Hurricane and Severe Storm Sentinel (HS3) Mission

HS3 2013.08.29-30 Flight Report: GLOBAL HAWK AV-6 mission to P25L

Mission Scientists:
Shift 1 (0800-1700 UT): Scott Braun/Pete Black
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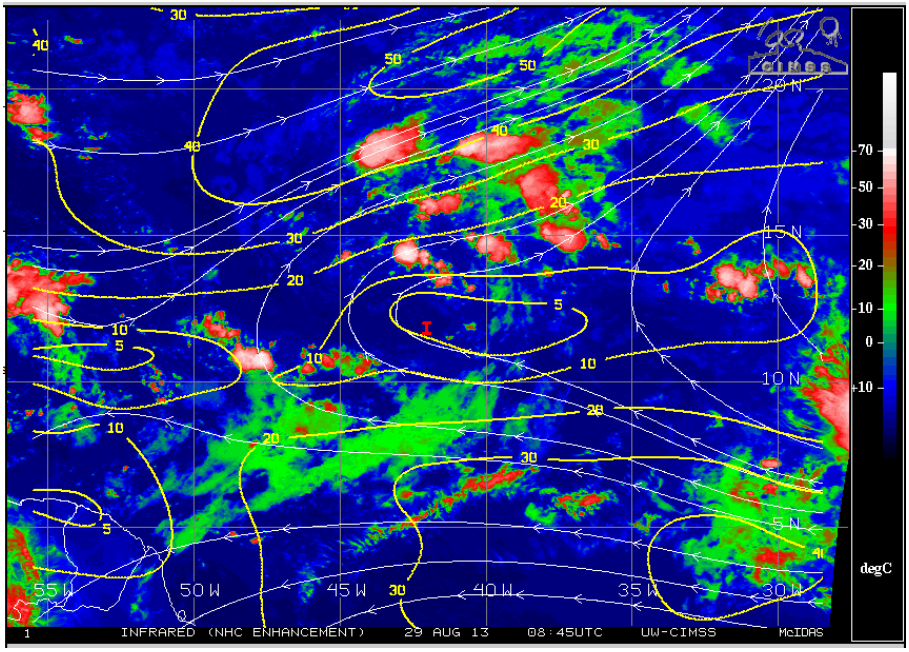
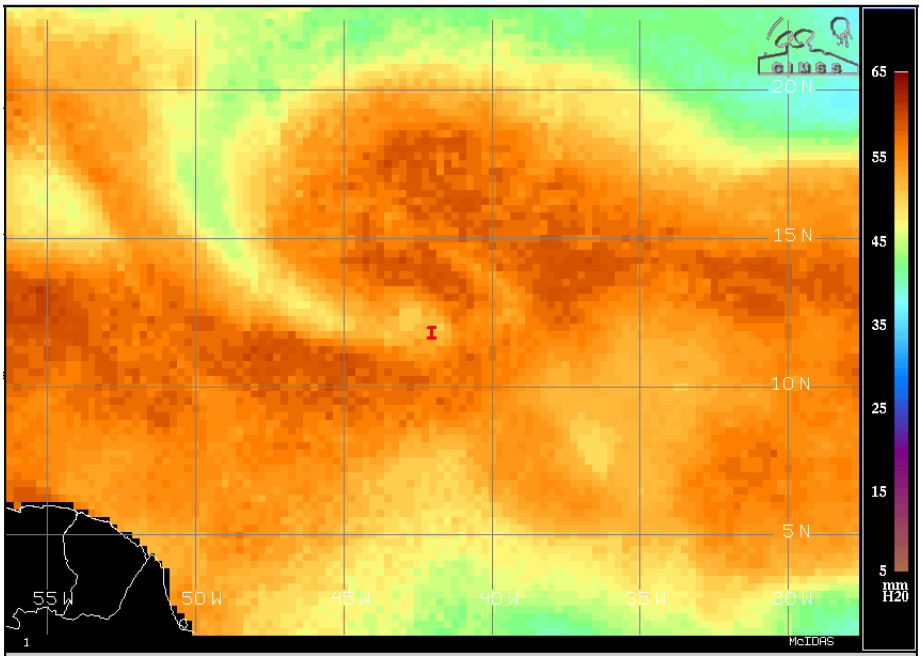
Shift 3 (0000-0900 UT): Steve Guimond/ Dan Cecil
Shift 4 (0800-1200 UT): Scott Braun/ Pete Black

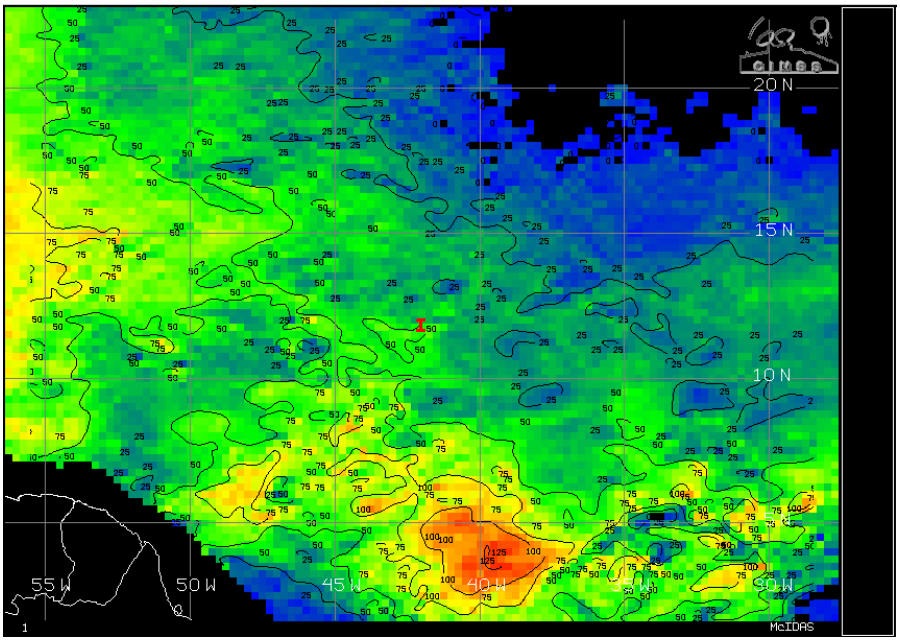
Mission goal: Lawnmower pattern covering P25L. This wave has been struggling of late to maintain convection. Early on, the models suggested the potential for development, but gradually have backed off. The overall circulation is large, with a low-level circulation on the southern side and a likely mid-level circulation on the northern side. Convection has been somewhat active in this northern region, but the circulation has been entraining dry air to its south. Closer to the southern vortex, there is substantial moisture, but the convection has been weak at best.



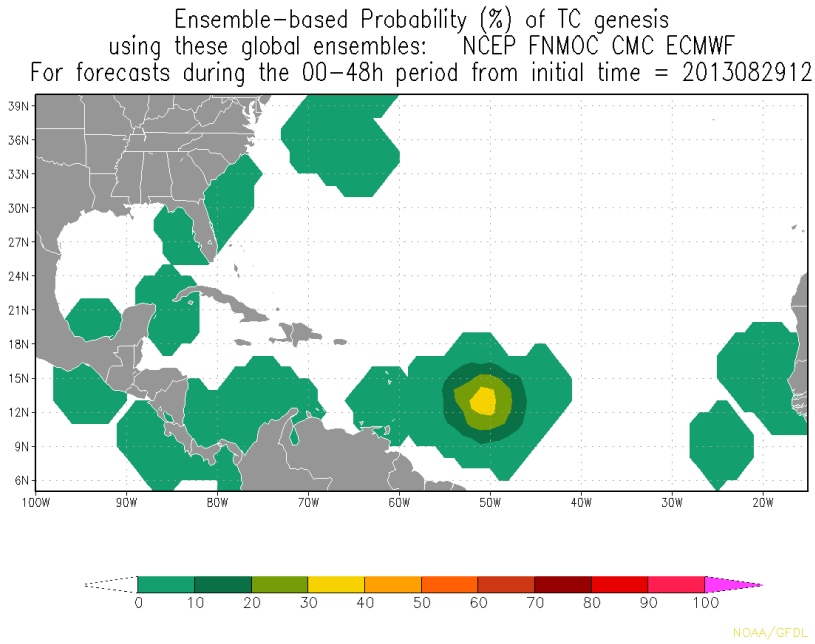
The CIMSS IR and shear product (above) shows significant cloud development on the northern side of the vortex, the northernmost convection experiencing strong vertical shear. Closer to the Invest center, the shear is weak and one can see relatively weak shearing of the convective tops closer to the center. Animations suggest that this convection just north of the center is growing with time. Very limited convection on the southwestern side of the Invest.



The CIMSS total precip. Water (TPW) shows higher moisture in the region of convection to the north and also in the region to the south, but one can see an intrusion of dry air from the west that has made it to the center and has probably been suppressing convection there. It remains to be seen today whether the vortex can strengthen enough to start better protecting itself from the dry air and consolidating the broad area of vorticity.



Ocean heat contents are low under the Invest, but increase to the west, so the storm will gradually see improving ocean conditions. SSTs are ~29C, with 30C just to the southwest.



12Z Multi-model ensemble probabilities show a 30-40% chance of development, which is on the lower end of the 'interesting' range from a predictability standpoint.

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1011 UTC Engine start.

1030 Low clouds still in the area, broken 900 ft broken 2500 ft.

1107 Now broken 2200 ft

1128 Chase pilots saying scattered 1200 and 2200 ft. GH pilots prepping for takeoff.

1130 Aircraft started rolling, but takeoff aborted. Pilots misinterpreted information from tower and started rolling before they should have. Tower called the abort. Would have to tow back to starting point for takeoff, but would take ~1 hour to get reset, which puts us very close to the end of our takeoff window.

1213 VACAPES has given us an extra half hour.

1215 Engine start.

1258 Taxi

1259 Take-off

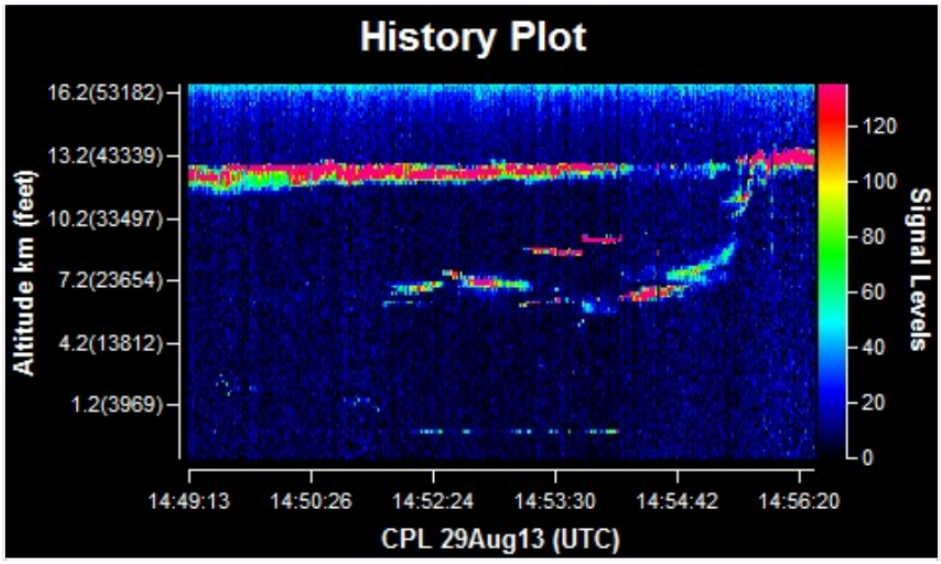
1345 Need to cut the flight by ~45 minutes so that we land at 12UTC tomorrow. We will be at the midpoint of the lawnmower by ~00UTC. Pattern is currently centered at -44.6W. Forecasters estimate a center position near 13.6N, 46W at 00Z. Shifting center of pattern to this location.

1425 Approaching convection with lightning with tops peaking between 48-50kft in isolated areas. GH altitude to be ~55kft by the time we get there. Pilots watching closely.

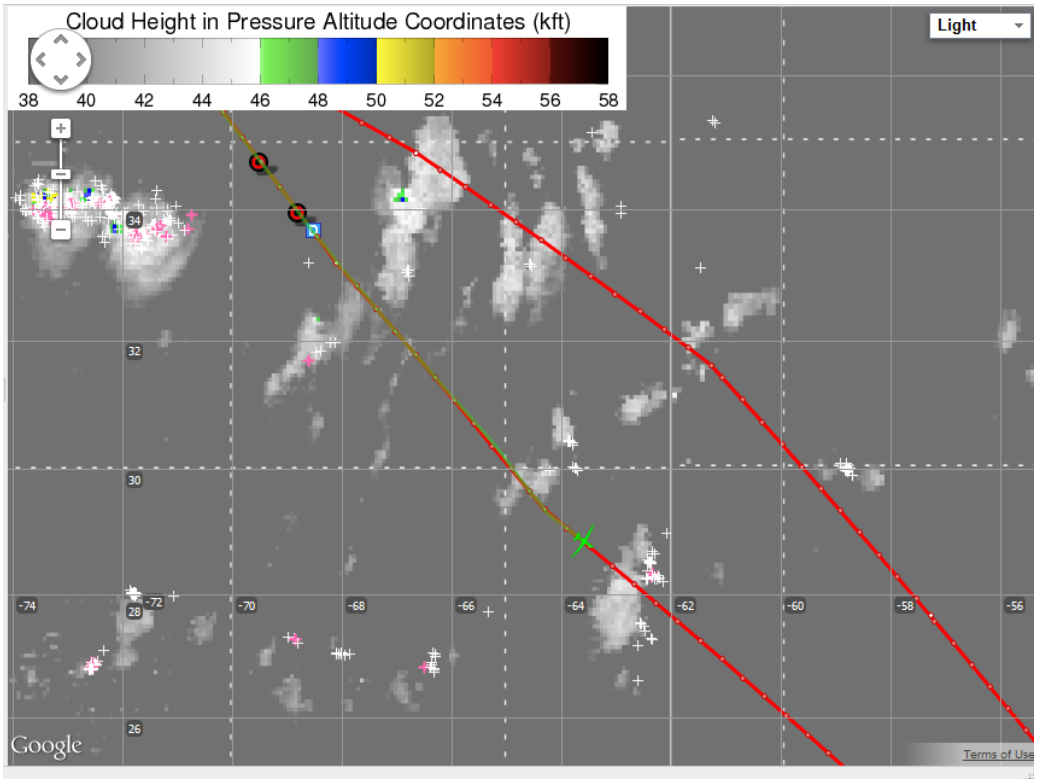
1439 Lightning and cloud tops along flight path diminishing, so will maintain current track.

1448 First drop released. Good data.

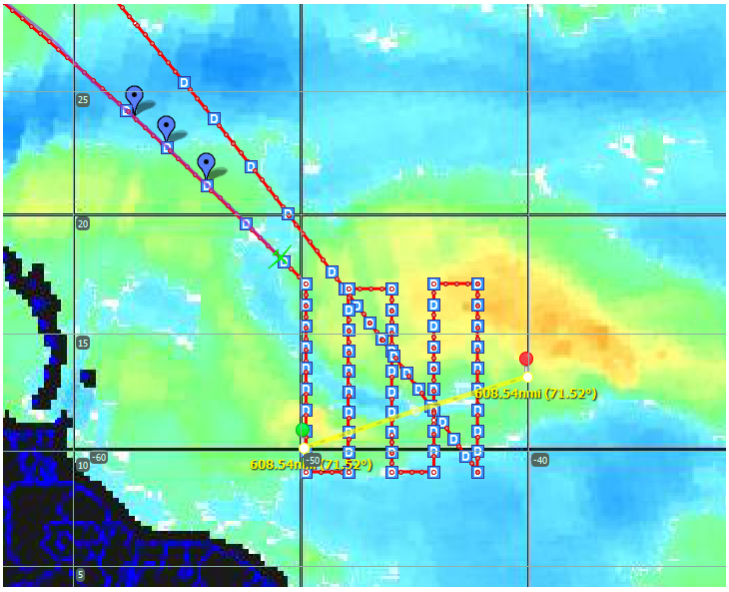
1458 CPL image shows clouds associated with earlier lightning with tops around 43-44 kft.



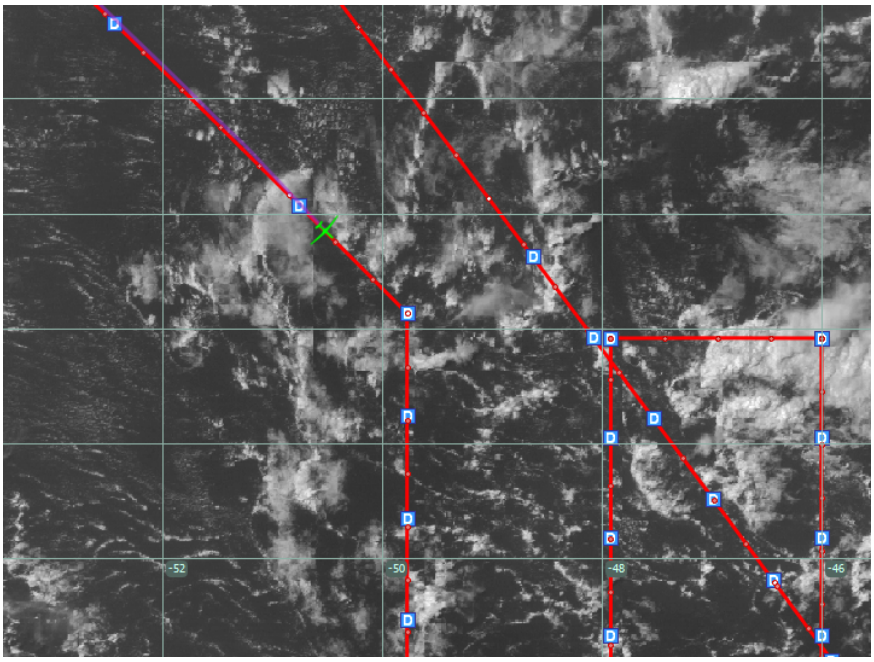
Approaching another frontal band with lightning and tops near 45kft, about 10kft below the GH.



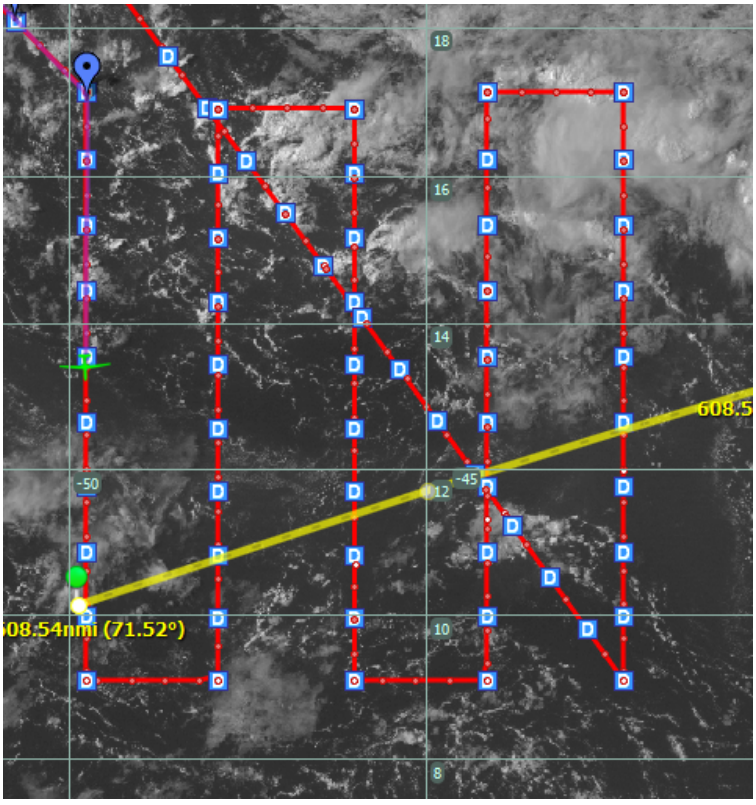
1806 Received word at 1750 CEST today that the Government of France has denied clearance for the HS3 mission on NASA 872 into ROCHAMBEAU FIR due to range safety concerns related to an Ariane 5 launch of an Eutelsat payload out of Kourou, French Guiana (scheduled for 1100 Z 30 August 2013; see http://www.arianespace.com/news-mission-update/2013/1091.asp). We are currently revising the flight plan to avoid ROCHAMBEAU.



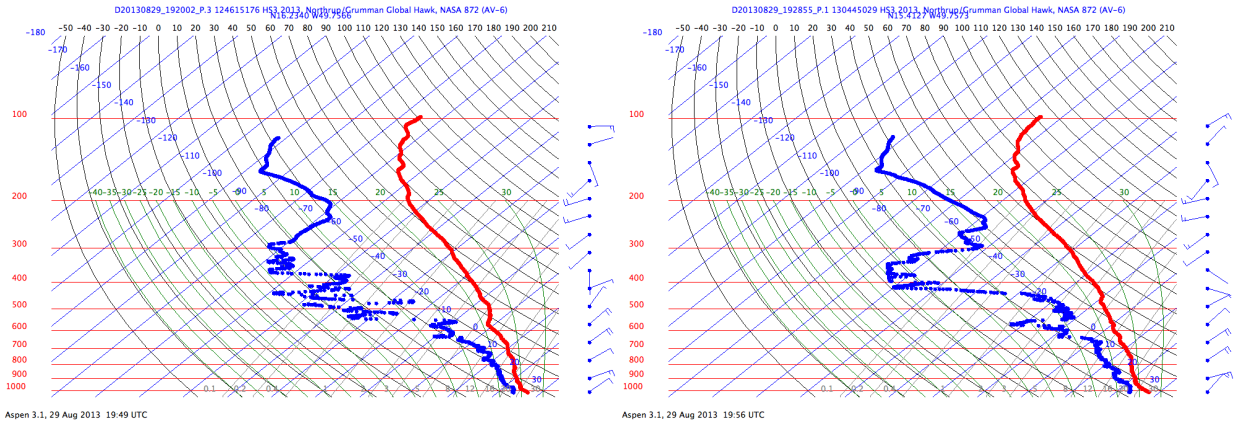
1800 UTC PW Anomaly from NOAA with plane location at 1855 UTC moving over dry slot. Yellow line shows approximate boundary we have to stay north of due to rocket launch



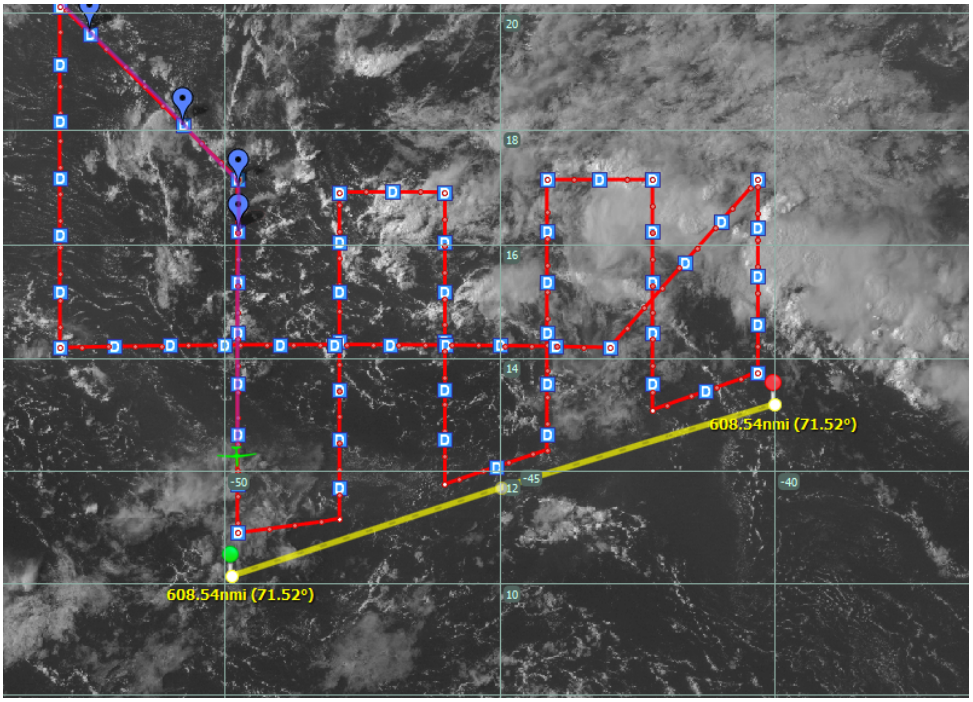
Outflow boundary under dry slot from visible GOES capture at 1900 UTC



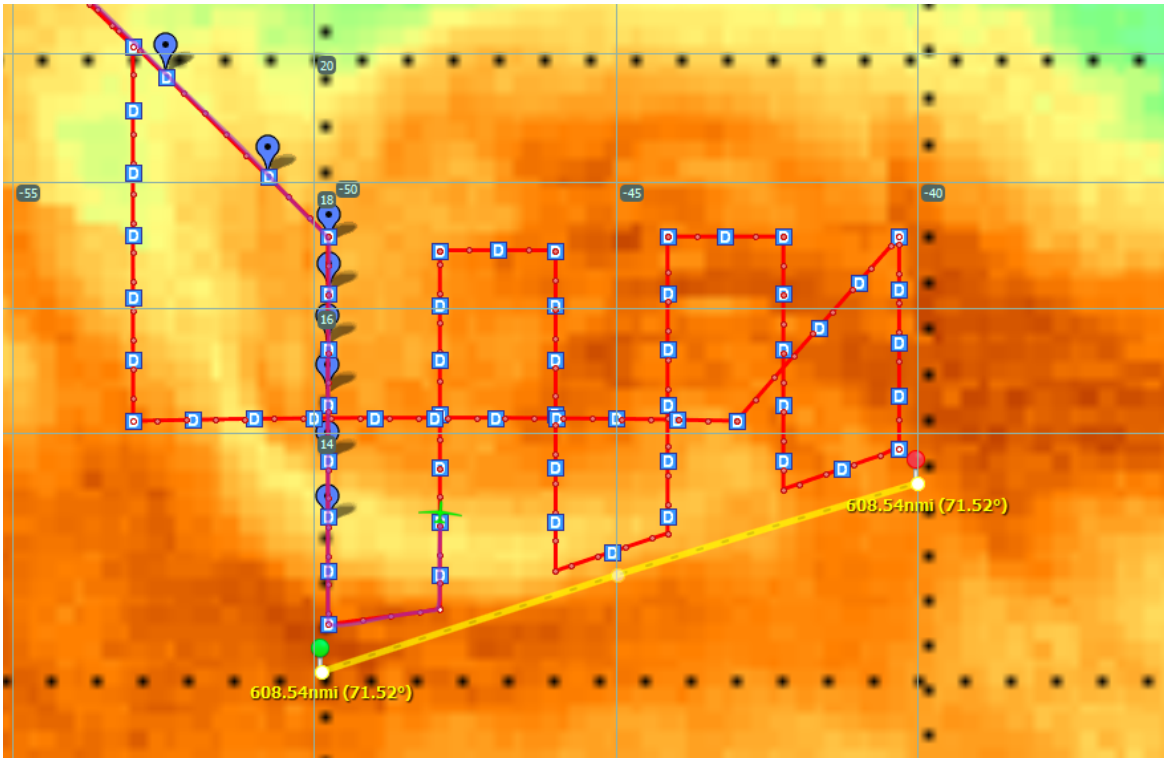
Large outflow boundary oriented ~E/W moving north to northeast relative to center along legs 3-6. Remnant MCV evident in loop 14.5N/43W



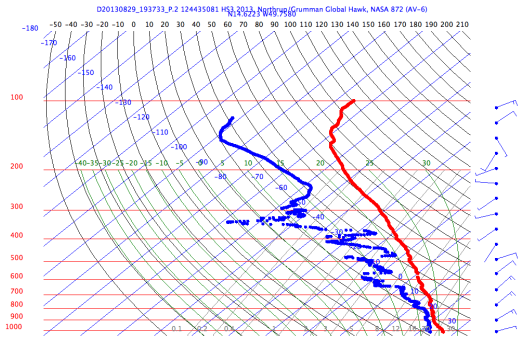
These are the second and third sondes on the first N/S leg – note the dry slot just above 500 hPa. The dry slot increases in magnitude and depth as one goes north, though it's not very obvious in the TPW image (below) presumably due to the heavier weighting of the LL moisture in the TPW retrieval, which is fairly high. Note westerly vertical wind shear.

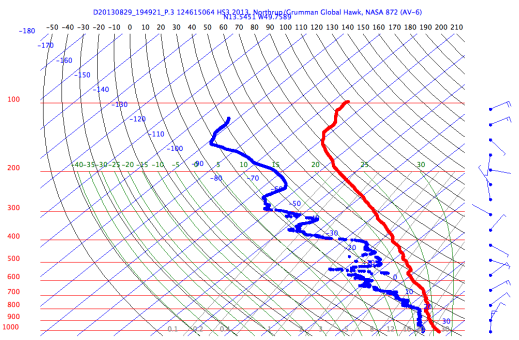


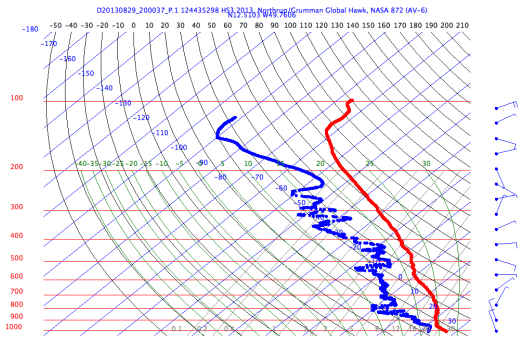
New flight plan shows up in MTS ~2000 UTC. Dropsonde in bend between NE/SW diagonal leg and last E/W long leg appears to be very near MCS center.

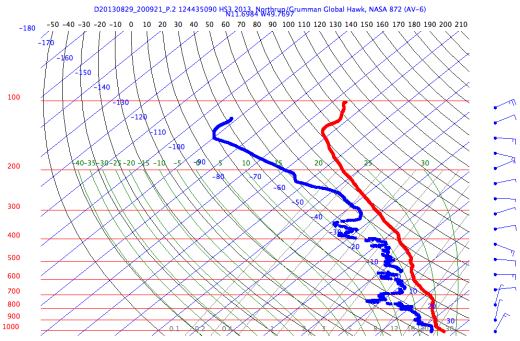


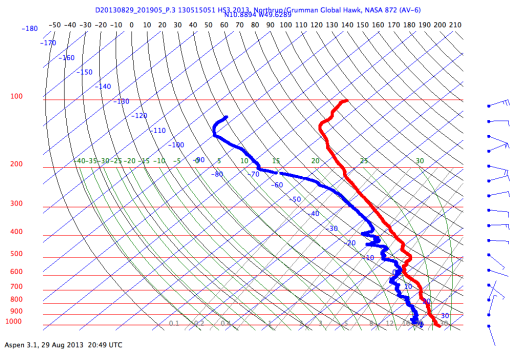
Here is a screenshot of TPW from roughly 2100 UTC (last image in loop). The medium oranges on the first leg are reflective of dry mid-upper level air (vs dark oranges farther east).



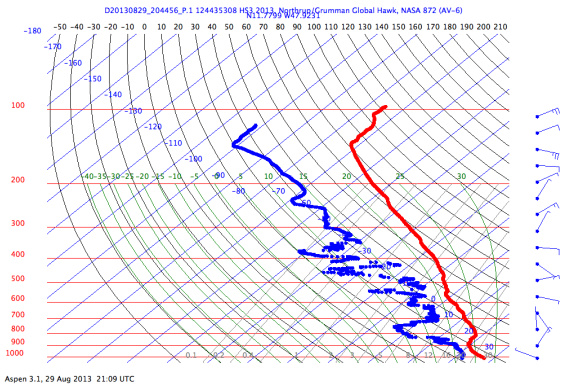




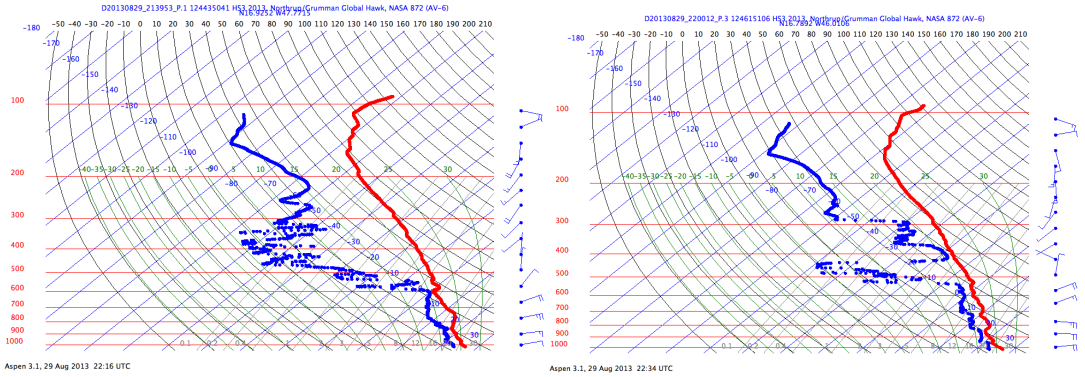




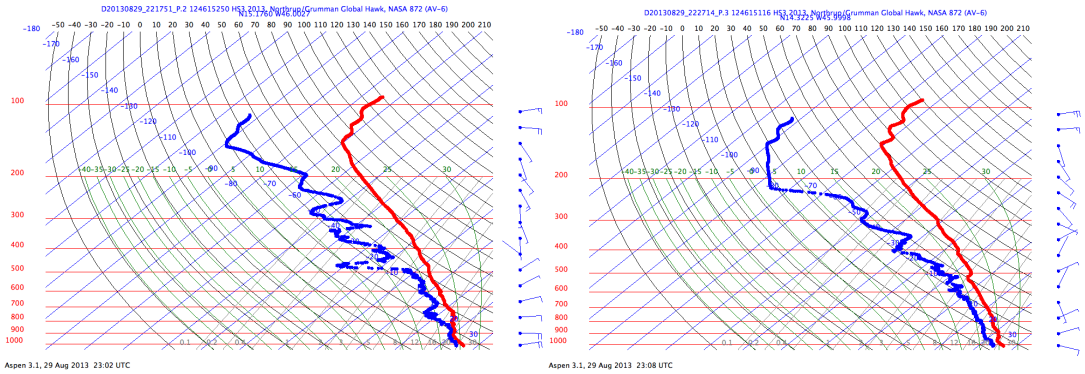
The above series of 5 sondes is a transect through the dry tongue seen in TPW, with the third one being apparently in the middle of the tongue and the fifth one being at the end of the leg.



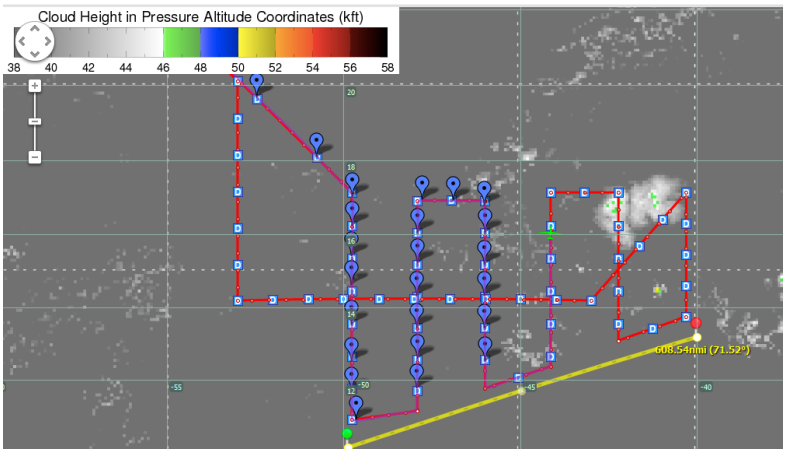
This next sonde was released on the edge of that tongue on the northbound leg.



Even at the north end of the second leg (left) a low-level inversion remains, as does quite dry mid-level air blowing in from the southwest – consistent with first leg. Just a little farther east, at the north end of the third leg, the air at the same level is much more moist (though a limited dry tongue remains).

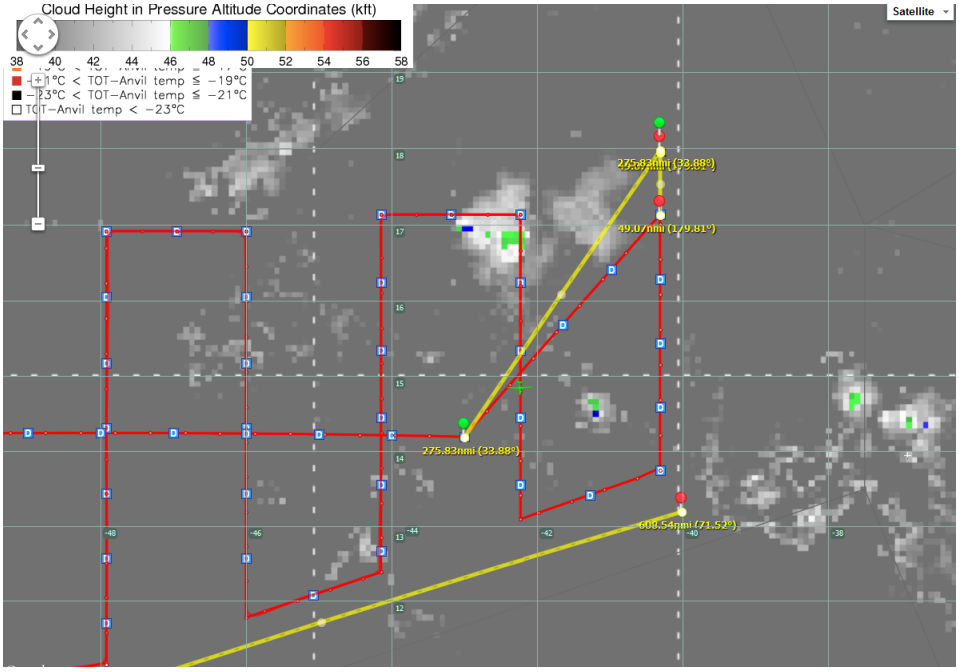


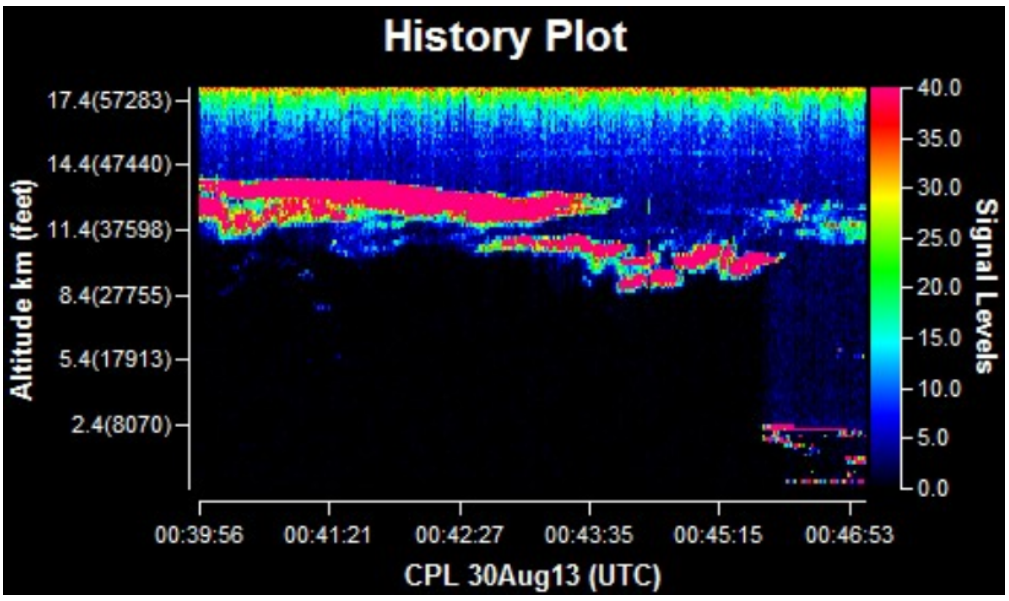
These two drops were taken near the center of the system – the third and fourth sondes on the third leg. Note one of these has a low-level inversion. Little doubt about why there's no convection near the center of this thing in the below image.

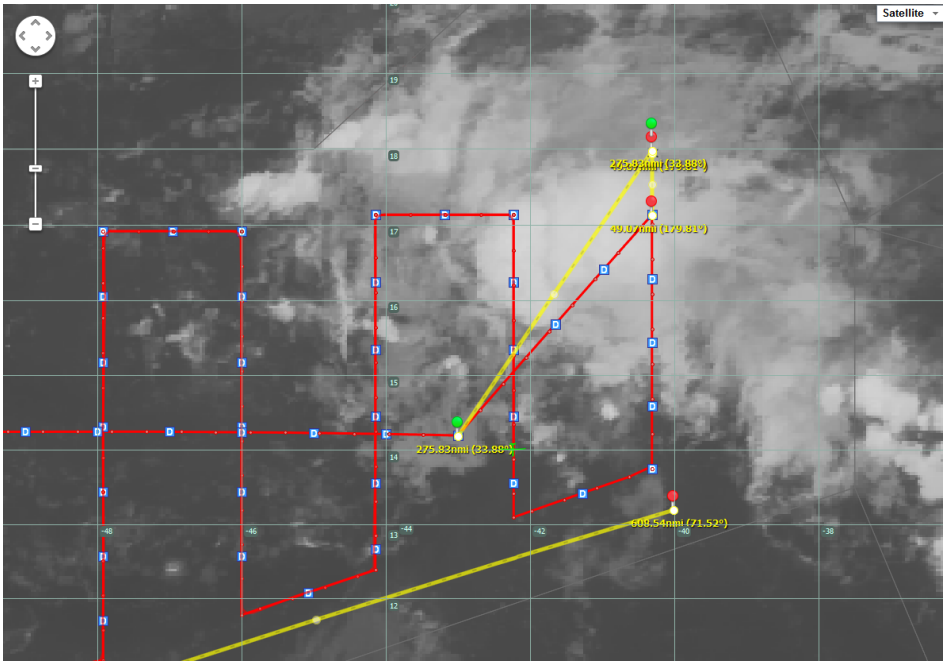


Cloud top height at 2332 UTC.

0045 We have passed over the convective region to the northeast of the circulation. Cloud tops according to CPL were as high as 46-47 kft which compares well with what the cloud top height product is showing. The image below also demonstrates the proposed adjustment to the plan which will take the track at the northeastern-most point on the last north-south leg farther north (18N). From there we will then go diagonal, overtop of the convective region, down to the final east to west crossing of the center. We'll add a drop at the end of the new endpoint (R02 moved to 18N) then have 4 drops between there and the turn to the west. These drops should sample the environment within the convective region. 20 minutes is expected to be added to the pattern. Right now, not expected to add any drops on the east-west crossing.

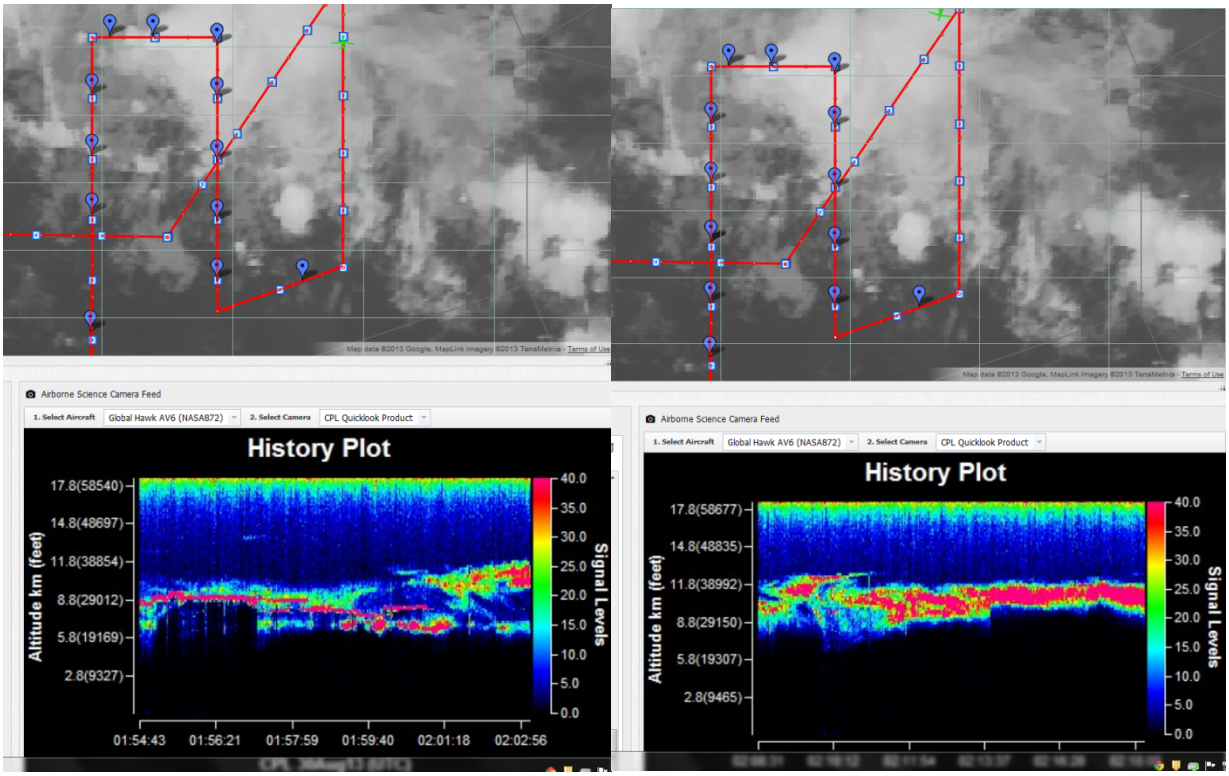




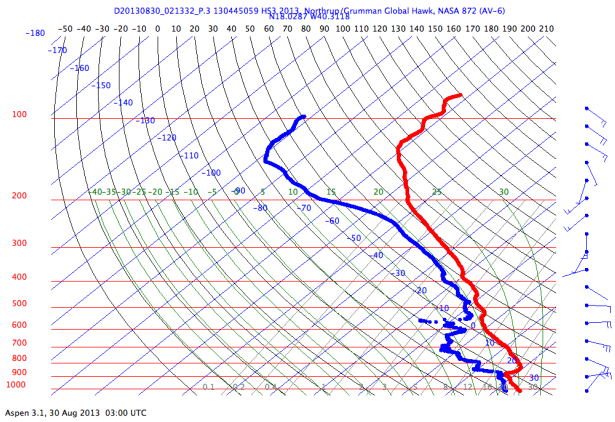


0107 Making turn at WC10. CPL has shown complete clear down to the surface on the southern side of the pattern.

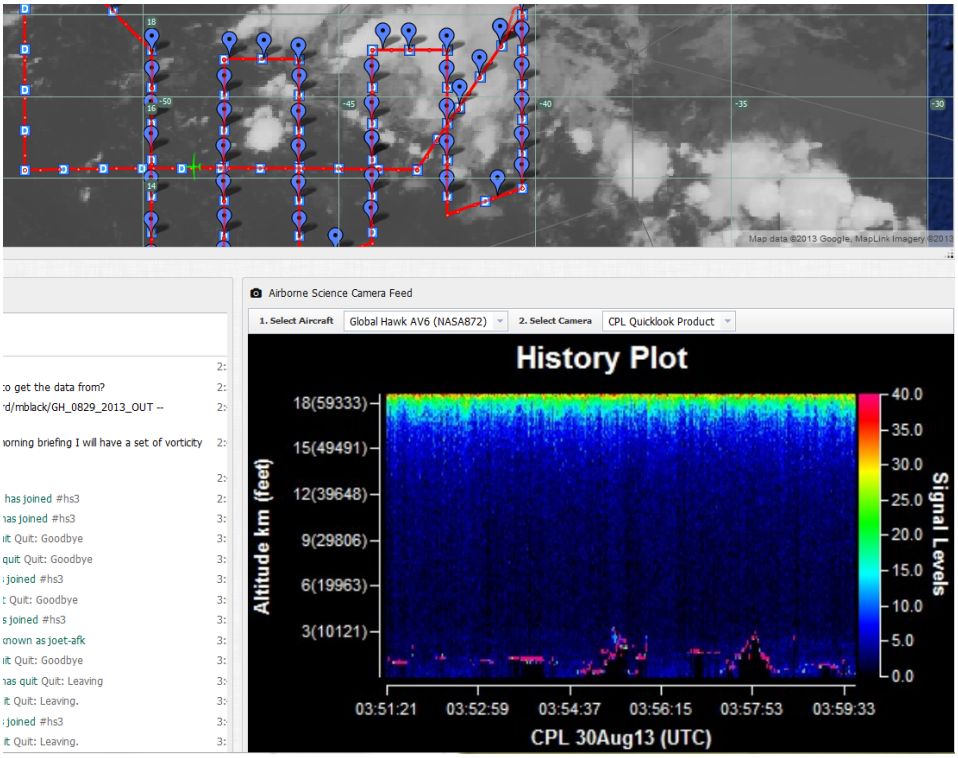
On the easternmost S-N leg, CPL shows that we went from fairly solid cloud tops to more diffuse cloud tops around 0200 UTC. Cloud tops go back to about 11-12 km by the north end of the leg.



Drop D48 at the northern end of the easternmost S-N leg will be dropped just before the turn. Hopefully that will not interfere with receiving the signal from the falling sonde during the turn… we'll test it out. Success:



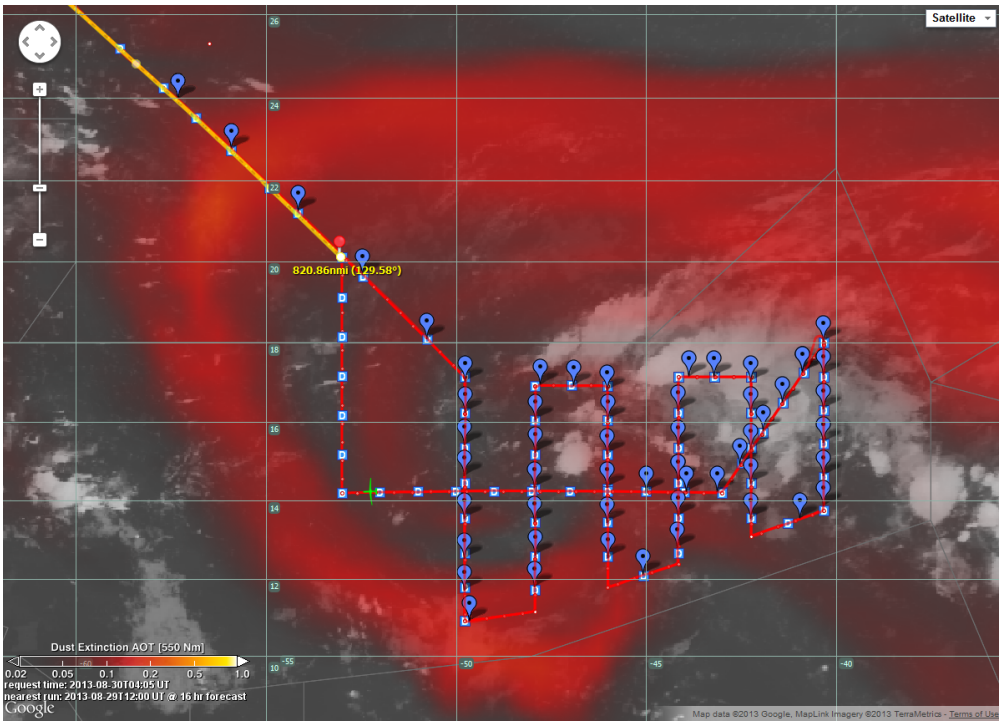
On the final E-W leg along 14.25 N, we have been seeing a faint hint of dust below 3 km in CPL:

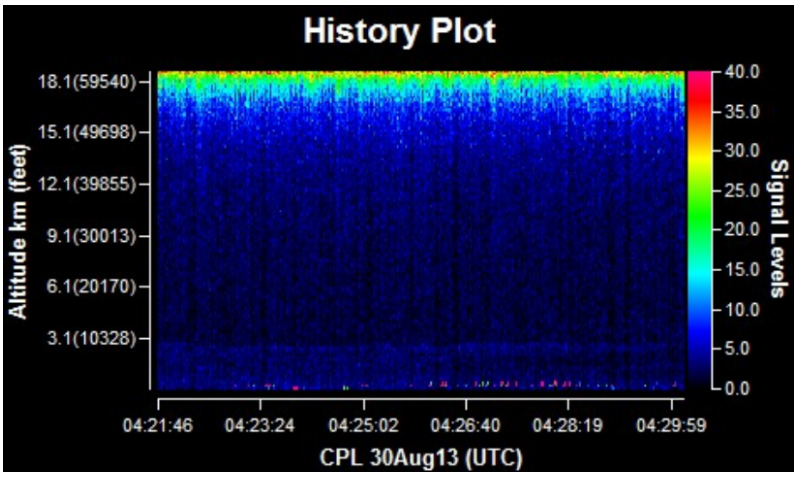


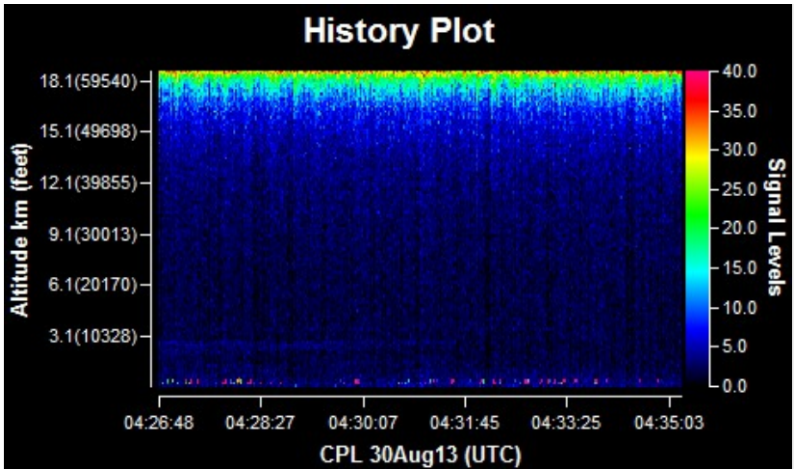
With five extra sondes loaded on the plane, we've considered planning drops along the trough / frontal boundary near Bermuda on the way back. That would be around the time of the handover from GHOC to GHOC-E, so we are leaning against adding that complication.

0413 According to GEOS-5 AOT, we are approaching a light dust load on the western portion of the final east-west leg (below). We also will be heading north through an apparent “clear” region and transiting back through a relatively high dust load.

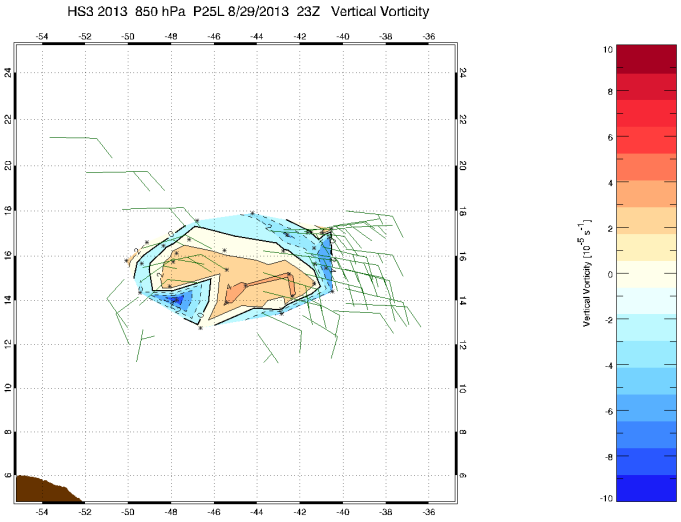
0433 Below is the CPL image corresponding to that “plume” of dust that the aircraft was approaching. There is a thin layer at 3 km (with a very weak signal) is this indicative of that dust layer? It thins out and completely disappears as we approach the turn.

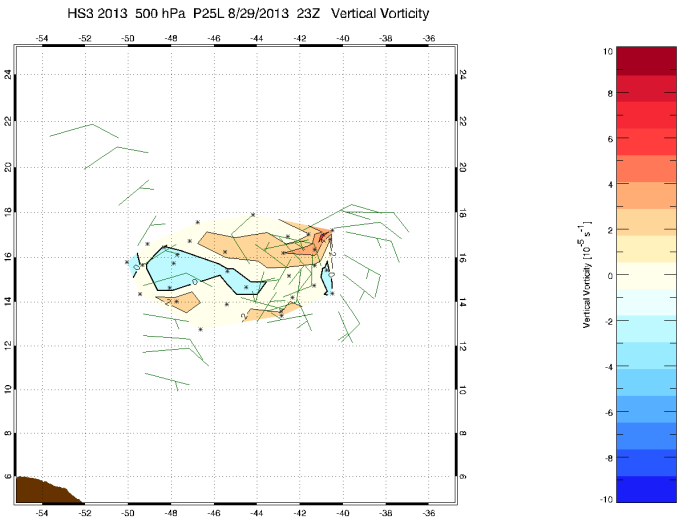




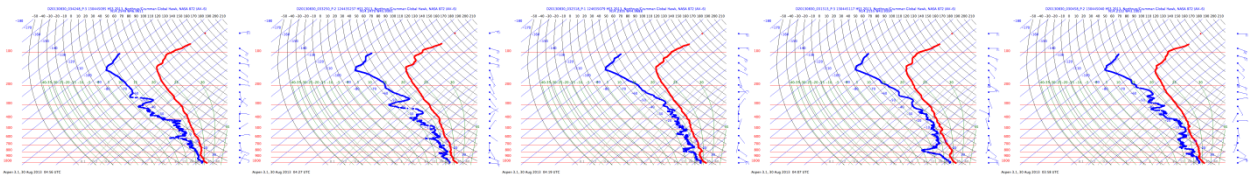


0445 Chip Helms has provided some derived vorticity plots at 850 and 500 hPa.





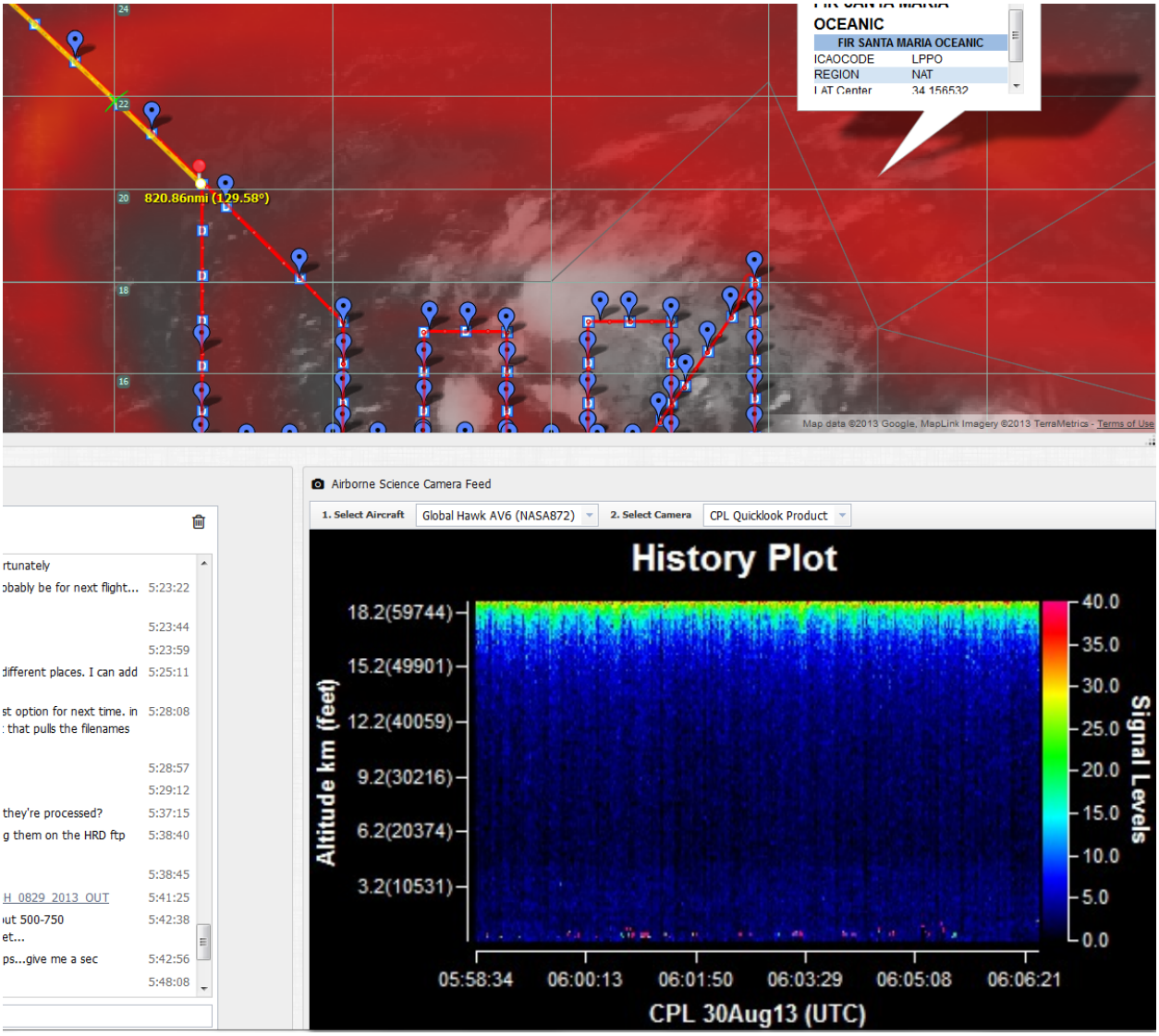
The E-W leg along 14.25 N shows a thin tongue of dry air between about 700-800 mb coinciding nicely with the spiral of dust simulated in the GEOS-5 model.



West-to-east sequence of sondes above: 0343 UTC, 14.25 N, 46.96 W; 0332 UTC, 14.25 N, 45.94 W; 0323 UTC, 14.23 N, 44.97 W; 0313 UTC, 14.21 N, 43.93 W; 0305 UTC, 14.21 N, 43.10 W.

SHIS has been getting a temperature issue – coolers not cooling the instrument enough – so they are powering down before the turn from the S-N leg to the SW-NE return home. Powered down at 0541 UTC. They will power back up after a few minutes. Powered back on at 0548 UTC. Hoping to see their temperatures back down toward 78 K by about 0700 UTC or so.

CPL is seeing a thick layer of dust on the return leg, consistent with GEOS-5 dust AOT: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Map data ©2013 Google, MapLink Imagery ©2013 TerraMetrics - Terms of Use
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Airborne Science Camera Feed
1. Select Aircraft
Global Hawk AV6 (NASA872)
2. Select Camera
CPL Quicklook Product
History Plot
18.2(59744)
15.2(49901)
12.2(40059)
9.2(30216)
6.2(20374)
3.2(10531)
Altitude km (feet)
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
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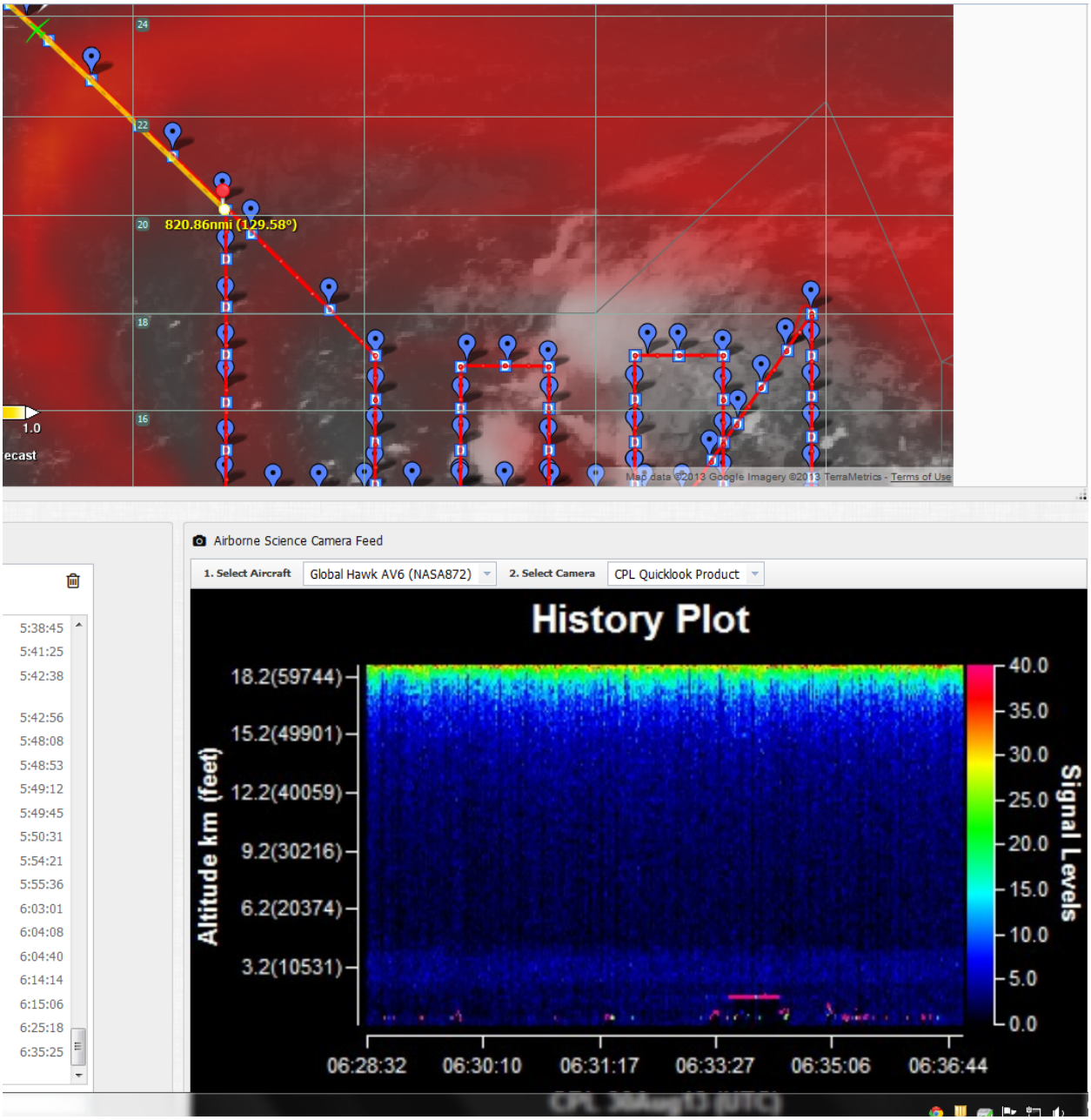
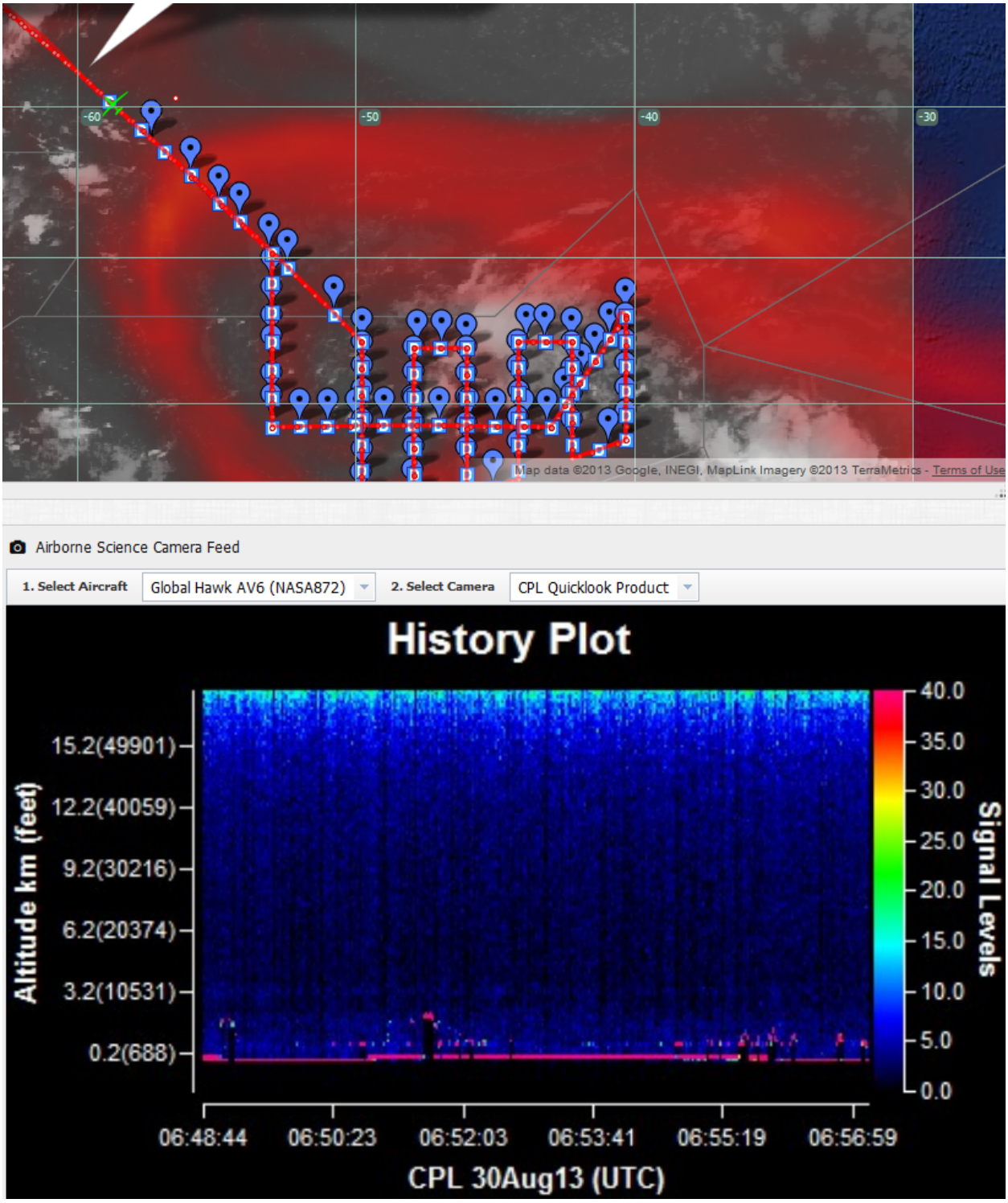
06:05:08
06:06:21
CPL 30Aug13 (UTC)

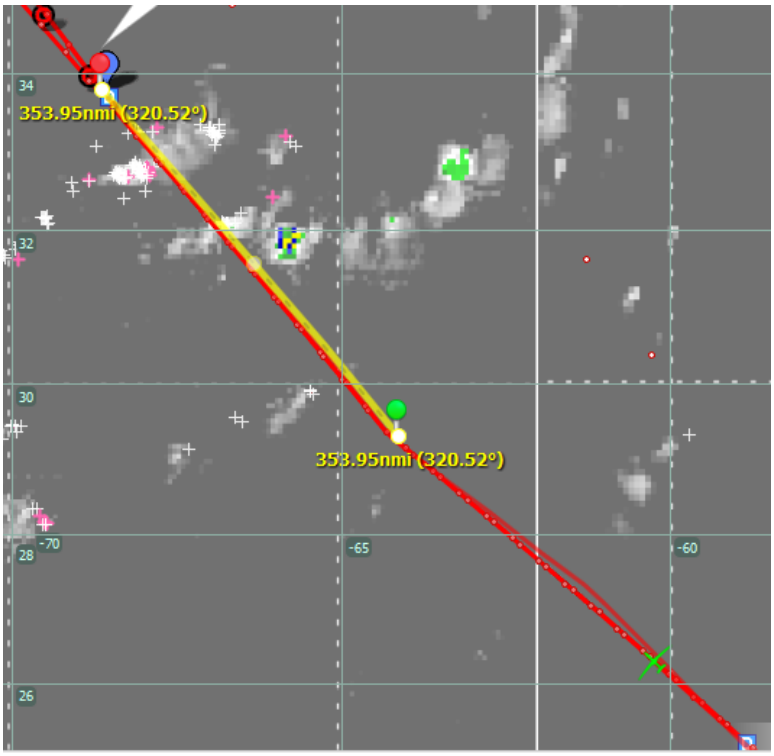


And leaving the dust behind, just before 0700 UTC:



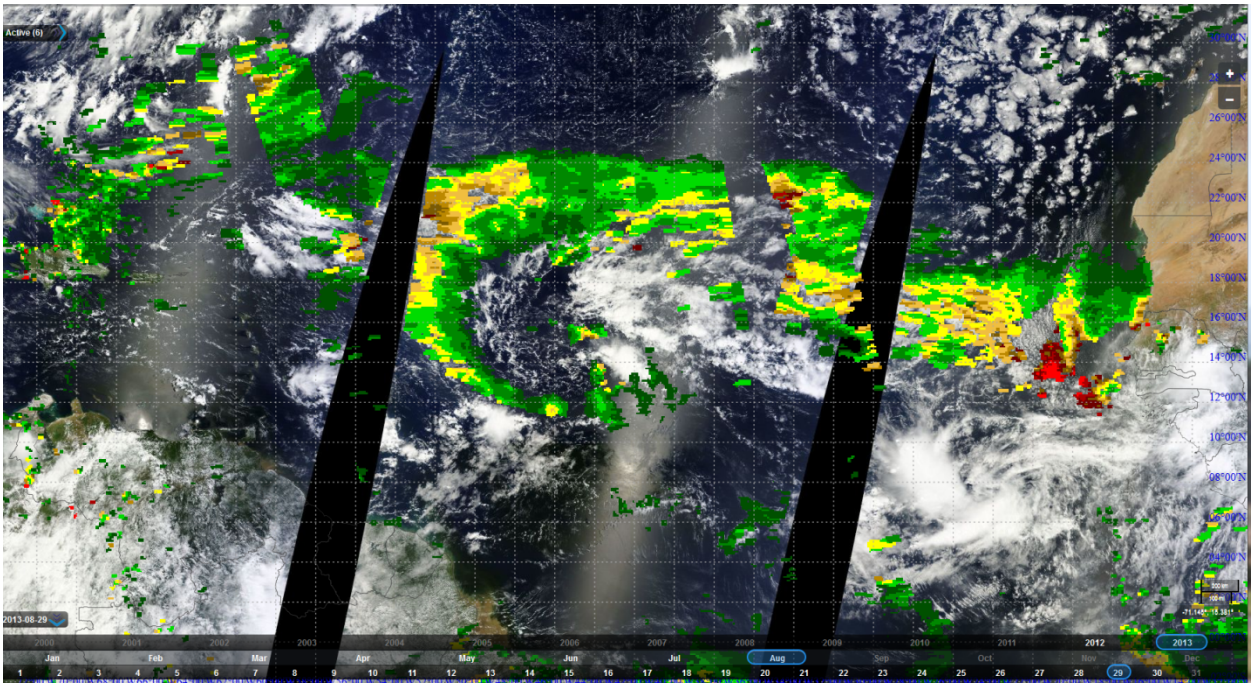
Dropsonde release *times* are noted below. The *locations are not necessarily correct*, coming from the original flight plan without modifications.

On the return to WFF, we are monitoring convection west of Bermuda. So far there is nothing we would have to divert around. Cloud tops slightly over 50 kft but without lightning in the area we should pass around 0830 UTC; more lightning (but not “too much”) but lower cloud tops in the region we should pass around 0850 UTC.



We are also monitoring landing weather outlook. Light rain approaching from SE PA; forecasters say it will not be a problem here (dissipating before arrival here).

0843 UTC we have been seeing several lightning flashes on the low-light camera, but associated with cloud tops below 50 kft. The USPLN lightning data also picked up to the left of the track (about 25 nmi) just as we were passing the most active cell. Accelerations topped out at about 1.25 g average; about 2 g would be a concern.



Above image shows MODIS AOD for Aug 29 showing the dusty air wrapping around the system to the west and into the system on the south side.

1006 Descending within W-386.

1018 Holding in Test-track C at 45 kft. Current air field conditions appear good.

1101 Beginning descent in Test-track C

1109 Level at 12 kft. Powering down instruments.

1134 AV-6 has landed.

Location	Time released	Comments	Time (UTC)	Elapsed	Lon.	Lat.
			hh mm.m	(hrs)		
D01	1448	Good data	. 14 51.0	1.87	W06832.611	N3341.844
D02	1721	Problem issuing launch command. A bit late but good.	. 17 15.8	4.28	W05742.194	N2415.312

D03	1740	Good	. 17 39.9	4.68	W05554.657	N2244.298
D04	1805	Good	. 18 3.9	5.08	W05409.498	N2112.112
D05	1830	Good	. 18 28.0	5.48	W05226.514	N1938.863
D06	1855	Good	. 18 52.0	5.88	W05045.516	N1804.656
D07	1911	Good, no wind (fast fall)	. 19 7.2	6.14	W04946.273	N1708.172
D08	1920	Good	. 19 16.9	6.3	W04946.273	N1614.598
D09	1928	Good	. 19 26.5	6.46	W04946.273	N1521.024
D10	1937	Good	. 19 36.0	6.62	W04946.273	N1427.450
D11	1949	Good	. 19 45.7	6.78	W04946.273	N1333.876
D12	2000	Good	. 19 55.3	6.94	W04946.273	N1240.296
D13	2009	Good	. 20 4.9	7.1	W04946.273	N1146.722
D14	2018	Good	. 20 14.5	7.26	W04946.273	N1053.148
D15	2044	Good	. 20 24.1	7.42	W04946.273	N0959.574
D16	2053	Good	. 20 35.5	7.61	W04946.273	N0906.000
D17	2102	Good	. 20 57.0	7.97	W04755.032	N0906.000
D18	2111	Good	. 21 6.4	8.12	W04755.032	N0958.134
D19	2120	Good	. 21 15.7	8.28	W04755.032	N1050.268
D20	2129	Good	. 21 25.0	8.43	W04755.032	N1142.402
D21	2139	Good	. 21 34.4	8.59	W04755.032	N1234.536
D22	2149	Good	. 21 43.7	8.75	W04755.032	N1326.664
D23	2200	Good	. 21 53.1	8.9	W04755.032	N1418.798
D24	2208	Good	. 22 2.4	9.06	W04755.032	N1510.932
D25	2217	Good	. 22 11.8	9.21	W04755.032	N1603.066

D26	2227	Good	. 22 22.9	9.4	W04755.032	N1655.200
D27	2237	Good	. 22 44.5	9.76	W04600.000	N1655.200
D28	2246	Good	. 22 53.8	9.91	W04600.000	N1603.066
D29	2305	Good	. 23 3.2	10.07	W04600.000	N1510.932
D30	2319	Good	. 23 12.5	10.23	W04600.000	N1418.798
D31	2327	Good	. 23 21.9	10.38	W04600.000	N1326.664
D32	2337	Good	. 23 31.2	10.54	W04600.000	N1234.536
D33	2346	Good	. 23 40.5	10.69	W04600.000	N1142.402
D34	2355	Good	. 23 49.9	10.85	W04600.000	N1050.268
D35	0007	Good	. 23 59.2	11	W04600.000	N0958.134
D36	0014	Good	. 00 10.4	11.19	W04600.000	N0906.000
D37	0026	Good	. 00 31.9	11.55	W04408.760	N0906.000
D38	0034	Good	. 00 41.5	11.71	W04408.760	N0959.574
D39	0044	Good	. 00 51.1	11.87	W04408.760	N1053.148
D40	0053	Good	. 01 0.7	12.03	W04408.760	N1146.722
D41	0102	Good	. 01 10.3	12.19	W04408.760	N1240.296
D42	0121	Good	. 01 19.9	12.35	W04408.760	N1333.876
D43	0129	Good	. 01 29.5	12.51	W04408.760	N1427.450
D44	0137	Good	. 01 39.1	12.67	W04408.760	N1521.024
D45	0146	Good	. 01 48.7	12.83	W04408.760	N1614.598
D46	0155	Good	. 02 0.2	13.02	W04408.760	N1708.172
D47	0204	Good	. 02 21.7	13.38	W04213.722	N1708.172
D48	0213	Good	. 02 31.3	13.54	W04213.722	N1614.598
D49	0226	Good	. 02 40.9	13.7		

					W04213.722	N1521.024
D50	0235	Good	. 02 50.5	13.86	W04213.722	N1427.450
D51	0244	Good	. 03 0.1	14.02	W04213.722	N1333.876
D52	0255	Good	. 03 9.7	14.18	W04213.722	N1240.296
D53	0304	Good	. 03 19.3	14.34	W04213.722	N1146.722
D54	0313	Good_	. 03 28.9	14.5	W04213.722	N1053.148
D55	0323	Good	. 03 38.5	14.66	W04213.722	N0959.574
D56	0332	Good	. 03 51.0	14.87	W04213.722	N0906.000
D57	0342	Good	. 04 0.5	15.03	W04244.789	N0948.990
D58	0352	Good	. 04 10.0	15.18	W04315.996	N1031.938
D59	0402	Good thermo, no winds (fast fall)	. 04 19.4	15.34	W04347.346	N1114.832
D60	0412	Good	. 04 28.9	15.5	W04418.845	N1157.672
D61	0422	Good	. 04 38.3	15.66	W04450.513	N1240.452
D62	0431	Good	. 04 47.8	15.81	W04522.363	N1323.166
D63	0443	Good	. 04 57.3	15.97	W04554.402	N1405.820
D64	0451	Good	. 05 6.8	16.13	W04626.640	N1448.396
D65	0505	Good, but late due to nasdat	. 05 16.2	16.29	W04659.088	N1530.906
D66	0512	Good	. 05 25.7	16.44	W04731.758	N1613.326
D67	0523	Good_	. 05 35.1	16.6	W04804.667	N1655.668
D68	0533	Good	. 05 44.6	16.76	W04837.824	N1737.920
D69	0545	Good	. 06 17.6	17.31	W05035.427	N2004.427
D70	0609	Good	. 06 43.8	17.75	W05211.492	N2159.916
D71	0634	Good, no	. 07 10.0	18.18		

		wind (fast fall)			W05350.186	N2354.446
D72	0659	Good	. 07 30.4	18.52	W05508.807	N2522.608

Instrument reports:

CPL

CPL performed nominally during the 29-30 Aug13 Science flight. Laser energies, laser 532 signal strength, and temperatures were all very good. We did sense the SAL dust layer on multiple occasions.

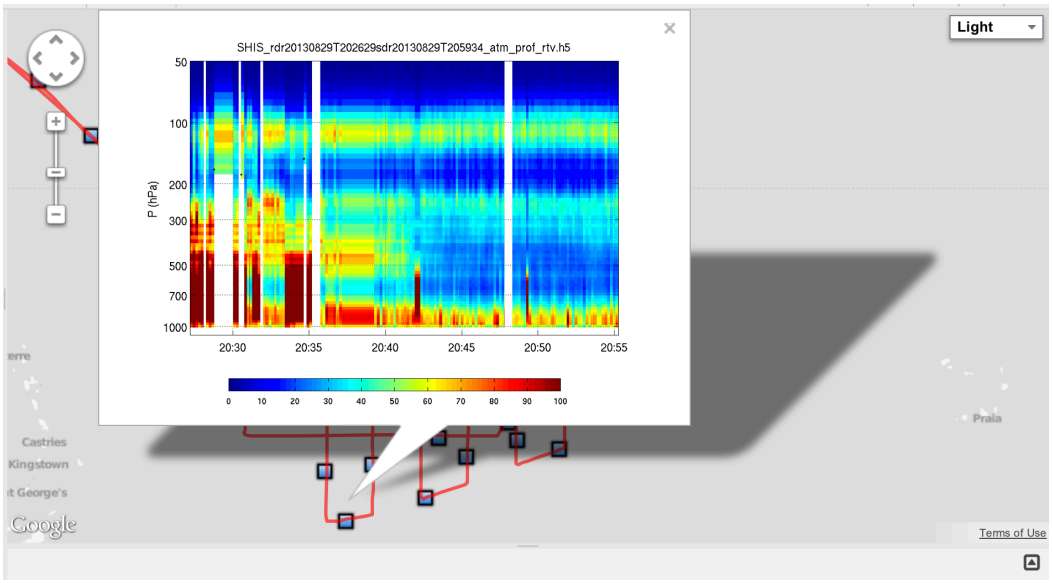
S-HIS

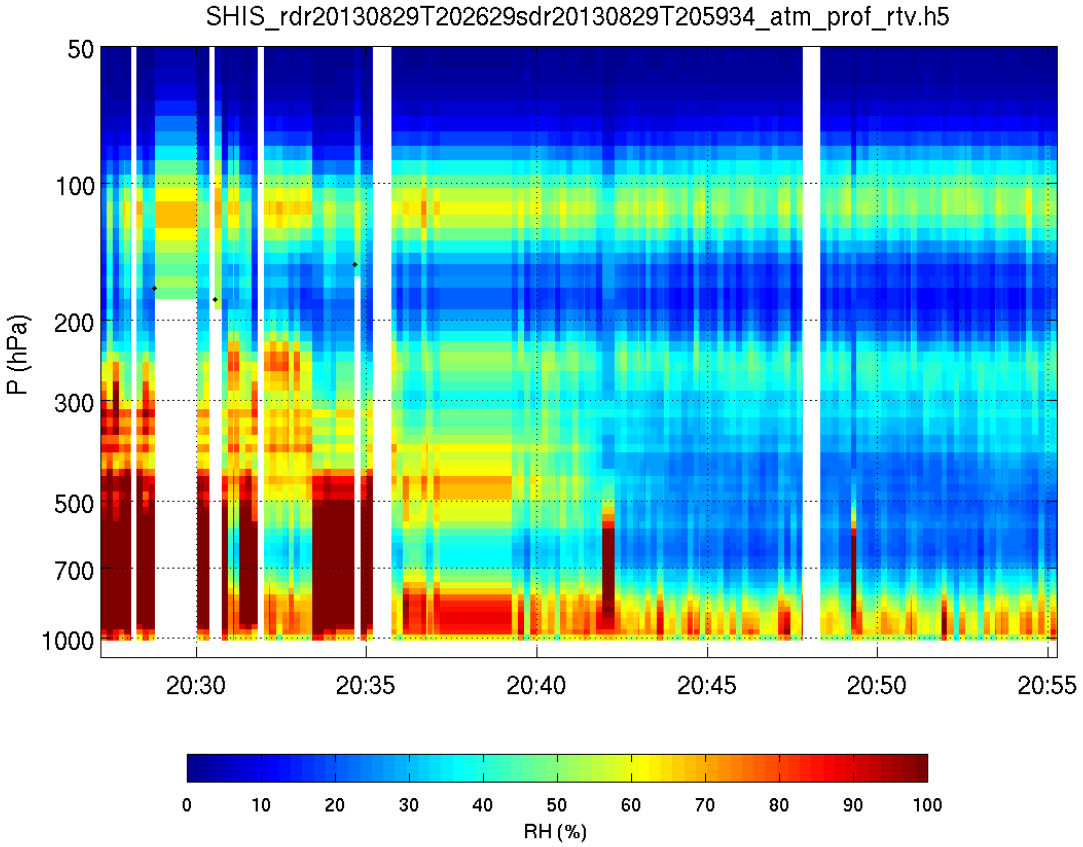
Ku lost in southernmost portion of first lawnmower flight leg however complete S-HIS data will be available in post-processed products.

The first and second legs of the lawnmower pattern provided an excellent opportunity for clear sky validation of the S-HIS dual regression (DR) and physical (UWPHYSRET) retrievals.

An anomalous S-HIS detector temperature rise was experienced on this flight (77 K gradually increased to 84 K). While the detectors were operational for the full flight, slightly reduced SNR for the tail end of the flight is expected given the change in detector temperature and preliminary analysis of the responsivity time series. The impact on the quality of the science data for the flight should be negligible, but we need review the processed data in further detail as soon as it's available to confirm this conclusion. We will be carefully monitoring detector cooler performance for further degradation.

S-HIS Retrieval: RH time-height cross-section Quicklook Example from MTS (Near line 30 minute summary, 1 hour latency)





S-HIS Retrieval: RH time-height cross-section Quicklook Example from MTS (Near line 30 minute summary, 1 hour latency)

AVAPS

AVAPS continued to perform well on the flight beginning August 29. All 72 of 72 sondes requested by mission science were successfully deployed. A total of 77 sondes had been loaded, so the aircraft returned with 5 sondes. We experienced 3 fast falls and a couple of additional sondes failed to report valid data all the way to the surface. This, however, did not appear to be representative of any broader or systematic problem, and telemetry quality again appeared to be good throughout the flight. Data was all worked up in near-real-time and again was transmitted through the GTS. We experienced some minor issues in the timing of drops during Iridium outages due to the lack of our status packets arriving over Ku. The IT group worked with us during the return portion to try and determine the source of the problem. This is something we would like to see resolved over the course of the campaign. Barring any unforeseen problems identified in postflight, AVAPS should remain ready for the next desired AV-6 flight.

Sondes Dropped

Qty	Date	Flight
6	8-01-13	Range Flight
15	8-20-13	RF01
54	8-24-13	RF02
72	8-29-13	RF03

147 Total Deployed as of 8-30-2013

As of 8-30-2013
Total Sondes available 403 (550-147=403)