2016 HFIP Annual Review PPAV Team Report

PPAV Team Leads:
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January 11, 2017

PPAV Team Contributing Organizations

- NHC
- NRL
- AOML/HRD
- NESDIS/CIRA
- DTC
- GFDL
- NCAR/RAL
- ESRL/GSD

NHC PPAV Team Milestones

- 3.1.1 June 1 2017 - Upgrade ATCF addressing requirements from operational centers. Develop a plan for pre genesis forecasts, required to issue pre-genesis watches and warnings. Begin software implementation

- 3.1.2 Sep 30, 2017 - Continue conversion ATCF to AWIPS2 and enhancements in the ATCF environment

See ATCF talk for details

- 3.3.4 Jul 31, 2017 - R&D for the HCCA ensemble improvements, including through CRADA with WP

See HCCA talk for details

NHC PPAV Team Milestones

- 3.1.3 Sep 30, 2017 - Create experimental new cone graphics that incorporate storm surge warnings, variable cone uncertainty sizes, and initial wind radii

- 3.1.5 May 15, 2017 – Develop new static and GIS graphics for pre-genesis watch/warning forecasts. Migrate existing cone, wind history, wind field, and wind speed probability graphics processing off of GEMPAK and build in and build in flexibility for pre-TC and weak TC forecasts, including variable cone sizes. Develop new GIS counterparts to all operational graphics using a unified language/method.
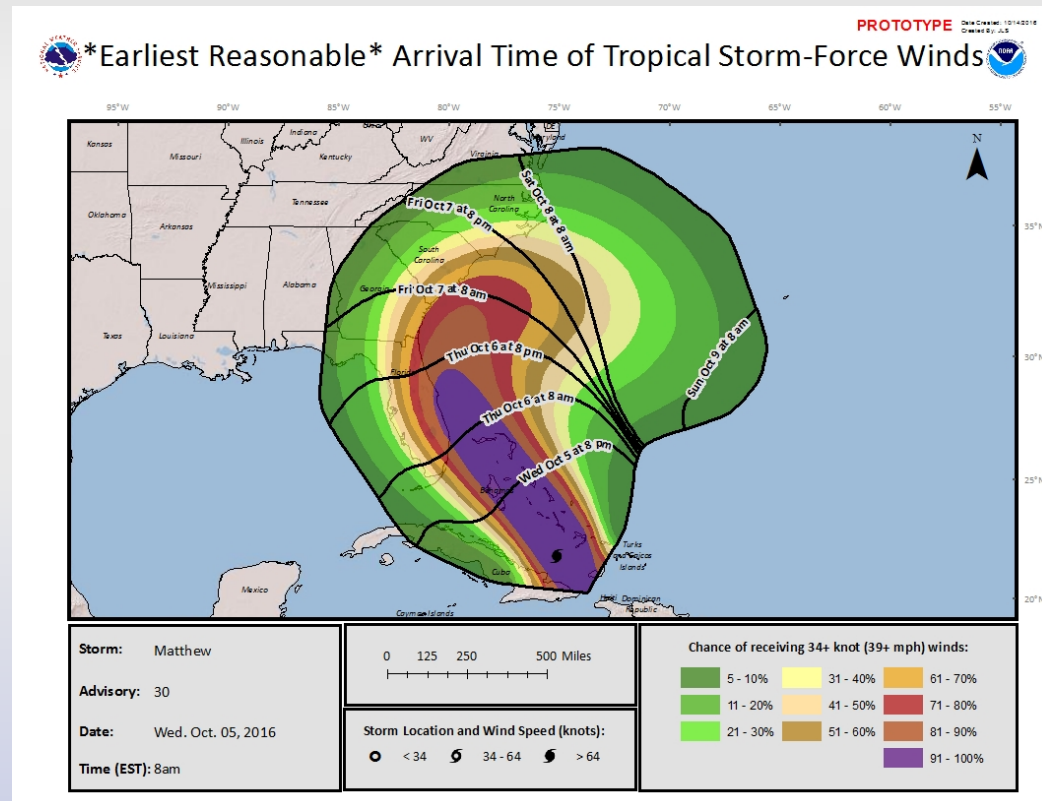
3.1.3 – New NHC Graphics Package: Cone Graphic

Users will be able to overlay the initial wind field (current wind extent) on the static and interactive cone graphics on the NHC webpage.
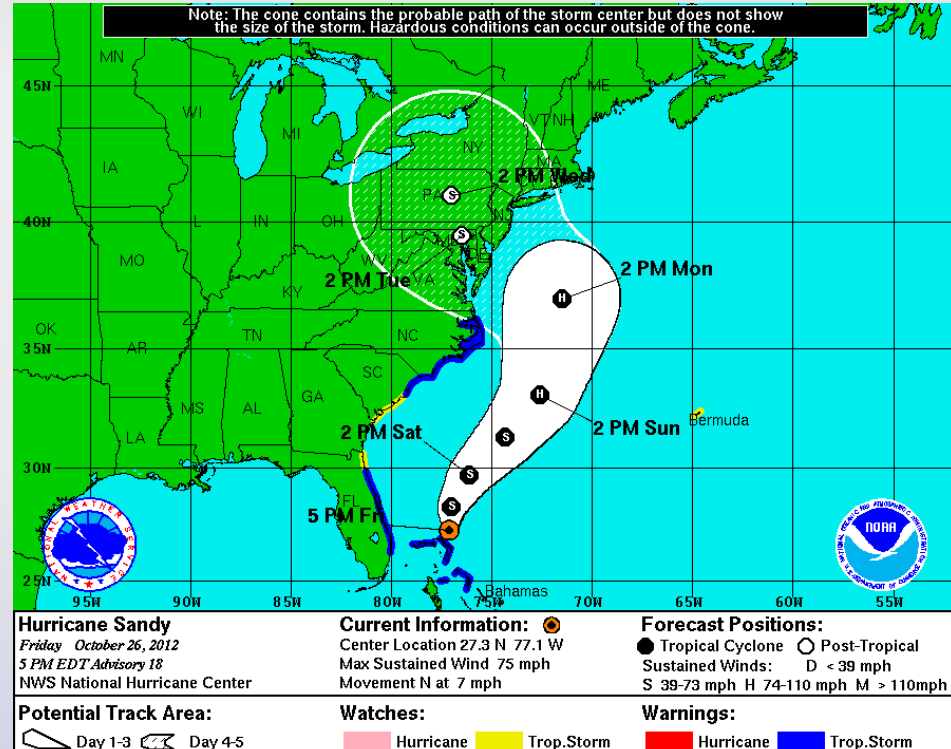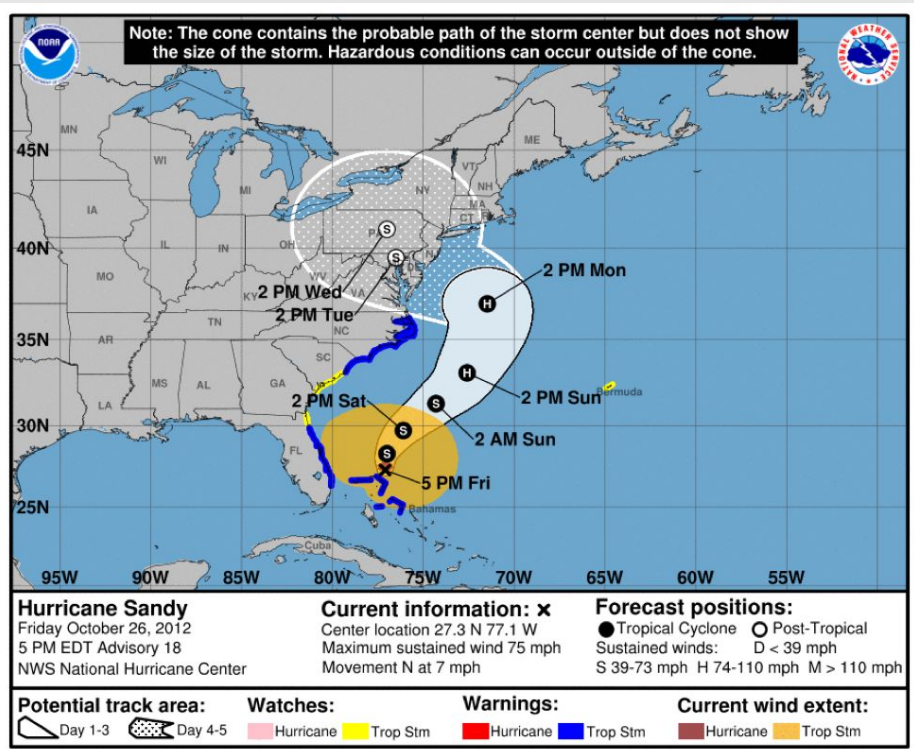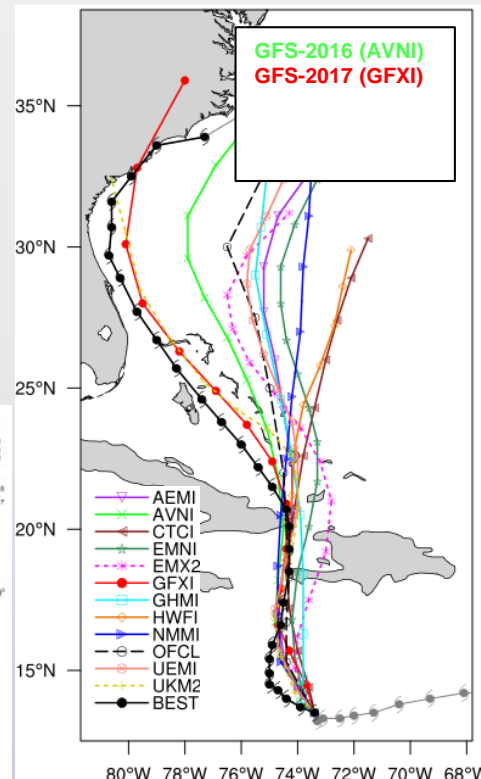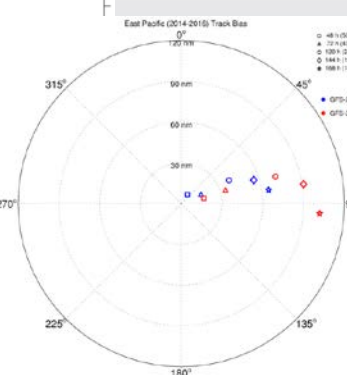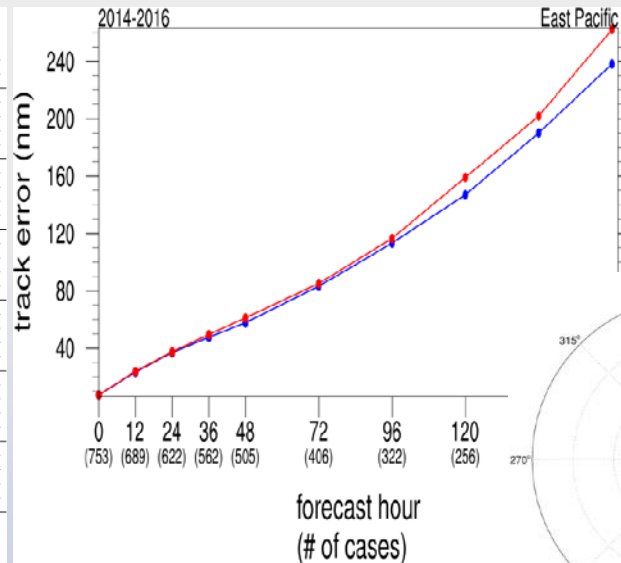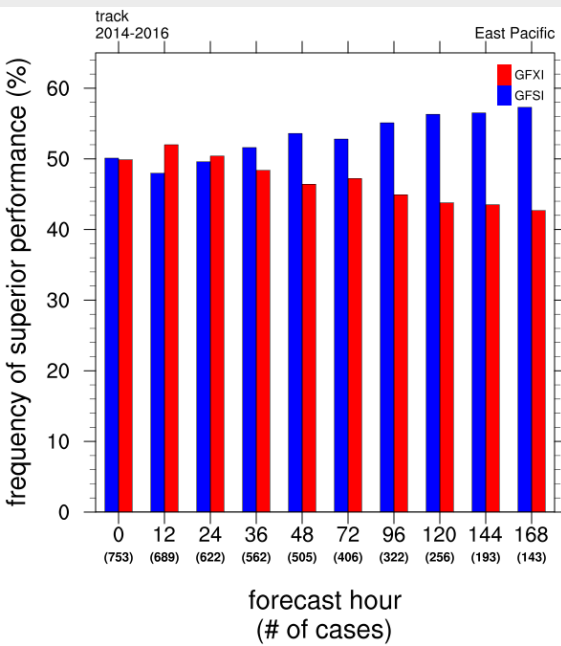
NHC PPAV Team Milestones

- 3.1.4 Sep 30, 2017 - Continue development of a new time of arrival product, including GIS version

- Uses timing information from the same realizations used to create the NHC wind speed probability products

- Accounts for forecast uncertainty

- Provides graphical depiction of potential arrival times of tropical-storm-force winds

Earliest Reasonable Arrival Time of Tropical Storm-Force Winds

PROTOTYPE

Storm:	Matthew
Advisory:	30
Date:	Wed. Oct. 05, 2016
Time (EST):	8am

Chance of receiving 34+ knot (39+ mph) winds:

5 - 10%	31 - 40%	61 - 70%
11 - 20%	41 - 50%	71 - 80%
21 - 30%	51 - 60%	81 - 90%
		91 - 100%

Storm Location and Wind Speed (knots):
< 34   34 - 64   > 64

NHC PPAV Team Milestones

- 3.2.1 Nov 30, 2016 – Conduct parallel model run evaluations

- 3.2.2 Sep 30, 2017 – Continue development of consensus forecast techniques and demonstrate in real time

- 3.3.6 Jun 30, 2017 – Develop model ensemble products
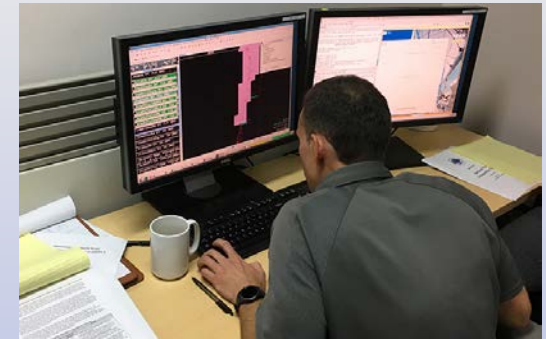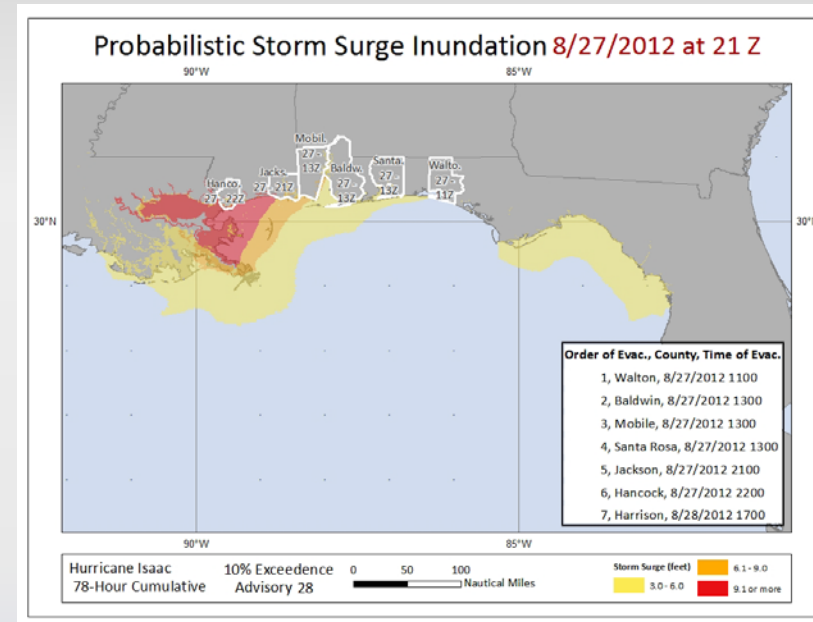
NHC PPAV Team Milestones

- 3.3.7 – Develop p-surge ensemble products

  - NHC began ingesting the experimental probabilistic extra-tropical storm surge (PETSS) model in to AWIPS

  - NHC performed in-house real-time testing during Matthew and Hermine. Plan to test again in 2017

  - PETSS scheduled to become operational in 2018, at which point NHC will update existing CONOPS and training based on 2016 and 2017 experiences

NHC PPAV Team Milestones

- 3.1.4 Sep 20, 2017 - Storm surge inundation data vs evacuation data product using 3 historical cases

- Establishing the appropriateness of proposed NWS Storm Surge Warning criteria.
  - 10% chance of 3 ft or great inundation

- Evacuation data has been obtained for hurricanes Ivan (2005), Irene (2011), and Isaac (2012).

- Probabilistic Storm Surge (Psurge) runs have been generated to compare proposed criteria with emergency management evacuation orders.

- Evaluations ongoing but expectation is that the warning areas and evacuation areas will converge.

Probabilistic Storm Surge Inundation 8/27/2012 at 21 Z

Order of Evac., County, Time of Evac.
1, Walton, 8/27/2012 1100
2, Baldwin, 8/27/2012 1300
3, Mobile, 8/27/2012 1300
4, Santa Rosa, 8/27/2012 1300
5, Jackson, 8/27/2012 2100
6, Hancock, 8/27/2012 2200
7, Harrison, 8/28/2012 1700

Hurricane Isaac   10% Exceedence
78-Hour Cumulative   Advisory 28

CIRA PPAV Team Milestones

- 3.3.1 Nov 30, 2016 - Develop wind speed probabilities for potential tropical cyclones

Pre-Hermine Example:
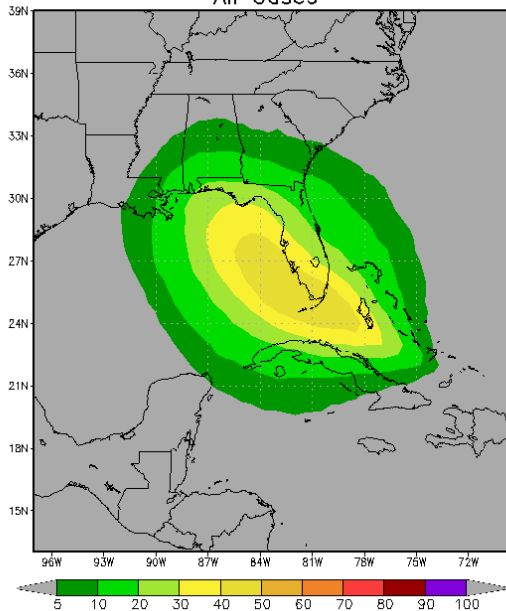
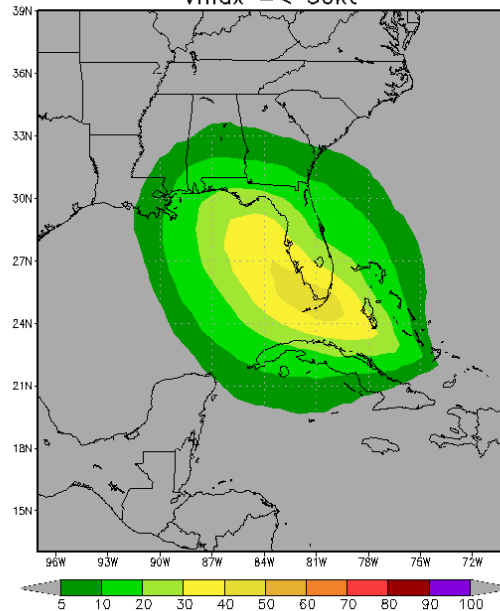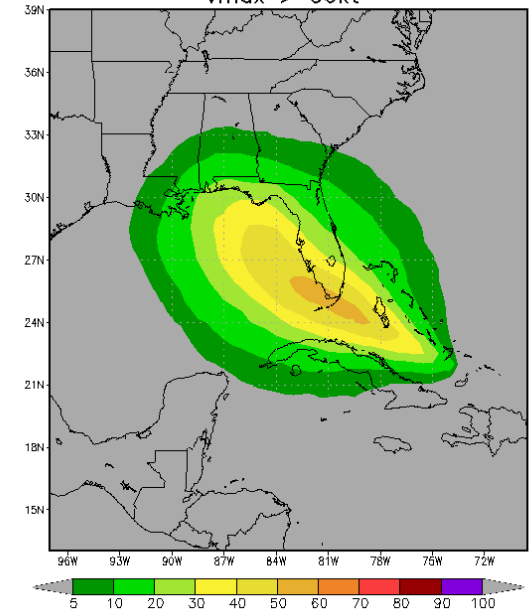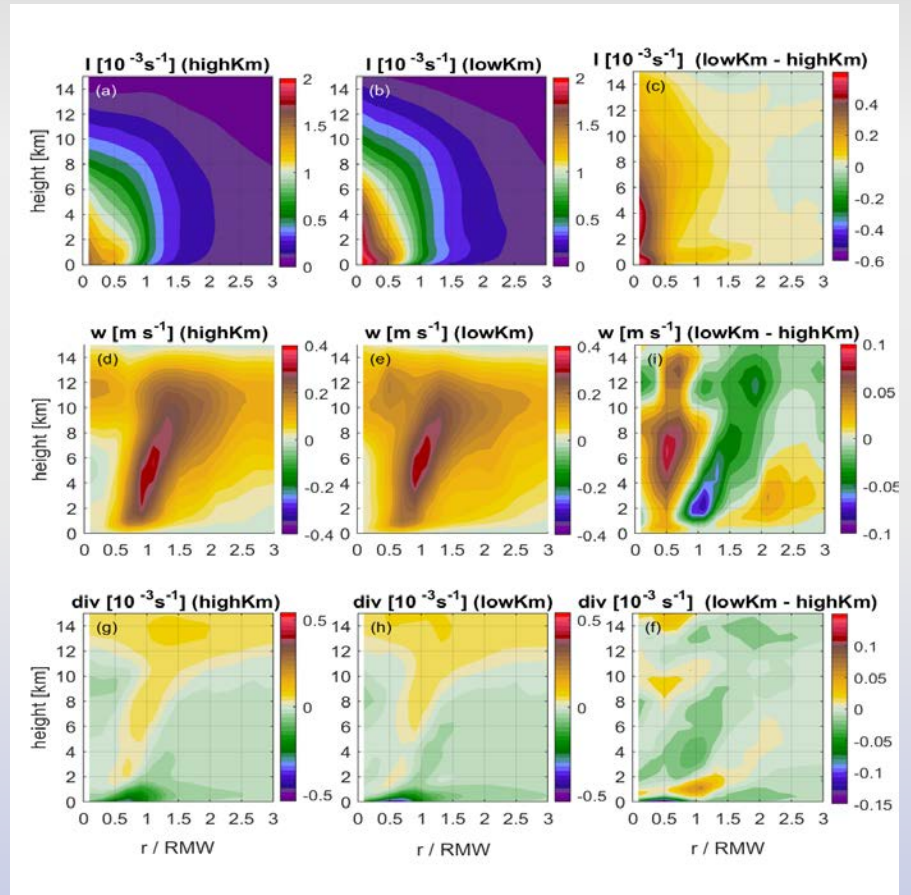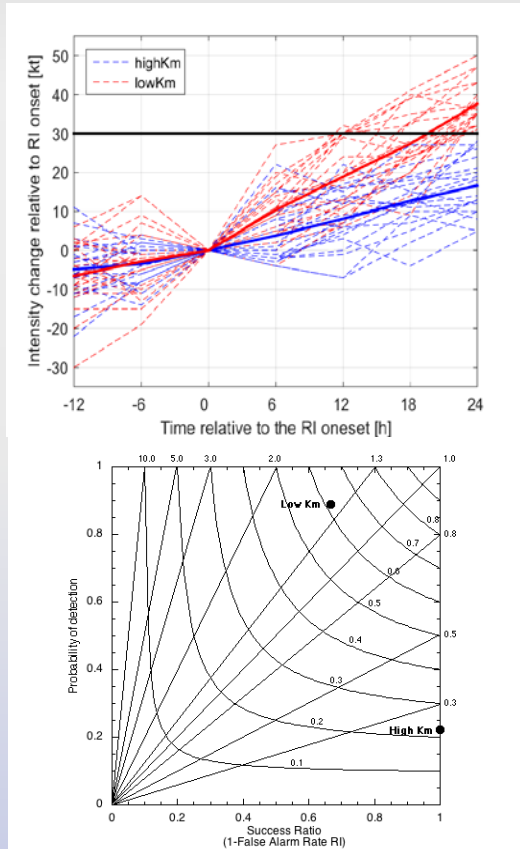# CIRA PPAV Team Milestones

- 3.3.2 Jun 30, 2017 – Develop a modern, common wind speed and p-surge probabilities framework

- 3.3.3 Jun 30, 2017 – Develop satellite databases for enhancements to SHIPS/RII/LGEM: Improve intensity statistical models using consensus versions with multiple model and enhanced satellite data inputs
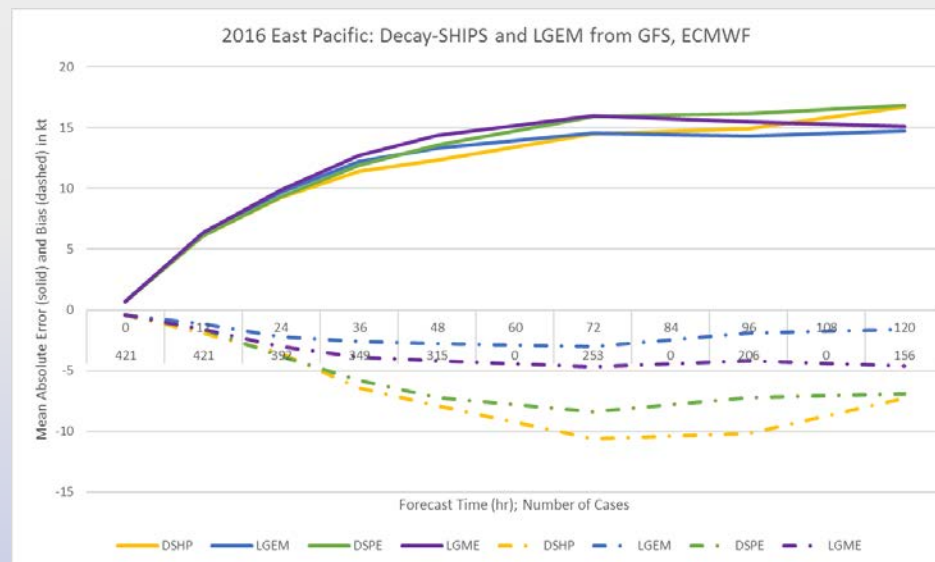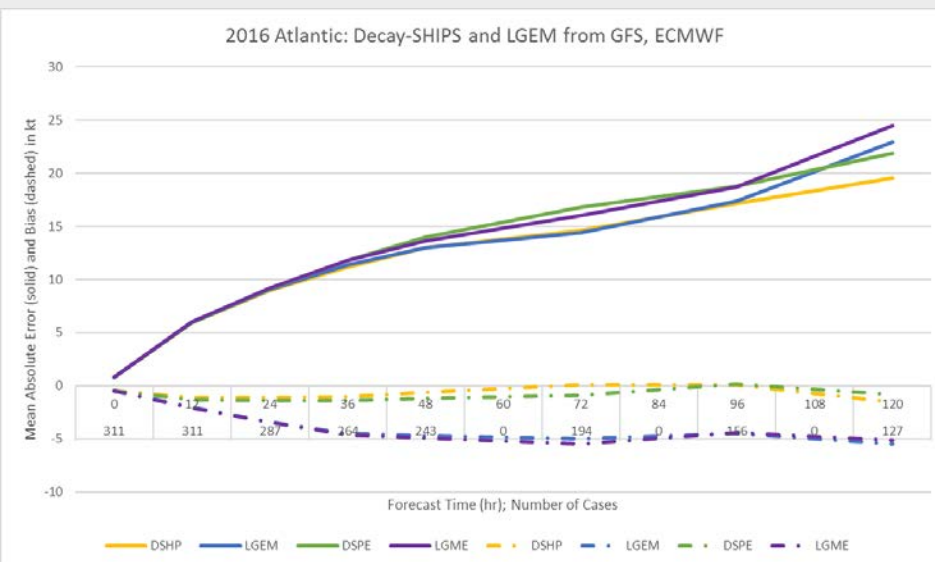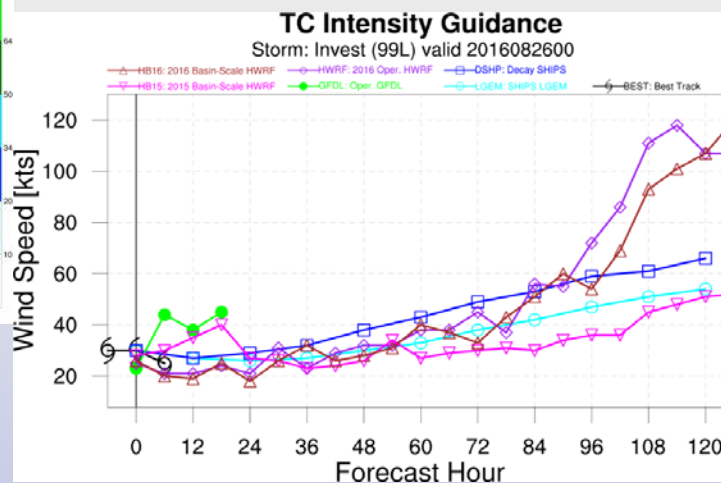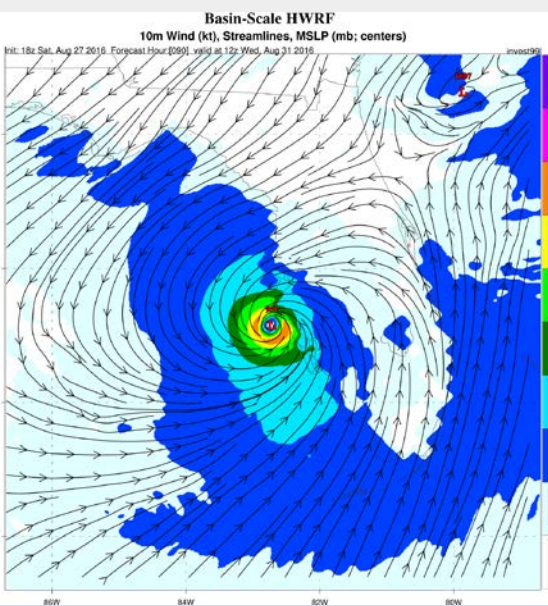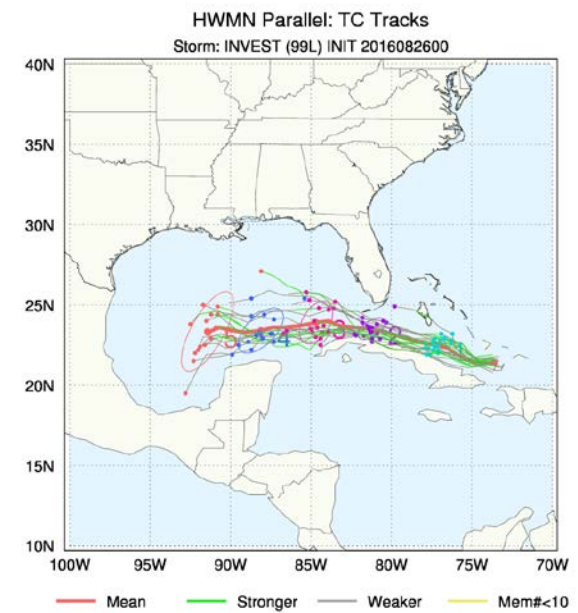
AOML PPAV Team Milestones

- 3.5.1 Jun 30, 2016 – Evaluate operational HWRF performance using IFEX aircraft observations in well sampled/documented hurricanes. Compare observed vs modeled

AOML PPAV Team Milestones

- 3.5.2 Jan 31, 2017 – Identify outlier events (those with the largest forecast errors) and evaluate operational HWRF forecasts using available data
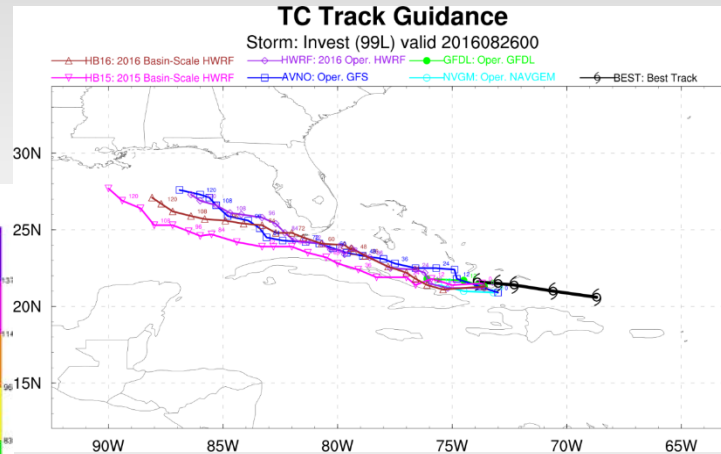
AOML PPAV Team Milestones

- 3.5.3 Mar 31, 2016 – Make the diagnostic tools available for researchers through contributed codes for evaluating future hurricanes

  - Scripts to create the diagnostic images shown here are available via FTP from HRD.

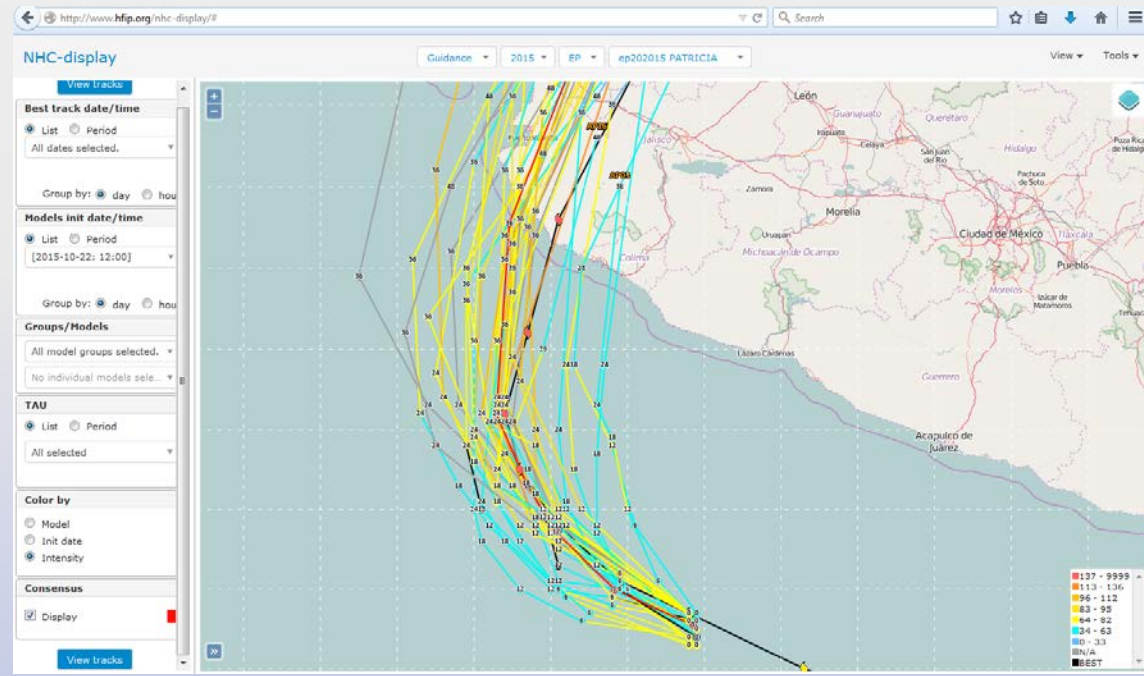# ESRL/GSD PPAV Team Milestones

- 3.4.1 Nov 30, 2016 – Maintain Products Webpage

- 3.4.2 Jun 1, 2016 – Make HFIP Product pages available on hfip.org with the following models: GFS, HWRF, GFDL

- 3.4.3 Aug 1, 2016 – Make HFIP product pages available to hurricane community with regional models and new products

- New in FY-16:
  - FIM9 diagnostic files and operational model diagnostics
  - FNMOC and EMC ensembles on ruc.noaa.gov/tracks
  - New HFIP website links on the hfip related links page (HWRF-NNMB, NUOPC, etc)
  - HFIP.org usage in 2016: 42.2K page views, over 9,000 unique IPs (increase from 2015… higher usage during landfalls)

NCAR PPAV Team Milestones

- HFIP Website Support

- HFIP Database Development

  - https://verif.rap.ucar.edu/repository

- HFIP Display and Diagnostic System

  - www.hfip.org/nhc-display

GFDL PPAV Team Milestones

- Transfer latest version of community tracker (GFDL tracker) to HWRF group for inclusion with operational FY16 HWRF upgrade and to DTC for release to the community. Latest version contains updates that are critical for tracking tropical cyclones that are small in size. Maintain and provide support for the GFDL community tropical cyclone tracker.

PPAV Team Priorities for 2017 and beyond

- Build on 2016 NHC development efforts and implement new NHC products

- Continue to support modeling efforts through diagnostics and verification with a focus on diagnostics that provide tangible ways to improve model physics, dynamics, etc (more than just track and intensity)

- Continue working toward unification of wind fields for p-surge and wind speed probability products

- Continue development of statistical models and ensemble-derived forecast aids

- Applications for NHC
  - Must be useful to NHC
  - Must be compatible with NHC computing environment
 - Must be sustainable
  - Must be automated

Extra Slides

3.1.3 – New NHC Graphics Package

Advantages to the new code:

- NCL supported/approved by NCO; removes a major dependency on NAWIPS/gempak

- Increased flexibility and easier for NHC/TSB to maintain (examples below)

- Consistent graphics between centers and from graphic to graphic

- New graphics package allows for pre-genesis watches and warnings

- Better graphics available for media briefings

- Increased product overlay capability on NHC's website

- Improved and more consistent GIS products
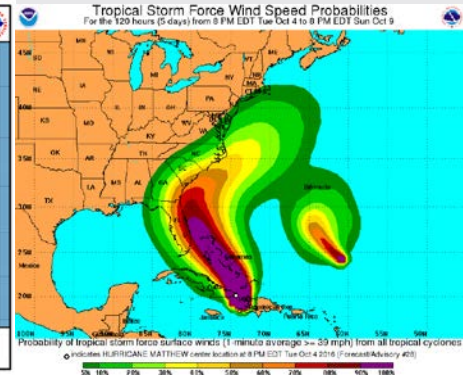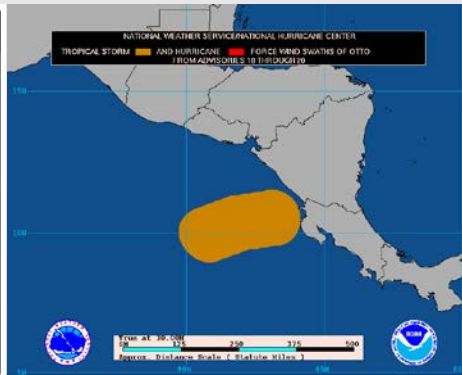
3.1.4 – Time of Arrival Graphic

Plans for 2017:

- Use results from emergency management/broadcast meteorologist survey to develop final experimental version

- Provide real-time experimental products on the NHC website in 2017 for all Atlantic and eastern North Pacific tropical cyclones

- Provide both "earliest reasonable" arrival (10%) and "most likely" arrival (50%) versions
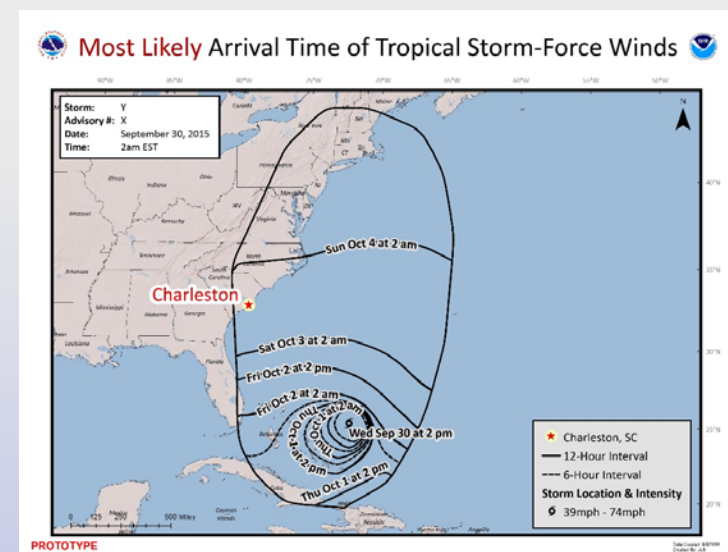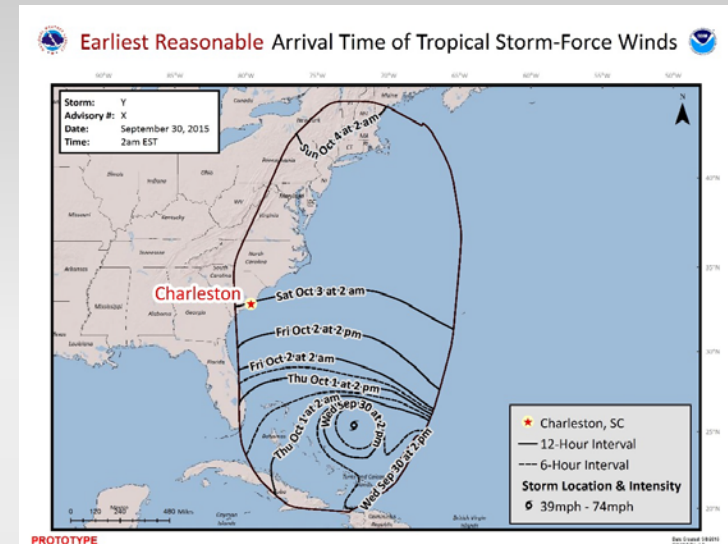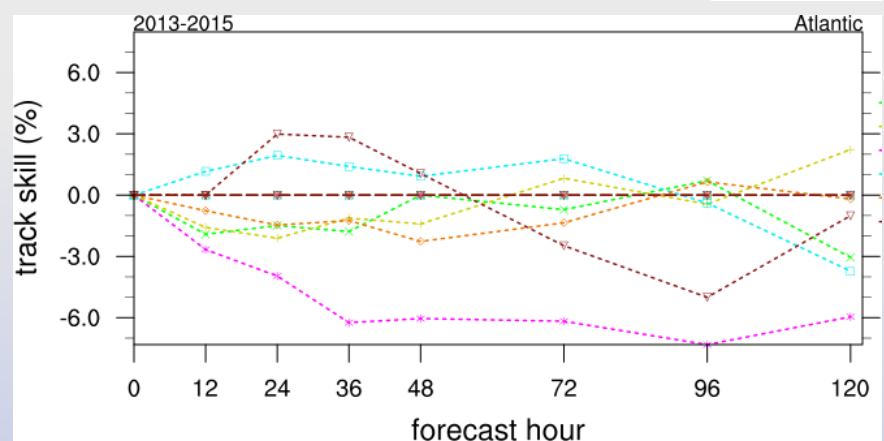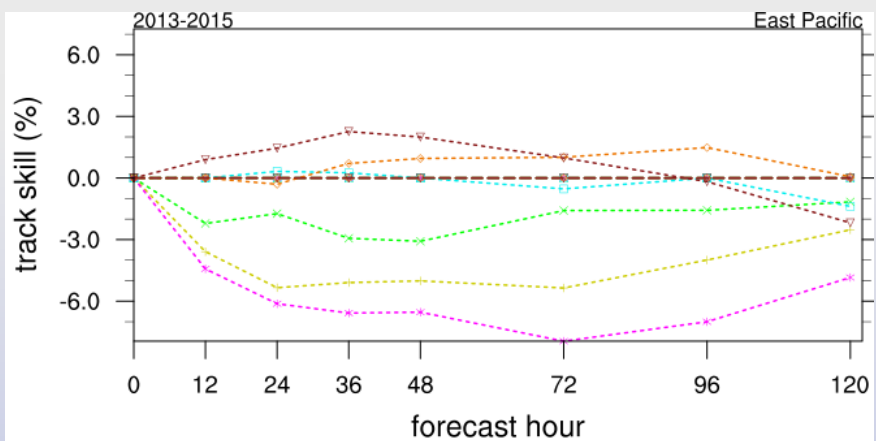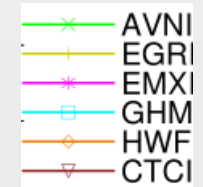
NHC PPAV Team Milestones

- 3.2.2 Sep 30, 2017 – Continue development of consensus forecast techniques and demonstrate in real time

- 3.3.6 Jun 30, 2017 – Develop model ensemble products

Skill relative to TVCN when excluding selected models:

Generating cone of uncertainty from WSP error distributions

- Would allow cone of uncertainty to change in size based on track forecast uncertainty due to the inclusion of GPCE in the WSPs
  - Provides consistency between NHC graphical forecast products
  - Still anchored to NHC official track forecast (versus other model-based methods)
- Preliminary work suggest serial correlation of errors introduces a positive bias in WSP-derived cone - work underway to correct for these errors
- Several methods for defining GPCE terciles can be considered…

Bias introduced by serial correlation of errors

Fcst Hr	2014 NHC Cone	Non-GPCE WSP-generated Cone
12	34	32
24	55	54
36	75	71
48	97	91
72	144	124
96	202	169
120	257	223

Cone sizes in nmi. 2009-2013 track errors used to generate WSP-based cone

Method #1:
GPCE Integrated* over entire forecast then divided into terciles

Fcst Hr	Low	Med	High
12	28	32	42
24	46	56	68
36	70	75	93
48	82	89	113
72	102	127	139
96	157	165	186
120	215	193	219

- Only 3 cone shapes (L, M, & H GPCE)
- Doesn't represent cases where GPCE increases or decreases with forecast time
- Low GPCE cone > Med GPCE cone at t=120h

Method #2:
GPCE Integrated* over early (days 1-2) and late (days 3-5) forecast

Fcst Hr	Low	Med	High
12	21	32	41
24	35	50	68
36	52	70	85
48	69	91	110
72	109	118	139
96	159	163	196
120	215	204	235

- 9 cones shapes possible
- Represents cases where GPCE differs between early and late forecast times
- Not completely consistent with WSPs

Method #3:
GPCE tercile calculated at each forecast time

| Fcst Hr	Low	Med	High
12	26	35	43
24	42	54	68
36	58	71	93
48	77	93	120
72	124	133	180
96	169	190	252
120	220	237	325

- Closest to WSP methodology – maximum consistency
- Cone can decrease or increase in size with forecast time (many variations in cone shape)

Evaluating HWRF ensemble with IFEX observations
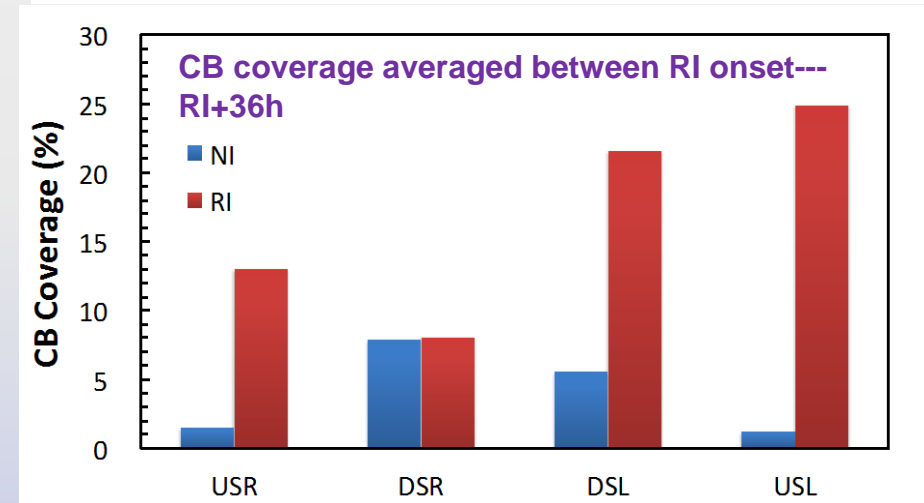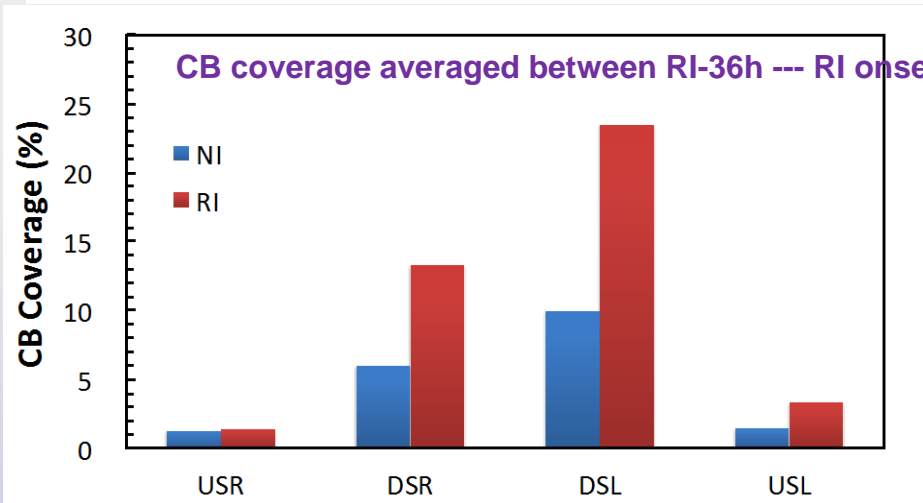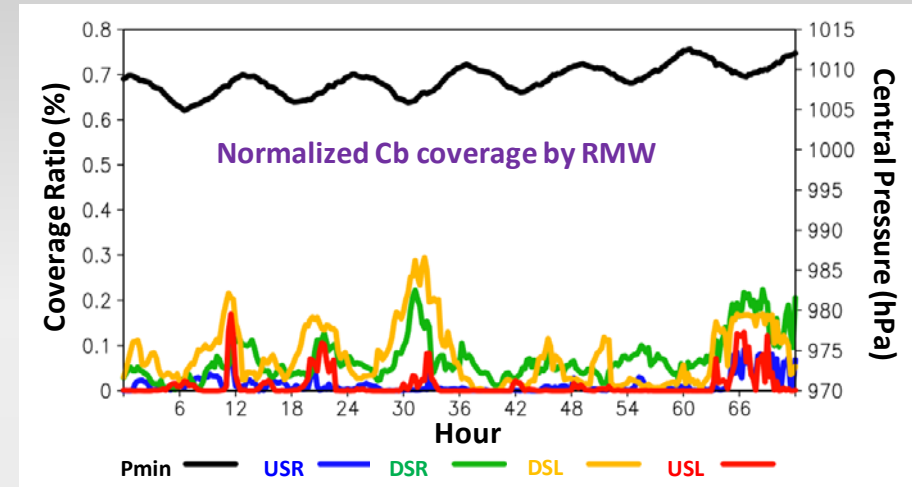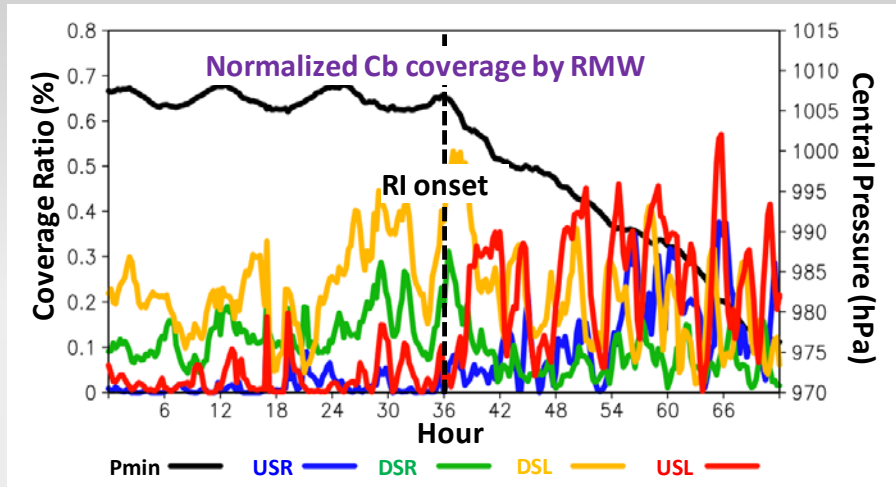
Evaluating HWRF with IFEX observations

Impact of horizontal mixing length on HWRF forecasts of Hurricane Earl
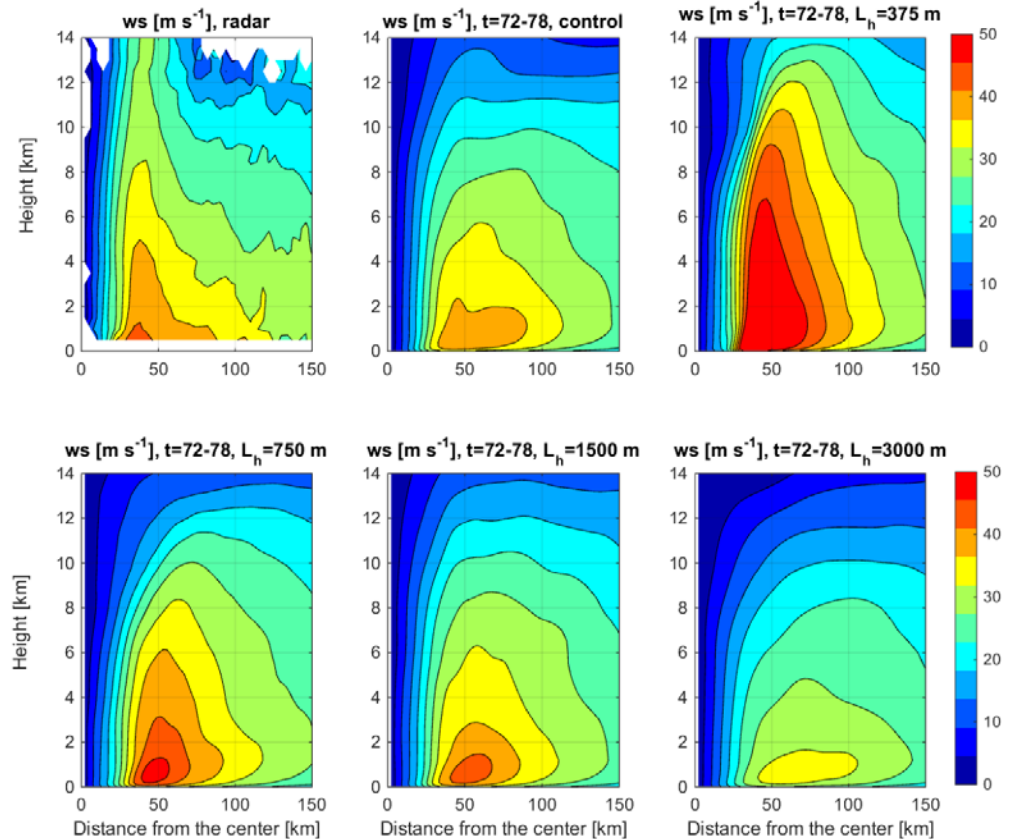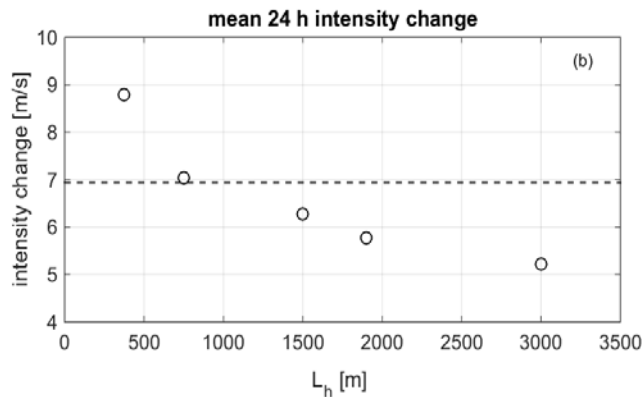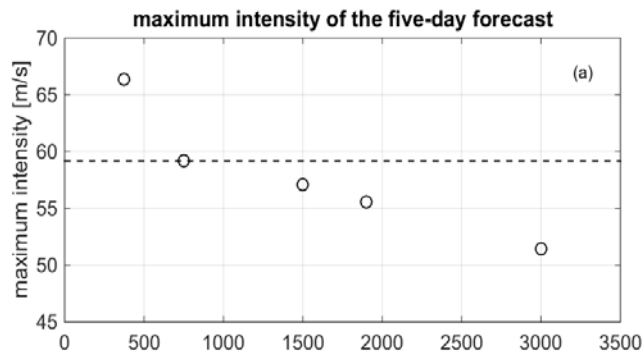
NHC Products/Post-Processing Priorities for 2017

- ## Continue to improve statistical models
  - SHIPS/LGEM/RII improvements and adapt to GOES-16
  - Work with TSB to make HCCA operational, add CPHC forecasts

- ## NHC Wind Speed Probability model
  - Improve probabilities for land cases
  - Coordinate with SSU on unified methods for track/intensity/size realizations

- ## Continue development of NHC graphical products
  - New time of arrival 34 kt winds
  - Updated TC graphical suite, including pre-genesis modifications

- ## Continue diagnostics to help identify areas for HWRF improvement

- ## Continue ensemble product development
  - Repeat Tiger Team demo at NHC in 2017
  - Use of ensembles to improve NHC deterministic forecast

- ## ATCF upgrades
  - Annual requirements for NRL
 - Continue ATCF in AWIPS project

Development of a Tropical Cyclone Display and Diagnostic System

Project Team: Paul Kucera, Tatiana Burek, and John Halley-Gotway

- A web-based display and diagnostic system has been developed to support NHC and the hurricane community

- Display is designed using modular and flexible technology:
    - OpenLayers Mapping tools (Platform independent, no license requirements)
    - MySQL database
    - Primary input: ATCF files (A-decks, B-decks, E-decks), and gridded products

- Built-in diagnostic evaluation tools

- Dynamic consensus forecast generation

http://www.hfip.org/nhc-display
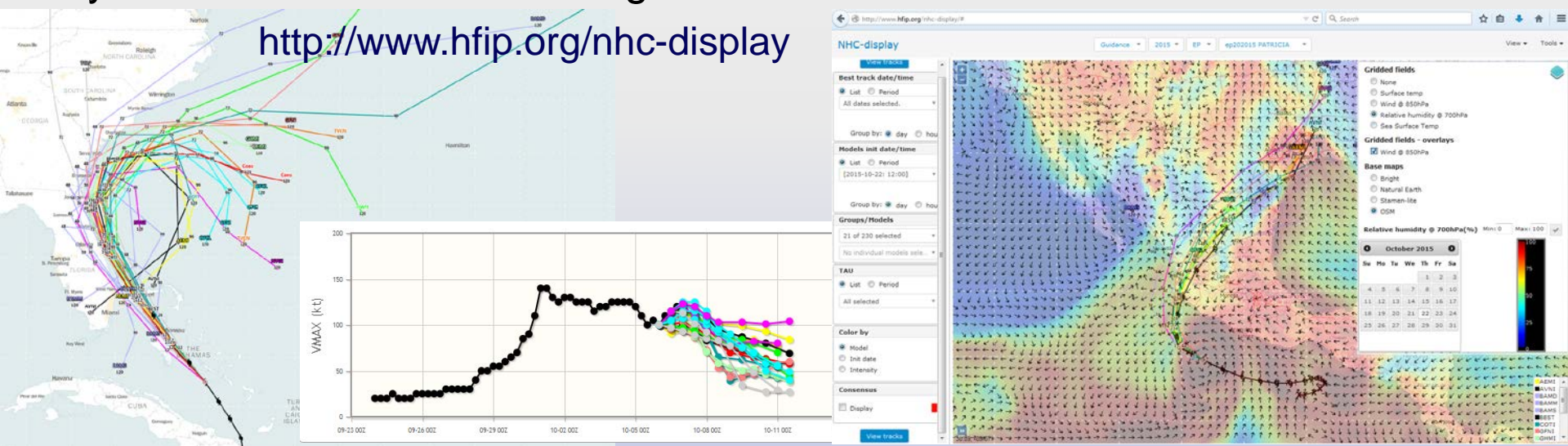
FY2016 New Development

Development of a fix-position (F-deck) display and database editing tool

- **F-deck fixes integration:**
- **Separate databases for the primary (official) display and editing (training) F-decks**
- **View summary and full fix database information**
- **Tools to add, edit, and delete fixes from the training database**
- **Display fixes on the plots using confidence symbols**
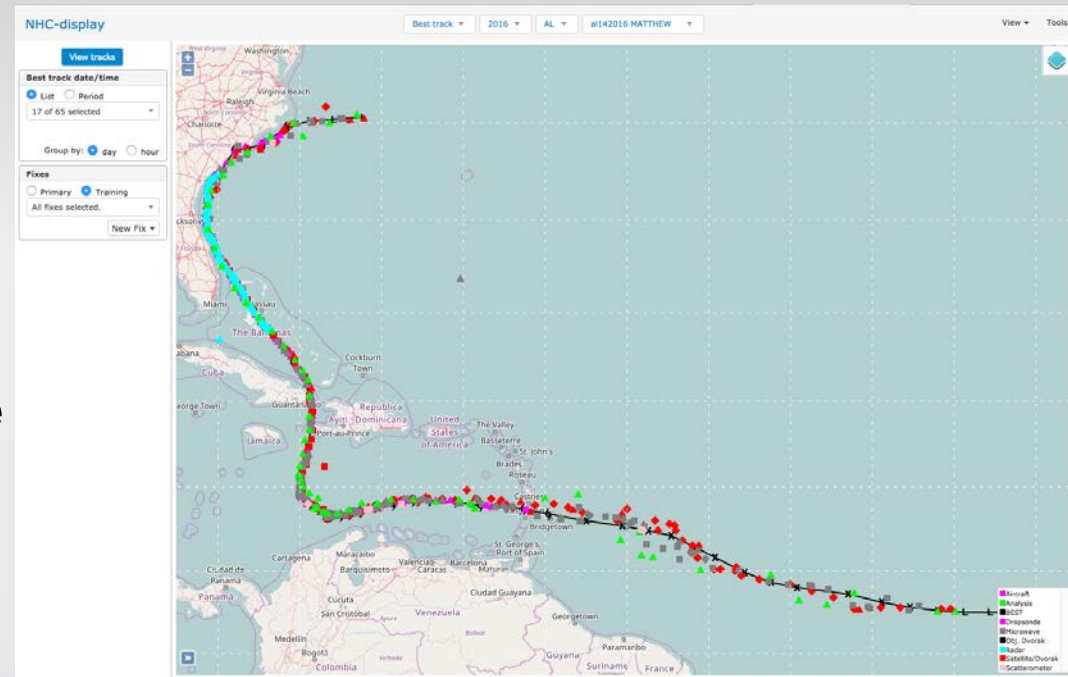
Mouse interaction between fix location on the time series plot and map
Import capability to update official F-deck database with new/updated fix locations
Dvorak conversion capability
Fix types: Aircraft, analysis, microwave, radar, satellite, scatterometer

FY2016 New Development
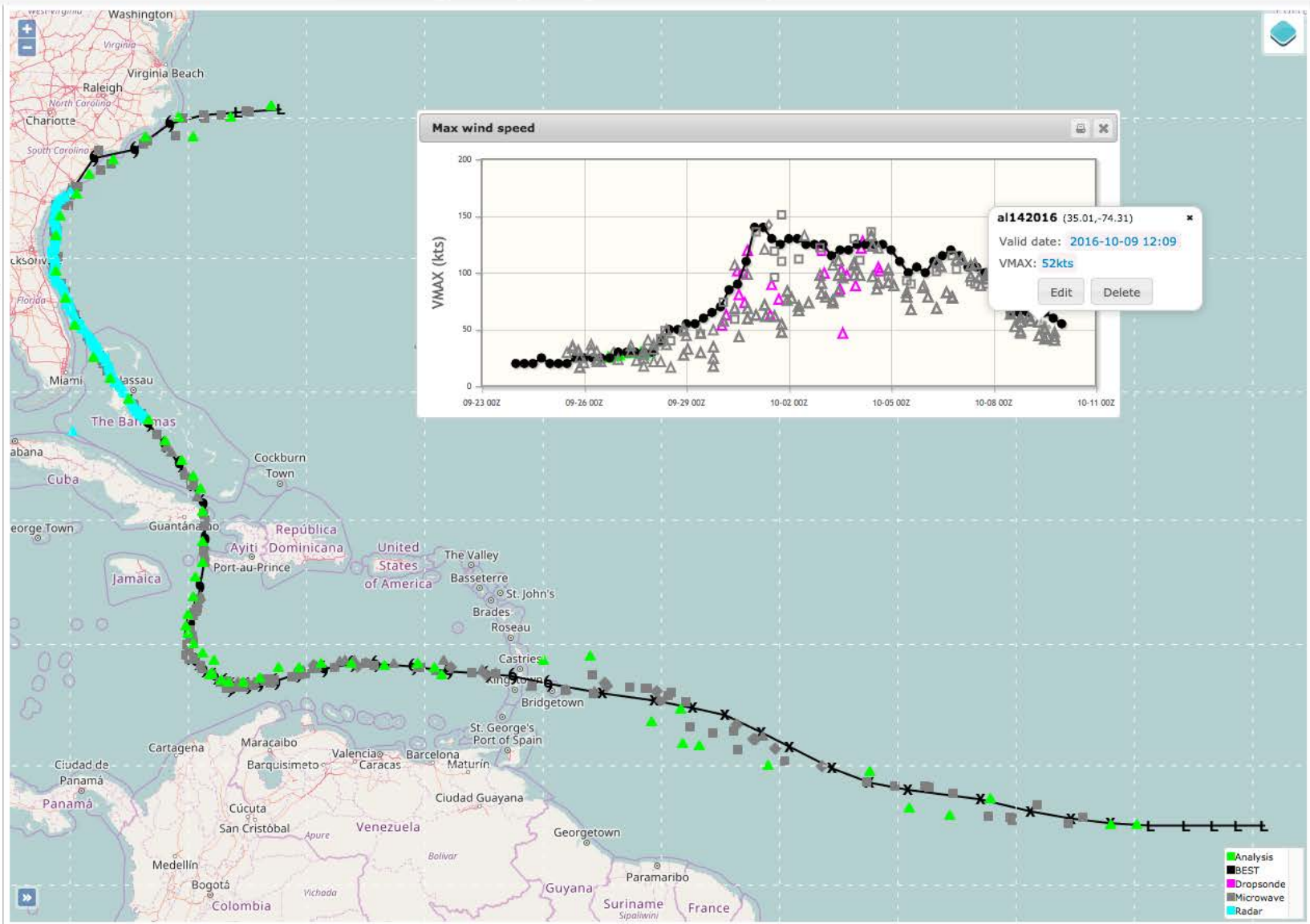
HFIP.org – Activities 2016

PRODUCTS & MAINTENANCE

Data Product Pages   (hfip.org/products/)

Showcases experimental forecast products contrasted with showing operational products *in the same formats*—key feature

Monitor of data completed. Occasional data interruption is noted and corrected, reasons can vary significantly, takes finesse to solve

Added FIM9 diagnostic files, and operational model diagnostics

Related Links Page   *(hfip.org/related_links/)*

'One-stop' resource for all known data links related to HFIP

New HFIP website links were added, HWRF NNMB, NUOPC, etc

Broken links were fixed, Defunct pages removed

Google Maps Tracker Page   *(ruc.noaa.gov/tracks)*

Added FMNOC and EMC's ensemble sets, mean tracks, FIM updated

USAGE BY THE NUMBERS

Google analytics reports show use of HFIP.org website for 2016

In 2016, 42.2K page views from over 9K unique user id's (Up over 2015, with 36.5K page views)

Spikes in use associated with TC events with risk of landfall

Paula McCaslin and HFIP Team January 2017

HFIP.org – Activities 2016

CONTINUED RESOURCE

HFIP products page has been a high priority for the project

Used for long range outlook by NHC, others

Used NWS Senior Executives

POTENTIAL

This is a perfect tool to

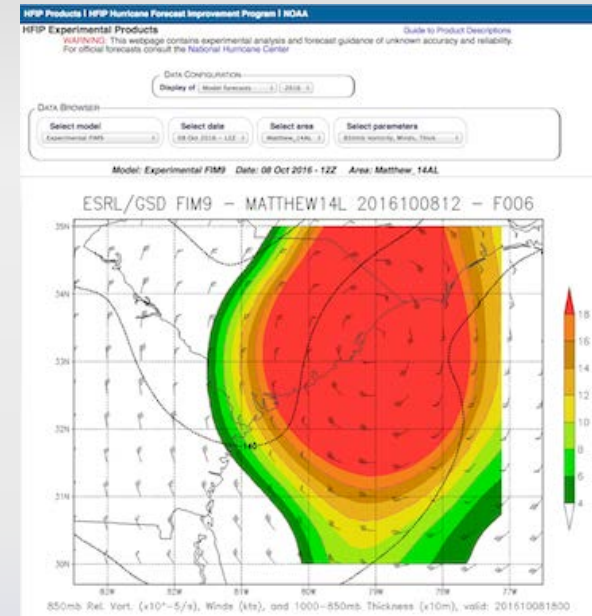Maintain as resource for NHC, NWS etc

Involve more modeling groups – increase participation

Established scripts allow additional participants to become involved easily

Script are stable, script changes would be automatically available to participants

Become a framework for 2017

HWRF showcase: all basins, parallel run, experimental runs, HRD output, HWRF results

TC Matthew 09 Oct 2016 FIM9

Paula McCaslin and HFIP Team January 2017