

**NOAA / AOML / Hurricane Research Division
2021 Hurricane Field Program
Advancing the Prediction of Hurricanes Experiment (APHEX)**

FLIGHT LOG -- 2021081511

MISSION PLAN			
FLIGHT ID	2021081511	STORM	AL07 / GRACE
MISSION ID	0207A	TAIL NUMBER	NOAA43
TASKING	NHC	PLANNED PATTERN	Alpha
MISSION SUMMARY			
TAKEOFF [UTC]	1553	LANDING [UTC]	2031
TAKEOFF LOCATION	Aruba	LANDING LOCATION	Aruba
FLIGHT TIME	4.6	BLOCK TIME	4.9
TOTAL REAL-TIME RADAR ANALYSES (Transmitted)	3 (3)	TOTAL DROPSONDES (Good/Transmitted)	4 (4/4)
OCEAN EXPENDABLES (Type)	None	sUAS (Type)	None
APHEX EXPERIMENTS / MODULES	Genesis Experiment: PREFORM		
HRD CREW MANIFEST			
LPS ONBOARD	Zawislak	LPS GROUND	None
TDR ONBOARD	Zawislak	TDR GROUND	Reasor
ASPEN ONBOARD	Sellwood	ASPEN GROUND	None
NESDIS SCIENTISTS	None		
GUESTS (Affiliation)	None		
AOC CREW MANIFEST			
PILOTS	Mitchell, Rannenberg, Copare, Legidakes		
NAVIGATOR	Freeman		
FLIGHT ENGINEERS	Darby, Wysinger		
FLIGHT DIRECTOR	Carpenter		
DATA TECHNICIAN	Mascaro		
AVAPS	Underwood		

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PRE-FLIGHT	
Flight Plan	Alpha pattern in support of the NHC-tasked 1730Z fix requirement; planned for radial legs starting NW to SE, then NE to SW, then if time permits, a third pass (perhaps from S to N to the center, then center to W to exit). 5000 ft is the expected altitude for the fix, and throughout the pattern.
Expendable Distribution	Dropsondes at endpoints and center
Preflight Weather Briefing	Tropical Storm Grace continues to struggle to develop further, even though it is exhibiting an extensive amount of deep convection around the center. It's likely that the low-level circulation still has not consolidated, though a distinct midlevel circulation from overnight convection is very apparent in the satellite imagery this morning. Deep convection will likely make it challenging to maintain straight legs on the radials. The decision was made to come in from the NW first for the fix, though, we expect to encounter a significant challenge in fixing a center at 5000 ft, if the storm still has a wave trough present in the low levels.
Instrument Notes	All instruments operational besides IWRAP

IN-FLIGHT	
Time [UTC]	Event

POST-FLIGHT	
Mission Summary	An NHC fix mission was flown into Tropical Storm Grace. Many challenges were encountered while trying to execute the standard Alpha pattern, the most significant of which was that there was no clear center; instead we observed a wave trough, or more likely elongated circulation oriented from WSW to ENE. Multiple attempts were made to find a westerly wind, but none would exist in such a wind structure at low-levels. The most valuable data came from the tail Doppler radar, which showed a midlevel circulation

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likely present in the eastern portion of the pattern (see below), and the elongated circulation below that level (including at flight level). An extensive amount of precipitation, particularly deep convection, was present throughout the disturbance, making it particularly challenging to execute the fix requirement, and maintain straight legs. Some modification in the strategy was made after the attempt at the fix by flying the originally intended outbound towards the SE, then flying northward to a NE inbound point. From there, a WSW leg was executed, but this was merely for tail Doppler radar sampling, rather than fixing a center in flight level winds. Despite being released to a transit back to base, we continued to fly at 5000 ft WSW in an attempt to find another wind shift (and maybe westerly wind) at that altitude -- none was encountered.

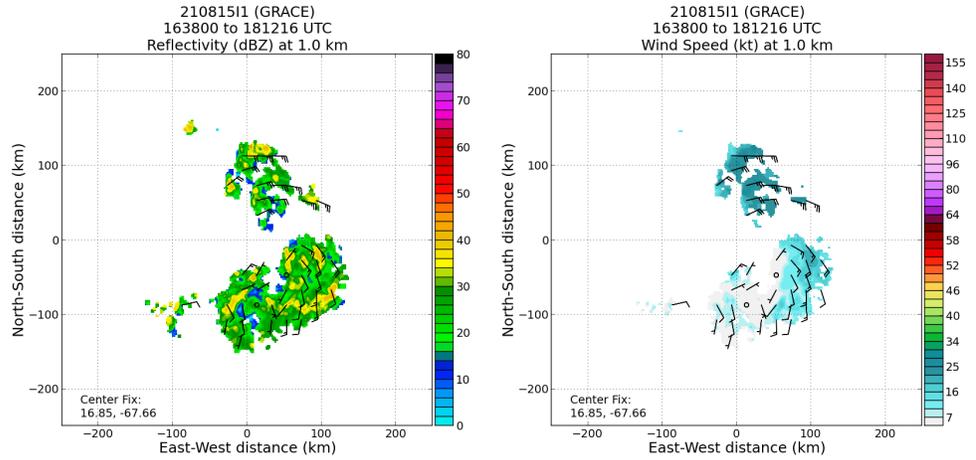
Ultimately, the Alpha pattern for such a storm state as this is not the right one. The square spiral pattern would serve as a much more effective pattern for sampling storms without clearly defined low-level circulations. This flight would have benefited significantly by flying a square spiral such that an outer box (surrounding the predicted, potential center location) could be used to identify the larger scale flow features, then based on that data, either fly an inner box, or Fig. 4, that surveys closer any circulation features identified by either dropsondes, flight-level data, or from the tail Doppler radar. Based on this flight's data, and the previous, it's very likely that Grace has never exhibited a persistent, symmetric low-level circulation -- as observed in the 1411 flight, there was an open wave trough, and during this flight an elongated circulation.

Now, given that there is a midlevel circulation in close proximity to the elongated low-level circulation, and the persistence of deep convection, perhaps there is an opportunity for Grace to intensify before landfall in Hispaniola in about 24 hours.

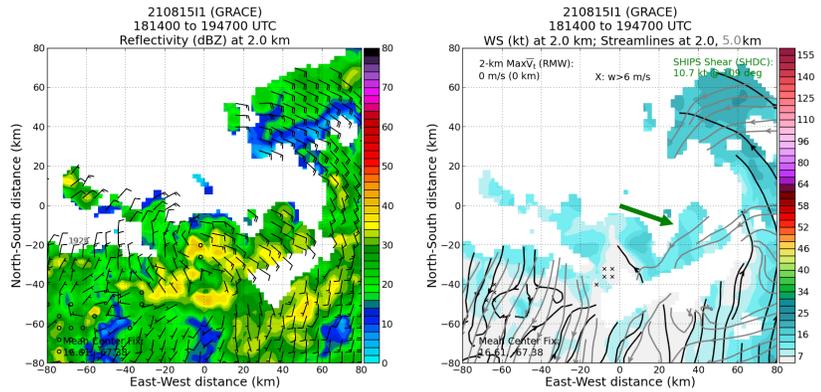
4 total dropsondes were released for NWS.

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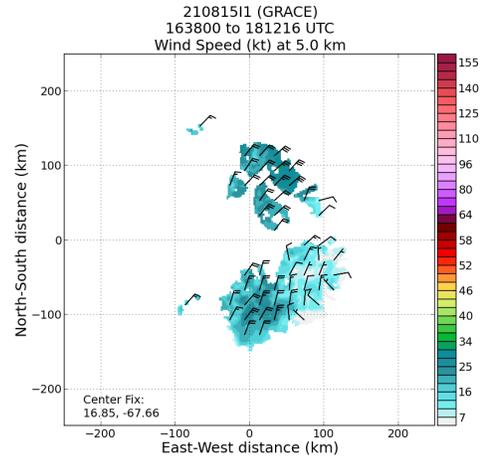
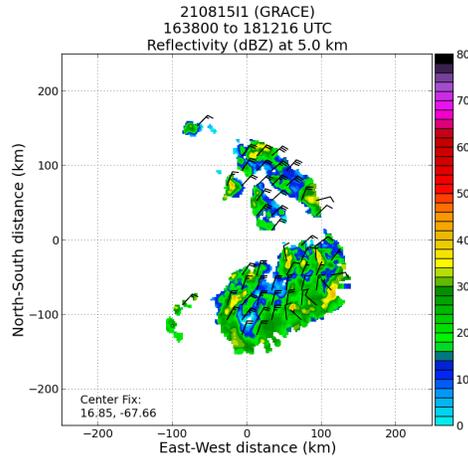


Winds and reflectivity at 1 km on the first pass of the storm, and the attempt at the fix; data shows the elongated axis of a trough or circulation at 1 km. Below is a zoomed in look at 2 and 5 km flow and 2 km reflectivity:

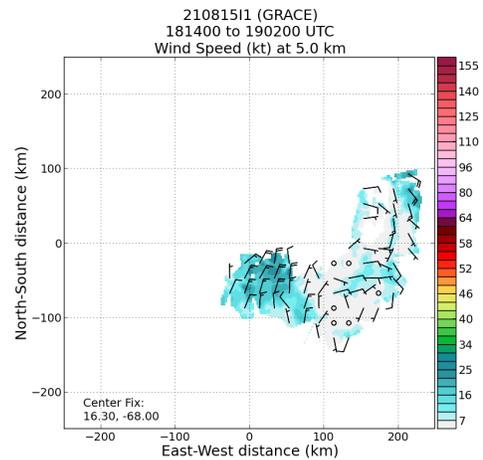
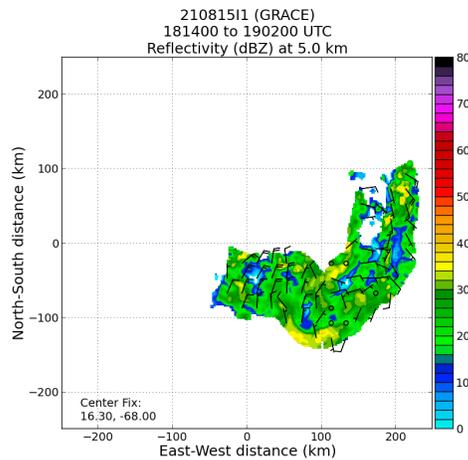


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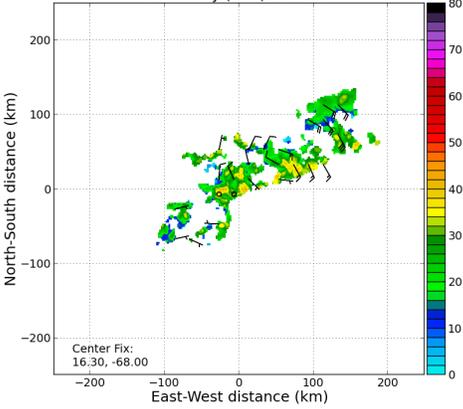
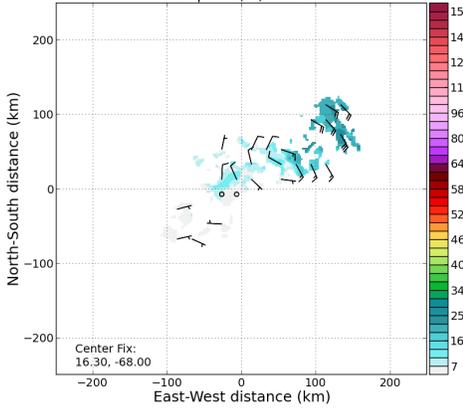
Winds and reflectivity at 5 km on the first pass of the storm, and the attempt at the fix; data shows evidence of a midlevel circulation to the east of the elongated low-level center -- the second analysis (for the outbound to the SE and reposition to the NE) sampled it better:



And finally, the final pass, which shows some possible consolidation of a circulation, but this is likely very transient in nature. With a considerable amount of convection present at this time, these could be temporary "swirls" that don't persist long enough to become the nascent surface/low-level circulation of the storm.

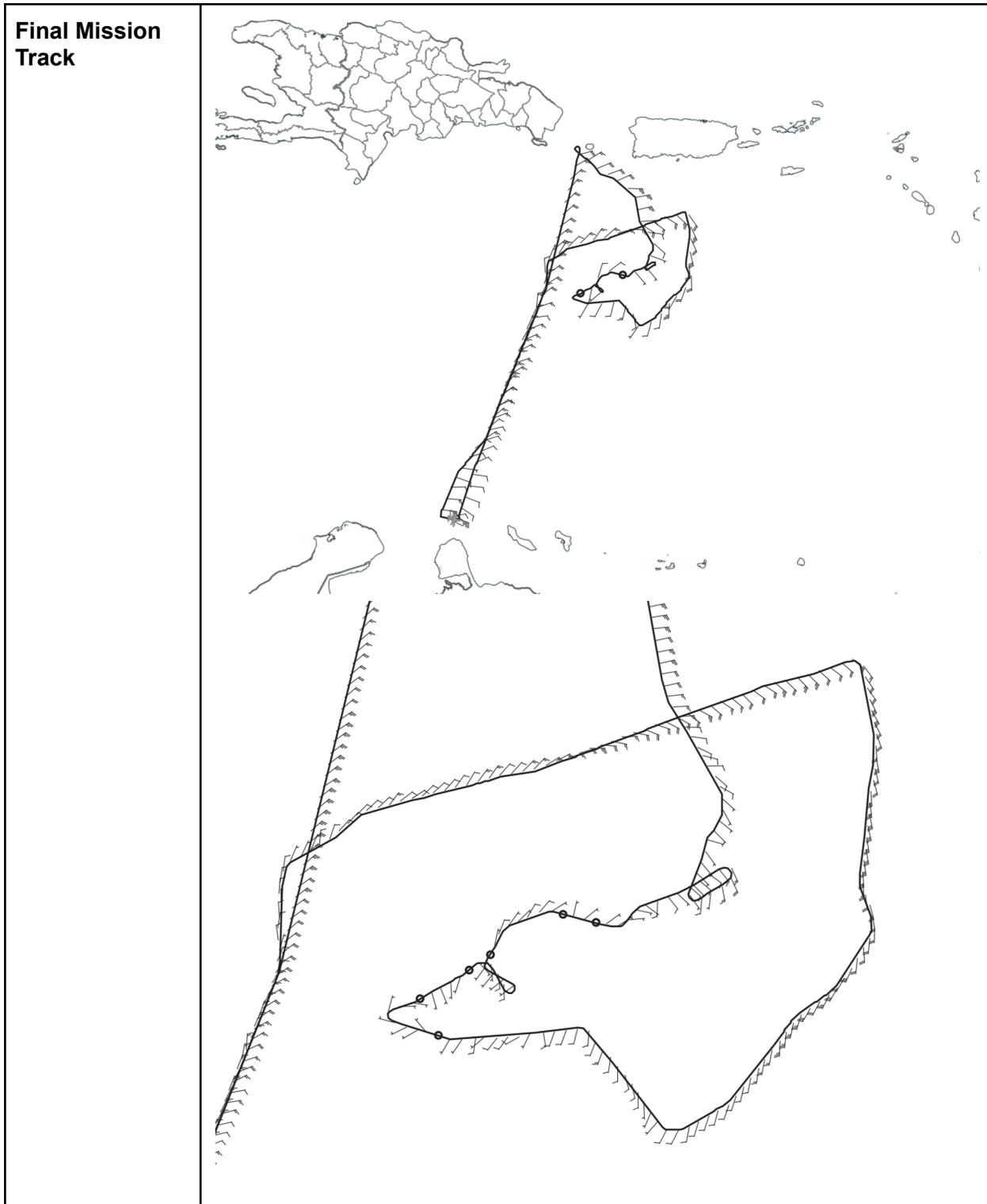
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	<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>210815I1 (GRACE) 190240 to 194700 UTC Reflectivity (dBZ) at 1.0 km</p>  <p>Center Fix: 16.30, -68.00</p> </div> <div style="text-align: center;"> <p>210815I1 (GRACE) 190240 to 194700 UTC Wind Speed (kt) at 1.0 km</p>  <p>Center Fix: 16.30, -68.00</p> </div> </div>
<p>Actual Standard Pattern Flown</p>	<p>Alpha pattern at 5000 ft; dropsondes released at a couple of endpoints and a closest-point-of-approach (CPA) of a “center” which was really just a shift in winds at one point along the elongated low-level circulation.</p>
<p>APHEX Experiments / Modules Flown</p>	<p>While tasked operationally, this flight’s data will be valuable to the <i>Genesis Experiment: PREFORM</i>.</p>
<p>Plain Language Summary</p>	<ul style="list-style-type: none"> ● This flight attempted to identify the center of circulation of Tropical Storm Grace. Rather than finding a clear center, instead data showed that the storm has an elongated circulation center or wave axis that made it challenging to fix an actual closed center. ● Although the pattern did not sample the system in its entirety, it does not appear that the storm has tropical storm force winds. ● The data collected (despite the tropical storm designation by NHC) will be valuable in research on hurricane formation.
<p>Instrument Notes</p>	<p>All instruments functioned nominally</p>

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