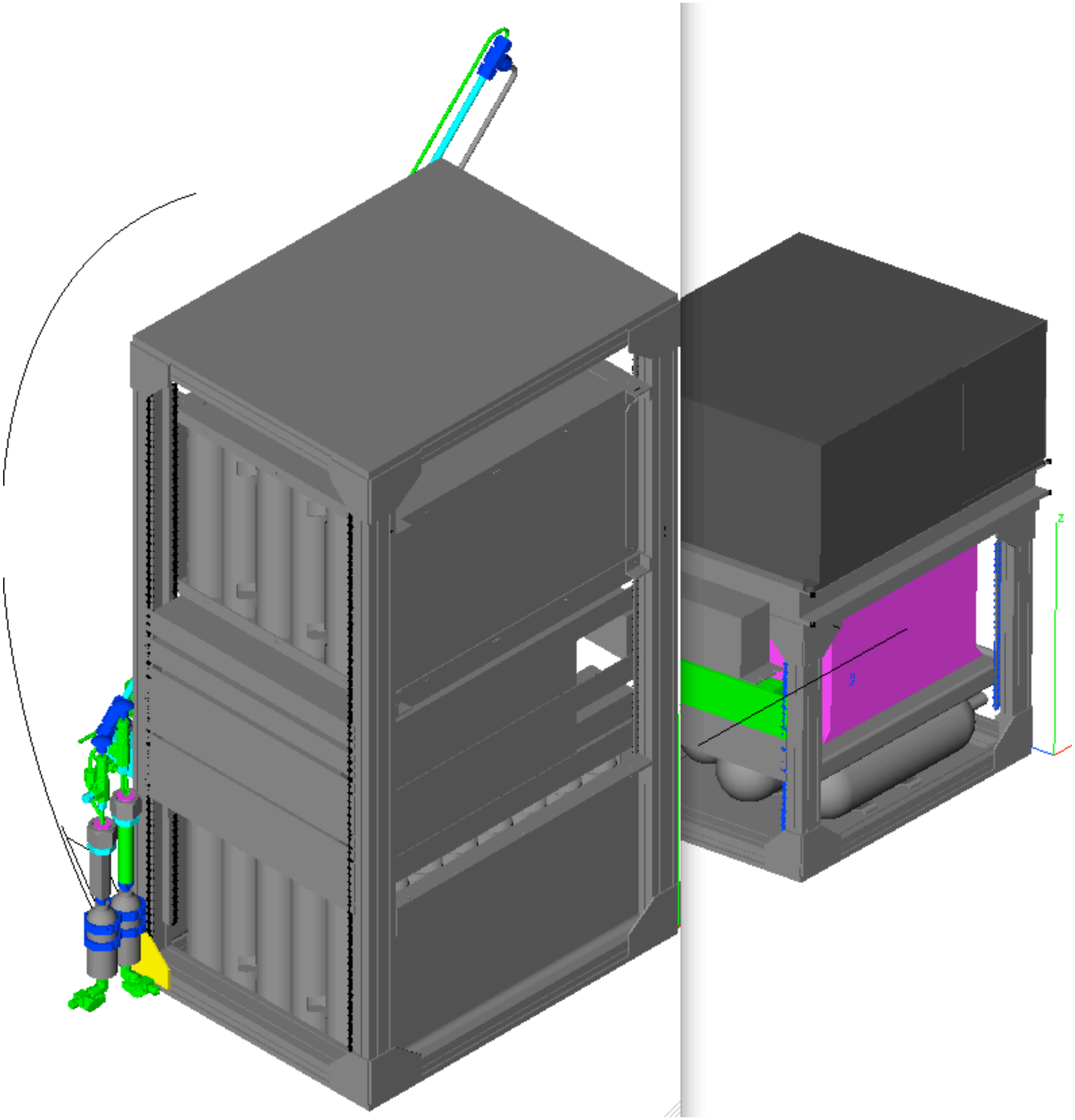
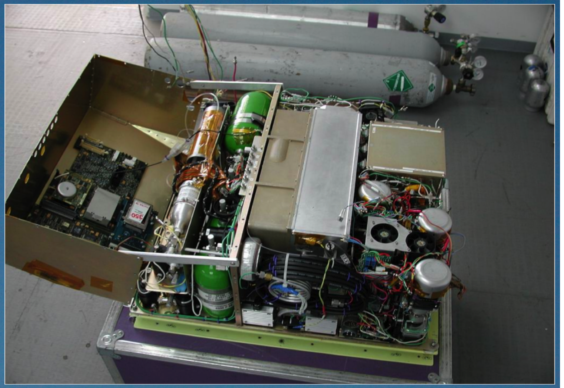
HIPPO-NOAA-GMD

J. Elkins[1], F. Moore[2], E. Hintsa[2], J.D. Nance[2], G.Dutton[2], B. Hall[1], S. Montzka[1], B. Miller[2], L. Miller[3], D. Hurst[2], L. Patrick[2], S. Oltmans[1] , D. M. Heller[2], P. Lang, J. Higgs[3], D. Neff [2], C. Sweeney[2], Guenther[2], and S. Wolter[2]
[1]GMD/ESRL, [2]CIRES/GMD/ESRL, [3] Science and Technology Corporation (STC) all in Boulder CO USA

Substantial Help from Elliot Atlas and group



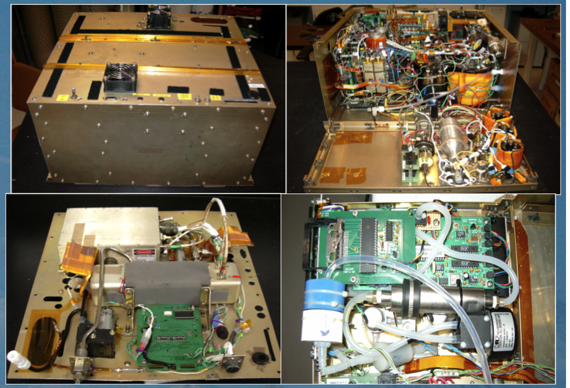
PANTHER: (PAN and other Trace Hydrohalocarbon ExpeRiment,) 200 lb., 6-channel GC (gas chromatograph).



* 3 ECD (electron capture detectors), packed columns.
* 1 ECD with a TE (thermal electric) cooled RTX-200 capillary column.
* 2-channel MSD (mass selective detector). 2 independent samples concentrated onto TE cooled Haysep traps, two temp programmed RTX-624 capillary columns.
* Tunable diode laser hygrometer (May Comm Inst.)

Measures: H_2O, N_2O, SF_6 , CCl_2F_2 (CFC-12), CCl_3F (CFC-11), $CBrClF_2$ (halon-1211), H_2, CH_4 , CO, PAN (peroxyl acetyl nitrate), methyl halides CH_3I, CH_3Br, CH_3Cl, the sulfur compounds COS, CS_2, hydrochlorofluorocarbons $CHClF_2$ (HCFC-22), $C_2H_3Cl_2F$ (HCFC-141b), $C_2H_3ClF_2$ (HCFC-142b), and hydrofluorocarbon $C_2H_2F_4$ (HFC-134a)

UCATS: (Unmanned aircraft systems Chromatograph for Atmospheric Trace Species), 60 lb. GC, TDL and Photometer.

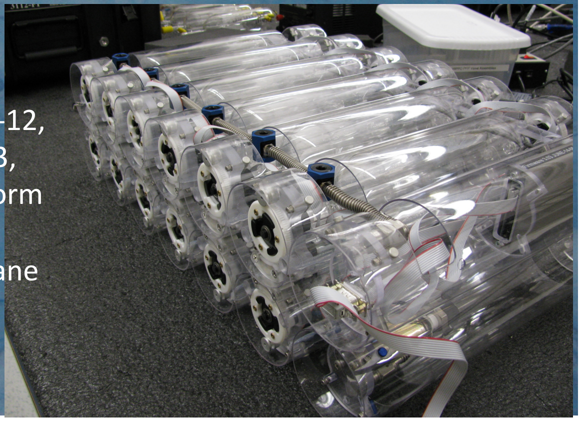


* 2-Channel ECD GC, packed columns.
* Tunable diode laser hygrometer (May Comm Inst.)
* Dual-beam ozone photometer (2B Inst.)

Measures: N_2O, SF_6 , H_2 , CH_4, CO, O_3 and H_2O.

NWAS: (NOAA Whole Air Sampler) 20 lb. per 12 flask pkg., 2 NWAS pkg per flight, 6 in rack.

* Total 48 flask per flight, 6 flasks per profile. [2 NWAS pkg +2 AWAS-Elliot Atlas]
* MSD (analysis by HATS/ESRL flask lab - Steve Montzka *et al.*)
* ECD, NDIR, FID and RGA (analysis by CCGG/ESRL flask lab - Pat Lang *et al.*)
* MSD (analysis by INSTARR/CU isotopes flask lab - James White *et al.*)



Measures: CO, CO_2 CH_4 and isotopes, H_2 , SF_6 , N_2O, tetrachloroethylene (C_2Cl_4), CCl_4 , CFC-11, CFC-12, CFC-13, CFC-113, CFC-114, CFC-115, HCFC-22, HCFC-124, HCFC-141b, HCFC-142b, HCFC-227ea, HFC-23, HFC-125, HFC-134a, HFC-143a, HFC-152a, HFC-365mfc, halon-1211, halon-1301, halon-2402, chloroform ($CHCl_3$), methyl chloroform (CH_3CCl_3), chloroethane (CH_3CH_2Cl), dichloromethane (CH_2Cl_2), methyl halides (CH_3Cl CH_3I CH_3Br), bromoform ($CHBr_3$), dibromomethane (CH_2Br_2), acetylene (C_2H_2), propane (C_3H_8), benzene (C_6H_6), perfluoropropane (PFC-218),
iso-pentane (C_5H_{12}), n-butane (C_4H_{10}), n-pentane (C_5H_{12}), n-hexane (C_6H_{14}),
carbonyl sulfide (OCS), and carbon disulfide (CS_2).

Vertical and Horizontal Profiles looking for:

* Source/Sinks.

    Ocean/Land/Atmospheric with dependency on Pollution/Biology/Chemistry.

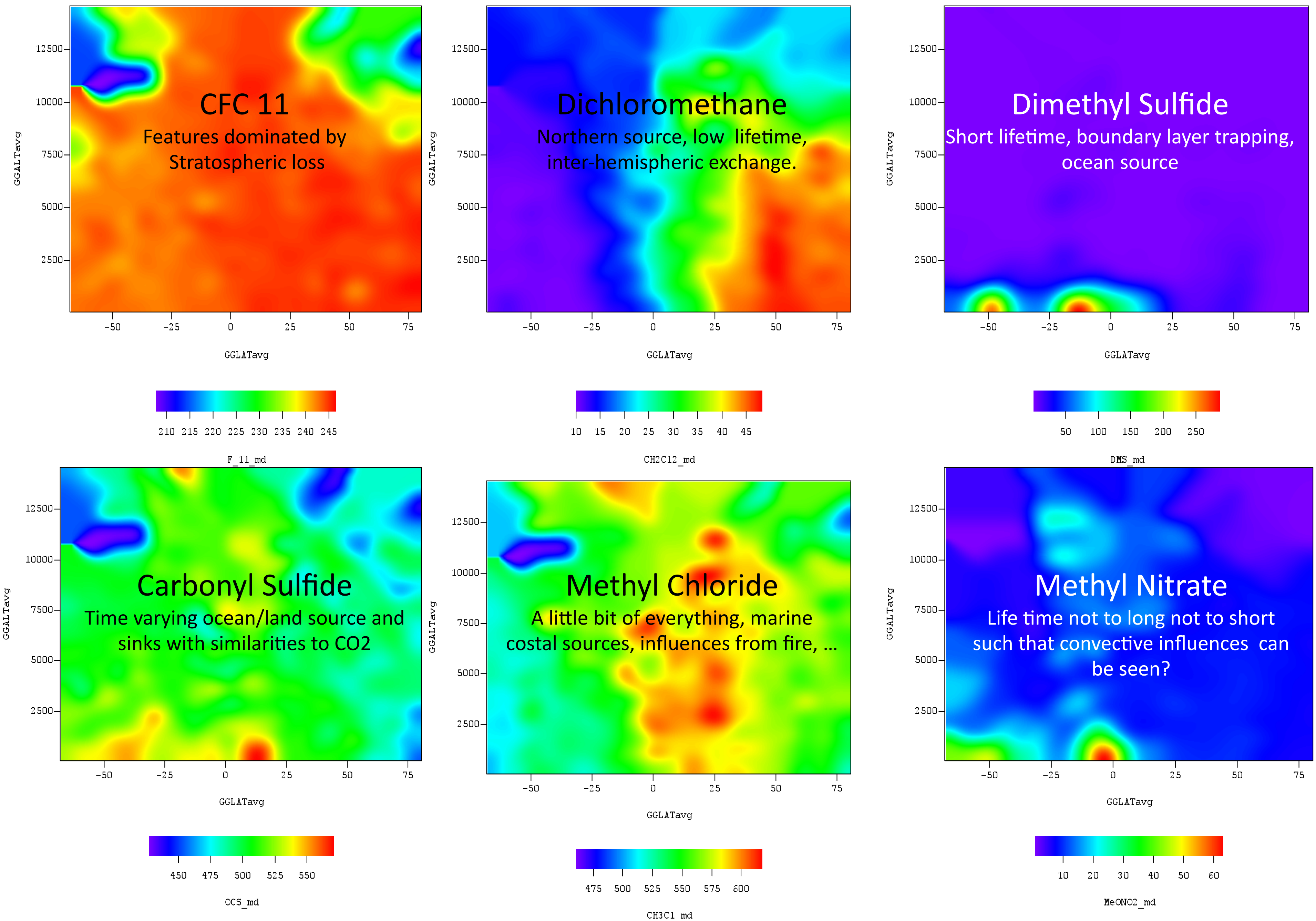
* Coupled with transport.

    Upwelling and Mixing.

    Inter-hemispheric Exchange.

    Interactions between Boundary-Layer <-> Troposphere <-> Stratosphere.

Combined NWAS and AWAS flask data (preliminary) from HIPPO-1 Jan 2009 *Courtesy Eliot Atlas*

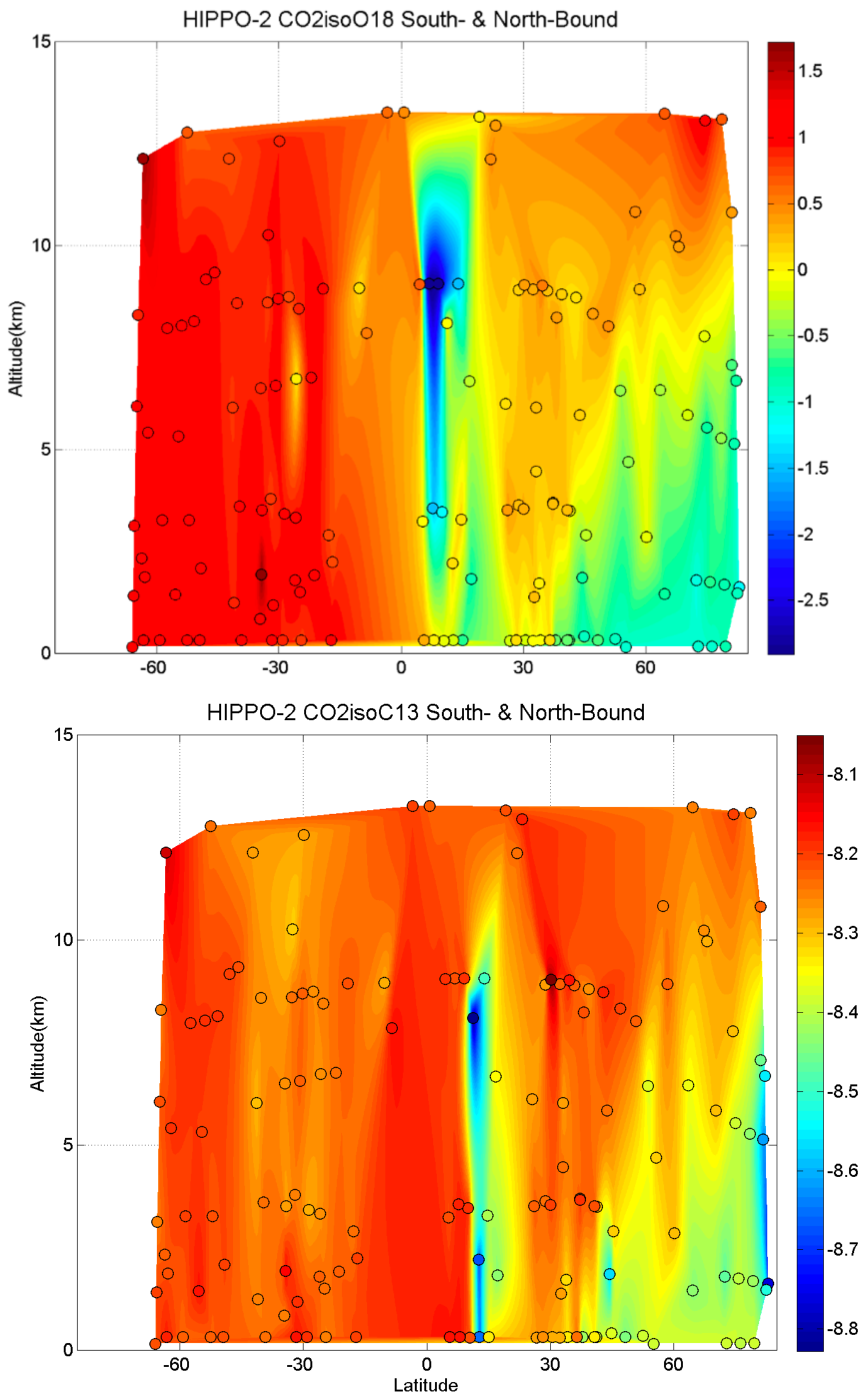


During HIPPO-1,

CO_2 and Isotope data suffered from water in the flasks during the storage time between sampling and analyzing. (Focus of Ben Millers presentation)

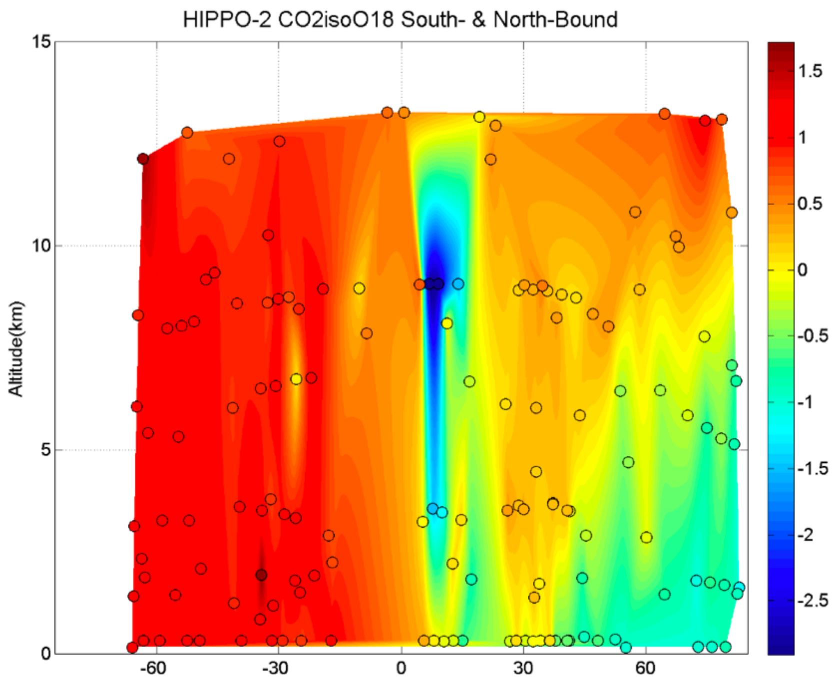
During HIPPO-2

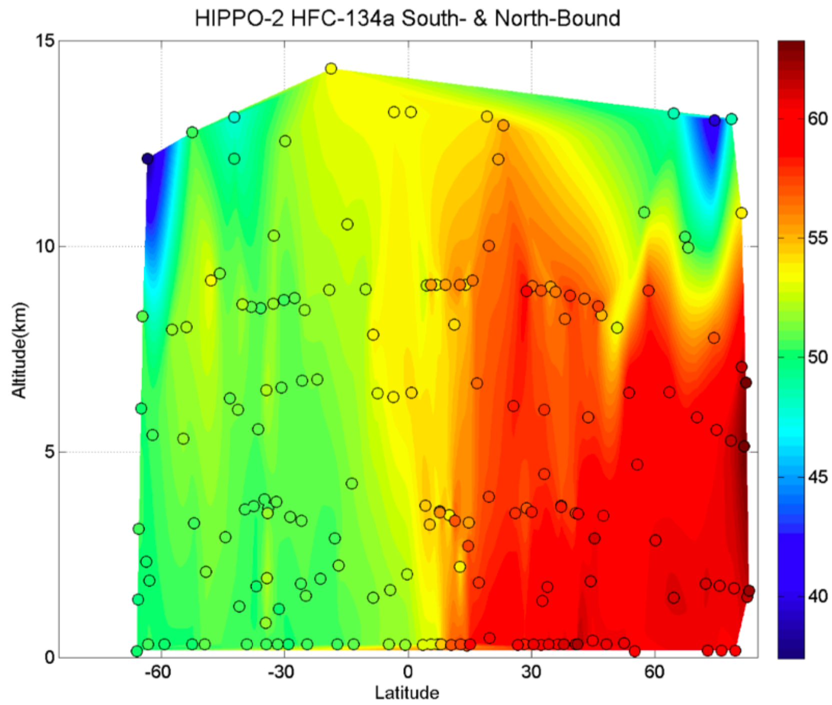
Improvements in the WAS data set for HIPPO-2 due to the water removal effort revealed interesting spatial gradients.

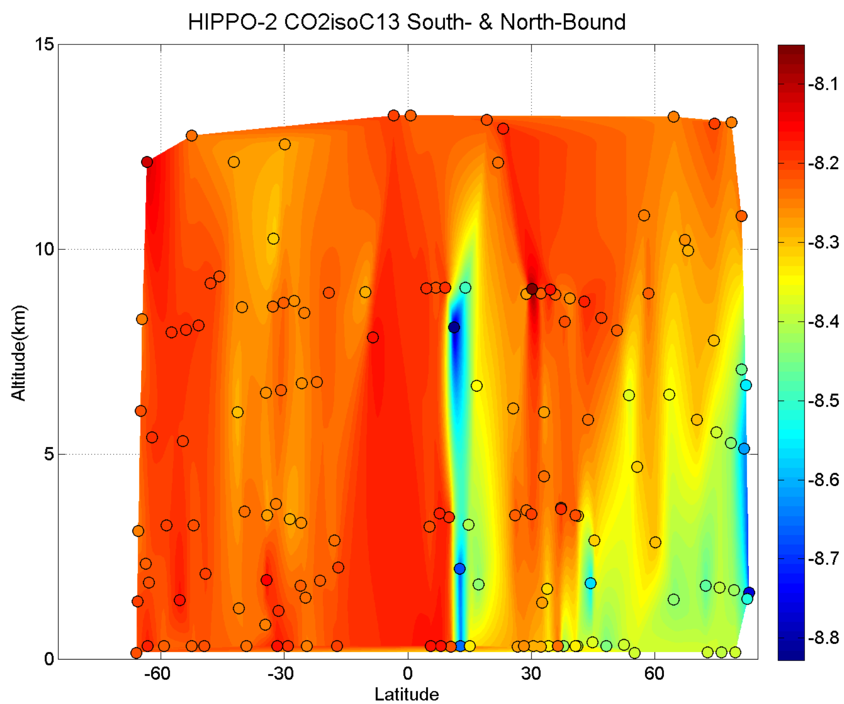


Isotopic date from NWAS flasks show unique gradients.

Differences reflect the varying source/sync regions and type of upwelling near these regions.



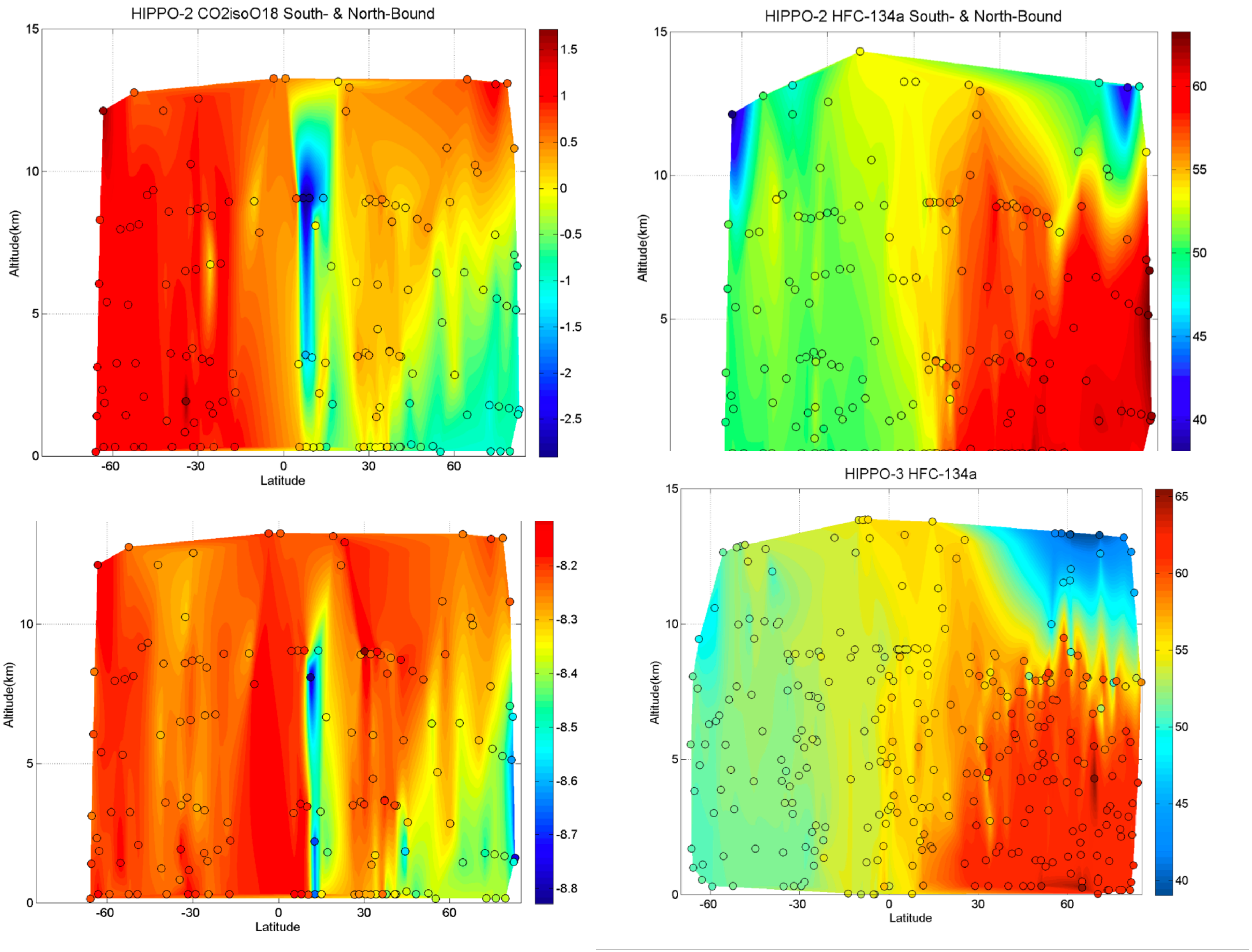




Differ from those seen in typical northern hemispheric source gases, like HFC-134a, that transition near the ITCZ.

It was clear from this data set that we could benefit from a higher density of flask sampling in this region.

We purchased 3 more FAA certified PFPs and increased our NWAS sampling rate from 24 to 36 flasks on average per flight.



Increased Coverage for HIPPO-3

Were we stand on data submission of NWAS Data:

GCMS-M2_ Large data set similar to Eliot's AWAS data set.
MAGICC_gmd_ CO_2, CO, CH_4, H_2, SF_6, N_2O (*available within GMD, see C. Sweeney*)
SIL_isotopes_ ^{18}O , ^{13}C (on CO_2) (*J. White and B. Vaughn INSTARR*)

HIPPO-1 178 "good fills" (for CO2) out of 228 flasks
GCMS-M2_ files (**Submitted**), **MAGICC_gmd_** (*Analyzed* no CO2 or isotopes)

HIPPO-2 197 "good fills" out of 264 flasks
GCMS-M2_ , (**Submitted**), **MAGICC_gmd_** (*Analyzed*), SIL_isotopes_ (**Submitted**)

HIPPO-3 328 "good fills" out of 336 flasks
GCMS-M2_ , (*Analyzed*), **MAGICC_gmd_** (*Analyzed*) , SIL_isotopes_ (1/2 *Analyzed*)

Data are in good shape >> Large group of people with automated systems in place.

PANTHER and UCATS add to this data set.

In situ MDS data is similar to flask data except for a higher 3 min. data rate and a sample width integration that is 80% sample duty cycle.

In situ ECD data have even higher data rate of 1 or 2 min (2-3 second sample width).
Stratospheric > Photolytic Loss.
Pollution: Dynamic correlations with PAN, O_3, CO and Black carbon

O_3 (0.1 Hz) UCATSO3_ (**submitted**).

H2O (1 Hz) UCATSH2O_ (**submitted** *or within one month of submission*)

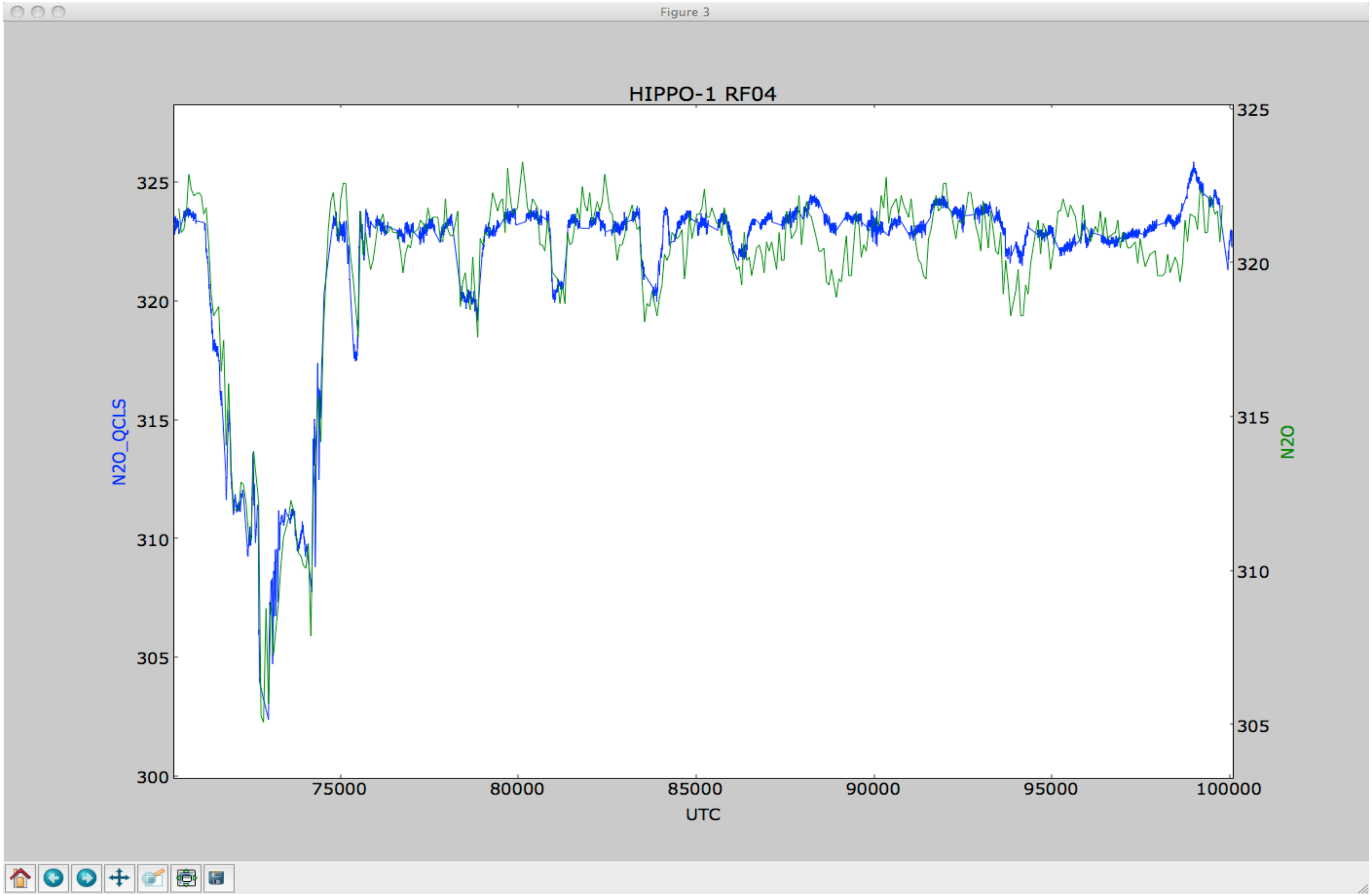
UCATSGC_ , and the PANTHER files **GC_ECD_** and **GC_MSD_** for the most part are Quick look data moving into final submission files. (See below).

The PANTHER and UCATS GC data processing is not automated and is a time intensive process. It has been difficult to keep up with the GC data processing because of the multiple deployments of these instruments each year. To date little final data has been submitted but ….

We hope to get caught up with final submission of this GC data over the up coming down year.

UCATS was unavailable for the HIPPO-3 deployment because of a previous commitment to NASA for the Glo Pack mission. The water TDL was therefore removed from UCATS and incorporated into PANTHER to maintain that measurement during this deployment. PANTHER duplicates the UCATS GC data so we did not loose any key measurements there; rather, we only lost a factor of 2 in the data rate. UCATS will be back on the GV for HIPPO-4 and HIPPO-5.

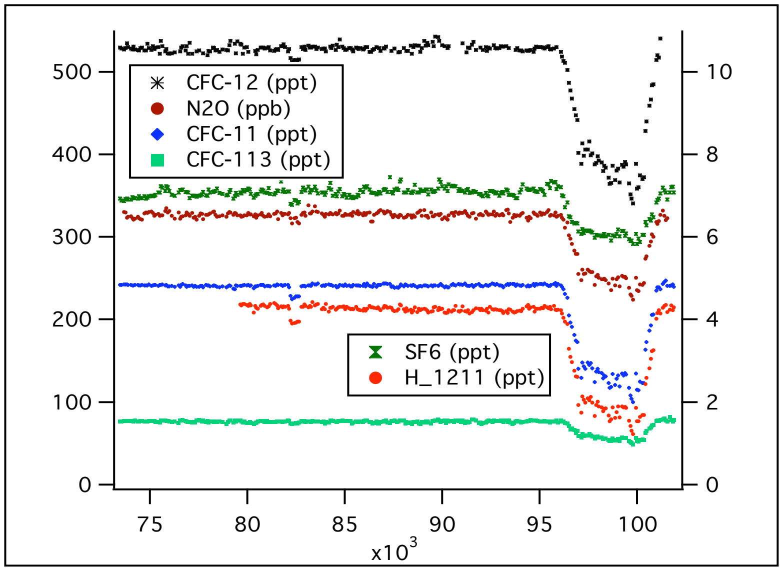
Even though final GC data is not submitted the next two slides show that the data is there and with enough work quality data will be submitted.

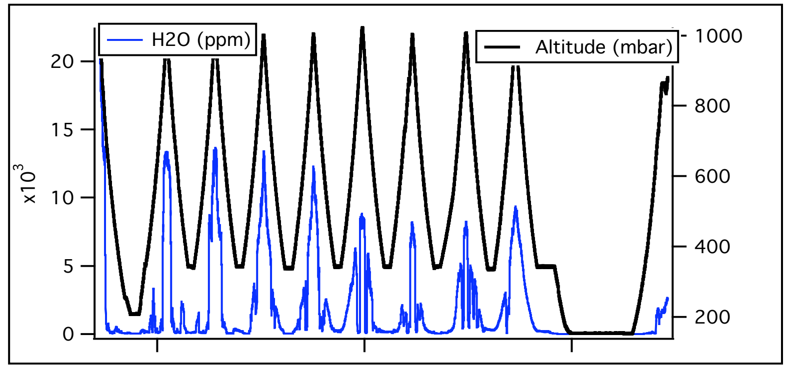


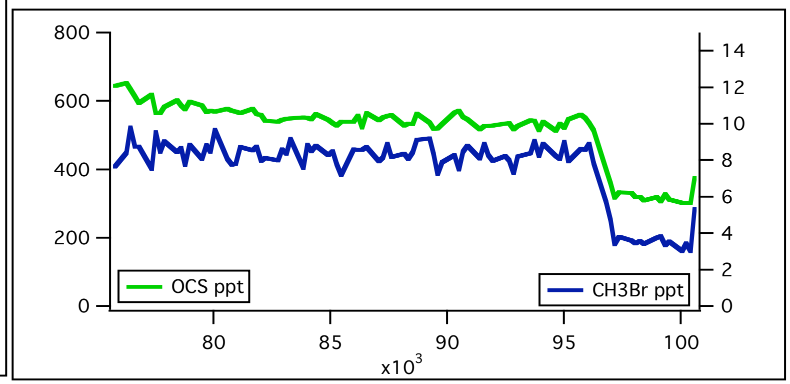
HIPPO-3 PANTHER RF09 data
Coincident with UCATS on Global Hawk
Satellite Cal-Val at multiple heights

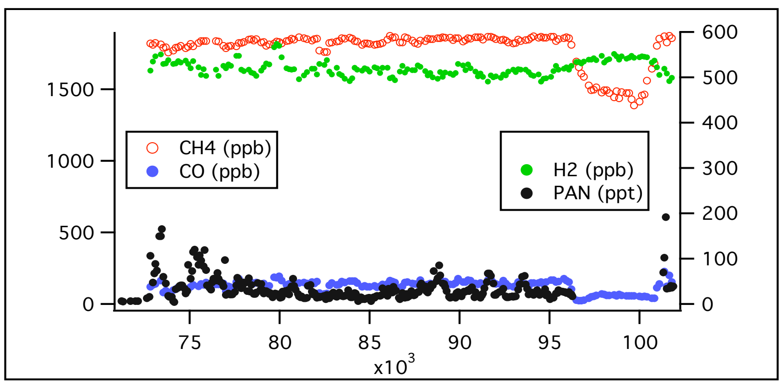
* Water TDL moved back into PANTHER for HIPPO-3
* UCATS not on HIPPO-3 so no GMD O_3 data.

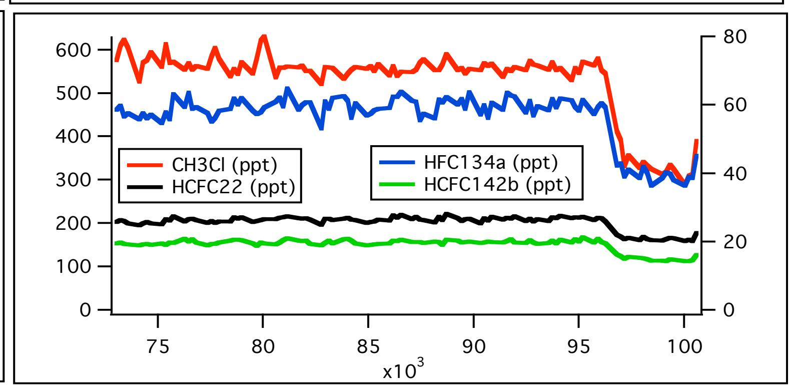
PANTHER data on NSF GV.
HIPPO-3
Research Flight 9
Kona HI <-> Anchorage AK.
Coinsident with Global Hawk near mid-flight.
CCG PFP data was also taken.





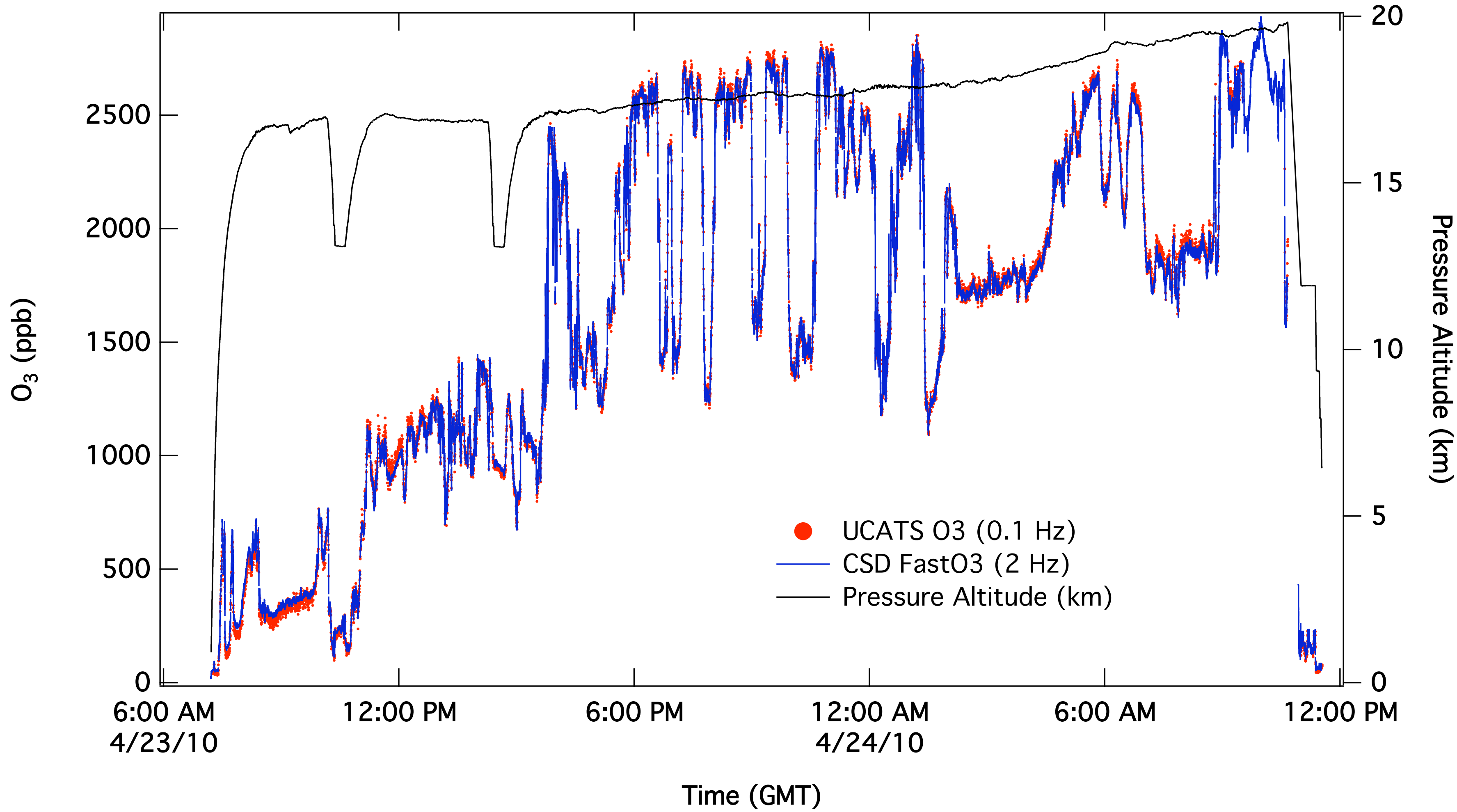






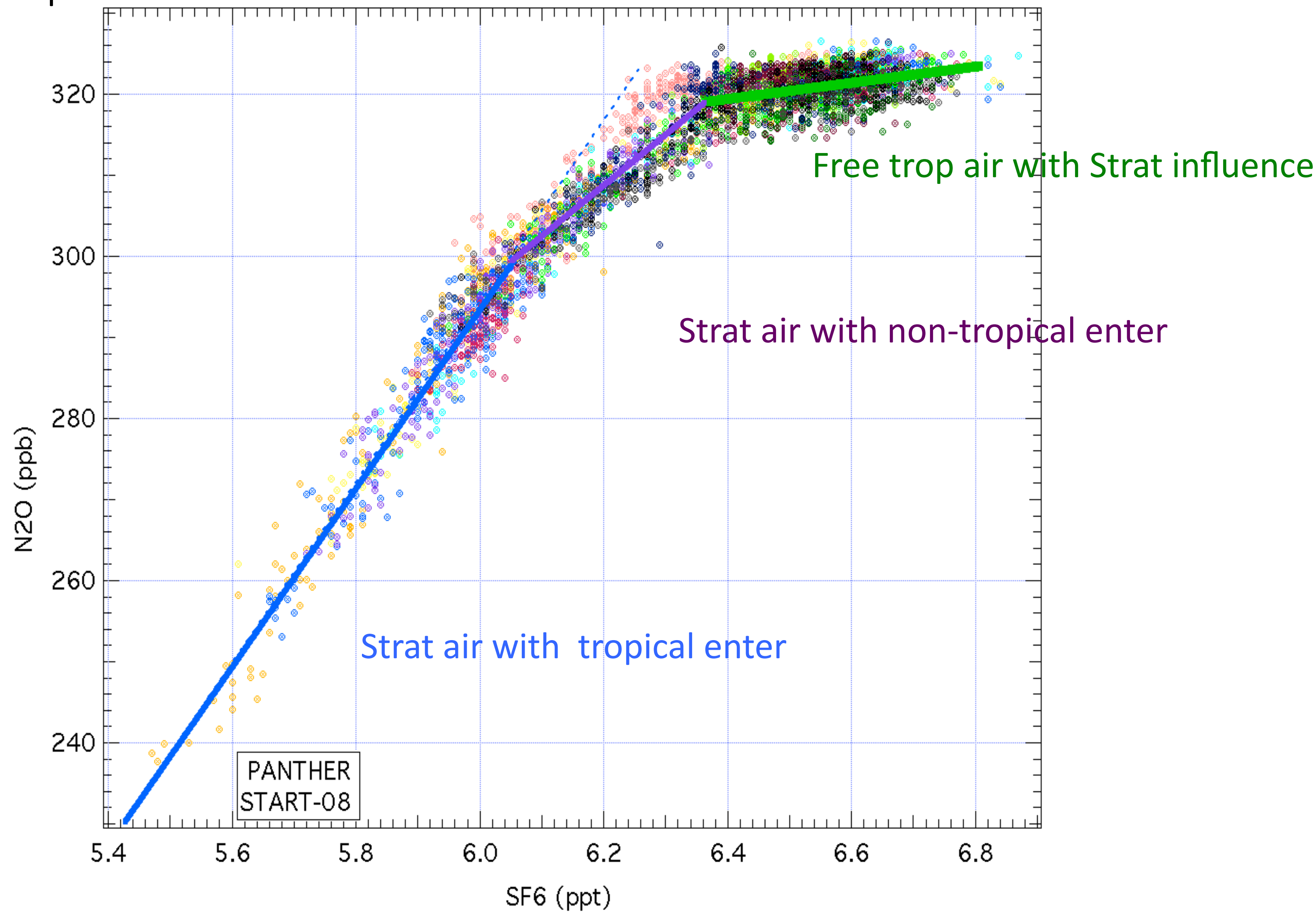
Mechanical issues hampered O_3 measurements on the HIPPO-2 deployment.
Patch fixes were made in the field during the deployment.
These and , a small pressure transducer calibration offset were then cleaned up between HIPPO-2 and -3.

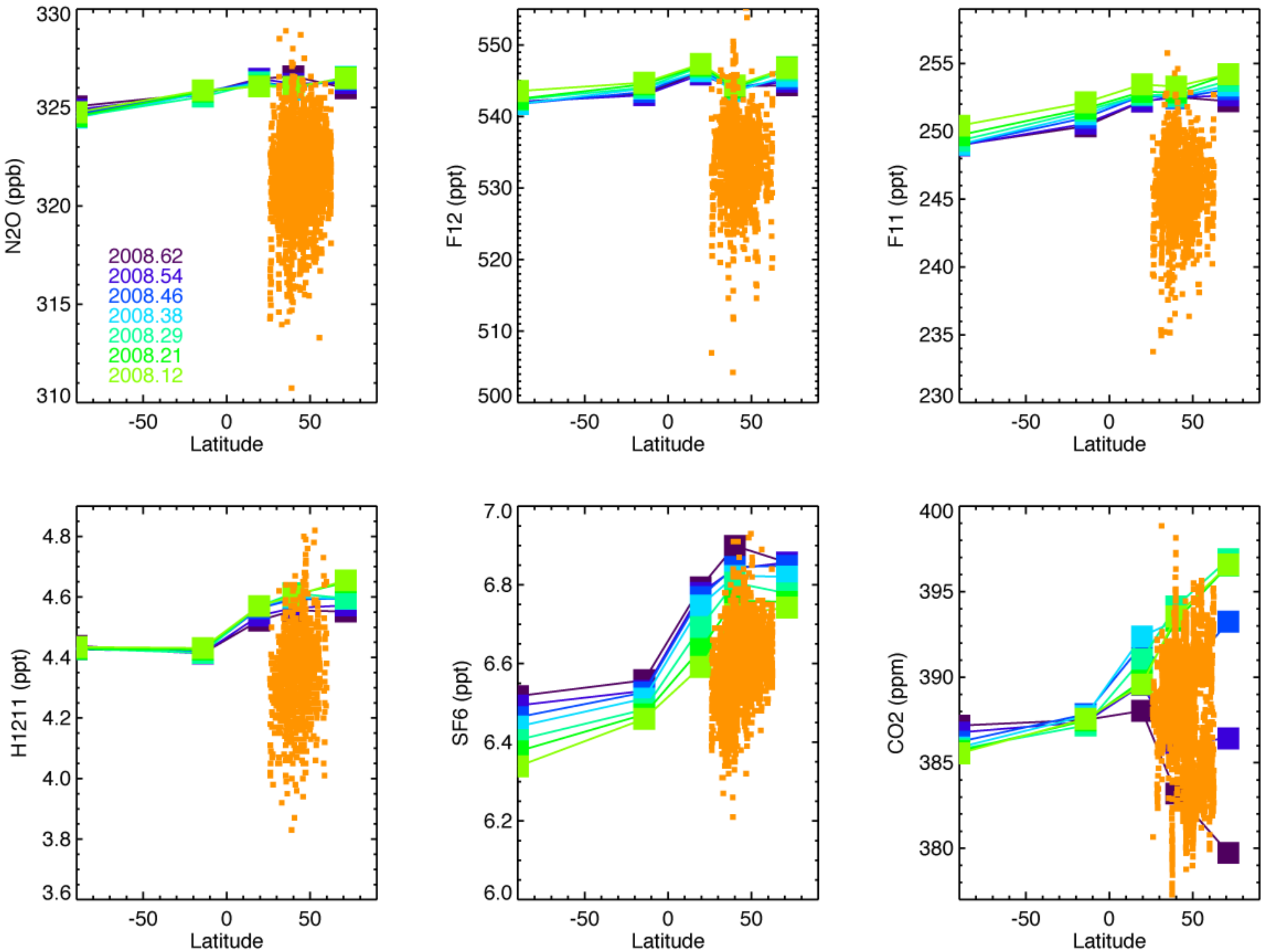
UCATS was not on the HIPPO-3 deployment, however the co-running NASA/NOAA Glo Pac mission benefited from this work (See below) as will the future HIPPO-4 and -5 deployment when UCATS comes back on board.



Stratospheric Loss > Photolytic

We are also looking for evidence of stratospheric air descended into the free troposphere consistent with what was seen in the PANTHER START-08 data.





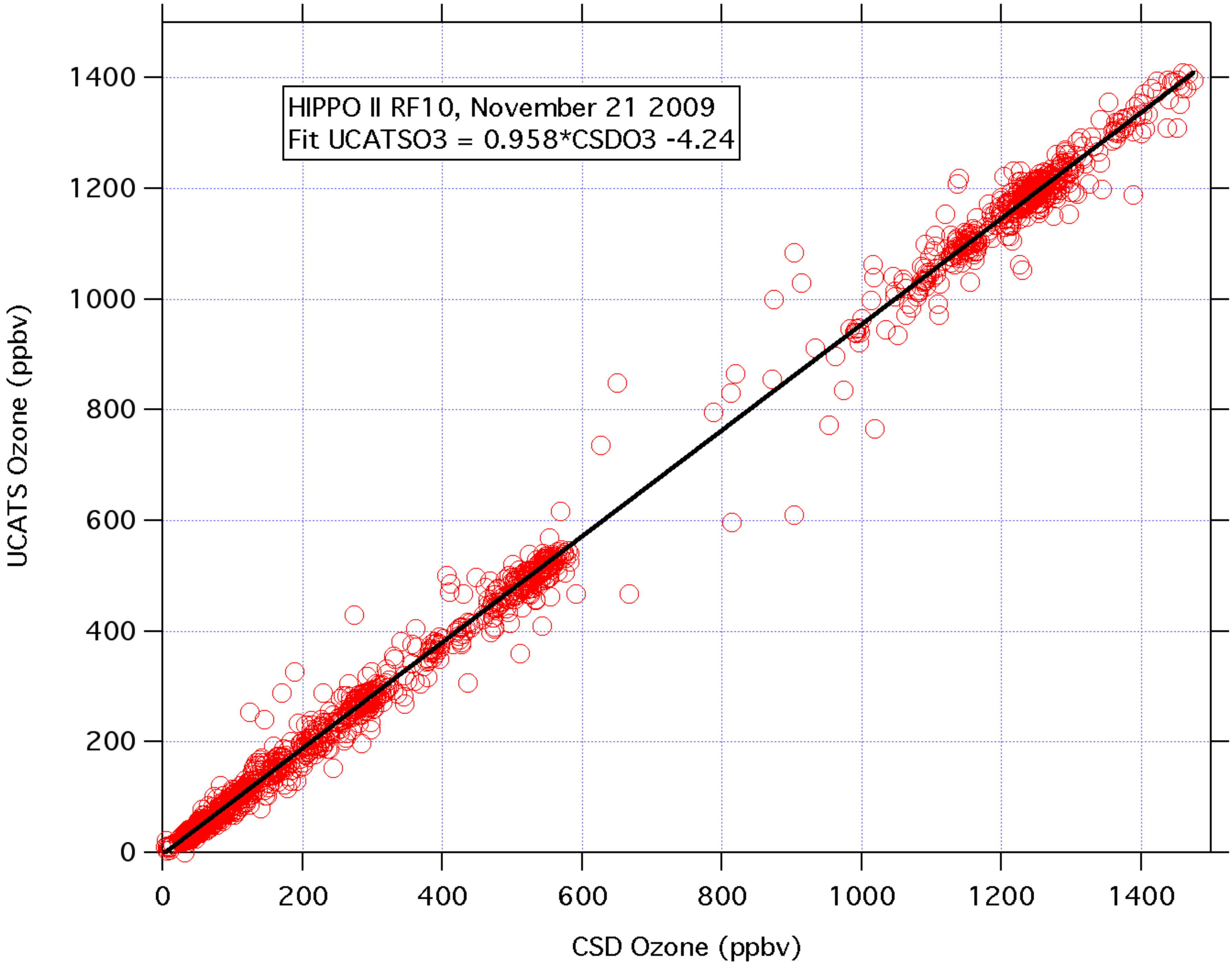
Large Strat influence seen in START-08 data is not as prevalent in HIPPO data but we still want to look for and quantify.

In Conclusion for GMD data:

* A large data set rich in process-oriented information is emerging.

* Will be beneficial to 3D-Modle programs and satellite calibration-validation.

*This data set will be augmented substantially once the PANTHER and UCATS data sets are finalized this year.


HIPPO II RF10, November 21 2009
Fit UCATSO3 = 0.958*CSDO3 -4.24
UCATS Ozone (ppbv)
CSD Ozone (ppbv)
0
200
400
600
800
1000
1200
1400