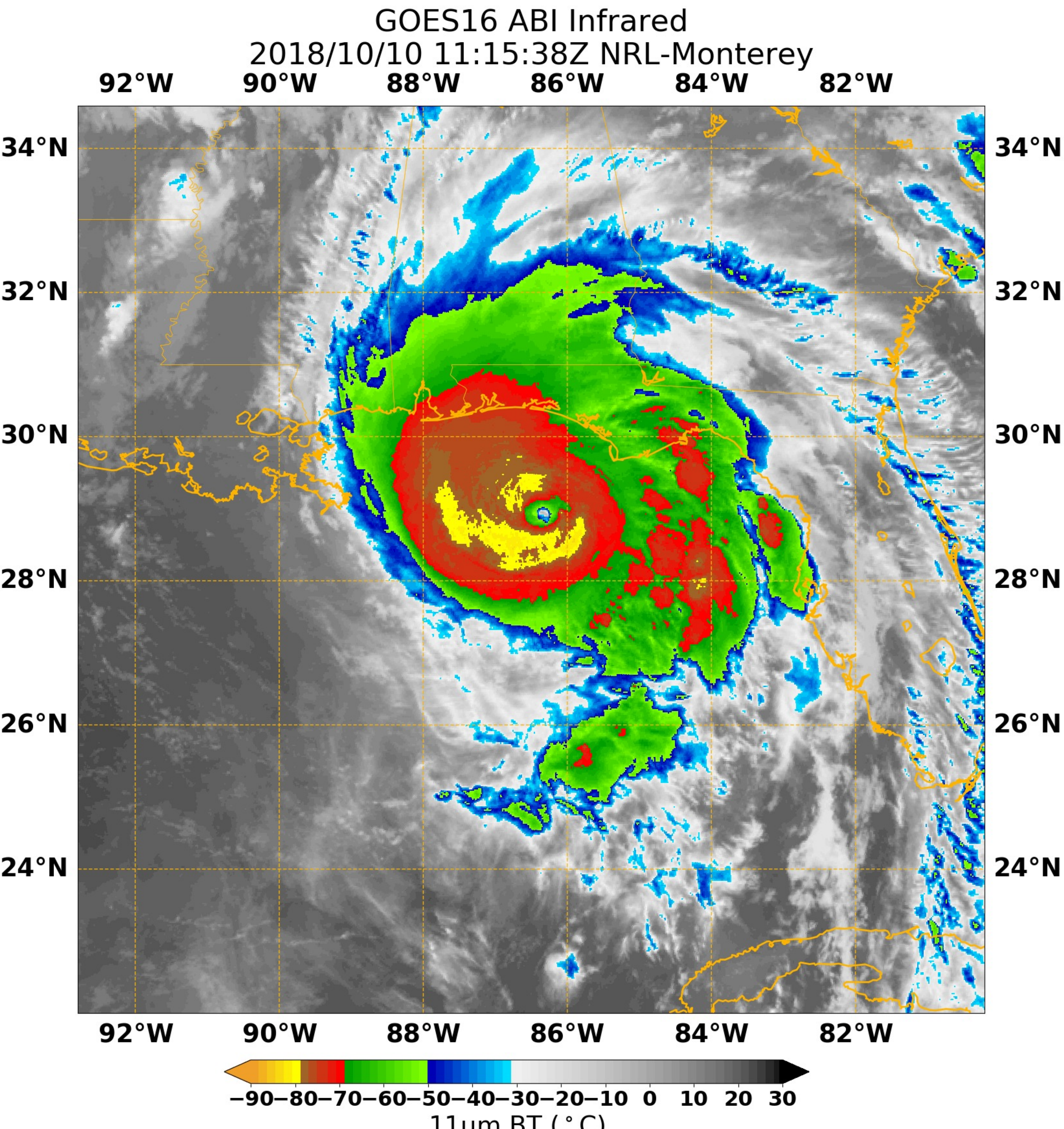


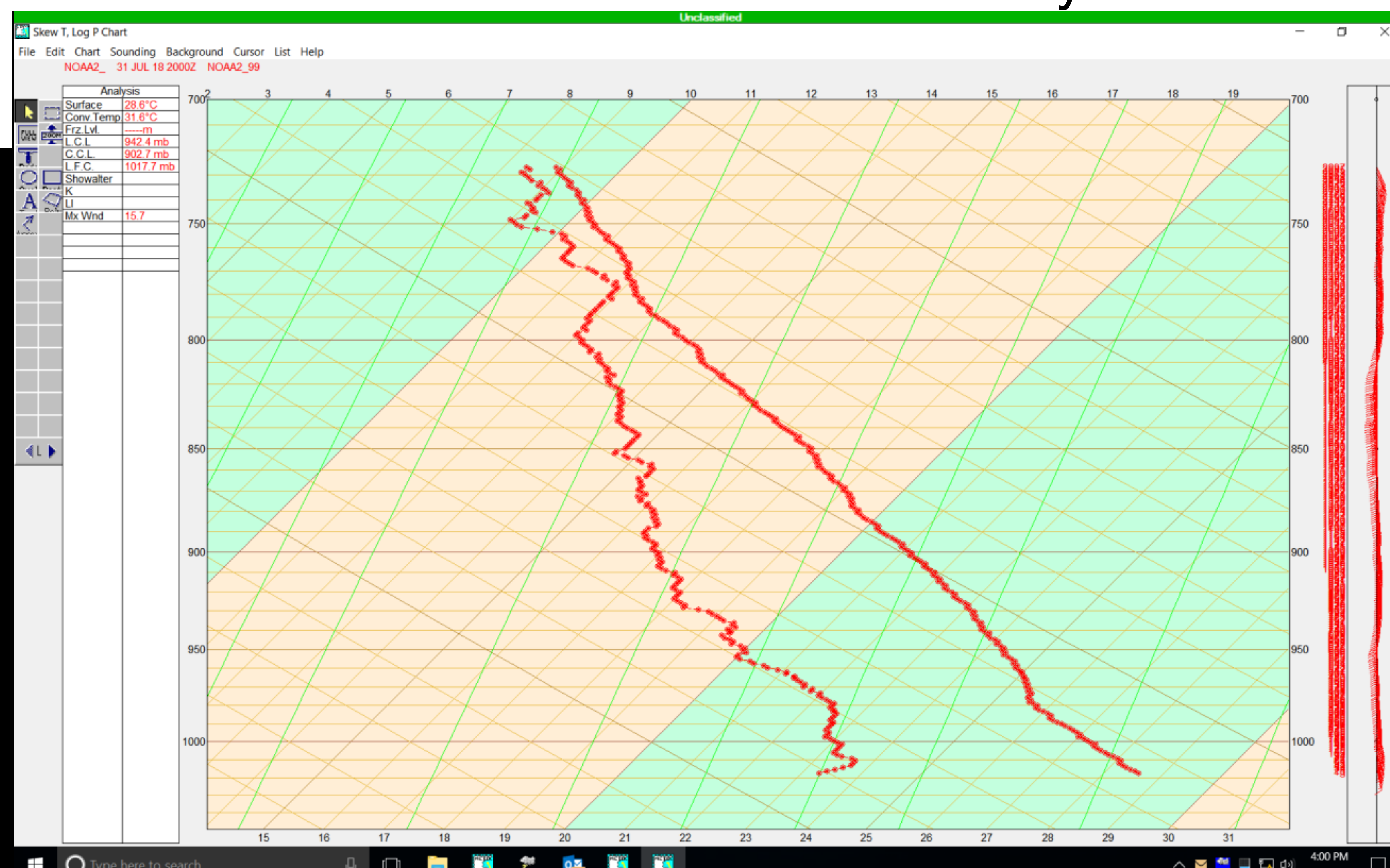
Recent Research with dropwindsondes at NOAA/AOML/HRD

Sim D. Aberson
NOAA/AOML/Hurricane Research Division

16 April, 2019
AVAPS Users Group Workshop

First successful transmission of high-resolution dropwindsonde data from Hurricane Hunter aircraft

During a 31 July test flight, AOC released a sonde and transmitted the data to the ground in both TEMP DROP and Binary Universal Form for the Representation of meteorological data (BUFR) formats. In this sonde, the old TEMP DROP format had only 17 observations, but hundreds of observations can now be seen by forecasters to see small-scale features in a hurricane, and can be used by models to improve forecasts.



Special thanks to Sonia Otero of HRD, John Hill and Mike Holmes of AOC, and the NCAR Earth Observing Laboratory who made this possible.

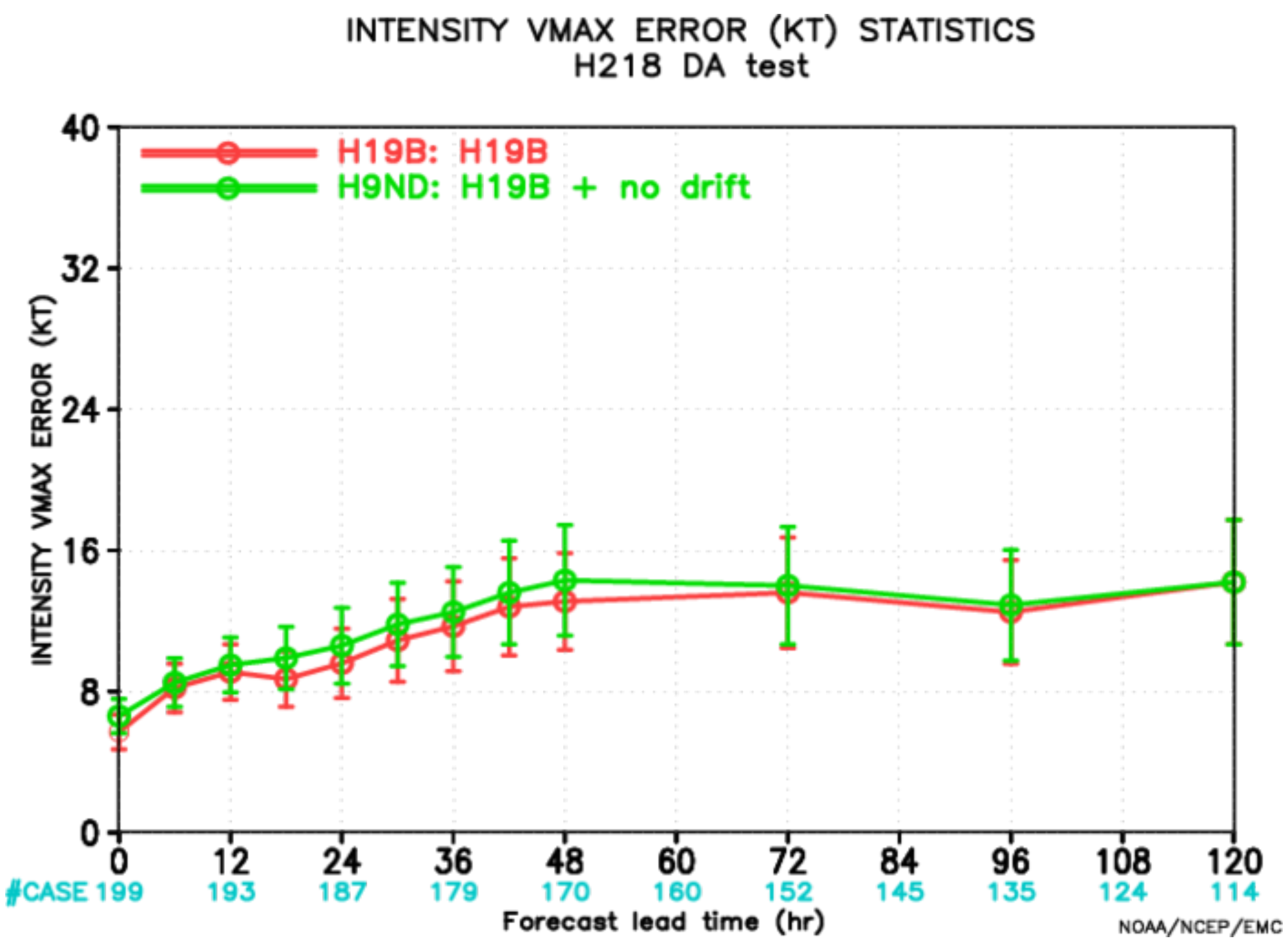
https://noaahrd.wordpress.com/2018/08/01/first-successful-transmission-of-high-resolution-dropwindsonde-data-from-hurricane-hunter-aircraft/

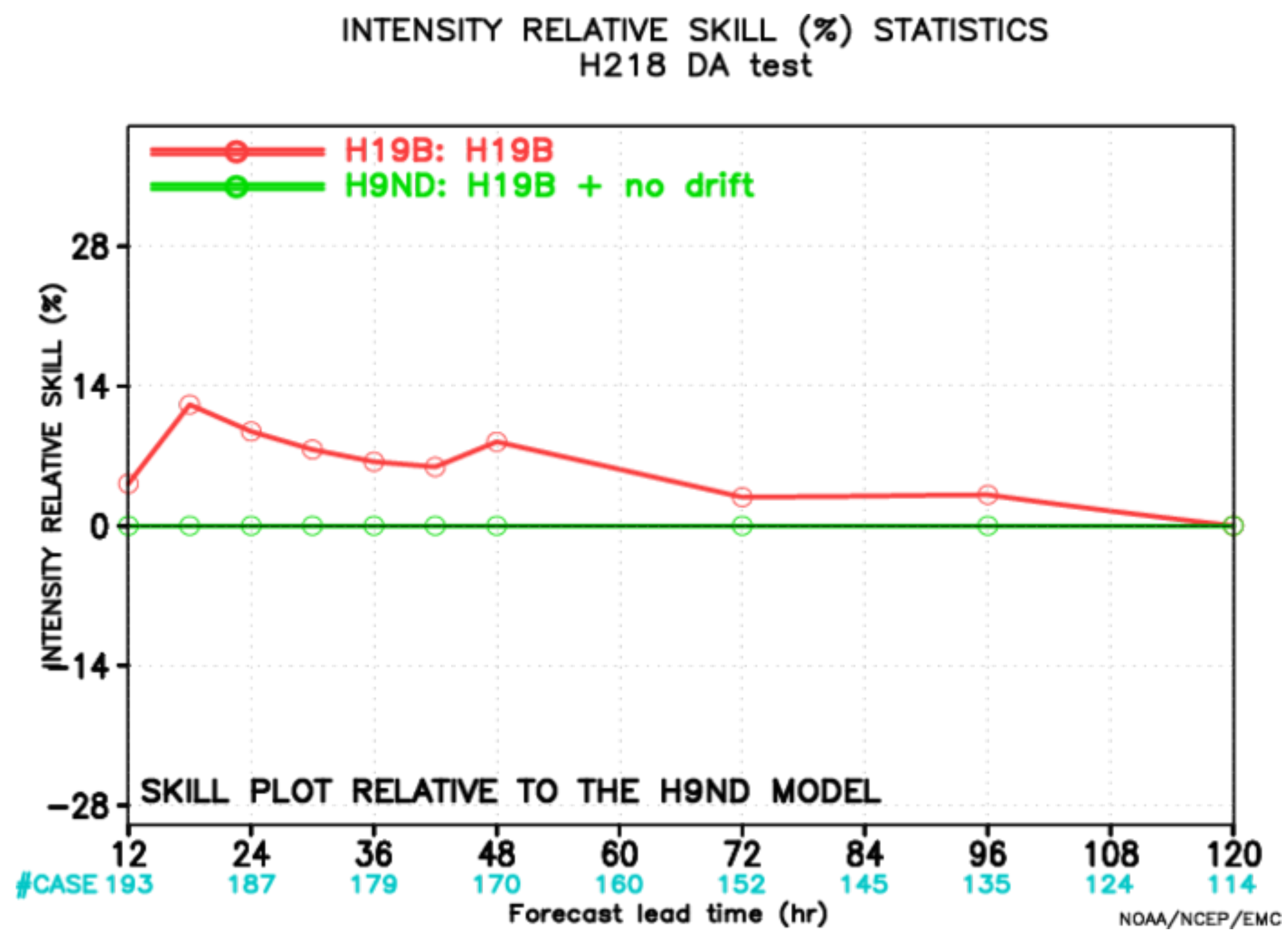
Impact of using the location of the instrument in data assimilation

Large positive impact on intensity, small improvements to wind radii, little impact on track.

Uses SPG and REL information to calculate location during descent.

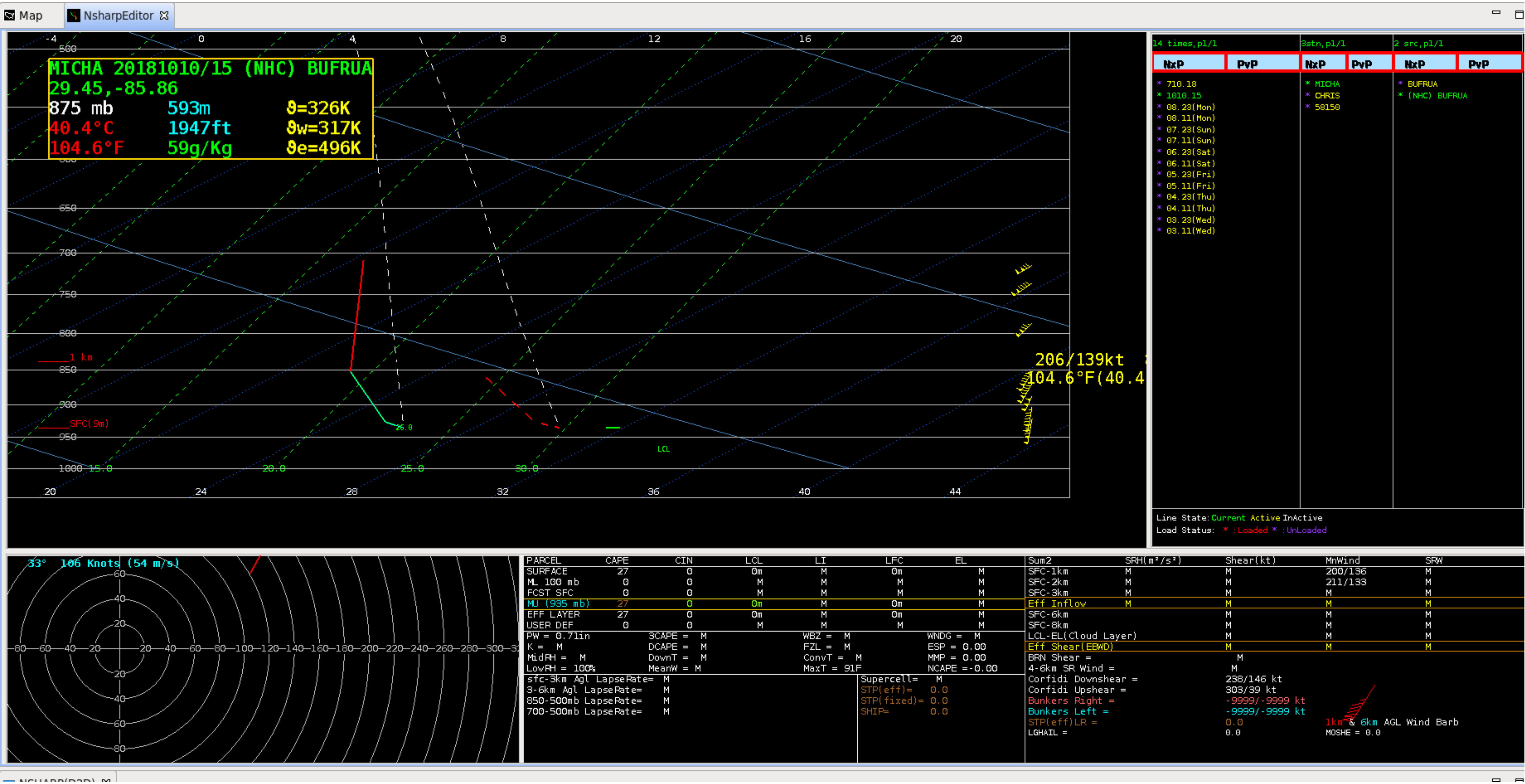
This is likely a lower bound to the impact of using bufr data





2018 NOAA/AOML/HRD Hurricane Field Program
Intensity Forecast Experiment (IFEX)

TDR Experiment



TDR and dropwindsonde data in AWIPS II at NHC beginning in 2018

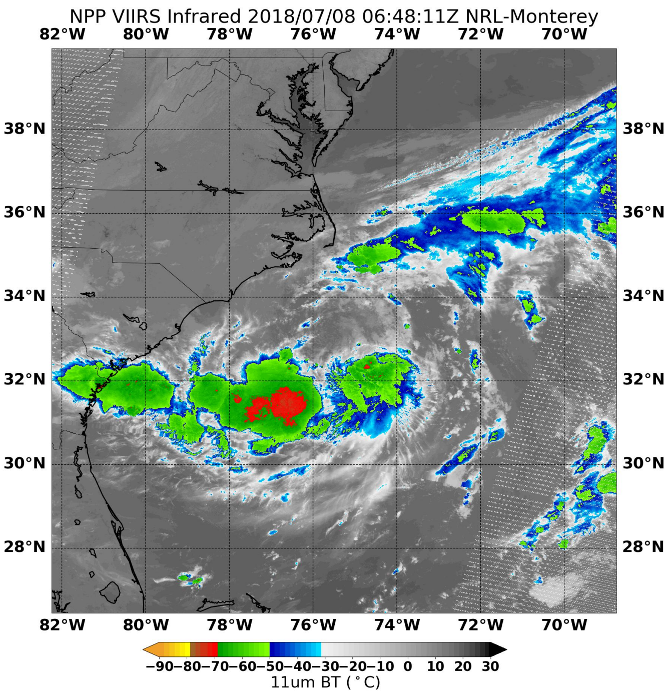
2018 NOAA/AOML/HRD Hurricane Field Program
Intensity Forecast Experiment (IFEX)

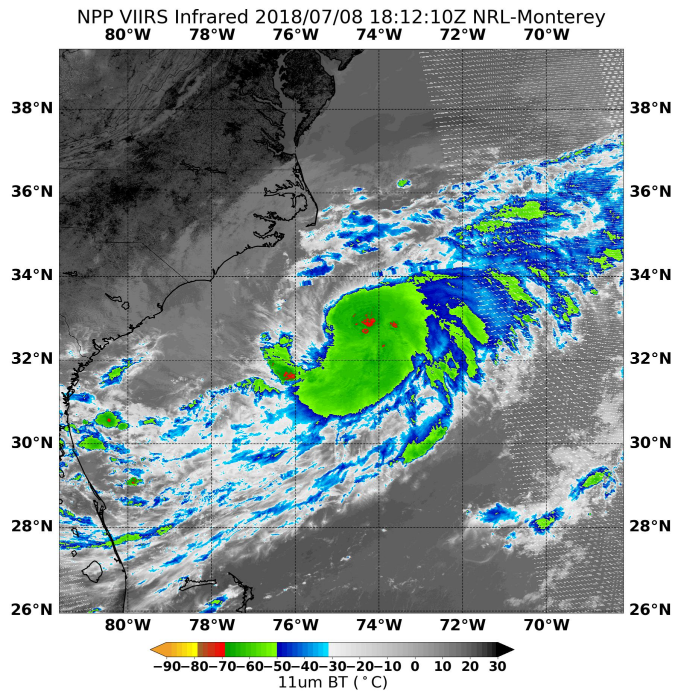
AL03/Chris

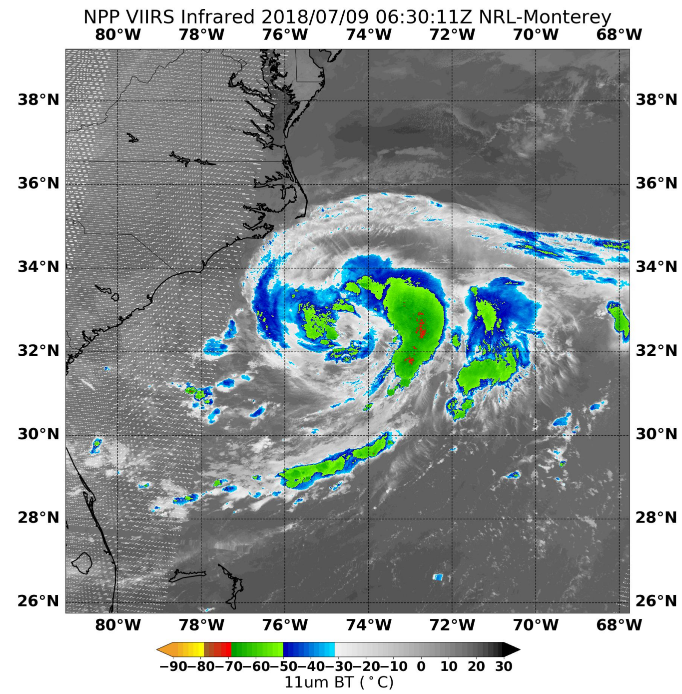
July 9-10

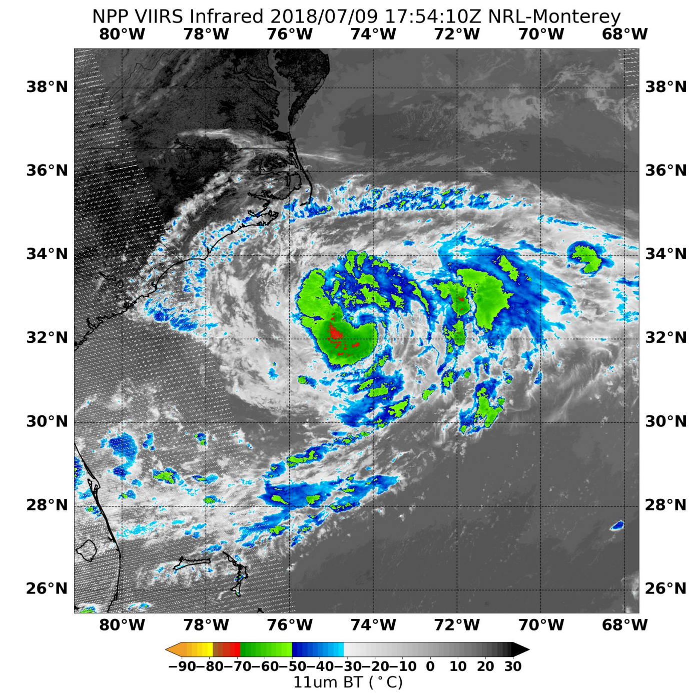
4 EMC-tasked Missions
30 P-3 Flight Hours
55 Drops

- 180708H1
- 180708H2
- 180709H1
- 180709H2



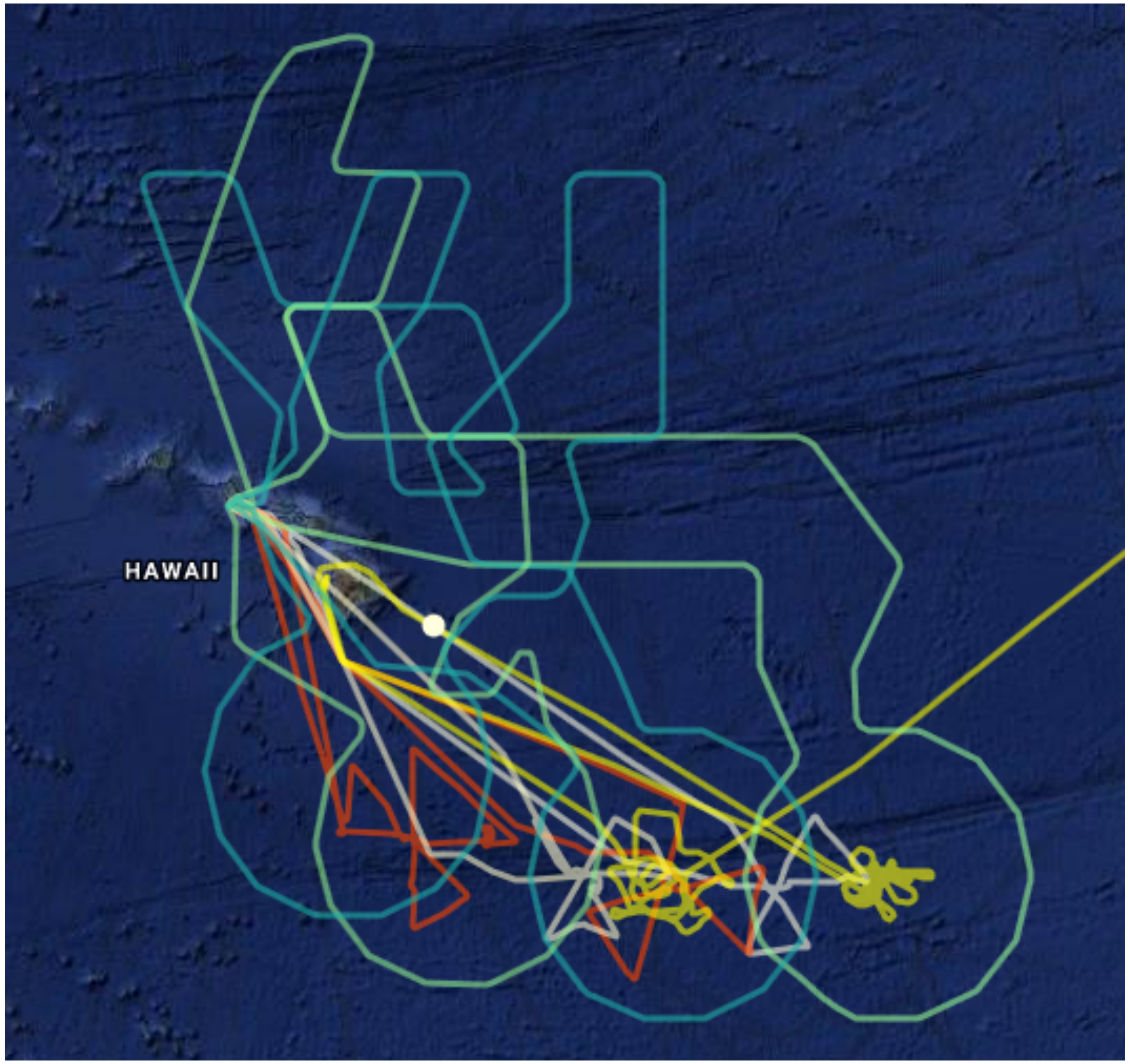






- Intrusion of dry air evident in dropsonde measurements
- Drops used to confirm SFMR measurement of 61 kt

2018 NOAA/AOML/HRD Hurricane Field Program
Intensity Forecast Experiment (IFEX)
EP14/Lane



P-3

- ➔ 4 EMC-tasked Missions

20180820H1 0200 UTC (4 PM HST/10 PM EDT)
20180820H2 1400 UTC (4 AM HST/10 AM EDT)
20180821H1 0200 UTC (4 PM HST/10 PM EDT)
20180822H1 0200 UTC (4 PM HST/10 PM EDT)

- ➔ 60 Flight Hours
  (27 h LAL-HNL-LAL, 33 h Operations)
- ➔ 77 Drops / 19 AXBTs

G-IV

- ➔ 4 CPHC-tasked Synoptic Surveillance Missions

20180819N1 1730 UTC (7:30 AM HST/1:30 PM EDT)
20180820N1 1730 UTC (7:30 AM HST/1:30 PM EDT)
20180821N1 1730 UTC (7:30 AM HST/1:30 PM EDT)
20180822N1 1730 UTC (7:30 AM HST/1:30 PM EDT)

- ➔ 53 Flight Hours
  (20 h LAL-HNL-LAL, 33 h Operations)
- ➔ 119 Drops

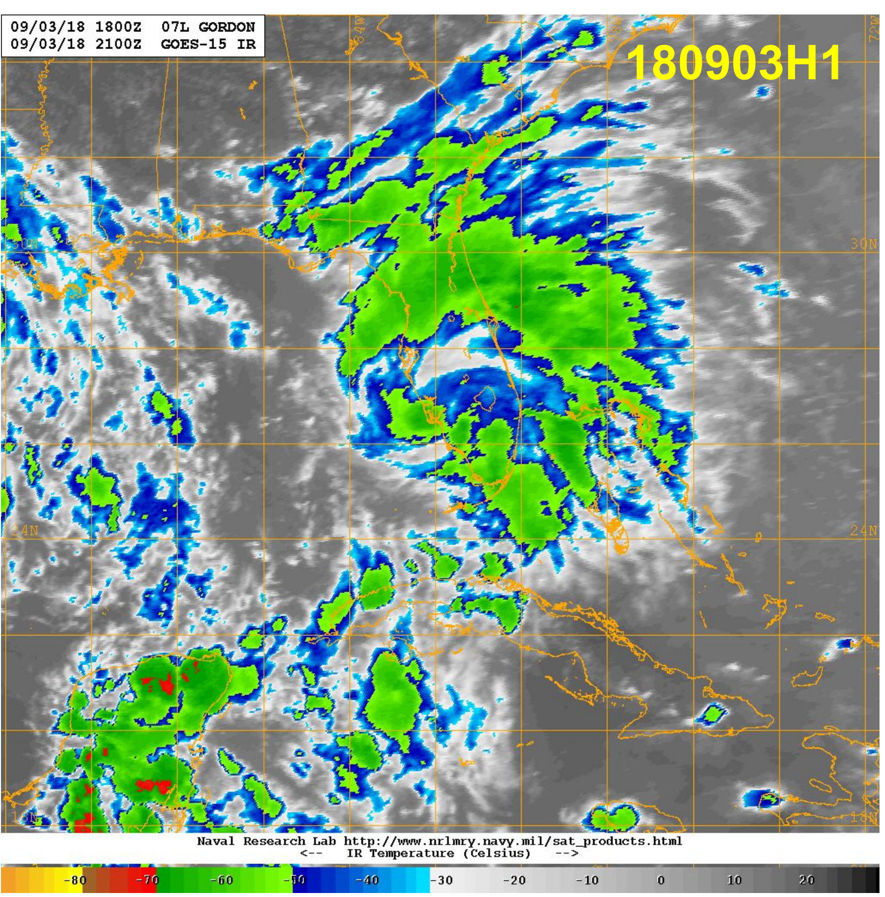
2018 NOAA/AOML/HRD Hurricane Field Program
Intensity Forecast Experiment (IFEX)

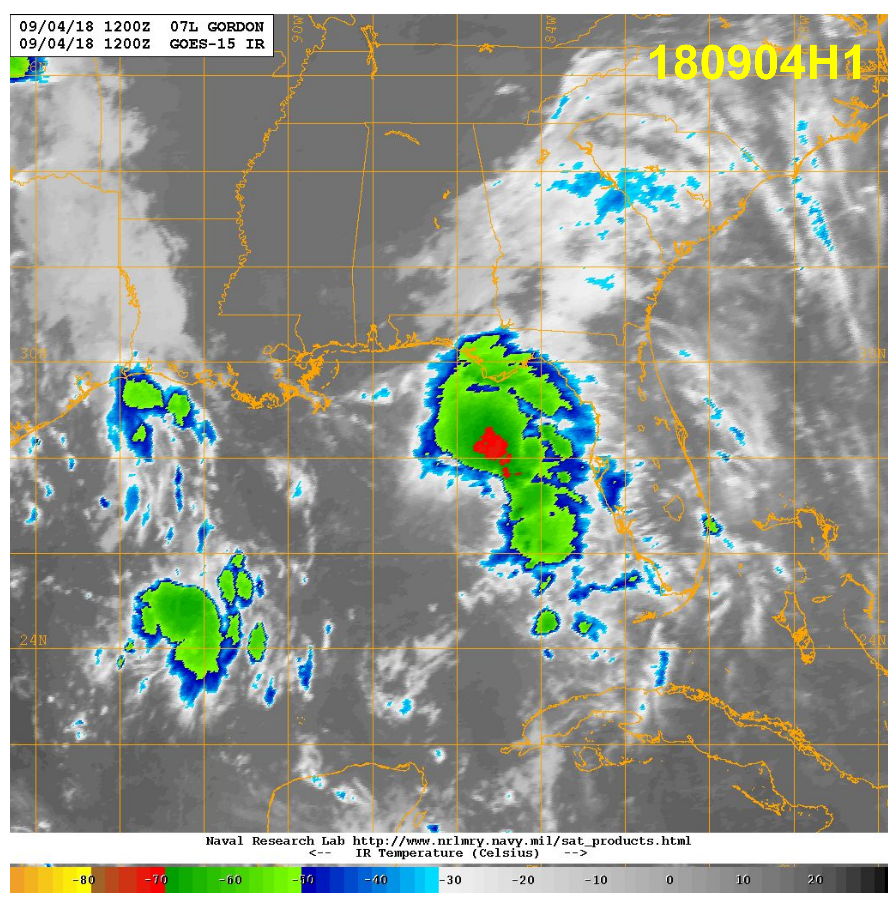
AL07/Gordon

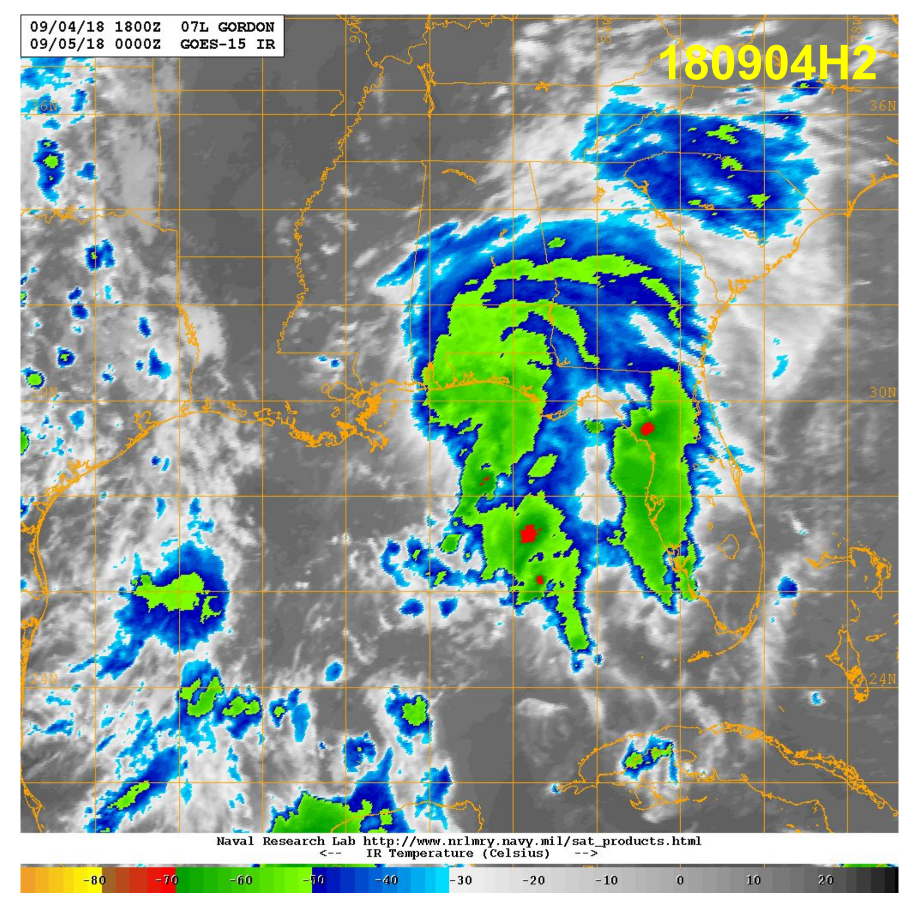
September 3-4

2 EMC-tasked P-3 Missions
1 NHC-tasked P-3 Mission
18 P-3 Flight Hours
45 Dropsondes
10 AXBTs

- 180903H1
- 180904H1
- 180904H2





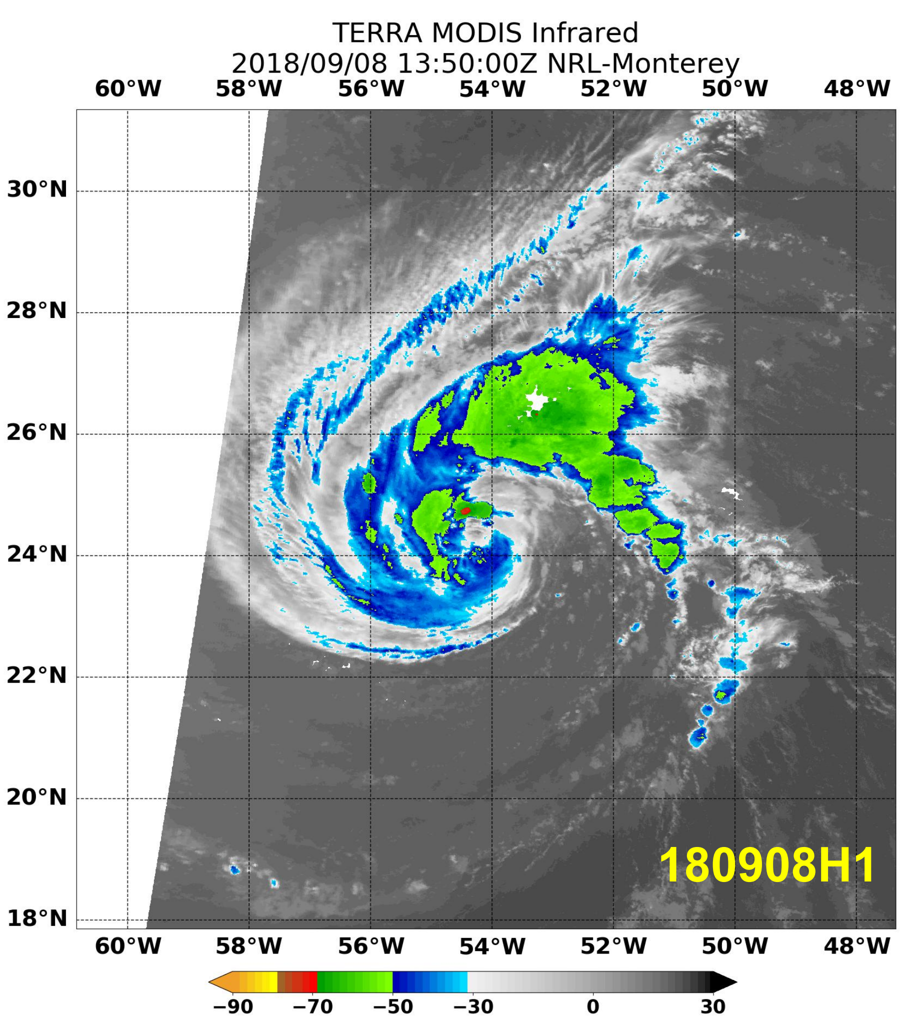


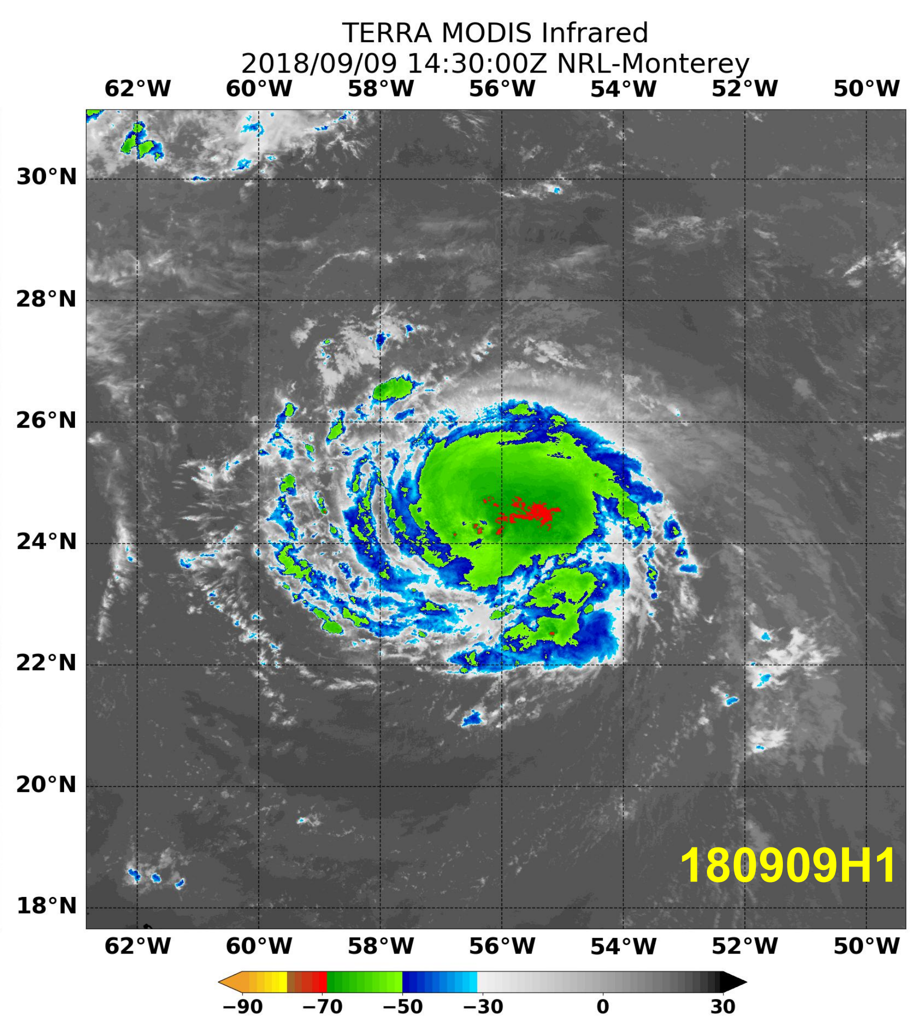
2018 NOAA/AOML/HRD Hurricane Field Program
Intensity Forecast Experiment (IFEX)
AL06/Florence

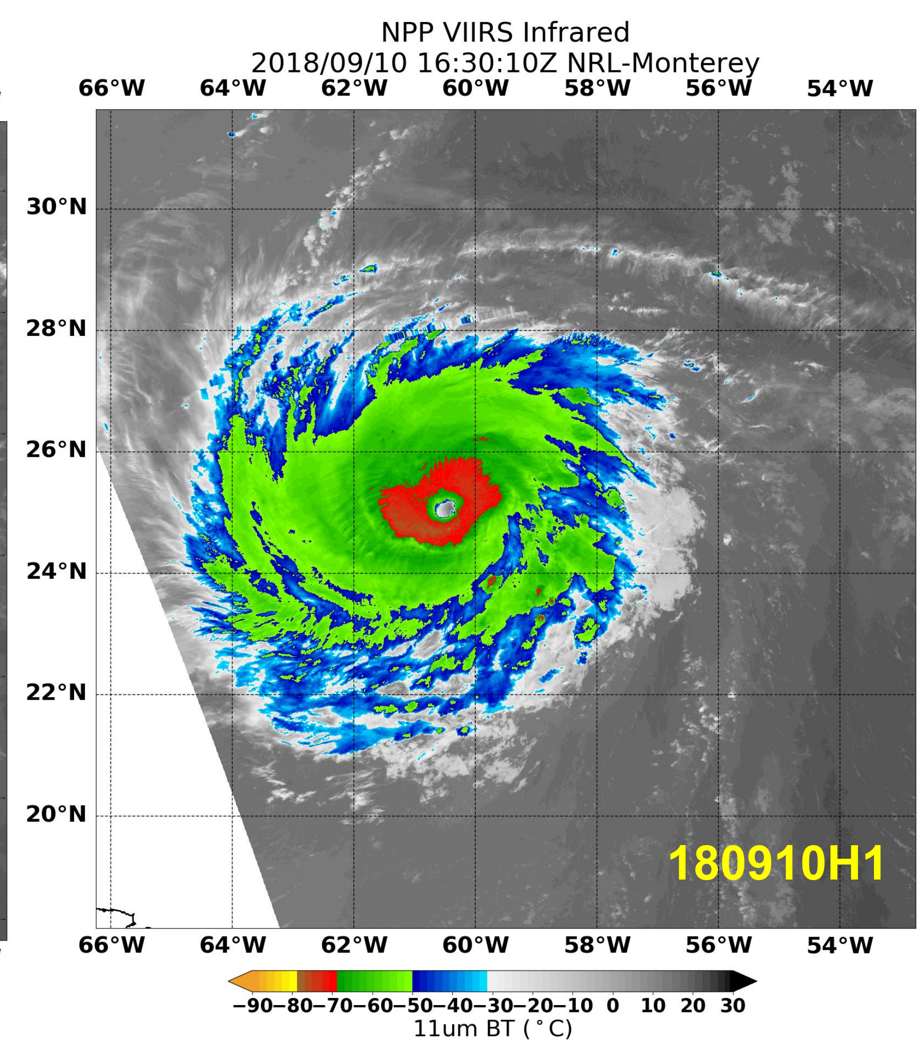
3	P-3 Research Missions
30	P-3 Flight Hours (including LAL-BDA-STX)
86	P-3 Dropsondes
20	P-3 AXBTs
9	G-IV NHC Synoptic Surveillance Missions
72	G-IV Flight Hours
281	G-IV Dropsondes

September 8-13

- 180908H1
- 180909H1
- 180910H1





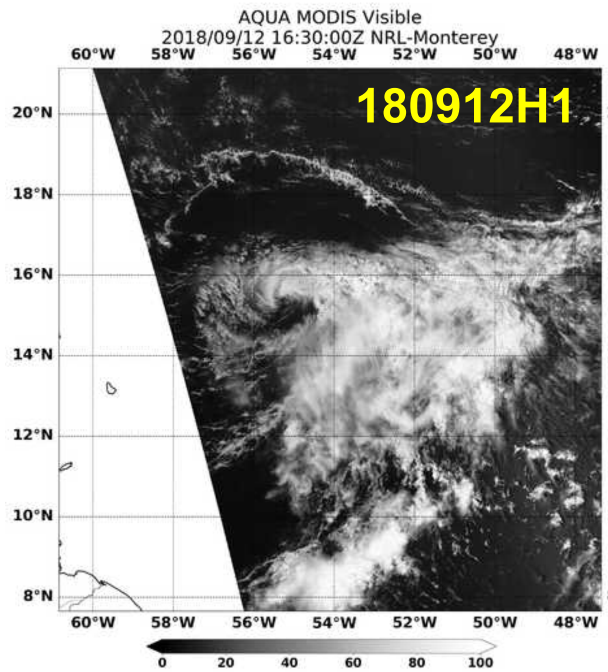


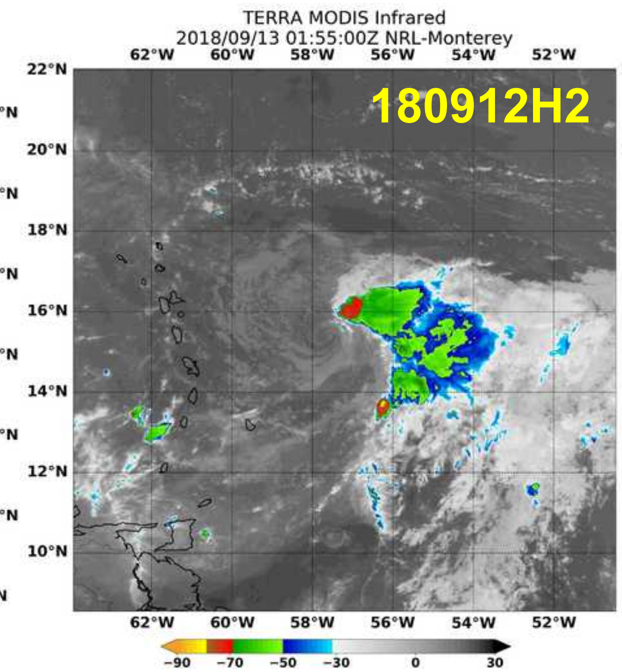
2018 NOAA/AOML/HRD Hurricane Field Program Intensity Forecast Experiment (IFEX)

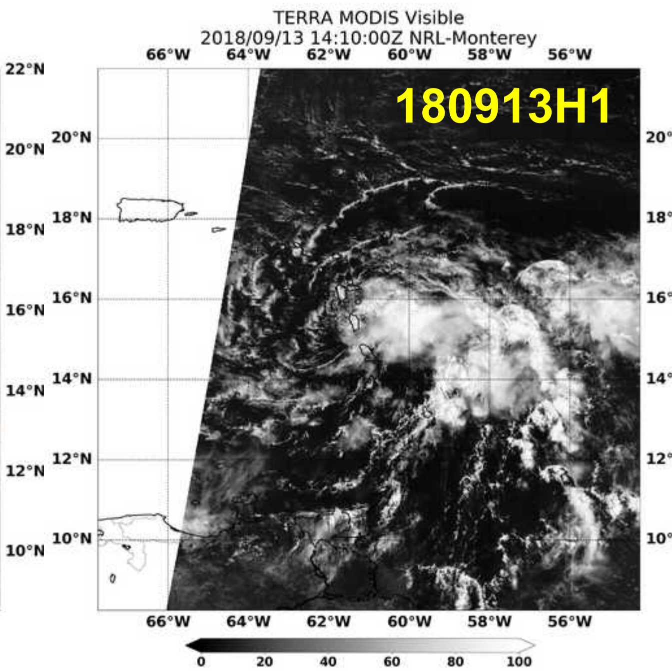
AL09/Isaac

September 12-15

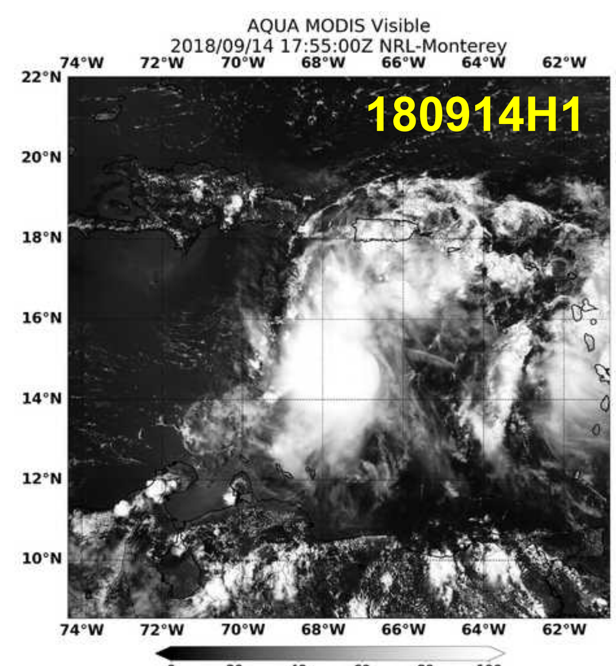
- 180912H1
- 180912H2
- 180913H1
- 180914H1
- 180915H1

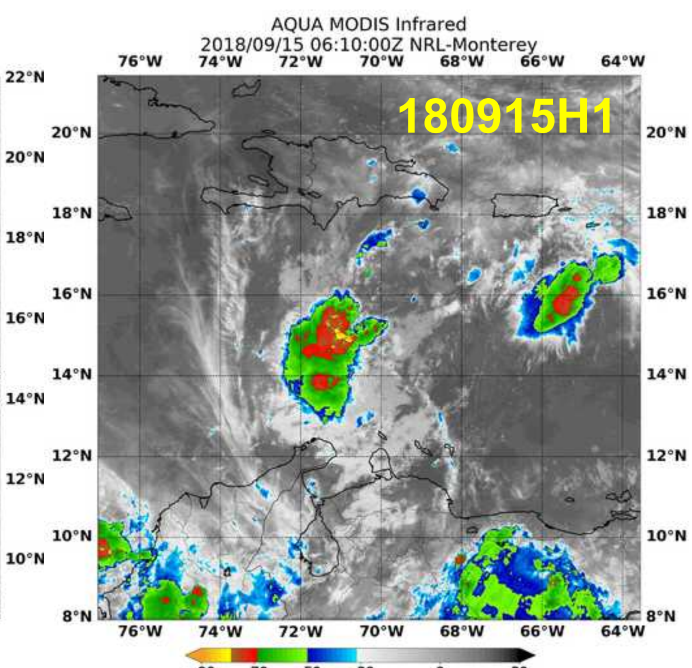






5 NHC-tasked P-3 Missions
38 P-3 Flight Hours
55 Dropsondes
0 AXBTs



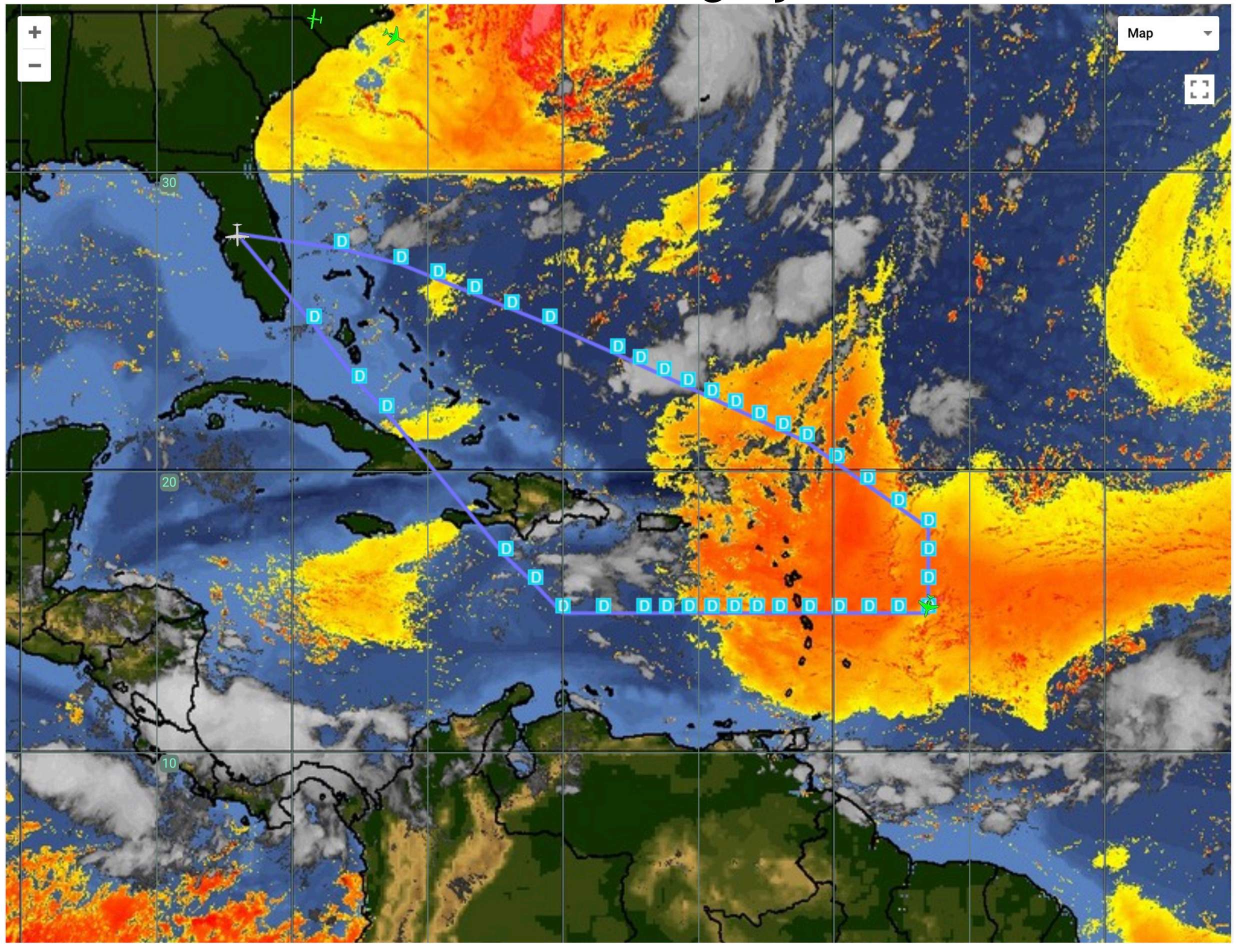


2018 NOAA/AOML/HRD Hurricane Field Program
Intensity Forecast Experiment (IFEX)
HRD-NESDIS G-IV SAL Mission

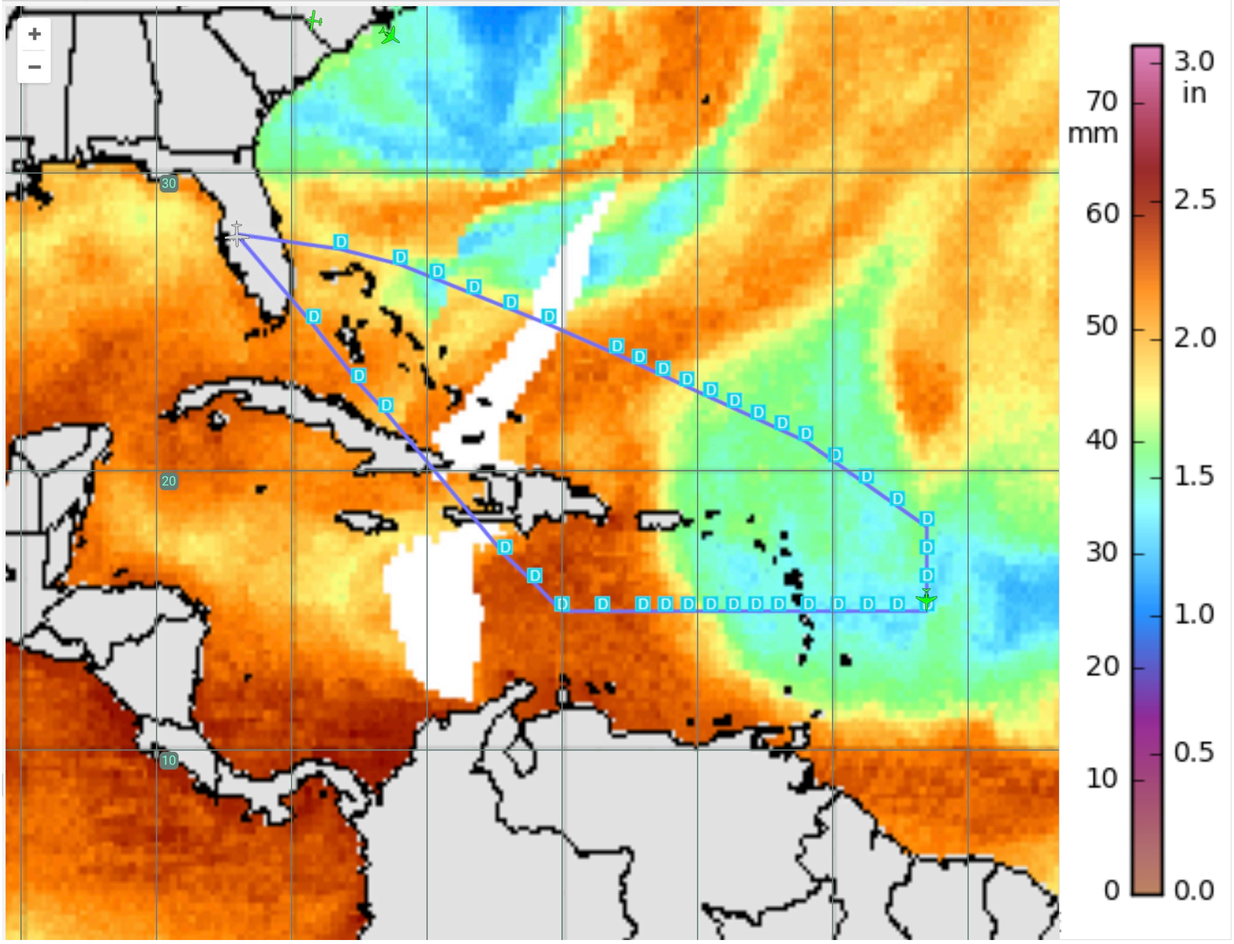
20180920N1

8.5 hr mission - flight-level 41-45 kft - 42 GPS dropsondes

G-IV Track & Dropsonde Points - GOES-E SAL Split Window Imagery



G-IV Track & Dropsonde Points – MIMIC Total Precipitable Water



HRD-NESDIS G-IV SAL Mission

20180920N1

Objectives

- Validate NESDIS NUCAPS sounding profiles with G-IV GPS dropsondes >> focus on SAL & MLDAI environments
- Assess NUCAPS performance in high gradient areas >> e.g., moist tropical-SAL (or mid-latitude dry air intrusion) boundaries
- Assess NUCAPS performance in SAL/MLDAI environments that are capped by moist layers (particularly challenging)
- Repeat assessments for various models (e.g., HRWF, Basin-Scale HWRF, GFS)

HRD-NESDIS Coordination

- G-IV take-off time: 1300 UTC/0900 LT
- optimize GPS dropsonde SAL sampling and coincident satellite overpasses (Suomi-NPP and NOAA-20)

Expendables

- 42 GPS dropsondes (40 + 2 back-ups)

2019 Plans

- Possible HRD-NESDIS/JPSS SAL missions pending NESDIS dropsonde purchase
- Possible inclusion of the Saharan Air Layer Experiment (SALEX) in the HRD HFP

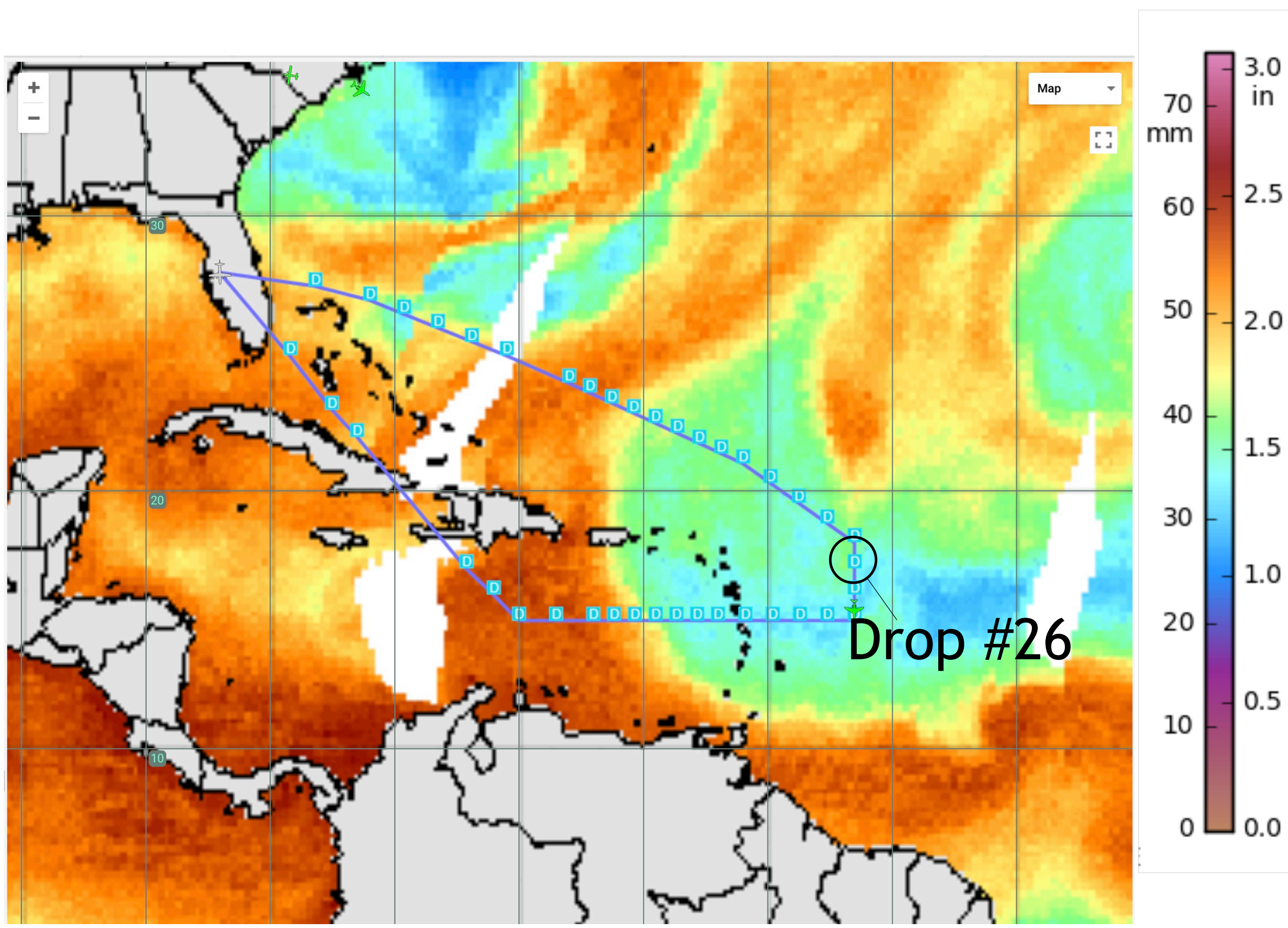
2018 NOAA/AOML/HRD Hurricane Field Program
Intensity Forecast Experiment (IFEX)
HRD-NESDIS G-IV SAL Mission

20180920N1

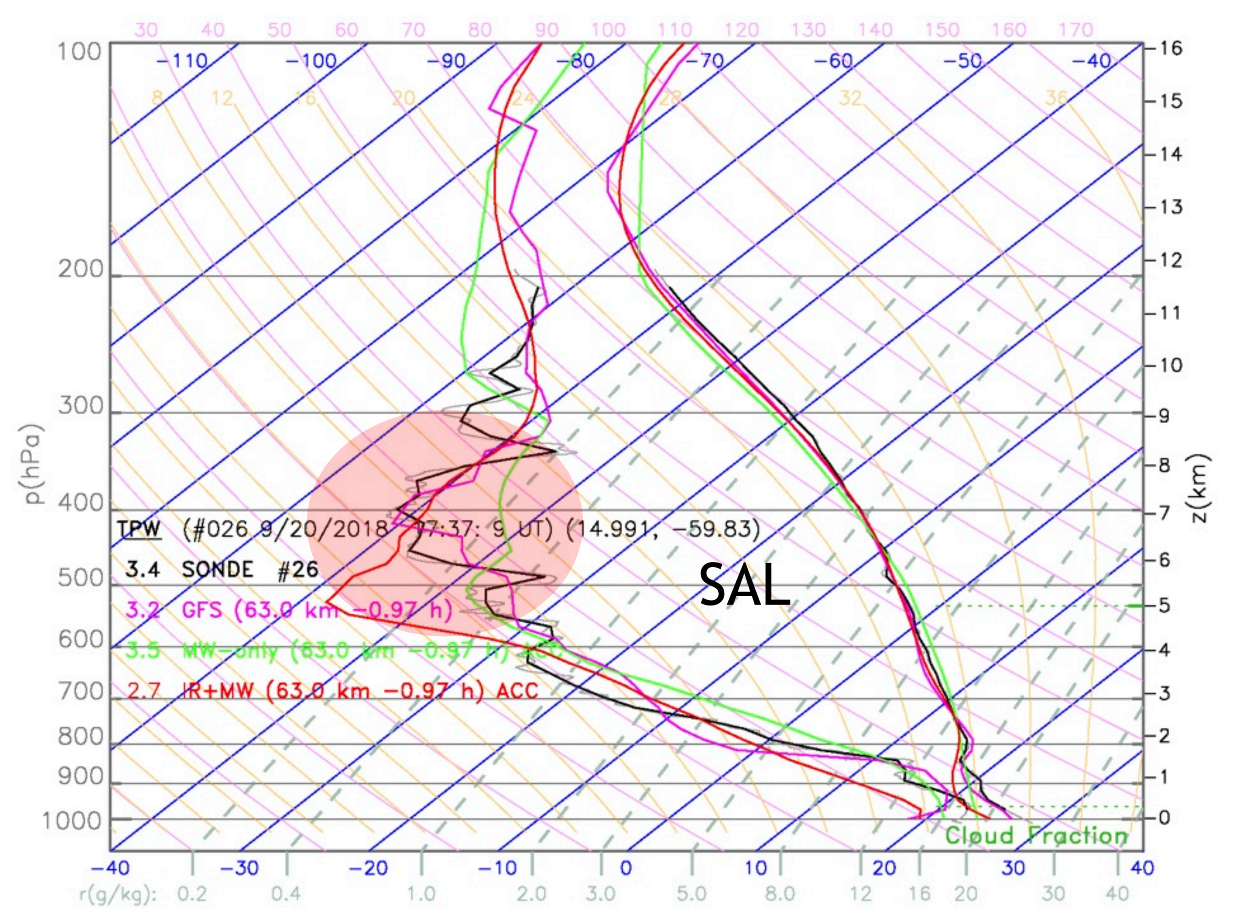
G-IV Drop #26 (172822 UTC)

- Environments: Saharan Air Layer, mid/upper-level subsidence
- Dropsonde-NUCAPS temporal & spatial separation: 9 min, 2.0 km

G-IV track - MIMIC TPW Imagery



G-IV GPS Dropsonde - GFS - NUCAPS



600 hPa RH

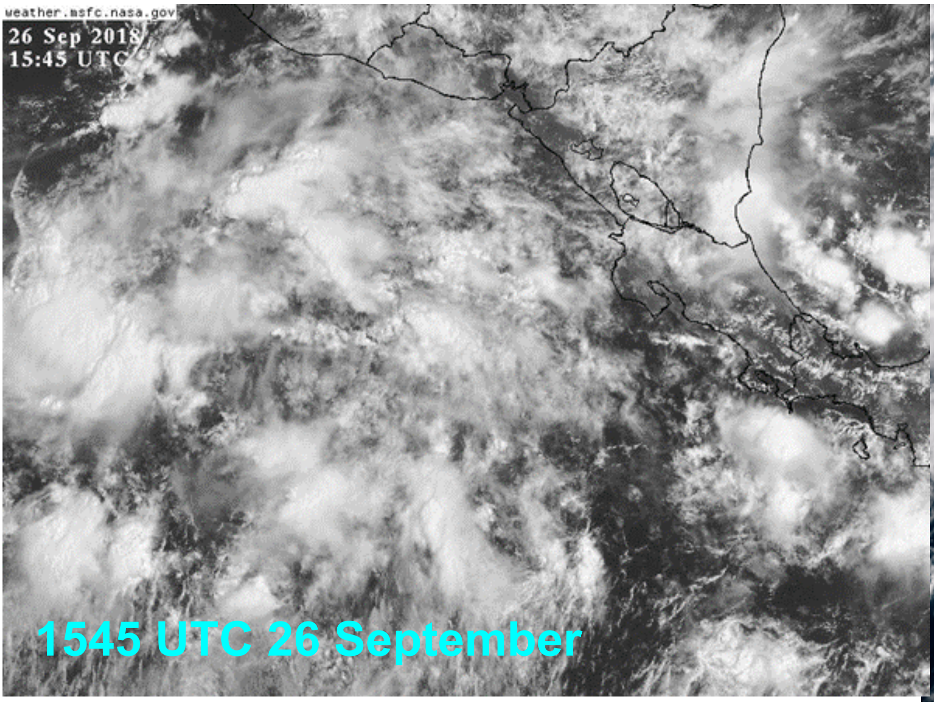
Dropsonde: 8.5% NUCAPS: ~8% GFS: ~10%

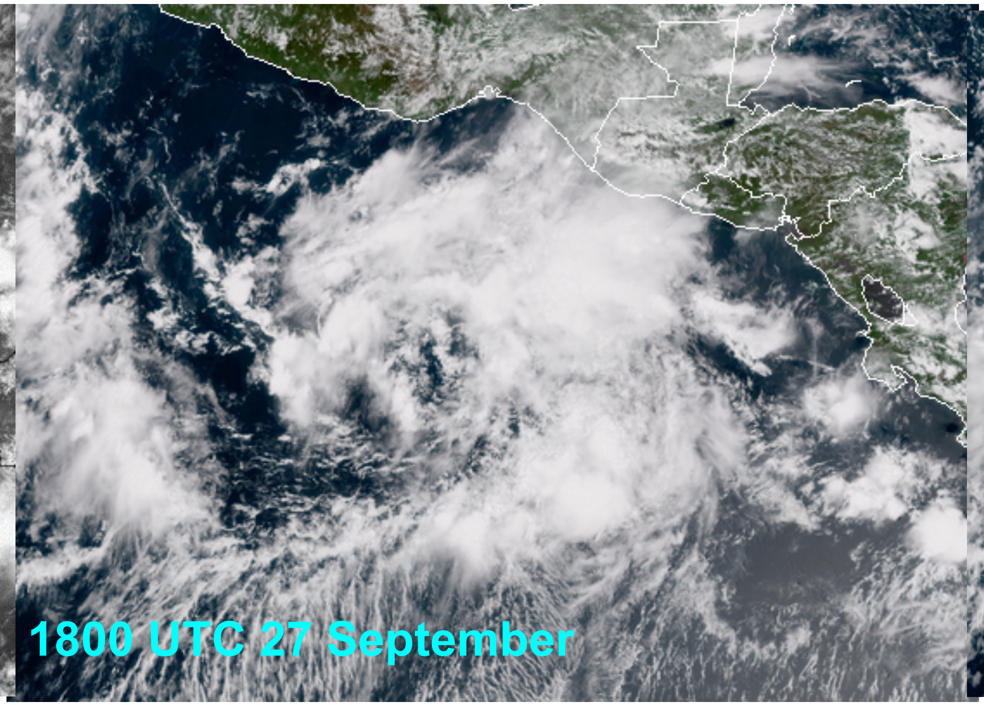
2018 NOAA/AOML/HRD Hurricane Field Program
Intensity Forecast Experiment (IFEX)
EP96/Pre-Sergio

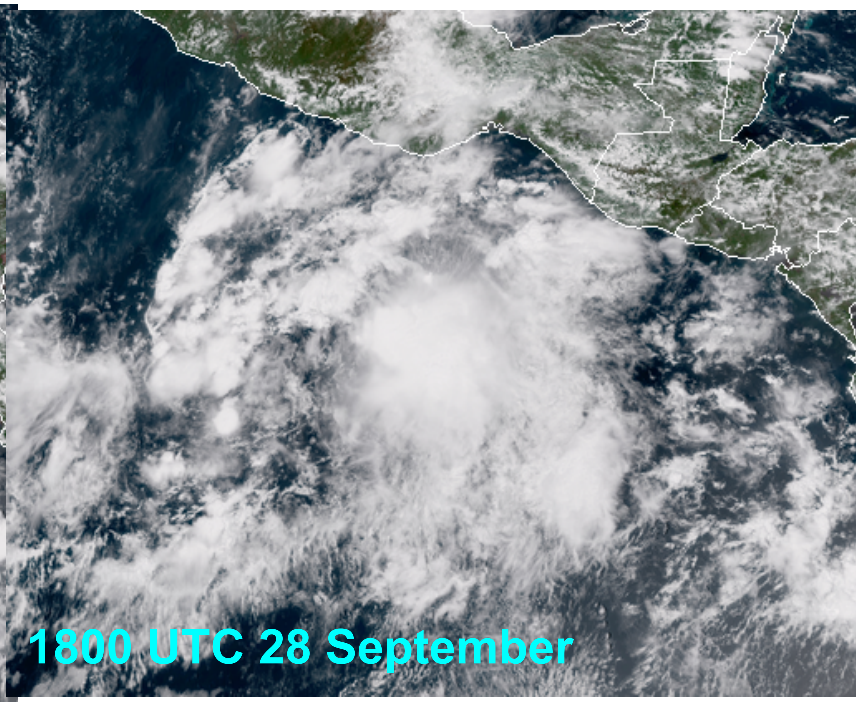
September 26-28

3 P-3 Research Missions
25 P-3 Flight Hours (includes LAL-LIR)
52 Dropsondes
7 AXBTs

- 180926H1
- 180927H1
- 180928H1

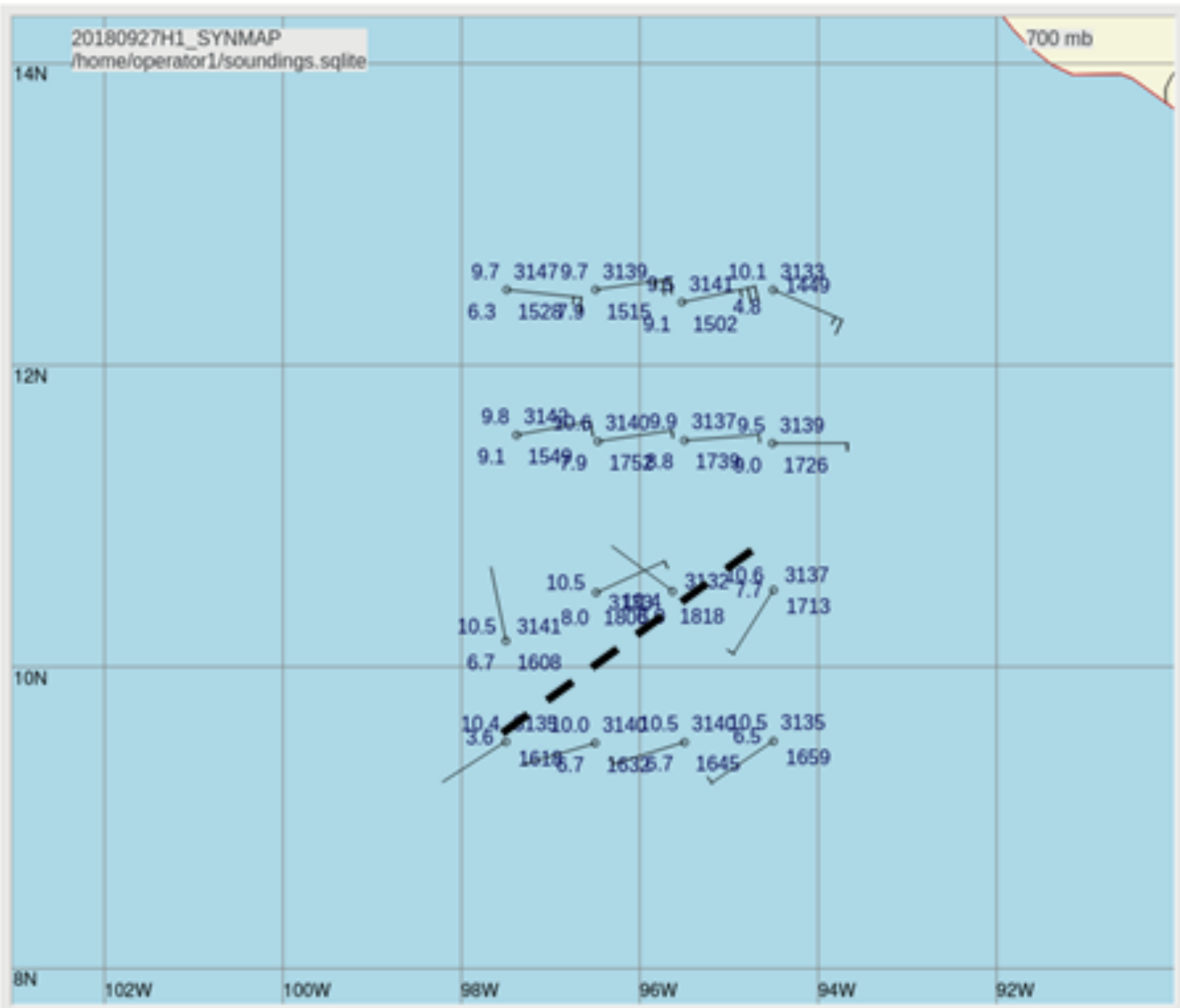






2018 NOAA/AOML/HRD Hurricane Field Program
Intensity Forecast Experiment (IFEX)
EP96/Pre-Sergio

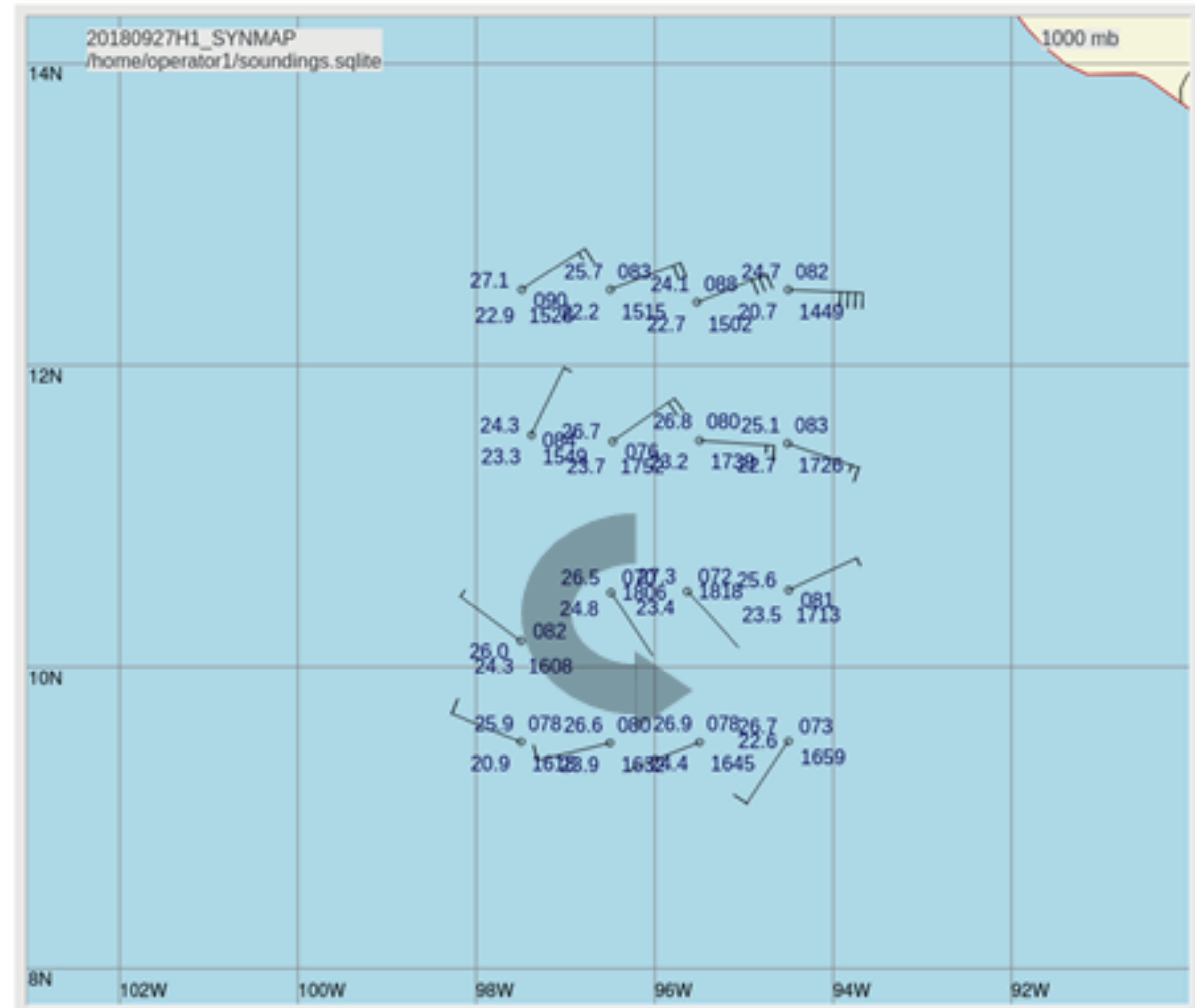
Dropsonde synoptic map at 700 hPa



Mostly easterly flow at 700 hPa, except for region of weak westerlies along southern west-east leg

Appearance of a shear axis oriented WSW/ENE

Dropsonde synoptic map at 1000 hPa



Strongest near-surface winds > 30 kt on northern side, likely reflecting presence of Papagayo jet

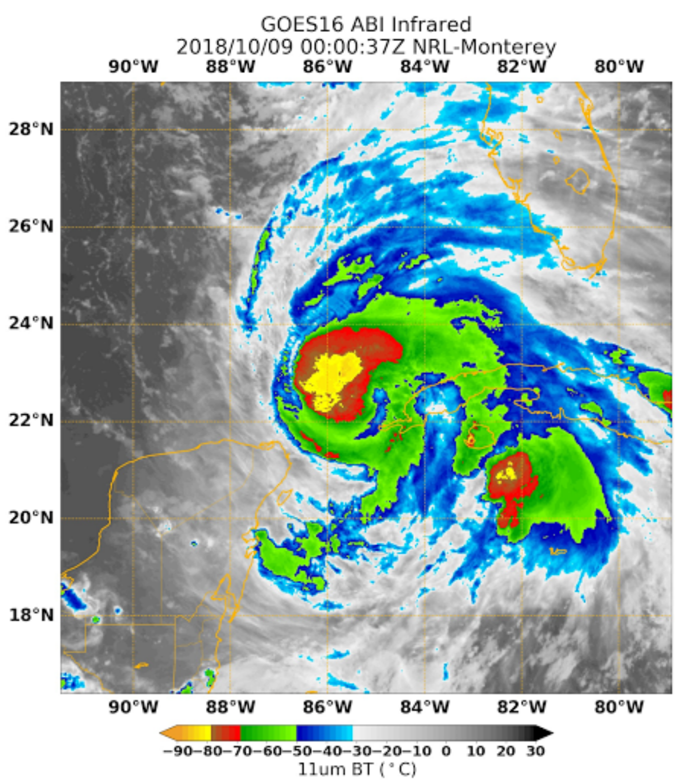
Appearance of circulation center in SW portion of domain

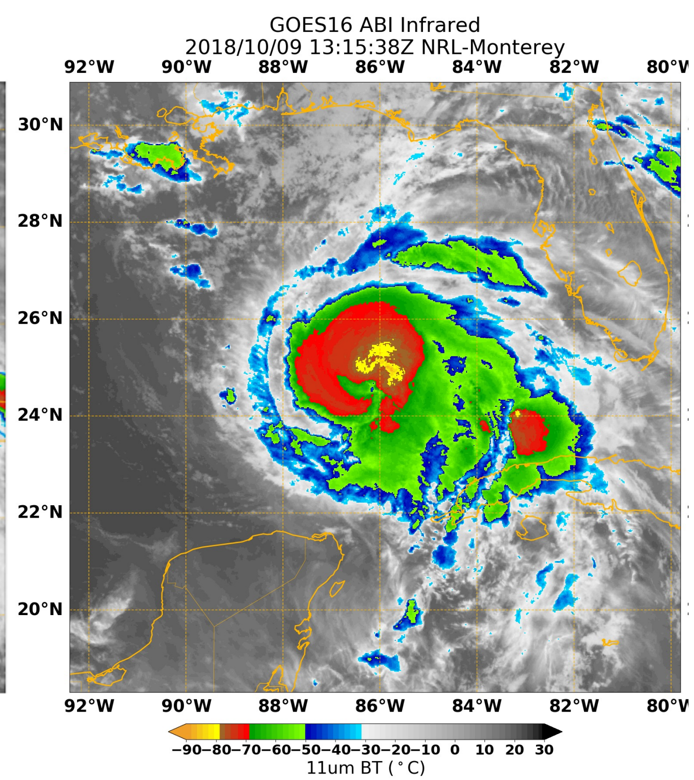
2018 NOAA/AOML/HRD Hurricane Field Program
Intensity Forecast Experiment (IFEX)

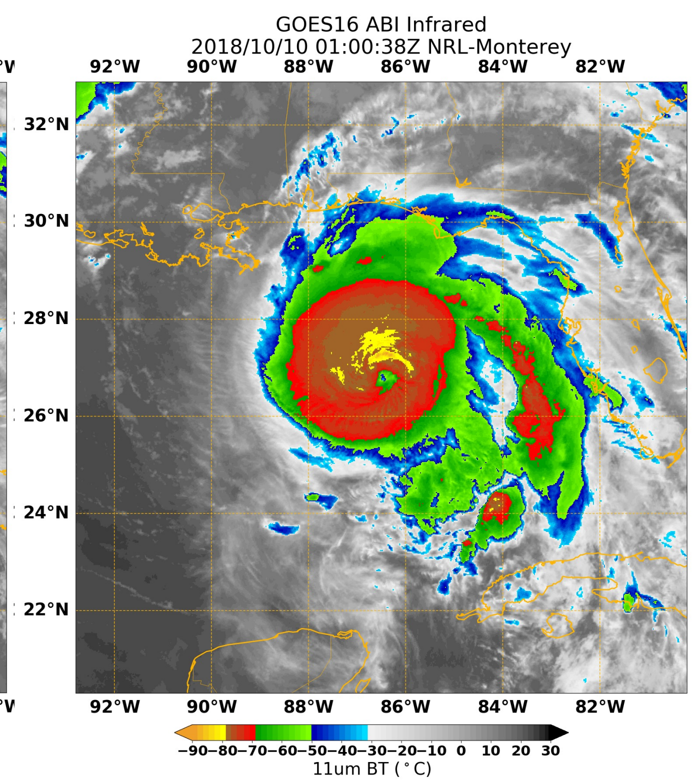
AL14/Michael

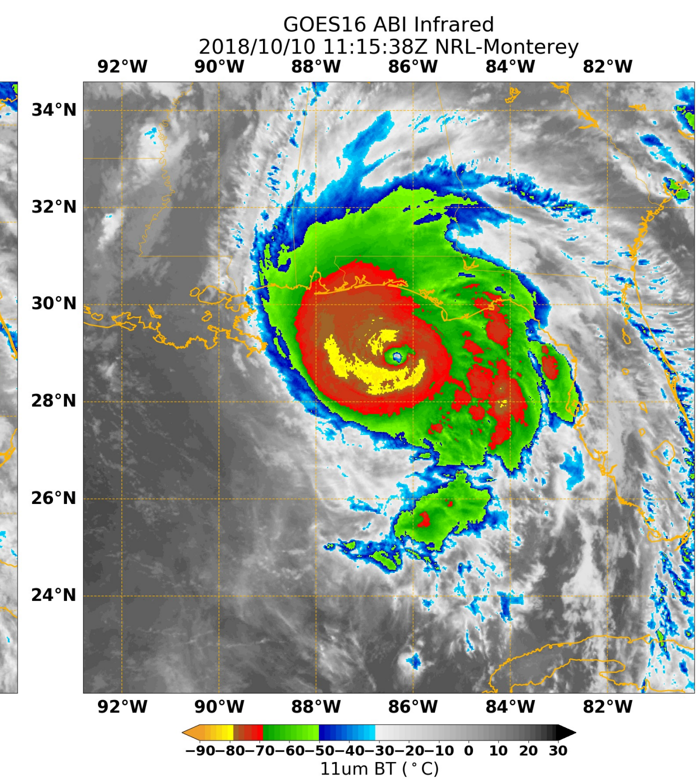
September 8-10

4	EMC P-3 Missions	**2**	**Pre-/Post-storm P-3 Missions**	• 181008H1
31	P-3 Flight Hours	**7**	**P-3 Flight Hours**	• 181009H1
107	Dropsondes	**2**	NHC G-IV Missions	• 181009N2
109	AXBTs	**1**	HRD G-IV Mission	• 181009H2
18	AXCPs	**21**	G-IV Flight Hours	• 181010H1
11	AXCTDs	**102**	Dropsondes	
1	Coyote			

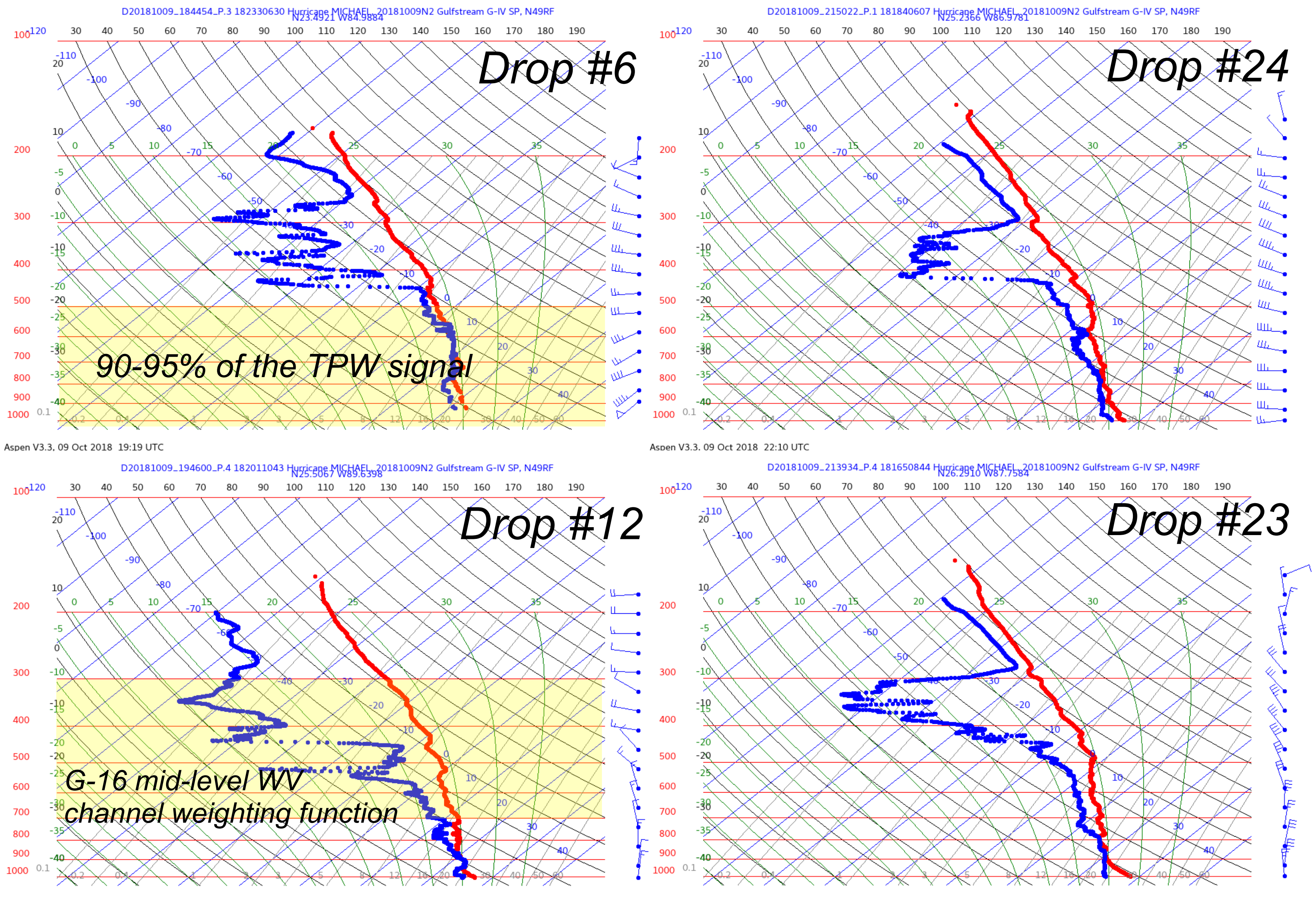




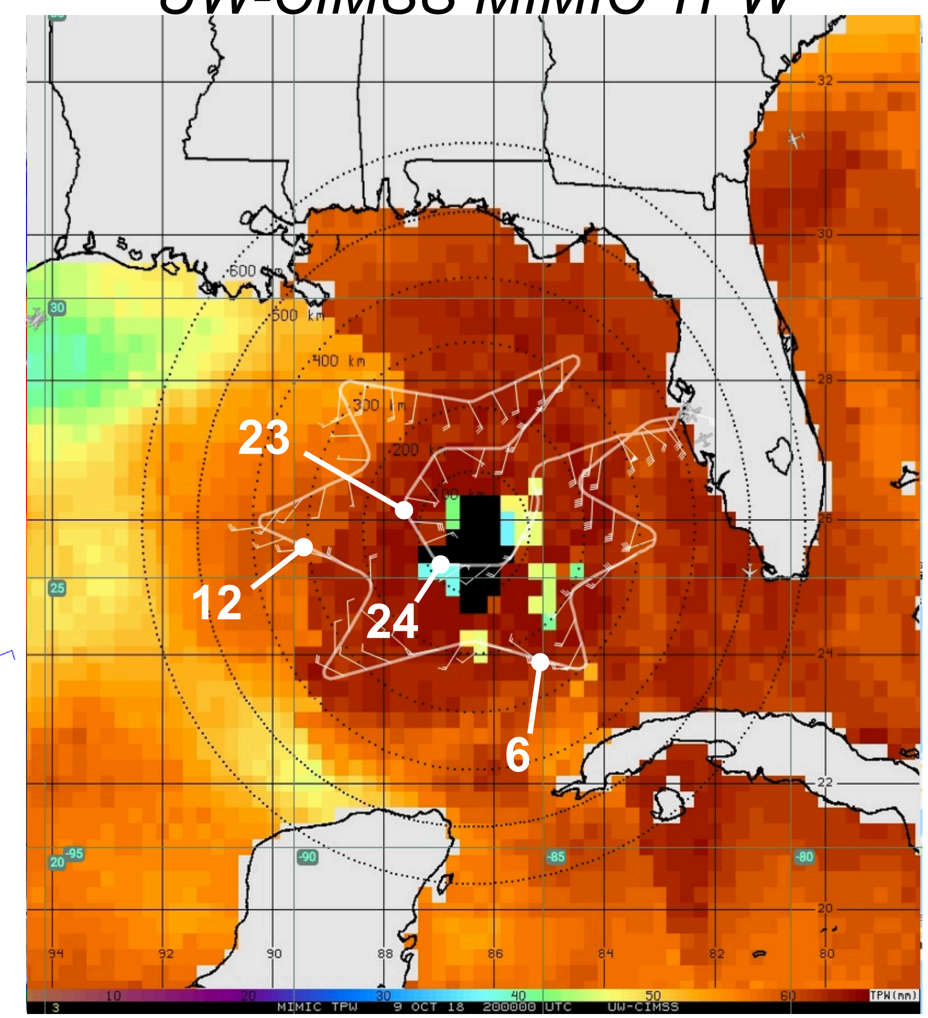




2018 NOAA/AOML/HRD Hurricane Field Program
Intensity Forecast Experiment (IFEX)
AL14/Michael



UW-CIMSS MIMIC TPW



Brinn Black holds her father's ashes wrapped in a Virginia state flag and decorated with his flight suit name tag and Senior Master Eye Rover patch before release into Hurricane Michael.

Sonde No. 21, the "Michael Black Memorial Sonde" was signed by everyone aboard NOAA's N42RF Hurricane Hunter aircraft with messages of friendship and farewell.

2018 NOAA/AOML/HRD Hurricane Field Program
Intensity Forecast Experiment (IFEX)
Season in Review

Individual Storm Flight Hour and Expendable Distributions

Storm	P-3 Flights	P-3 Hours		G-IV Flights	G-IV Hours		Total Flights	Total Hours	P-3 Dropsondes		G-IV Dropsondes		Total Drops
		Operational	Research		Operational	Research			Operational	Research	Operational	Research	
Chris	4	30.3	-	-	-	-	**4**	**30.3**	55	-	-	-	**55**
Hector	-	-	-	3	24.1	-	**3**	**24.1**	-	-	90	-	**90**
Lane	4	32.6	-	4	32.8	-	**8**	**65.4**	73	5	125	-	**203**
Gordon	3	17.8	-	-	-	-	**3**	**17.8**	45	3	-	-	**48**
Norman	-	-	-	2	15.7	-	**2**	**15.7**	-	-	68	-	**68**
Florence	3	-	26.4	9	72.3	-	**12**	**98.7**	15	71	281	-	**367**
Isaac	5	38.4	-	-	-	-	**5**	**38.4**	46	9	-	-	**55**
SAL/JPSS	-	-	-	1	-	8.8	**1**	**8.8**	-	-	-	42	**42**
EP96/Pre-Sergio	3	-	21.2	-	-	-	**3**	**21.2**	-	52	-	-	**52**
Michael	6	31.6	6.8	3	15.9	5.6	**9**	**59.9**	107	-	74	28	**209**
TOTAL	**28**	**150.7**	**54.4**	**22**	**160.8**	**14.4**	**50**	**380.3**	**341**	**140**	**638**	**70**	**1189**

Legend
- Atlantic
- Central Pacific
- East Pacific

- 5 Atlantic, 1 East Pacific (pre-genesis), and 3 Central Pacific storms sampled
- Lane, Florence, and Michael most sampled storms of the season
- A G-IV collaborative research mission for HRD & NESDIS/JPSS

2018 NOAA/AOML/HRD Hurricane Field Program
Intensity Forecast Experiment (IFEX)
Season in Review

- **Highlights: Research to operations**
  - **AWIPS-II development to view P-3 data** (Tail Doppler radar, dropsonde, and flight level) **and G-IV** (Tail Doppler radar, dropsonde)
    - ➢ **P-3 and G-IV data is in the hands of NHC/CPHC and WFO forecasters in their preferred environment in near real-time**
  - **EMC assimilation of Doppler velocity from both P-3 *and G-IV***, complete suite of P-3/G-IV data
    - ➢ **Improved representation of TC structure in HWRF forecast initialization**
  - **Inner circumnavigation on G-IV (90 nmi) for the first time around Florence**
    - ➢ **More opportunities for dropsonde and radar observations within the inner core for assimilation into forecast models**
  - **BUFR formatted dropsonde transmission**
    - ➢ **Higher vertical resolution dropsonde data assimilated into forecast models**

Combined Use of Satellite Observations and Global Hawk Unmanned Aircraft Dropwindsondes for Improved Tropical Cyclone Analyses and Forecasts

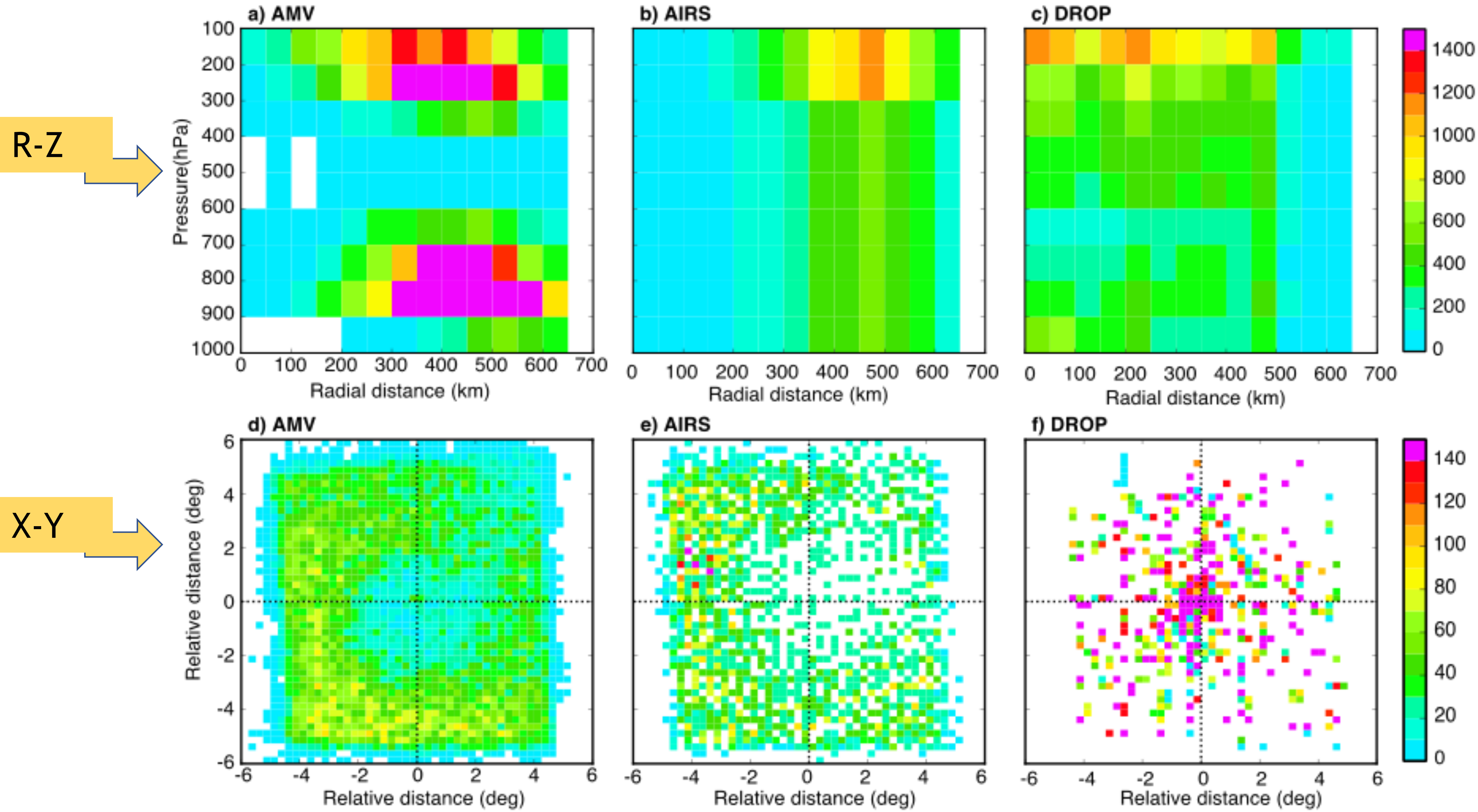
Hui Christophersen
CIMAS and AOML/HRD

Christophersen H., R. Atlas, A. Aksoy and J. Dunion, 2018: Combined Use of Satellite Observations and Global Hawk Unmanned Aircraft Dropwindsondes for Improved Tropical Cyclone Analyses and Forecasts, Wea. Forecasting. doi.org/10.1175/WAF-D-17-0167.1

- The joint impact of GH dropsondes and satellite observations is explored using OSEs in a regional DA and forecast model

Storm name	Initial time	Initial best-track intensity (kt)	Peak intensity over the 5-day forecast (kt)
Nadine (2012)	09/15 06Z	70	70
	09/20 06Z	50	55
	09/23 06Z	50	65
	09/26 18Z	50	80
Humberto (2013)	09/17 06Z	35	40
Cristobal (2014)	08/29 06Z	70	70
Edouard (2014)	09/12 06z	35	105
	09/14 18Z	75	105
	09/15 06Z	85	105
	09/16 18Z	95	95
	09/17 06Z	85	85
	09/18 18Z	65	65
Gaston (2016)	08/27 06Z	55	105
Karl (2016)	09/23 18Z	50	60
Hermine (2016)	08/30 06Z	30	70
	09/01 06Z	50	70
	09/01 18Z	65	70
Matthew (2016)	10/05 18Z	105	120

Composite Data Distribution



Conclusions

- Global Hawk sonde and AIRS data are complementary in sampling the TC. Global Hawk sondes are usually released close to the TC center, and AIRS usually measures areas away from the TC
- Global Hawk sondes and the AIRS data together provide better analyses and forecasts than either one itself
- Satellite data should be considered in planning Hurricane Hunter aircraft missions to provide the best TC forecasts

AUGUST 2018 CHRISTOPHERSEN ET AL. 1021

Combined Use of Satellite Observations and Global Hawk Unmanned Aircraft Dropwindsondes for Improved Tropical Cyclone Analyses and Forecasts

HUI CHRISTOPHERSEN

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ROBERT ATLAS

NOAA/Atlantic Oceanographic and Meteorological Laboratory, Miami, Florida

ALTUG AKSOY AND JASON DUNION

Cooperative Institute for Marine and Atmospheric Studies, University of Miami, and NOAA/Atlantic Oceanographic and Meteorological Laboratory/Hurricane Research Division, Miami, Florida

(Manuscript received 9 November 2017, in final form 4 June 2018)

ABSTRACT

This study demonstrates that Global Hawk unmanned aircraft system dropwindsondes and Atmospheric Infrared Sounder (AIRS) observations can be complementary in sampling a tropical cyclone (TC). The assimilation of both datasets in a regional ensemble data assimilation system shows that the cumulative impact of both datasets is greater than either one alone because of the presence of mutually independent information content. The experiment that assimilates both datasets has smaller position and intensity errors in the mean analysis than those with individual datasets. The improvements in track and intensity forecasts that result from combining both datasets also indicate synergistic benefits. Overall, superior track and intensity forecasts are evident. This study suggests that polar-orbiting satellite spatial coverage should be considered in operational reconnaissance mission planning in order to achieve further improvements in TC analyses and forecasts.

Conclusions:

- The Global Hawk sondes
- improve track forecasts for Hurricanes Matthew and Nicole by up to 30%.
- The Global Hawk sondes are partly able to fill in the gap of a possible future loss of satellite coverage.
- The Global Hawk sondes released over the Atlantic not only improve forecasts of hurricanes in the Atlantic, but over the entire globe by almost 10%.
- Sampling the Pacific Ocean with Global Hawk observations improved the forecast over the southeastern United States tied to a severe tornado outbreak.

Impact of UAS Global Hawk Dropsonde Data on Tropical and Extratropical Cyclone Forecasts in 2016

A. C. KREN

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(Manuscript received 15 February 2018, in final form 23 July 2018)

ABSTRACT

A preliminary investigation into the impact of dropsonde observations from the Global Hawk (GH) on tropical and extratropical forecasts is performed using the National Centers for Environmental Prediction (NCEP) Global Data Assimilation System (GDAS). Experiments are performed during high-impact weather events that were sampled as part of the NOAA Unmanned Aerial Systems (UAS) Sensing Hazards with Operational Unmanned Technology (SHOUT) field campaigns in 2016: 1) three extratropical systems in February 2016 and 2) Hurricanes Matthew and Nicole in the western Atlantic. For these events, the benefits of GH observations under a satellite data gap scenario are also investigated. It is found that the assimilation of GH dropsondes reduces the track error for both Matthew and Nicole; the improvements are as high as 20% beyond 60 h. Additionally, the localized dropsondes reduce global forecast track error for four tropical cyclones by up to 9%. Results are mixed under a satellite gap scenario, where only Hurricane Matthew is improved from assimilated dropsondes. The improved storm track is attributed to a better representation of the steering flow and atmospheric midlevel pattern. For all cases, dropsondes reduce the root-mean-square error in temperature, relative humidity, wind, and sea level pressure by 3%–8% out to 96 h. Additional benefits from GH dropsondes are obtained for precipitation, with higher skill scores over the southeastern United States versus control forecasts of up to 8%, as well as for low-level parameters important for severe weather prediction. The findings from this study are preliminary and, therefore, more cases are needed for statistical significance.

Conclusions:

1. DWL, airborne Doppler radar, and sonde wind measurements are all similar to each other, showing that the DWL can accurately measure wind speed and direction in TCs.
2. The DWL measurements show that the air is spinning rapidly near the sea surface at the storm center of Erika, which helps explain why Erika stayed the same strength even though other things suggested it should weaken.
3. The DWL will be useful for real-time hurricane intensity forecasts and will help us understand the boundary layer. It will also help us understand winds near the surface that can cause damage to buildings.

Article

Airborne Doppler Wind Lidar Observations of the Tropical Cyclone Boundary Layer

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Received: 16 April 2018; Accepted: 23 May 2018; Published: 25 May 2018

check for updates

Abstract: This study presents a verification and an analysis of wind profile data collected during Tropical Storm Erika (2015) by a Doppler Wind Lidar (DWL) instrument aboard a P3 Hurricane Hunter aircraft of the National Oceanic and Atmospheric Administration (NOAA). DWL-measured winds are compared to those from nearly collocated GPS dropsondes, and show good agreement in terms of both the wind magnitude and asymmetric distribution of the wind field. A comparison of the DWL-measured wind speeds versus dropsonde-measured wind speeds yields a reasonably good correlation ($r^2 = 0.95$), with a root mean square error (RMSE) of 1.58 m s^{-1} and a bias of -0.023 m s^{-1}. Our analysis shows that the DWL complements the existing P3 Doppler radar, in that it collects wind data in rain-free and low-rain regions where Doppler radar is limited for wind observations. The DWL observations also complement dropsonde measurements by significantly enlarging the sampling size and spatial coverage of the boundary layer winds. An analysis of the DWL wind data shows that the boundary layer of Erika was much deeper than that of a typical hurricane-strength storm. Streamline and vorticity analyses based on DWL wind observations explain why Erika maintained intensity in a sheared environment. This study suggests that DWL wind data are valuable for real-time intensity forecasts, basic understanding of the boundary layer structure and dynamics, and offshore wind energy applications under tropical cyclone conditions.

Keywords: tropical cyclones; Doppler Wind Lidar; atmospheric boundary layer; wind structure

Conclusions:

1. The ADWL shows great potential to measure wind where we have not been able to measure it before.
2. The ADWL wind measurements are as accurate as other wind data.
3. The ADWL has some problems measuring where wind changes quickly in a small area.

sensors

MDPI

Article

Validation of an Airborne Doppler Wind Lidar in Tropical Cyclones

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Received: 20 October 2018; Accepted: 28 November 2018; Published: 5 December 2018

Abstract: This study presents wind observations from an airborne Doppler Wind Lidar (ADWL) in 2016 tropical cyclones (TC). A description of ADWL measurement collection and quality control methods is introduced for the use in a TC environment. Validation against different instrumentation on-board the National Oceanographic and Atmospheric Administration's WP-3D aircraft shows good agreement of the retrieved ADWL measured wind speed and direction. Measurements taken from instruments such as the global positioning system dropsonde, flight-level wind probe, tail Doppler radar, and Stepped Frequency Microwave Radiometer are compared to ADWL observations by creating paired datasets. These paired observations represent independent measurements of the same observation space through a variety of mapping techniques that account for differences in measurement procedure. Despite high correlation values, outliers are identified and discussed in detail. The errors between paired observations appear to be caused by differences in the ability to capture various length scales, which directly relate to certain regions in a TC regime. In validating these datasets and providing evidence that shows the mitigation of gaps in 3-dimensional wind representation, the unique wind observations collected via ADWL have significant potential to impact numerical weather prediction of TCs.

Keywords: tropical cyclones; Doppler Wind Lidar; wind structure; validation

Conclusions:

- Moist and dry downdrafts both occurred in Hurricane Earl.
- A lot of past research assumed that all downdrafts should limit the intensification of tropical cyclones. However, in Hurricane Earl the high-humidity downdrafts did not greatly affect the storm's intensity.
- The high-humidity downdrafts were stronger than the low-humidity ones.
- In this storm, the ocean was able to provide enough energy for the storm to recover from the dry downdrafts.

Downdrafts and the Evolution of Boundary Layer Thermodynamics in Hurricane Earl (2010) before and during Rapid Intensification

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(Manuscript received 15 March 2018, in final form 9 August 2018)

ABSTRACT

Using a combination of NOAA P-3 aircraft tail Doppler radar, NOAA and NASA dropsondes, and buoy- and drifter-based sea surface temperature data, different types of downdrafts and their influence on boundary layer (BL) thermodynamics are examined in Hurricane Earl (2010) during periods prior to rapid intensification [RI; a 30-kt ($15.4\,m\,s^{-1}$) increase in intensity over 24 h] and during RI. Before RI, the BL was generally warm and moist. The largest hindrances for intensification are convectively driven downdrafts inside the radius of maximum winds (RMW) and upshear-right quadrant, and vortex-tilt-induced downdrafts outside the RMW in the upshear-left quadrant. Possible mechanisms for overcoming the low entropy (θ_e) air induced by these downdrafts are BL recovery through air–sea enthalpy fluxes and turbulent mixing by atmospheric eddies. During RI, convective downdrafts of varying strengths in the upshear-left quadrant had differing effects on the low-level entropy and surface heat fluxes. Interestingly, the stronger downdrafts corresponded with maximums in 10-m θ_e. It is hypothesized that the large amount of evaporation in a strong ($>2\,m\,s^{-1}$) downdraft underneath a precipitation core can lead to high amounts of near-surface specific humidity. By contrast, weaker downdrafts corresponded with minimums in 10-m θ_e, likely because they contained lower evaporation rates. Since weak and dry downdrafts require more surface fluxes to recover the low entropy air than strong and moist downdrafts, they are greater hindrances to storm intensification. This study emphasizes how different types of downdrafts are tied to hurricane intensity change through their modification of BL thermodynamics.

SPECIAL NASA HS3 COLLECTION

Observations and Predictability of a Nondeveloping Tropical Disturbance over the Eastern Atlantic

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(Manuscript received 21 February 2018, in final form 9 July 2018)

ABSTRACT

A strong African easterly wave (AEW) left the West African coast in early September 2014 and operational global numerical forecasts suggested a potential for rapid tropical cyclogenesis of this disturbance in the eastern Atlantic, despite the presence of a large region of dry air northwest of the disturbance. Analysis and in situ observations show that after leaving the coast, the closed circulation associated with the AEW trough was not well aligned vertically, and therefore, low-level or midlevel dry air was advected below or above, respectively, areas of closed circulation. GPS dropwindsonde observations highlight the dry air undercutting the midlevel recirculation region in the southwestern quadrant. This advection of dry air constrains the spatial extent of deep convection within the AEW trough, leading to the vortex decaying. As the column continues to be displaced horizontally, losing vertical alignment, this enables increased horizontal advection of dry air into the system further limiting convective activity. Ensemble forecasts indicate that short-term errors in precipitation rate and vorticity generation can lead to an over intensified and well-aligned vortex, which then interacts less with the unfavorable environment, allowing for further convection and intensification. The stronger vortex provides more favorable conditions for precipitation through a more vertically coherent closed circulation and thus a positive feedback loop is initiated. The short-term forecasts of precipitation were shown to be sensitive to lower-tropospheric moisture anomalies around the AEW trough through ensemble sensitivity analysis from Global Ensemble Forecast System real-time forecasts.

Conclusions:

1. Dropwindsonde data improve track and intensity forecasts.
2. There is a preferred region for hurricane data at a distance from the hurricane's center that depends on the size of the hurricane. We should gather these observations in a large area around large hurricanes and in a small area around small hurricanes
3. Dropwindsonde data closest to the hurricane most improved the track forecasts.

Impact of Gulfstream-IV Dropsondes on Tropical Cyclone Prediction in a Regional OSSE System

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https://doi.org/10.1175/MWR-D-18-0157.1
Published Online: 19 March 2019

Abstract PDF

Abstract

Aircraft reconnaissance missions remain the primary means of collecting direct measurements of marine atmospheric conditions affecting tropical cyclone formation and evolution. The National Hurricane Center tasks the NOAA G-IV aircraft to sample environmental conditions that may impact the development of a tropical cyclone threatening to make landfall in the United States or its territories. These aircraft data are assimilated into deterministic models and used to produce real-time analyses and forecasts for a given tropical cyclone. Existing targeting techniques aim to optimize the use of reconnaissance observations and partially rely on regions of highest uncertainty in the Global Ensemble Forecast System. Evaluating the potential impact of various trade-offs in the targeting process is valuable for determining the ideal aircraft flight track for a prospective mission.

AOML's Hurricane Research Division has developed a system for performing regional Observing System Simulation Experiments (OSSEs) to assess the potential impact of proposed observing systems on hurricane track and intensity forecasting. This study focuses on improving existing targeting methods by investigating the impact of proposed aircraft observing system designs through various sensitivity studies. G-IV dropsonde retrievals were simulated from a regional Nature Run, covering the life cycle of a rapidly intensifying Atlantic hurricane. Results from sensitivity studies provide insight into improvements for real-time operational synoptic surveillance targeting for hurricanes and tropical storms, where dropsondes released closer to the vortex-environment interface provide the largest impact on the track forecast. All dropsonde configurations provide a positive 2-day impact on intensity forecasts by improving the environmental conditions known to impact tropical cyclone intensity.

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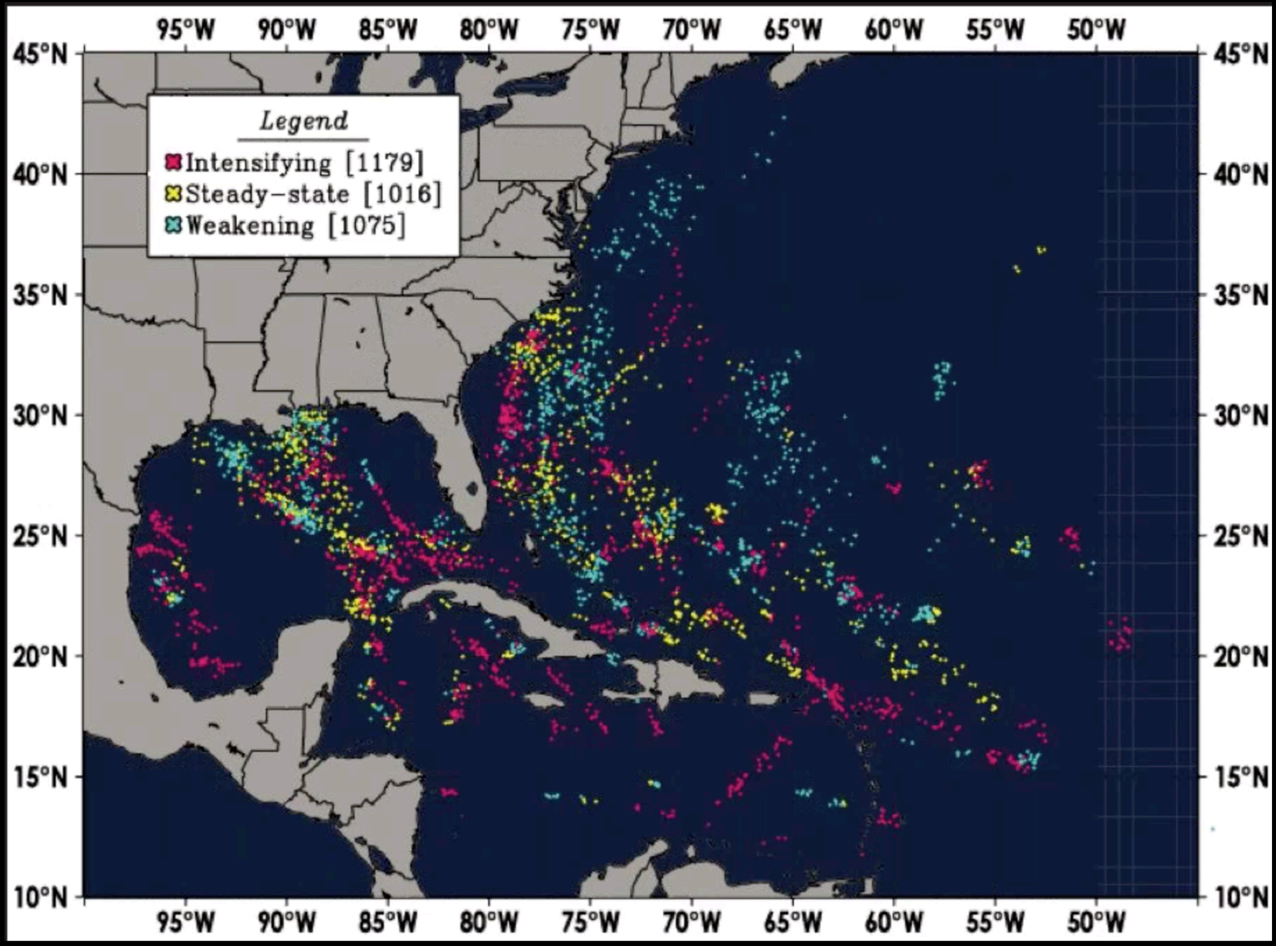
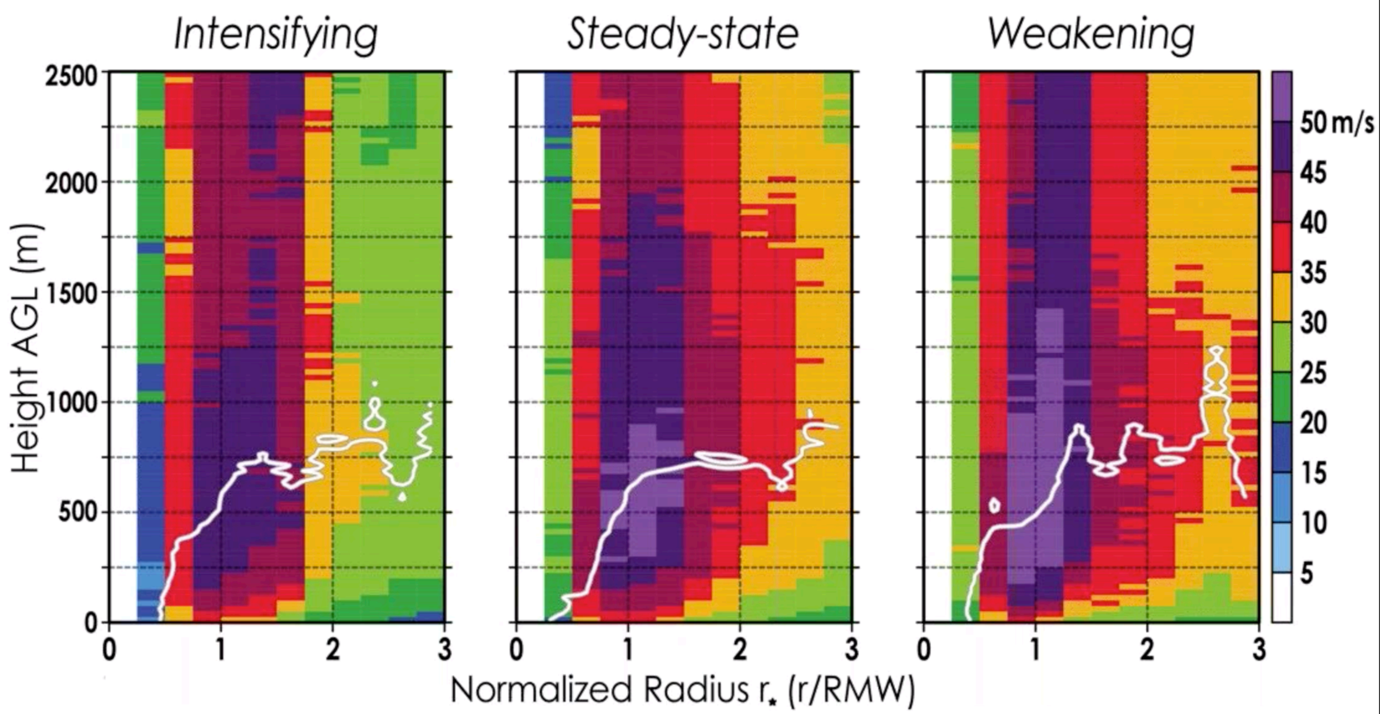
Observed and Simulated Boundary Layer Structures in the Hurricane Inner-core During Intensity Change

Kyle Ahern, Mark Bourassa, Robert Hart, Jun Zhang, and Robert Rogers

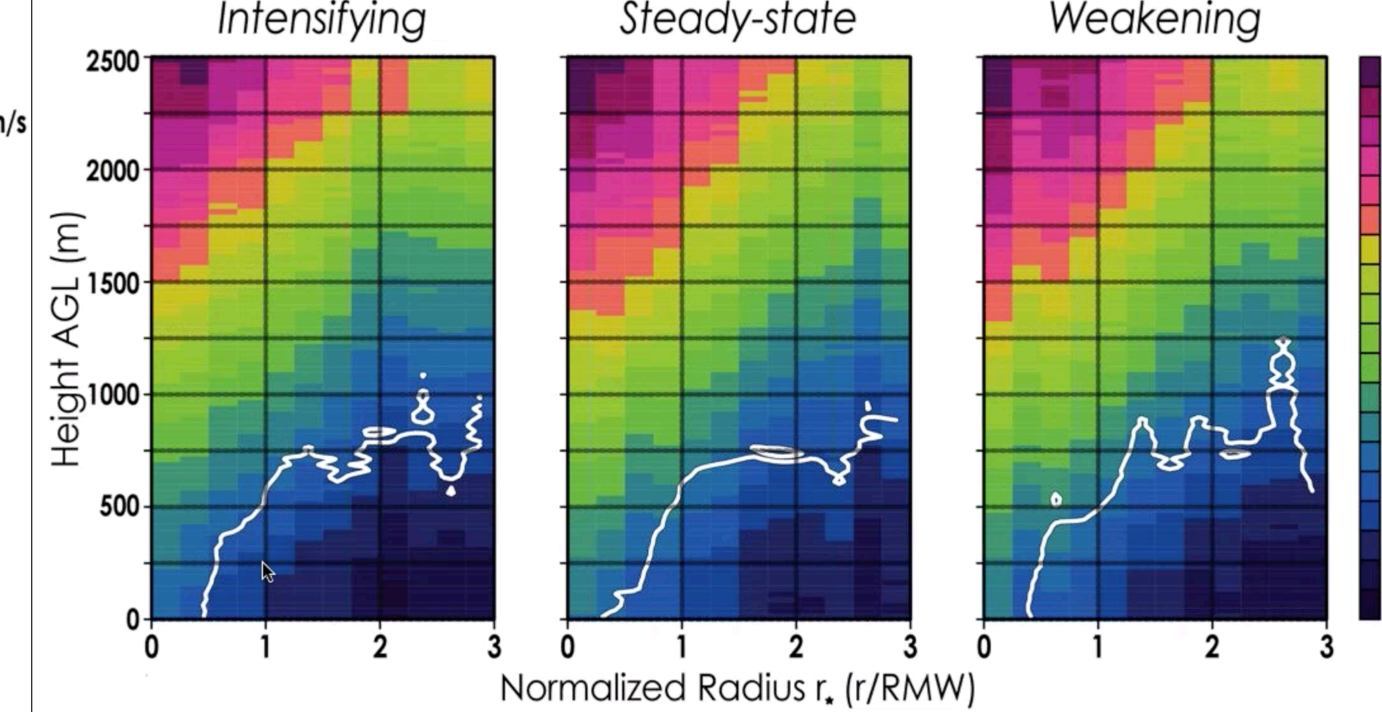
4 September 2018

Sonde data from flights equipped with SFMR are collected from 1998 - 2015; 12,045 total

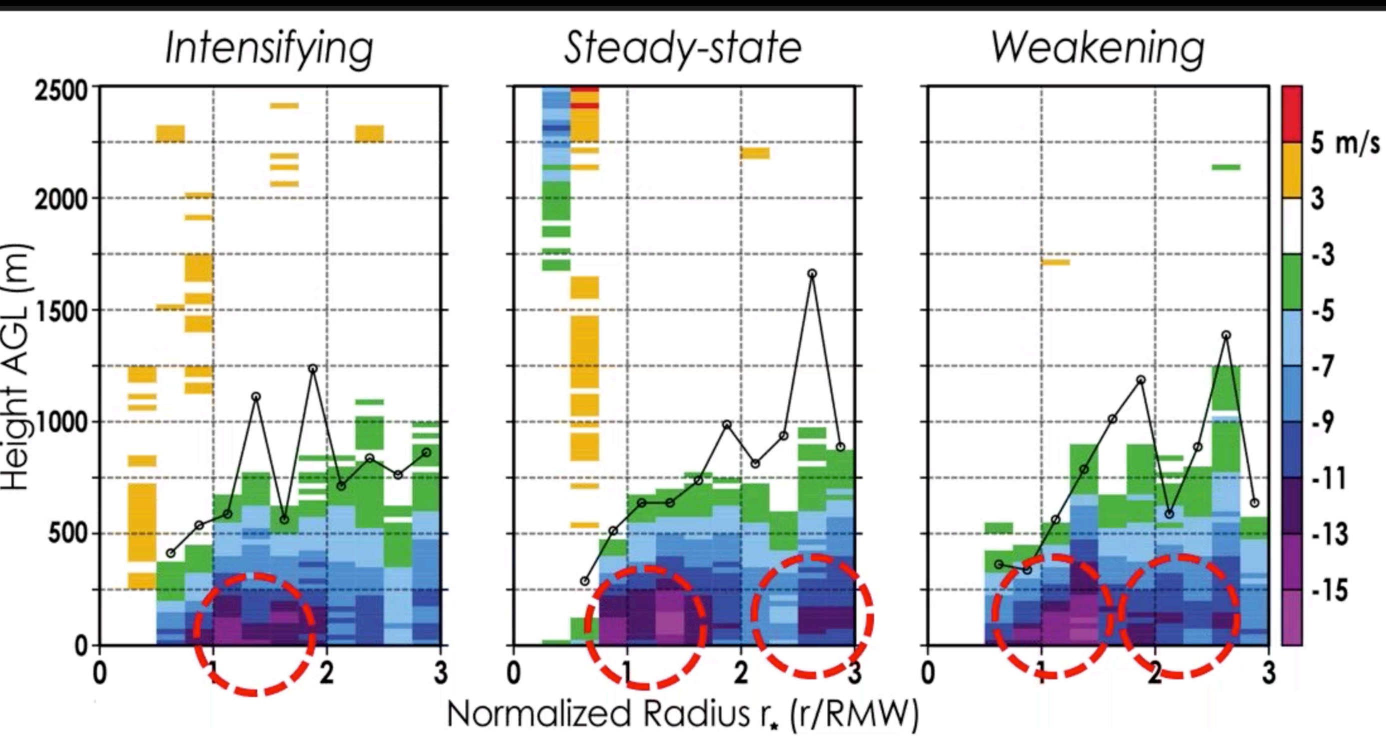




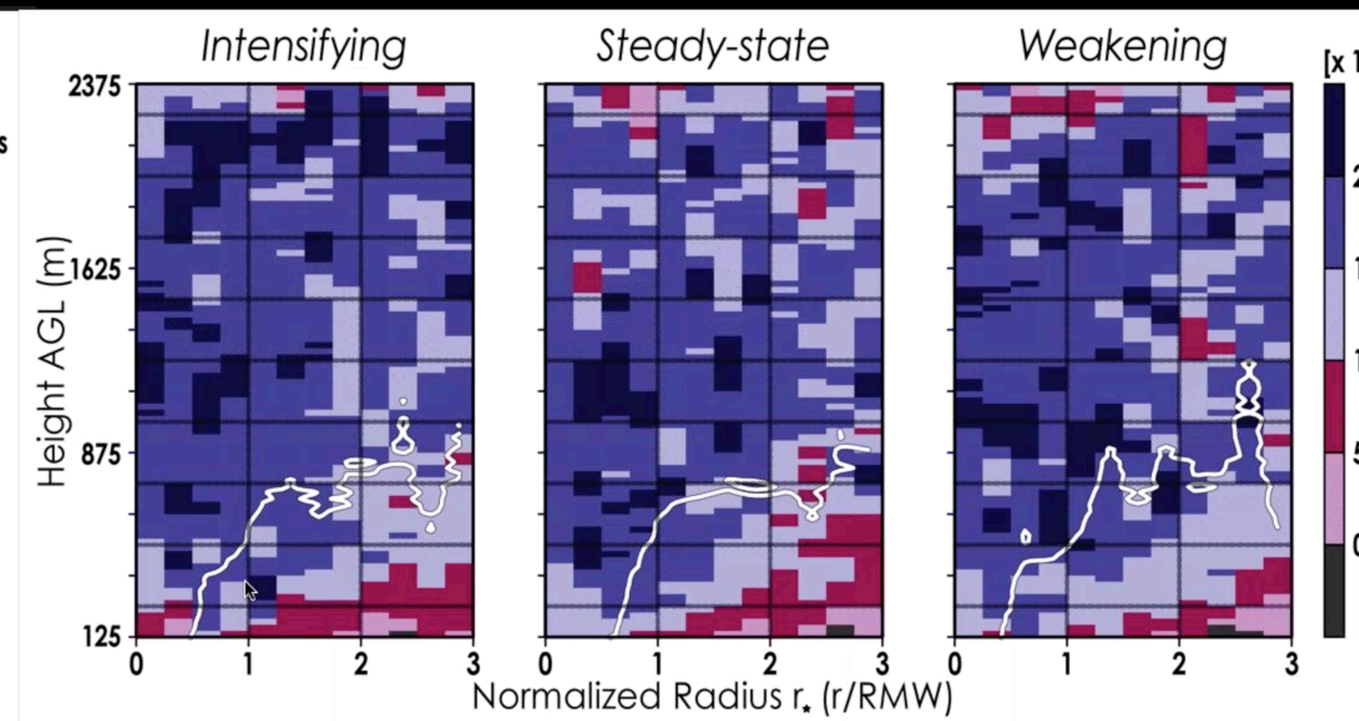
Above: $(r_{\star}, z)$ cross-sections of axisymmetric, storm-relative tangential velocity (shaded). The white line denotes the height at which radial velocity is $-3\ m\ s^{-1}$.



Above: $(r_{\star}, z)$ cross-sections of virtual potential temperature θ_v (shaded

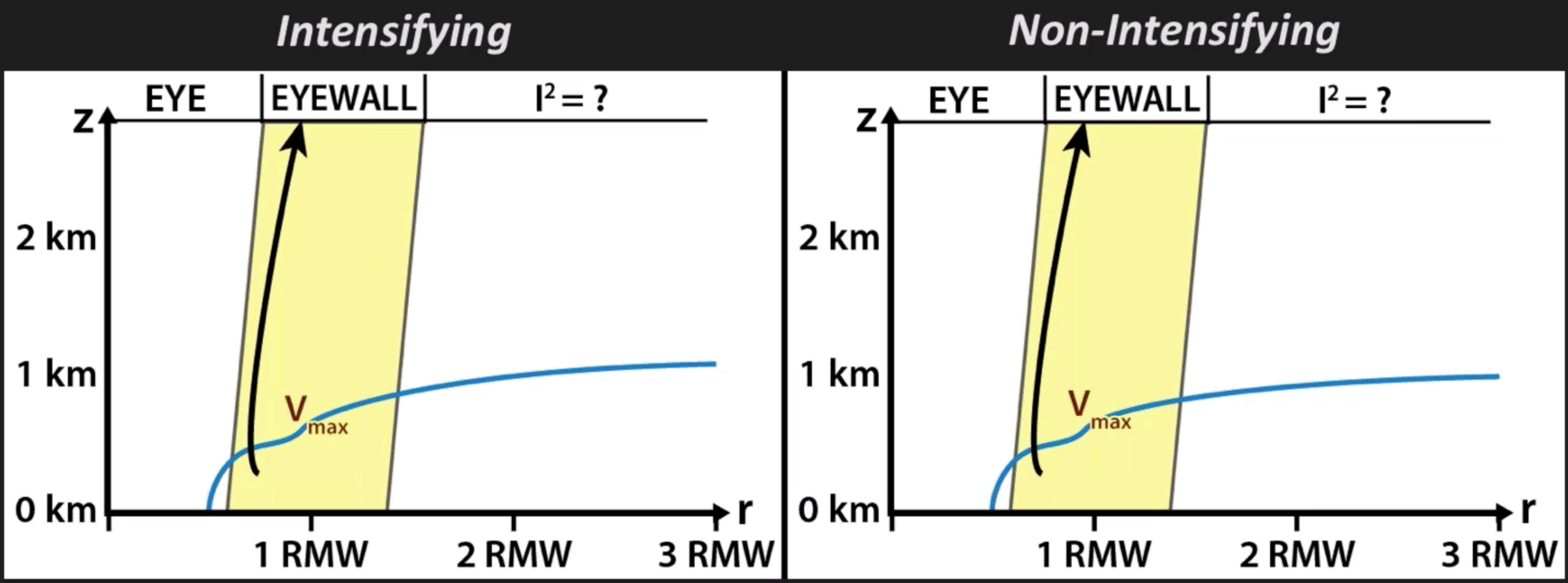


Above: $(r_{\star}, z)$ cross-sections of axisymmetric, storm-relative radial velocity (shaded). The black line denotes the height at which tangential velocity is maximized for the given radial bin.



Above: $(r_{\star}, z)$ cross-sections of Brunt-Väisälä frequency N^2 (shaded
High values (blue shades) indicate greater static stability.

Composite Takeaways



All groups exhibit **similar inflow layer depths** (blue line), with a tangential wind maximum located at the RMW and intersecting the inflow layer top. Inflow in all groups appears to penetrate through the RMW near the surface.

Tangential winds outside of the eyewall region imply **greater inertial stability *I* outside of the eyewall in non-intensifying groups**.

All groups show an inflow maxima near the RMW, suggesting enhanced convergence in that area.

Non-intensifying groups had regions of **strong radial inflow away from the RMW**, which could point to possible differences in convection outside the RMW.

The **hurricane eye is less conditionally stable in the IN group**, which implies more buoyancy can be introduced to the eyewall for IN if low-level air from the eye is mixed into the eyewall.

Chris Barnet
Dec. 13, 2018

Overview of JPSS Atlantic / SAL Field Campaign Activities

Collaboration with Michael Folmer (OPC/OFB), Jason Dunion (AOML/HRD) and Jon Zawislak (AOML/HRD)

Support from Nadia Smith, Colby Francoeur, and Rebekah Esmaili at STC.

OTREC: Organization of Tropical East Pacific Convection [1]

David J. Raymond and Željka Fuchs

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[1] Supported by US National Science Foundation

Questions/Concerns

BUFR is now a requirement in the NHOP. What is the likely timetable for the AF being able to send BUFR?

ASPEN processing is a little different for optimal TEMP DROP than for optimal BUFR.

Is information on mandatory and significant levels in BUFR?
Is the 62626 information in BUFR?

The best solution is to send both TEMP DROP and BUFR. If only one is possible for a period of time, NHC's preference is to send BUFR so that the data can be assimilated into models *only if all information from TEMP DROP is available in BUFR and is easily accessible by hurricane specialists.*

What is the optimal way to assimilate the observations into models?