

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

FLIGHT LOG - 20210925H1

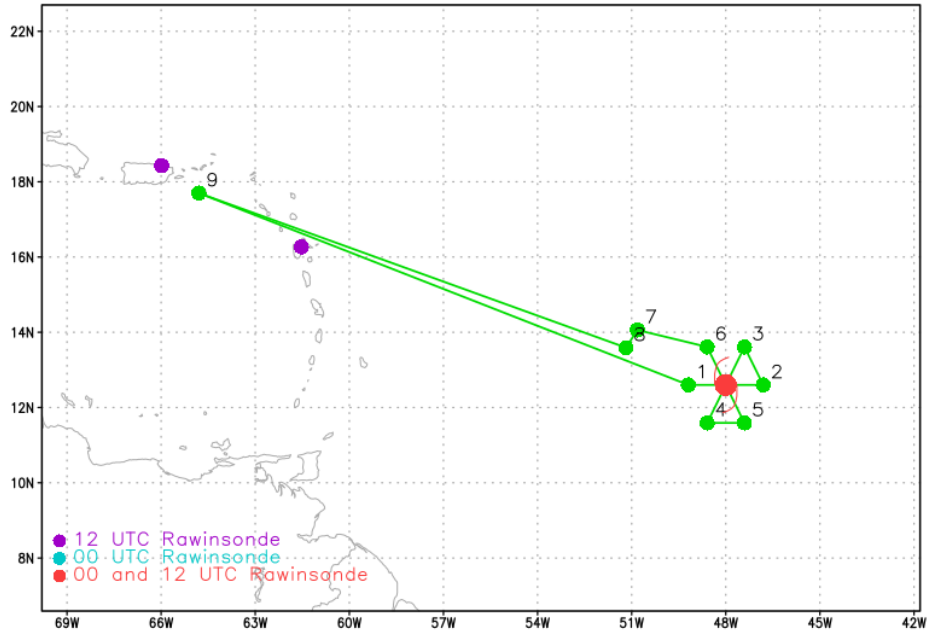
MISSION PLAN			
FLIGHT ID	20210925H1	STORM	AL18 / SAM
MISSION ID	WB18A	TAIL NUMBER	NOAA42
TASKING	HRD/ONR TCRI	PLANNED PATTERN	Butterfly
MISSION SUMMARY			
TAKEOFF [UTC]	1848	LANDING [UTC]	0311
TAKEOFF LOCATION	St. Croix	LANDING LOCATION	St. Croix
FLIGHT TIME	8.4	BLOCK TIME	8.6
TOTAL REAL-TIME RADAR ANALYSES (Transmitted)	3 (3)	TOTAL DROPSONDES (Good/Transmitted)	34 (31/31)
OCEAN EXPENDABLES (Type)	8 ONR AXBT, 2 Navy ALAMO	sUAS (Type)	None
APHEX EXPERIMENTS / MODULES	Ocean Observing: Sustained and Targeted Observations; Satellite Validation: ADM-Aeolus		
HRD CREW MANIFEST			
LPS ONBOARD	Bucci	LPS GROUND	Zawislak
TDR ONBOARD	Bucci	TDR GROUND	Gamache
ASPEN ONBOARD	J. Zhang	ASPEN GROUND	None
NESDIS SCIENTISTS	None		
GUESTS (Affiliation)	None		
AOC CREW MANIFEST			
PILOTS	Legidakes, Keith, Rannenberg		
NAVIGATOR	Hough, Utama		
FLIGHT ENGINEERS	Sanchez, Levine		
FLIGHT DIRECTOR	Hathaway, Lundry		
DATA TECHNICIAN	T. Richards		
AVAPS	McAllister		

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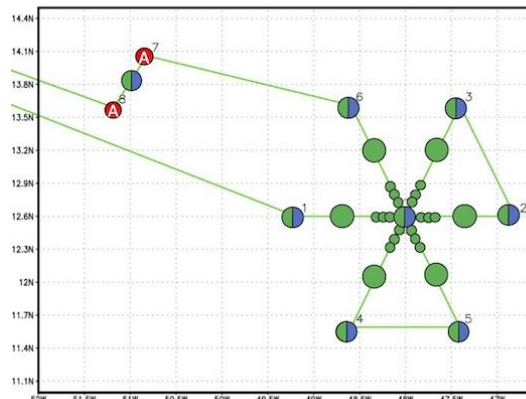
PRE-FLIGHT

Flight Plan



Tasking: HRD-TCRI

N42 flight into Sam: 25 September, 2021



- Flight track
- Regular drop
- Combo drop (Regular + AXBT)
- Eyewall rapid drop sequence
- A Navy ALAMO float

Dropsone payload: ~34 total (13 ONR, 21 EMC)
 6 turn point drops (EMC)
 6 midpoint drops (EMC)
 3 center drops (EMC)
 ~18 RMW rapid drops (~12 ONR, 6 EMC)
 1 drop between 7 and 8 (ONR)

AXBT payload: 8 (NRL/ONR)

center drop guidance: Regular drops in the center on each center pass; attempt combo AXBT drop on 1 center pass. 1 mid-pt drop WP 7-8

RMW drop guidance: release at least 3 drops on each pass through eyewall/RMW.

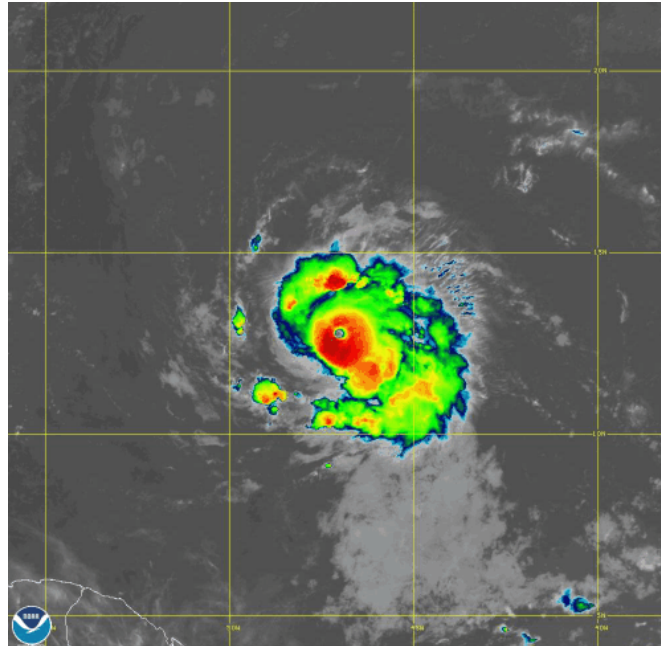
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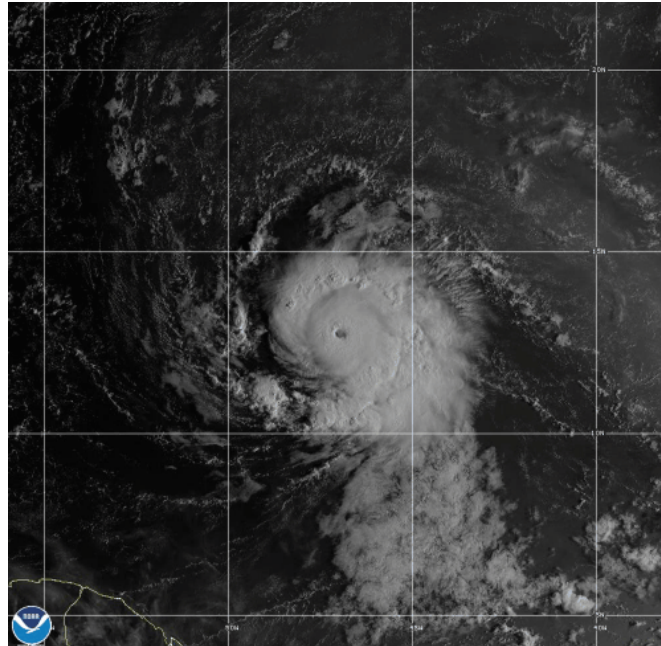
	<p>The planned pattern is for a 70 nmi butterfly with a brief module northwest of the storm to release 2 Navy ALAMO floats (at a location 24 hours in advance of the passage of the storm center track). Altitude in pattern and for ALAMO releases will be 10 kft.</p>
<p>Expendable Distribution</p>	<p>Dropsondes to be released at the endpoints (EMC), midpoints (EMC), center (EMC), and RMWs on each inbound and outbound (6 charged to EMC, the remainder to ONR TCRI). Another sonde will be released in combo with an ONR AXBT between the ALAMO releases. ONR AXBTs will be released at each endpoint, once in the center (if possible), and once between the 2 Navy ALAMO releases.</p>
<p>Preflight Weather Briefing</p>	<p>As of the 2 PM EDT NHC advisory, Hurricane Sam is located near 12.9N / 47.6W, has an estimated max sustained winds of 105 kt, MSLP of 960 mb, and is moving west-northwest at 9 kt. Over the past 24 hours, Sam has continued to rapidly intensify. The inner core continues to gain symmetry as it is no longer somewhat constricted on the west side of the storm and there is a complete ring of deep convection around the center. The eye has also been progressively clearing over the past few hours. It's possible the storm is continuing to intensify, though this mission will collect the first in-situ data from the center of the storm. The environment remains very favorable for rapid intensification, with possibly only a slight cool ocean eddy and eyewall replacement cycles being the limiting factor for further intensification today.</p>

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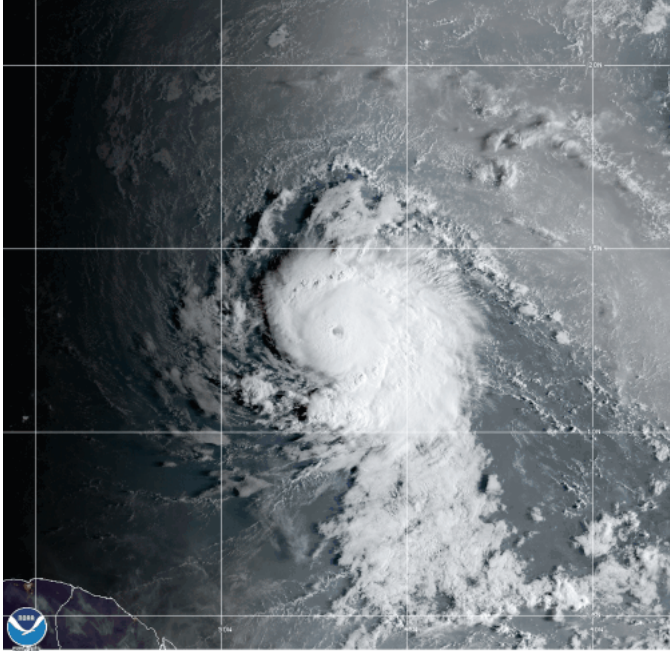
25 Sep 2021 10:50Z NOAA/NESDIS/STAR GOES-East Band 13 HU Sam



25 Sep 2021 10:40Z NOAA/NESDIS/STAR GOES-East Band 02 HU Sam

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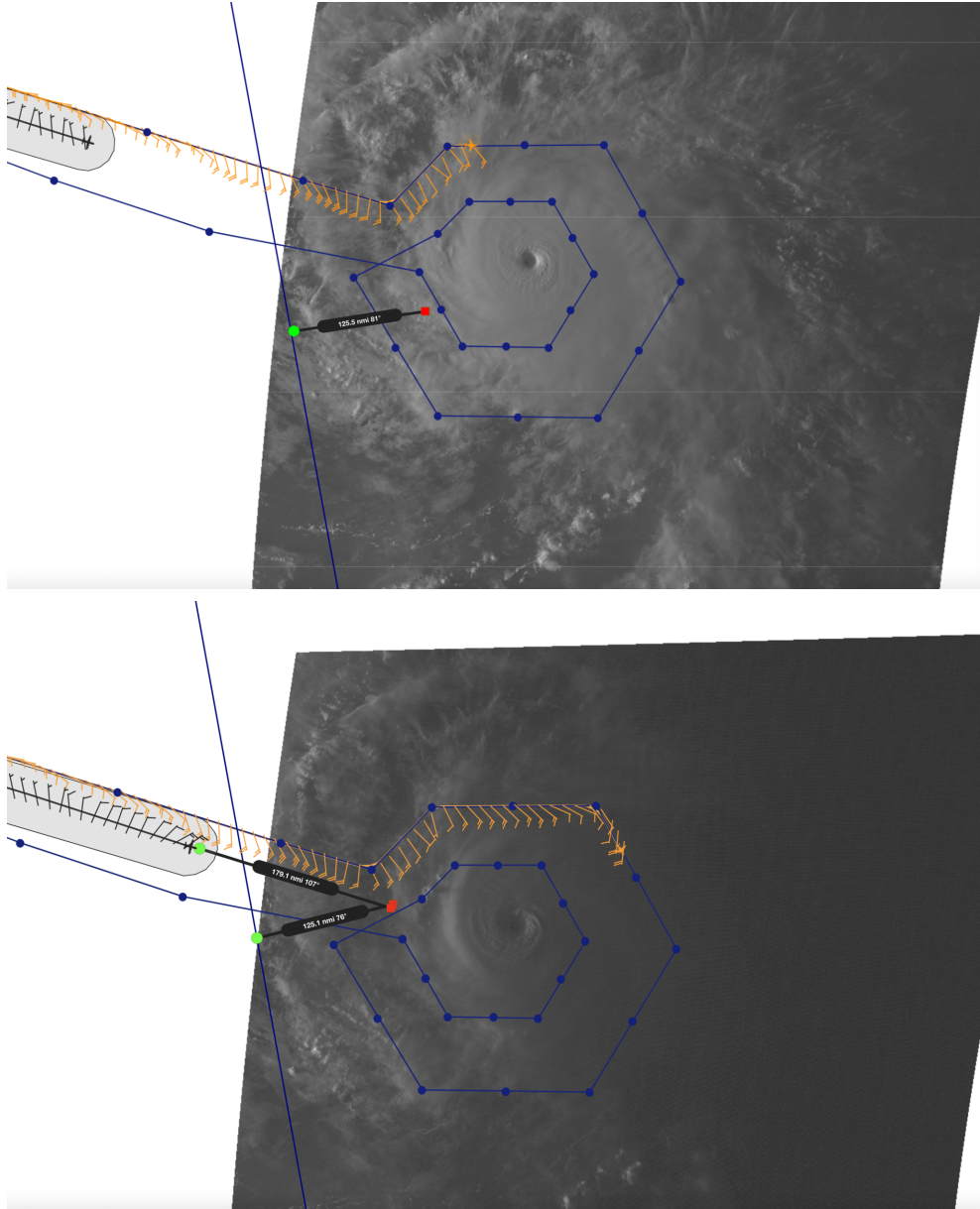
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	 <p style="font-size: small; text-align: center;">25 Sep 2021 10:00Z NOAA/NESDIS/STAR GOES-East GEOCOLOR</p>
Instrument Notes	None notable

IN-FLIGHT	
Time [UTC]	Event
1848	Takeoff from St. Croix
2057	Potential fortuitous Aeolus overpass validation as Aeolus will be passing just west of the storm at 2121Z. The G-IV dropsondes on the W and SW side of the inner circumnav will be after the satellite passes overhead by 45 min - 1 hour, but will be in the footprint of the satellite.

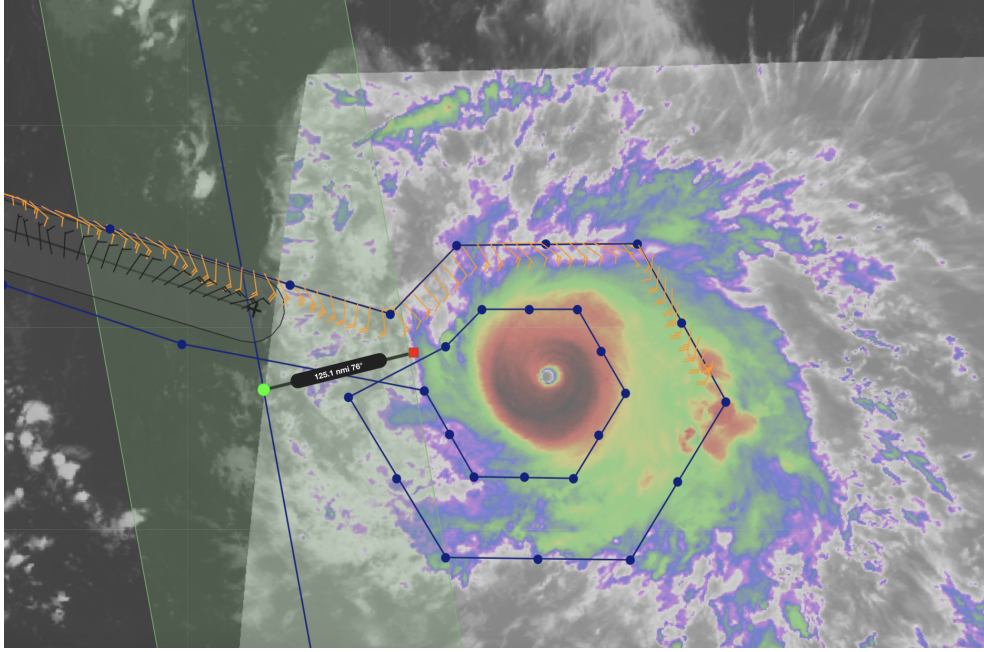
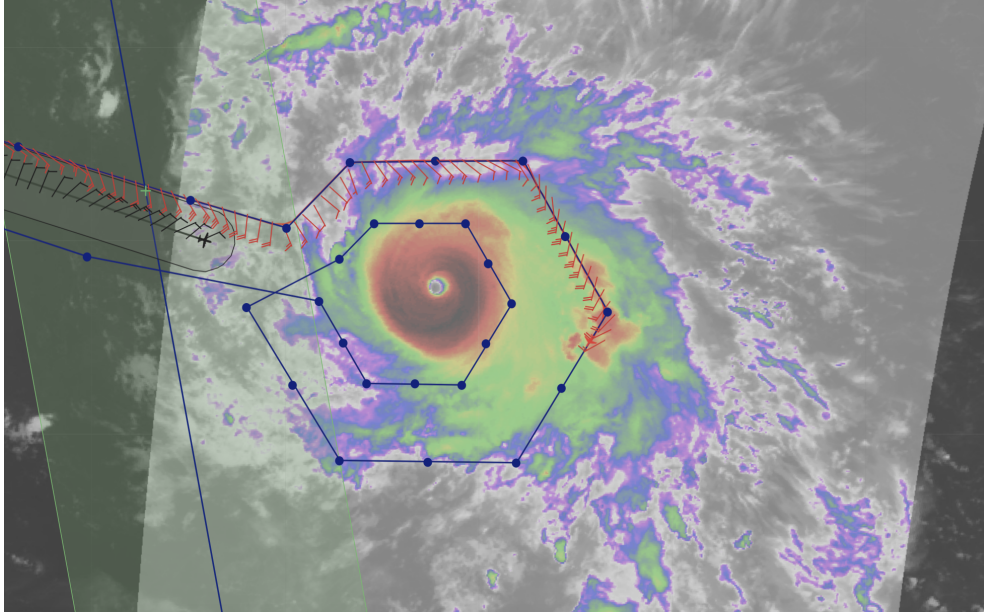
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	 <p>The figure consists of two vertically stacked satellite images of a hurricane. The top image shows a flight path (blue line) with a sensor footprint (orange arrows) and a specific location marked '125.5 nmi 81°'. The bottom image shows a similar flight path with two sensor footprints marked '126.1 nmi 107°' and '125.1 nmi 70°'. Both images show the hurricane's eye and surrounding cloud structure.</p>
2105	Will attempt to work in an Aeolus validation sonde near 50.5W on their ferry, which would be released just inside 125 nmi from the Aeolus footprint about 15 min after the satellite comes over head:

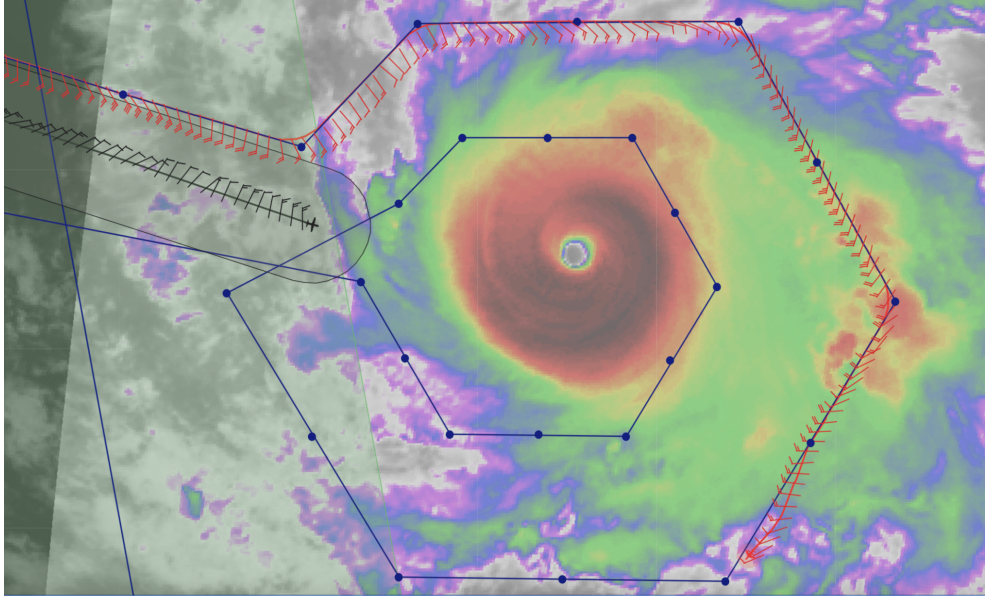
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	 <p>A satellite image of Hurricane Sam showing cloud tops and precipitation. A flight path is overlaid with a green cross marking the position of ADM-Aeolus. A label '125.1 nm 18°' is visible near the green cross.</p>
2121	<p>ADM-Aeolus passed the storm (green cross in screenshot)</p>  <p>A satellite image of Hurricane Sam, similar to the first image, but with a red cross marking the position of ADM-Aeolus, indicating it has passed the storm.</p>
2130	<p>In the 5 PM EDT advisory, NHC upgraded Sam to 120 kt, 943 mb, and is located near 13.3N/48.5W.</p>
2135	<p>Sonde #1 [HRD1] released for ADM-Aeolus validation just inside of the 125</p>

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	<p>nmi edge of the descending footprint of the satellite. Still with thinnish cirrus overhead before getting under the thicker dense overcast. Screenshot below near time of release...</p> 
2143	Descending to get to IP to do first inbound from the west
2149	Combo drop / Arrive at IP / Released ahead of convective line (Sonde #2 [EMC1], ONR AXBT #1). SST 28.5 sfc 17 kts dir 025
2201	SMRF values look suspect
2159	West mid pt drop (Sonde #3 [EMC2])
2204	First RMW W (Sonde #4 [EMC3])
2206	Second RMW W (Sonde #5 [ONR1])
2207	Third RMW W (Sonde #6 [ONR2])
2207	Center Combo (Sonde #7 [EMC4]; ONR AXBT #2). No SST from center BT.
2209	As expected, very tight wind gradient!

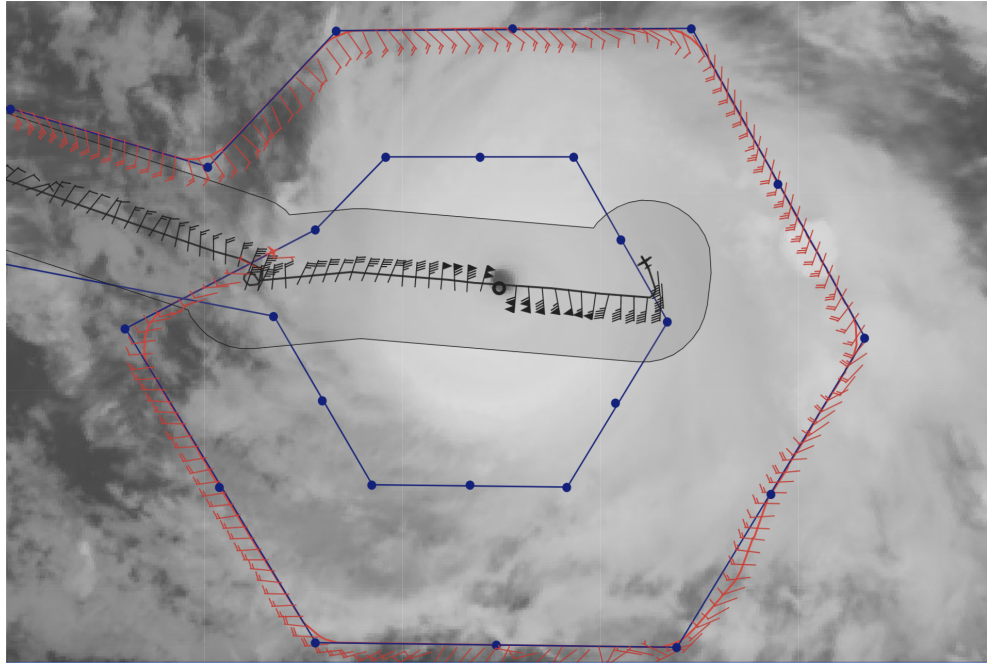
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2209	First RMW E (Sonde #8 [EMC5])
2210	Second RMW E (Sonde #9 [ONR3])
2215	East mid pt drop (Sonde #10 [EMC6])
2221	Extrapolated MSLP was 942 mb and the 10-sec SFMR winds peak

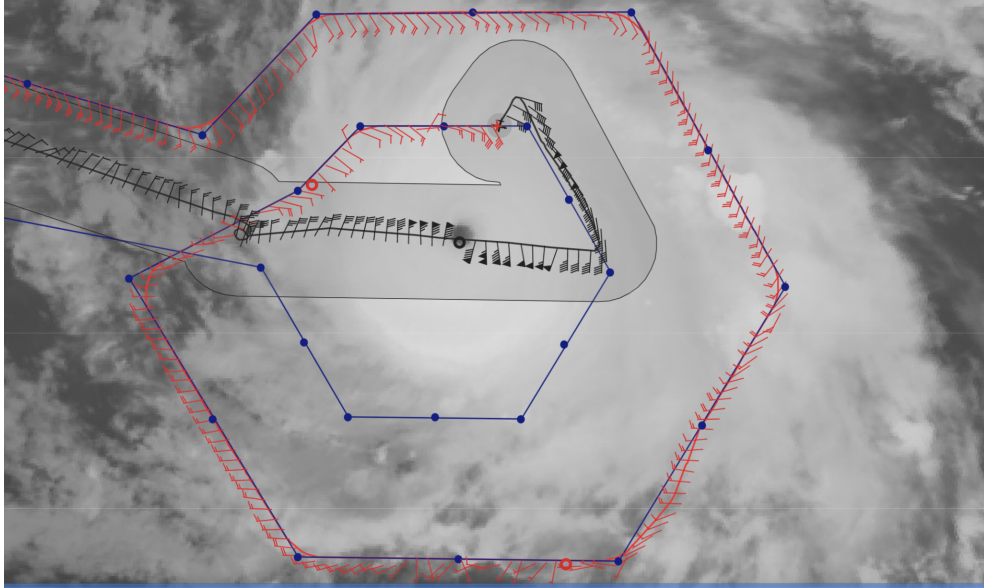
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	outbound were 133 kt, although there was an instantaneous measurement of 140 kt. Center sonde splash at 945 with 9 kt of wind.
2223	Endpoint east (Sonde #11 [EMC7]; ONR AXBT #3). SST 27.8C
2227	<p>A look at the first pass as the G-IV arrives into the inner circumnavigation</p> 
2237	New points for the Navy ALAMO releases: 14.66N / 50.73W and 14.15N / 51.05W
2245	The G-IV and P-3 are right on top of one another as the P-3 heads inbound to the center from the NE and the G-IV is on the northern portion of its inner circumnav.

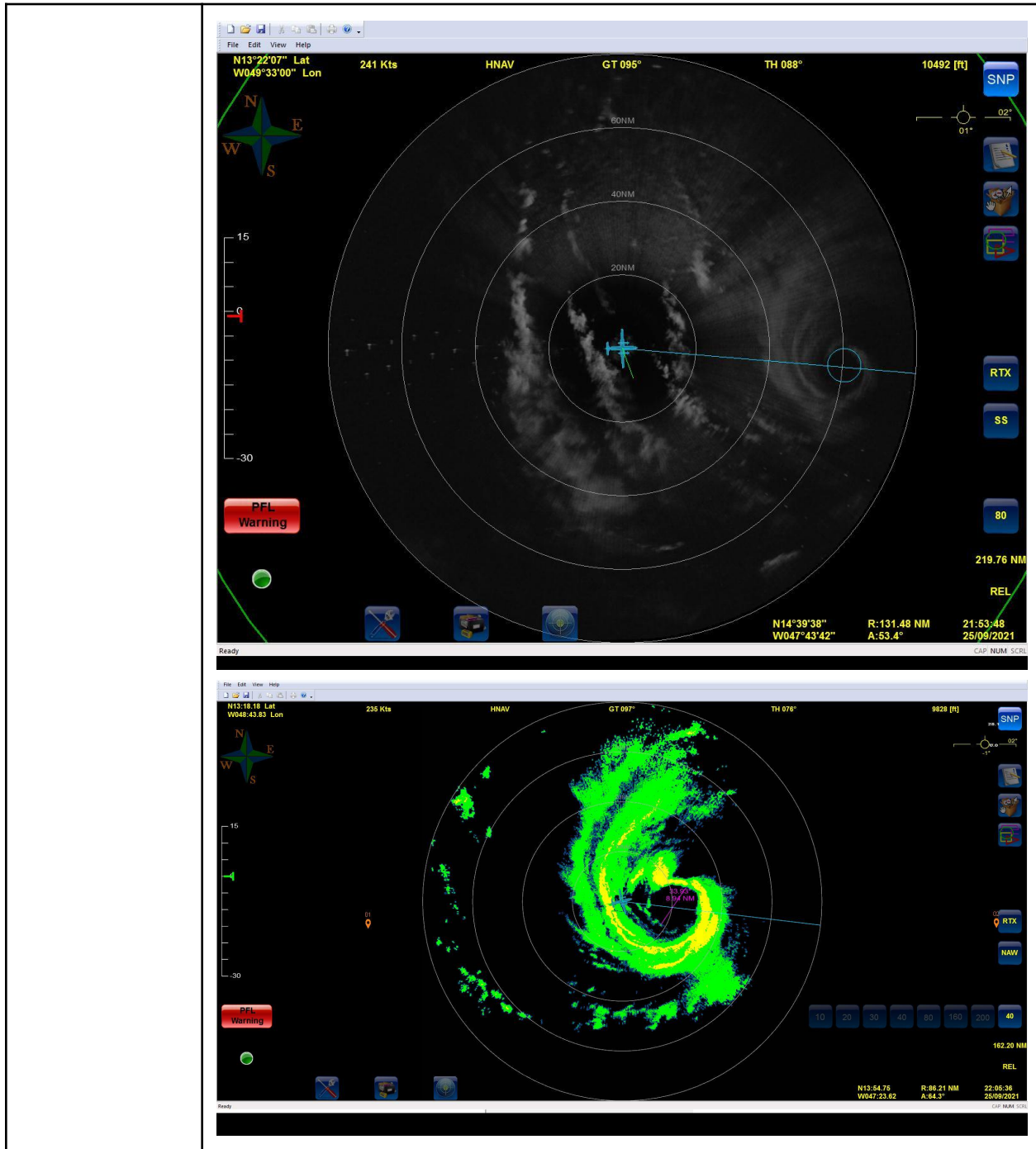
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2242	IP northeast (Sonde #12 [EMC8]; ONR AXBT #4). SST 27.9C
2251	Northeast mid pt (Sonde #13 [EMC9]) -- No launch detect, but there are data that can be reprocessed
2255	A look at the MMR inbound from the west on the first pass. Reports from the plane were significant turbulence outbound with graupel. Lots of lightning, as well, so pretty significant convection as seen in the satellite imagery below from the first pass.

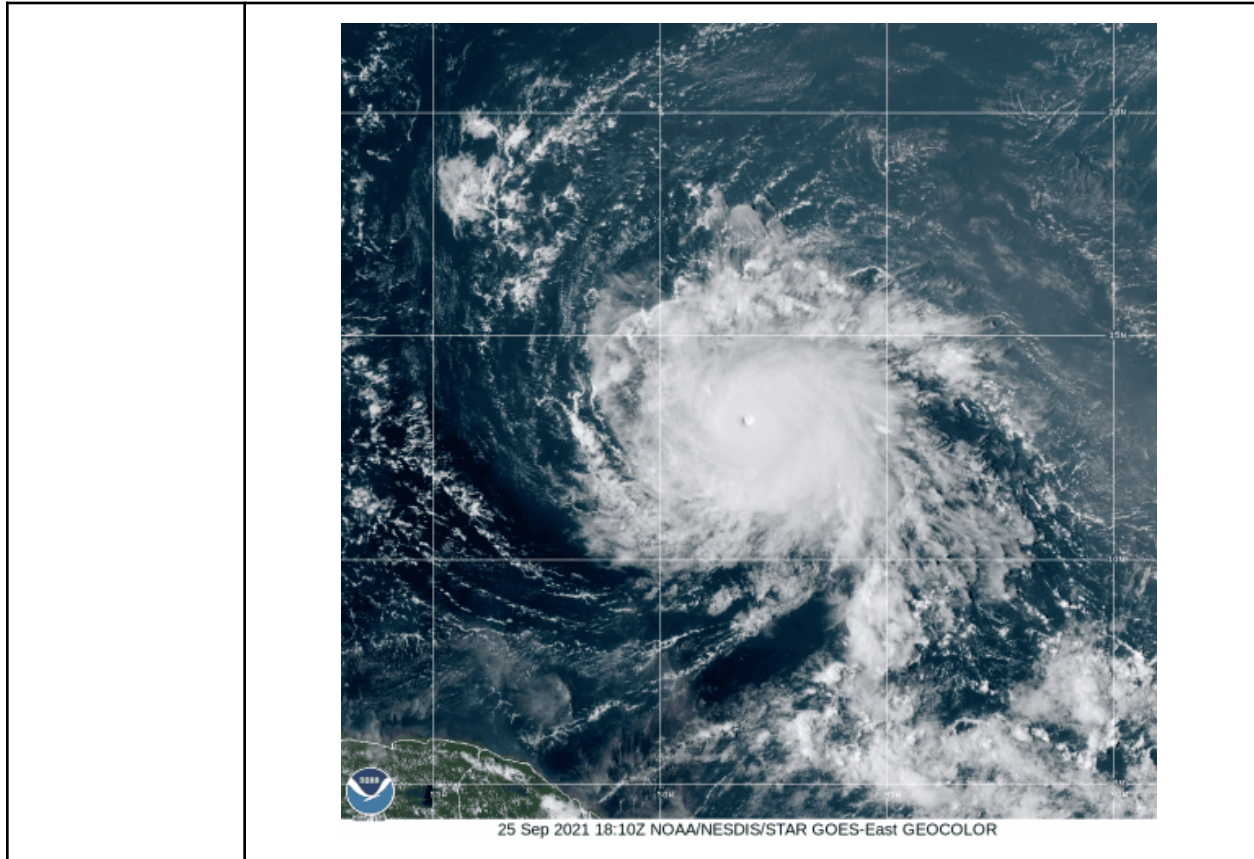
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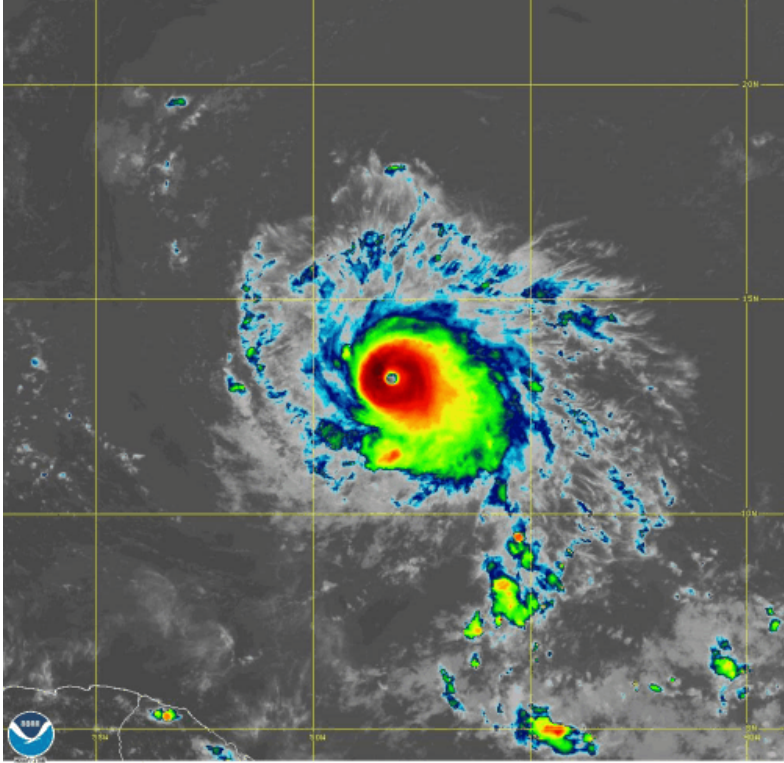
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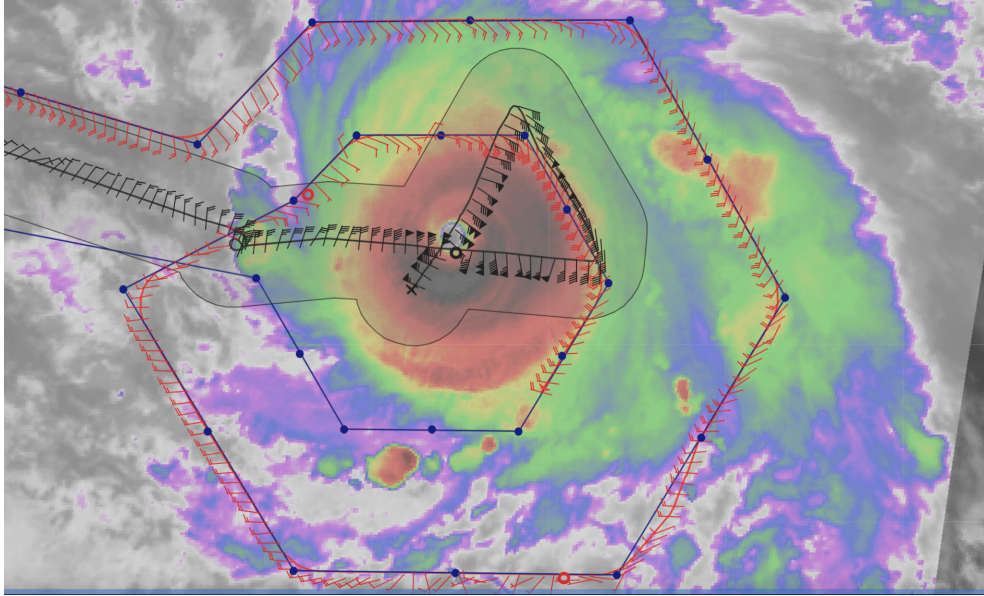
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	 <p style="text-align: center; font-size: small;">25 Sep 2021 18:50Z NOAA/NESDIS/STAR GOES-East Band 13 HU Sam</p>
2257	First RMW NE (Sonde #14 [EMC10]), Second RMW NE (Sonde #15 [ONR4]), Third RMW NE (Sonde #16 [ONR5])
2259	Center #2 (Sonde #17 [EMC11])
2301	First RMW SW (Sonde #18 [EMC12]), Second RMW SW (Sonde #19 [ONR6]), Third RMW SW (Sonde #20 [ONR7])
2307	A look at the 2nd pass of the center from NE to SW

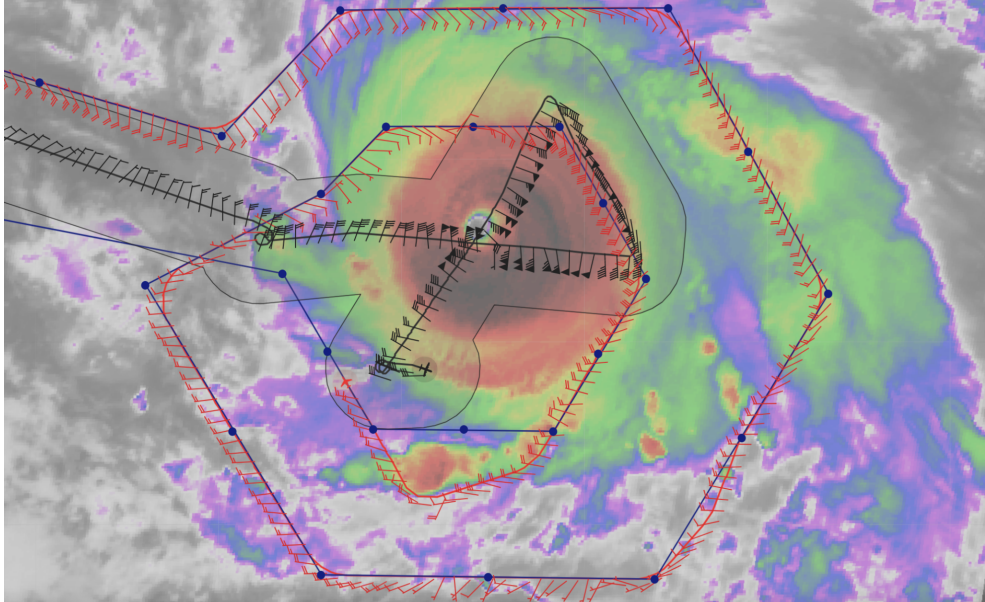
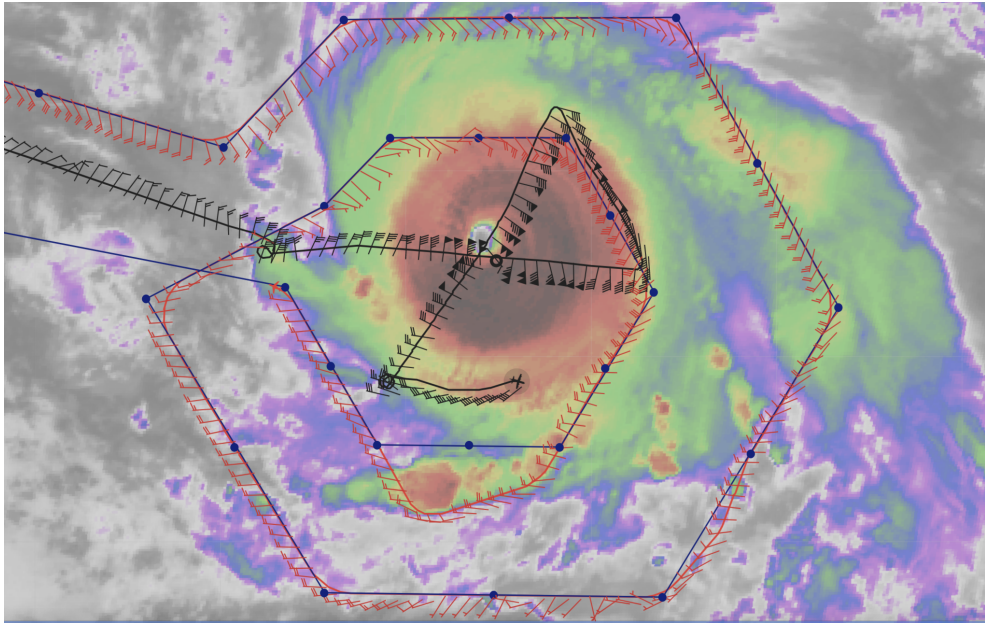
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2308	SW midpoint (Sonde #21 [EMC13])
2312	The maximum inbound surface wind was 136 kt! Still extrapolated MSLP of 942 mb.
2322	Circling to give AVAPS a moment to reset
2323	SW endpoint combo (Sonde #22 [EMC14]; ONR AXBT #5)
2330	P-3 now downwind headed towards its last pass as the G-IV is on the SW side in close vicinity to the P-3 as it nears completion of the inner circumnav.

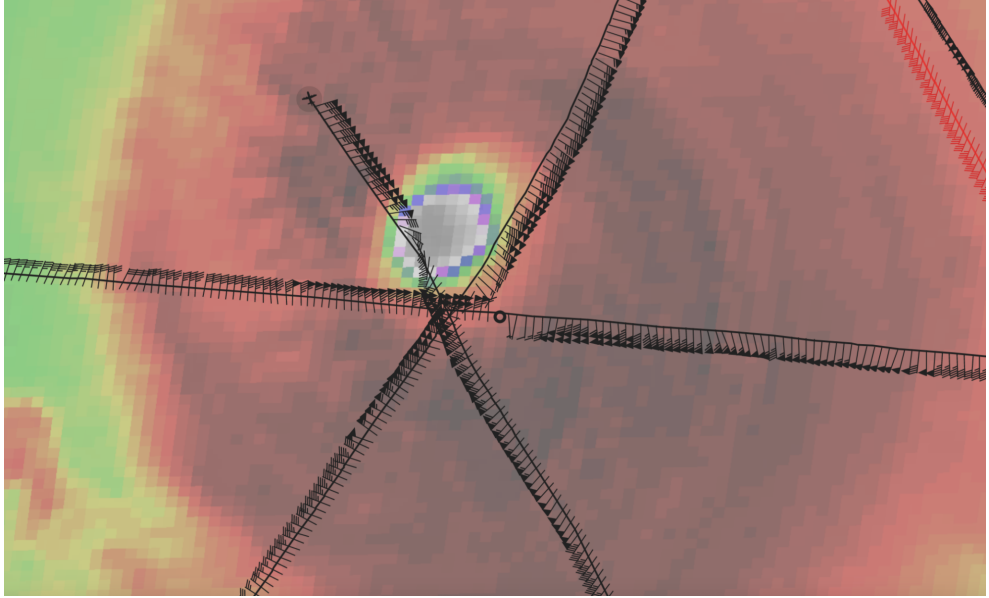
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2333	Looks like the storm has about a 7-8 n mi RMW
2337	<p>G-IV has completed the inner circumnav as the P-3 heads downwind for its final pass.</p> 
2340	SE IP (Sonde #23 [EMC15]; ONR AXBT #6)

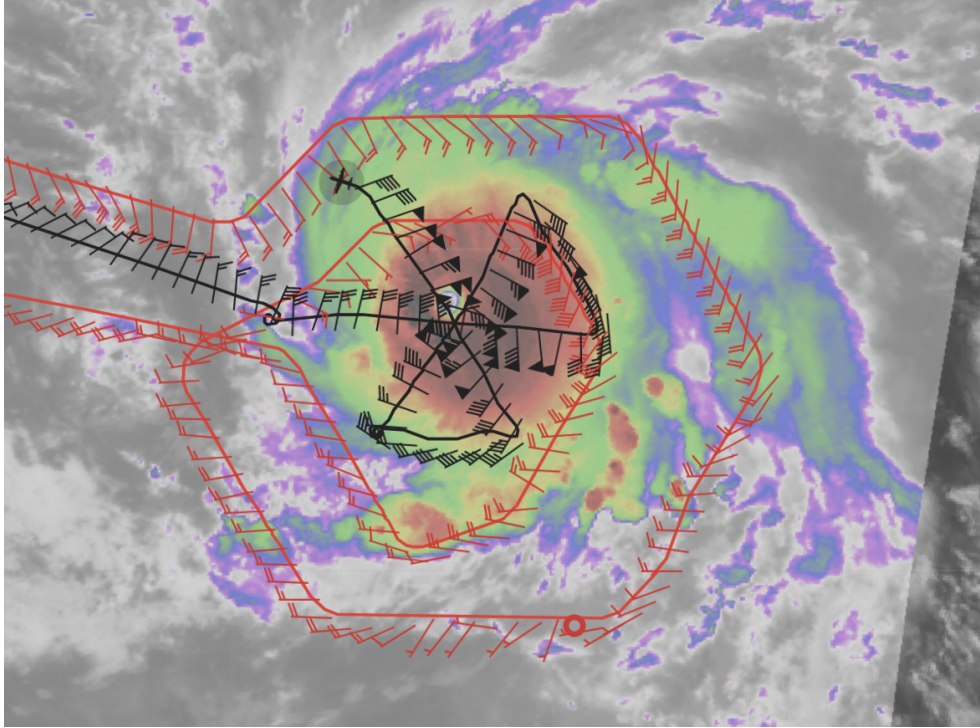
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2349	SE midpoint (Sonde #24 [EMC16])
2355-2356	First RMW SE (Sonde #25 [EMC17]), Second RMW SE (Sonde #26 [ONR8]), Third RMW SE (Sonde #27 [ONR9])
2357	Center #3 (Sonde #28 [EMC18])
2358	First RMW NW (Sonde #29 [EMC19]), Second RMW NW (Sonde #30 [ONR10]), Third RMW NW (Sonde #31 [ONR11])
0002	<p>A look at the third and final pass of the center as reports from the P-3 were that they once again hit graupel. There has been plenty of inner core lightning during the flight.</p> 
0005	NW midpoint (Sonde #32 [EMC20]), at the edge of the precip shield
0012	The P-3 has completed the butterfly pattern and is now headed towards the ALAMO and AXBT deployments.

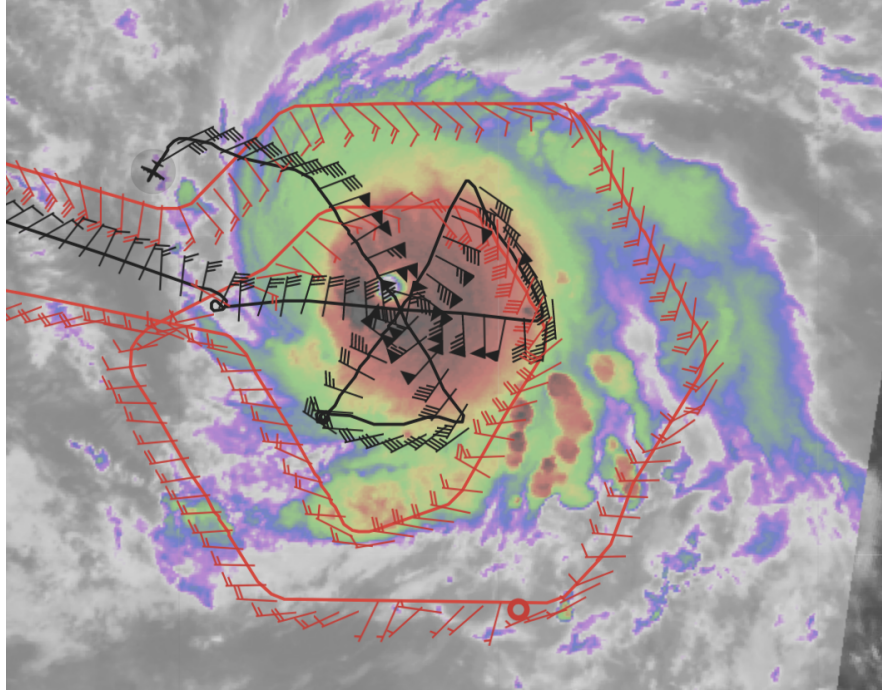
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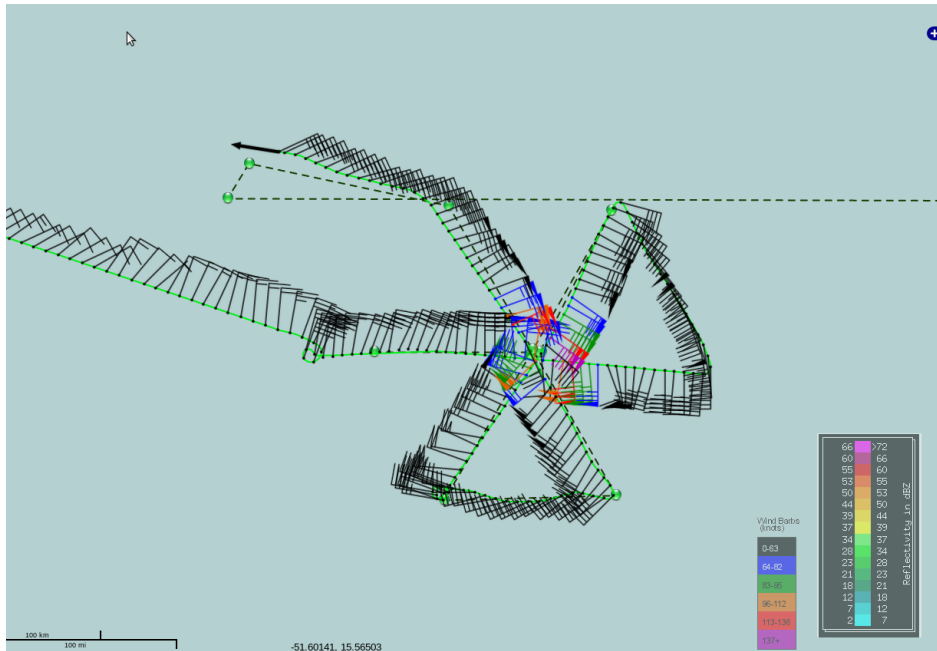
	
0012	NW Endpoint (Sonde #33 [EMC21]; ONR AXBT #7)
0031	Navy ALAMO 1 out -- 14 39.9'N 50 43.6'W, true air speed (TAS) 250 kt, FL wind 30 kt

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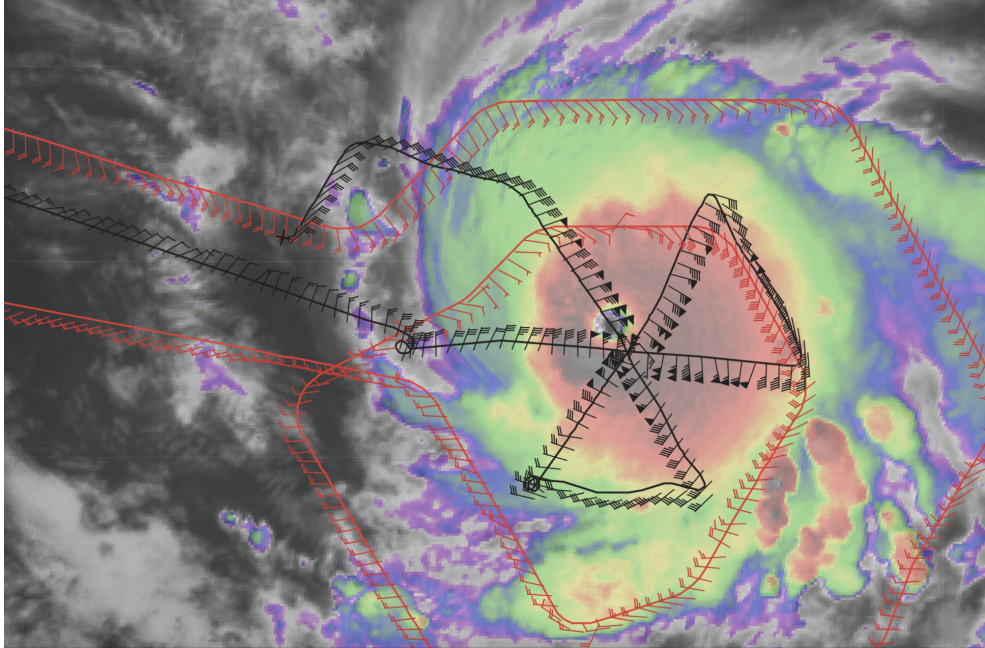


Test screenshot upload from Karma -- it worked!



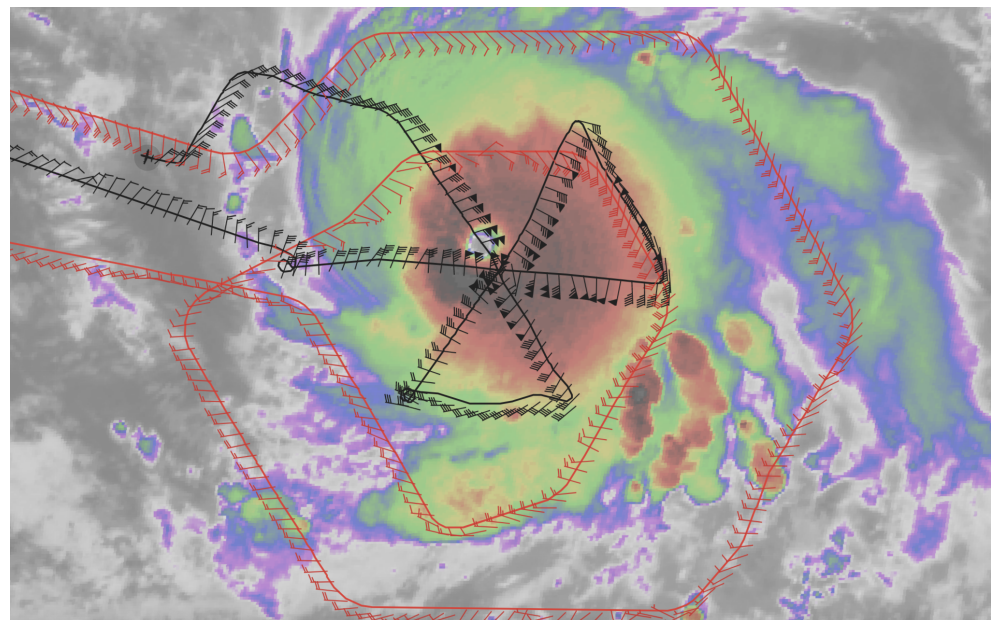
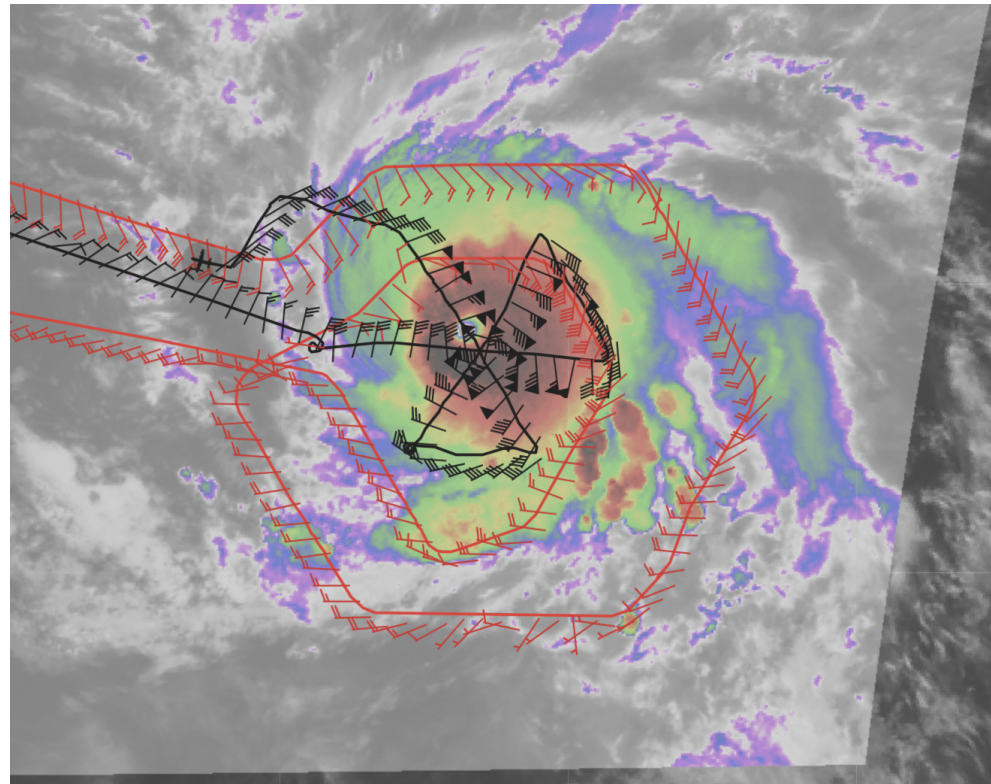
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0035	Between ALAMO releases, Sonde #34 [ONR12]; ONR AXBT #8
0038	Navy ALAMO 2 out -- 14 8.0°N 51 3.6°W, TAS 251 kt, FL wind 27 kt 
0039	Pattern complete:

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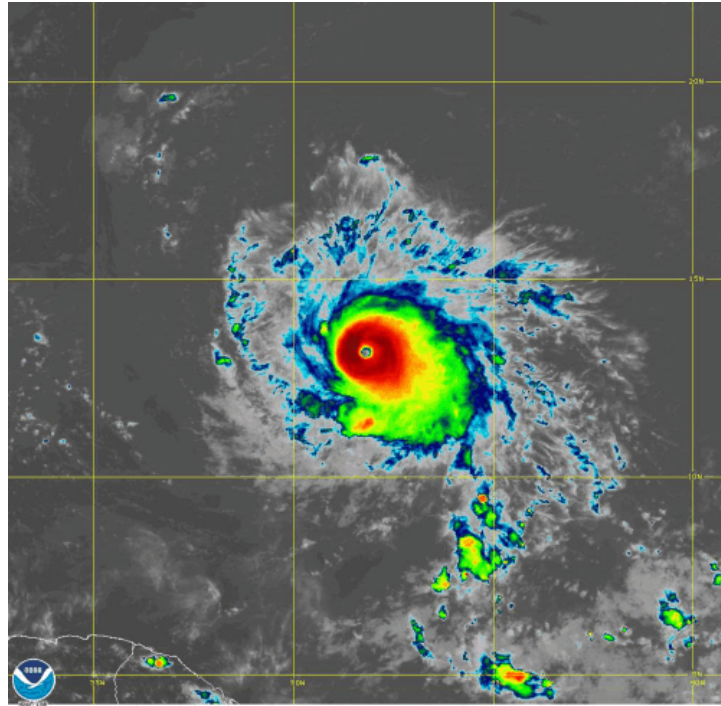
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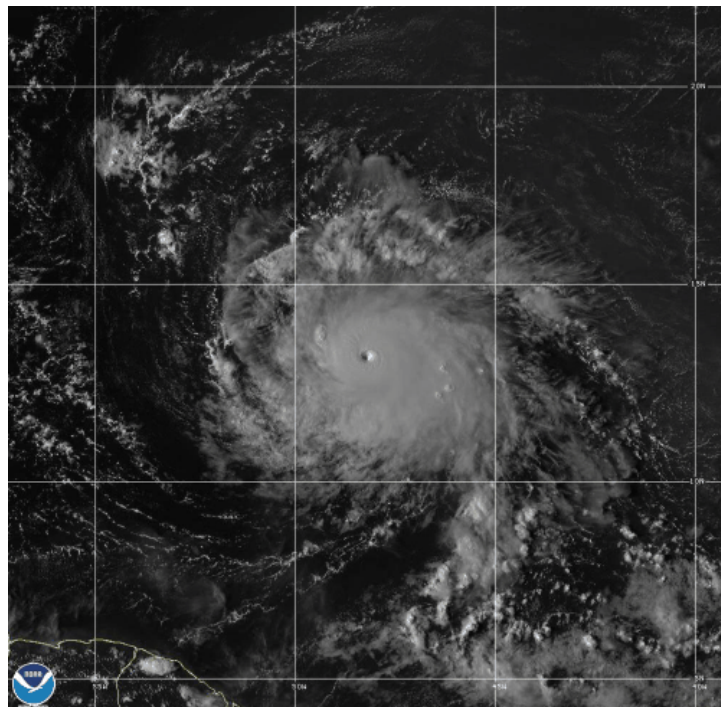
The final satellite loops encompassing the mission:

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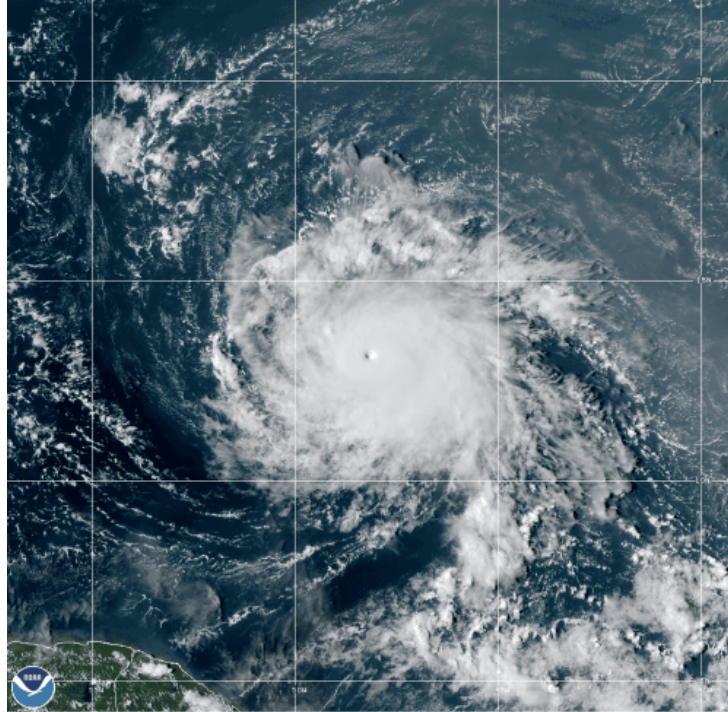
25 Sep 2021 18:50Z NOAA/NESDIS/STAR GOES-East Band 13 HU Sam



25 Sep 2021 19:10Z NOAA/NESDIS/STAR GOES-East Band 02 HU Sam

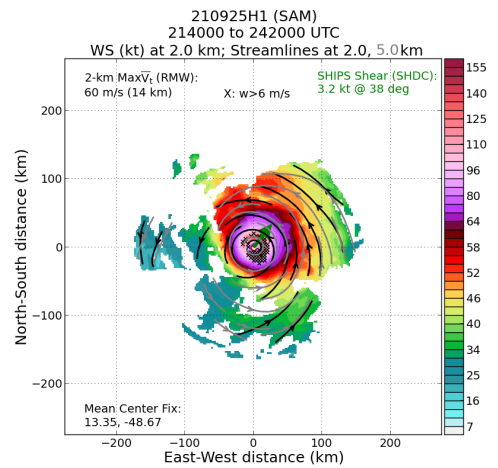
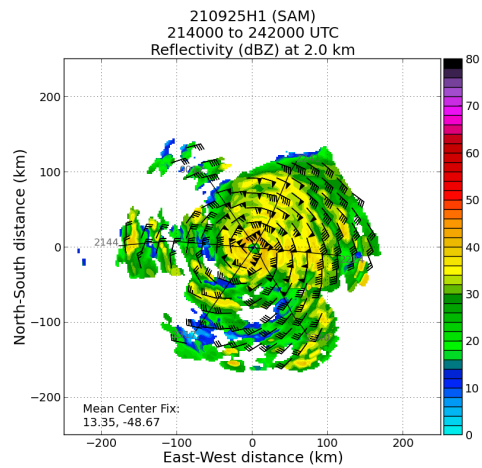
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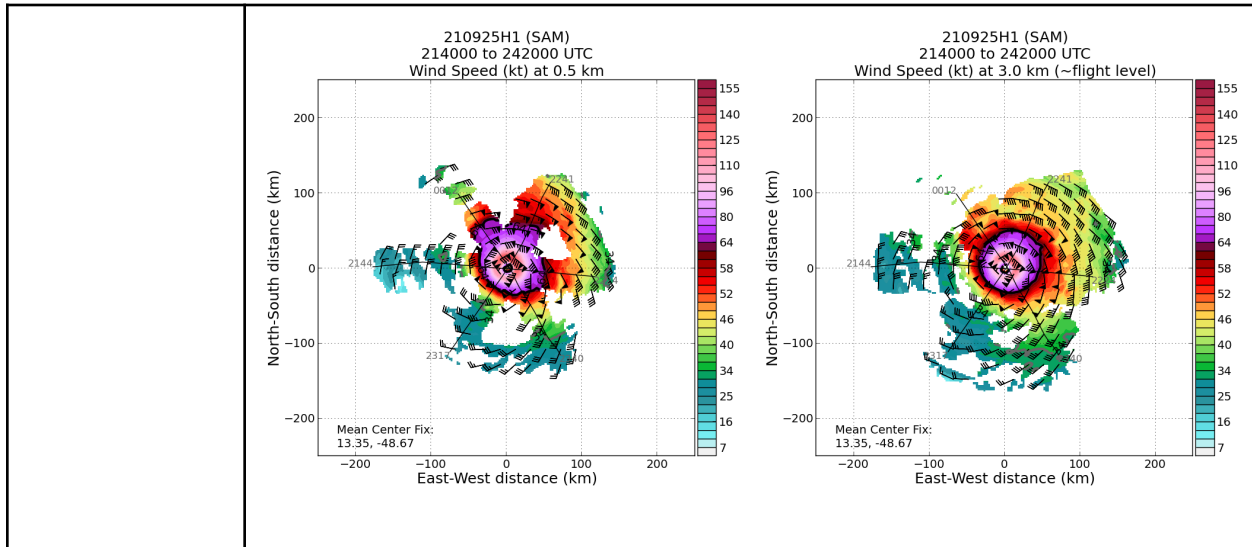
25 Sep 2021 18:40Z NOAA/NESDIS/STAR GOES-East GEOCOLOR

And the final TDR composites from the mission:



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POST-FLIGHT

Mission Summary

This flight perhaps captured the end of what has been a very impressive period of rapid intensification for Sam as the MSLP was consistently 943-945 mb. The peak surface winds were up above 140 kt (observed on the NE inbound and NW outbound), with some impressive dropsondes showing up to nearly 200 kt winds at 900 mb, and 162 kt surface winds in a SE eyewall sonde that translated to the NE quadrant. Convection was vigorous throughout the mission, with plenty of inner core lightning and graupel and turbulence reported by the crew. Dry air appears to be ~40 n mi outside of the core in the northwest quadrant which could be limiting convection. The mission successfully dropped almost all planned sondes, all planned ONR AXBTs, and the two Navy ALAMO floats, meeting all of the APHEX-AIPEX and ONR TCRI goals. An additional ADM-Aeolus validation module was planned on the fly as Aeolus passed just west of the storm around 2121Z; an improvised sonde was released from the P-3 at 2135Z in the Aeolus footprint, about 15 min after its passage.

34 total dropsondes released (31 of them good and transmitted; 21 charged to NWS, 12 charged to ONR, and 1 charged to HRD)

8 ONR AXBTs released; all good

2 Navy ALAMO floats deployed

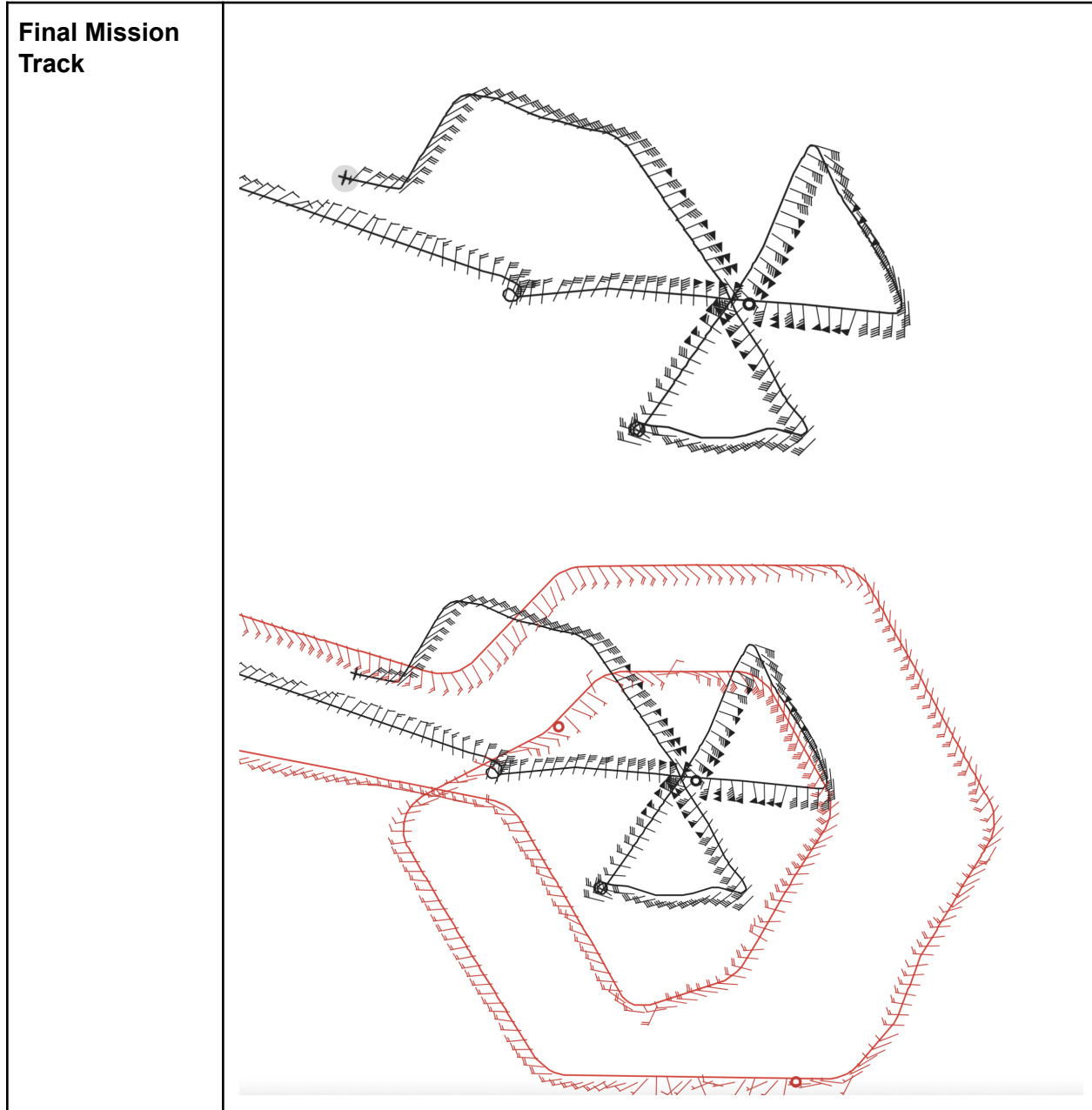
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Actual Standard Pattern Flown	Butterfly with 70 n mi radial legs at 10 kft
APHEX Experiments / Modules Flown	<i>Ocean Observing: Sustained and Targeted Observations; Satellite Validation: ADM-Aeolus; flown in collaboration with ONR TCRI</i>
Plain Language Summary	<ul style="list-style-type: none"> ● This mission observed the latter stages of an impressive rapid intensification period that Sam has been experiencing over the last day. ● Observations taken from the flight will support research into how the ocean and atmosphere work together to intensify hurricanes rapidly.
Instrument Notes	<ul style="list-style-type: none"> - WSRA was sending suspect data, believed to be caused by a software update. - SFMR appeared “stuck” at 7 m/s but once winds increased, began giving more reasonable measurements. Unit has been recently recalibrated. - CRL shut down automatically, likely during the first pass when we encountered strong turbulence. Switched back on for the transit, but probably missed the majority of the storm. - TDR radarsync failed three times on the last jobfile (and then worked!)

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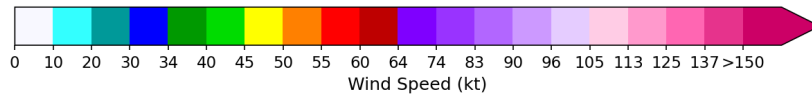
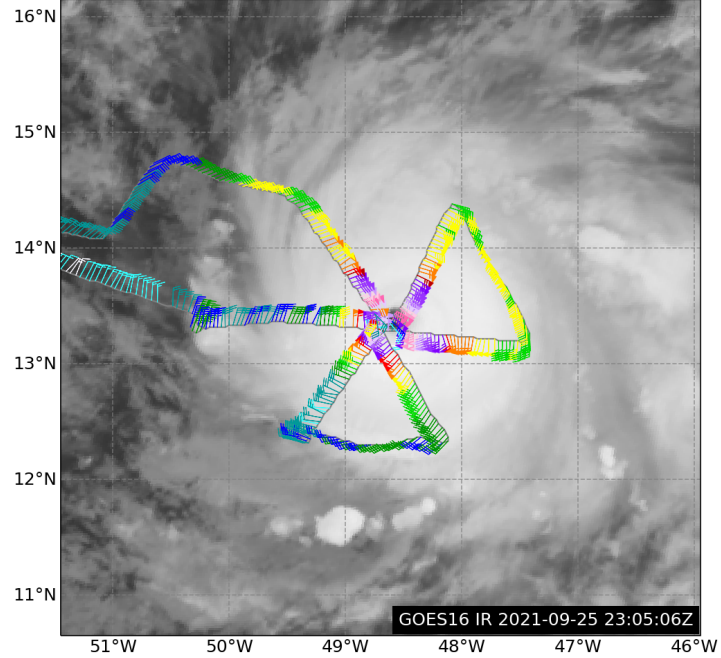
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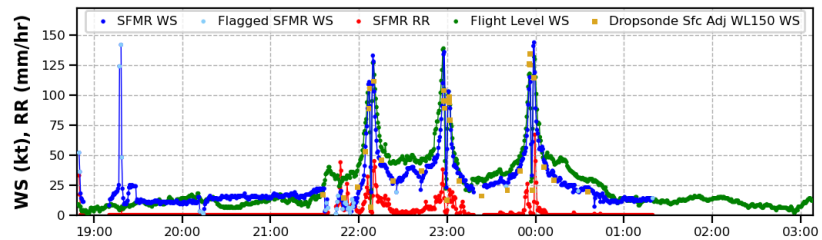
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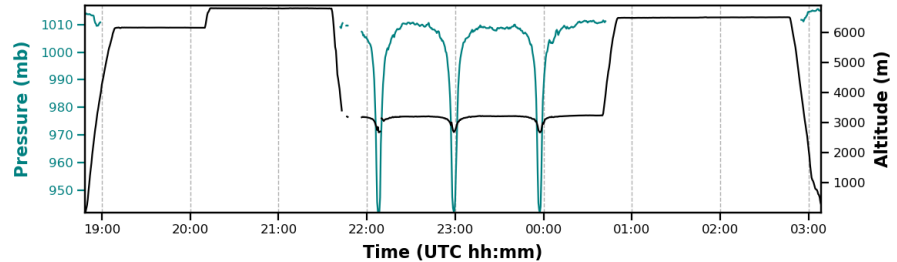
Flight track + Flight-level Winds: SAM (NOAA 20210925H1)



Wind Speed and Rain Rate (NOAA 20210925H1)



Extrapolated Surface Pressure (mb) and Geopotential Altitude (m)



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