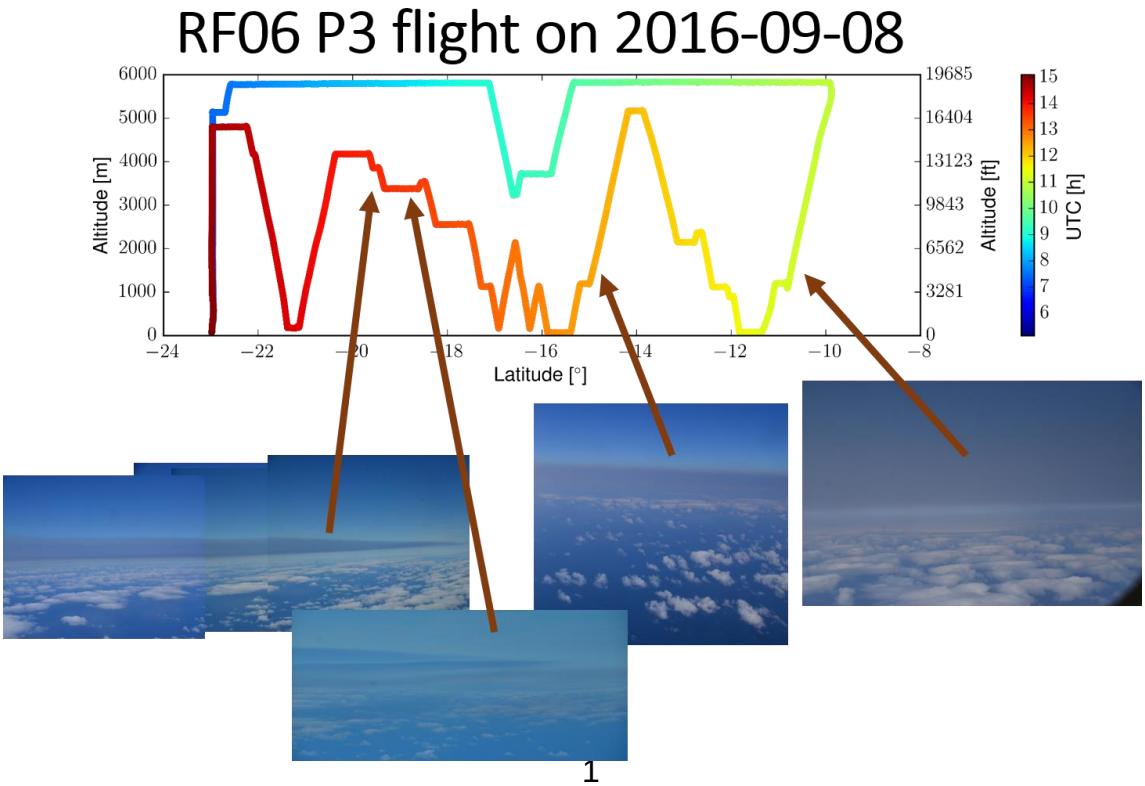
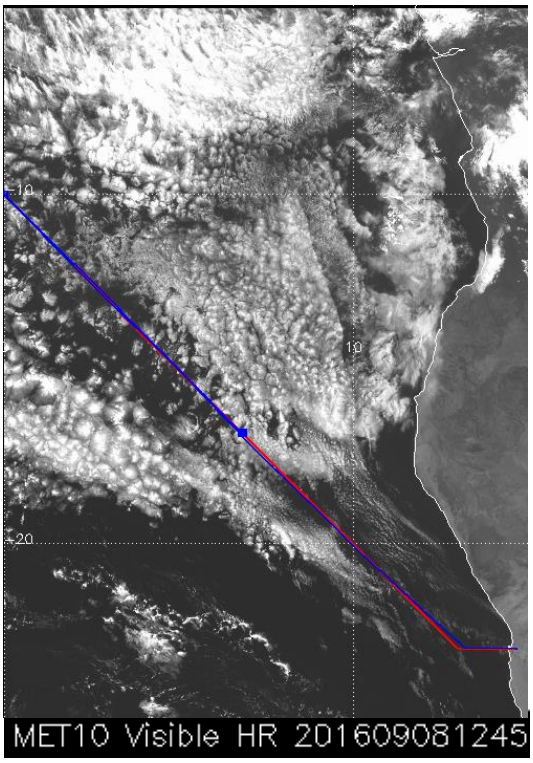
RF06 September 8 Thursday **Mission Report**

flight scientist: Samuel LeBlanc, Sarah Doherty (2nd flight scientist)
mission scientist: Jens Redemann

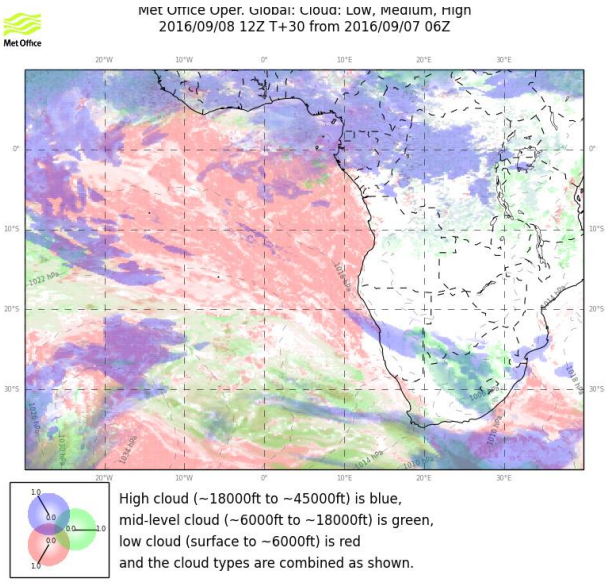
Flight plan and objective:
Routine plan along the diagonal from WVB. Plan is to reach 10°S first with a single profile out midway, then on return do multiple profiles, planned for 2 profiles with steps going back up. Main objective is to quantify discrepancy in amount and vertical location of aerosol plumes between WRF and GEOS. WRF predicted aerosols from 2km-4km near 10S, while that aerosol was not present in GEOS.

Flight Summary:
Got to 10°S and profiled down. Succeeded in doing 3 profiles 2 with stair steps up and one with small sawtooth, see latitudinal cross section of the flight below. On the way out, dipped lower to evaluate the altitude of the plume, did not see a high amount there. The last profile on the way back, with no steps or sawtooth was surprisingly clear. We were well out of the aerosol layer, in fact we were able to see the edge of the layer to the north east of the plane. The edge of the layer seemed to taper off to a point, with multiple layers stacked on top of each other. The focus of this flight was to prove or disprove different aerosol model. There were aerosols at 2 km-4 km at 10°S like WRF predicted the day before, and GEOS predicted the day of, but with higher AODs than predicted. The aerosol layers were more complicated than modelled, with multiple layers of aerosol, some were not mixing, some were (especially near the far end). There were clear slot between aerosol layers, with different aerosol composition of the different layers. At least 3 layers, plus below cloud layers at about 25-50% less aerosol content. Max AOD ~0.4. Some cloud work but mostly over scattered and few cloud areas. In the last profile coming back, we saw the cleanest air measured yet, low CO, low aerosol concentration, low AOD near sea surface.

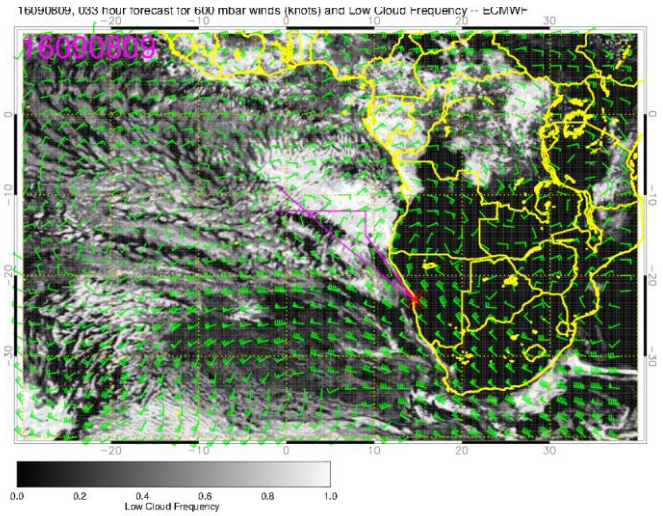


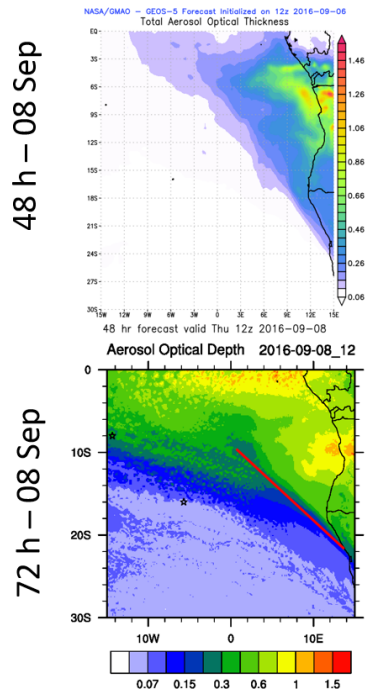


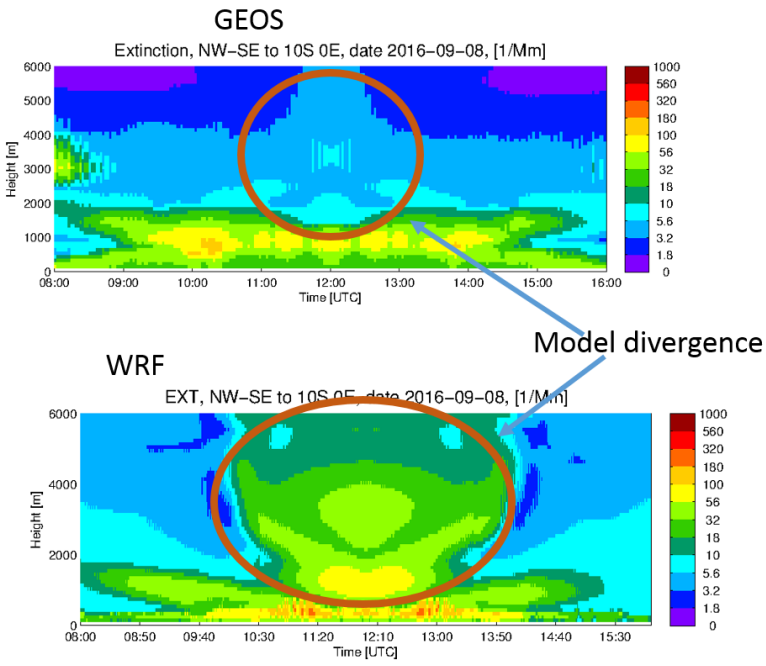
Forecast:
Clouds: Some high level clouds at the southern part of the flight track, seen in both ECMWF and UKMO with thinning of low level cloud towards the northern end.
Aerosols: WRF showing aerosol plume going further west and south, and in response entering the routine flight track near 10°S, as compared to GEOS aerosol forecast. This puts an aerosol layer at 2-4 km in the WRF curtain along the routine track, whereas, no such aerosol layer is present in GEOS.



High cloud (~18000ft to ~45000ft) is blue,
mid-level cloud (~6000ft to ~18000ft) is green,
low cloud (surface to ~6000ft) is red
and the cloud types are combined as shown.







Notes from flight:
manifest (full flight)
crew (5): Michael Singer [co-pilot]/Mark Russell [pilot in charge]/Brian Yates/Todd Brophy/Mike Terrell
science (19): Samuel LeBlanc [flight scientist]/Steffan Freitag/Nikolai Smirnow/Amie Dobracki [HiGear]/Jacek Chowdhary [RSP]]/Eric Stith [Data]/Jim Podolske [COMA] David Simmons [AMPR]/Art Sedlacek [PTI]/Siddhant Gupta [cloud probes]/Warren Gore/Sabrina Cochrane

[SSFR]/Yohei Shinozuka [4STAR]/Elin Mcilhatten/Ousmane Sy/Andrew Dzambo/Greg Sadowy [APR3] /Mary Kacarab [CCN]/Sarah Doherty [2nd flight Scientist]
ground mission scientist: Jens Redemann

Instrument status:
Almost all instruments worked well. Failure in WISPER's vacuum causing no good data for the flight. The start of the flight had some problems with HiGEAR's SP2. Some issues in GPS signal for the data system. RSP had similar problems than before with rotating mechanism and scans not linked up. AMS recorded interesting organic to nitrate ratios that varied between the different layers.

Run Table [UTC]
green-success likely red-success uncertain

Run #	Start time	End time	Alt [kft]	Short title	Notes	SO
1	07:05	07:28	0-16	Take off and climb to alt	Started	
2	7:28	9:08	16-18	Transit at altitude	Initially at 16kft, 18kft	SO2-3 SO3-3
3	9:08	9:35	10-15	Descend to sniff aerosol layer	Peak at 11.5 kft, 600/cc black carbon, aod of layer ~0.03, flew below layer most of the upper layer at 10kft, then in it at the 11.5kft., clouds below thinning and mostly clear.	SO1-1 SO2-1 SO1-3
4	9:35	10:48	18	Transit to 10°S		SO2-3 SO3-3
5	10:48	11:27	18-0.2	Descent at 10°S	Multiple aerosol layers present, top most juicy, with diffuse top, 13.1 -12 kft, Distinct hole between layers at 10.1kft, second 8.8 kft to cloud top. Aod at cloud top 0.3,	SO1-1 SO1-2 SO1-3 SO2-1 SO2-2 SO3-1
6	11:27	11:45	0-3.7	Low level work at 10° S	Above cloud leg, little cloud sampling below cloud 10 min. 25% of black carbon than above. Some sampling leg above cloud.	SO1-1 SO1-3 SO2-1 SO2-2 SO2-3 SO3-1 SO3-2
7	11:45	12:00	3.7-13	Stepped ascent	Aerosol layer peaked at 6.8 kft, in between layers at 8.3 kft, top at 13.7 kft	SO1-1 SO1-2 SO1-3 SO2-1 SO2-2

						SO2-3 SO3-1 SO3-2
8	12:15	12:27	13-3.9	Descent again	Descent over scattered clouds, Aerosol layer separation at 8.8kft, some decrease in aerosol concentration at 5.8kft, Seperation between aerosol layer and top of clouds.	SO1-1 SO1-2 SO1-3 SO2-1 SO2-2 SO3-1
9	12:27	12:36	3.7 – 0.2	Lower level leg in boundary layer+clouds	Descent below clouds and boundary layer, ~40/cc black carbon counts, likely processed pollution	SO1-1 SO1-3 SO3-1 SO3-2
10	12:36	13:11	0.2-8	Sawtooth for clouds+aerosol layers	2 sets of ascents and descents through clouds (few) and lowest aerosol layer above boundary layer. Black carbon at 200/cc in layer above clouds. Clouds from 2.8 to 3.3 kft	SO1-1 SO1-3 SO2-1 SO2-3 SO3-1 SO3-2
11	13:11	13:27	0.2-8	Stair step up	Larger spaces between clouds, max aerosol loading at 8kft, no gap between aerosol layers, but chemically different aerosols	SO1-1 SO1-2 SO1-3 SO2-1 SO2-2 SO2-3 SO3-1 SO3-2
12	13:27	13:43	8-12	Mid level	Within the top of the aerosol layer	SO1-1 SO1-3
13	13:43	13:59	12-14	Level at high alt	Going into clean area, only slight possible residual layer, seeing the aerosol layer edge to the left of the plane	SO1-1 SO1-3
14	13:59	14:40	14-0.2-16	Profile down and back up	Some cirrus, very low AOD, similar sulfate levels	SO1-1 SO1-2 SO1-3 SO2-1 SO2-2 SO3-1
15	14:40	15:01	16-0	Transit back+landing	Clear	

Progress towards Science Objectives: expectation-based estimates need further analysis green-success likely red-success uncertain

Direct Forcing

SO1-1 evolution of BBA properties with transport:	~ 4 hours
SO1-2 spectral radiative fluxes	~ 2 hours
SO1-3 factors that control seasonal variation of aerosol	~ 4 hours

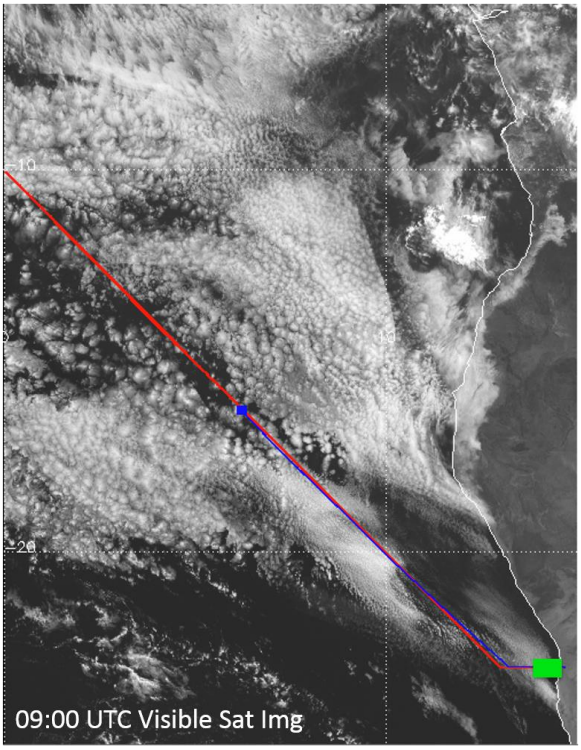
Semi-Direct Effect

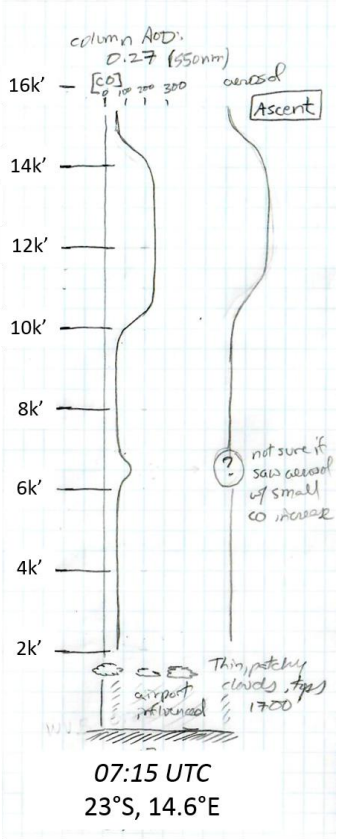
SO2-1 relative aerosol-cloud vertical structure	~3.4 hours
SO2-2 constrain aerosol heating rates	~2.3 hours
SO2-3 cloud microphysics	~4.3 hours

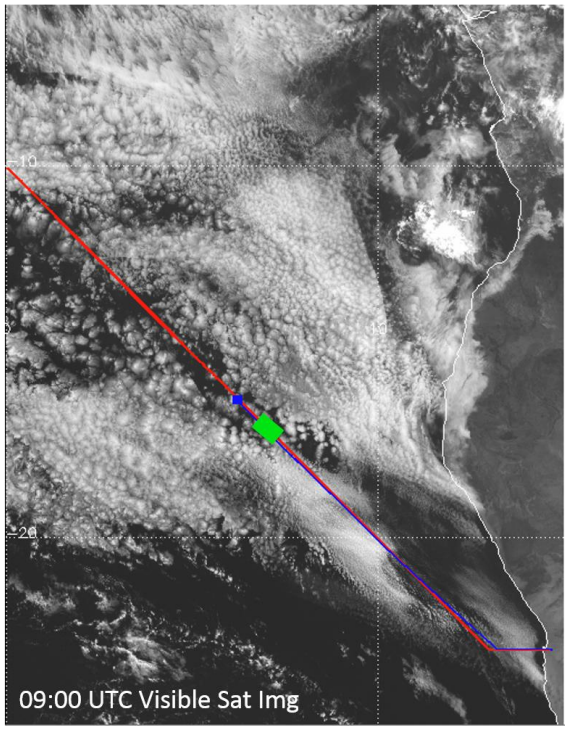
Indirect Effects

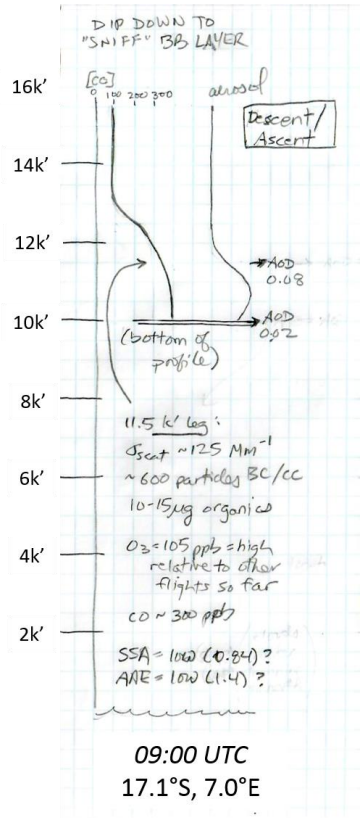
SO3-1 aerosol-BL mixing	~3 hour
SO3-2 aerosol-BLcloud microphysics	~1.5 hour
SO3-3 precipitation susceptibility	~2.9 hour

Preliminary analysis of profiles (from Sarah Doherty):

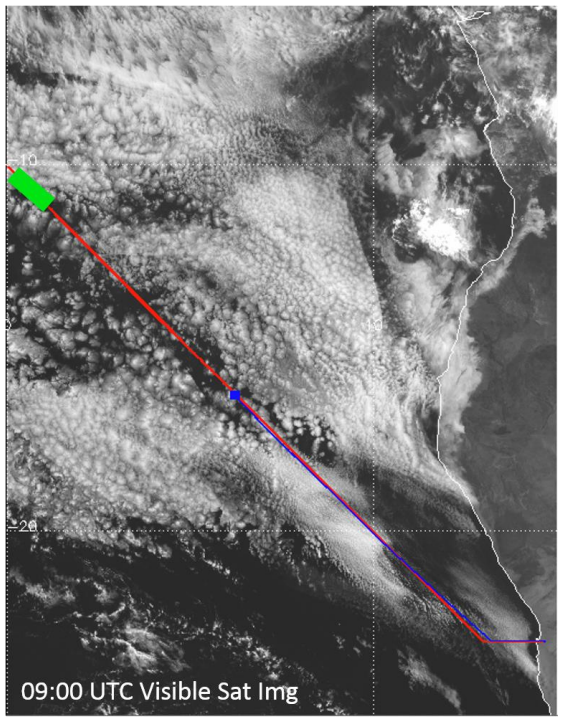


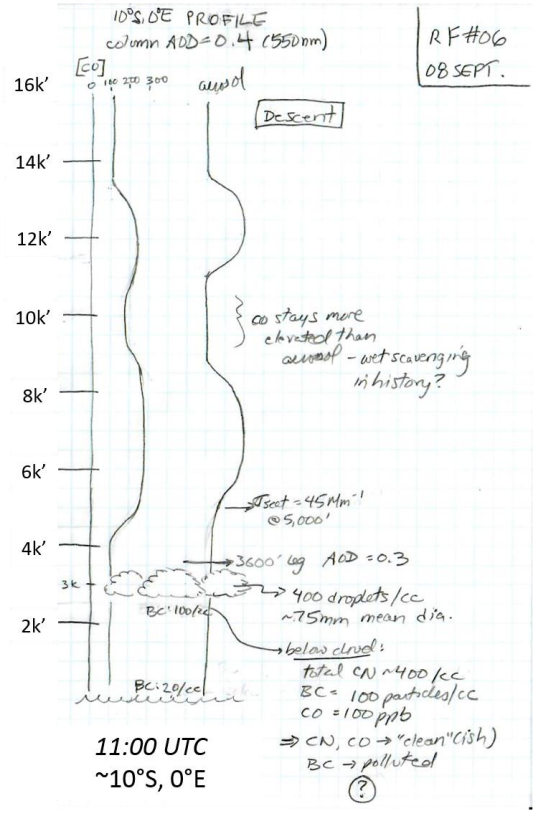




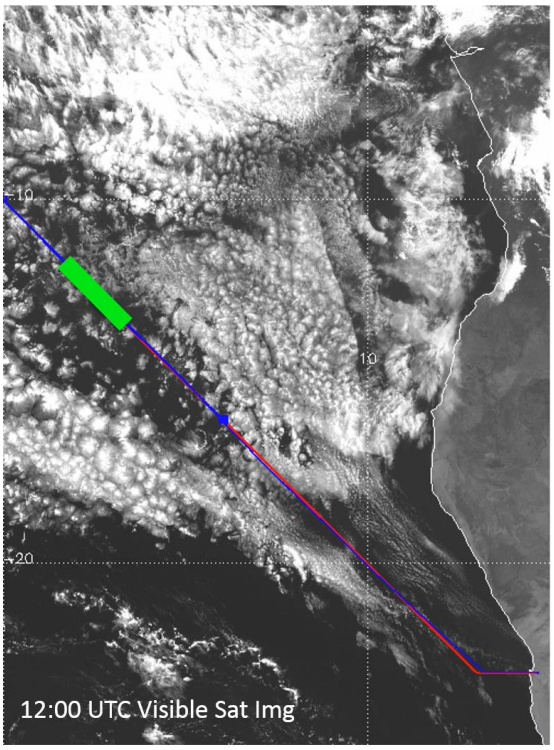


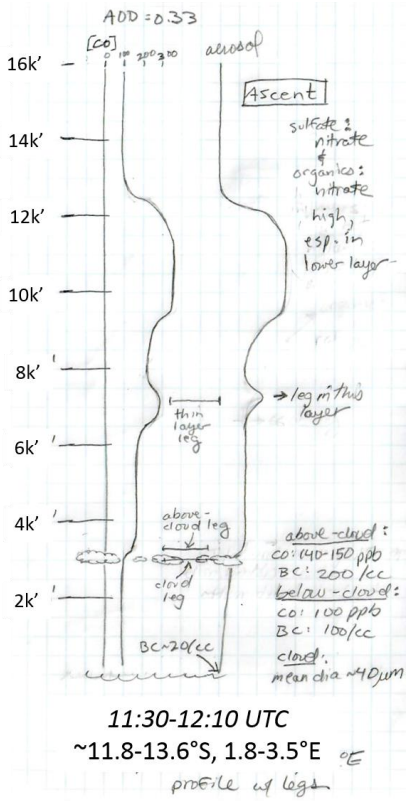
09:00 UTC
17.1°S, 7.0°E



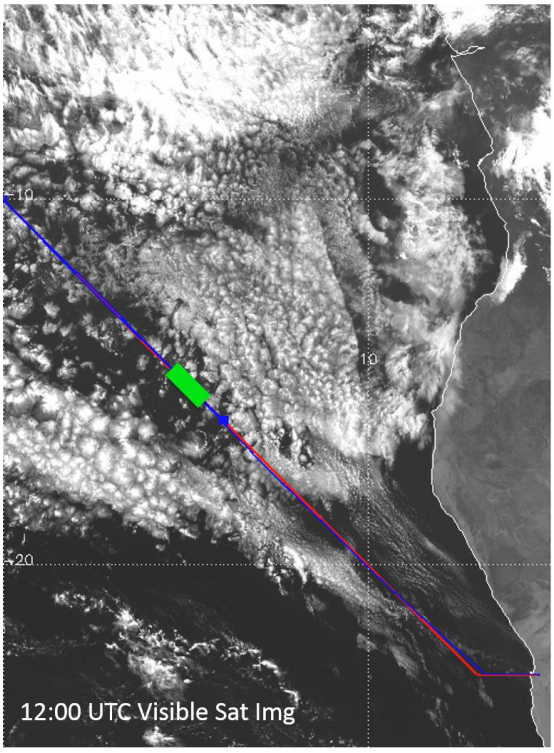


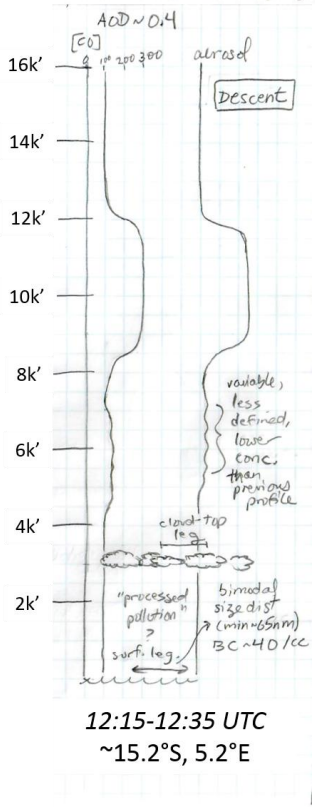
11:00 UTC
~10°S, 0°E



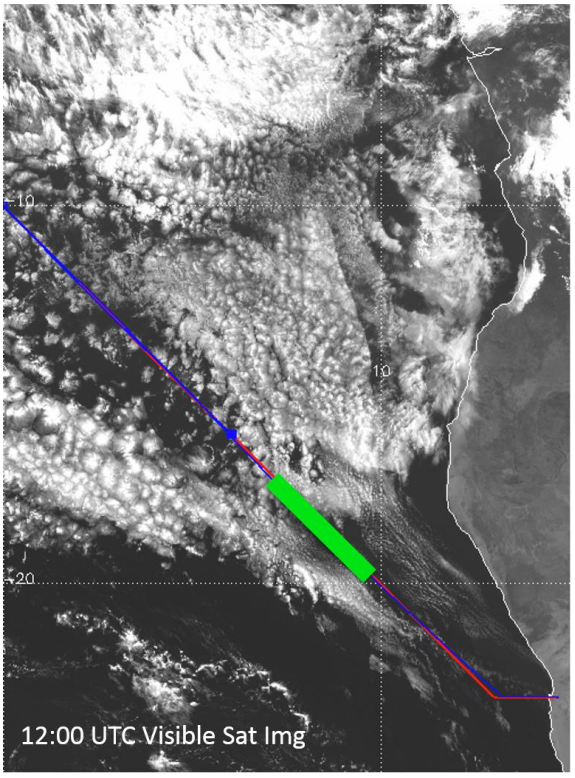


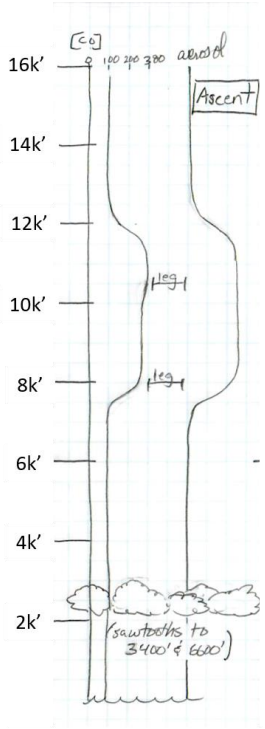
11:30-12:10 UTC
~11.8-13.6°S, 1.8-3.5°E



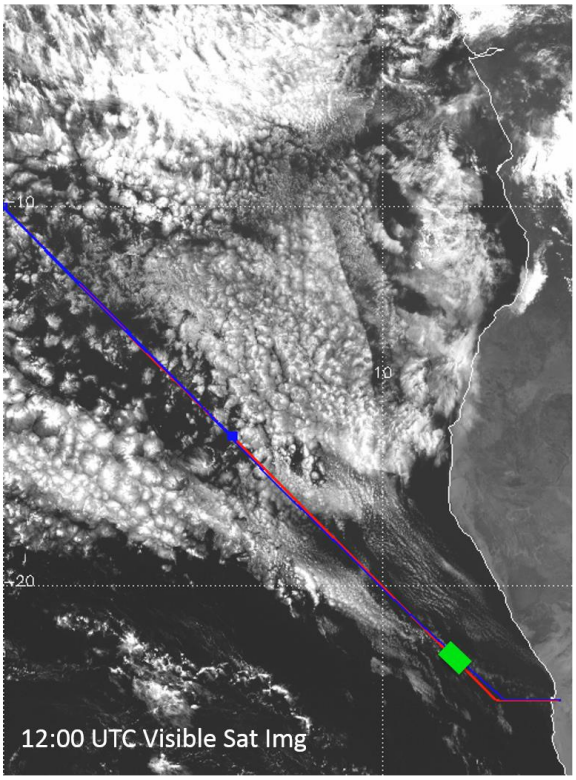


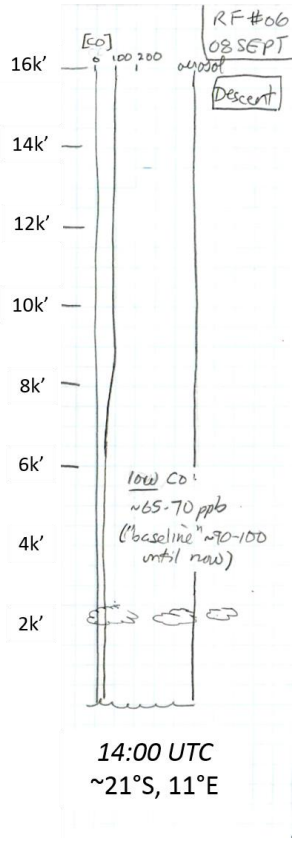
12:15-12:35 UTC
~15.2°S, 5.2°E





13:00-13:45 UTC
~17-20°S, 7-9.5°E

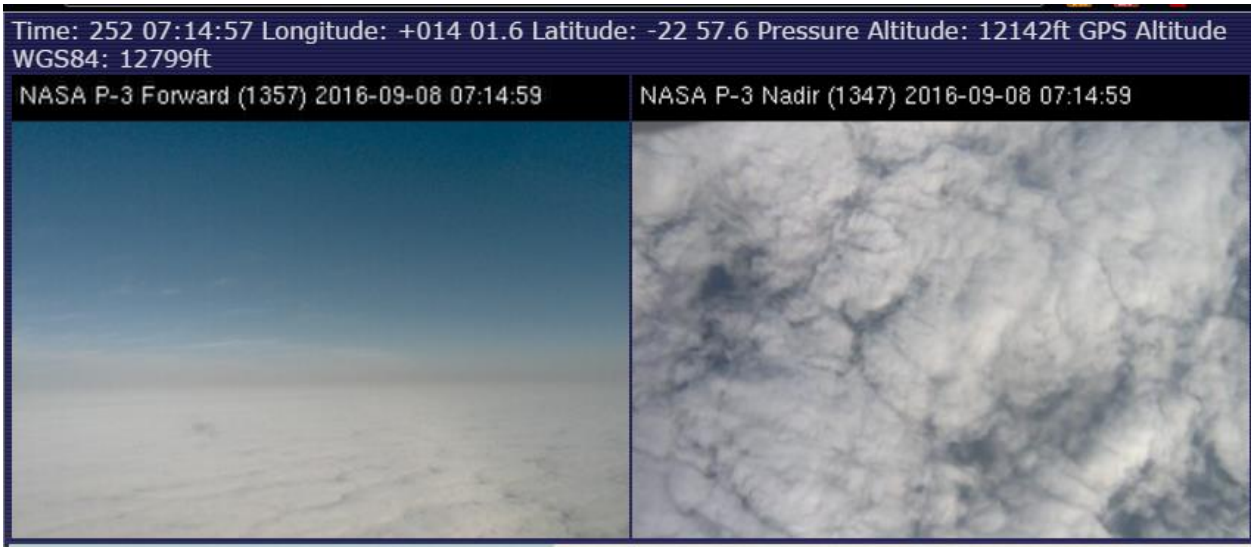




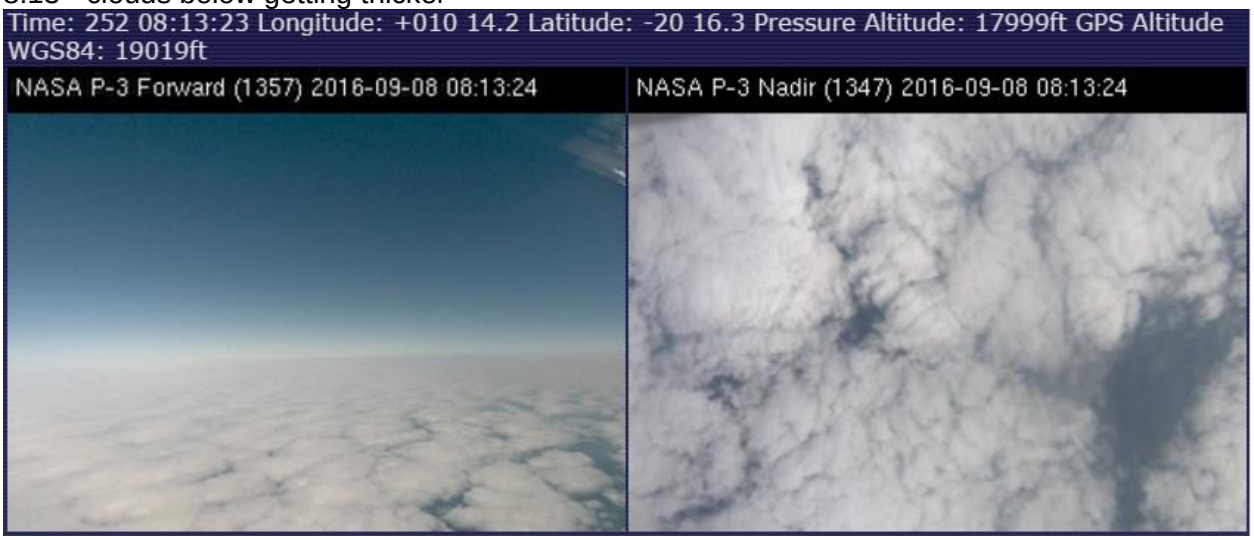
14:00 UTC
~21°S, 11°E

Detailed log:

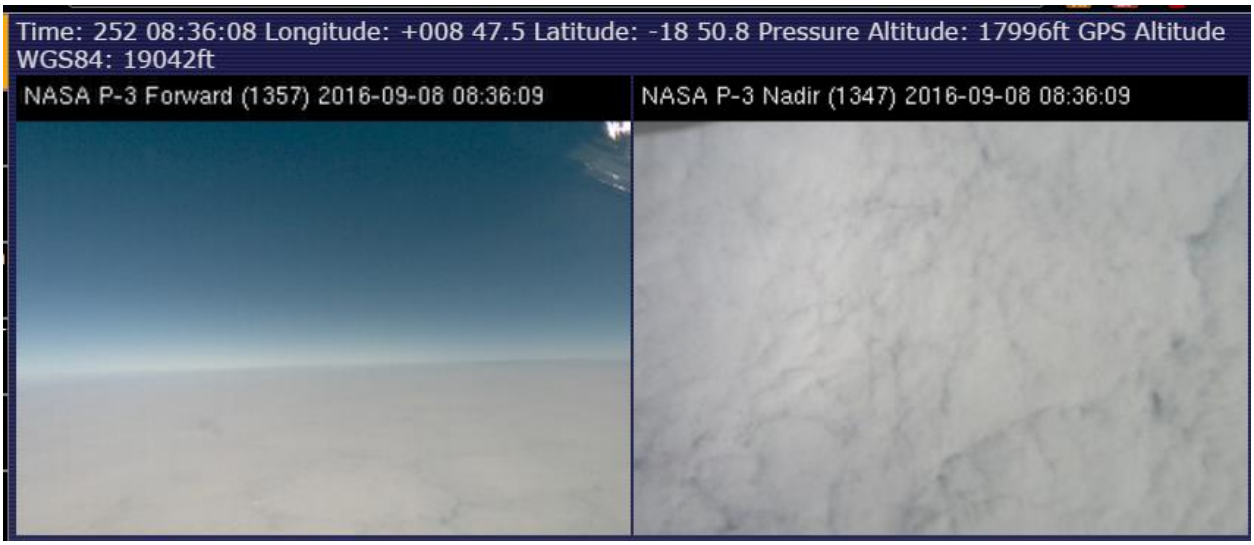
6:50 - clouds scattered ove>1000ft
6:55 - power transfer
6:59 - taxi start
7:02 - ‘climb above the scud layer’ - Mark Russell
7:05:08 - take off
7:06 - climbed through clouds at 2500ft
7:09 - some cirrus to the left, there seems to be a gap between cloud and aerosol layer
7:12 - 10kft elevated CCN counts.



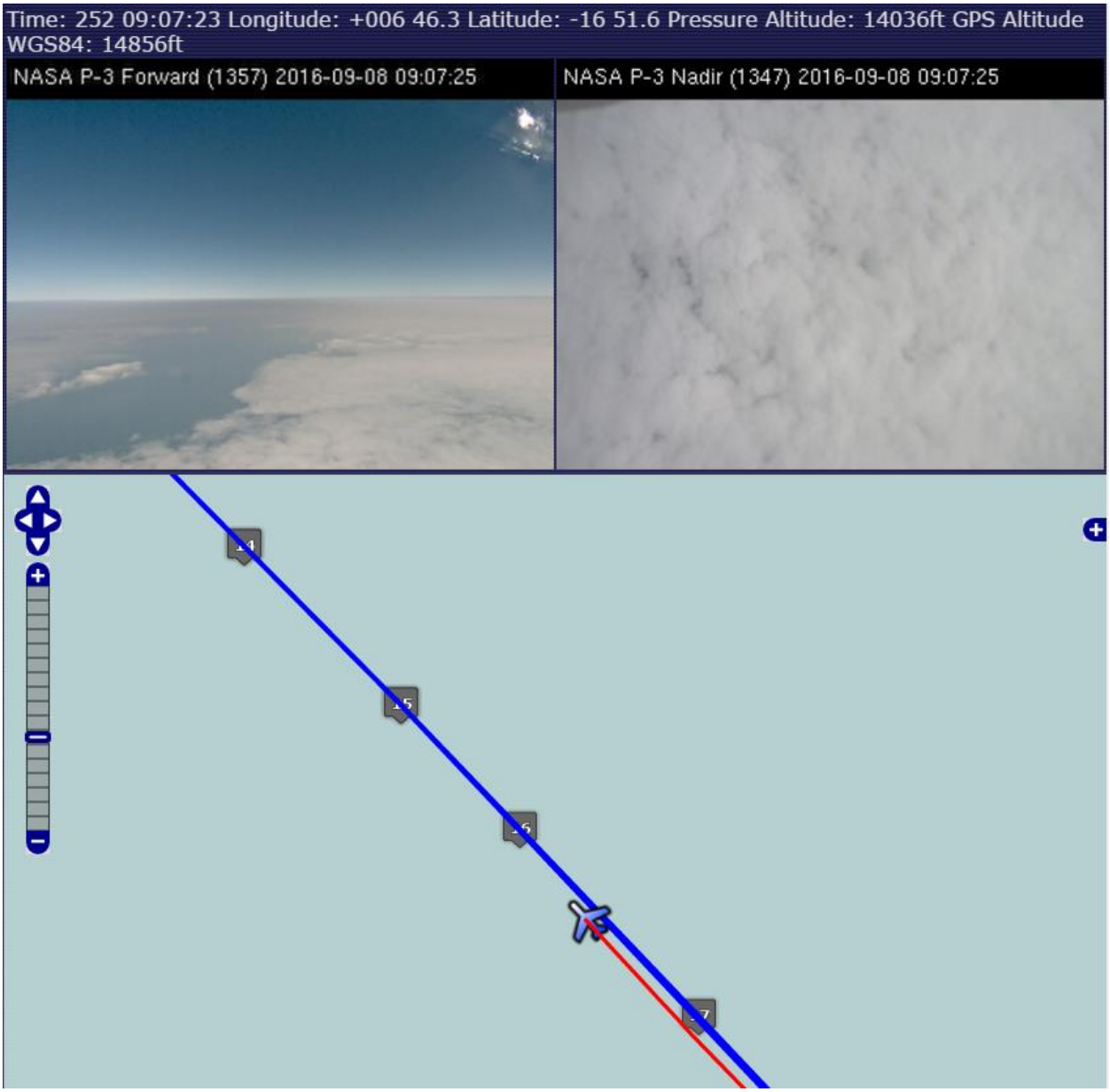
7:17 - 14.2 kft drastic dip in CCN, dip n CO at 14.9kft
7:28 - turned north.
7:31 - increasing altitude to get faster interesting
8:13 - clouds below getting thicker



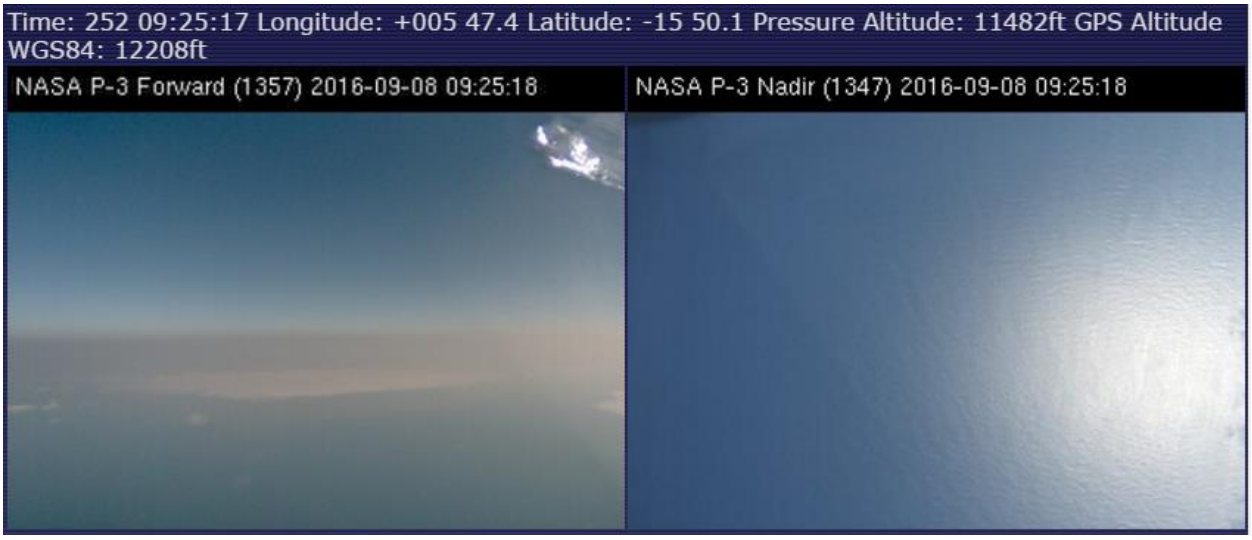
8:19 - APR seeing some thin band in W, not much aod above, from COMA, estimate is that airmass is an area that was influenced by biomass burning, but no aerosol from insitu
8:20 - some issues with data server. Chat down.



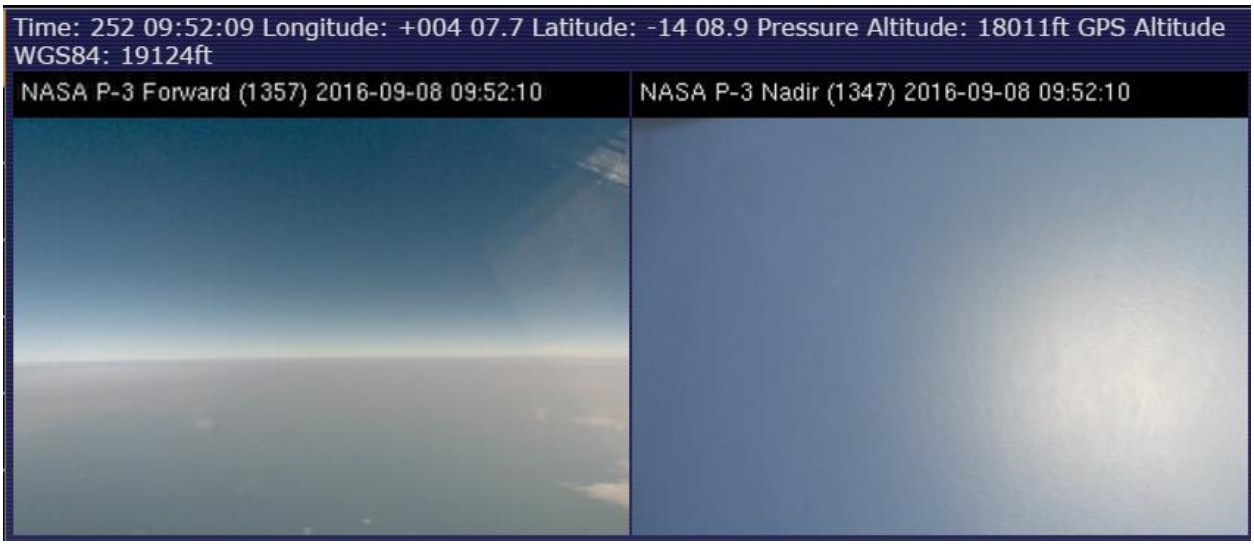
8:38 - questions about exhaust vent, water isotopes has disconnected pumps. Cabin air leak to exhuast?
8:53 - cloud transitionning to slightly more open cell.
9:03 - descending to 10kft, CO_2 dropping as we descend. 16kft, background air
9:06 - APR seeing some precip under



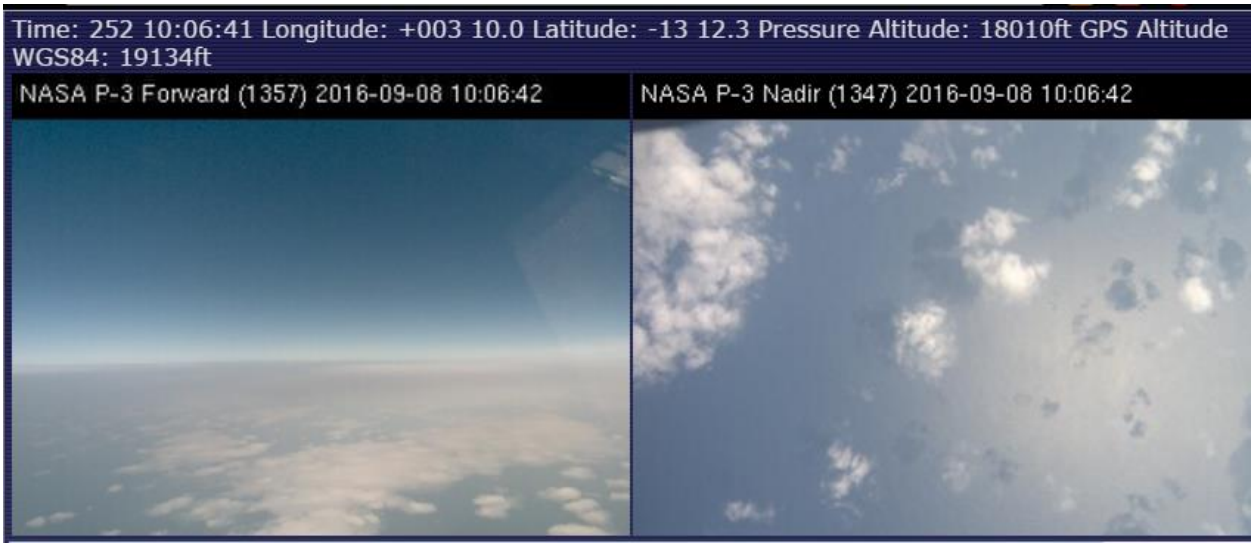
9:09 - little bump, got through top of layer, 12.6 kft, slow rising. Scattering 40 Mm^-1, diffuse top. Well mixed region according to gas. Peak at 11.5kft, decreasing as we go below.
9:14 - Went back up to 10kft, 600/cc black carbon particles at 11.5kft.
9:16 - 10 minute leg, ozone at 105. Aod of layer is likely about 0.04
9:21 - bimodal distribution.
9:23 - some larger aerosol particles



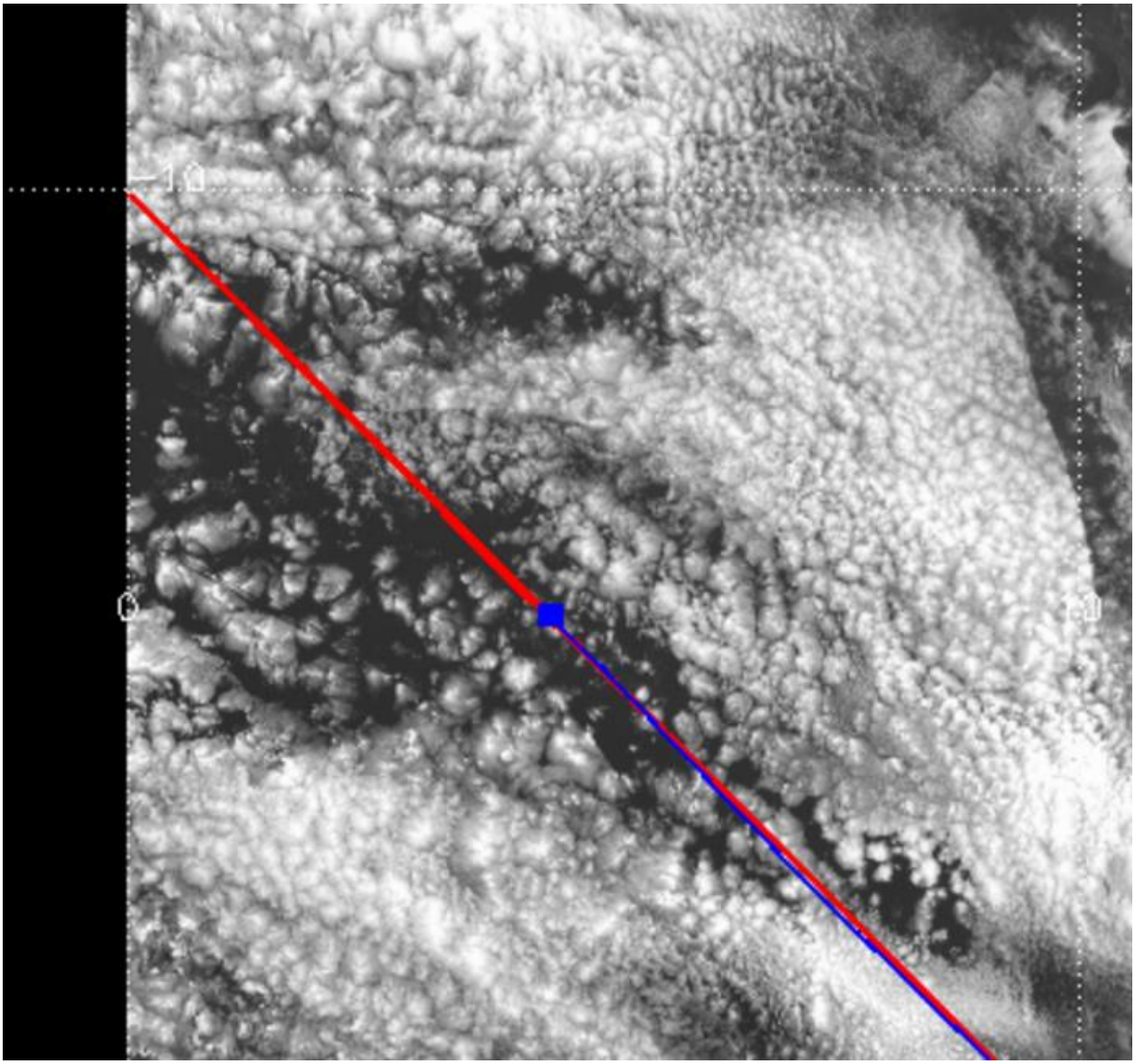
9:26 - 13 kft, drop off in AMS.
9:35 - level at 18kft
9:46 - low aerosol values



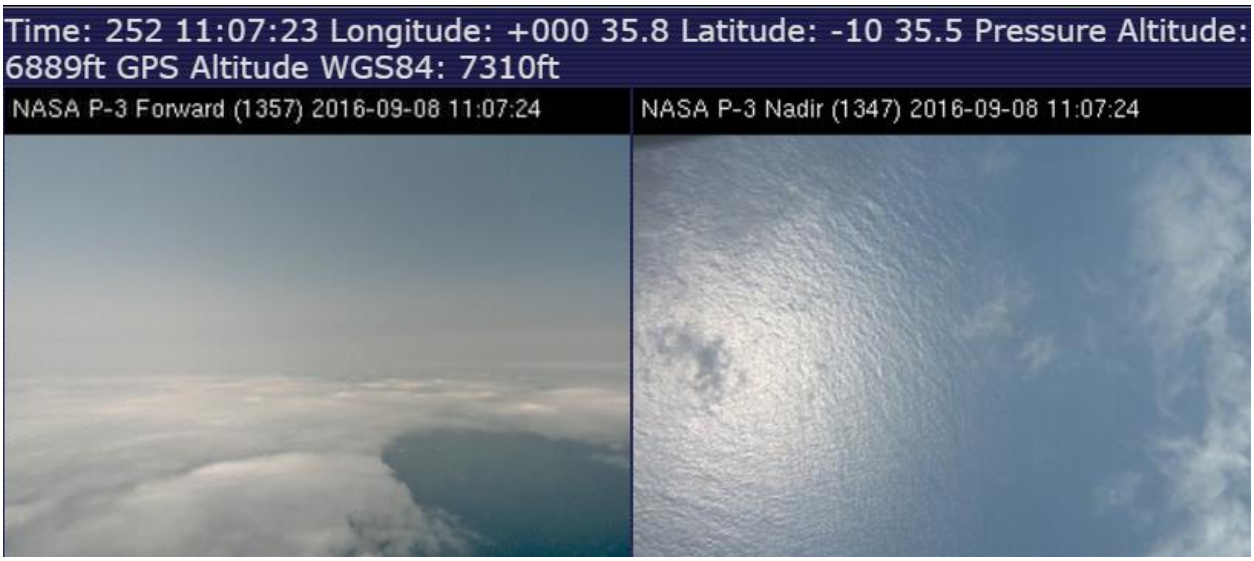
10:06 - some cumulus below ust starting.



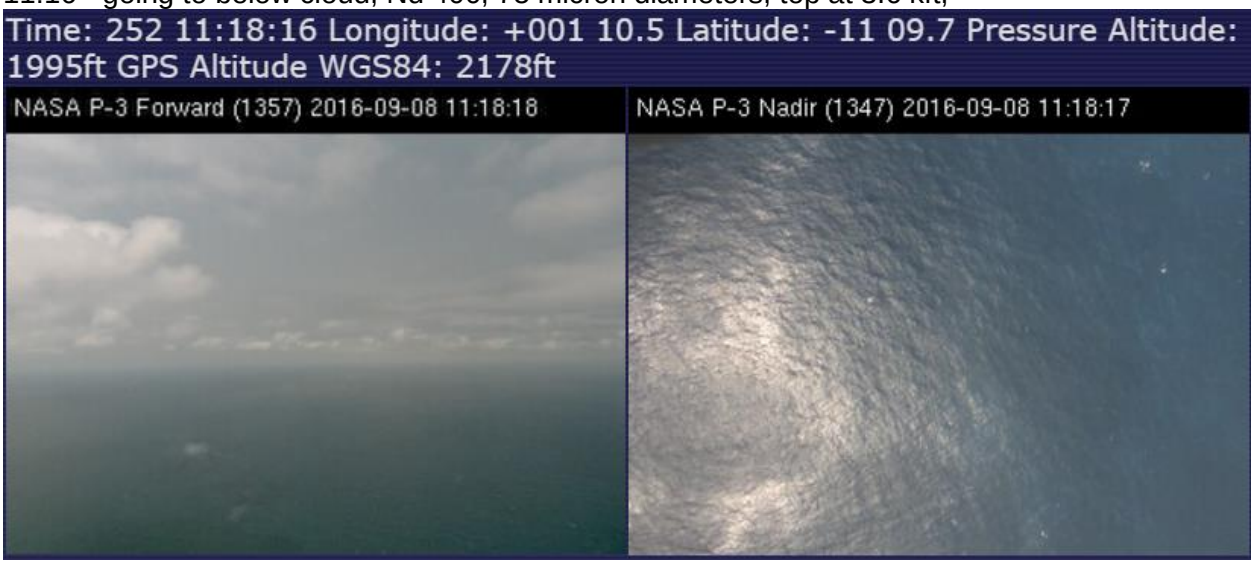
10:27 - still high alt, near 2 aod, cloud thickening.below us.



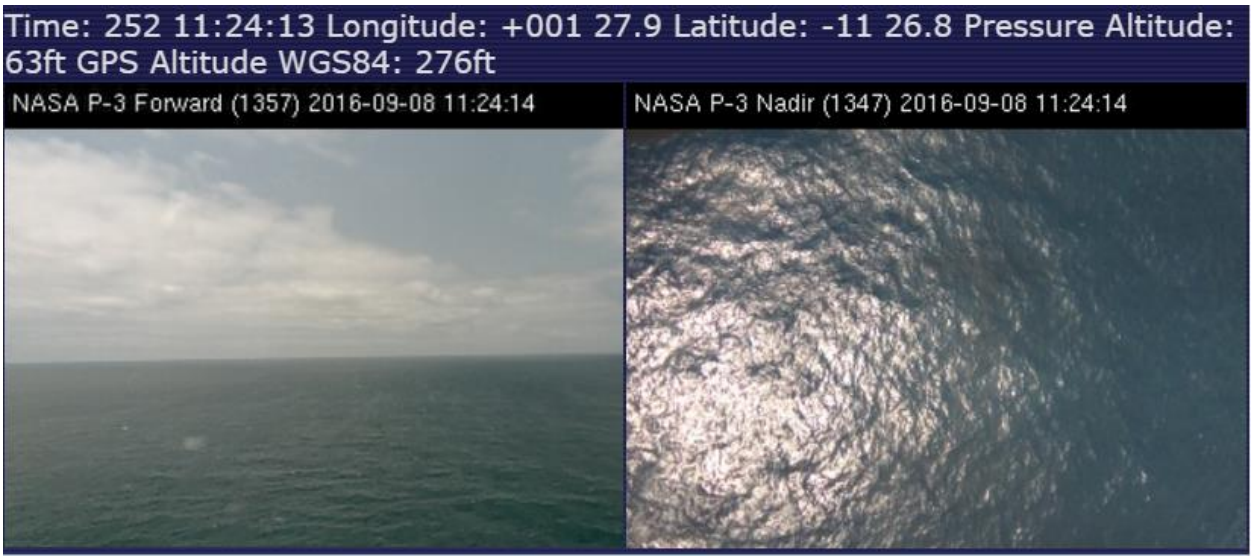
10:48 (ish) - 10S! turning and descending
10:53 - CO ramping up, no aerosol from AMS.
10:55 - CO increase at 17kft,
11:01 - aerosol top at 13.1 kft, slightly diffuse,
11:02 - aerosol layer bottom at 12 kft.
11:04 - significant aerosol drop in between two layer, at 10.1 kft
11:06 - top of second layer at 8.8 kft



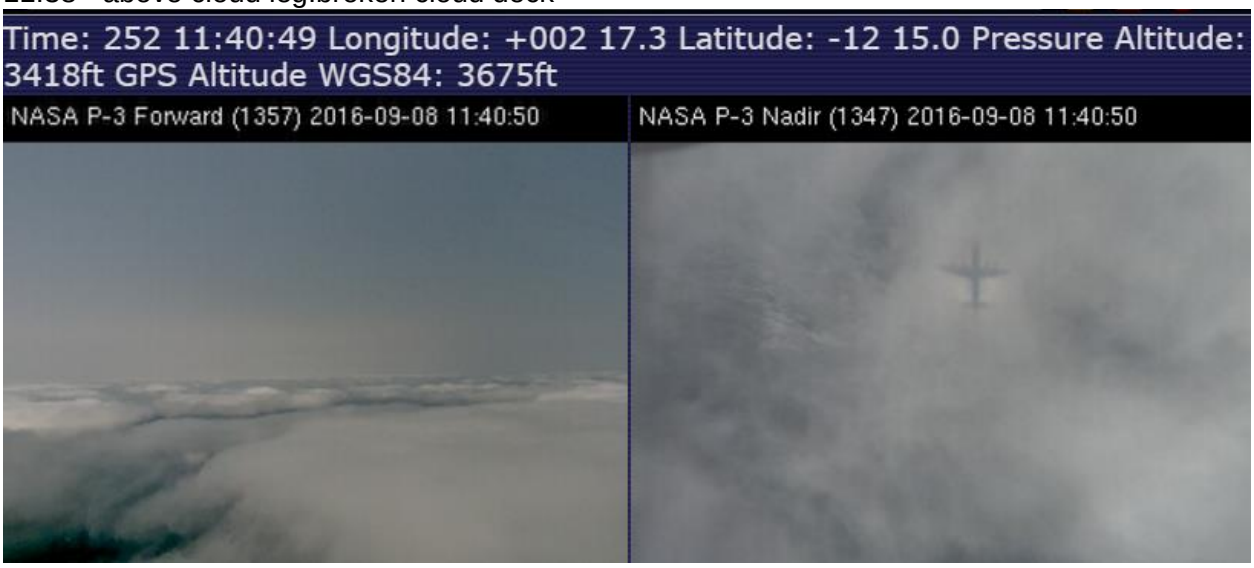
11:09 - getting to cloud top
11:16 - going to below cloud, Nd 400, 75 micron diameters, top at 3.6 kft,



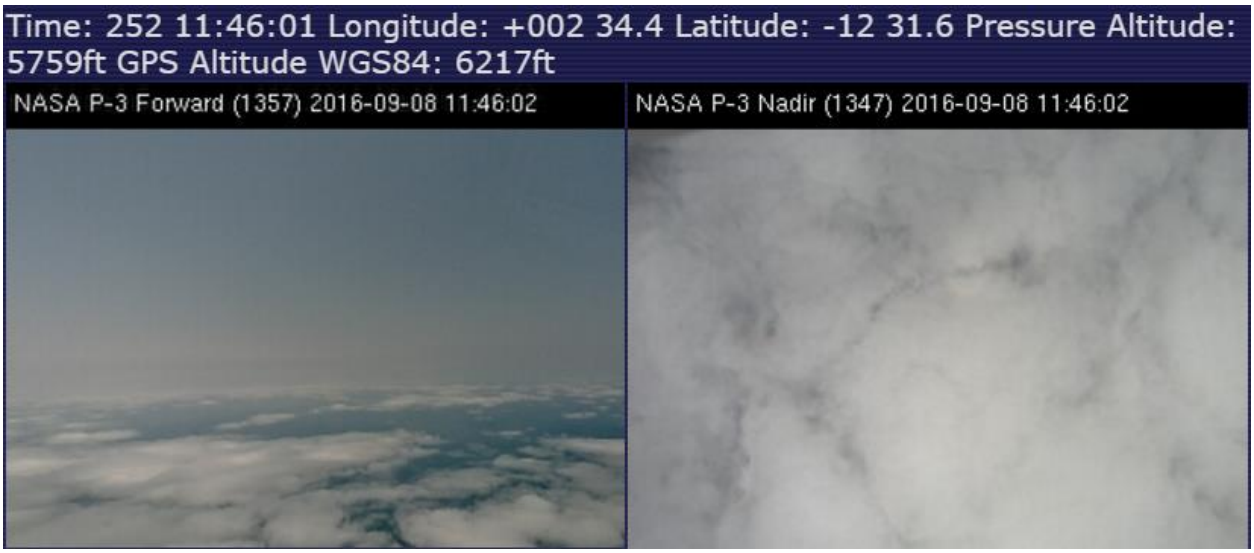
11:23 - level legs below cloud, scattered clouds. 300 ft above water. 110/cc blakc carbon, moderately polluted,, 25% from above, 13 knots



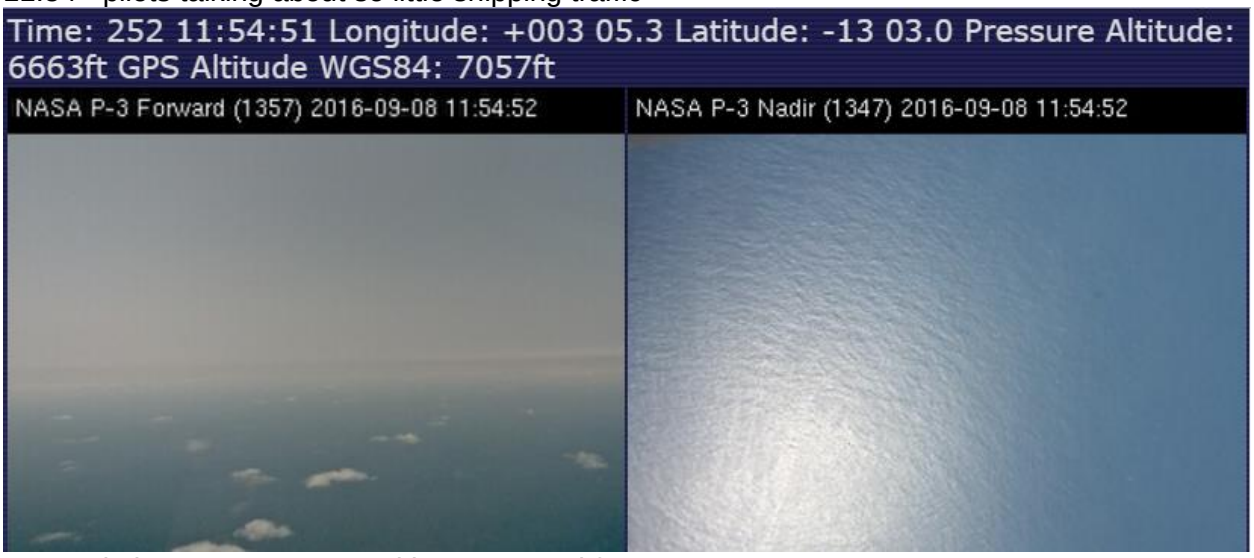
11:27 -
11:33 - going bac up.
11:34 - in cloud at 3kft
11:38 - above cloud leg.broken cloud deck



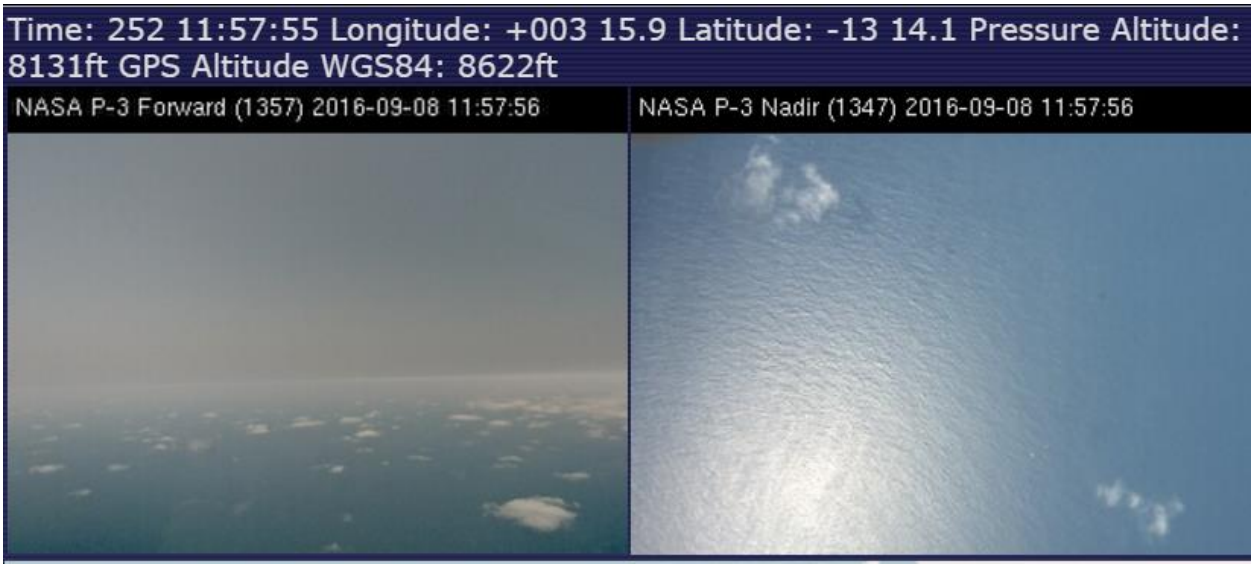
11:45 - going back up after step above clouds



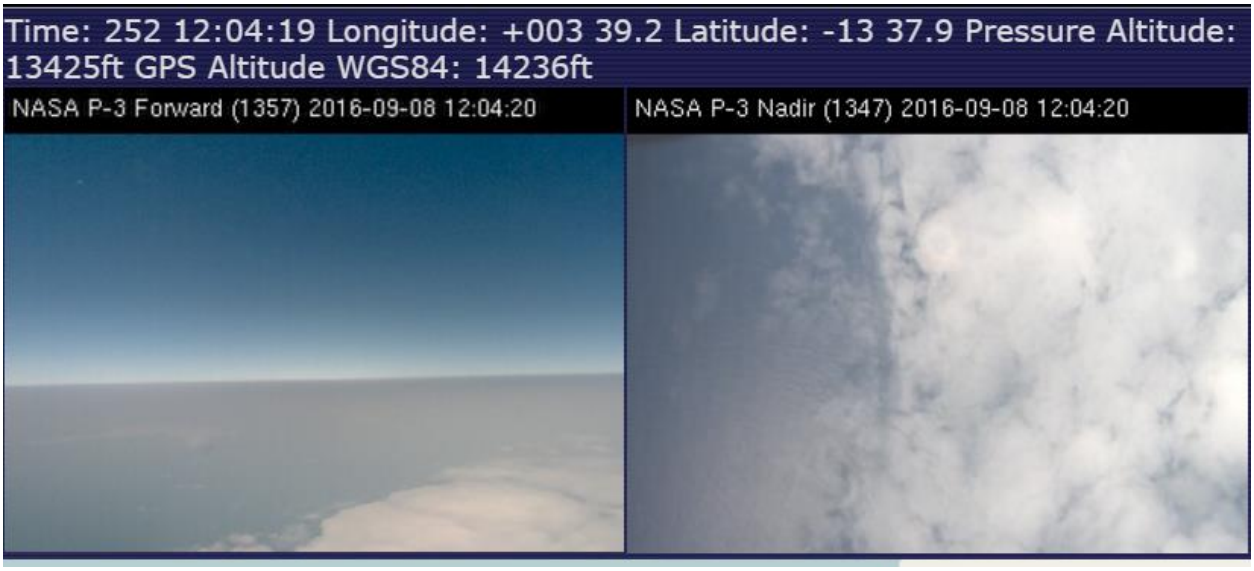
11:49 - going to 6800 ft for level leg there.
11:51 - level in biggest peak of aerosol
11:54 - pilots talking about so little shipping traffic



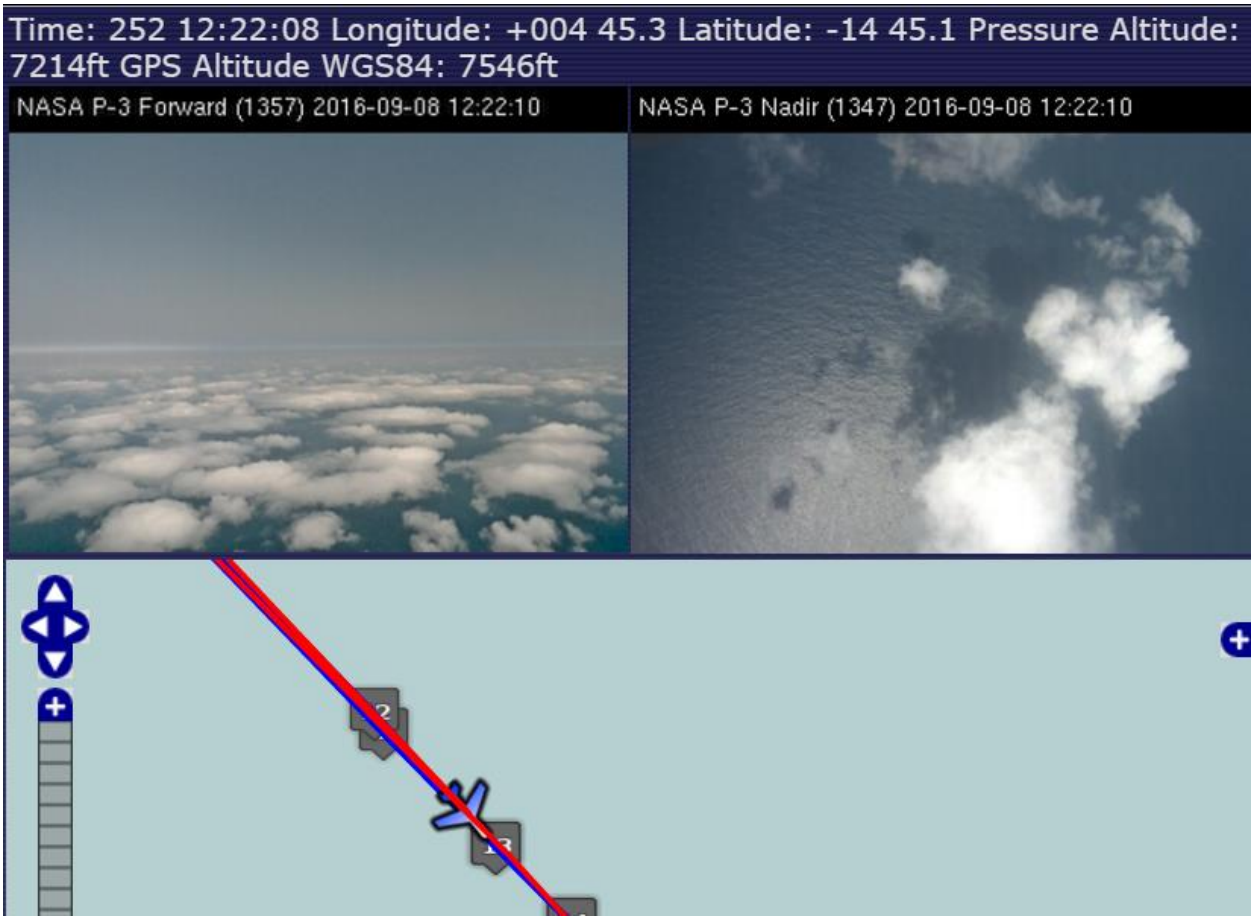
11:58 - in between two aerosol layers at 8.3 kft



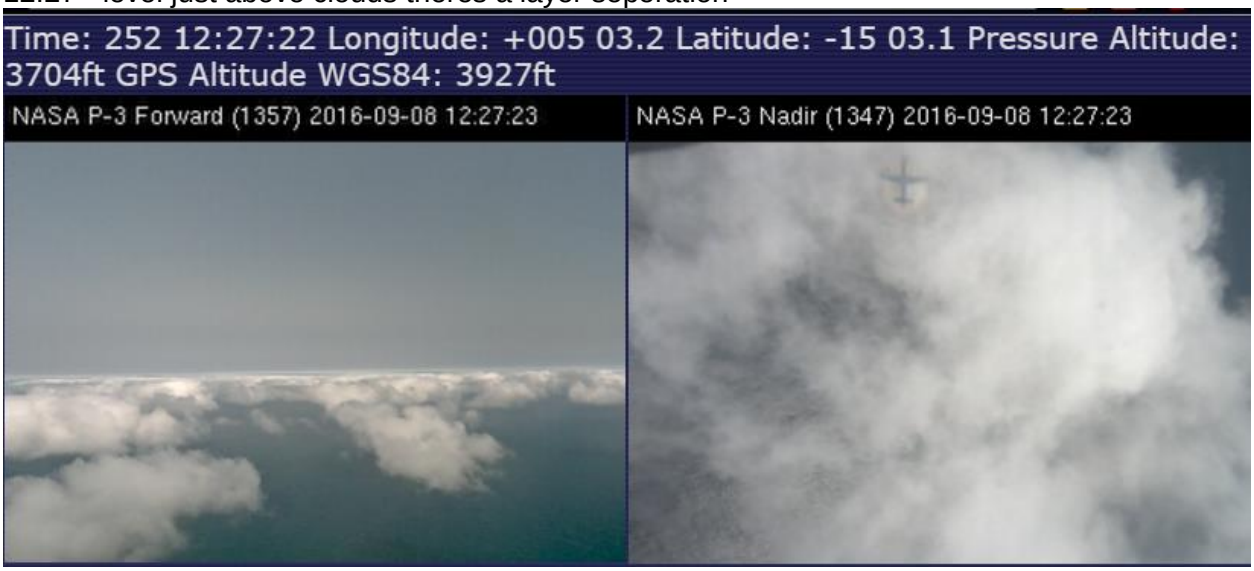
11:59 - aerosol going up at 9.5 kft
12:00 - decrease at 13.2 kft



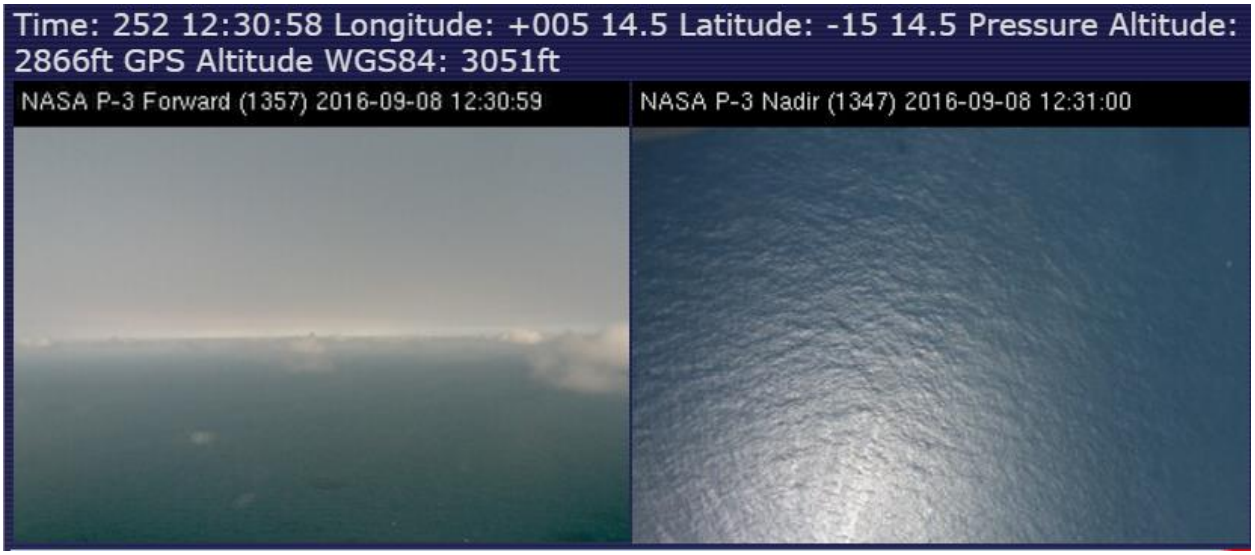
12:15 - starting descent again.
12:16 - hit aerosol layer at 13.7 kft
12:40 - decrease between aerosol layer about 8.8kft



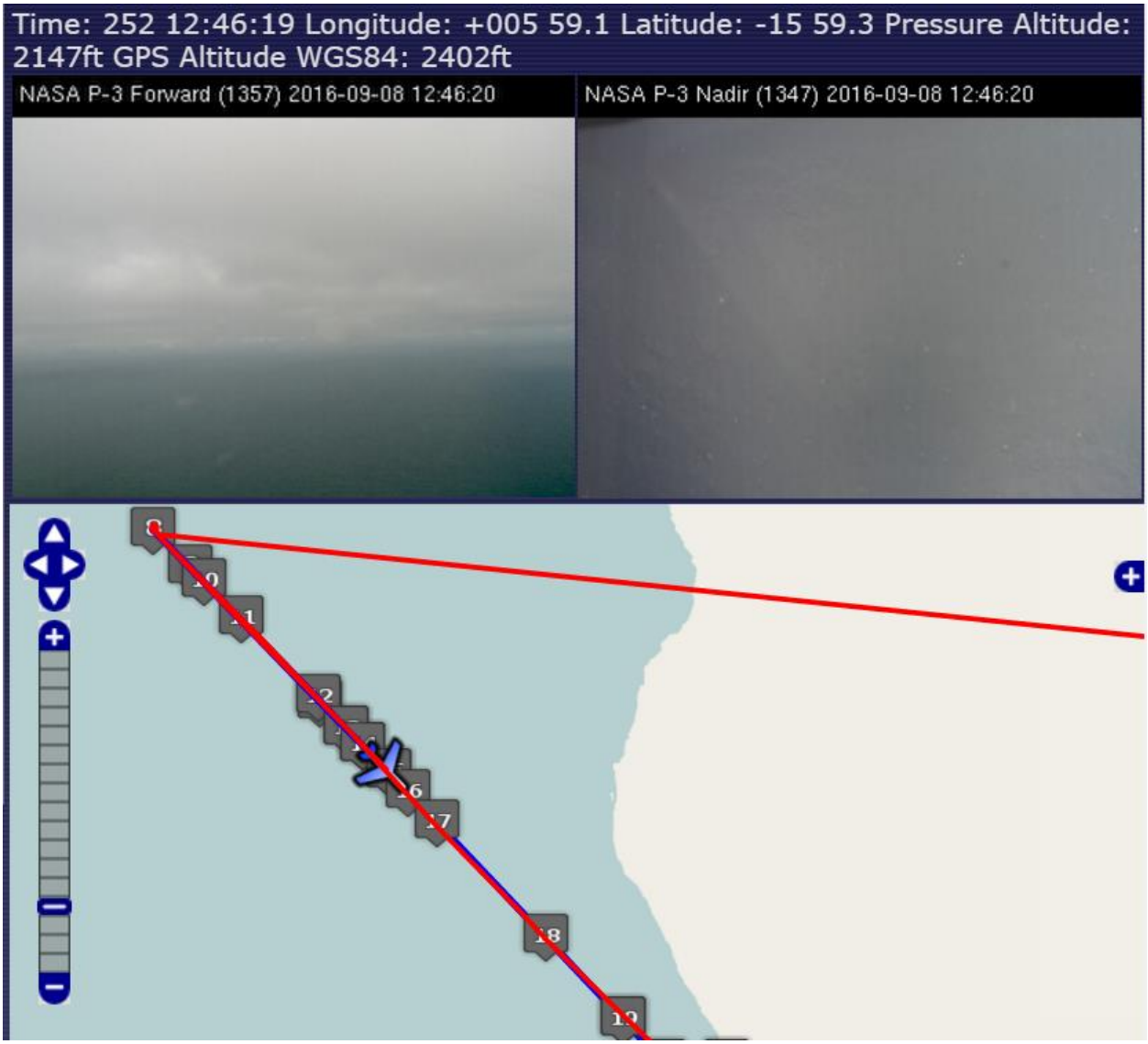
12:24 - decrease at around 5.8kft, some differences in aerosol composition
12:27 - level just above clouds theres a layer seperation



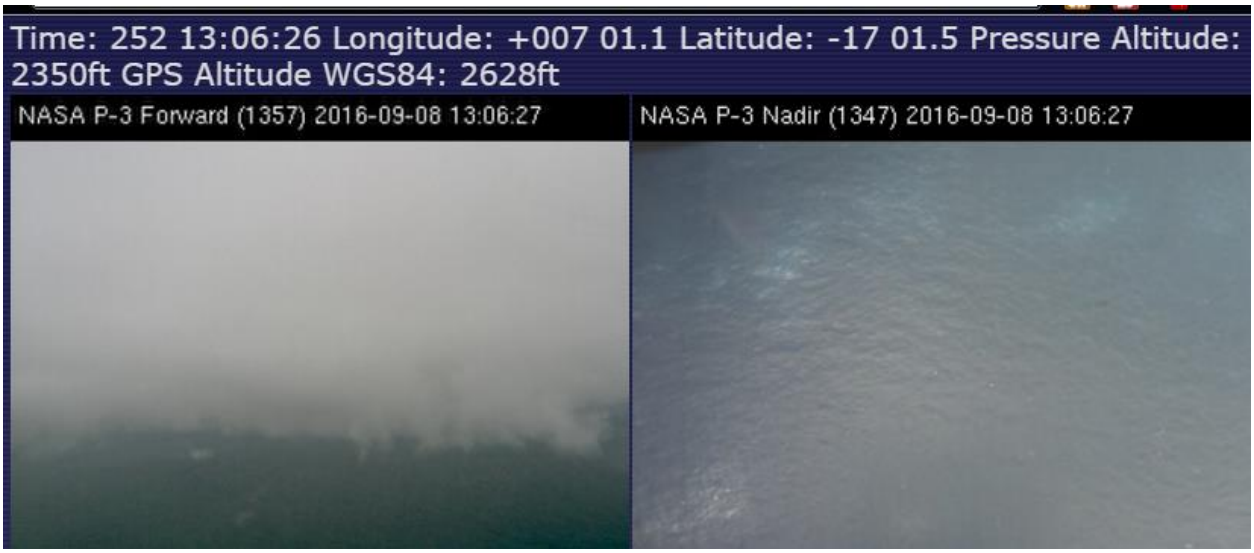
12:30 - going to below cloud



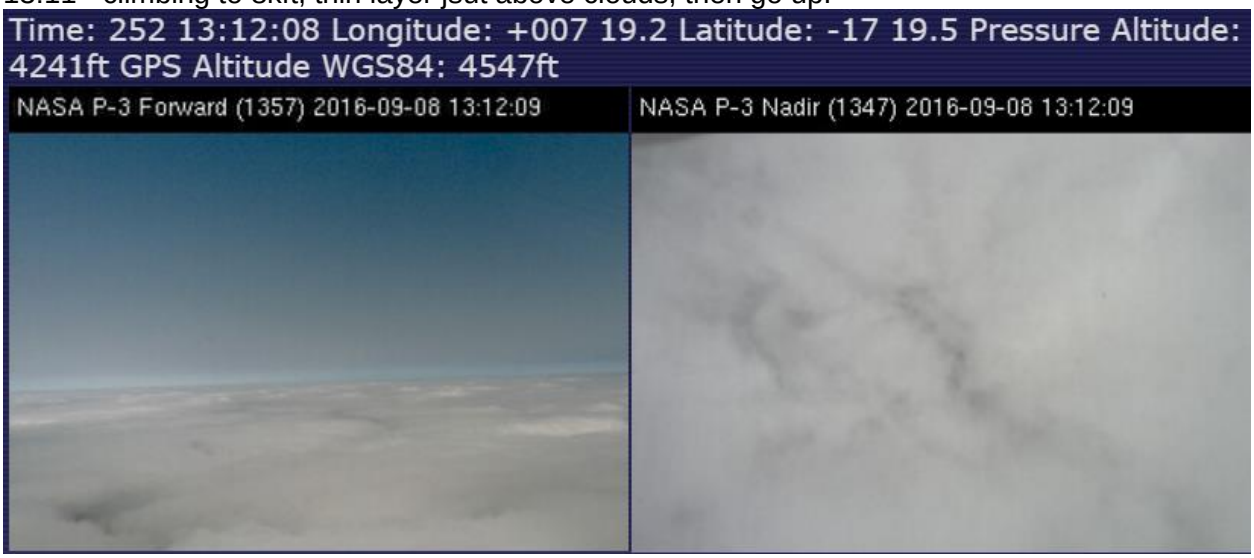
12:34 - 200 ft asl 10 minutes, 12 knots wind speed, aerosol concentration, bimodel size distribution, min 65 nm, proessed pollution, 2x more black carbon concentration. ~40/cc.
12:36 - sawtooth in clouds / boundary layer



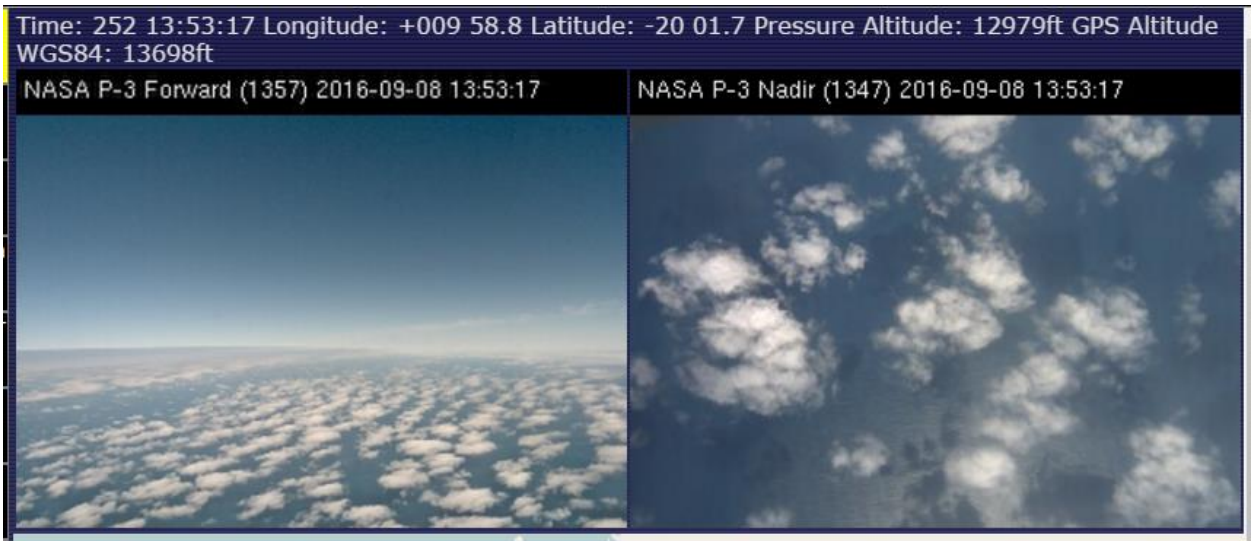
12:47 - cloud top 3100 ft, bottom,
12:51 - below clouds
12:53 - going back up
13:01 - cloud probes awake, entering a big cloud. 3.5 kft cloud top,
13:05 - getting back to cloud base at 2.8 kft, top 3.3 kft



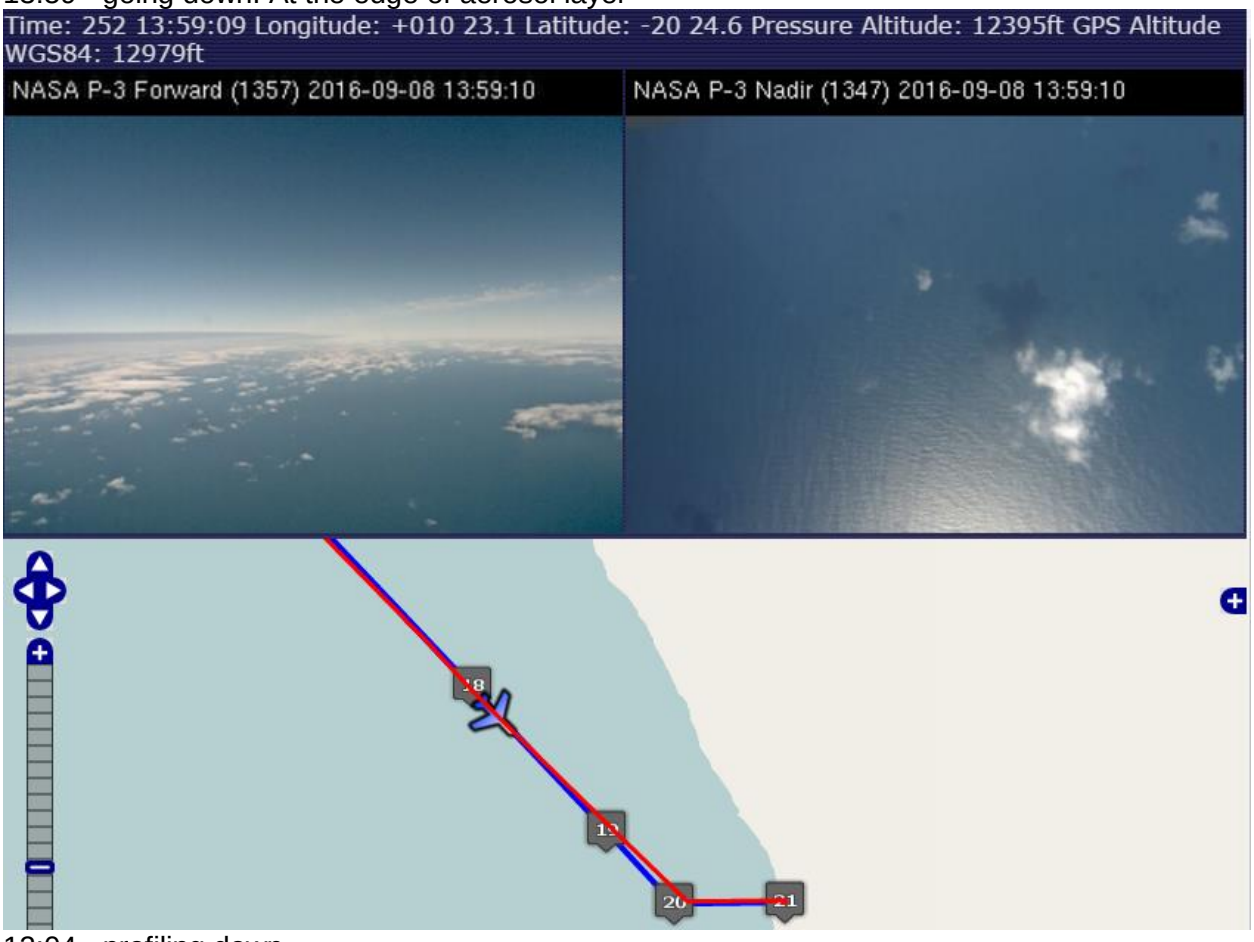
13:08 - black carbon at 200/cc, just above layer
13:11 - climbing to 8kft, thin layer jsut above clouds, then go up.



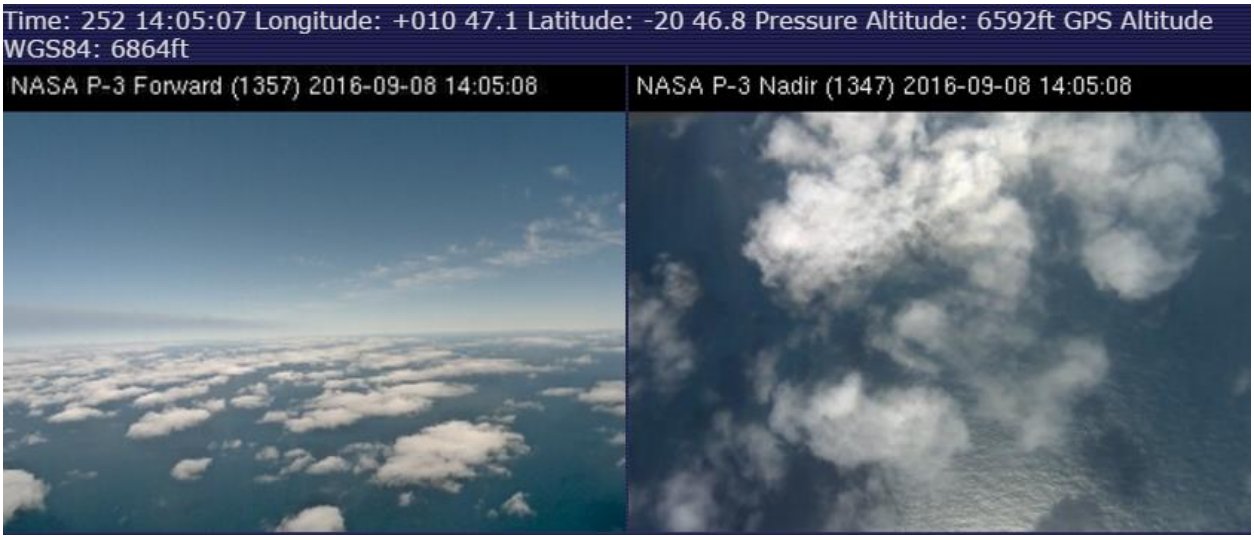
13:16 - level at 8kft, in juice, 600/cc blakc carbon. Possibly the lower that was up norht is now at higher alt down south.
13:27 - increasing in altitude. Clouds below are clearing, bigger holes in between, but also bigger clouds.
13:30 - no gap in between aerosol layer, but chemically different layers present.
13:33 - within aerosol, at the top of aerosol layer. Different nitrate to organic aerosol composition.
13:43 - going up
13:48 - pretty clean, at residual layer

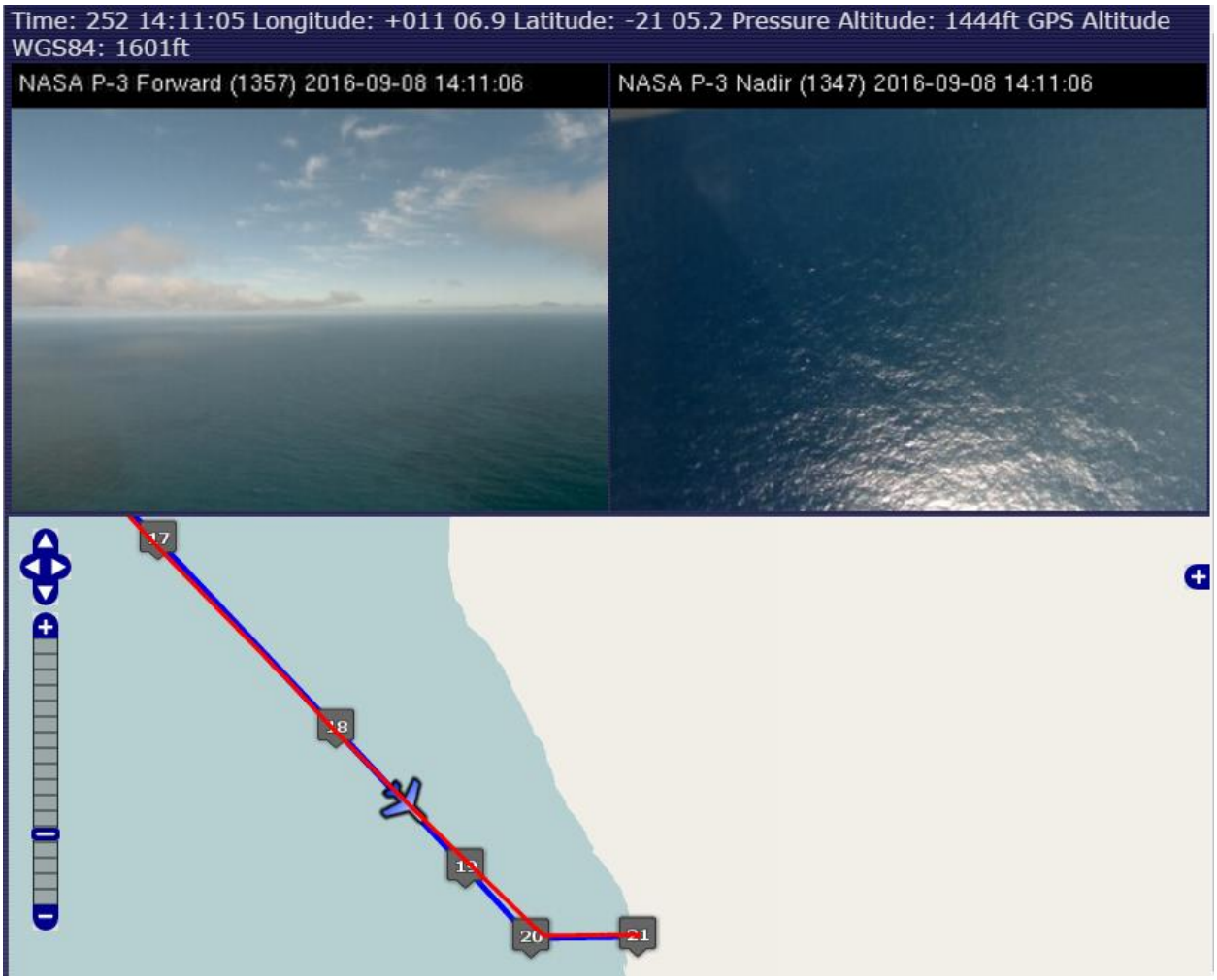


13:59 - going down. At the edge of aerosol layer

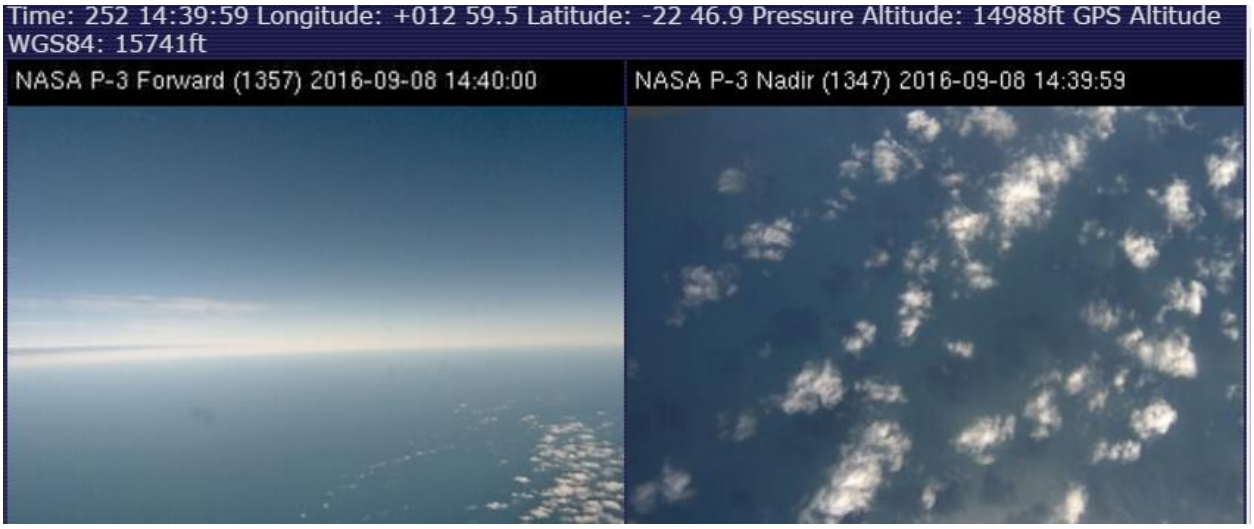


12:04 - profiling down

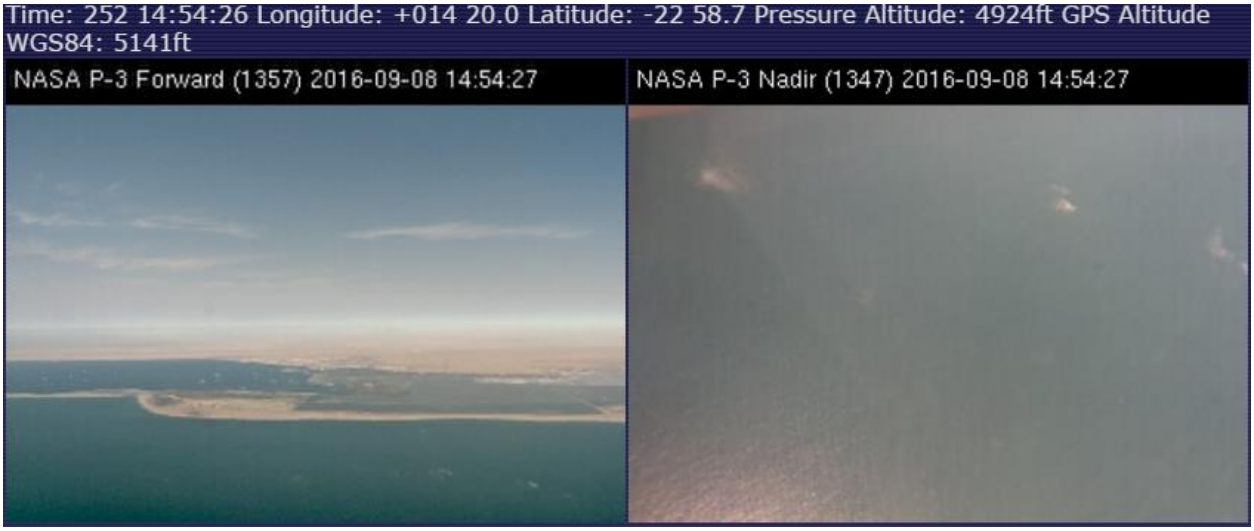




14:13 - at low level, 5 minutes level. Winds 9 knots, sulfate at about the same level as before. Some cirrus contamination.
14:20 - going back up. Very low aod,
14:40 - getting ready to turn and descend



14:56 -



15:01:20 - landed
15:05 - taxi stop
15:07 - power transfer.