HIPPO-NOAA-GMD RACK/DATA SET

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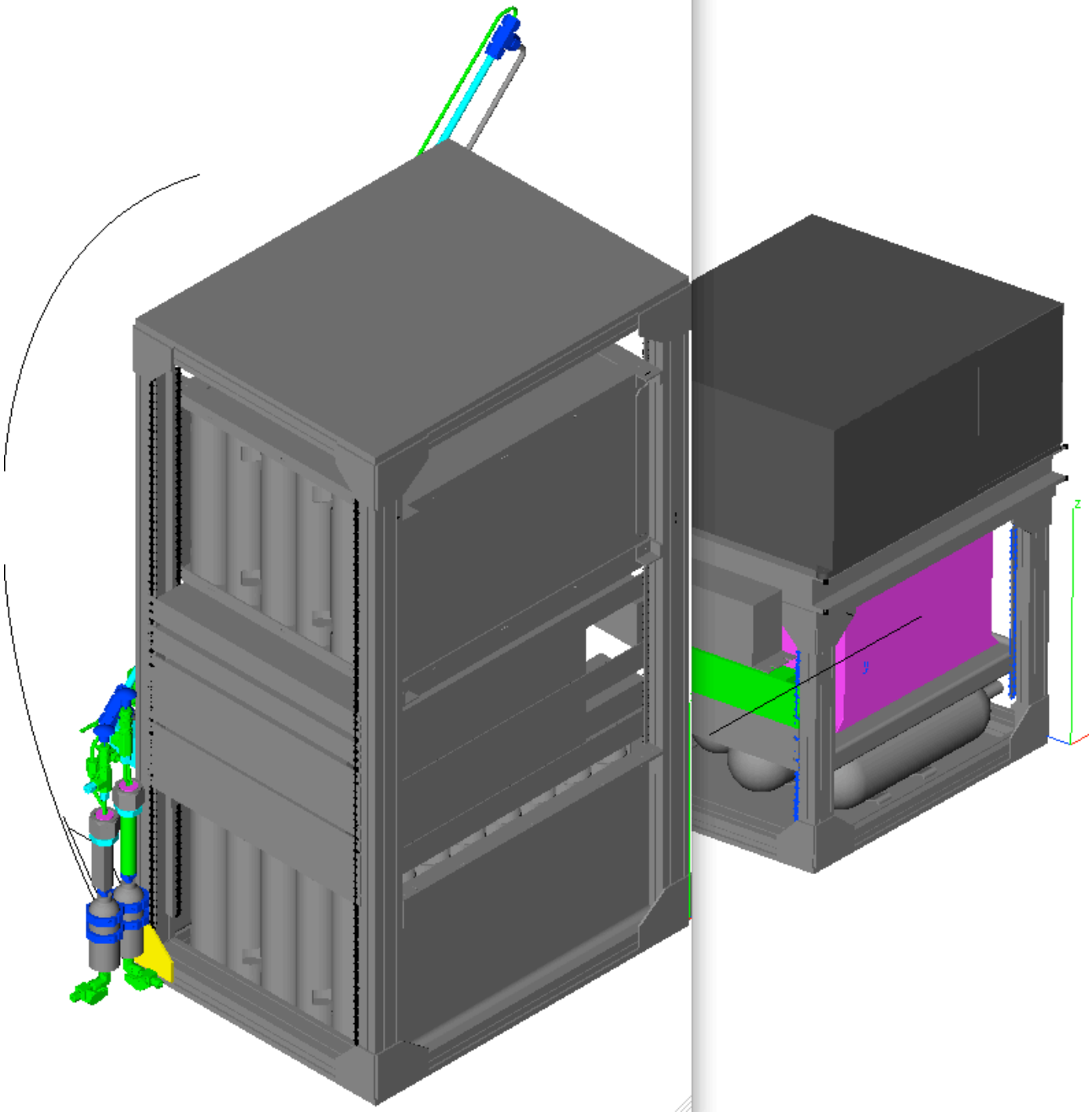
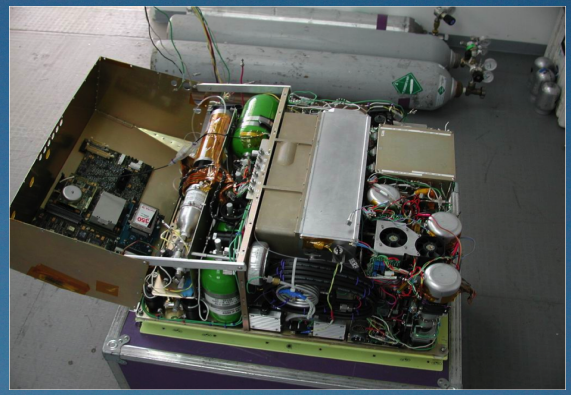
[1]GMD/ESRL, [2]CIRES/GMD/ESRL, [3] Science and Technology Corporation (STC) all in Boulder CO USA

Substantial Help from Elliot Atlas and group



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

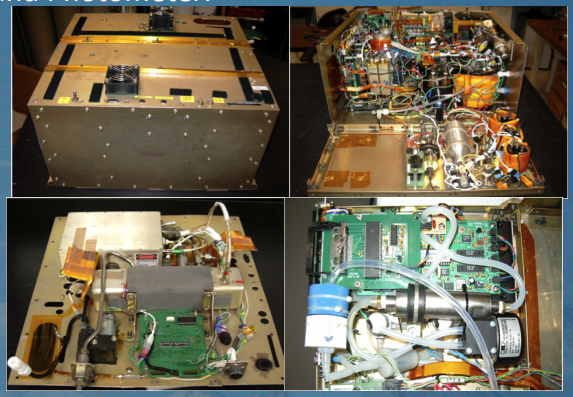
* 3 ECD (electron capture detectors), packed columns.
* 1 ECD with a TE (thermal electric) cooled RTX-200 capillary column.
* 2-channel MSD (mass selective detector). 2 independent samples concentrated onto TE cooled Haysep traps, two temp programmed RTX-624 capillary columns.
* Tunable diode laser hygrometer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



Measures: H2O, N2O, SF6 , CCl2F2 (CFC-12), CCl3F (CFC-11), CBrClF2 (halon-1211), H2, CH4 , CO, PAN (peroxyl acetyl nitrate), methyl halides CH3I, CH3Br, CH3Cl, the sulfur compounds COS, CS2, hydrochlorofluorocarbons CHClF2 (HCFC-22), C2H3Cl2F (HCFC-141b), C2H3ClF2 (HCFC-142b), and hydrofluorocarbon C2H2F4 (HFC-134a)

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

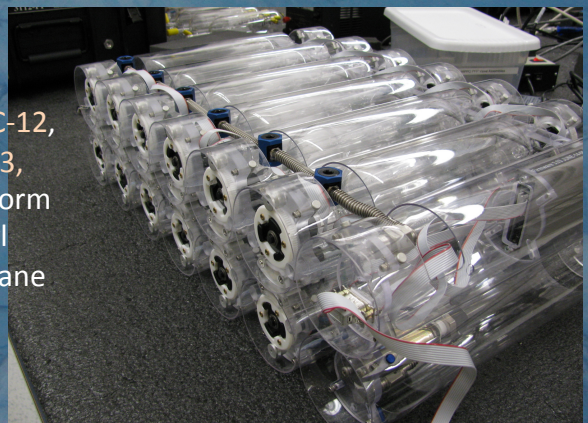
* 2-Channel ECD GC, packed columns.
* Tunable diode laser hygrometer (May Comm Inst.)
* Dual-beam ozone photometer (2B Inst.)



Measures: N2O, SF6 , H2 , CH4, CO, O3 and H2O.

NWAS: (NOAA Whole Air Sampler) 20 lb. per 12 flask pkg., 2 to 4 NWAS pkg per flight, 6 in rack.

* Total > 48 flask per flight, 6 flasks per profile. [2 to 4 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, CO2 CH4 and isotopes, H2 , SF6 , N2O, tetrachloroethylene (C2Cl4), CCl4 , 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 (CHCl3), methyl chloroform (CH3CCl3), chloroethane (CH3CH2Cl), dichloromethane (CH2Cl2), methyl halides (CH3Cl CH3I CH3Br), bromoform (CHBr3), dibromomethane (CH2Br2), acetylene (C2H2), propane (C3H8), benzene (C6H6), perfluoropropane (PFC-218), iso-pentane (C5H12), n-butane (C4H10), n-pentane (C5H12), n-hexane (C6H14), carbonyl sulfide (OCS), and carbon disulfide (CS2).

NOAA_GMD generates ***8*** separate submission **files** for each flight.

GCMS-M2_ **Mass Spec Flask Data.** *S. Montska etal.*

MAGICC_gmd_ **Carbon Cycle Group Flask Data** *C. Sweeney et. al.*
(CO_2, CO, CH_4, H_2, SF_6, N_2O)

SIL_isotopes_ **Isotope Flask Data.** (*J. White and B. Vaughn INSTARR*)
(^{18}O , ^{13}C on CO_2)

UCATSO3_ 2B Photometer (O_3) *J. Elkins et. al.*

UCATSGC_ In Situ Chromatograph-ECD *J. Elkins et. al.*
(N_2O, SF_6, CH_4, CO, H_2)

UCATSH20_ MayComm TDL (H_2O) *J. Elkins et. al.*

GC_ECD_ In Situ Chromatograph-ECD *J. Elkins et. al.*
(N_2O, SF_6, CH_4, CO, H_2, CFC-11, -12, -131, halon-1211, PAN)

GC_MSD_ In Situ Chromatograph-MSD *J. Elkins et. al.*
(CH3Cl, CH3Br, CH3I, HCFC-22, HCFC-141b, HCFC-142b, HFC-134a, OSC, CS2)

HIPPO-1 _QAQC

F = final data

= Data OK not submitted yet.

ND = No Data

* Missing GC_ECD will be submitted on second pass.

RF#	01	02	03	04	05	06	07	08	09	10	11
GCMS-m2_	ND	F	F	F	F	F	F	F	F	F	F
MAGICC_	ND	ND	F	F	F	F	F	F	F	F	F
SIL_isotopes_	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
GC_ECD_	F	F	F	F	F	F	F				F
GC_MSD	F	F	F	F	F	F	F		F	F	F
UCATSH2O_	F	F	F	F	F	F	F	F	F	F	F
UCATSO3_	F	F	F	F	F	F	F	F	F	F	F
UCATSGC_	F	F	F	F	F	F	F	F	F	F	F

HIPPO-2 _QAQC

F = final data

= Data OK not submitted yet.

ND = No Data

* Missing GC_ECD will be submitted on second pass.

RF#	01	02	03	04	05	06	07	08	09	10	11
GCMS-m2_	F	ND	F	F	F	F	F	F	F	F	F
MAGICC_	F	ND	F	ND	F	F	F	F	F	F	F
SIL_isotopes_	F	ND	F	ND	F	F	F	F	F	F	F
GC_ECD_	F	F	F		F	F	F	F			
GC_MSD	F		F	F	F	F	F	F	F	F	F
UCATSH2O_	F	F	F	ND	F	F	F	F	F	F	F
UCATSO3_	F	F	F	ND	F	F	F	F	F	F	F
UCATSGC_	F	F	F	F	F	F	F	F	F	F	F

HIPPO-3 _QAQC

F = final data

= Data OK not submitted yet.

ND = No Data

* UCATS was not on GV so not O3 or GC data. MayComm TDL in PANTHER generated UCATSH2O_ data. GC_ECD data will be processed after all GC_MSD data is submitted by the end of the week.

RF#	01	02	03	04	05	06	07	08	09	10	11
GCMS-m2_	F	F	F	F	F	F	F	F	F	F	ND
MAGICC_	F	F	F	F	F	F	F	F	F	F	ND
SIL_isotopes_	F	F	F	F	F	F	F	F	F	F	ND
GC_ECD_											
GC_MSD	F	F	F	F	F	F	F	F	F	F	
UCATSH2O_	F	F	F	F	F	F	F	F	F	F	F
UCATSO3_	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
UCATSGC_	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

HIPPO-4 _QAQC

F = final data, F = final data by end of week.

= Data OK not submitted yet.

ND = No Data

*UCATS GC data close to final will be reanalyzed and uploaded soon. (Calibration?)

TDL water - need to be reprocessed. (Calibration?)

Ozone- need to be checked for QAQC and timing adjusted.

GC_ECD data will be processed after all GC_MSD data is submitted by the end of the week.

RF#	01	02	03	04	05	06	07	08	09	10	11
GCMS-m2_	F	F	F	F	F	F	F	F	F	F	ND
MAGICC_	F	F	F	F	F	F	F	F	F	F	ND
SIL_isotopes_	F	F	F	F	F	F	F	F	F	F	ND
GC_ECD_											
GC_MSD	F	F	F	F	F	F	F	F	F	F	
UCATSH2O_											
UCATSO3_											
UCATSGC_											

HIPPO-5_QCQA

F = final data

= Data OK not submitted yet.

ND = No Data

*UCATS GC data close to final (except for N2O), will be reanalyzed and uploaded soon. (Calibration)
TDL water - needs to be reprocessed. (Calibration) Ozone- need to be checked for QAQC and timing adjusted.
GC_ECD data will be processed after all GC_MSD data is submitted by the end of the week.
NO GC_MSD data because of a broken "ion source unit" inside the mass spectrometer.

RF#	01	02	03	04	05	06	07	08	09	10	11
GCMS-m2_	F	F	F	F	F	F	F	F	F	F	ND
MAGICC_	F	F	F	F	F	F	F	F	F	F	ND
SIL_isotopes_	F	F	F	F	F	F	F	F	F	F	ND
GC_ECD_											
GC_MSD	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
UCATSH2O_											
UCATSO3_											

Sample Volume information:

PFP Flask data is altitude targeted (on dives) with ~ 10-20 seconds of sample width.
(24 to 36 flask samples per flight).
(target precision 0.05% on up depending on species)

In situ MDS data is similar to flask data except for a higher 3 min. data rate and
a sample width integration of ~ 150 sec , or about an 80% sample duty cycle.
(target 1% precision)

In situ ECD data have even higher data rate of 1 or 2 min (2-3 second sample width).
(target 0.5% precision)

O_3 (0.1 Hz) (target 2% +2 ppb precision)

H2O (1 Hz) (target 3% + 1 ppb precision)

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In situ ECD data have even higher data rate of 1 or 2 min (2-3 second sample width).
(target 0.5% precision)

Correlate with Fast Data sets.

O_3 (0.1 Hz) (target 2% +2 ppb precision)

H2O (1 Hz) (target 3% + 1 ppb precision)

Sample Volume information:

Integrate over Fast Data sets.

PFP Flask data is altitude targeted (on dives) with ~ 10-20 seconds of sample width.
(24 to 36 flask samples per flight).
(target precision 0.05% on up depending on species)

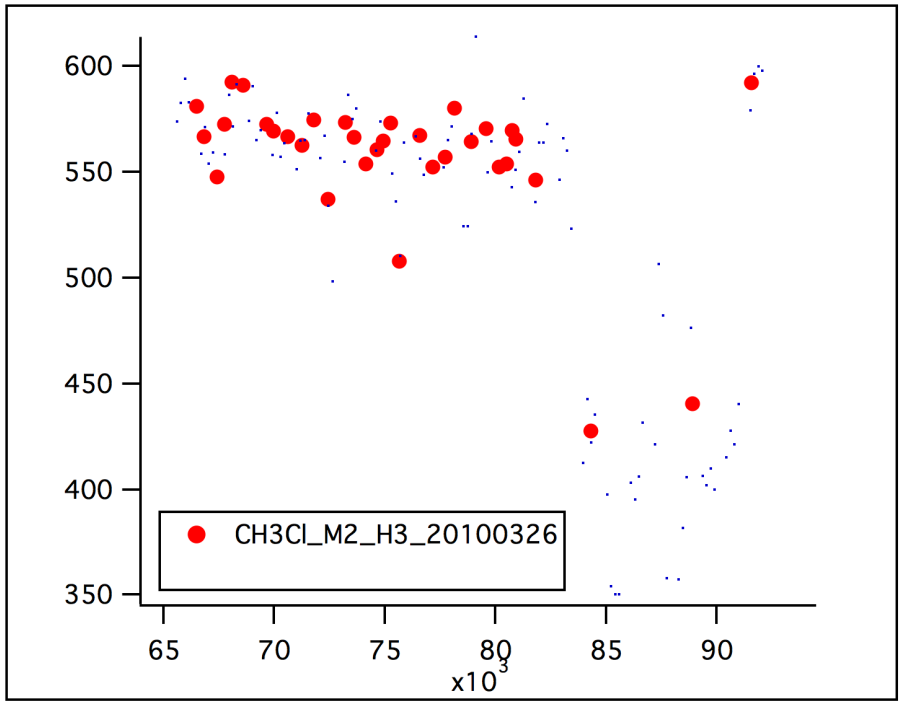
In situ MDS data is similar to flask data except for a higher 3 min. data rate and a sample width integration of ~ 150 sec , or about an 80% sample duty cycle.
(target 1% precision)

Correlate with Fast Data sets.

In situ ECD data have even higher data rate of 1 or 2 min (2-3 second sample width).
(target 0.5% precision)

O_3 (0.1 Hz) (target 2% +2 ppb precision)

H2O (1 Hz) (target 3% + 1 ppb precision)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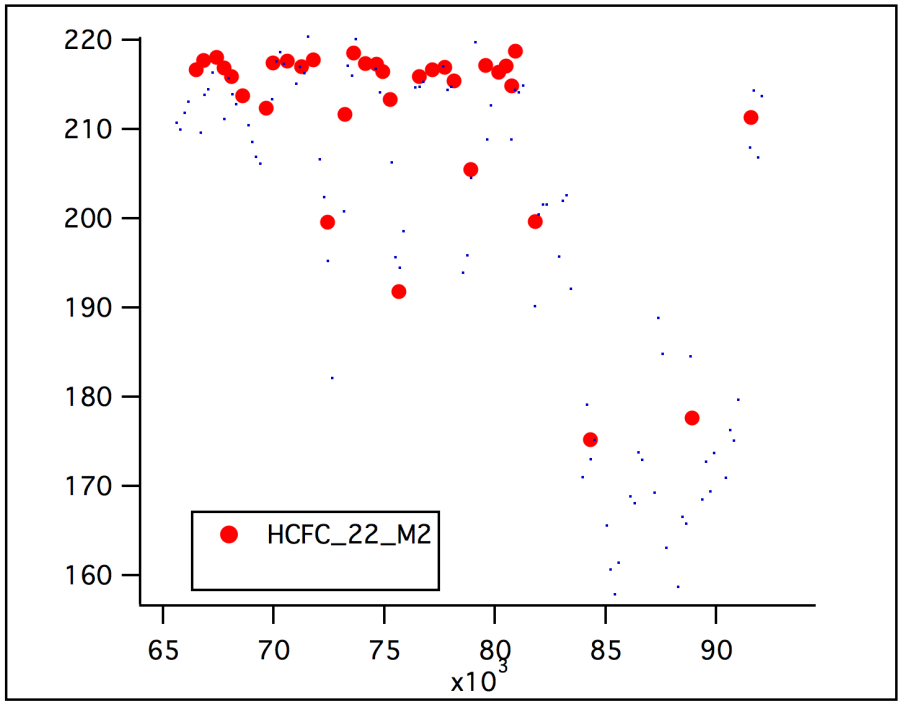
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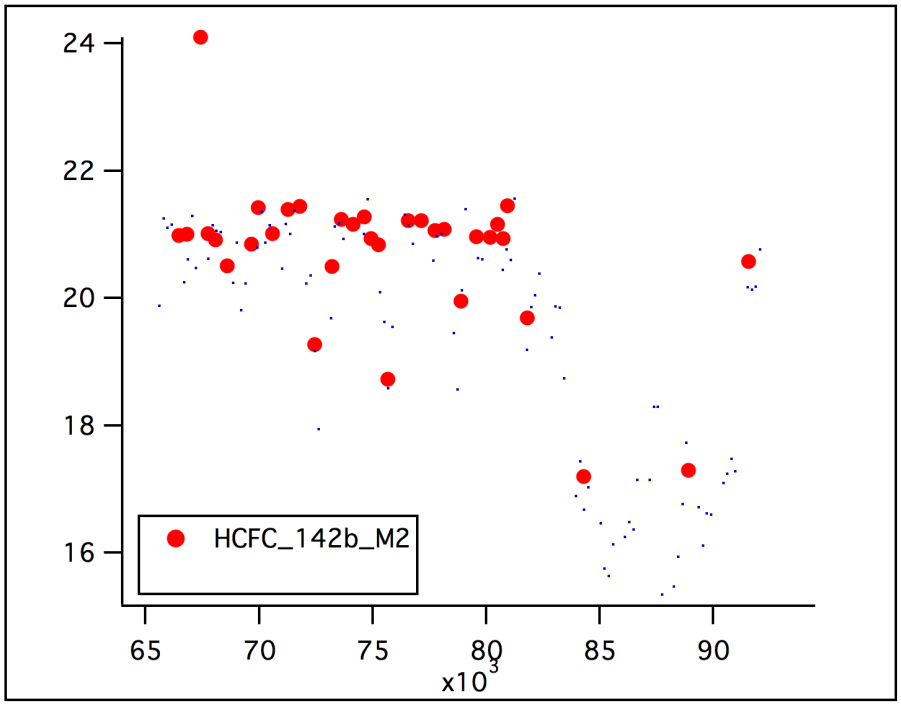
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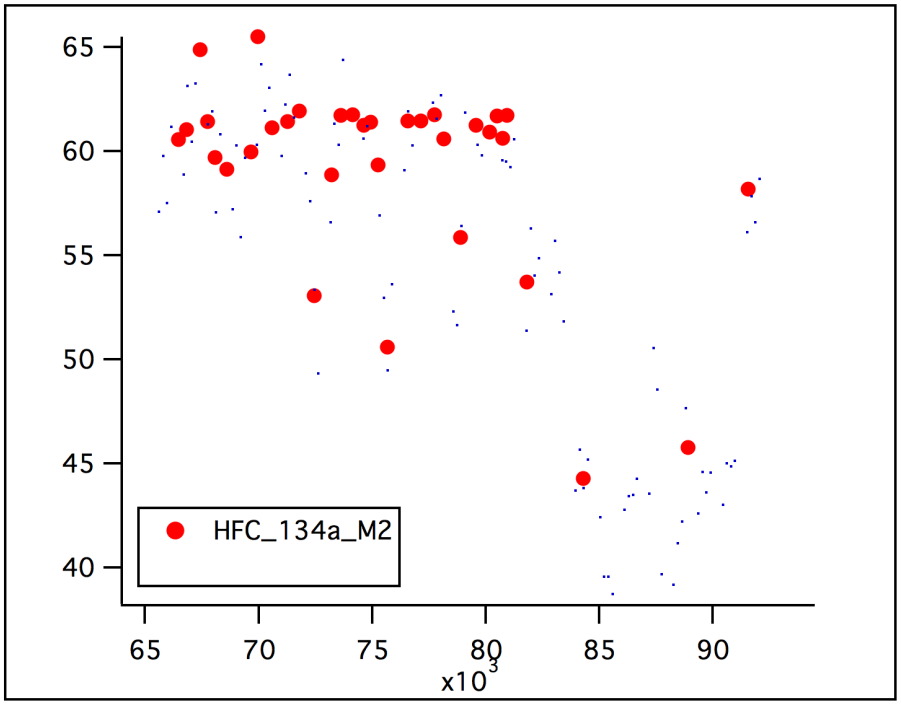
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HFC_134a_M2
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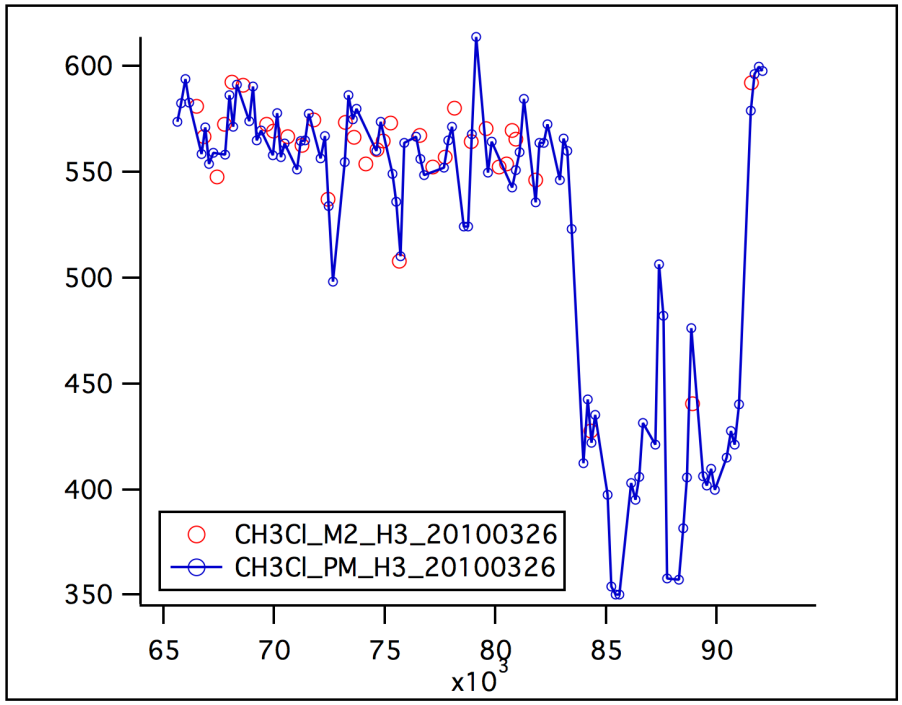
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CH3Cl_PM_H3_20100326
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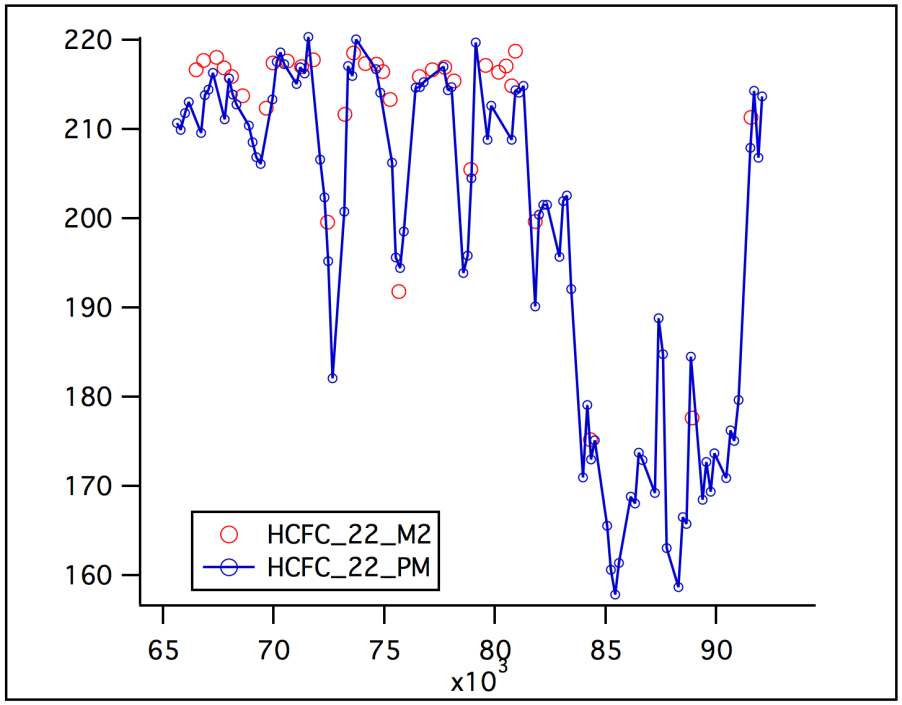
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HCFC_22_PM
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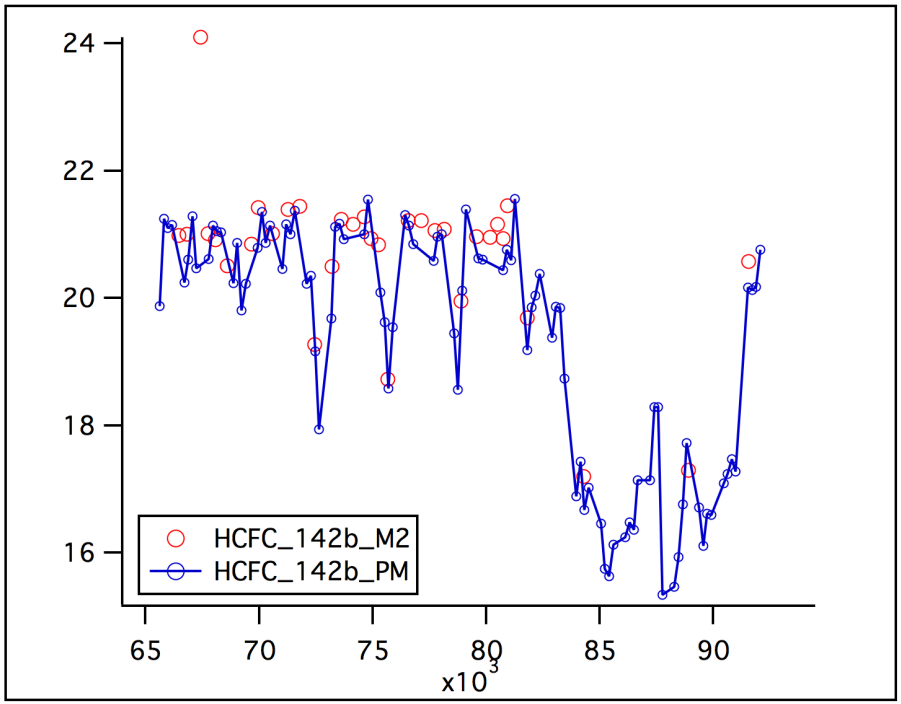
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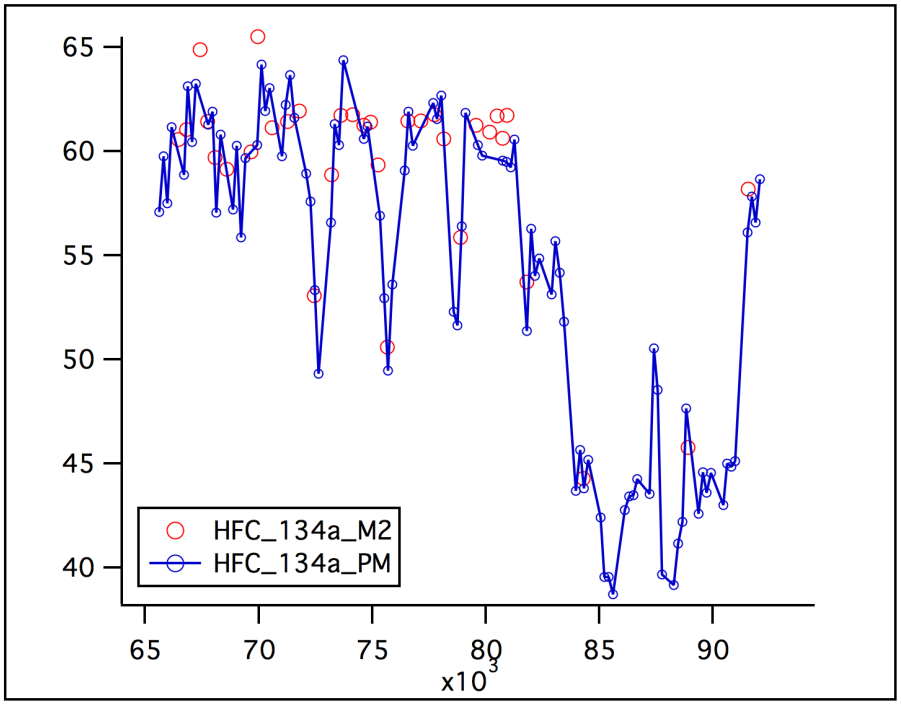
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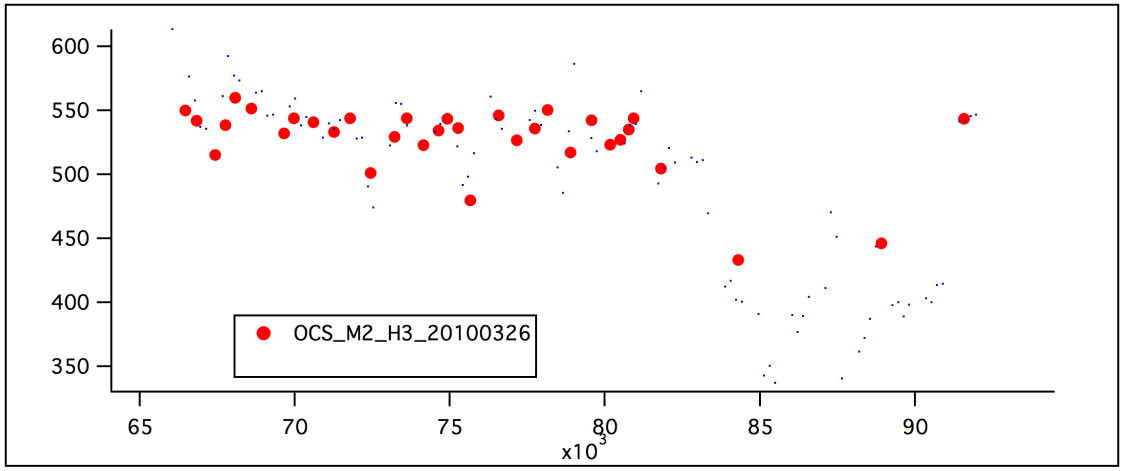
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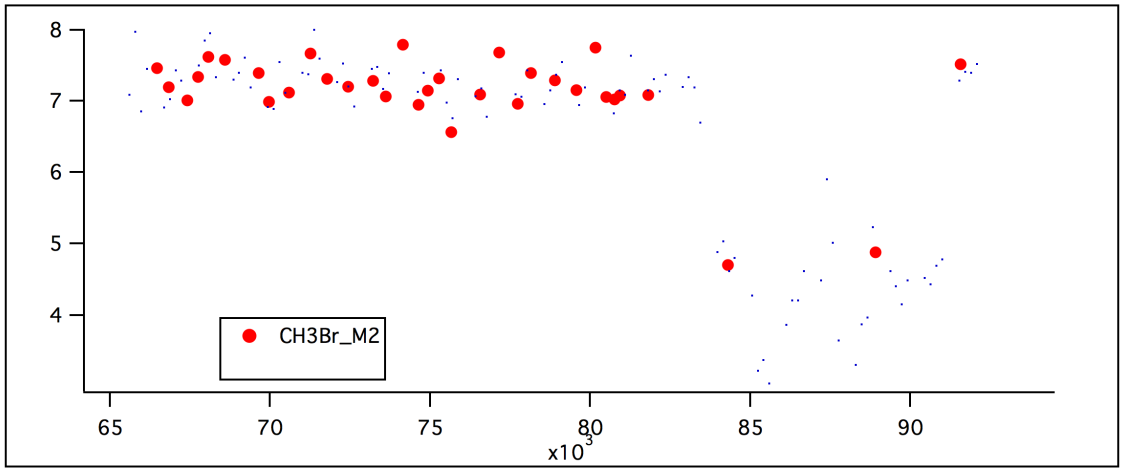
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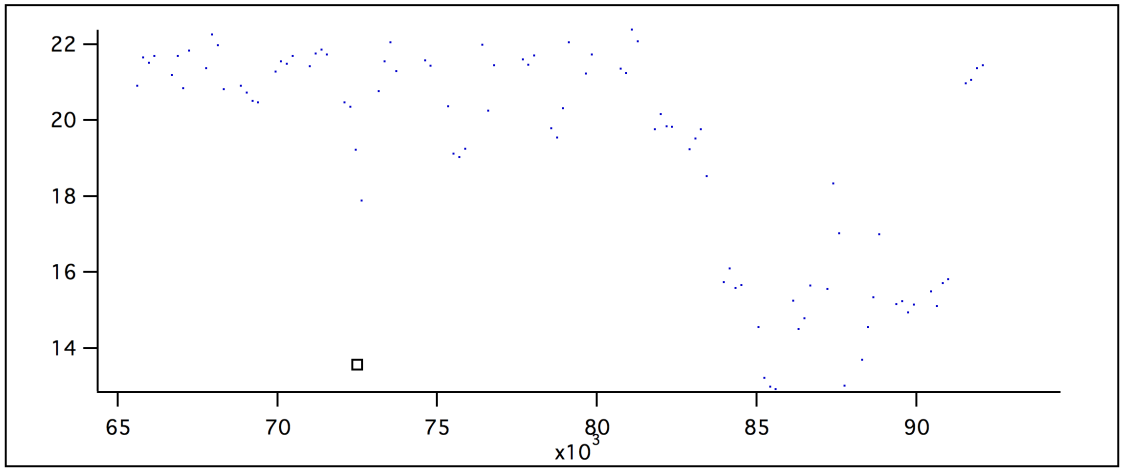
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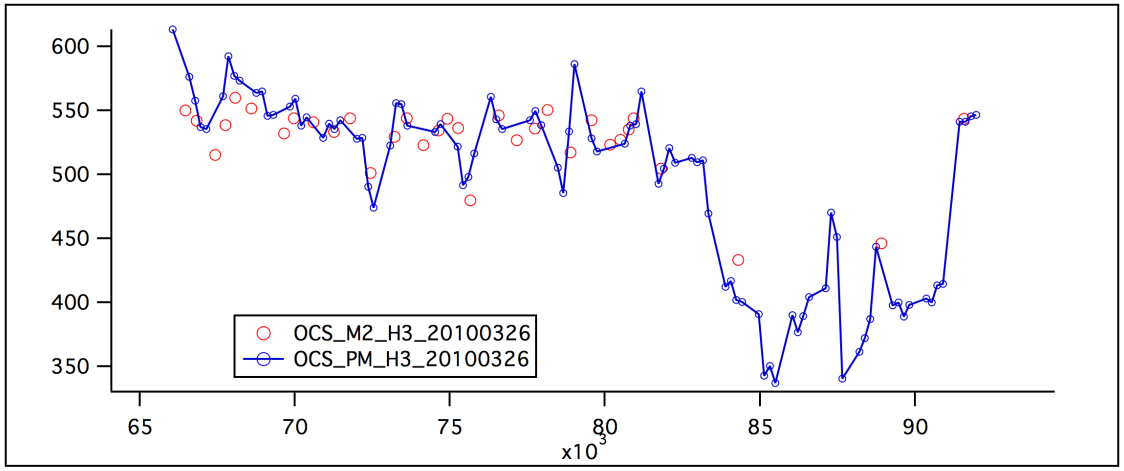
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OCS_M2_H3_20100326
OCS_PM_H3_20100326
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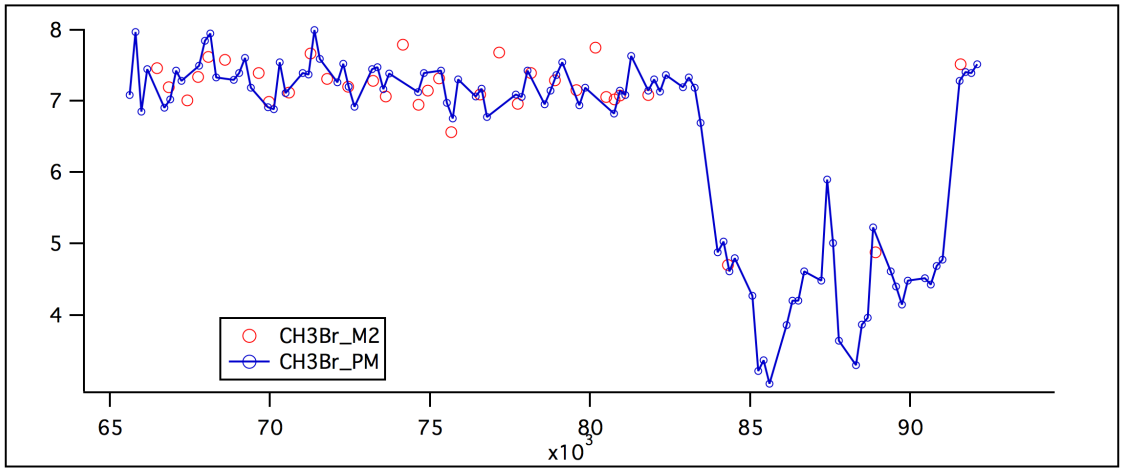
x10^3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CH3Br_M2
CH3Br_PM
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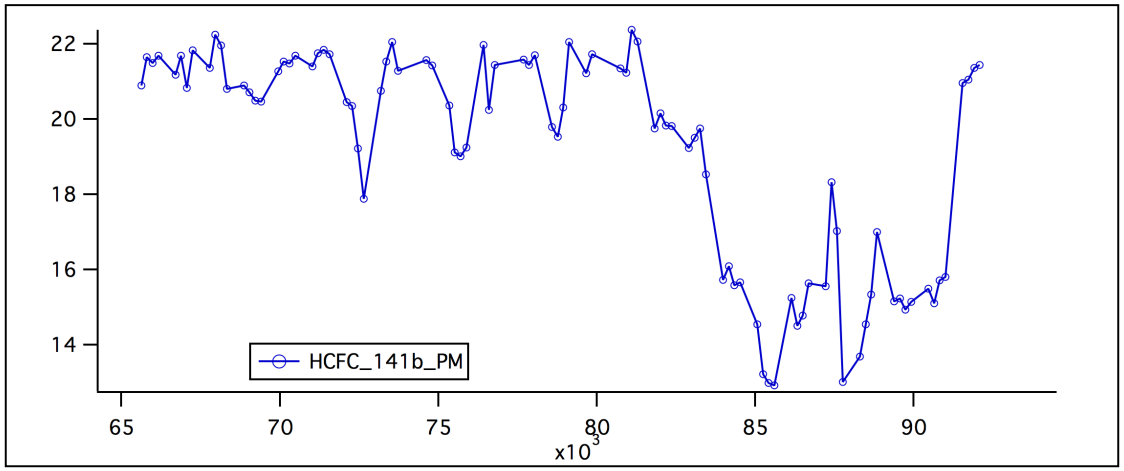
x10^3


22
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HCFC_141b_PM
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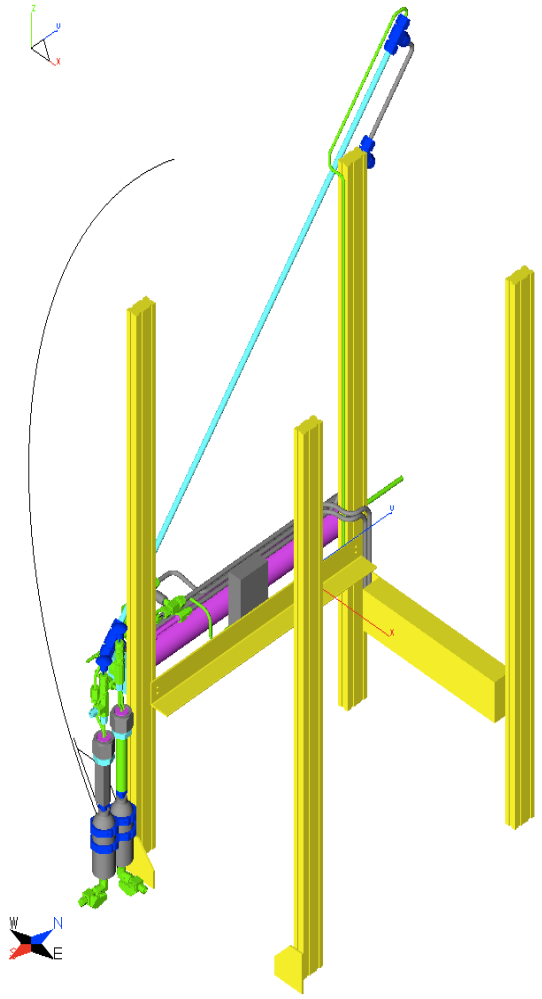
x10^3

Instrument Improvements: HIPPO-1,2,3

#1 Water traps for flasks:

Removed water to below saturated at 2 ^{o}C and 40 psia.

To improve Isotope and CO_2 data.



Instrument Improvements: HIPPO-1,2,3

#1 Water traps for flasks:

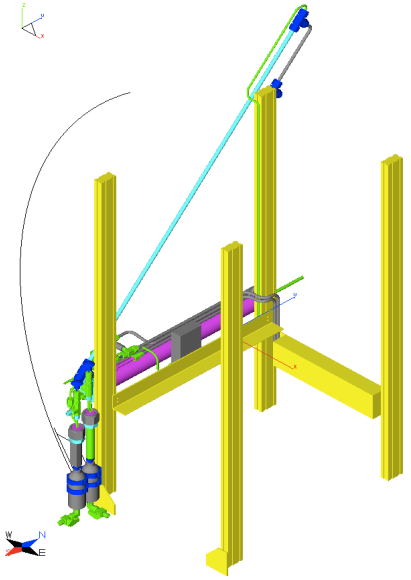
Removed water to below saturated at 2C and 40 psia.)

#2 Improved Flask data rate:

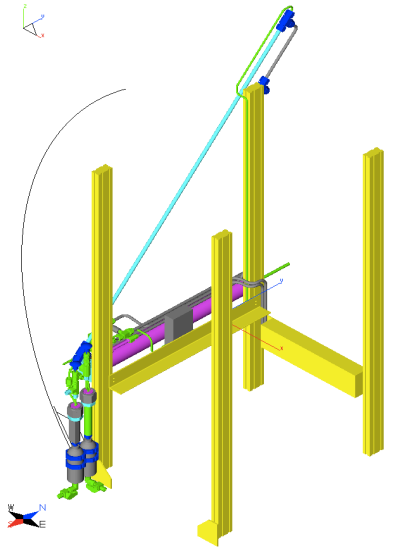
HIPPO-1 228 PFP flasks.

HIPPO-2 264 PFP flasks.

HIPPO-3 336 PFP flasks.



Instrument Improvements: HIPPO-1,2,3



#1 Water traps for flasks:

Removed water to below saturated at 2C and 40 psia.)

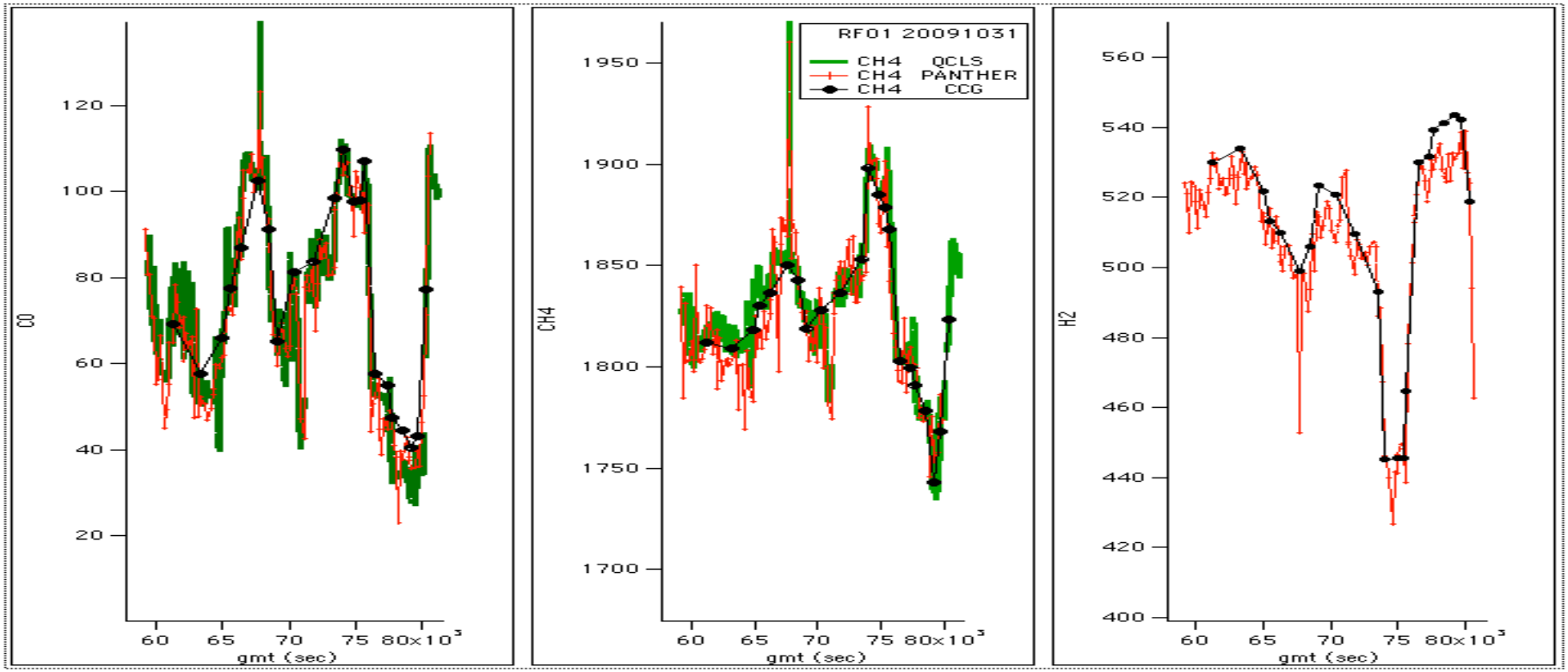
#2 Improved Flask data rate:

HIPPO-1 228 PFP flasks.

HIPPO-2 264 PFP flasks.

HIPPO-3 336 PFP flasks.

#3 PANTHER CH4, CO, H2 channel improved for HIPPO_2,3,4,5 (NRC temp



GC Calibrations:

Every 5th sample is from an in-flight calibration gas. (red points below.)

Fit smooth curve through in-flight data (black line).

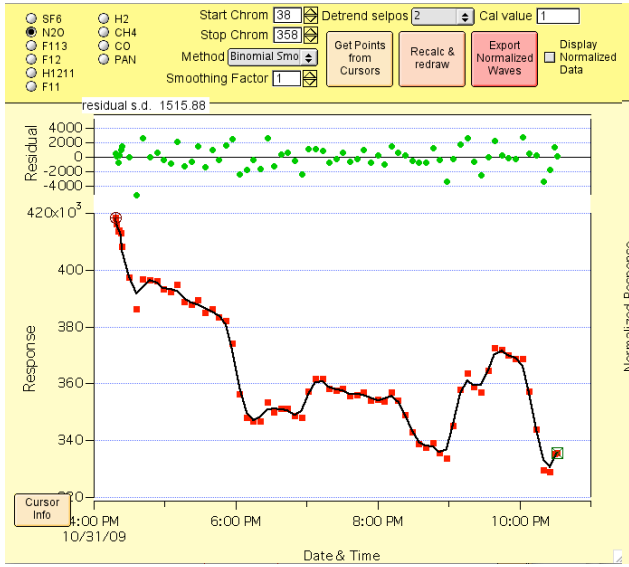
Uncertainty in data is 1-sigma spread in the residuals to this fit, added in quad with uncertainty in a calibration curve.

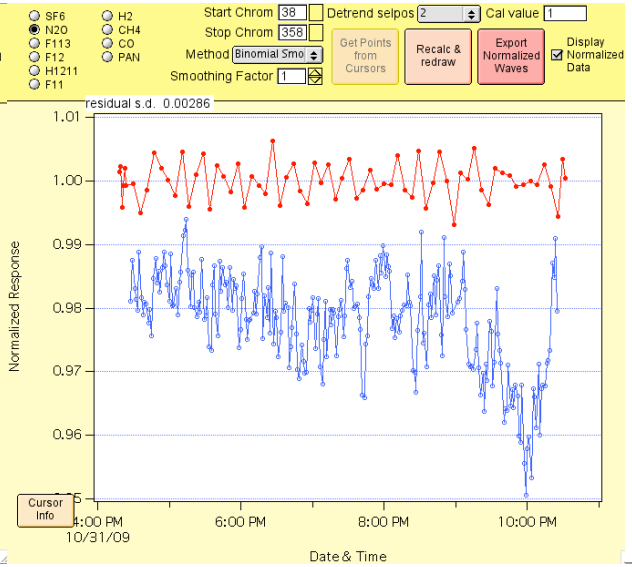
Normalize flight data to this smooth fit through the in-flight calibration data.

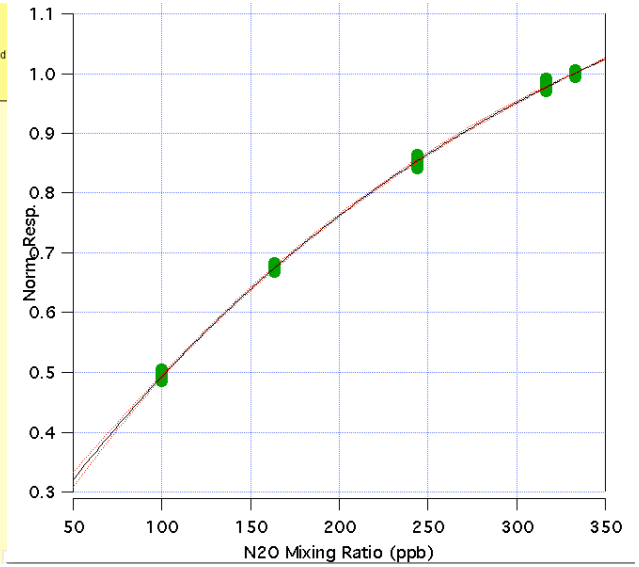
Convert normalized data to ppt via a calibration curve generated in the lab using multiple standards. (tied to gravimetrically prepared Primaries.)

This takes out the non-linearity and offsets associated with the chromatography and ECD's.

Lab cal-curves are generated Pre- and Post- mission.





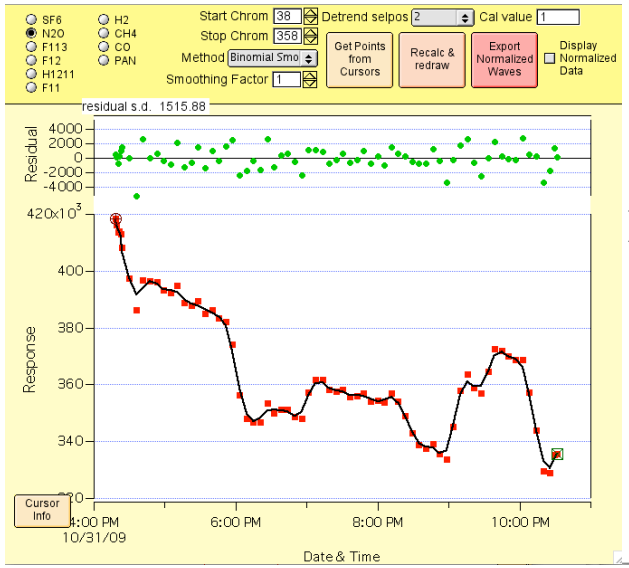


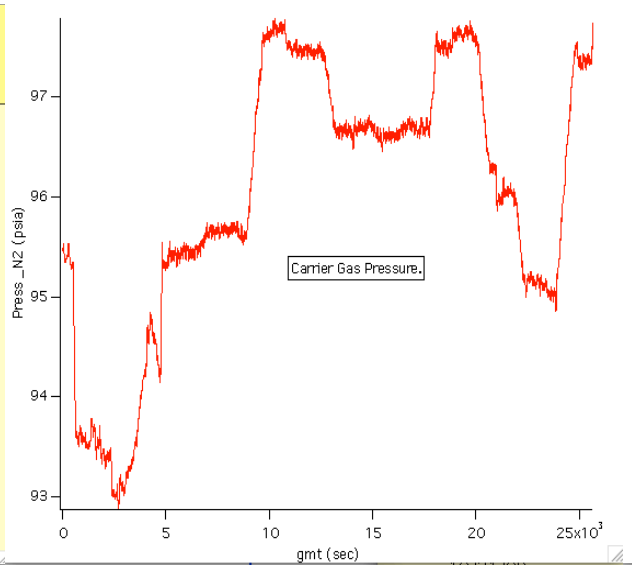
HIPPO GC Calibration issues.

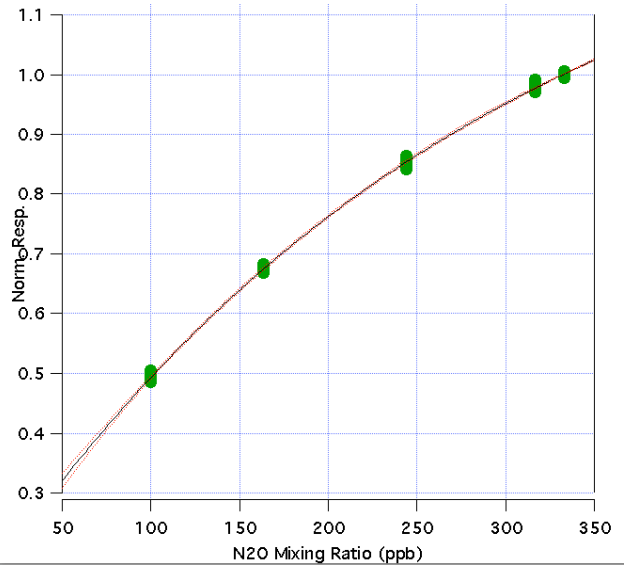
For HIPPO these gain changes are dominated by:

1) Changes in the Carrier Gas head pressure.

2) Water moving through columns onto the ECD.







HIPPO GC Calibration issues.

For HIPPO these gain changes are dominated by:

1) Changes in the Carrier Gas head pressure.

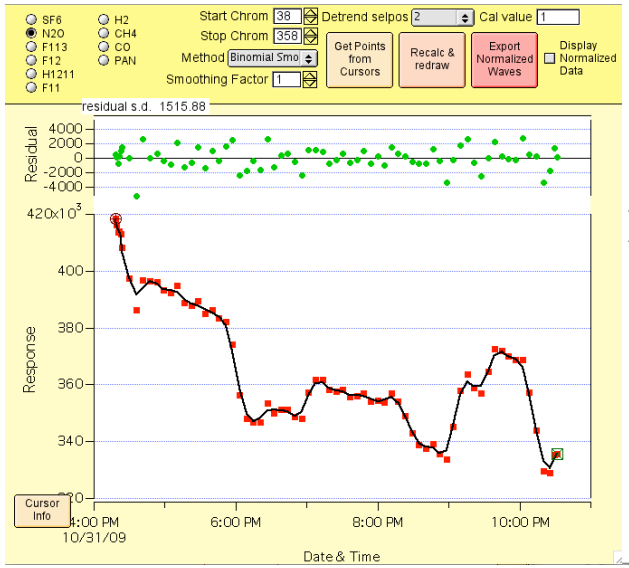
2) Water moving through columns onto the ECD.

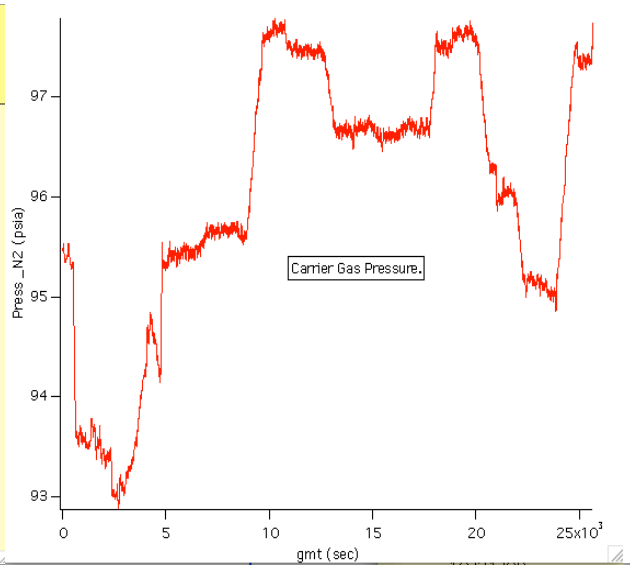
Curvature in cal curve implies detector is showing effects of saturation.

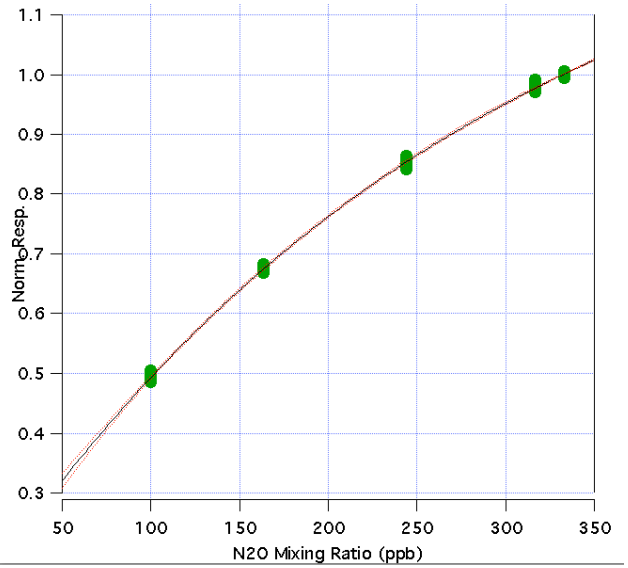
As gain goes up or down you are effectively moving the normalizing cal to a different point on the cal-curve below..

This changes the effective cal-curve.

> Systematic for UCATS and PANTHER .







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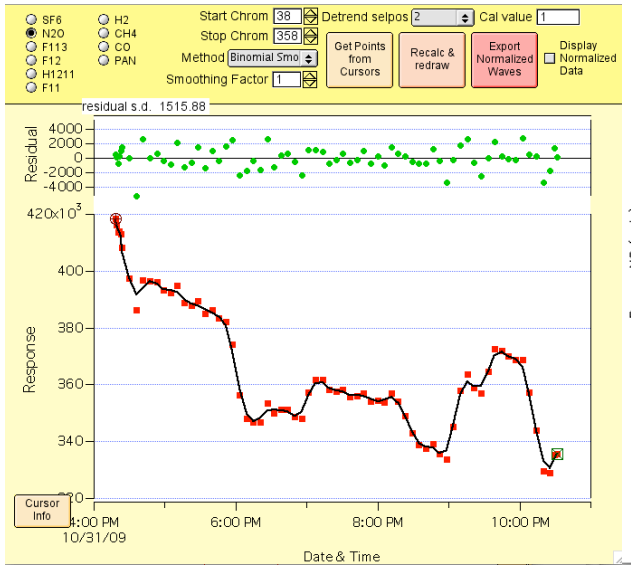
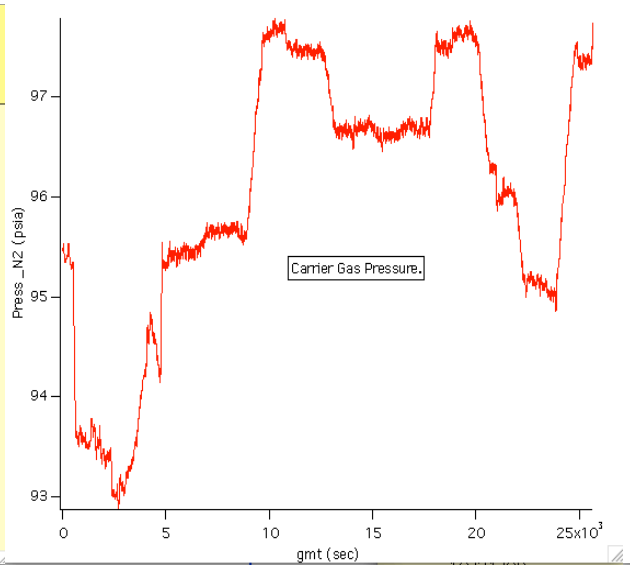
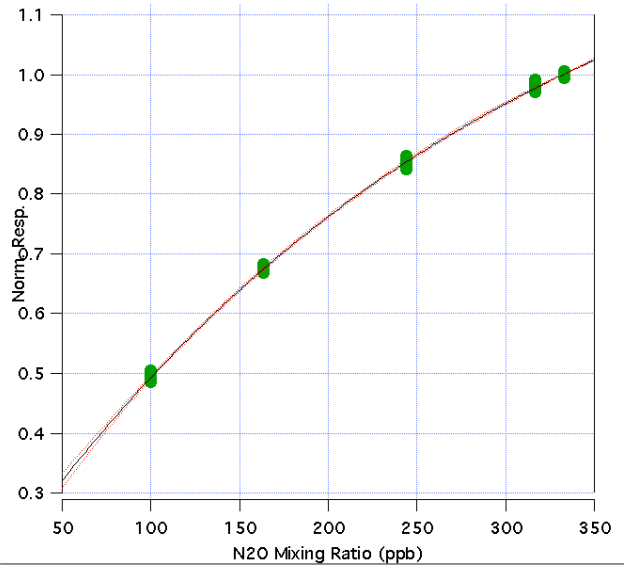
Solution: Reduce the gain changes > remove water and stabilize N2 carrier gas press.
Reduce calibration curvature with smaller sample size.



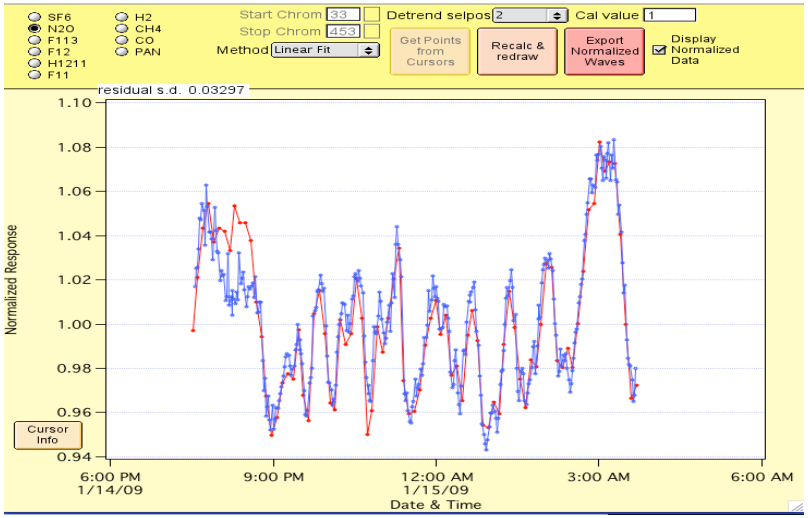




Pre-Naf-Dryer flight: HIPPO-1,-2,-3

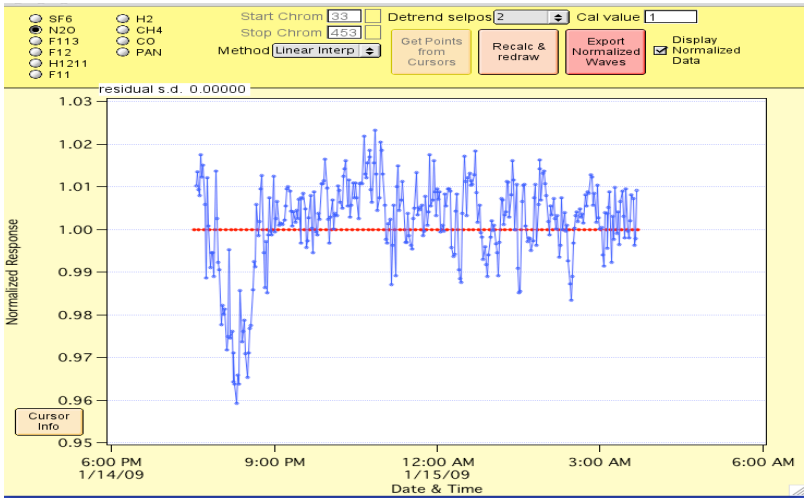
Big change in gain with the each vertical profile.

> due to changing water on detector etc.



Recoverable final precision about 1.0% with outliers.

(Air sample in blue, flight-cal sample in red)



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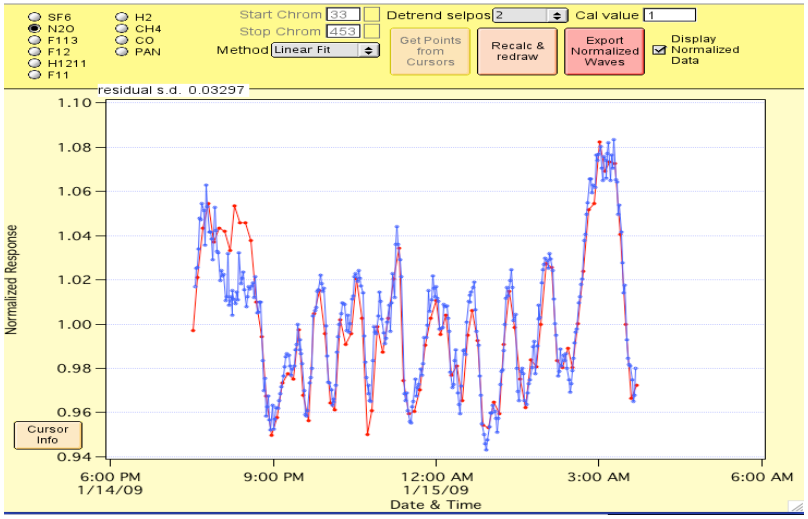

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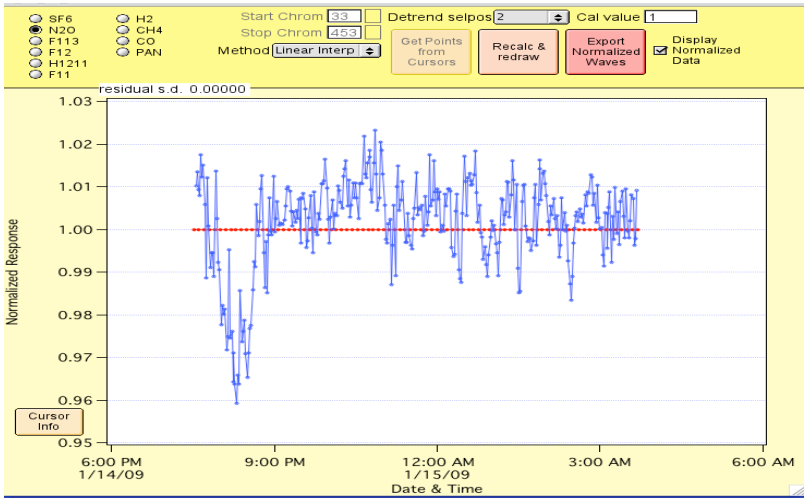
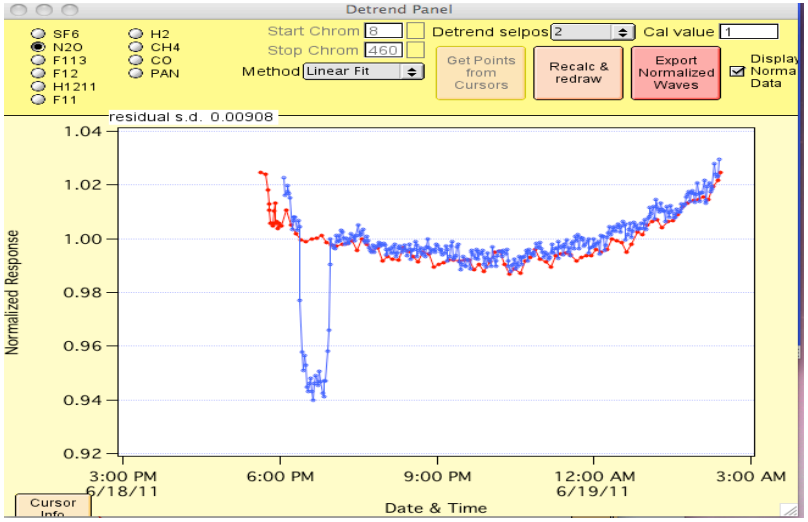


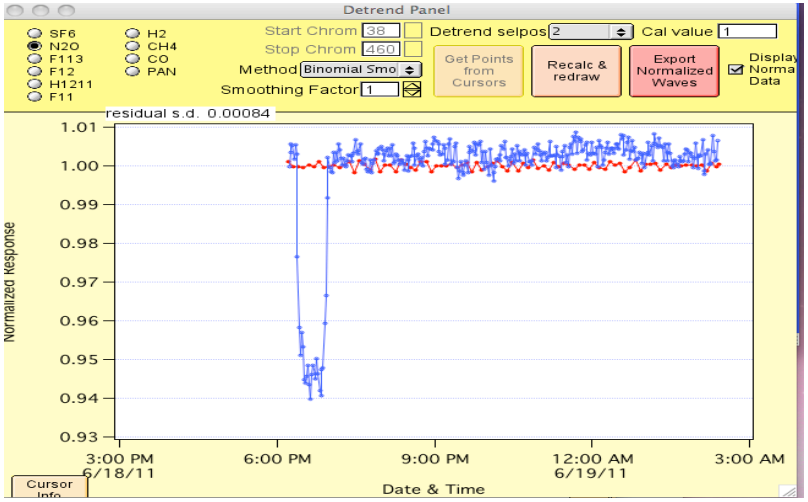
Naf-Dryer in sample line HIPPO-4,-5

No change in gain with the each vertical profile.

> Stable water on detector etc.



Final precision 0.2% with no outliers.



Final data submitted for HIPPO.

#1 All Flask data submitted as final. (GCMS-M2_, MAGICC_gmd_, and SIL_isotopes_).
*Issues exist with drifting calibration tanks etc. that will result in re-submission soon.
this will affect primarily OCS, SF6, and H2 data.

#2 UCATS data is final through HIPPO_2, no data for 3, and 4 and 5 are near final with time-sync and calibration issues to be resolved. (UCATSGC_, UCATSH20_, UCATS03_.)

#3 All PANTHER mass spec data will all be submitted as final by the end of the week with no mass spec data for HIPPO-5. (GC_MSD_). ECD data is final through HIPPO-2 and remaining ECD data will begin processing next week after final submission of MSD data.

Instrument Improvements throughout HIPPO.

#1 Water traps for flasks after HIPPO-1: Targeted water at saturation at 2C and 40 psia.

#2 Progressively Improved Flask data rate : Averaged over 300 PFP flasks per mission.

#3 PANTHER CH4, CO, H2 channel improved over HIPPO-1.

#5 Water removal for PANTHER and UCATS ECD sample flow improving precision.

#6 Stabilize N2 carrier gas regulator improving precision for PANTHER and UCATS.

#7 Reduce Sample Loop size to reduce calibration curvature and reduce systematic.