WP-3D-00208 (8 Feb 2020)

Robert Pincus

1. Objective

The first of three nighttime flights with the aim of characterizing the large-scale environment and clouds within the HALO circle and a circle centered on the Ron Brown. After transit to the circle at 5000 ft, a slow descent was performed to 500 ft to sample water isotopes and identify flight levels. After short leg feet within the circle, clouds were sampled along the western edge of the HALO circle. The aircraft then ascended to 24000 ft where it dropped sondes around the HALO circle, transited to the east, and dropped sondes in a circles around the Ron Brown. After another slow descent to 500 ft within the circle, the aircraft ascended again to 10000 ft and sampled clouds at three levels before returning to Barbados at 16000 ft to avoid conflicts with other aircraft. The full moon provided ample light for observation.

2. Crew

Eleven crew, five science: R. Pincus (flight scientist), D. Henze (isotope sampling), J. Kazil (W-band radar, observer), M. Hughes (observer), A. L. Albright (observer).

3. Synoptic Situation

The morning weather briefing noted that a sea level pressure maximum of 1022 hPa had moved to the northeast during the preceding few days, causing a pressure difference of ~8 hPa between Trinidad and Antigua and generating strong winds with unusually large (for the experiment) directional wind shear and high waves at sea.

4. Flight Elements

Element	(ºN, ºW)	Flight Level (FL)	Time (UTC)	Notes
Takeoff-Ferry	GAIA	Ascent to FL50	01:56	(10 Feb UTC)
Clouds 1	(14, 58.75)	FLs 5, 10, 24, 35, 70	02:34	
HALO Circle	(13.3, 57.717)	FL 240	04:18	
Transit		FL 240	~05:26	
RHB circle	(13.9, 54.9)	FL 240	05:57	
Isotopes			06:54	
Clouds 2		FLs 22, 28	07:25	
Transit		FL 160	09:21	

Cloud sampling in/near HALO circle: Sampling along 58.75W between 14N and 13N planned at flight levels 10 (just below cloud base), 15 (just above cloud base), 35 (mid-cloud) and 70 (above cloud). During flight the second level was increased twice, ending at FL24, to sample more clouds. Four dropsondes were deployed along the highest flight level. This module sampled some reasonably vigorous convection with tops as high as 9000 ft (est.). During transit to start the dropsonde circle the path crossed a large linear feature at roughly 04:10.

HALO Circle: Location noted is center of a 2.2 degree circle centered on13.3, 57.717. This turns out to have been slightly bigger than the circle normally flown by HALO. Twelve drop sondes were

deployed. Cloudiness was apparently greatest from 05:00 to 05:23, during which time the soundings exhibited complicated structure in humidity up to 17500 ft.

Transit to RHB Circle: At 05:28 another linear feature was observed running roughly E-W. Cloudiness including some isolated stratiform layers starting at 05:38.

RHB Circle: Location noted is center of a 90-km radius circle centered on the nominal position of the RHB. Twelve dropsondes were deployed. An extensive stratiform deck was seen inside the circle at 06:09 (11 o'clock on the circle). This deck included an isolated, narrow tower extending to 25000 ft. Similar isolated towers were observed at roughly 06:50.

Isotope sampling in RHB circle: Given a moist layer apparent in the dropsondes the descent rate was slowed to 1000 ft/min starting at 20000 to 500 ft. The lowest layers, e.g. at 08:19, appeared to be clear when viewed from above but were in fact quite murky and contained some small clouds. This may have been a dusty layer.

Cloud sampling in RHB circle: Sampling along 58.75W between 14N and 13N planned at flight levels 100, 67 (at the layer of stratiform cloud), 25 (just above cloud base), 18 (below cloud base). The second flight level sampled mostly cumulus clouds, starting with small clouds and increasing to more frequent and deeper convection. At 08:20 the aircraft found stratiform clouds and sampled them for about 4 minutes at ~6900 ft. Four dropsondes were deployed at the highest flight level. The murky layer identified during the isotope profile was also sampled (08:48).

5. Instrument Status

Radiosondes: Launched only during cloud modules. All provided good data.
Cloud physics: probes appeared operational though low values were reported by the CDP.
W-band radar: operational; turned off below ~1500 m during cloud modules
WSRA surface wave radar: operational
SFMR: operational
Picarro isotope sampler: operational

6. Figures

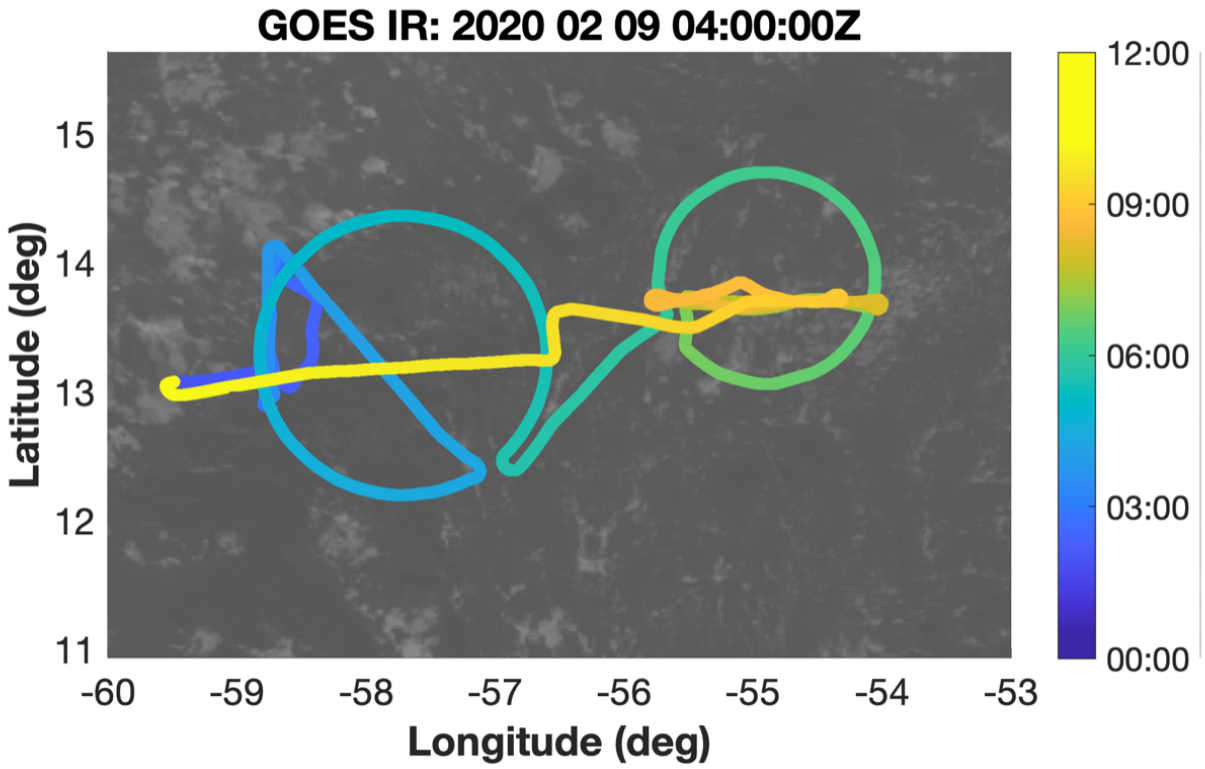

Figure 1. Plan view of flight path for WP-3D RF09. The track is superimposed on a satellite image from GOES-14 Channel 13 (11 micron, "clean" IR window) at 04:00Z.

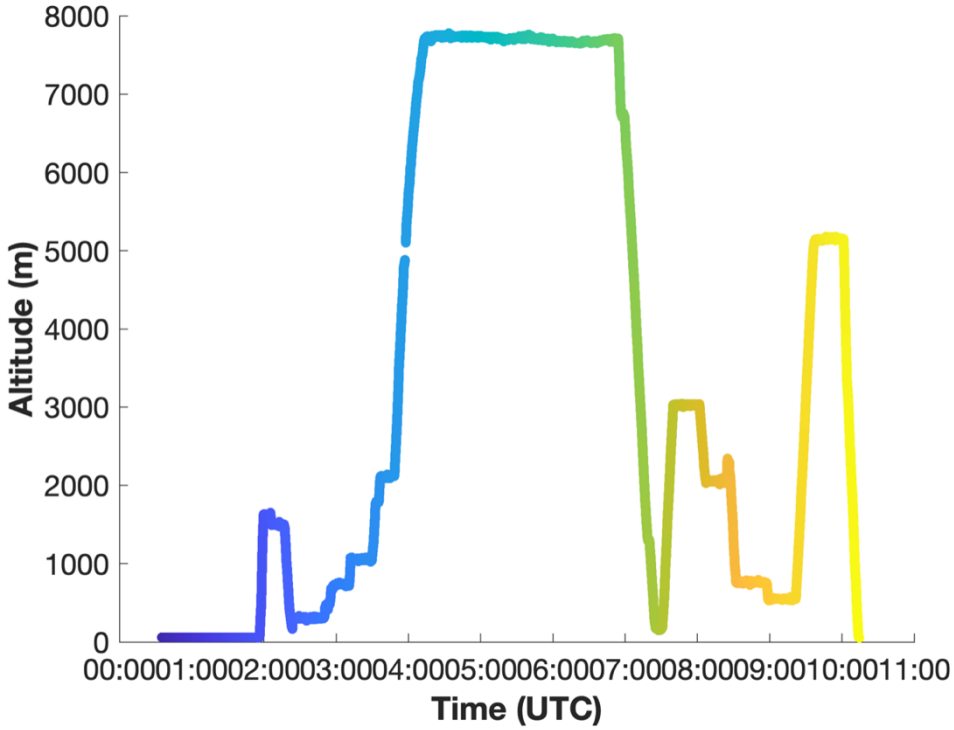

Figure 2. Profile view of flight plan.

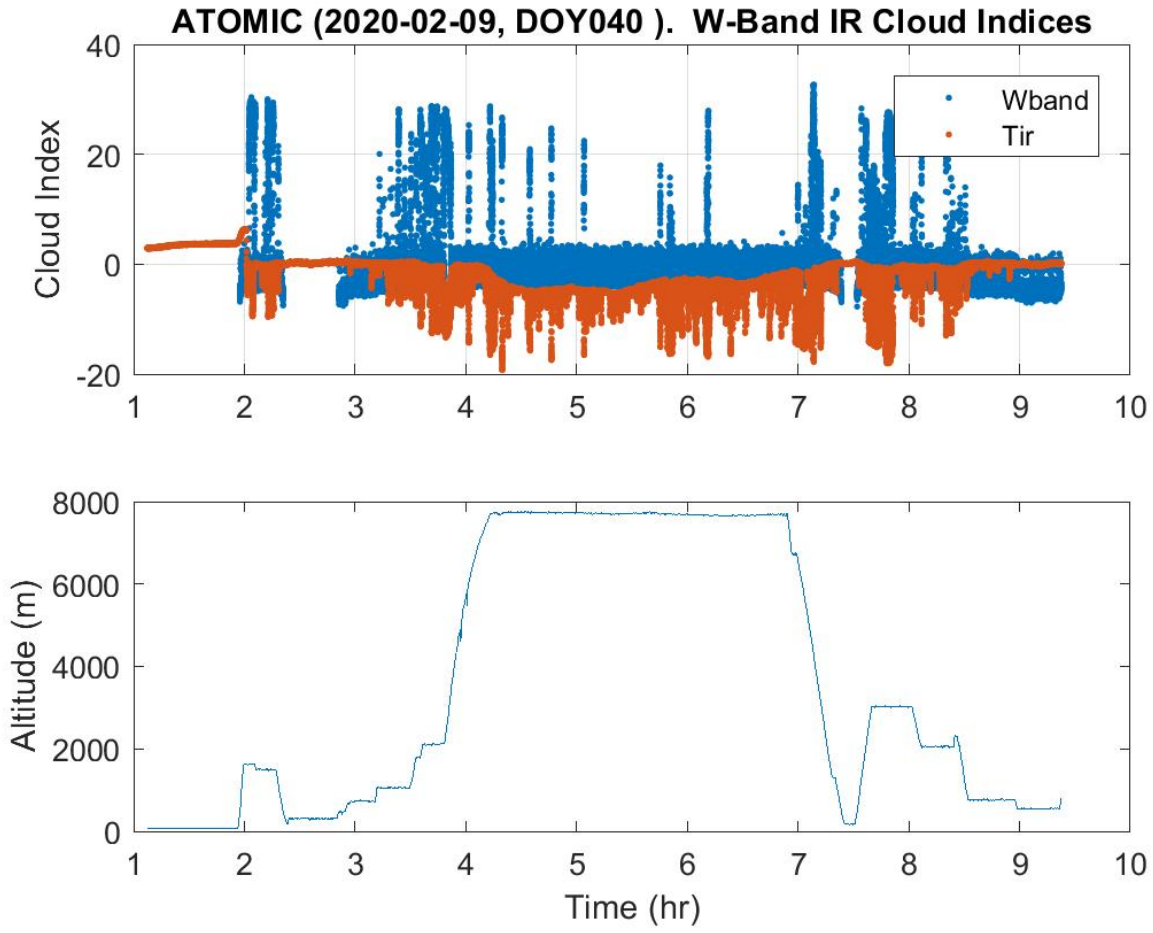

Figure 3. Two very rough estimates of cloudiness as a function of flight time (top panel). Blue dots show the maximum signal-to-noise ratio in the W-band radar, red dots the approximate difference in the brightness temperature of upwelling infrared radiation from the sea surface. A profile view of the flight plan is repeated in the lower panel.

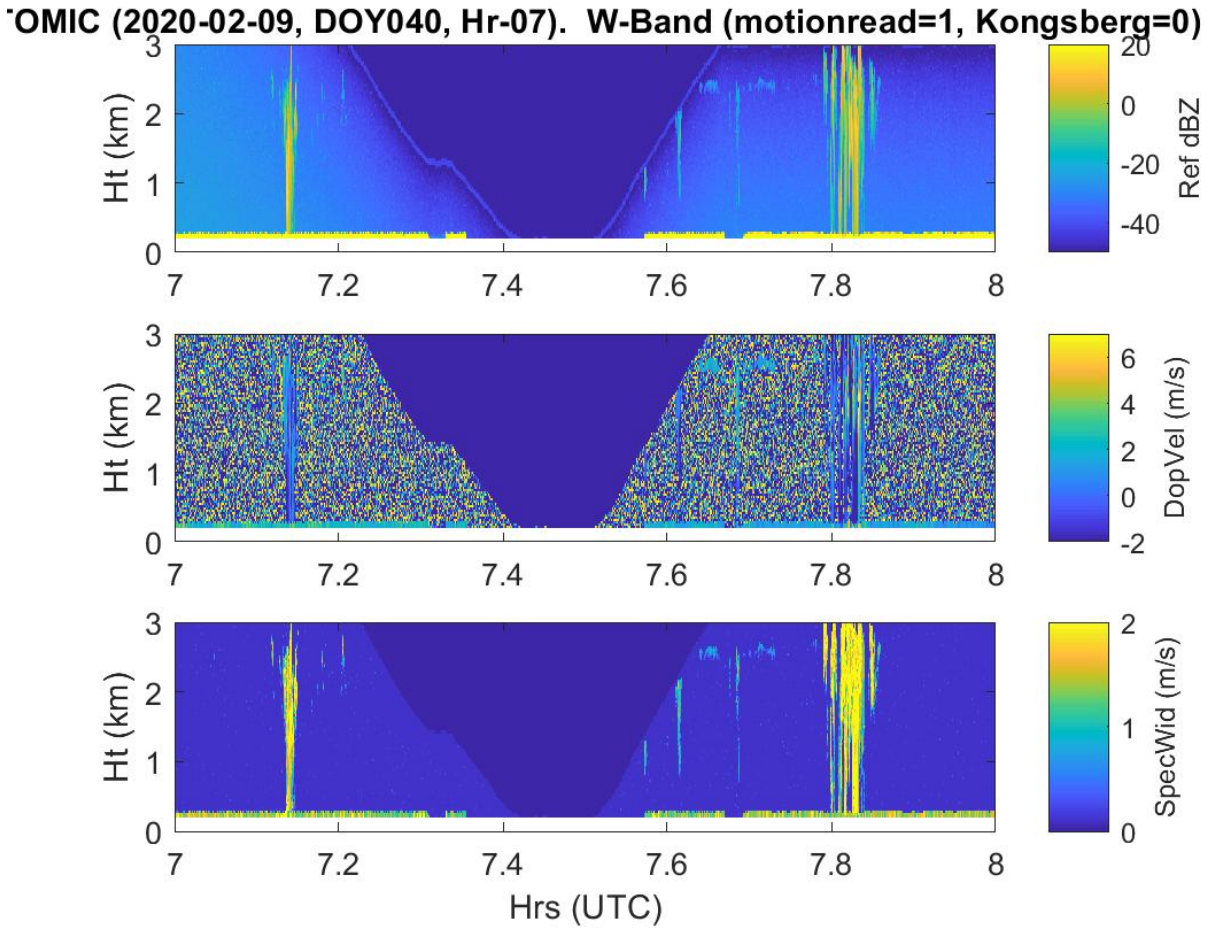

Figure 4. Radar reflectivity, doppler velocity, and spectral width during the isotope profile and the beginning of the second cloud module.

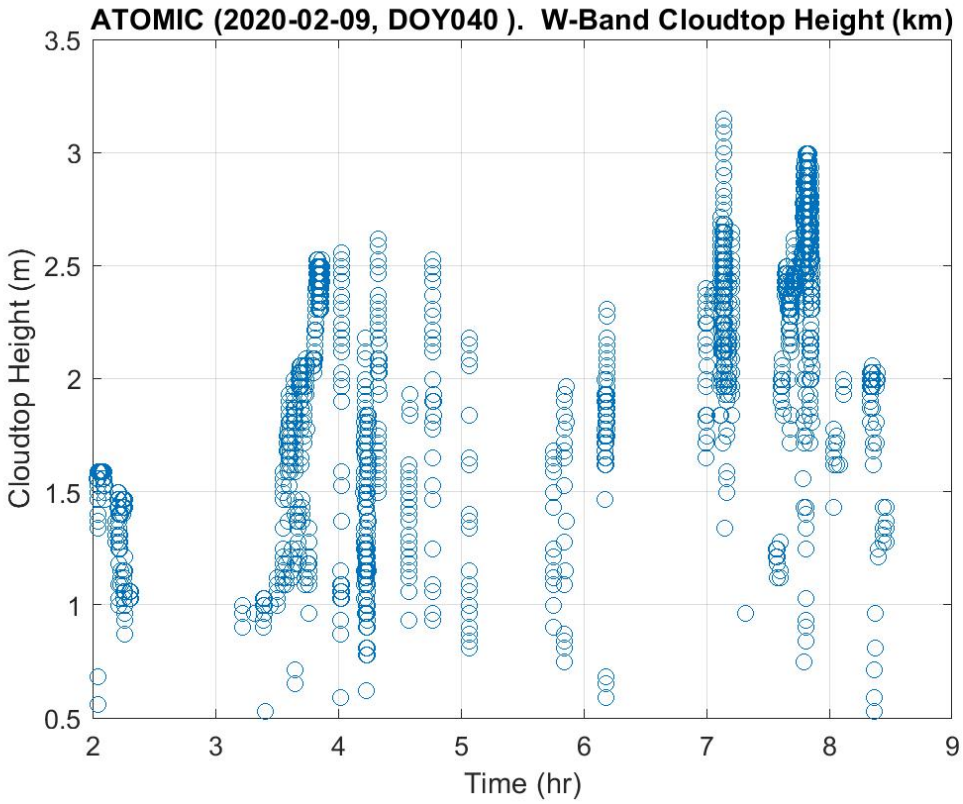

Figure 5. Distribution of cloud-top heights observed by the W-band radar.

Figure 6. Clouds at sunrise, 05:35 LT/09:35Z, during transit back to Barbados at roughly FL 160. .