AL05 / DORIAN MISSION HIGHLIGHTS

- **Fifteen NOAA P-3 (NOAA42) missions were flown into Dorian (AL05) in the Caribbean and West Atlantic. The missions were flown as taskings for the NOAA/National Centers for Environmental Prediction/Environmental Modeling Center (NCEP/EMC)** to provide airborne data collection (tail Doppler radar, dropsonde, Stepped Frequency Microwave Radiometer [SFMR], and flight level observations), to initialize the operational Hurricane Weather Research and Forecasting (HWRF) Model. **Many other research objectives were accomplished, in addition to the operational taskings.** Missions were flown once a day initially when the storm was in the Caribbean, and then (when possible) twice a day out of Lakeland. Crewing challenges (because of staggered down days) and a couple of maintenance issues interrupted that sequence at times. Takeoff times were set to try and get the P-3 pattern timing centered on 0000 and 1200 UTC for model assimilation.

[#] Note one NHC-tasked reconnaissance mission was flown into Tropical Storm Fernand in the western Gulf

P-3 Flight ID	Departure - Arrival Airport	Planned Takeoff	Dropsondes	AXBTs
20190826H1	Lakeland - St. Croix	1800 UTC	16 (11 Regular, 5 Mini)	0
20190827H1	St. Croix - Barbados	2100 UTC	25 (17 Regular, 8 Mini)	0
20190828H1	Barbados - Lakeland	2100 UTC	22 (14 Regular, 8 Mini)	0
20190829H1	Lakeland - Lakeland	0930 UTC	19 ( )	
20190829H2	Lakeland - Lakeland	2030 UTC	17 ( )	
20190830H1	Lakeland - Lakeland	0930 UTC	22 ( )	
20190830H2	Lakeland - Lakeland	2030 UTC	28 ( )	
20190831H1	Lakeland - Lakeland	0900 UTC	30 ( )	
20190831H2	Lakeland - Lakeland	2100 UTC	16 ( )	
20190901H1	Lakeland - New Orleans	0930 UTC	24 ( )	
* Ferry	New Orleans - Lakeland	1500 UTC	-	-
20190902H1	Lakeland - Lakeland	2000 UTC	24 ( )	
20190903H1	Lakeland - Lakeland	0800 UTC	26 ( )	
[#] 20190903H2	Lakeland - Lakeland	1900 UTC		
20190904H1	Lakeland - Lakeland	2000 UTC	29 ( )	
20190905H1	Lakeland - Lakeland	0800 UTC	19 ( )	
20190905H2	Lakeland - Lakeland	2000 UTC	25 ( )	

- **Ten NHC-tasked Synoptic Surveillance missions were flown by the NOAA G-IV (NOAA49) into and around Dorian. Sampling targeted the potential steering flow, as well as inner (90 n mi) and outer circumnavigations of the storm, when possible. Takeoff times were either 0530 and 1730 UTC.** The G-IV encountered a maintenance issue that prevented three consecutive missions on 30-31 August, but returned for a 1730 UTC mission on 31 August.

G-IV Flight ID	Departure - Arrival Airport	Planned Takeoff	Dropsondes
20190825N1	Lakeland - St. Croix	1730 UTC	26
20190826N1	St. Croix - St. Croix	1730 UTC	30
20190827N1	St. Croix - Barbados	1730 UTC	30
20190828N1	Barbados - Lakeland	1730 UTC	30
20190829N1	Lakeland - Lakeland	1730 UTC	33
20190831N1	Lakeland - Lakeland	1730 UTC	32
20190901N1	Lakeland - New Orleans	0530 UTC	27
20190902N1	New Orleans - Lakeland	0530 UTC	16
20190903N1	Lakeland - Lakeland	0530 UTC	29
20190904N1	Lakeland - Lakeland	0530 UTC	27

- **Due to maintenance issues with the planned 53rd C-130 missions, the P-3 picked up 2 NHC-required fixes on mission 20190829H1, as well as a reconnaissance mission into Tropical Storm Fernand (20190903H2), which was in the western Gulf of Mexico. In addition, the 20190830H2 P-3 mission flew a long return leg, dropping sondes at equal spacing, requested by NHC to fill some of the gap opened by a cancelled G-IV mission.**

- **We believe this is the most *NOAA P-3 missions (15)* ever flown in a single storm. Combined with the G-IV missions, the *25 total G-IV and P-3 Dorian flights* tied Ivan (2004) for the most total NOAA flights into a single storm. Combined with the 53rd Air Force Reserve Weather Reconnaissance Squadron missions, *this was also the most operationally-tasked missions into a single storm (51)*.**

- **Several HRD scientists participated as crew onboard the P-3 (NOAA42): Rob Rogers, Frank Marks, Xuejin Zhang, Jun Zhang (CIMAS), Andrew Hazelton (CIMAS), Ghassan Alaka, Jason Sippel, Brittany Dahl (CIMAS), Kathryn Sellwood (CIMAS), Jason Dunion (HFP Science Director; CIMAS), and Jon Zawislak (HFP Director; CIMAS). Jason Dunion and Lisa Bucci supported HFP Director responsibilities during the sequence.** In addition, Kurt Hansen, a PhD candidate at UM under Sharan Majumdar flew as a guest of HRD on the final mission. He was previously a Hollings Scholar with Sim Aberson.

- **John Gamache and Paul Reasor provided ground radar science support for the P-3. The ground support assist in the transmission of the Tail Doppler Radar (TDR) analyses from the aircraft to EMC and NHC** (for visualization in their AWIPS-II environment)**.**

- **A total of 342 dropsondes (approximate at the moment) were launched over the fifteen P-3 missions into Dorian** (## were regular RD-41 sondes for EMC; ## were mini-sondes available from AOC for research, ## were infrared [IR] sondes in support of HRD research). Flight altitudes were typically 8-10 kft, except in the center when the P-3 was lower since it was often flying pressure altitude.

- **A total of 280 dropsondes were launched over the ten NHC-tasked G-IV missions.**

- **Although the missions were all operationally-tasked, P-3 and G-IV flights into Dorian will likely prove to be very beneficial for research as many experiments within the Early, Mature, and End Stages of the HFP Science Plan overlap with sampling performed during the missions. Sampling of the near complete life cycle with aircraft is unique, and should be valuable to our researchers and collaborators. Here are a few examples:**

    - The evolution in precipitation from asymmetric to symmetric during the early missions as the storm transitioned from a weak, disorganized tropical storm to major hurricane north of the islands is beneficial to the Analysis of Intensification Processes Experiment (AIPEX) of the Early Stage science in the HFP Plan.
    - During 20190902H2 and 20190903H1 missions, the Secondary Eyewall Formation (SEF) module was flown, which is one of the objectives within the Mature Stage science of the HFP Plan. The first module was flown after real-time tail Doppler radar profiles from the first pass were observed to have a secondary wind maximum and disruption in the radial inflow on the east side of the storm (see figure below). Eventually the storm completed an eyewall replacement cycle, broadening the wind field.

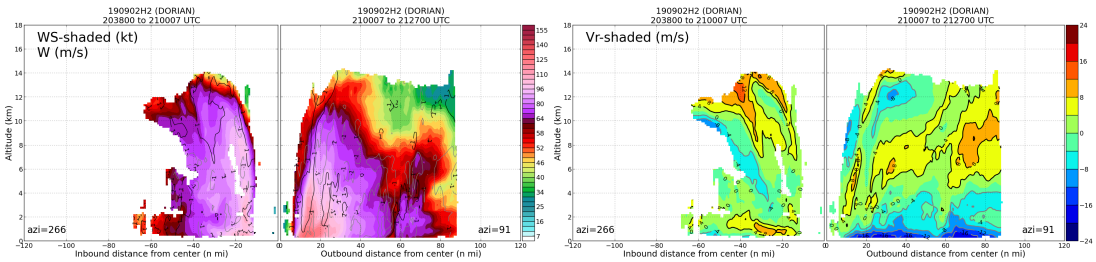


Figure showing the TDR wind profile (left) from the first pass of 190902H2 mission, in which an SEF was observed to the east of the center (also north side, seen later in the flight), as well as a disruption in the radial inflow (right) near 60 nmi.

    - Parts of the last two missions were flown parallel to land as the storm was moving north along the South/North Carolina coastlines. These can serve as Landfall modules within the Landfall Experiment of the End Stage of the HFP Plan.

- **As the NESDIS IWRAP (Imaging Wind and Rain Airborne Profiler) instrument was onboard NOAA42, the NESDIS Ocean Winds science team flew multiple modules during the missions, focusing on repeated passes through high wind and rain regions of the storm.**

- **One mission (20190828H1) included overflight of NOAA/AOML Ocean Gliders located north and south of Puerto Rico (see figure below).** The P-3 "butterfly" mission plan enabled us to release two dropsondes within 10-13 n mi of two glider locations in the storm. One sonde was released at the initial point of the pattern to the south of the storm center (about 90 n mi out) near glider SG668, the other at the midpoint of the P-3 pattern northwest of the center (north of Puerto Rico) about 45 n mi out near glider SG665. *Unfortunately, a drifter buoy deployment by the 53rd USAF planned by NOAA/AOML/PhOD was not successfully flown ahead of the storm on 30 August due to an issue with the 53rd C-130 that led to the airplane to return to base.*

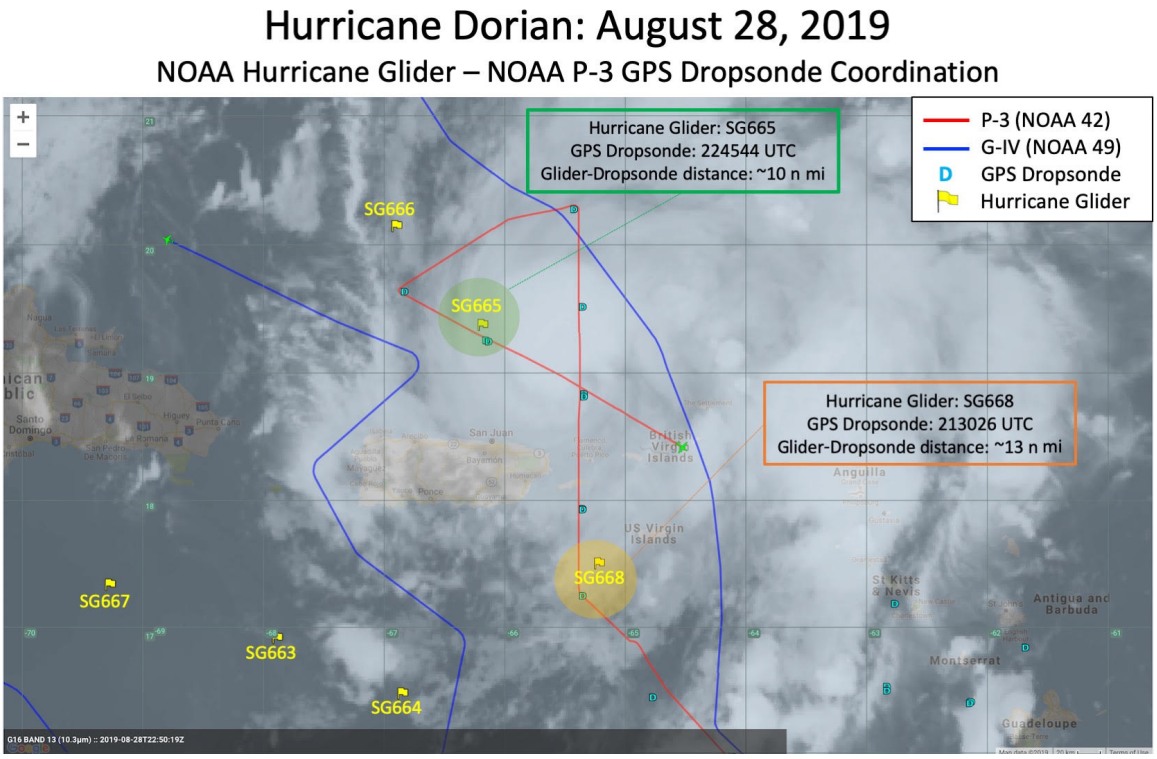
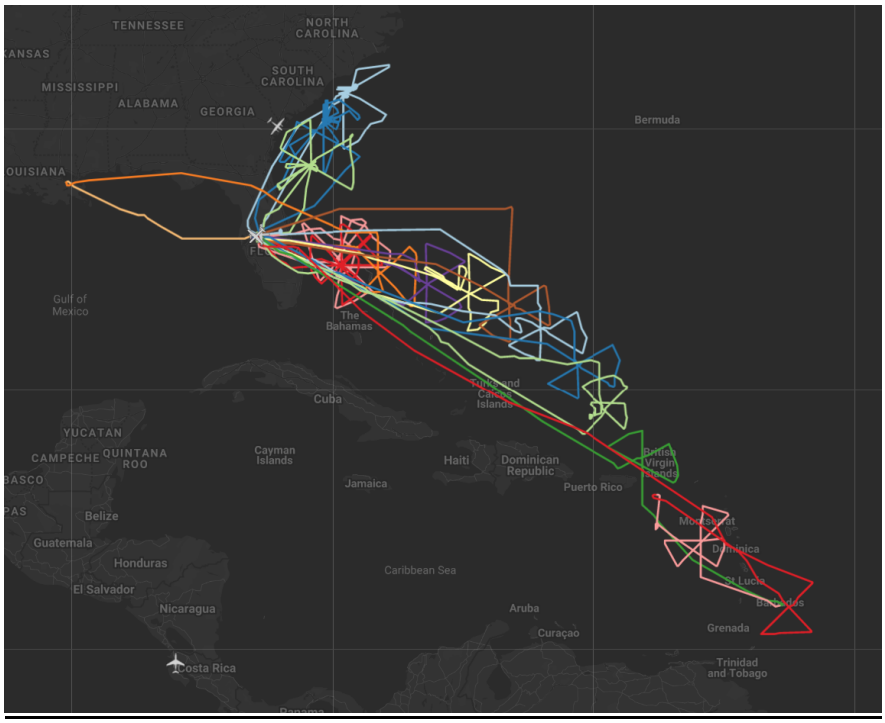
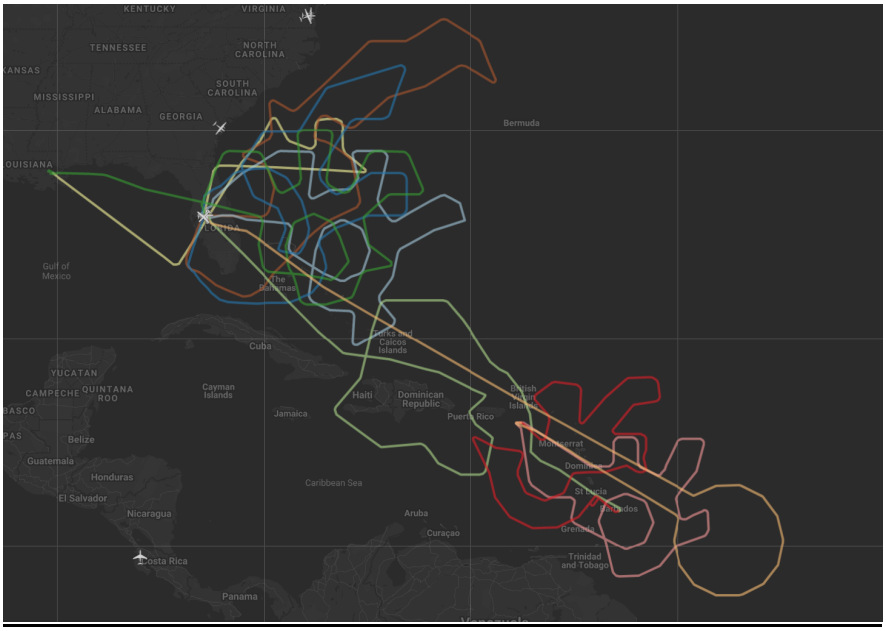


Figure showing the P-3 flight pattern (orange line), G-IV pattern (blue line), and the location (highlighted in circles, yellow and green) of the two NOAA/AOML Ocean Gliders where dropsondes were released in close proximity from the P-3.

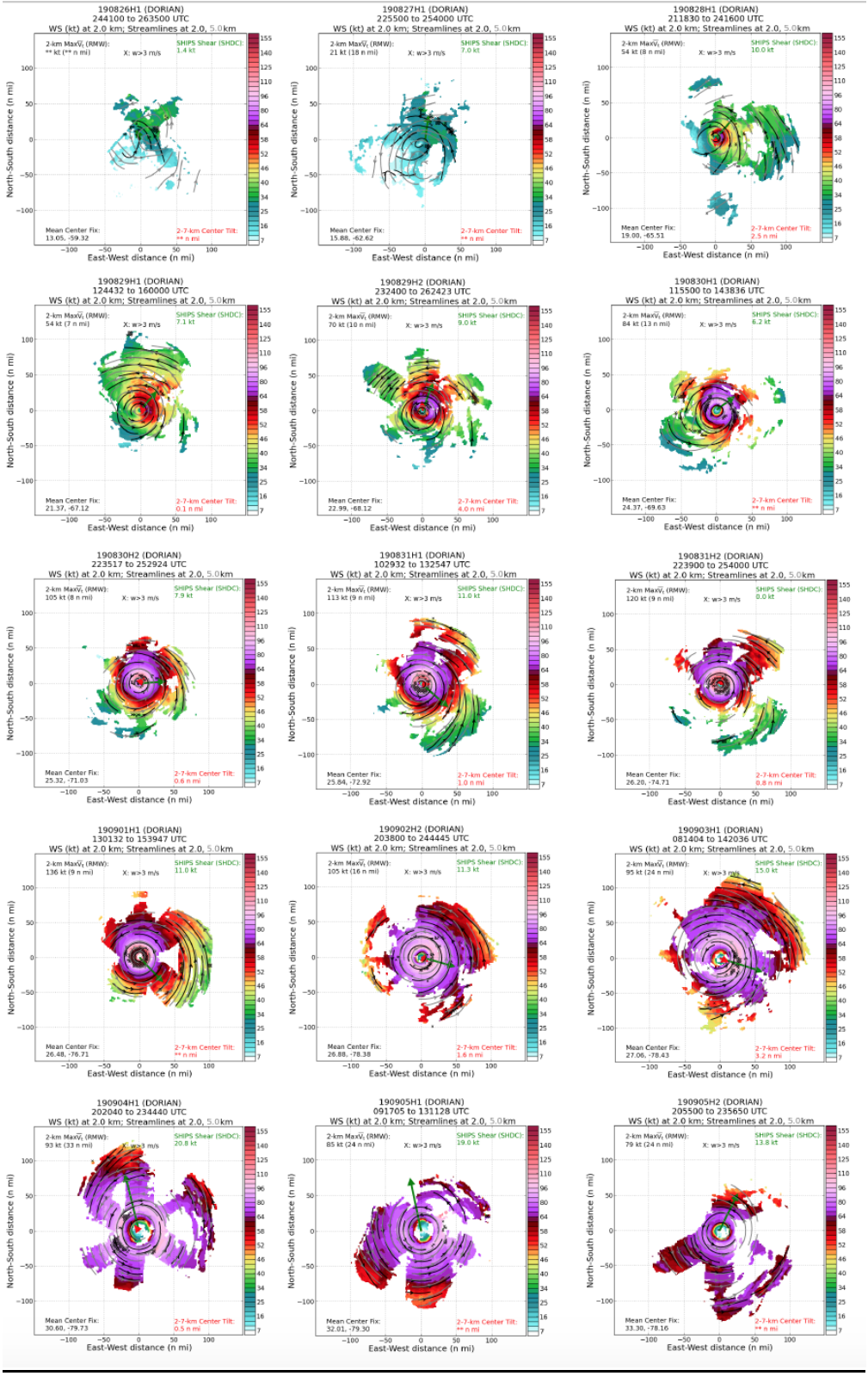
SUMMARY FIGURES



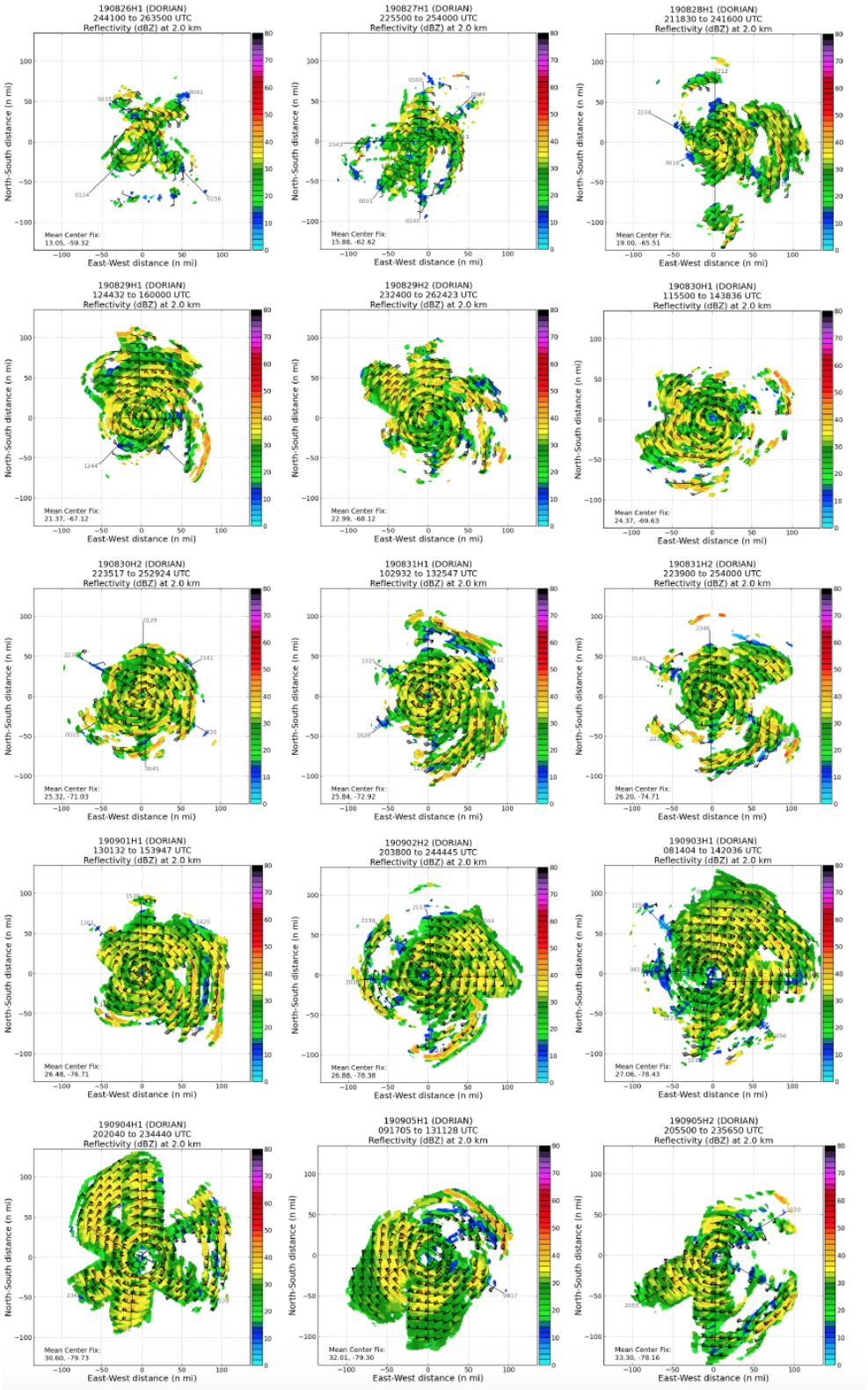
Tracks of the 15 NOAA P-3 (NOAA42) EMC-tasked missions into Dorian



Tracks of the 10 NOAA G-IV (NOAA49) NHC-tasked missions into Dorian



Sequence of P-3 composite TDR analyses showing wind speed at 2 km (shading), as well as streamlines at 2.0 (black) and 5.0 km (grey)



Sequence of P-3 TDR analyses showing composite reflectivity at 2 km