WP-3D-0204 (04 Feb 2020, Tuesday) RF07

Paquita Zuidema

1. Objective

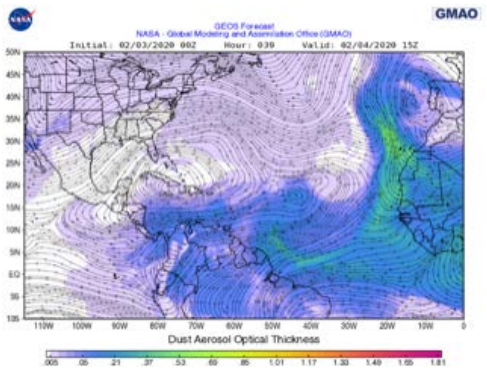
Solo flight by the P3 (unaccompanied by any other EUREC4A aircraft platforms). Original intent was to coordinate with the R/V Ronald H. Brown to the east of the HALO circle. RHB was back near Barbados due to a medical emergency, and objective was changed to maximize in-cloud information. WP-3D transited to 54W, 13.5N, the center of the west side of the dropsonde circle, performed a dropsonde circle with its center at 13.5N, 53.15W, then conducted three cloud modules incorporating AXBT drops+dropsonde, all east of 56W.

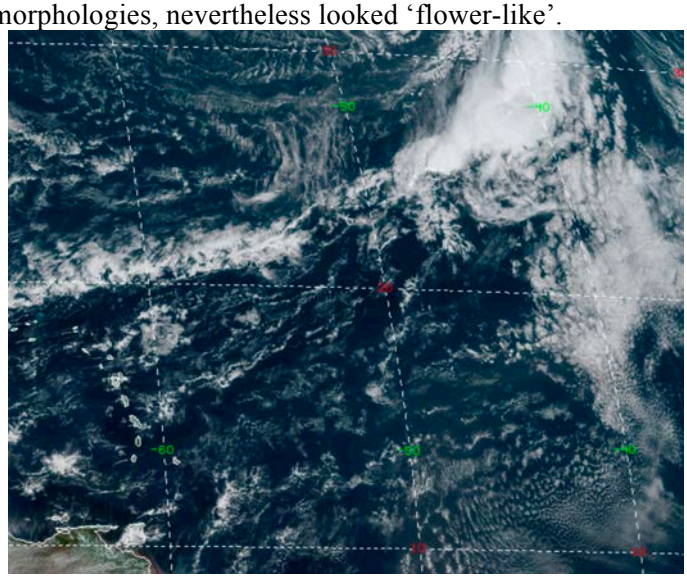
2. Crew

Eleven crew, five science: P. Zuidema (flight scientist), Dean Henze (isotope sampling), R. Pincus (W-band radar), Mason Leandro (cloud microphysics), Andrea Sealy (observer).
Ground Support: Patrick Chuang, Graham Feingold

3. Synoptic Situation

A recent dry Saharan Air Layer event is continuing but the dust is diminishing, with another dust layer will be moving in over the next few days. Dust was clearly present in Barbados boundary layer yesterday (Feb 3), with the total water vapor path on the drier side (consistent with a low-altitude SAL layer).
A synoptic riding pattern is continuing. A slight pressure gradient increase associated with a stationary front at 20N may increase surface wind speeds. Shallow convective cloud was forecast for today, which, while not clearly organized into one out the Bjorn morphologies, nevertheless looked 'flower-like'.





Shallow clouds encountered during flight were more 'gravel-like', with many cold pools but with vertical cloud development within the mesoscale arcs remaining below 2 km. large-scale GOES-16 noon LT image above.

4. Flight Elements:

Element	(°N, °W)	Flight Level (FL)	Time (UTC)	Notes
Takeoff-Ferry	GAIA	Ascent to 10kft	13:20	Ending at 54W, 13.5N

Element	(ºN, ºW)	Flight Level (FL)	Time (UTC)	Notes
Circle	(13.5, 53.15 CC)	23kft	Ending 15:21	90km radius. Hazy (MODIS Terra AOD of almost 0.3 was a maximum w/in circle for flight). Largish cloud blob squarely within circle.
Isotope			15:21-15:46	Descent to NE (CC), 1000ft/min, ascent going to SE to set us up for CM1
Cloud 1	(13N, 53W)	8.2,6.7,4.5,2.6,1.8, 0.5 kft	15:50-17:00	
Transit to CM2		3.3kft	17:30-17:50	5AXBTs. Cloud-clear but aerosol-laden
Cloud 2	12.5, 52.5	500ft N-S, followed by 1.8, 2.5, 4.6,6.7kft legs going E-W	18:00-19:10	E-W mesoscale arc feature. Easily identified from plane. Little (any?) rain
Transit to CM3	W to 54.5W, N to 13.25N	3.3kft	19:10-19:40	Some in-situ sampling. 500ft leg at end sampling in->out cold pool, previously sampled during CM1
Cloud 3		1.8, 2.3->2.7, 4.6, 6.7 kft	19:40-21:00	15-minute legs. 2.3kft was below cloud base, went 400 ft higher. 6.7kft was the above-cloud remote sensing leg.
Landing time			21:54	

Circles: One circle, 90 km in radius, flown at 23kft, centered on 13.5W, 53.15N. 12 dropsondes. Flew clockwise => all photos taken looking inside the circle.

After circle the aircraft descended at 1000 ft/min going northeast towards the circle center, then pivoted towards southeast for ascent (1000 ft/min) towards first cloud sampling leg.

Cloud sampling 1: inside dropsonde circle. A set of convective lines oriented SW to NE, sampling was perpendicular to the lines. 4 dropsondes

transited at 3.3 kft en route to pick up some in-situ data. 5AXBTs

Cloud sampling 2: targeted an E-W mesoscale arc to south of the dropsonde circle, 12.5N, 52.5W. 4 dropsondes+AXBTs

Transited to CM3 at 3.3 kft, west to 54.5W, then N to 13.25N. did the 500 ft portion of CM3 going N at end of the northward transit, to sample a clear->cloudy edge of a cold pool, previously sampled during CM1. Although have to check again to make sure, my recollection is that the cold pool appeared cloud-free from space but already contained small clouds similar to those in Fig. 3. More AXBTs (7?)

Cloud sampling 3: targeted 'sugar' field. 15 minute legs. 4 dropsondes+AXBTs

5. Instrument Status

Radiosondes: 12 during dropsonde circle, 4 per module (24 total)
AXBTs: 20 dropped during cloud modules and their connecting transits.
Cloud physics:
CAS appears to have worked well,
CDP not functioning appropriately, data not usable
CIP, PIP imagery data collected.
W-band radar: operational
WSRA surface wave radar: operational
SFMR: operational
Picarro isotope sampler: operational
Downward-pointing IR camera:
Plane: lost autopilot en route, will be lost for the remainder of the flights.

Photos (e.g. Fig 3) from flight available through
https://www.dropbox.com/sh/h07cz22wjkj1vam/AACXLVypcuruv5c1yKuw8gcna?dl=0
Filenames contain date and UTC time.

6. Figures

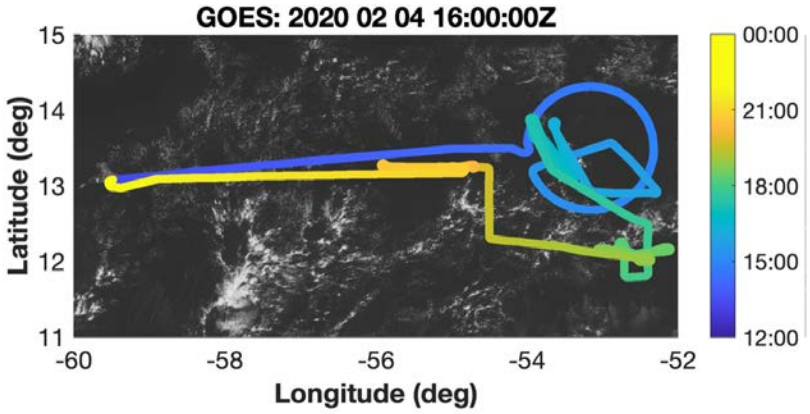


Figure1Plan view of flight path for WP-3D RF07. The track is superimposed on a satellite image from GOES-16 Channel 2 (red wavelengths in the visible) at 16:00Z (local noon)

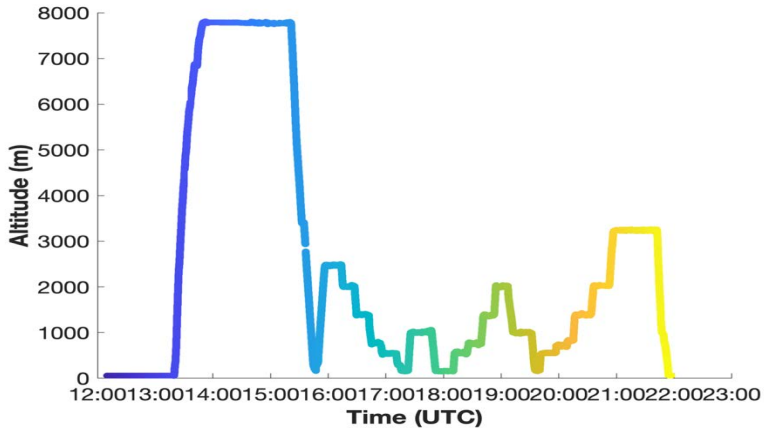


Figure 2. Profile view of flight plan.

Figure 3. photo from 15:10 UTC along dropsonde circle edge looking in on cloud complex (see Fig. 4). Combination of convergence lines and newly-developing small Cu, already appearing to be adopting a linear organization.

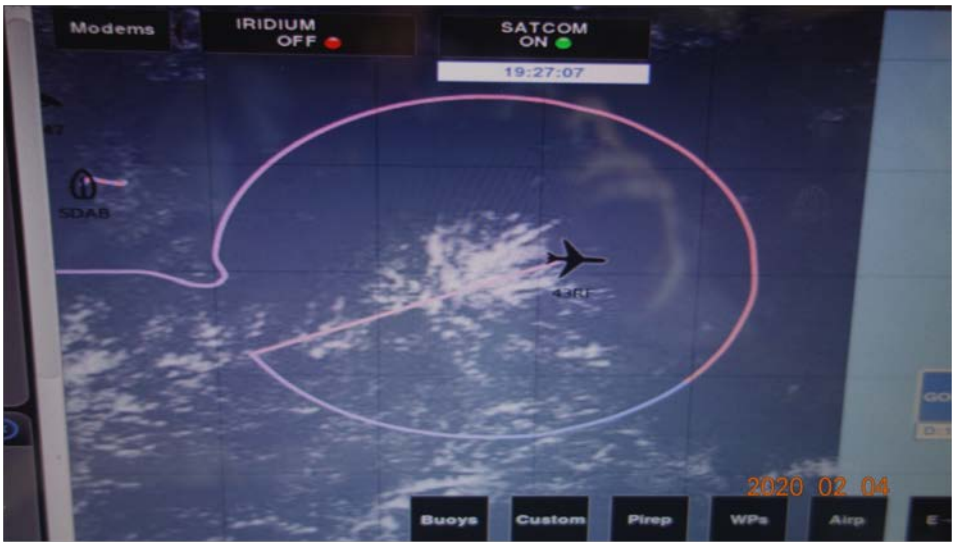


Figure 4. Planet screenshot at 15:30 UTC

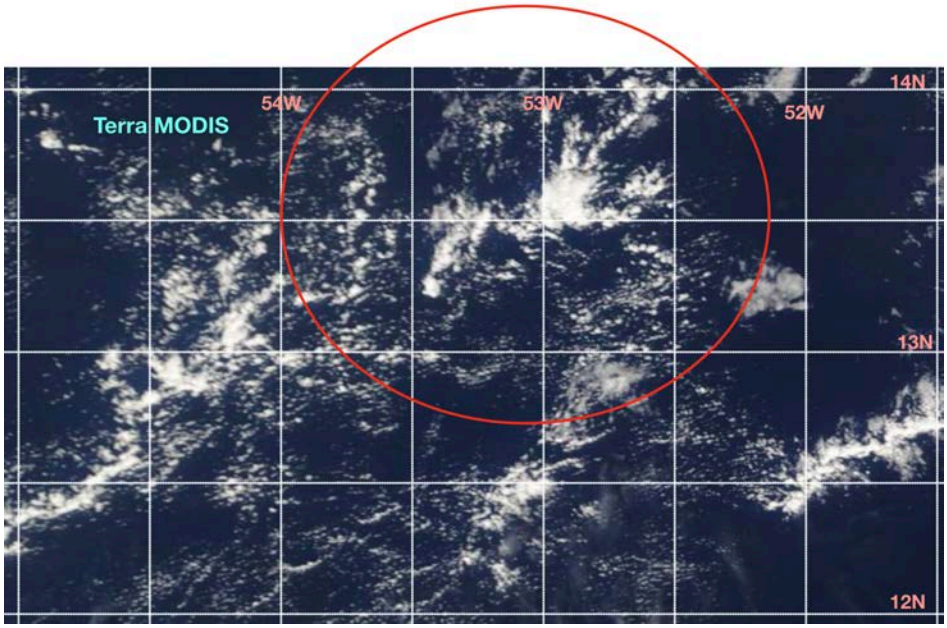


Figure 5. The MODIS Terra view of the dropsonde circle (~14:30UTC, so at beginning of dropsonde circle)

Figure 6. ~16:30UTC visible image on Planet, overlain with current flight track (~17 utc?). note mesoscale arc.

Fig. 7: left: 15:58utc, aerosol (dust) apparent in dropsonde circle boundary layer. right:16:51 utc, looking at cold pool edge. Clean?

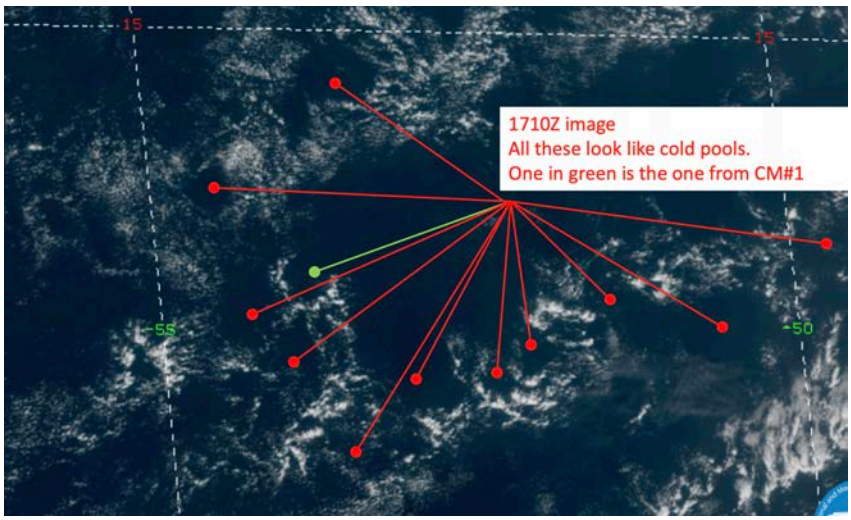


Figure 6. 17:10UTC RAMMB image

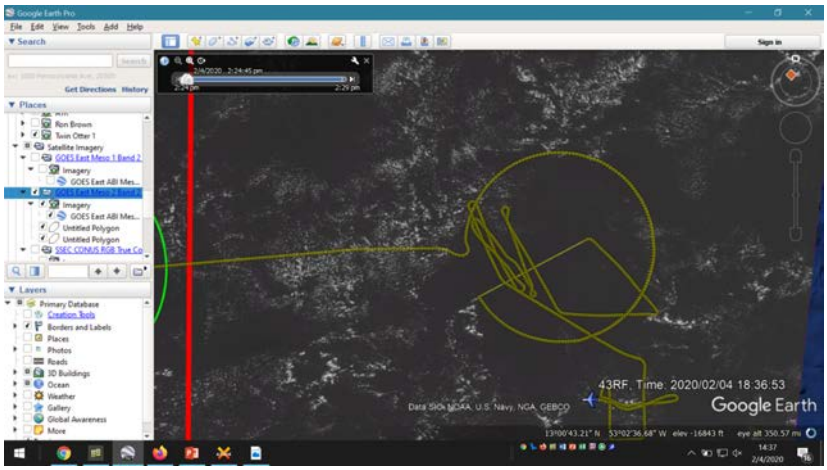


Figure 7: cloud complex inside dropsonde circle advected west and dissipated into 'sugar' and 'small gravel' to west of circle by the end time of cloud module 2 (18:40UTC).Image shows isotope leg descent into circle, a 90deg turn+ascent to SE, followed by CM1 sampling, transit to CM2, and CM2.

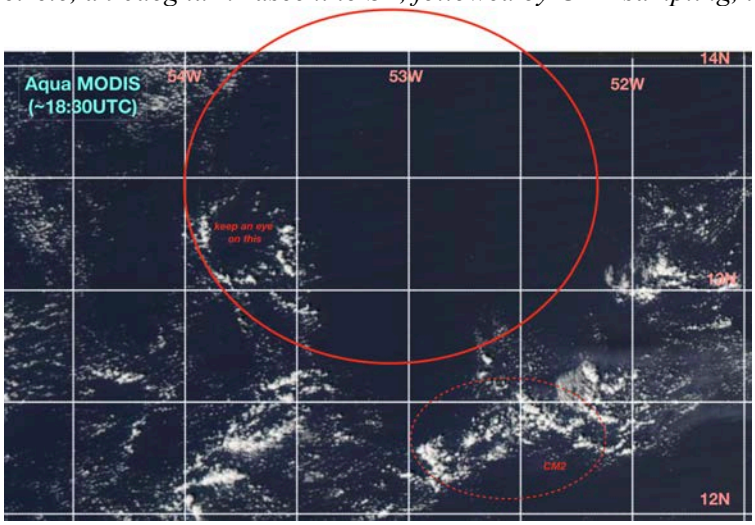


Fig. 8: Aqua MODIS image (~18:30 UTC), same domain as in Fig. 3.

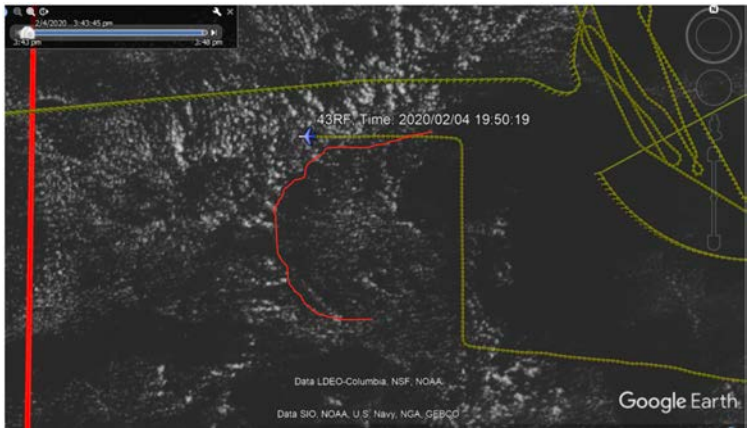


Fig. 9. Cold pool traverse was at 500 ft before going west.

Fig. 10: 19:42UTC photo suggests resampled cold pool was still cloud-free.