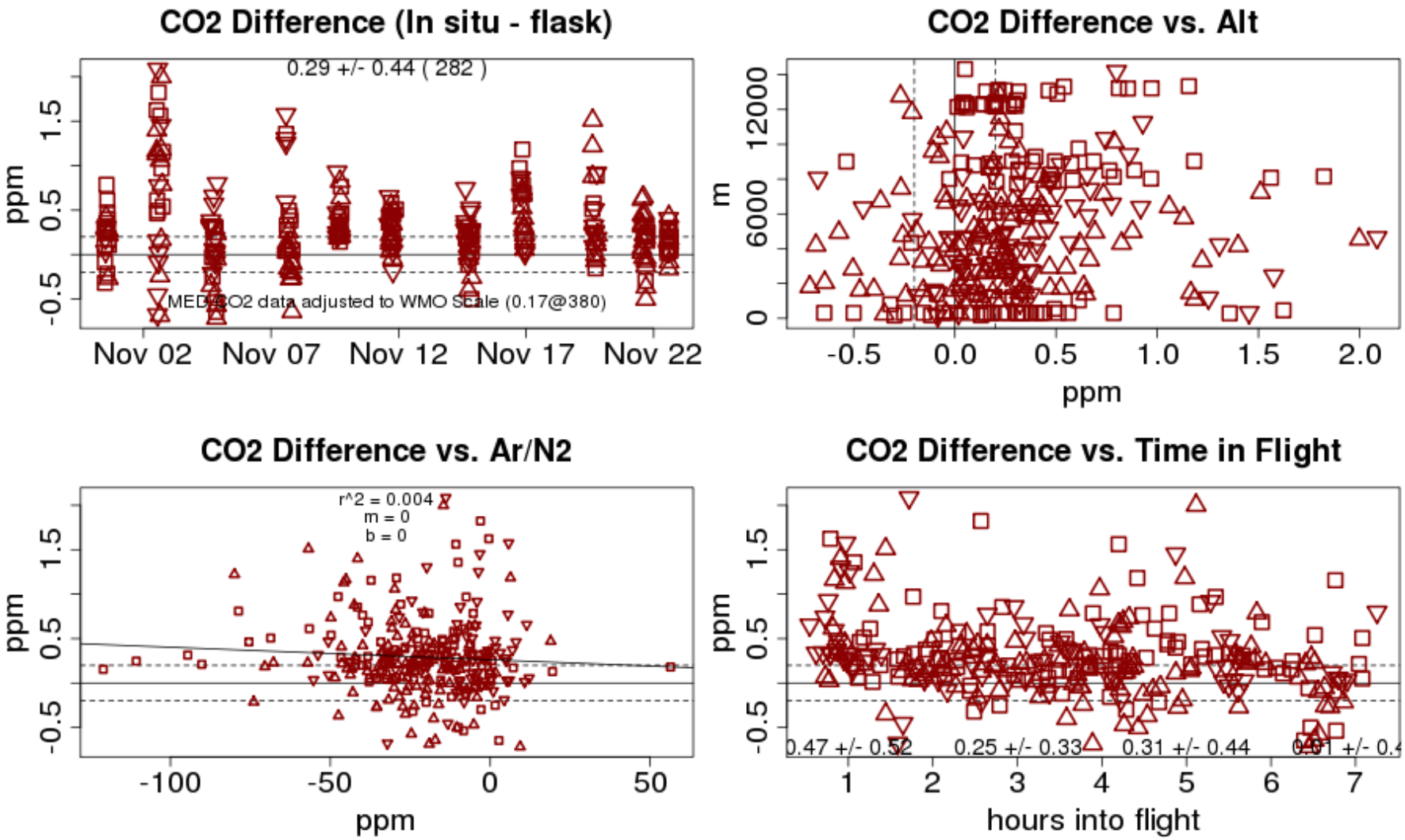


Atmospheric Potential Oxygen:
APO = O_2 + 1.1*CO_2

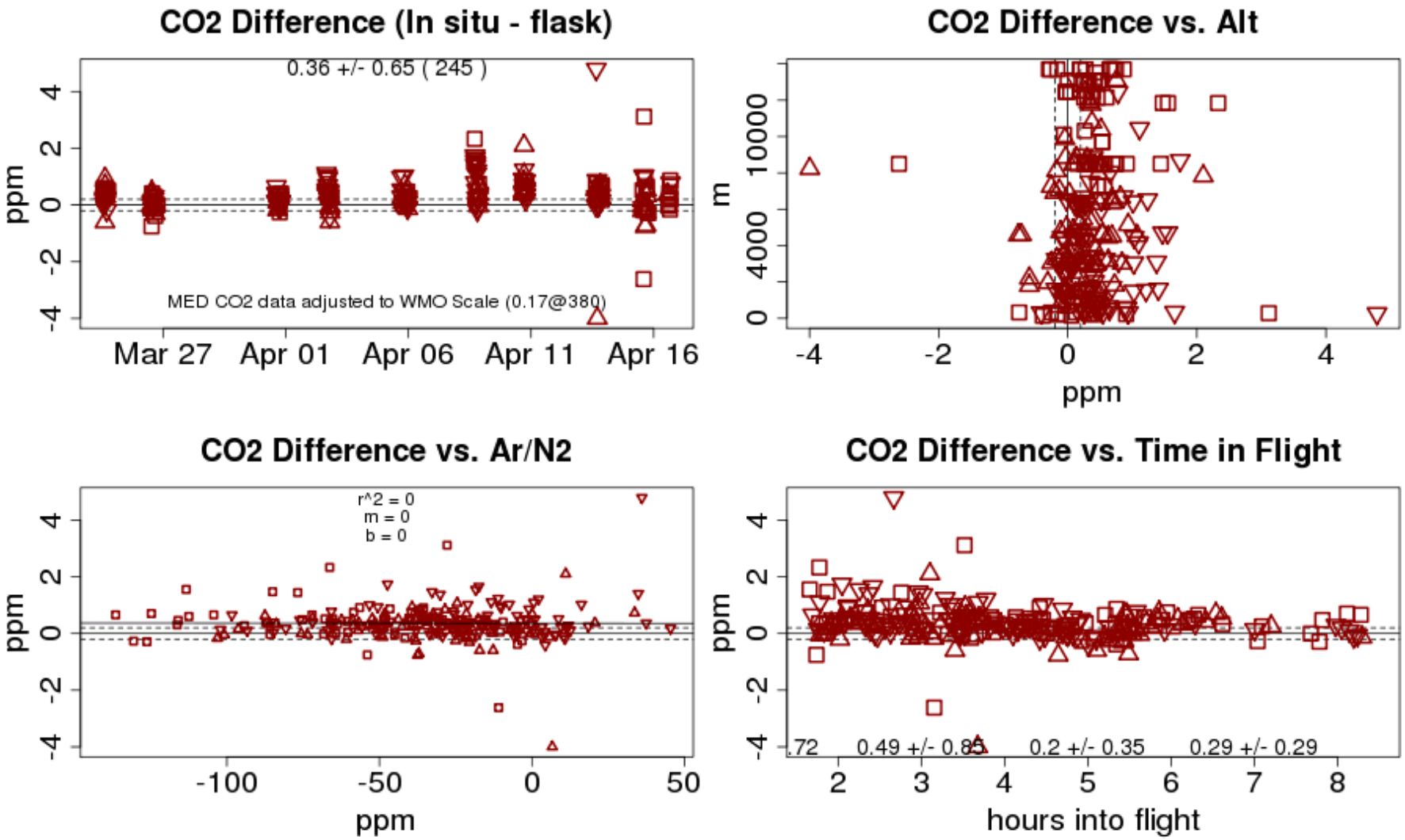
HIPPO1 ALL AO2

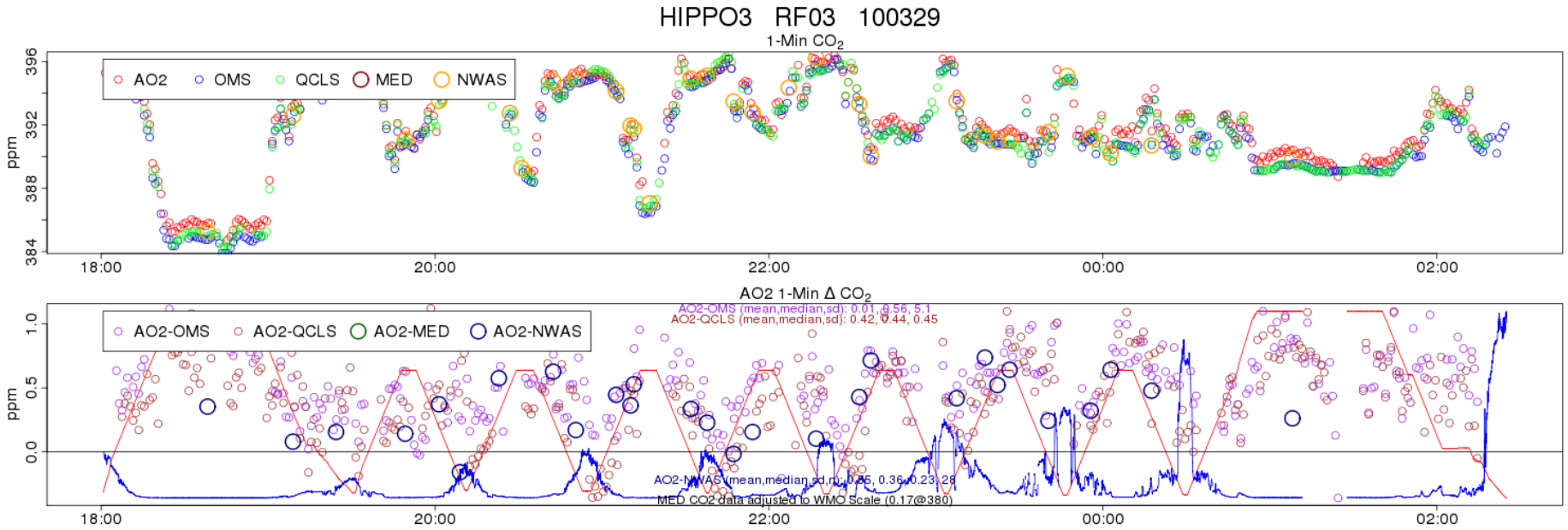


HIPPO2 ALL AO2



HIPPO3 ALL AO2




HIPPO3 RF03 100329
1-Min CO2
AO2
OMS
QCLS
MED
NWAS
ppm
396
392
388
384
18:00
20:00
22:00
00:00
02:00
AO2 1-Min Δ CO2
AO2-OMS
AO2-QCLS
AO2-MED
AO2-NWAS
AO2-OMS (mean,median,sd): 0.01, 0.56, 5.1
AO2-QCLS (mean,median,sd): 0.42, 0.44, 0.45
AO2-NWAS (mean,median,sd,n): 0.35, 0.36, 0.23, 28
MED CO2 data adjusted to WMO Scale (0.17@380)
1.0
0.5
0.0

Summary

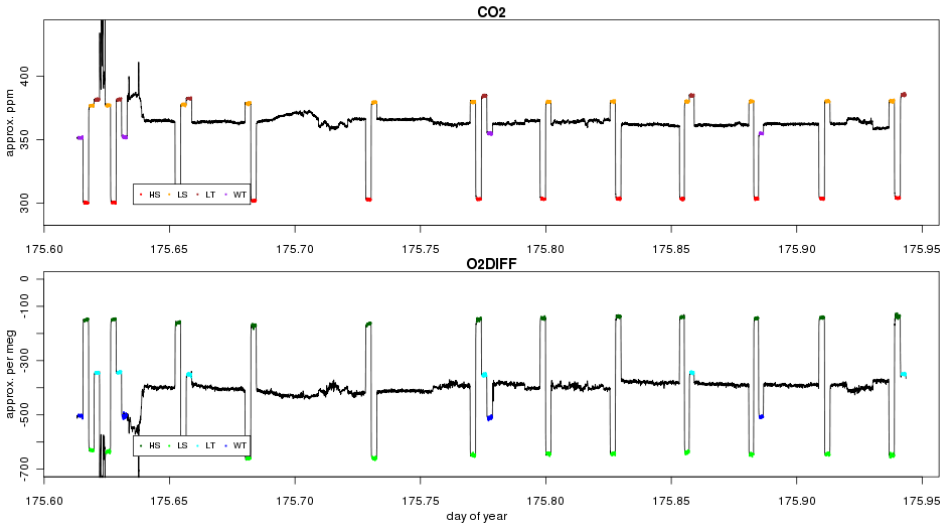
- AO2 has operated on every flight
- HIPPO1 RF02 CO2_AO2 suffered from a cabin pressure effect and is not reported
- HIPPO3 RF06 O2_AO2 has several hours of missing data due to a noise problem
- HIPPO2 and HIPPO3 CO2_AO2 quality is degraded by inlet humidity effect and not appropriate for rigorous comparison to other sensors
- O2_AO2ADJ and APO_AO2ADJ are recommend variables for O2 analyses

Between now and HIPPO4

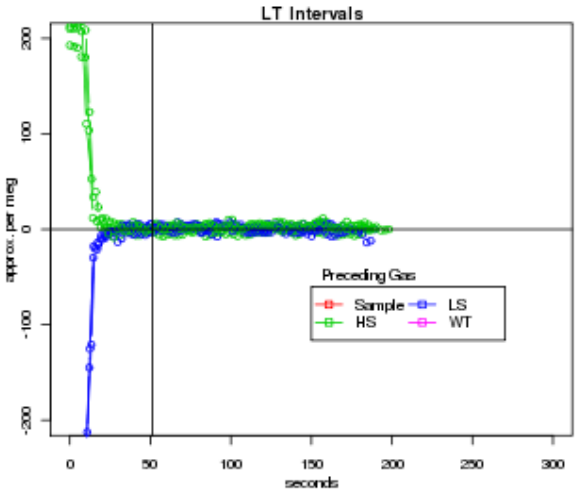
- Laboratory experiments to characterize inlet humidity effects on O_2 and CO_2
- Replacing tubing with e-polish and/or cleaning
- Software improvements to reduce remaining motion sensitivity
- Laboratory tests on calibration gas delivery consistency

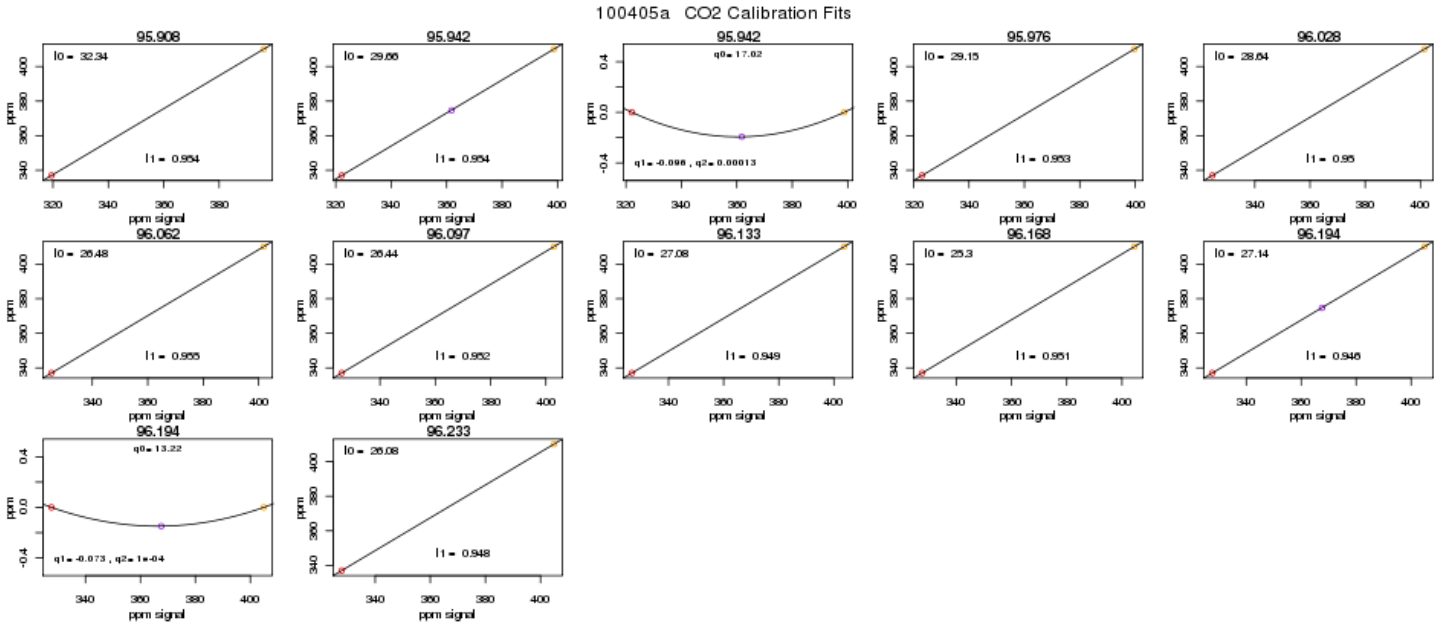
NCAR Airborne Oxygen Instrument (AO2)

8-hour flight



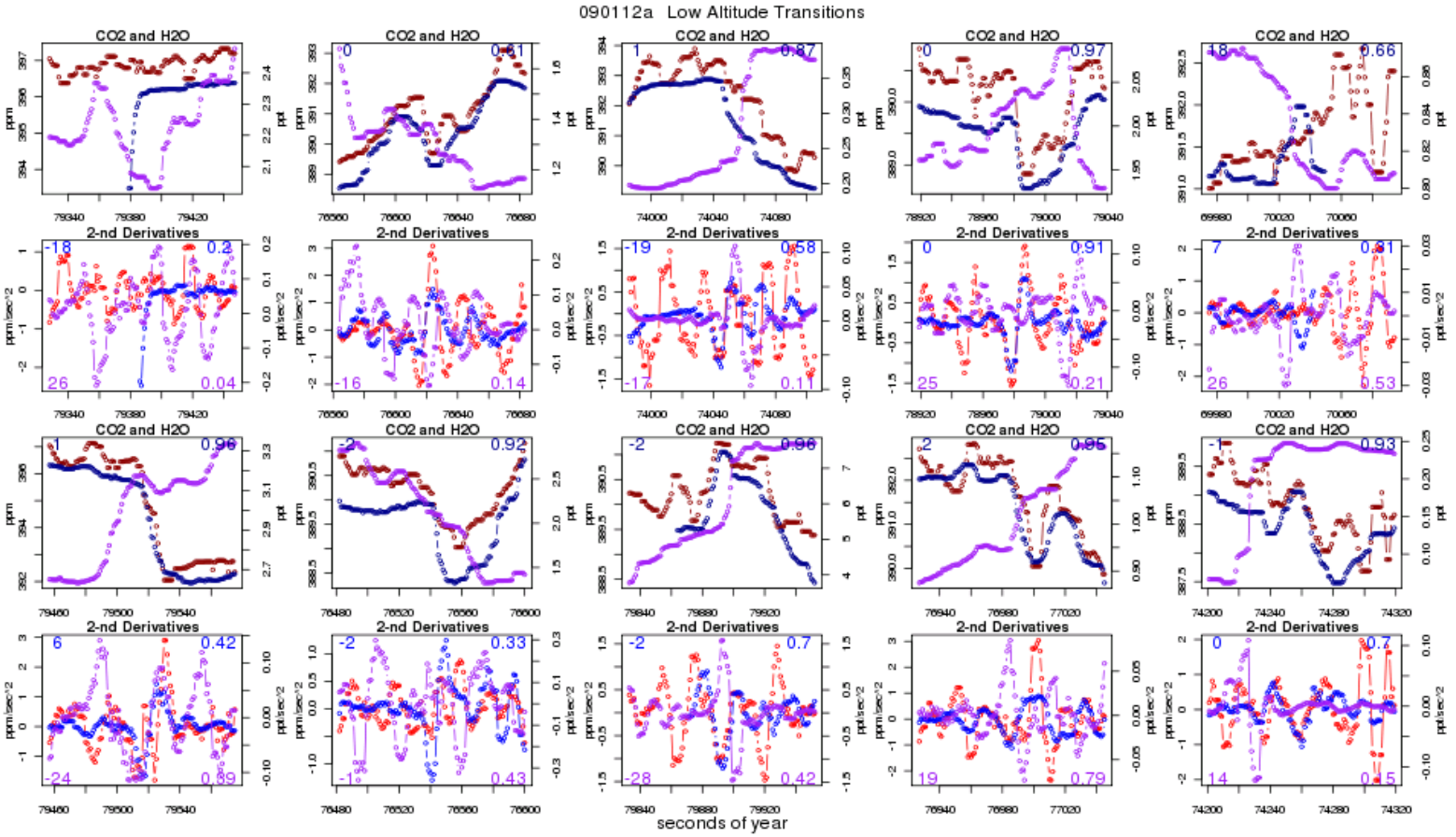
3-min cal



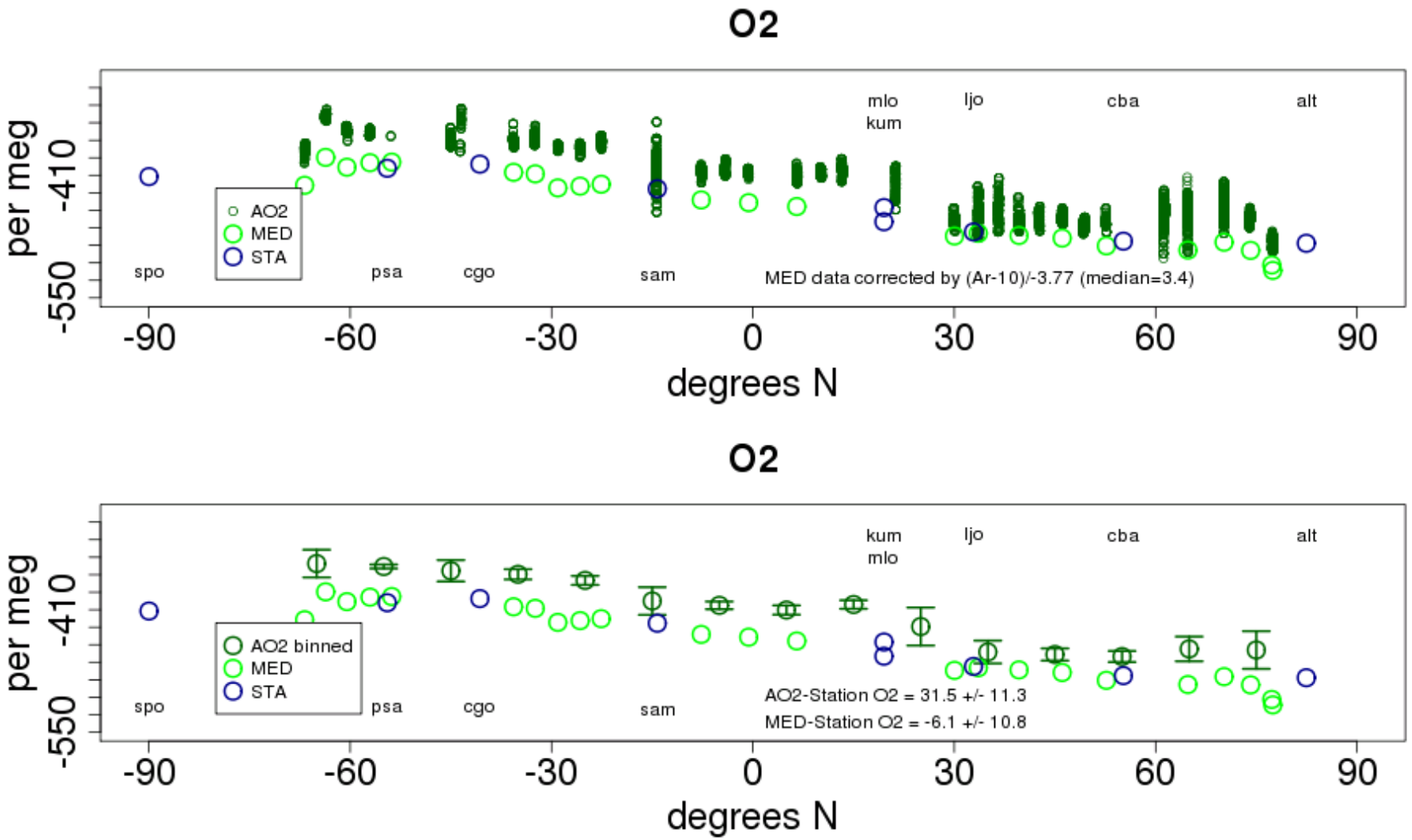


NCAR Airborne Oxygen Instrument (AO2)

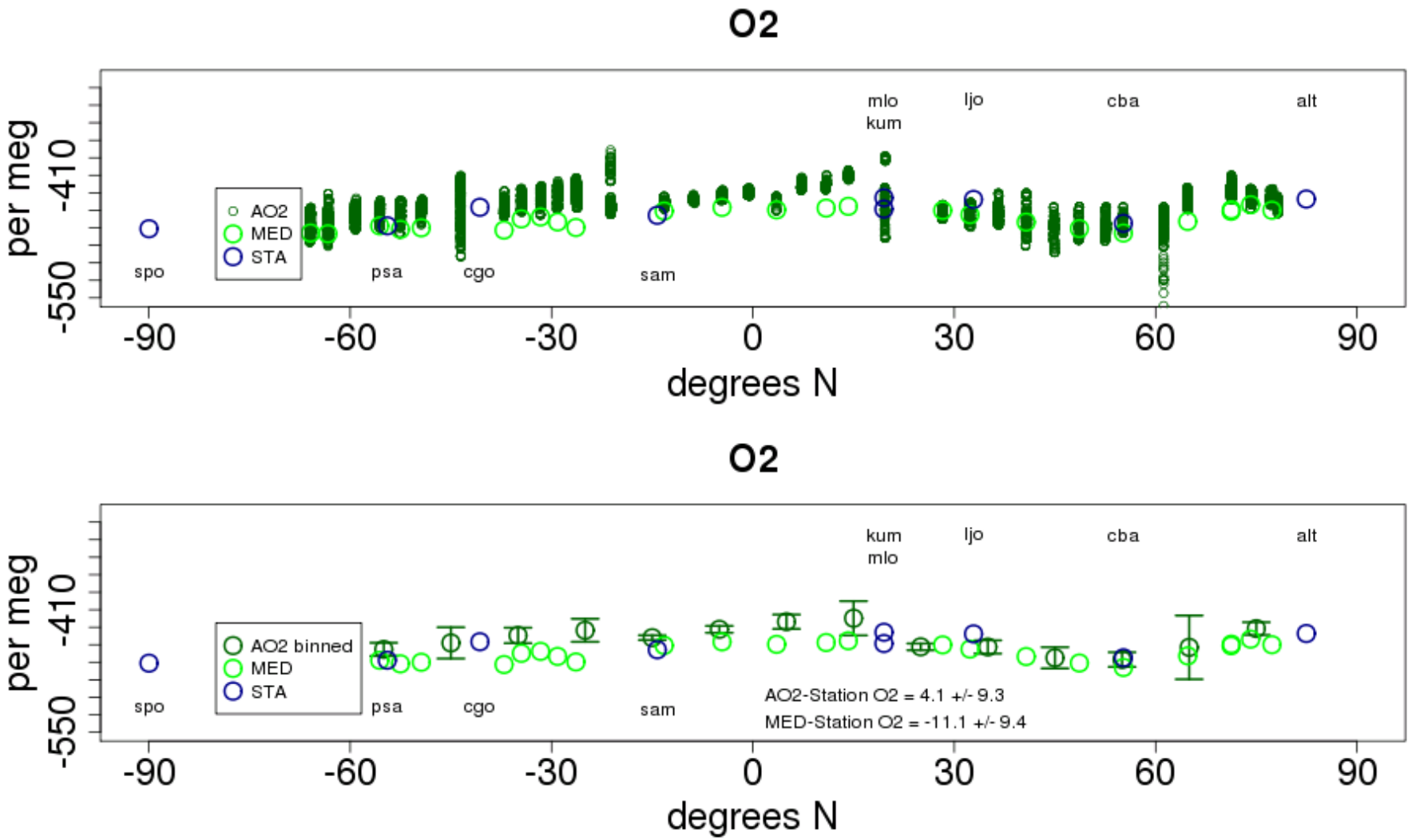
- Inlet delay ~ 40 seconds with only a few second altitude dependency
- Checked against OMS and VCSEL for 10 low and 10 high-alt transitions per flight



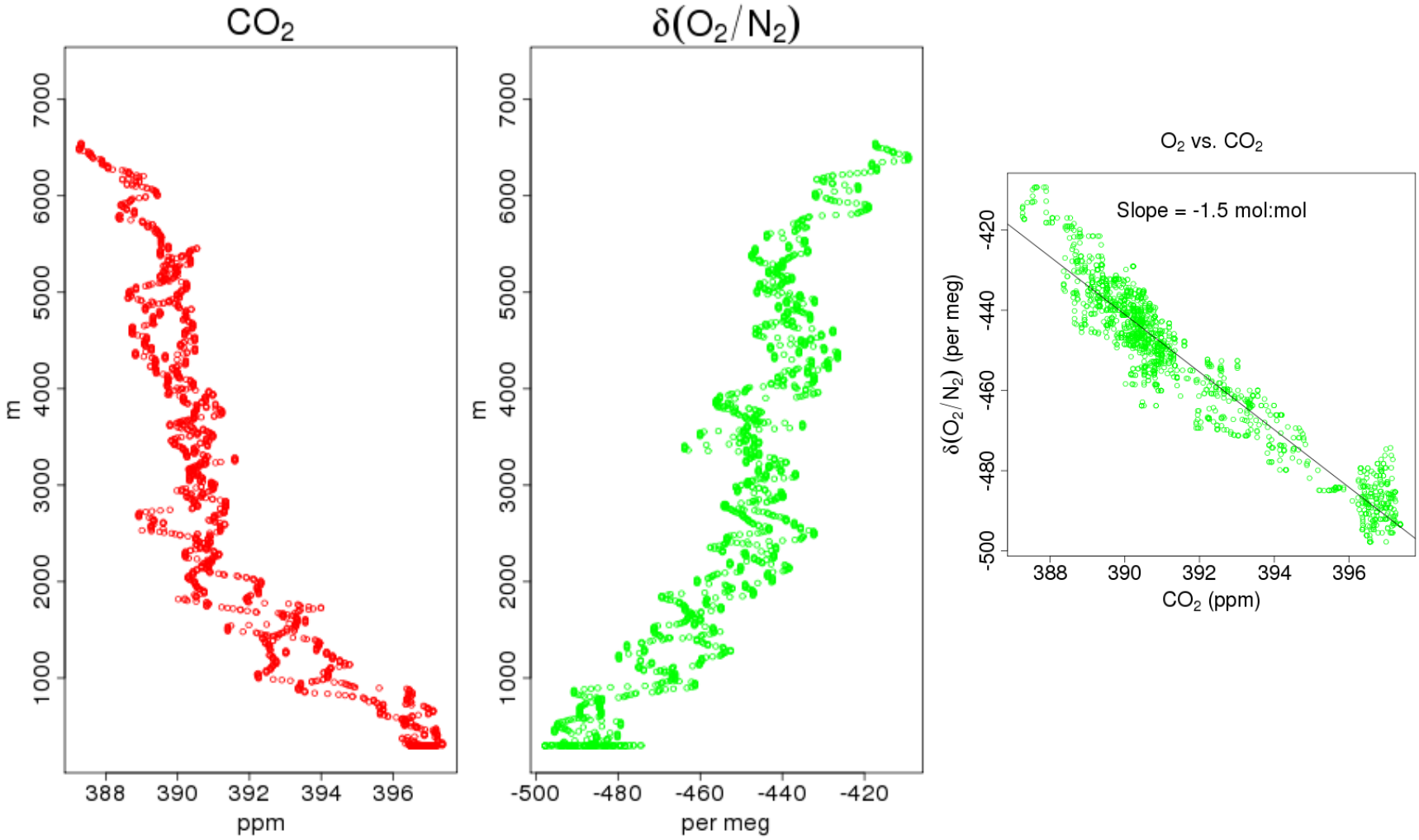
HIPPO1 Station Comparison



HIPPO2 Station Comparison



HIPPO1 Profile at 80 N



January 12, 2009