WP-3D-0210 RF10
(2020-02-10 01h49-09h55 UTC)

Jan Kazil/Paquita Zuidema

1. Objective

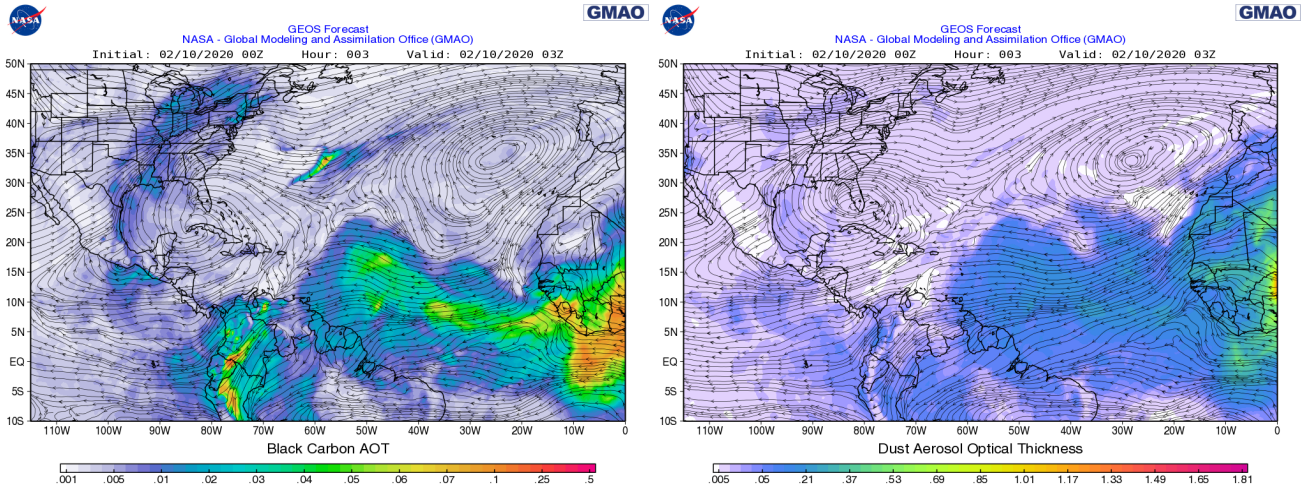
Nighttime flight by the P3 under a full moon, unaccompanied by any other EUREC^{4}A aircraft platforms. Idea is to help fill in diurnal cycle information through a 10 pm takeoff, landing 6-6:30 am local time. Cloud modules are front-loaded as a guard against late-flight fatigue and because the plane at full fuel load is less efficient at climbing to altitude. First a cloud module inside the HALO circle, followed by 12 dropsondes deployed from the HALO circle at 110 km radius, to be compatible with the HALO flights. Then a cloud module in the vicinity of the NOAA RV Ronald H. Brown (13°51.0' N / 54°51.6' W, or 13.8° N, 54.8° W). No AXBT were deployed during this flight.

2. Crew

Eleven crew, five science: Jan Kazil (flight scientist), Dean Henze (isotope sampling), Paquita Zuidema (W-band radar), Alison Wing (observer), Andrea Sealy (observer).

Ground Support: Patrick Chuang, Chris Fairall, Mason Leandro, Robert Pincus

3. Synoptic situation



Satellite imagery suggests some dust in the flight area, aerosol measurements made by the RHB during the flight indicate only slightly elevated values of pollution. Forecast is for a rough sea state, with strong winds up to 600 hPa bringing in low-level moisture. An upper-level trough to the northeast. This situation is relatively common in the winter, if new to EUREC^{4}A/ATOMIC.

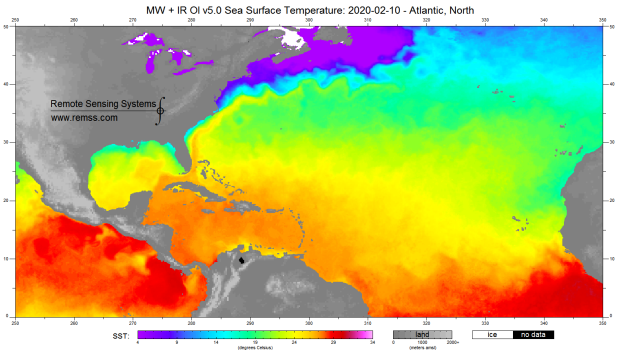


Figure 1: http://www.remss.com/measurements/sea-surface-temperature/oisst-description

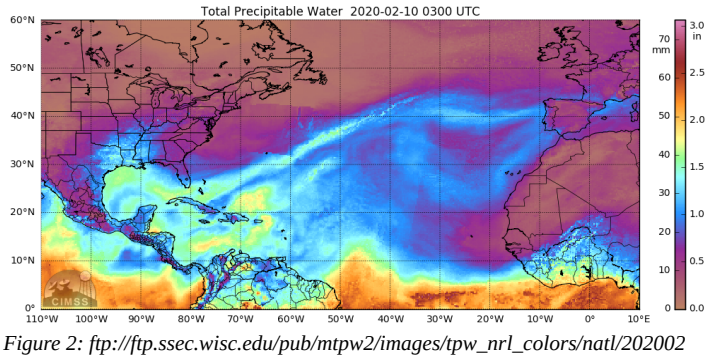


Figure 2: ftp://ftp.ssec.wisc.edu/pub/mtpw2/images/tpw_nrl_colors/natl/202002

4. Flight elements

Element	Location	Altitude (ft)	2020-02-10 UTC	Notes
Takeoff and outbound transit	13.08° N, 59.49° W	5000	01:49	
Cloud module 1	12.75° N, 58.5° W to 57.25° W	~ 500, 2000, 2800, 4500, 10000	02:07 - 03:51	Cloud base ~ 2500 ft. Cloud hunting along legs. Two-layer clouds present. Maneuvering around deeper, more convective cells. 4 dropsondes deployed.
Circle 1	13.3 N, 57.17 W, 2° ∅	25400	04:13 - 05:24	12 drop sondes deployed.
Transit		25400	05:25 - 05:45	
Circle 2	13.8° N, 54.8° W, 1.62° ∅	25400	05:46 - 06:42	12 drop sondes deployed. Inversion consistently at 7500 ft.
Isotope profile	13.2° N, 55.4° W to 14.8° N, 54.6° W	25400 - 460	06:42 - 07:10	Crossing an extended cloud deck/aggregation, visible as a blob in IR satellite imagery, with elevated radar dBz and strong turbulence during descent.
Cloud module 2	14.5° N to 13° N, 55.2° W to 55.5° W	~ 500, 1800, 2800, 4500, 9000	07:12 - 09:02	Dense cloudiness with turrets rising higher. Maneuvering around deeper, more convective cells. 4 dropsondes deployed.
Inbound transit		10500	09:02	
Landing	13.08° N, 59.49° W		09:55	

Cloud module 1: Targeting convection visible in GOES IR south-east of Barbados at 12.75 N, 58 W (Fig. 4), inside first drop sonde circle. Pilots estimate cloud base at 2500'. 5 minute leg at ~ 500 ft, followed by below-cloud base, above-cloud base, in-cloud, and above cloud top legs. The 2000 ft leg at 02:15 - 02:35 UTC is nicely located below cloud base. Lateral cameras show dense Cu cloudiness. At 02:43 UTC, isolated strong convective cells with strong nose radar echos ahead, requiring turning early. High dBz nose radar echos prompt further diversions around cloud elements during later legs of the module (Fig. 7). At 03:24 UTC, many small cumuli at various levels around the aircraft which do not have a very large vertical extent. There also appear to be patches of stratiform clouds just above the aircraft (~ 5000 ft), with optical thickness perhaps 1-2 (since one can clearly see the well-defined disk of the moon through these clouds). These patches may be associated with a vigorous, 40 dBz convective cell in the vicinity.

Transit to drop sonde circle 1: After completion of the cloud module, transiting to the drop sonde circle, diverting to overfly a pronounced, high-rising convective cell (Fig. 8) with strong nose radar echos at approximately 04:01 UTC, 12.65 N, 58.1 W, 6000 m, obtaining down-ward pointing W-band radar data of the cell. Echos to the ground, 3-4 m s^{-1} updrafts.

Drop sonde circle 1: Counter-clock-wise at location of HALO circle.

Drop sonde circle 2: Clock-wise at location of Ron Brown. Drop sondes show an inversion consistently at 7500 ft.

Isotope profile: Dense cloudiness with very strong W-band radar echos. Cutting through an extended cloud deck/aggregation ("blob" visible in IR satellite imagery) with elevated nose and W-band radar dBz and strong turbulence during descent. This cloud aggregation may have crossed over the Ron Brown earlier.

Cloud module 2: Targeting convection visible in GOES IR in the western part of the second drop sonde circle, on a north-south transect. 5 minute leg at ~ 500 ft, followed by below-cloud base, above-cloud base, in-cloud, and above cloud top legs. Air masses that passed earlier above the Ron Brown are possibly sampled along the way. Very dense cloudiness, and convection with high dBz values is avoided. The dense cloudiness is documented in photos which show, rising from the underlying cloud deck, turrets (Fig. 9) and stratiform elements (Fig. 10). The latter may have formed from convective outflow. On the top leg of the cloud module, pilots adjust flight level to be just above the highest cloud elements.

Inbound transit: Some stratiform cloud elements/layer below flight level, downdrafts 2-3 m s^{-1} on W-band radar.

5. Instrument status

Radiosondes: 12 per drop sonde circle, 4 per cloud module (32 total)

AXBTs: None deployed

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:

Downward-pointing camera: operational

Lateral cameras: operational

Plane: Autopilot out of commission.

Photos

(Dropbox):

https://www.dropbox.com/sh/6w76xzqlnzcy3mt/AAAggcTOGrNZtE3xeOSpLLMqa?dl=0

https://www.dropbox.com/sh/7krslfp1r516zq4/AABPRAVoriQhyINl1I_xEnLva?dl=0

(Google Drive):

https://drive.google.com/drive/folders/1zRehR9CLT1vkZGyhCRVqv51KQuOR_W0Y

https://drive.google.com/drive/folders/1zRehR9CLT1vkZGyhCRVqv51KQuOR_W0Y

Filenames contain date and UTC time.

6. Figures

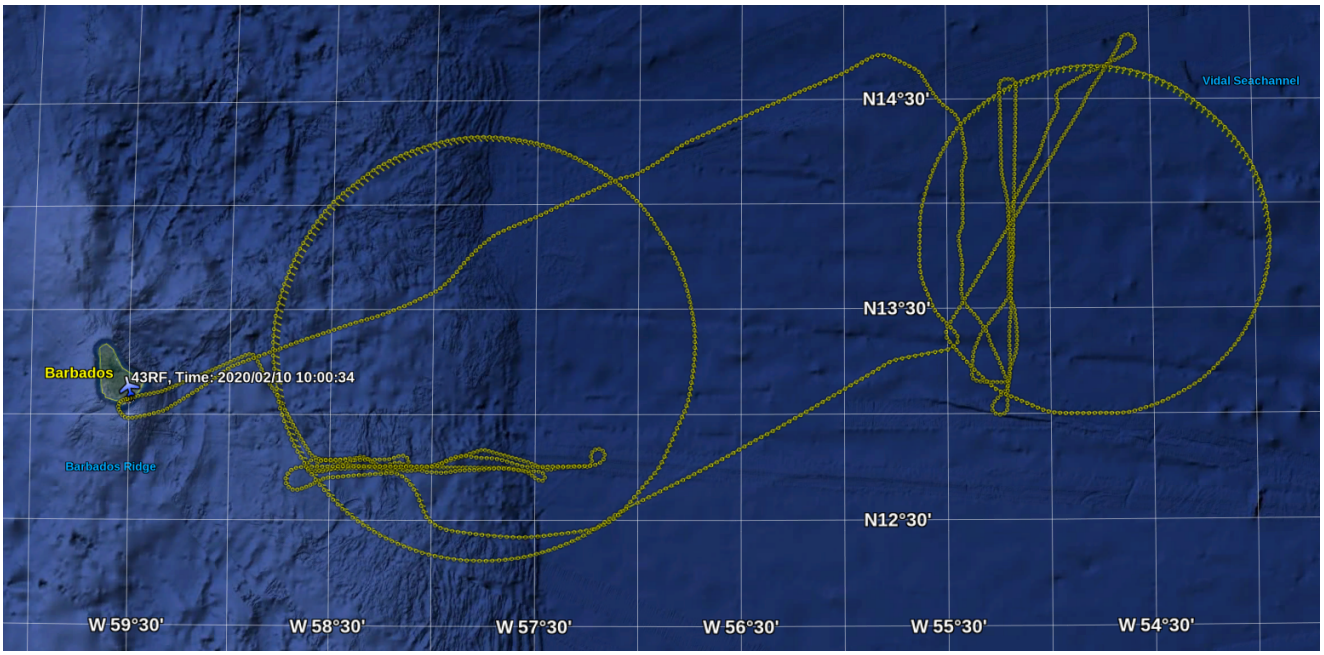


Figure 3: Plan view of flight path for WP-3D RF10.

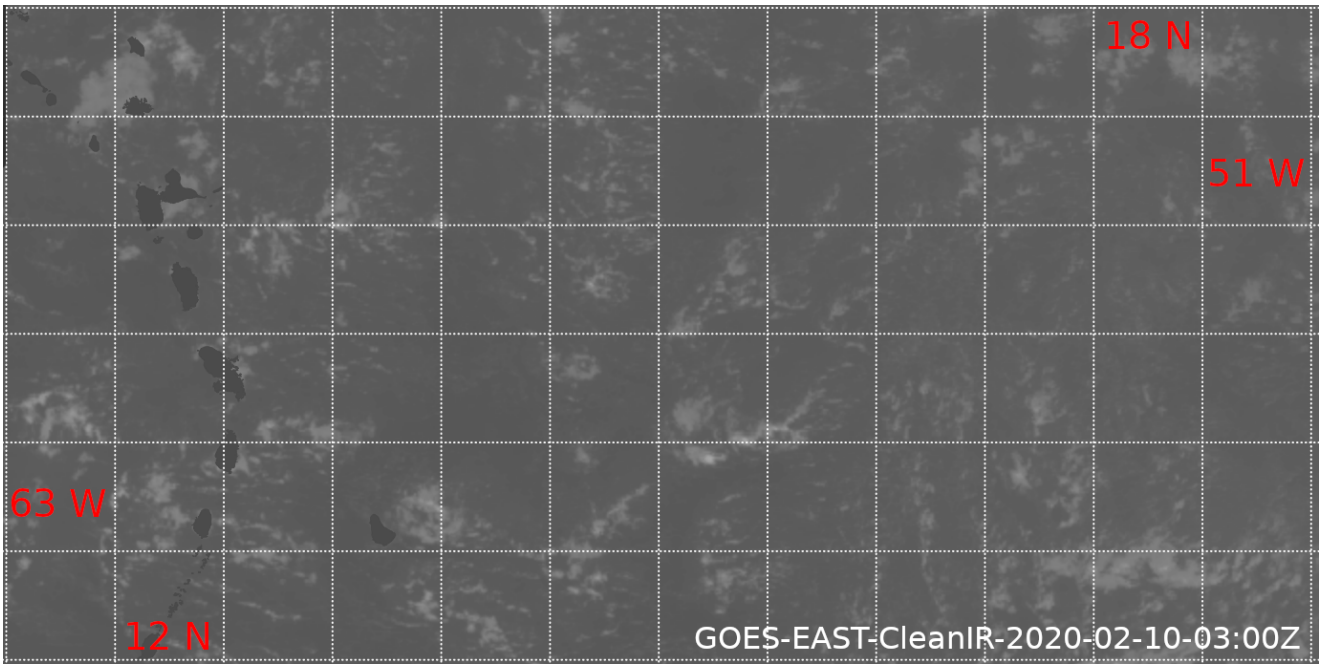
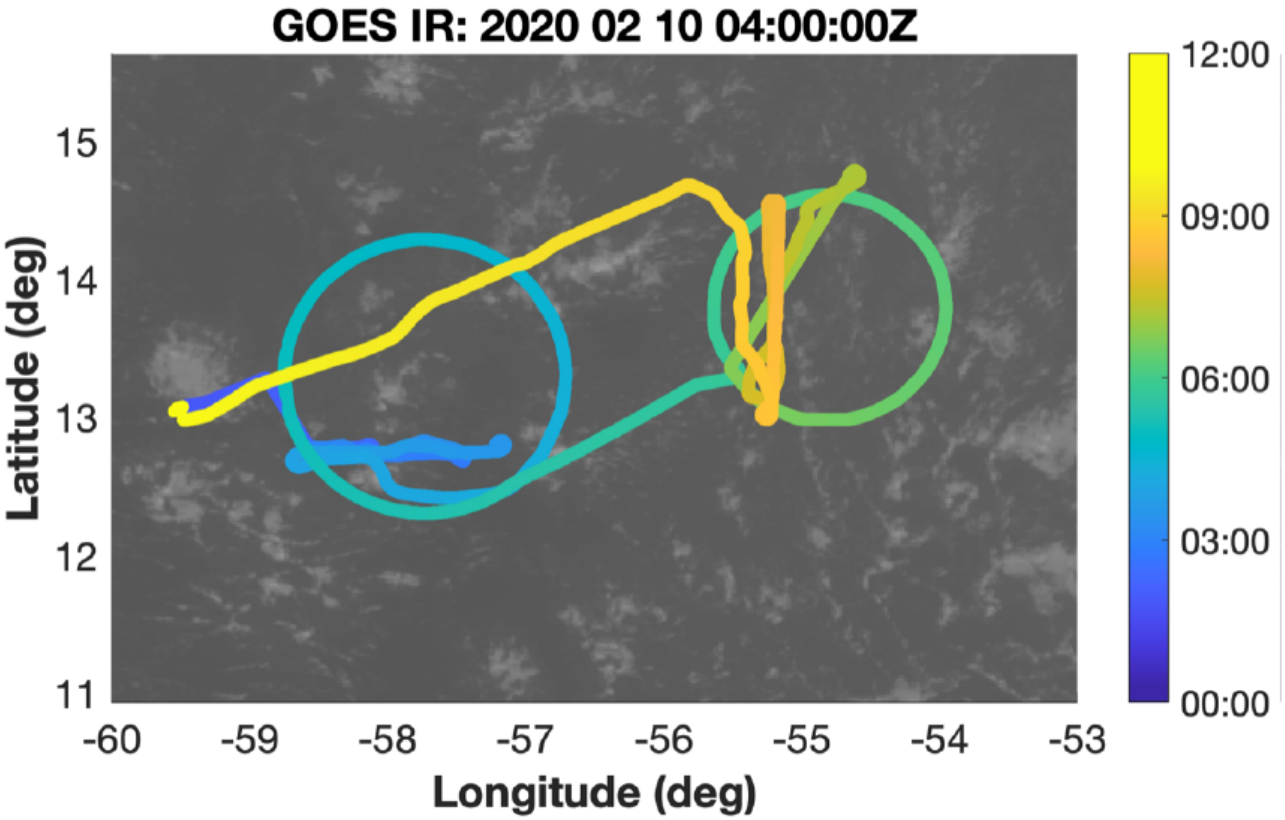


Figure 4: Cloud structure seen in the "clean" infrared channel 13 of GOES East.



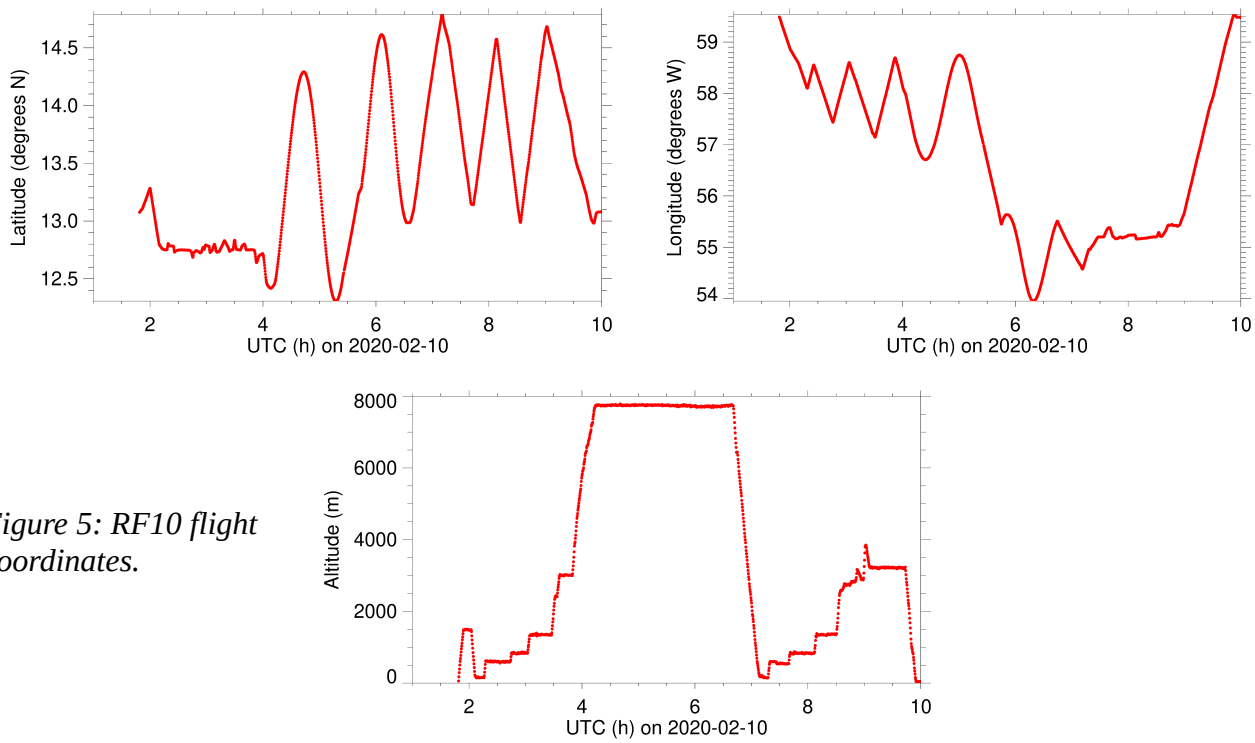


Figure 5: RF10 flight coordinates.

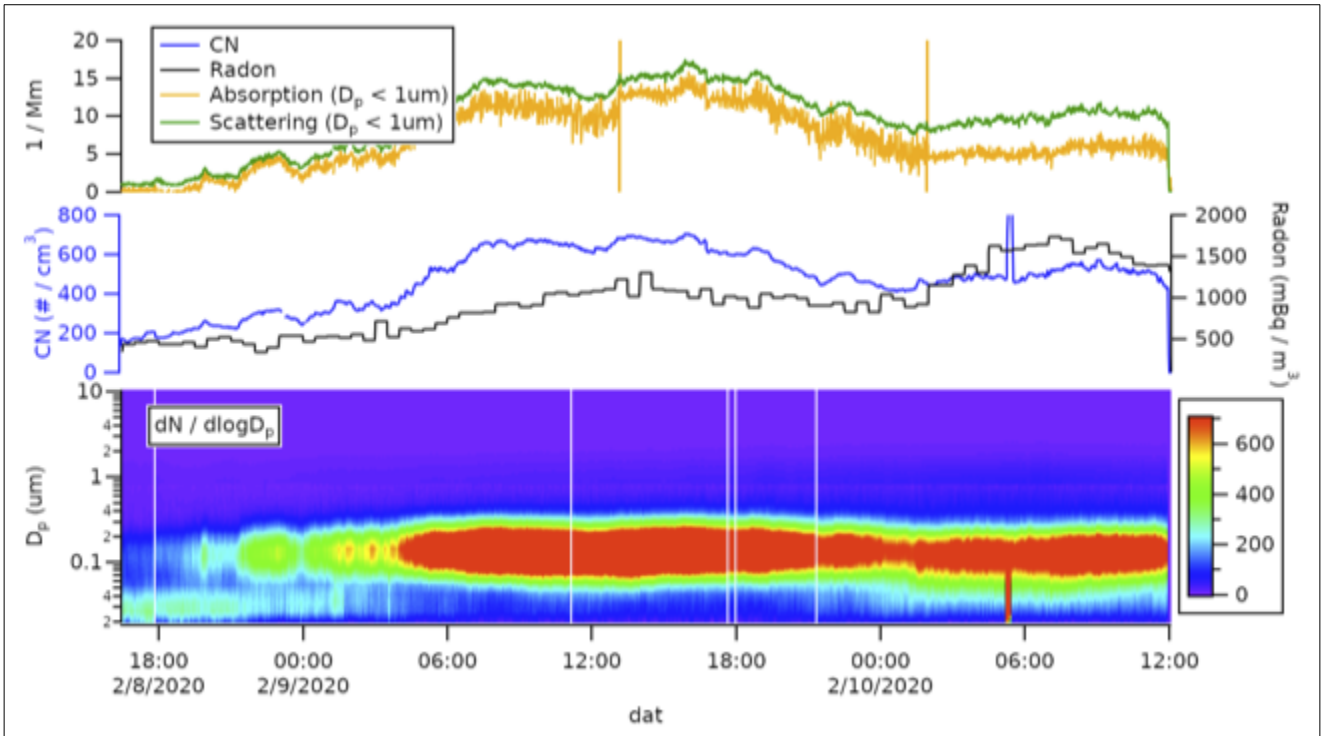


Figure 6: Aerosol and Radon measurements from the NOAA RV Ronald. H. Brown, courtesy of Derek Coffman.

Figure 7: Flight track with POLDIRAD radar reflectivity, 2020-02-10 03:36:32 UTC.

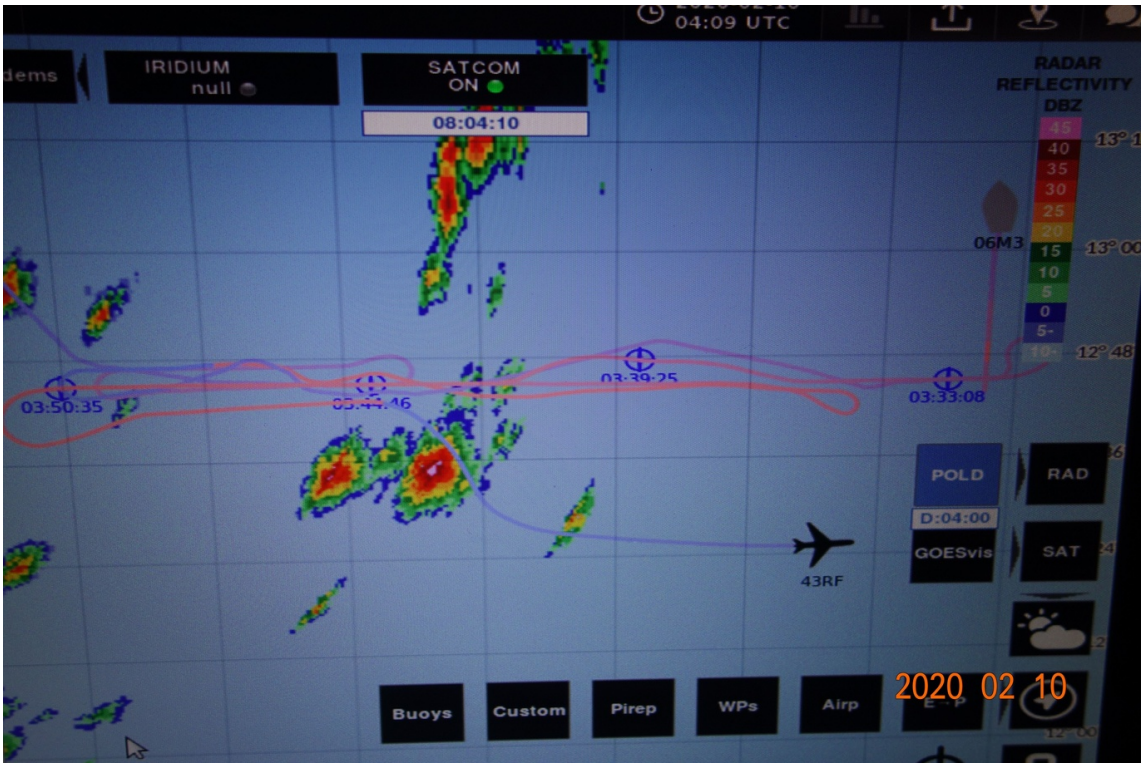


Figure 8: Flight track with POLDIRAD radar reflectivity, 2020-02-10 04:05:32 UTC.

Figure 9: Turret at 2020-02-10 08:33:57 UTC. Photography by Paquita Zuidema.

Figure 10: Elevated (stratiform?) cloud element, possibly a remnant from convective outflow, at 2020-02-10 08:45.10 UTC. Photography by Paquita Zuidema.