



2017 HFIP Annual Review PPAV Team Report

PPAV Team Leads:
David Zelinsky
Mark DeMaria

November 8, 2017



PPAV Team Contributing Organizations

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

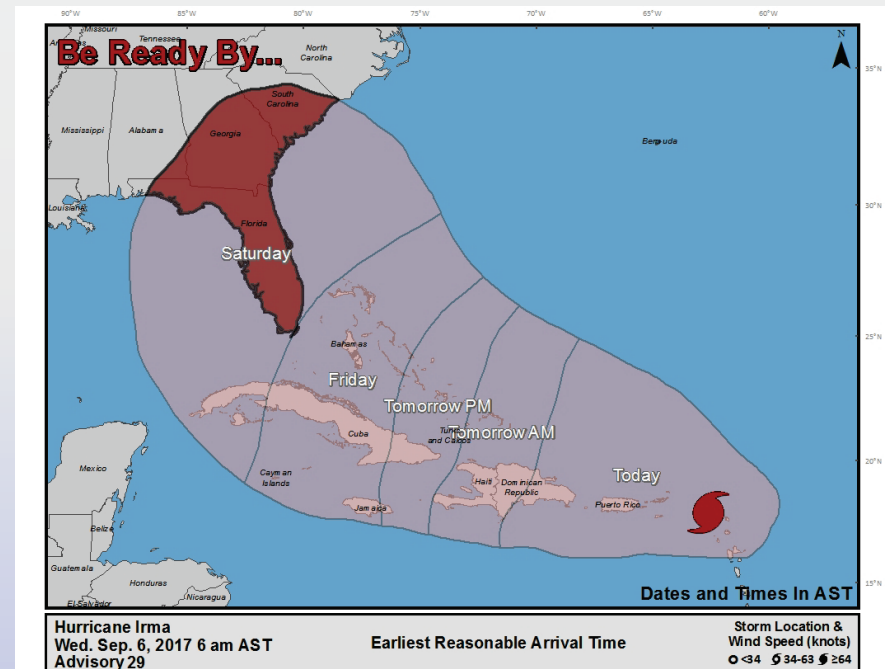
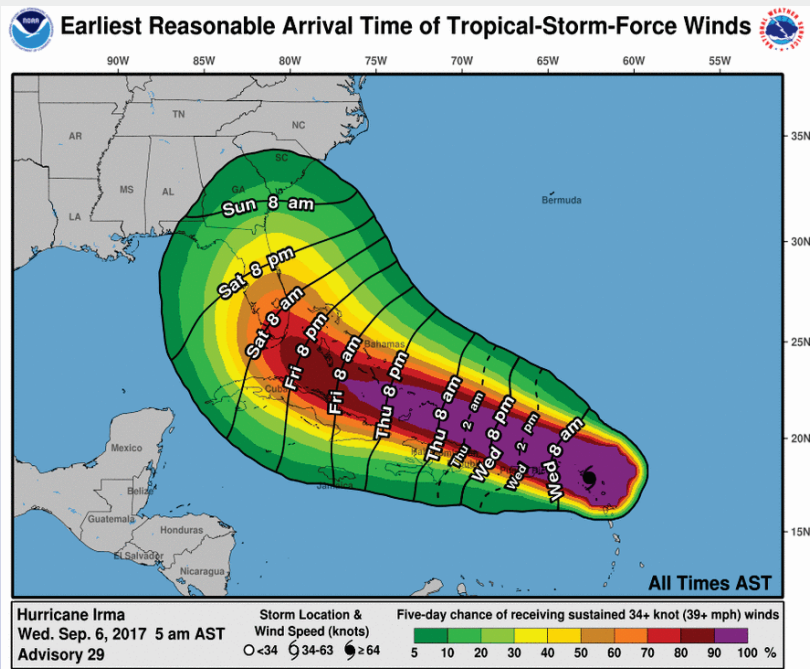


PPAV Activities Covered By Other Presentations

- ATCF (NRL)
- DTC
- RI Tiger Team

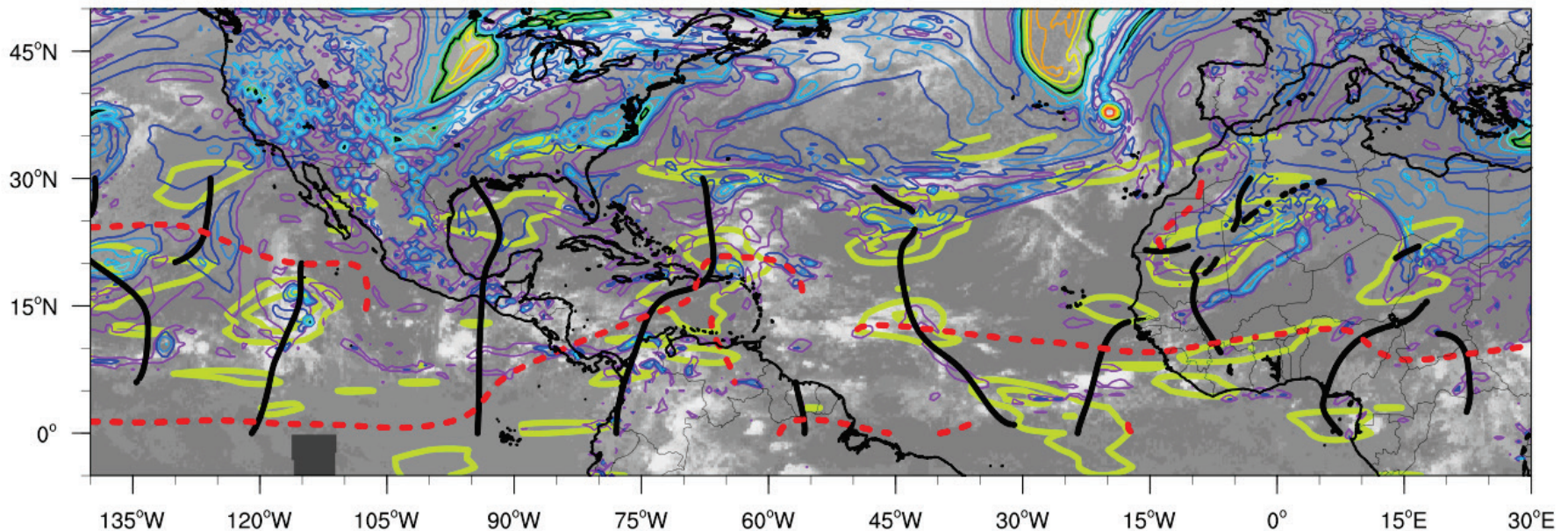
NHC Activities: New Products and Tools

- Experimental Time of Arrival – Operational in 2018
- Developing graphics for TV and DSS briefing
 - Storm Surge, “Be Ready By”
- Improved GIS-based graphics for TCRs and other studies/reports



NHC Activities: Model Diagnostics

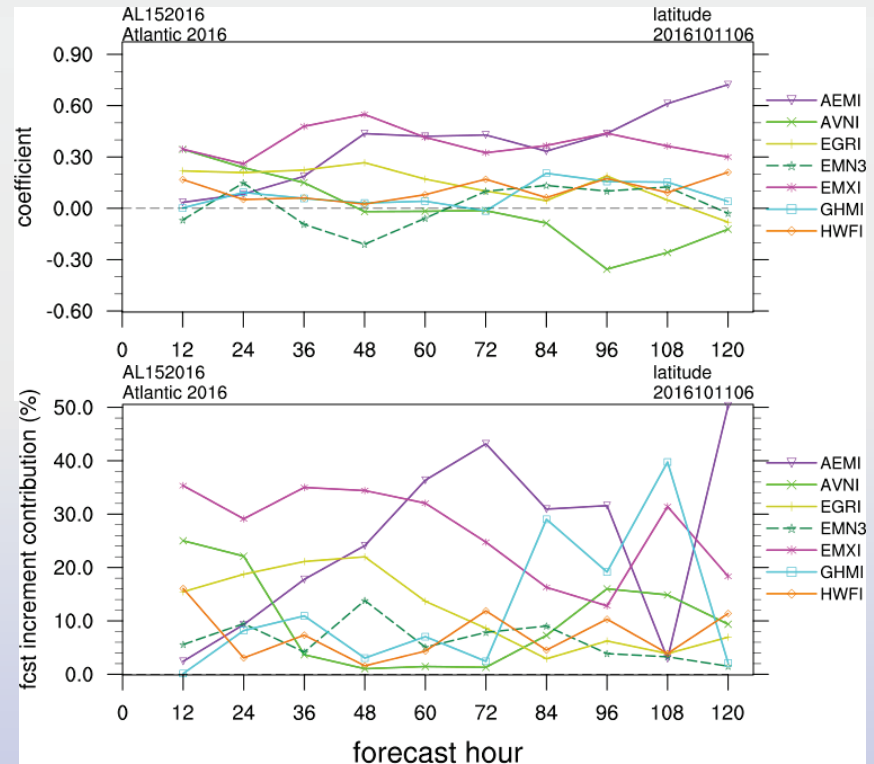
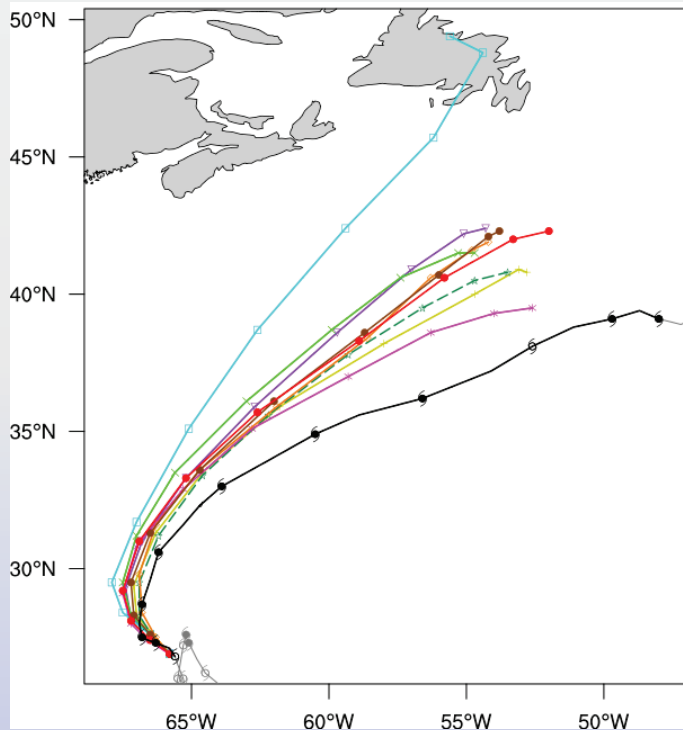
- Real-time cluster analysis for model ensembles
- Tropical wave diagnostics for TAFB
- Operational model implementation evaluations
- Consensus and Interpolator tracker experiments





NHC Activities: HCCA

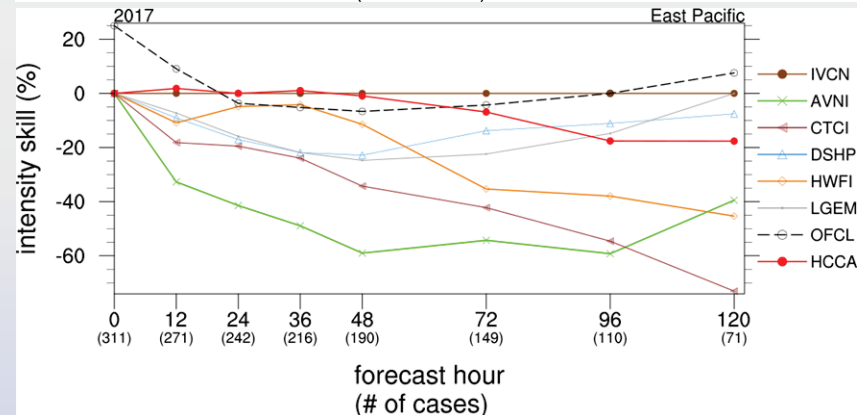
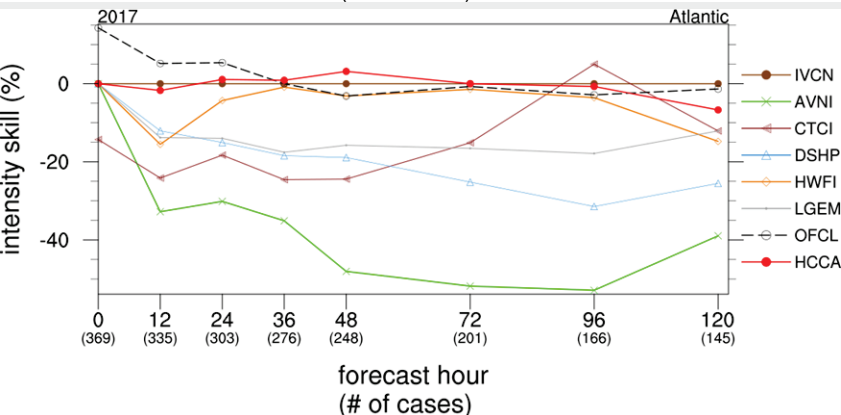
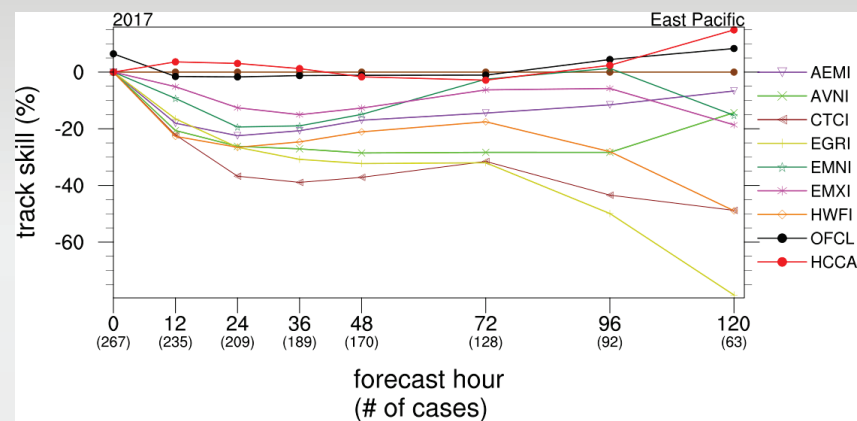
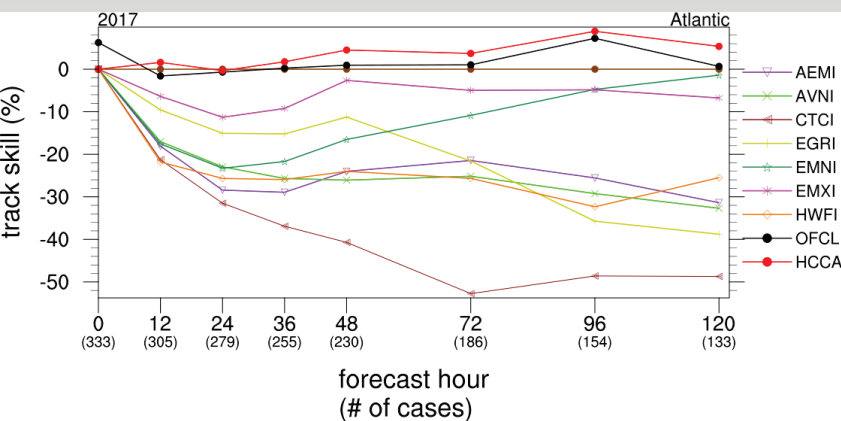
- Input model sensitivity experiments
- Experimental 7-day track forecasts
- Identifying and correcting for outlier contributions to HCCA





NHC Activities: HCCA

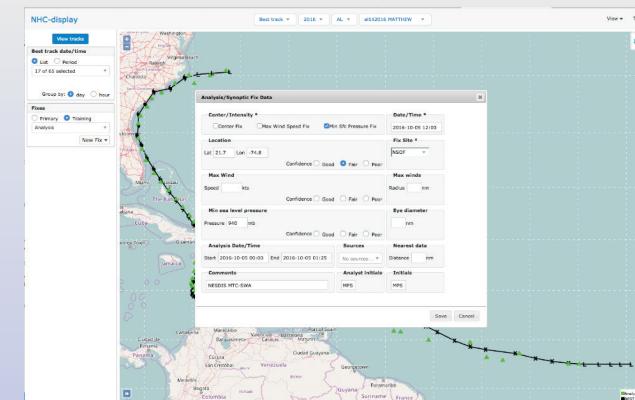
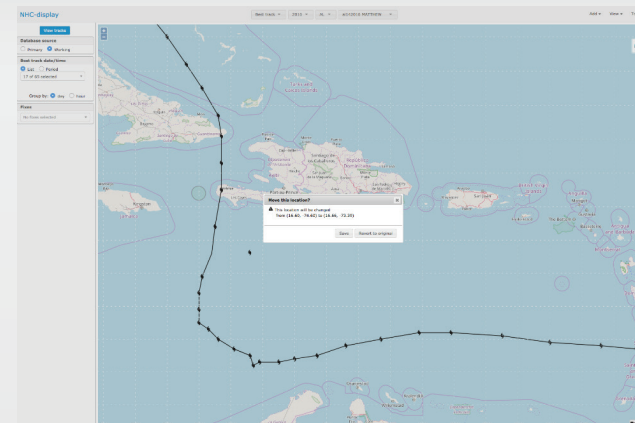
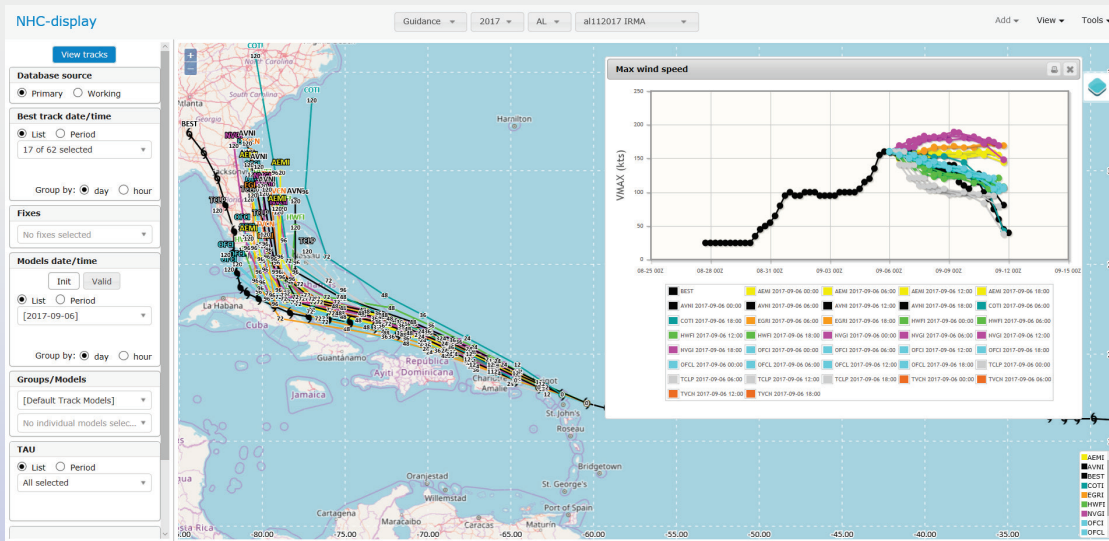
- 2017 Verification



NCAR Activities: HFIP Display and Diagnostic System

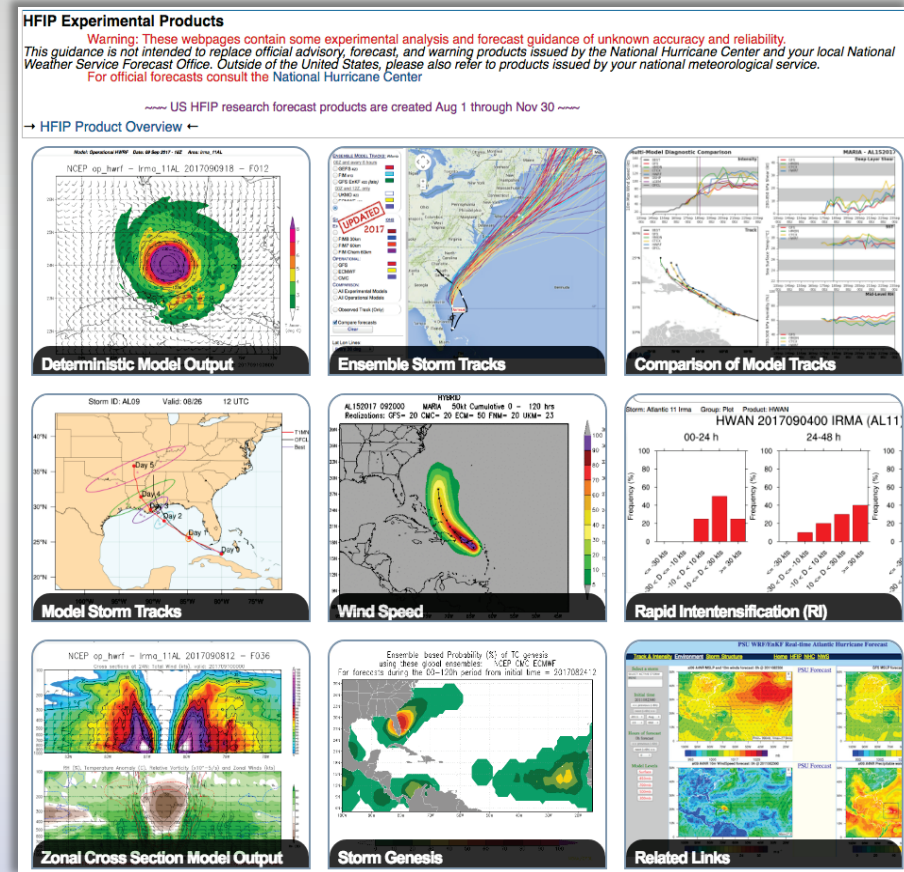
- Web-based display and diagnostic system available to support NHC and the hurricane community
- Implementation of b-deck and f-deck display and editing tool
- Wind radii and model information GUI Display

Example: Hurricane Irma – 06 Sep 2017

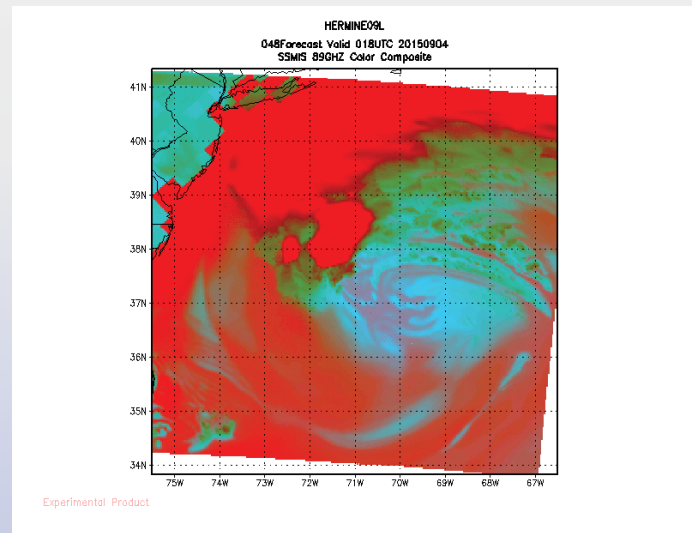
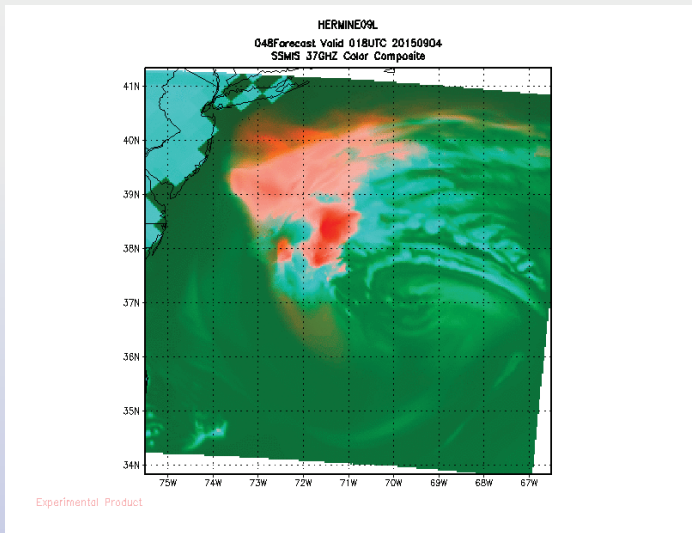
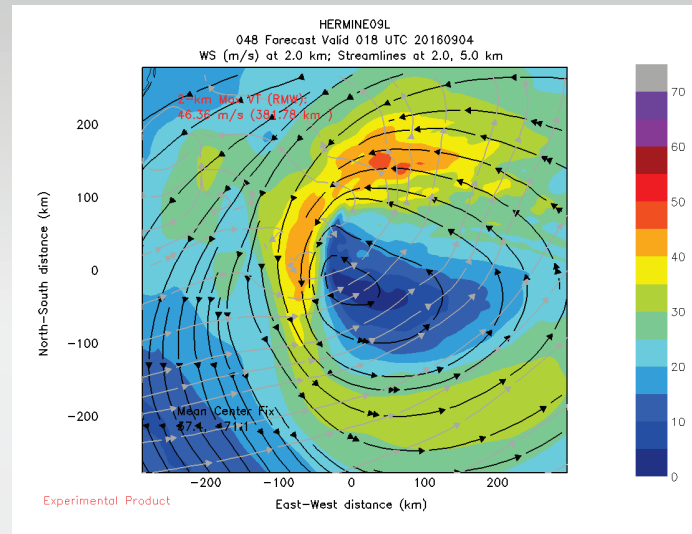
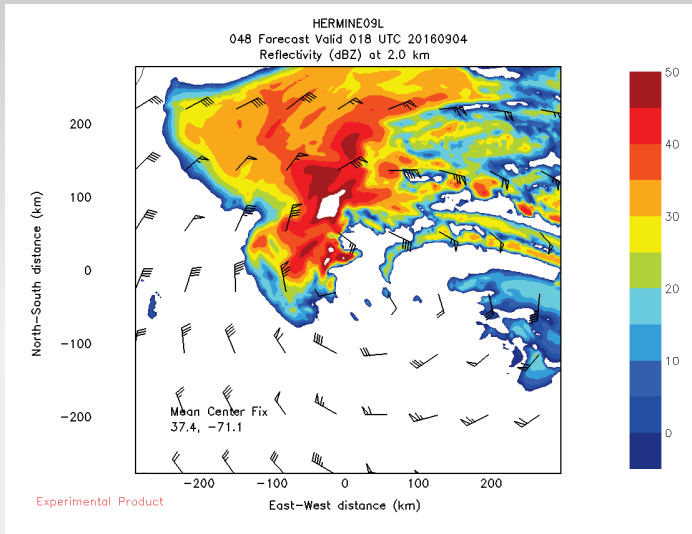


ESRL Activities: HFIP Webpage

- HFIP products page remains a popular resource in HFIP community and larger community and usage increased in 2017
- Increases visibility and recognition of HFIP
- Maintained operational model displays, experimental products, related links, and added diagnostics and entry points in 2017
- Products supported in near-real time

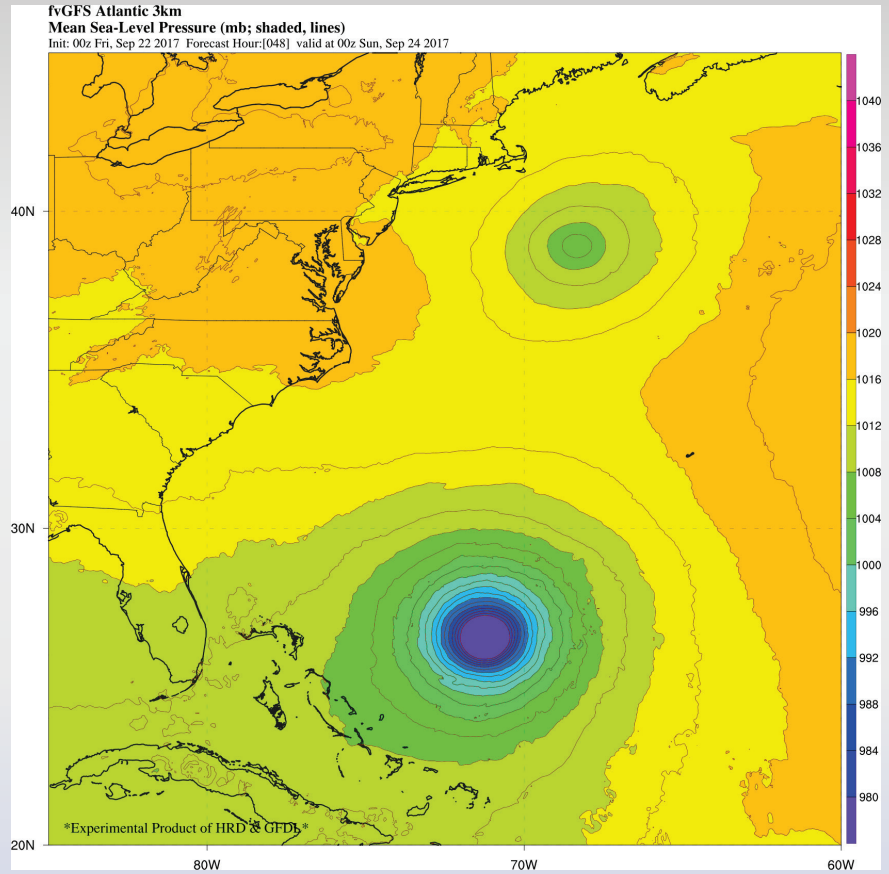
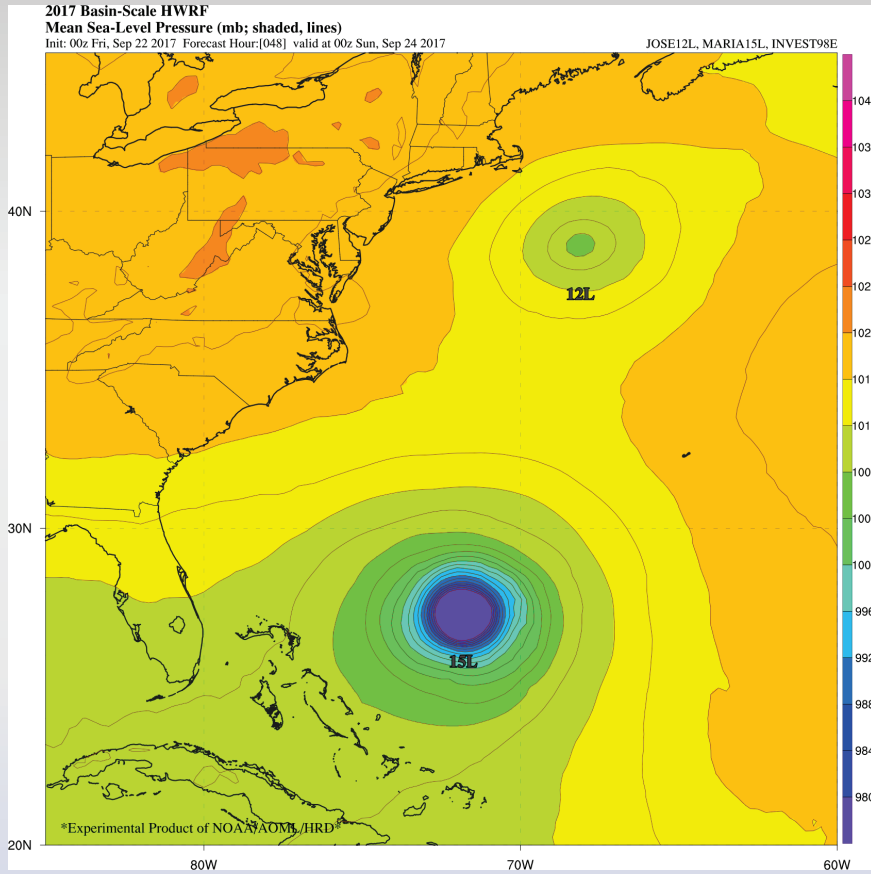


HRD Activities: Observational Comparisons

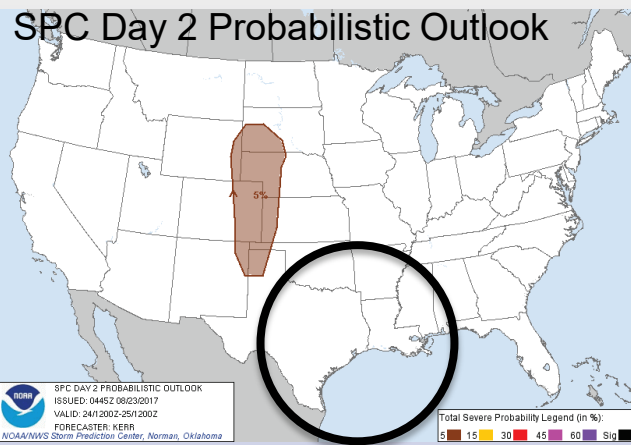
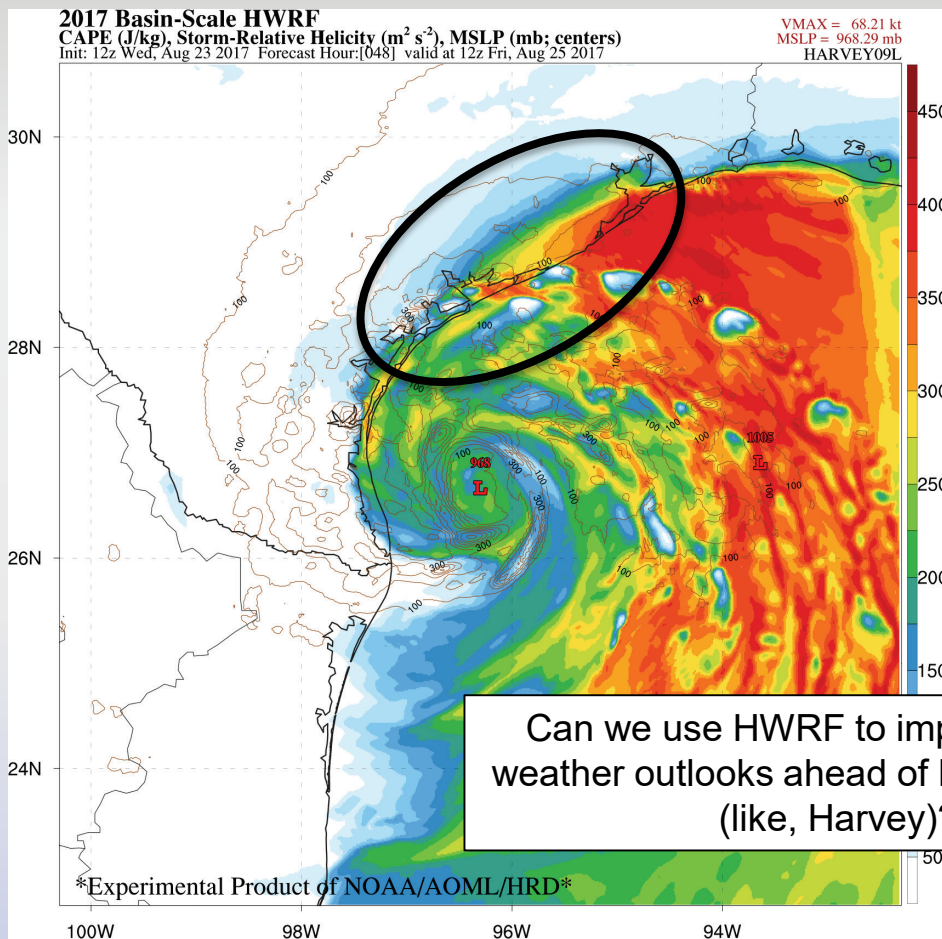
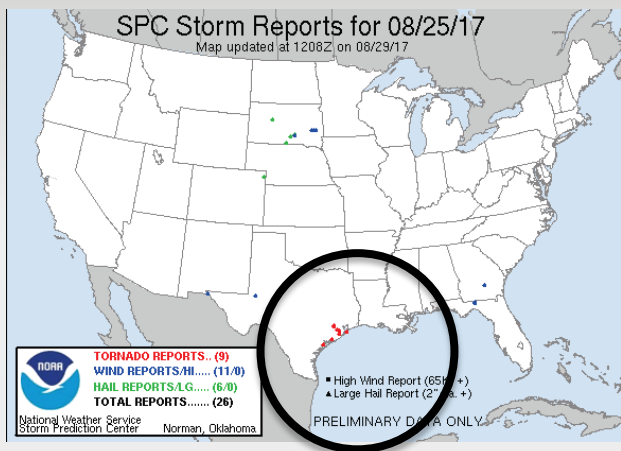




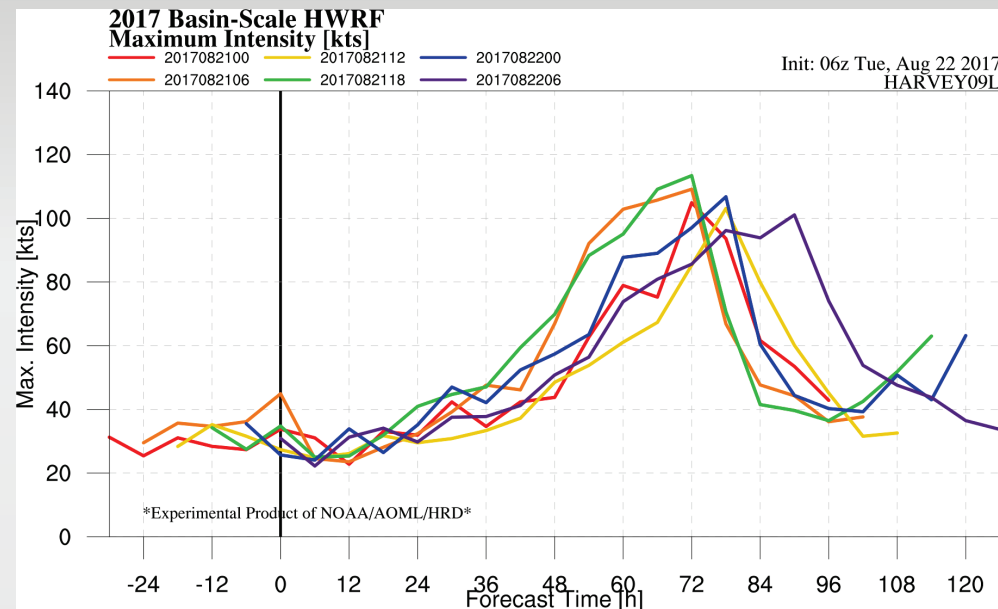
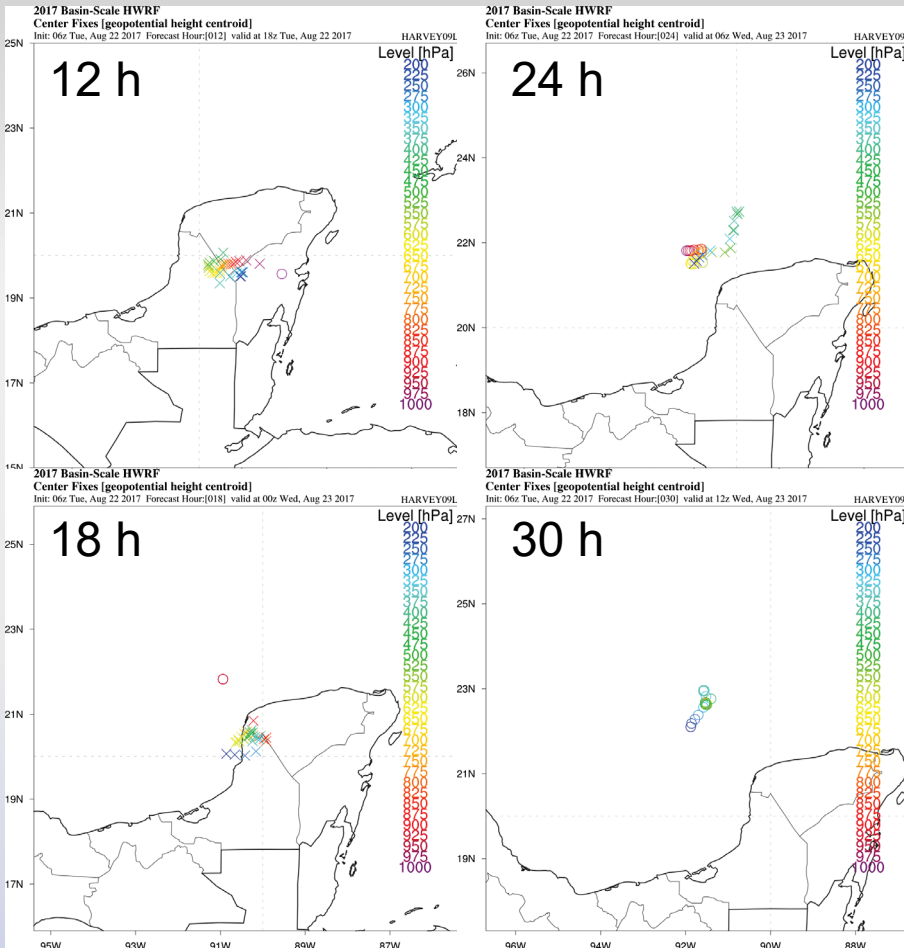
HRD Activities: Inter-model comparisons



HRD Activities: Forecast Applications



HRD Activities: Model-based research

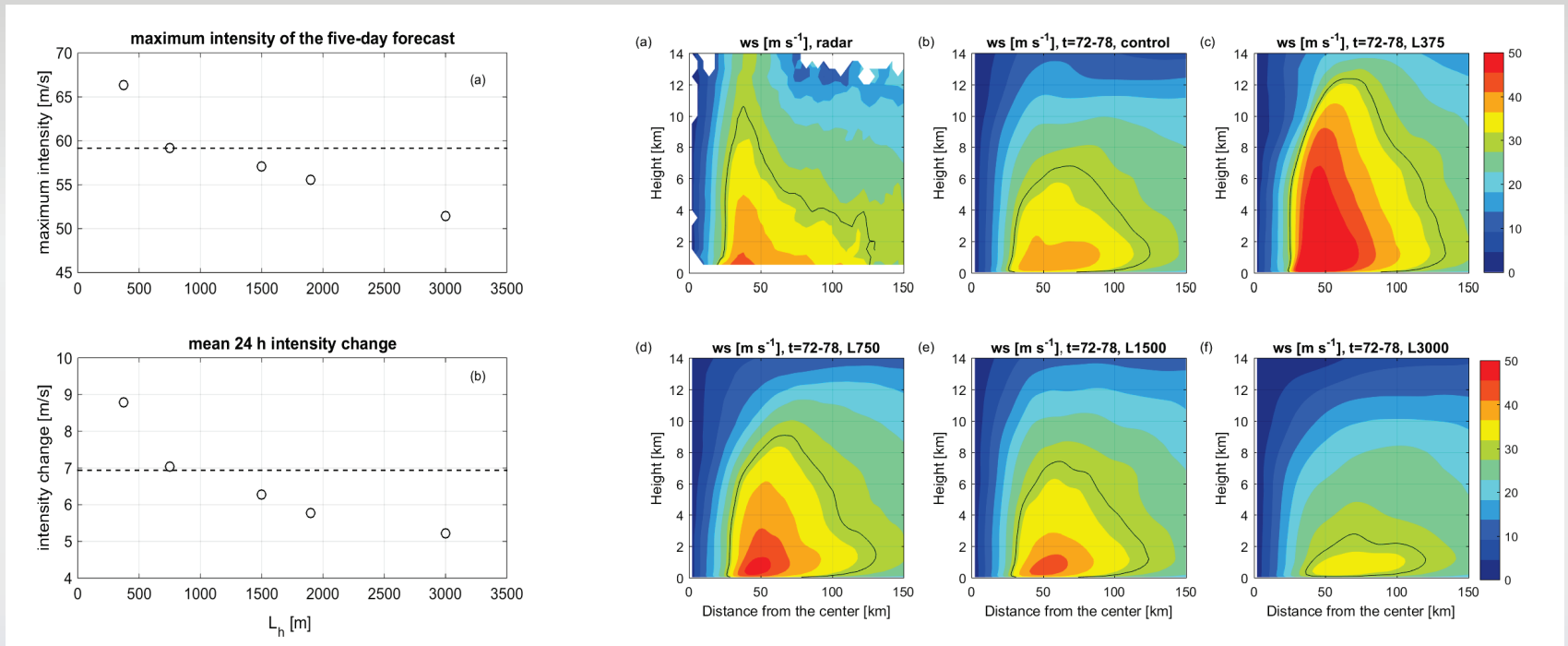


Calculate the geopotential height centroid at each pressure level

Harvey's vortex was aligning just before a period of rapid intensification

HRD Activities: Model-based research

Sensitivity of HWRP forecasts of Hurricane Earl (2010) to horizontal mixing length



- In the control experiment $L_h=1900$ m, same as in the 2015 version operational HWRP model (H215), which is too large based on the sensitivity test. In the 2016 and 2017 version HWRP, L_h is reduced to a value close to observational estimates.



CIRA Activities

- **SHIPS/LGEM/RII/SPICE Improvements**

- GOES-16 infrared and GLM data has been collected to perform comparison with GOES-E/W for 2017 season; preparing for implementation of GOES-16 in 2018 SHIPS
- The latest version of RII has been integrated into SHIPS for the 2017 season
- The SHIPS developmental database has been updated to include the 2016 season, and expanded back in the global basins
- As part of updates to SPICE, HMON is being ingested and diagnostics generated and delivered to HFIP products page; partial ingest of NAVGEM and COAMPS-TC has also been implemented
- In progress: improvements to SPICE; model testing; updates to 2018 SHIPS/LGEM/RII

- **Improving the Monte Carlo Wind Speed Probability Model**

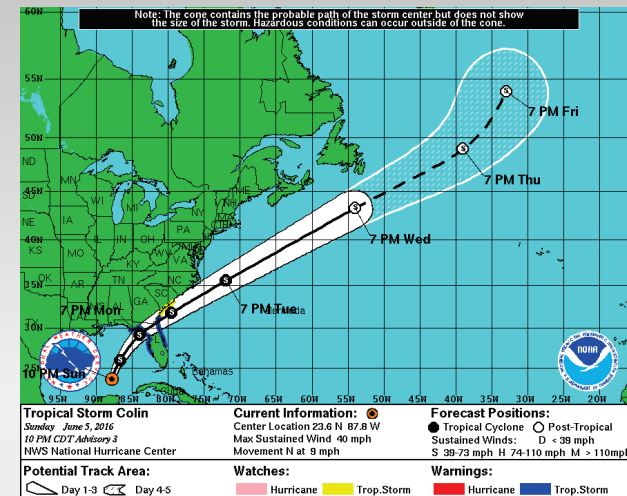
- Two main areas of focus for improving the MCWSP model are improving the representation of TCs moving over land, and investigating the use of global model ensembles to incorporate forecast model uncertainty into MCWSP
- Ensemble-based MCWSP has been developed and tested, found to be more skillful than statistical MCWSP (manuscript in preparation)

- **Developing Statistical Products for Rapid Intensification Forecasting**

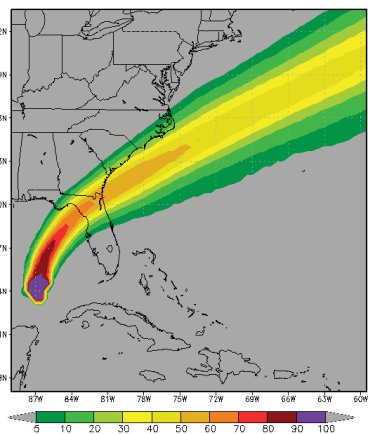
- In progress: RII in SPICE is currently being upgraded to latest version; testing underway for replacement of GFDL
- Operational RII was processed and delivered during 2017 demonstration period, and e-deck generation was implemented in operational RII for the 2017 season

CIRA Activities: WSPs over land

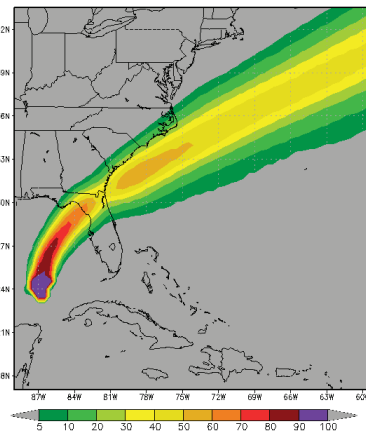
- MC model accounts for land at 12-hourly forecast positions
- For cases where 12-hourly forecast positions are both over water but TC crosses land during intermediate times, WSPs are overestimated
- MC model updated to check for land points at hourly time sub-intervals
- Only increases run time by ~2%



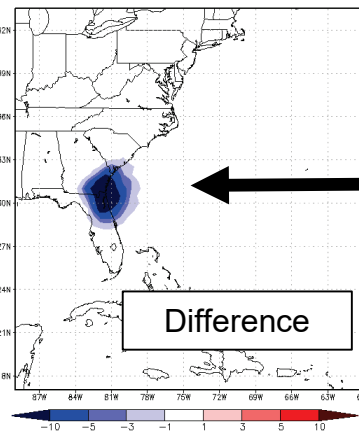
ai032016
06/06/16 00Z
0-120h 34kt Cum Wind Speed Probs (%)



ai032016
06/06/16 00Z
0-120h 34kt Cum Wind Speed Probs (%)



ai032016
06/06/16 00Z
0-120h 34kt Cum Wind Speed Probs (%)



WSPs now reduced over land - more realistic representation



PPAV Team Future Directions

- Align PPAV team with new HFIP goals
- Continue model diagnostics to improve hurricane models
- Continue post-processing for track and intensity forecasting
 - HCCA based on synoptic environment
 - Extend statistical intensity guidance to 7 days
 - Statistical and dynamical RII models
- New product development
 - Landfall intensity probabilities
 - Inclusion of dynamical model uncertainty in wind speed probabilities and storm surge
 - New tools for conveying forecast confidence
- AWIPS tools for linking probabilistic models to graphical watch/warning products



Questions



Extra Slides



HFIP NHC GIS Contractor

Time of Arrival

Be Ready By Graphic

MEOW inland wind graphics updates

Monte Carlo track simulations

Inundation values plotting from public advisory

Rainfall total graphics updates

Maintain breakpoint data and maps

Evacuation zone study

Mortality from hurricane events map

Seasonal summary of wind and surge warning

Maintain the TCR map generation script



HFIP Corrected Consensus Approach (**HCCA**) for tropical cyclone track and intensity guidance

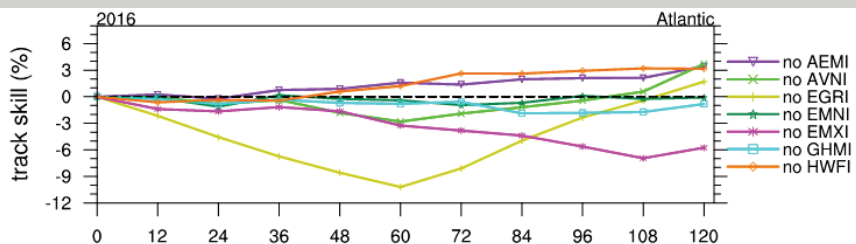
Testing and Development



HCCA

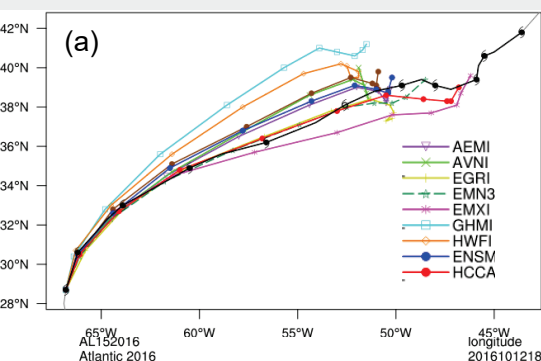
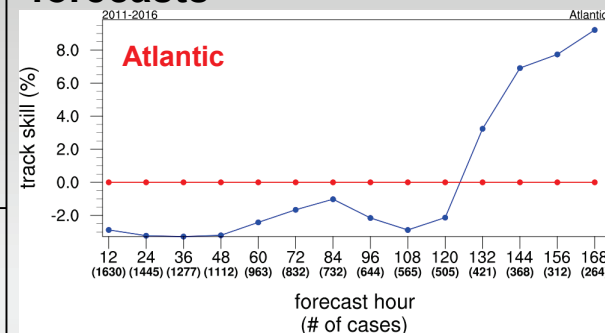
Testing and Development

Input model sensitivity experiments

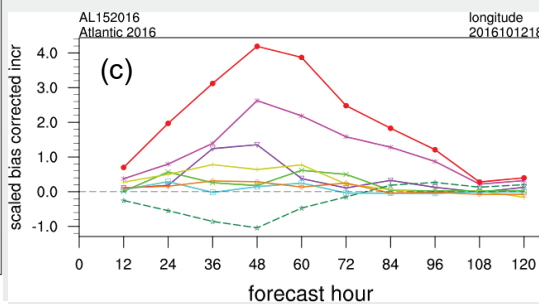


Track skill for 2016 Atlantic HCCA forecasts with an input member model excluded (see legend). Skill is relative to the HCCA configuration that includes all input models.

experimental 7-day track forecasts



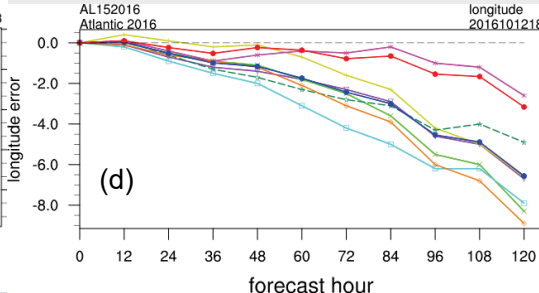
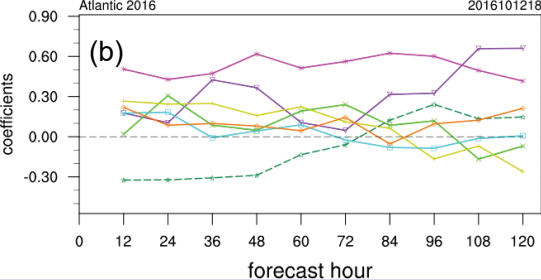
forecast error diagnostics



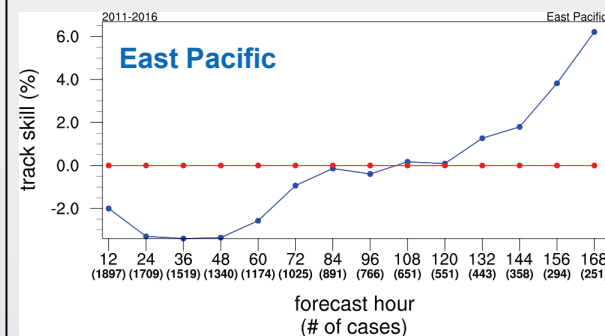
a) Track forecast for Hurricane Nicole (2016) initialized at 1800 UTC October 12.

b) Input model coefficients for longitude.

c) scaled-bias corrected increments for the HCCA input models and the total HCCA increment (red).



d) Longitude error of the forecasts of the HCCA input models, ensemble mean (blue), and HCCA (red).

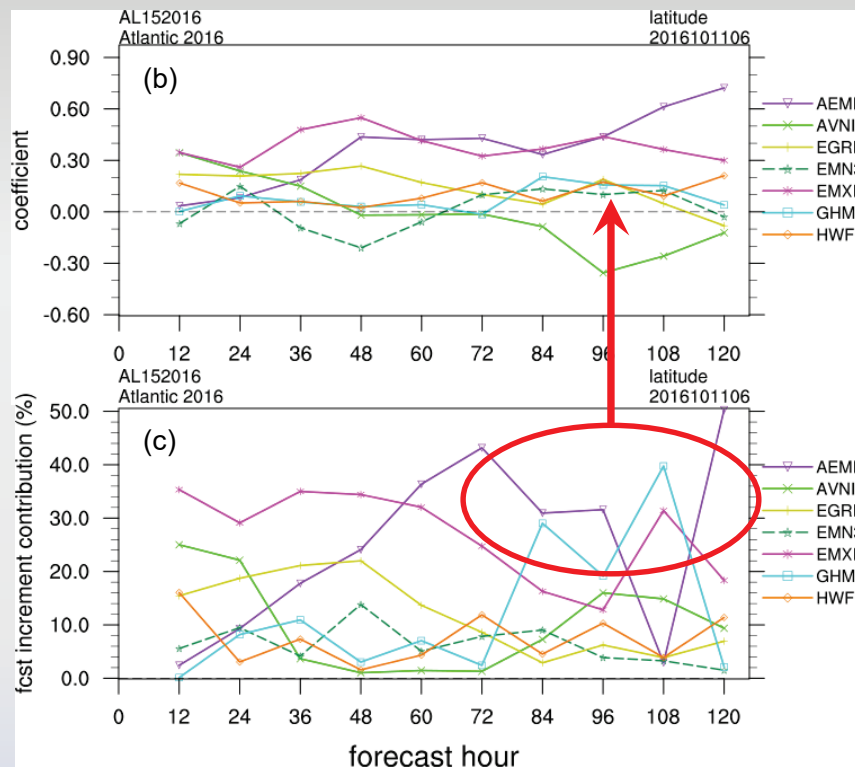
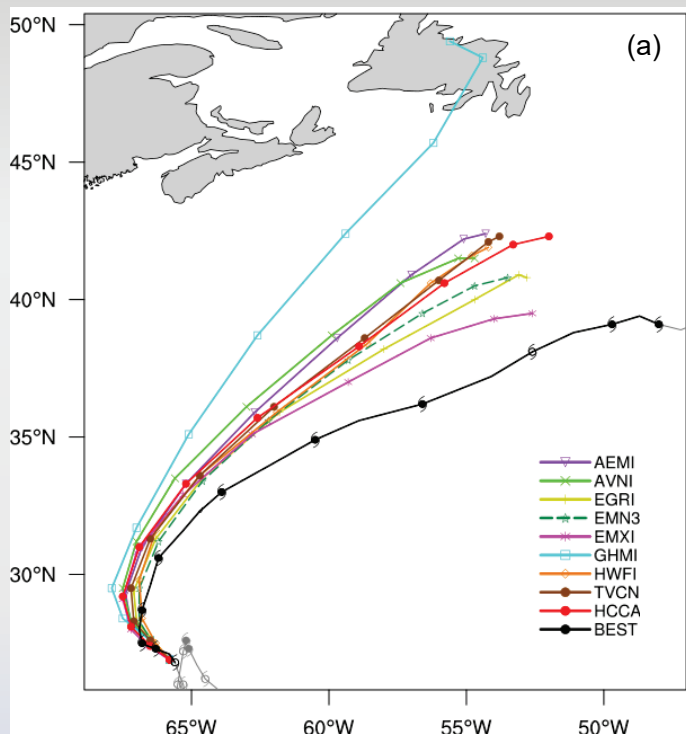


Track skill of ensemble mean (blue) and HCCA (red) retrospective forecasts from 2011-2016 for the (top) Atlantic and (bottom) eastern North Pacific basin.

HCCA

Testing and Development

identifying potential areas for improvement: accounting for instances when the size of the input model coefficients are disproportional to the contribution to the total HCCA forecast increment



a) Track forecast for Hurricane Nicole (2016) initialized at 0600 UTC October 11. b) Input model coefficients for longitude. c) HCCA input model forecast increment contribution (percentage of total HCCA increment).



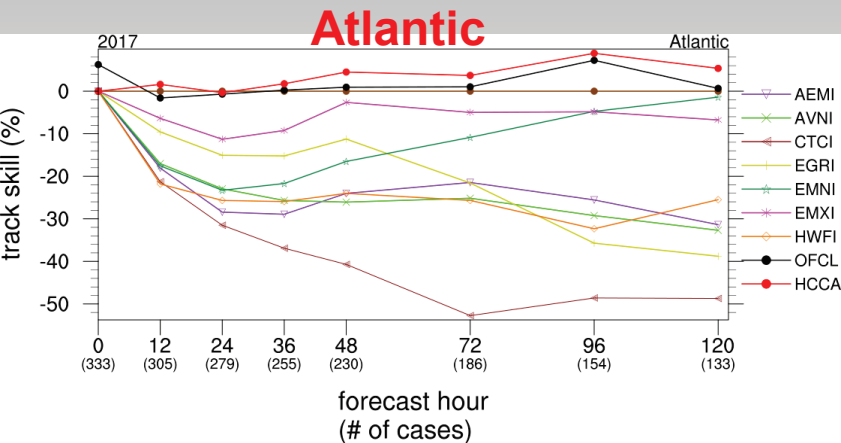
HFIP Corrected Consensus Approach (**HCCA**) for tropical cyclone track and intensity guidance

2017 Verification Results and Highlights



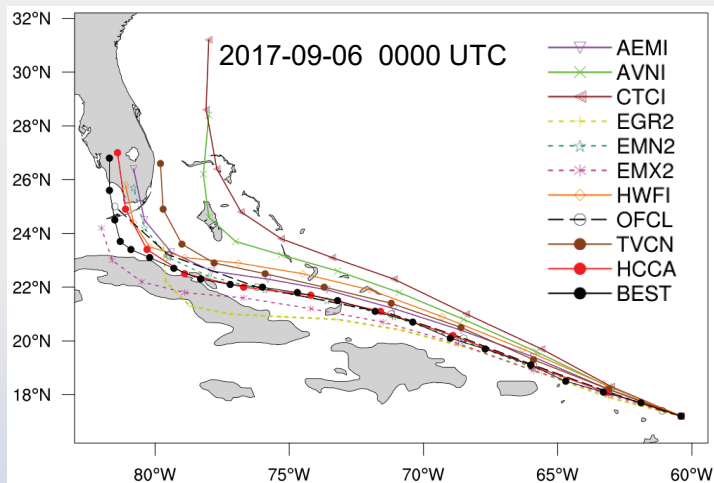
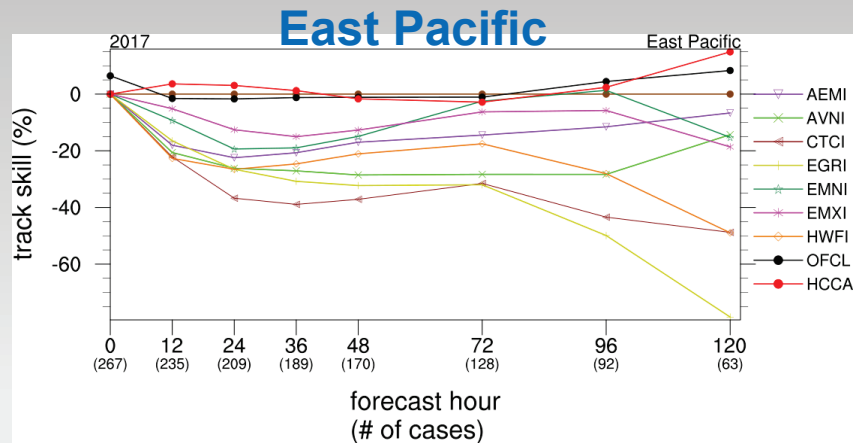
HCCA

2017 Verification Results and Highlights

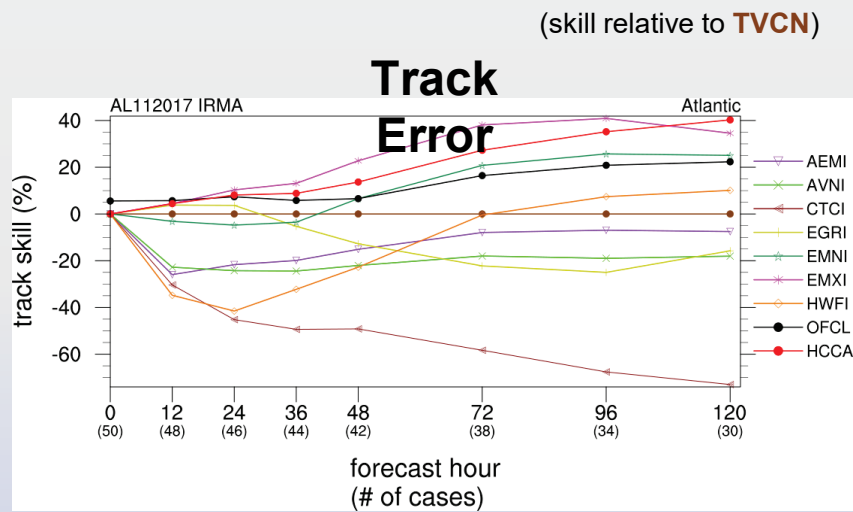


Track Error 2017

(skill relative to TVCN)



AL112017 IRMA

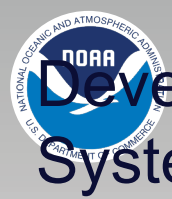




HFIP Display and Diagnostic System Development

Paul A. Kucera and Tatiana Burak
NCAR/Research Applications Laboratory

HFIP Annual Meeting
Miami, FL
November 2017



Development of a Tropical Cyclone Display and Diagnostic System

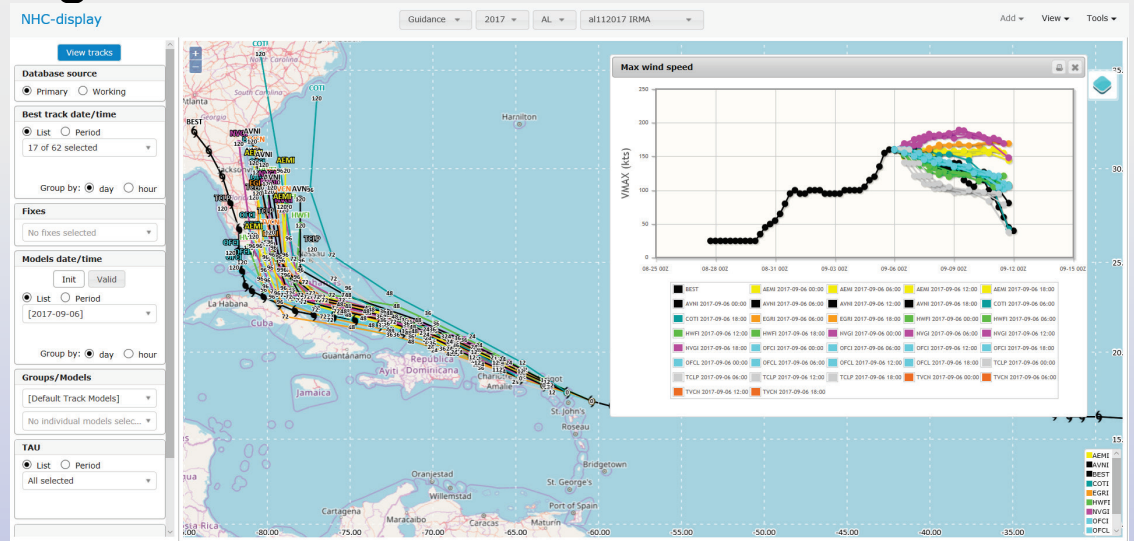


Project Team: Paul Kucera and Tatiana Burek (NCAR)

- A web-based display and diagnostic system is available 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, F-decks), and gridded fields (SST)
- Built-in diagnostic evaluation tools
- Dynamic consensus forecast generation

Web: <http://www.hfip.org/nhc-display>

Example: Hurricane Irma – 06 Sep 2017





FY2017 Development

Implementation of best-track (B-deck) fix-position (F-deck) display and database editing tool:

Separate databases for the primary (official) display and editing (working)

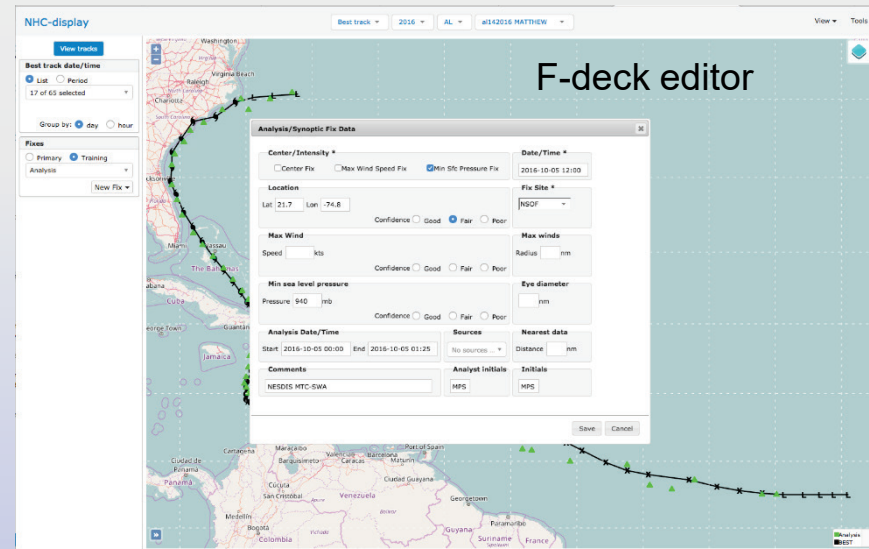
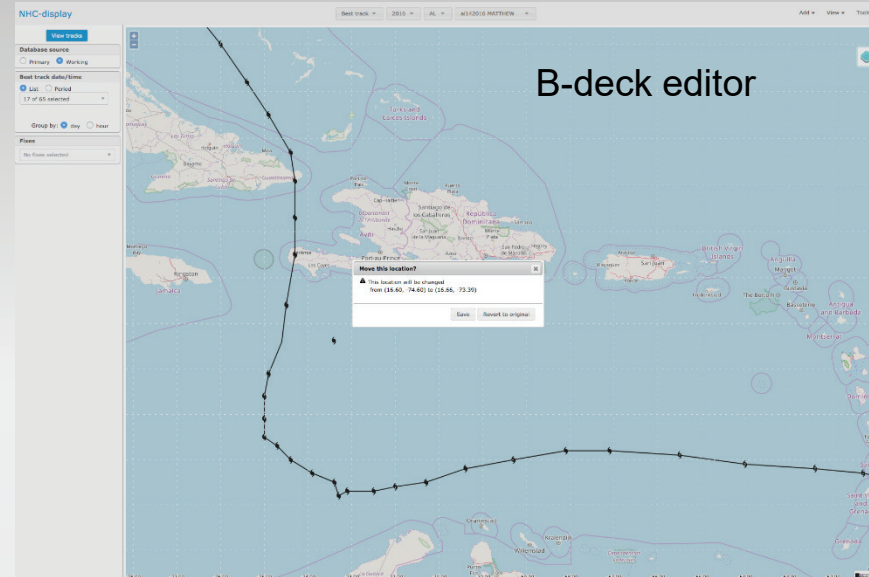
Graphically or numerically edit (pop-up GUI boxes) capability

Tools to add, edit, and delete fixes from the working database

F-deck fixes analysis

Fix types: Aircraft, analysis, microwave, radar, satellite, scatterometer

Import capability to update official B-deck and F-deck databases with new/updated location and intensity



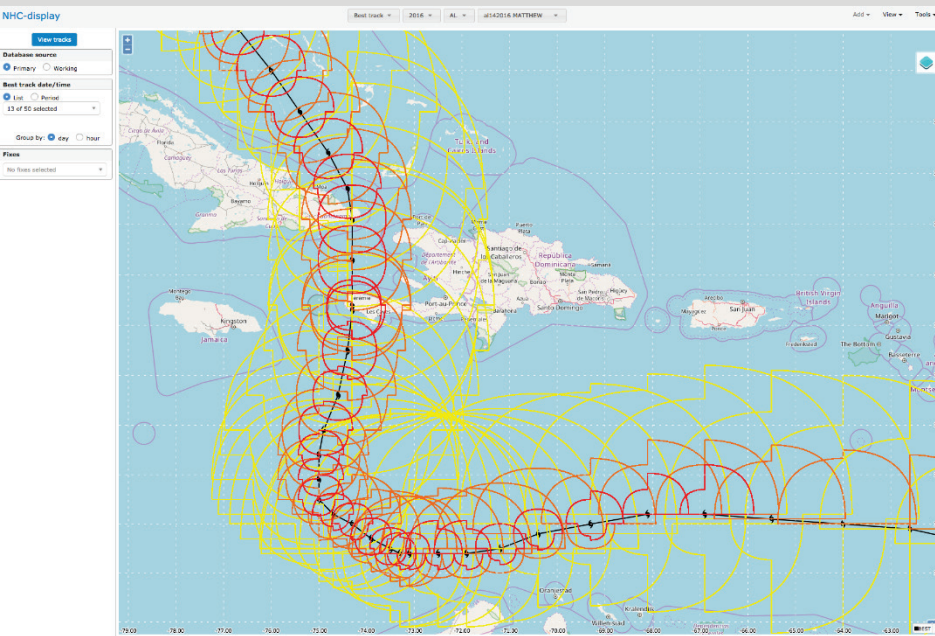


FY2017 Development

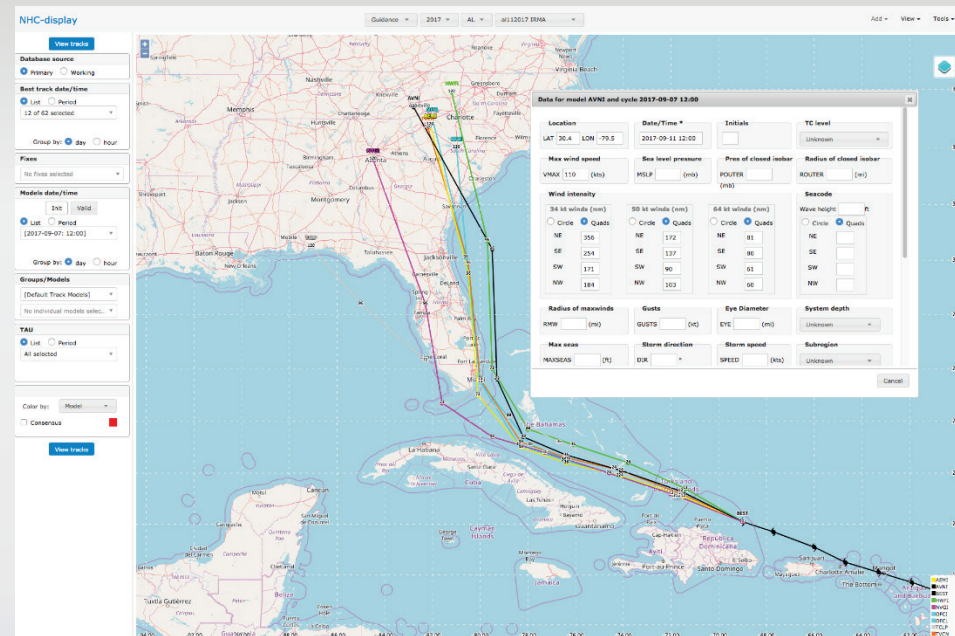
Development of wind radii display and model information GUI

Display capability

Wind Radii Display



Model Information Display

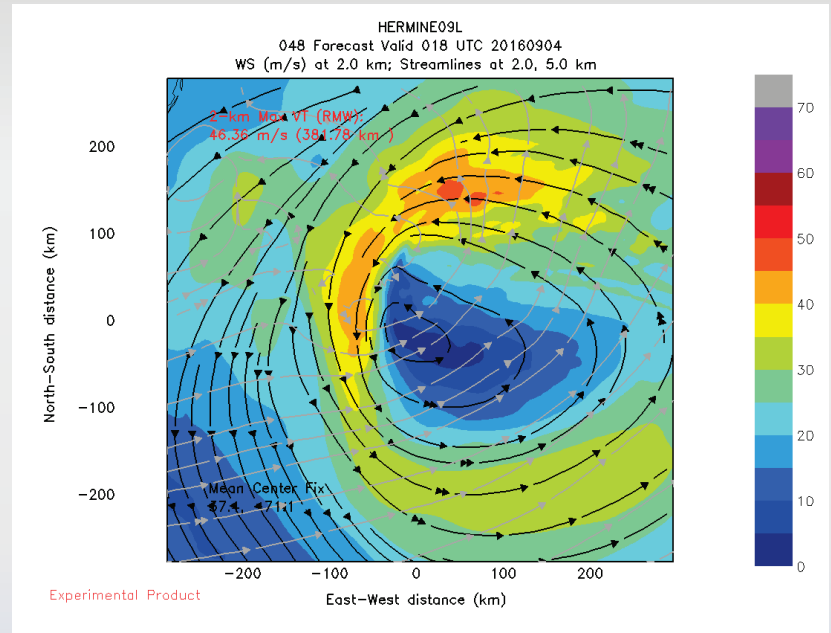
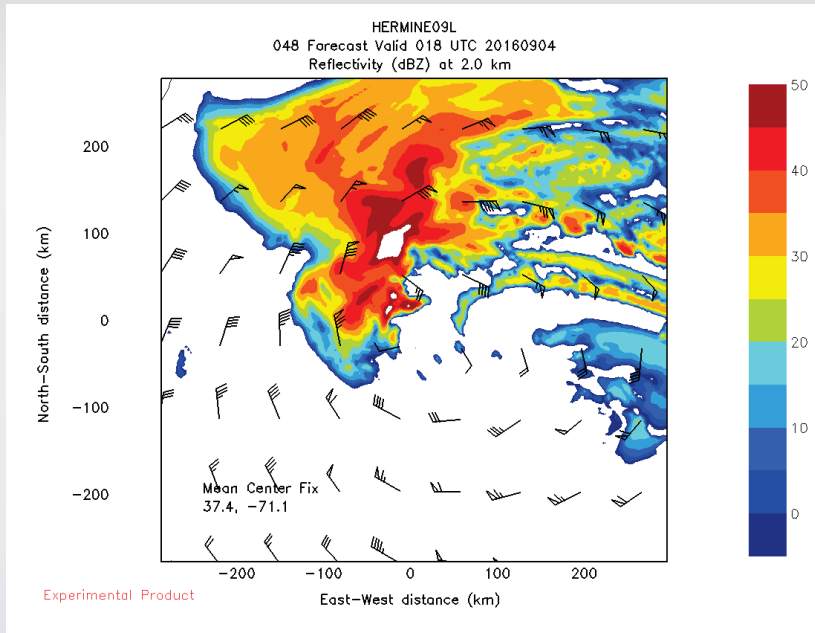




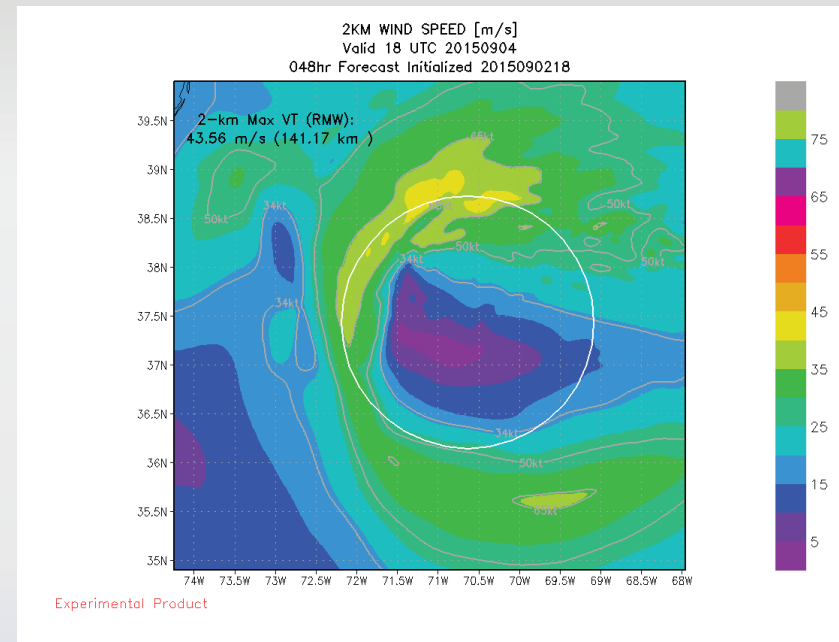
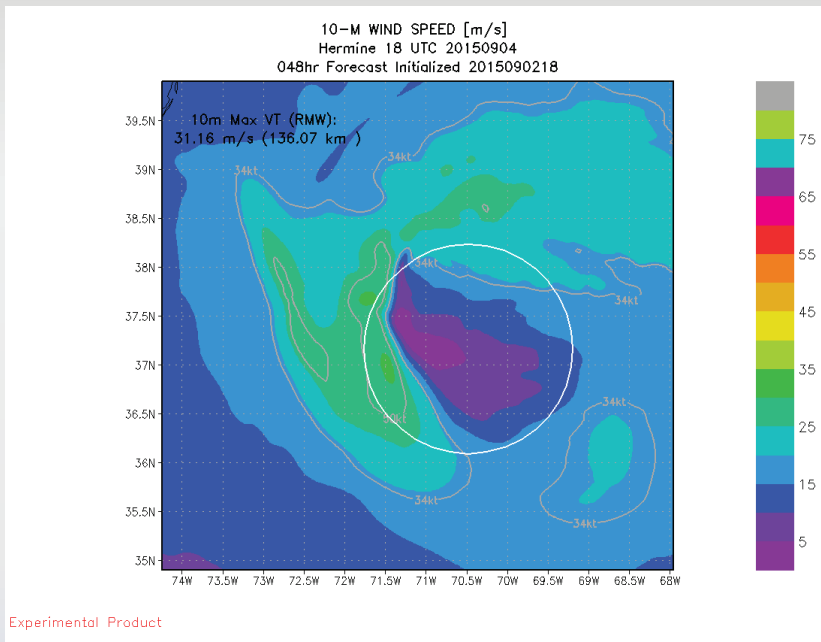
HFIP PPAV work at HRD (Ghassan Alaka, Paul Reasor, Rob Rogers, Kathryn Sellwood, Jun Zhang)

- HRD is actively working on developing many diagnostic capabilities intended to depict the environmental, vortex, convective, and boundary-layer scale structures from both the operational and basin-scale HWRF
- These diagnostics are useful for
 1. observational comparisons
 2. inter-model comparisons
 3. forecasting applications
 4. model application and development research
- Examples of each of the applications are provided in following slides

Obs Comparison: Radar equivalent plots: Storm center out to 250km

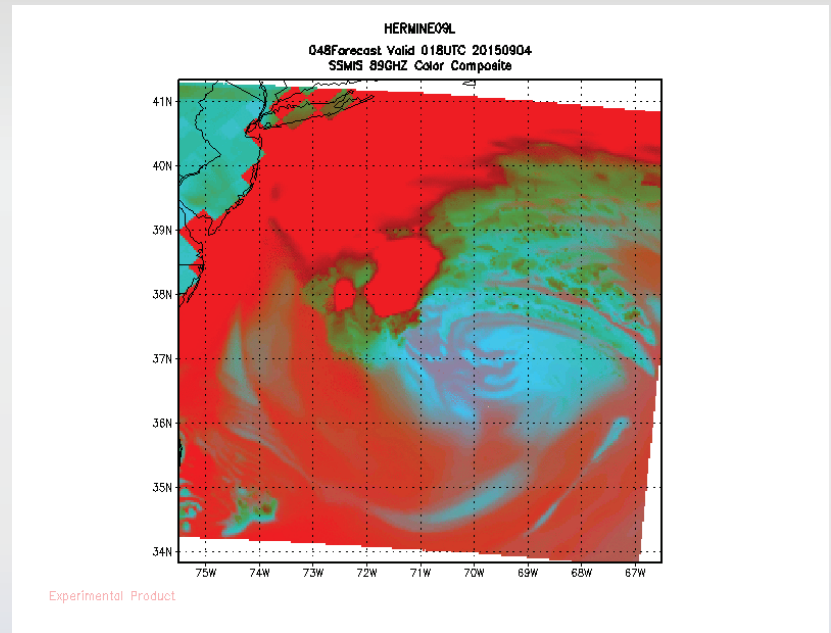
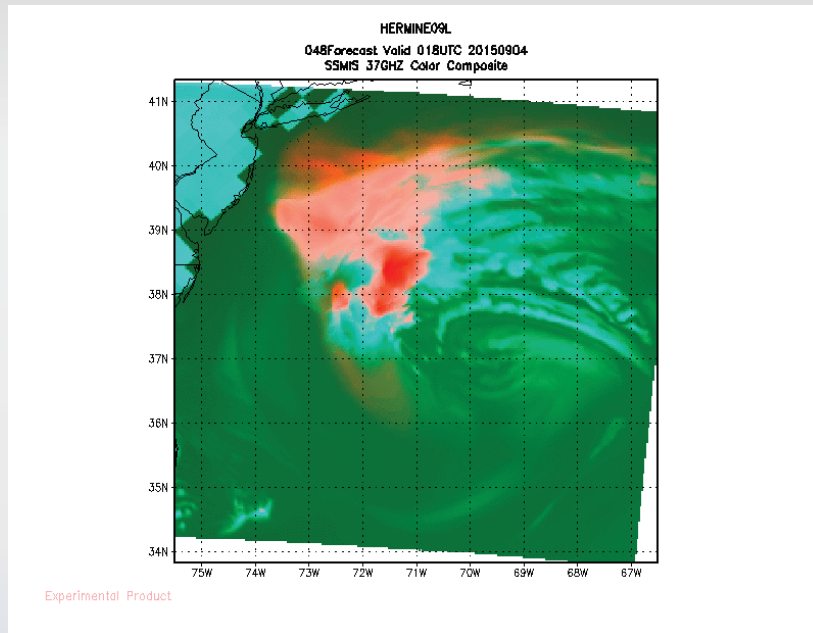


Obs Comparison: Radar Equivalent plots – Earth relative at 10m and 2km



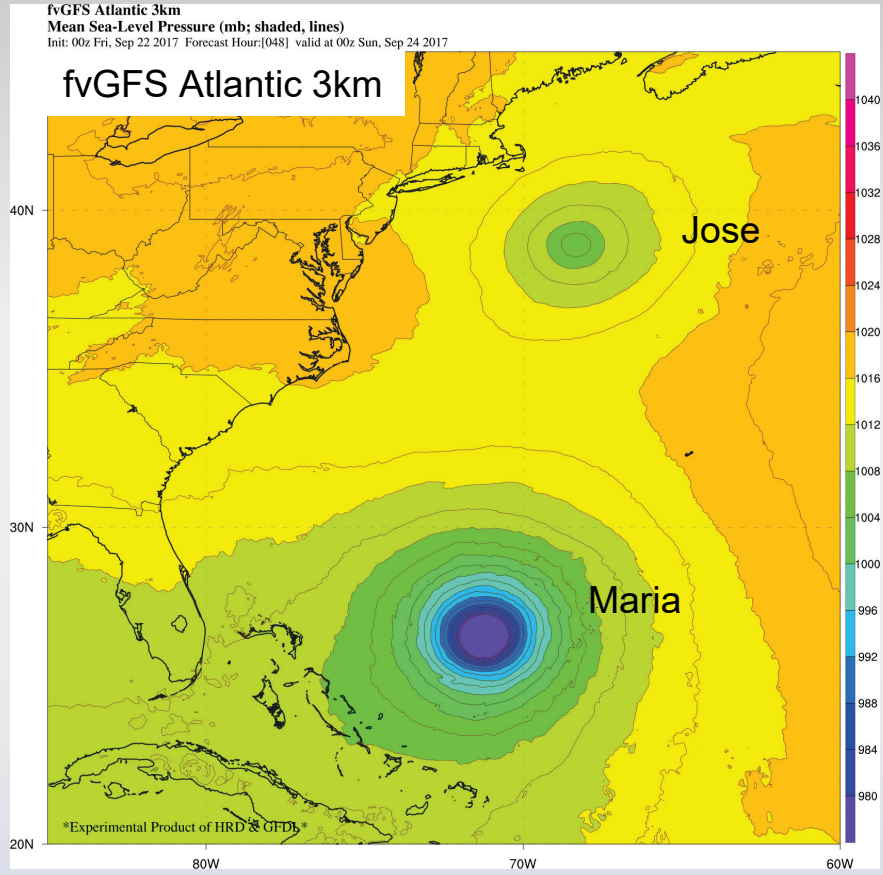
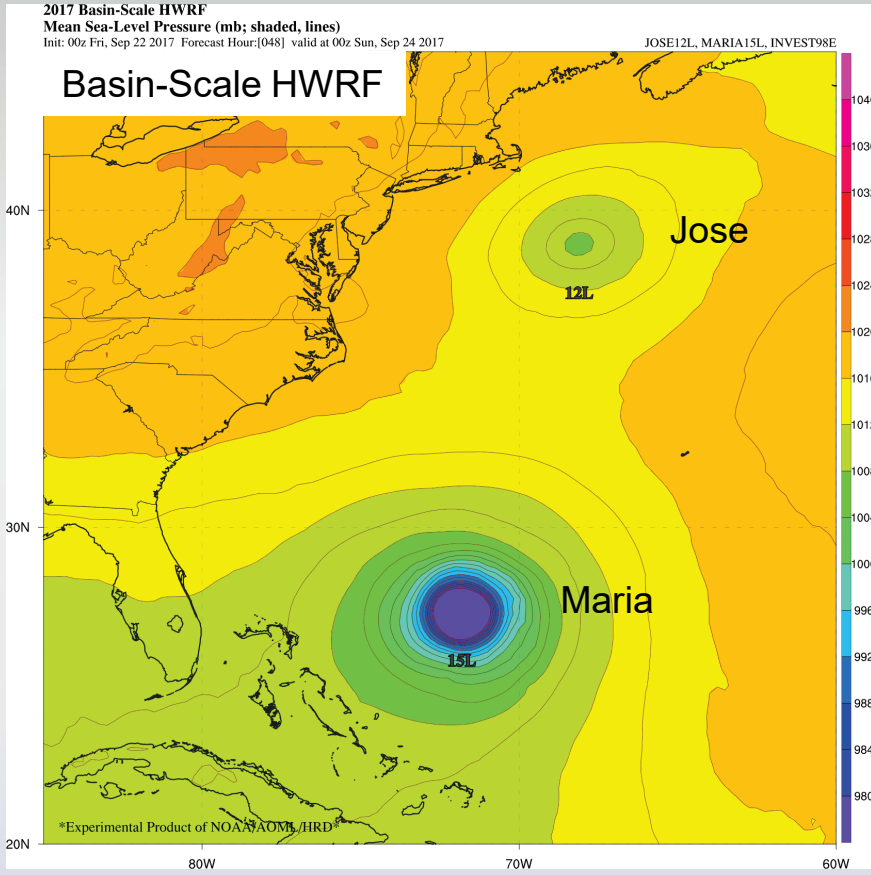


Obs Comparison: Microwave PCT: 37GHZ 89GHZ

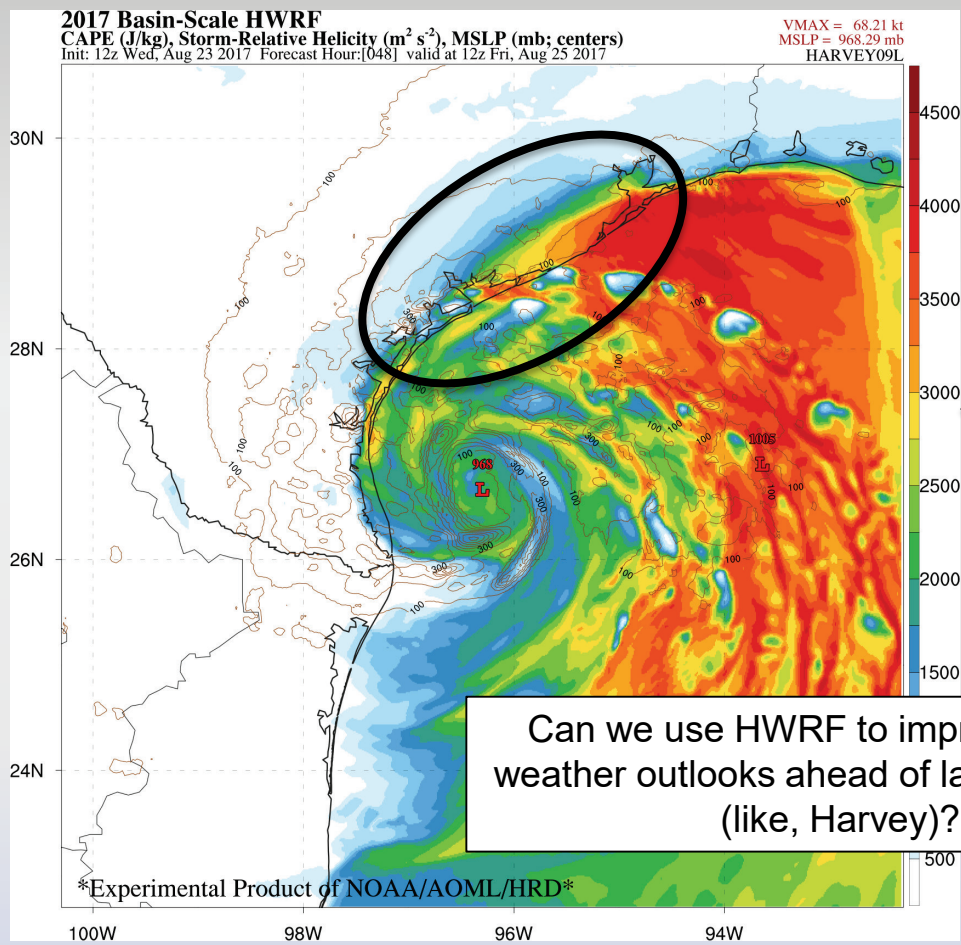
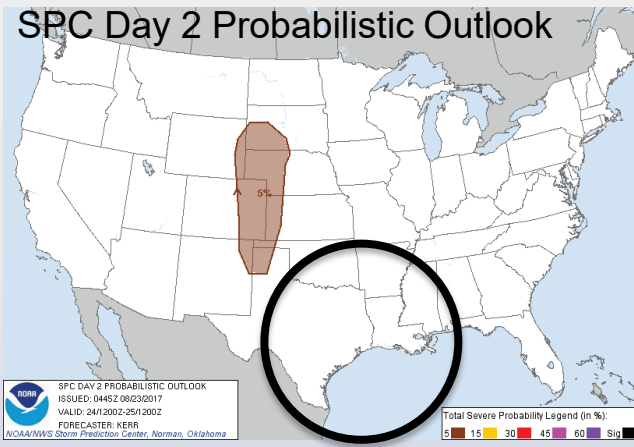
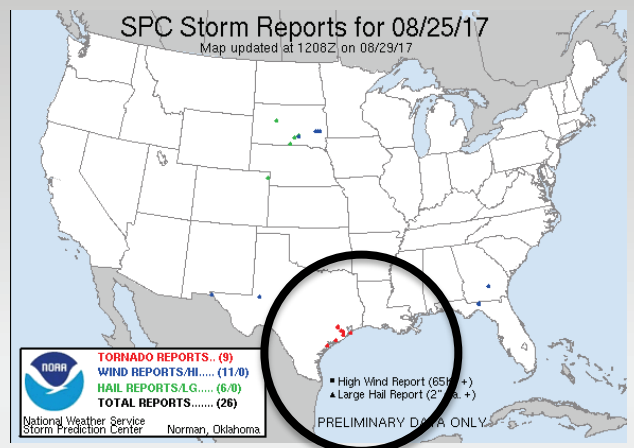




Real-Time HFIP Model Comparisons



Forecast Applications: Severe Weather & Tornadoes

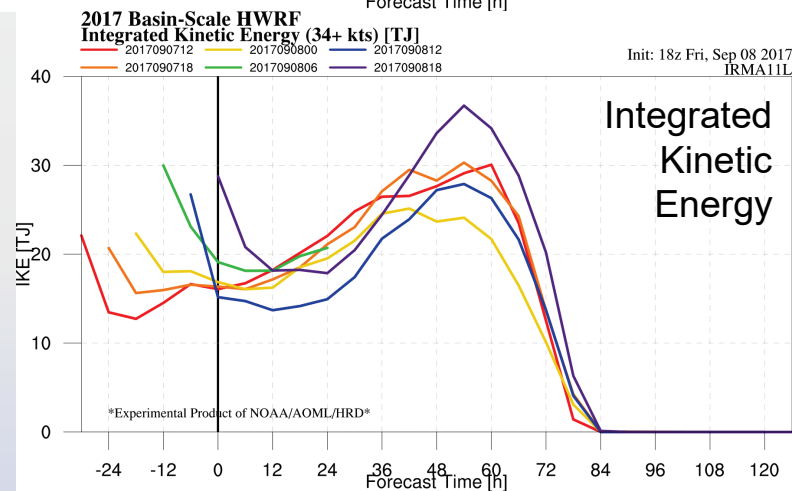
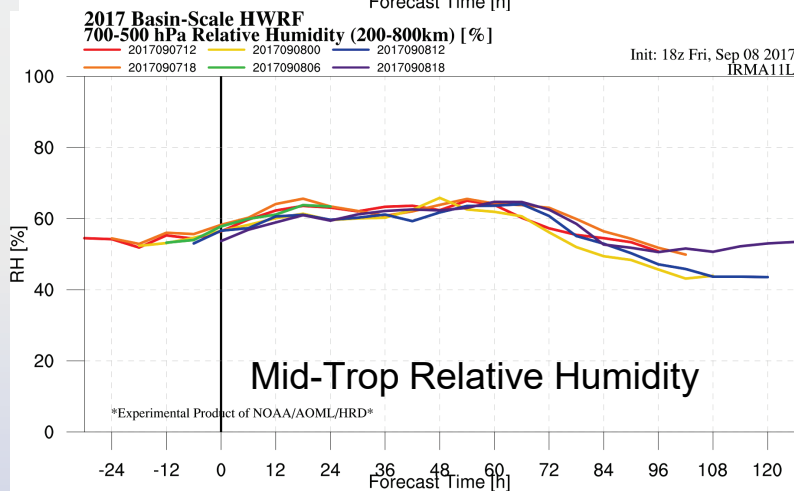
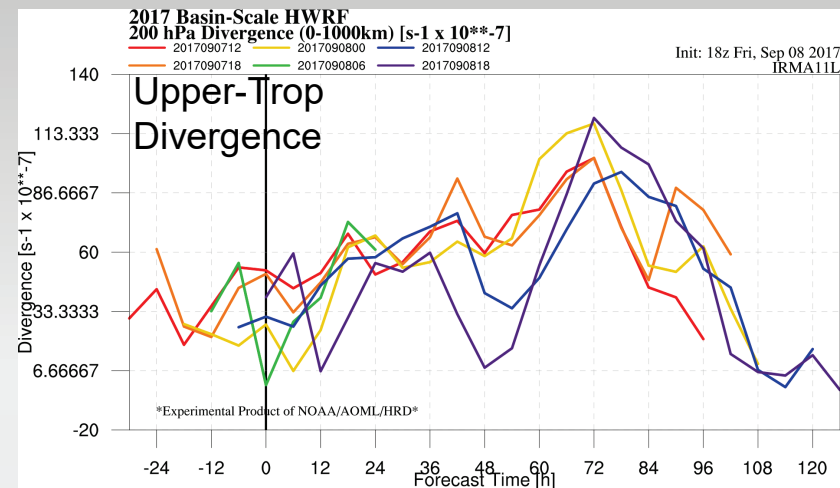
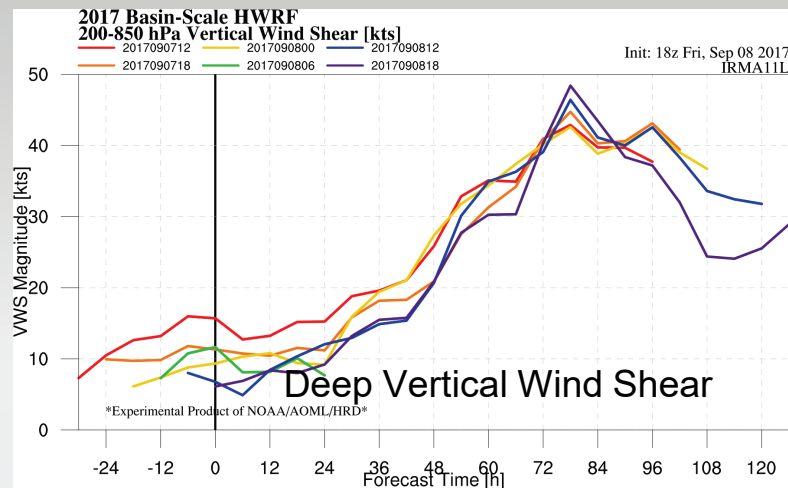


48-h forecast for
CAPE & Helicity in
Hurricane Harvey

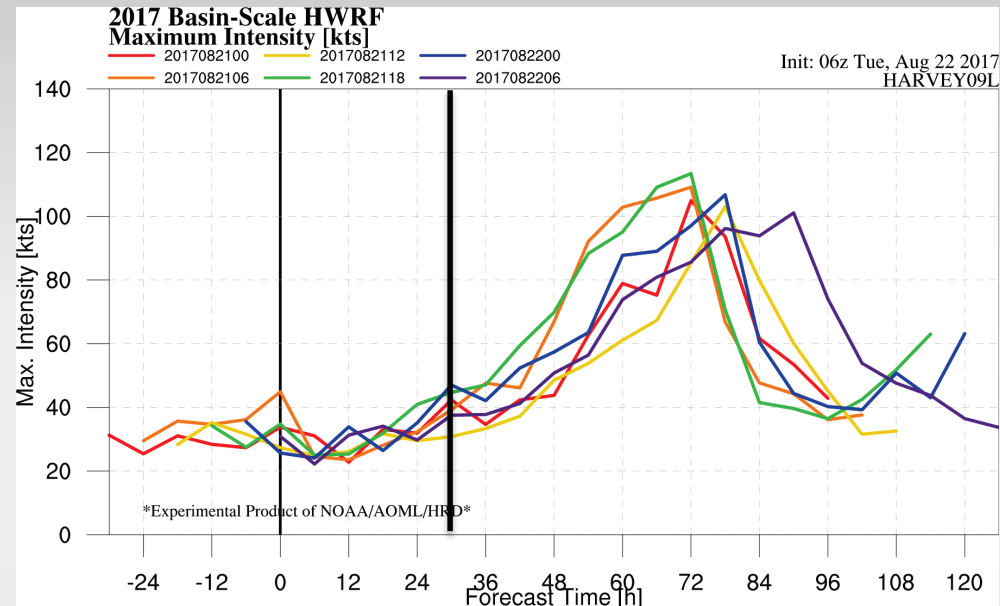
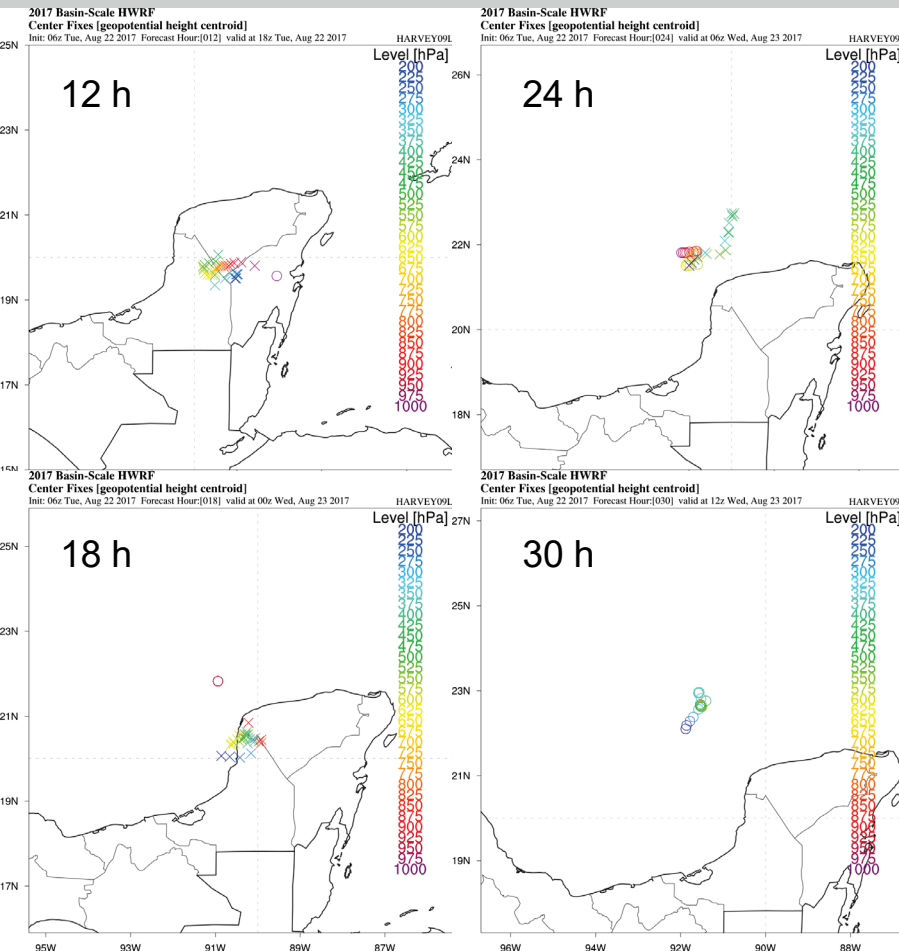
Can we use HWRF to improve severe weather outlooks ahead of landfalling TCs (like, Harvey)?



Forecast Applications: Model Trends of SHIPS Predictors & IKE



Model-based research: Vortex Tilt

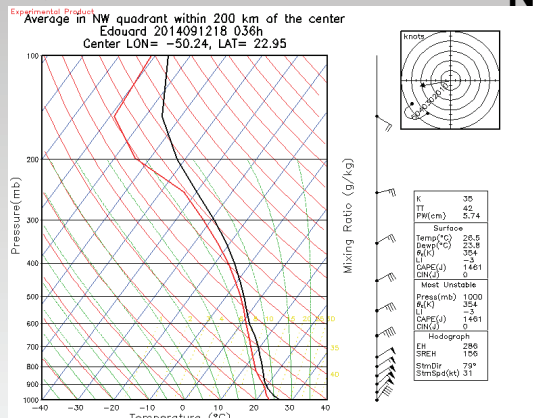


- Calculate the geopotential height centroid at each pressure level
- Harvey's vortex was aligning just before a period of rapid intensification

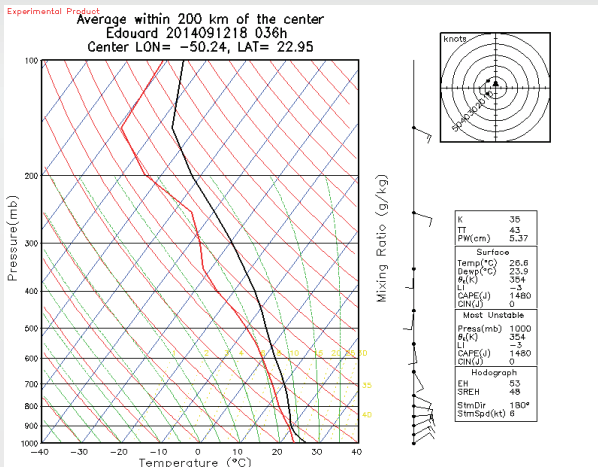
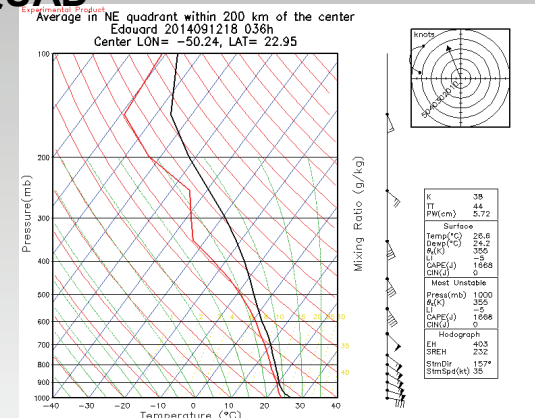


Model-based research: Skew-T Log P CENTER

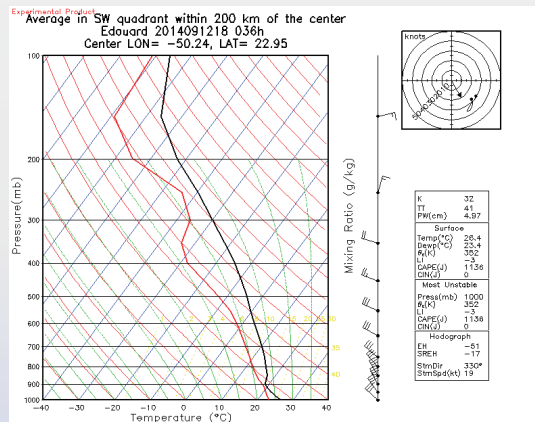
NW QUAD



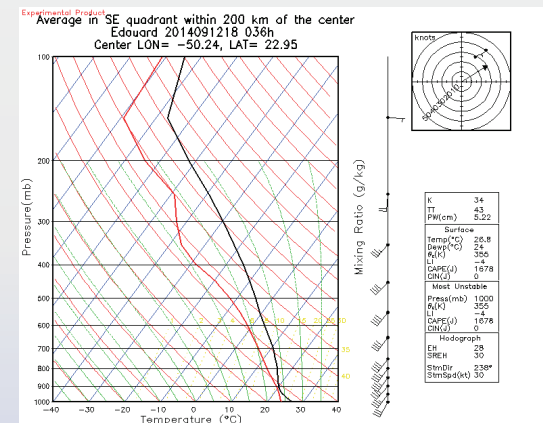
NE QUAD



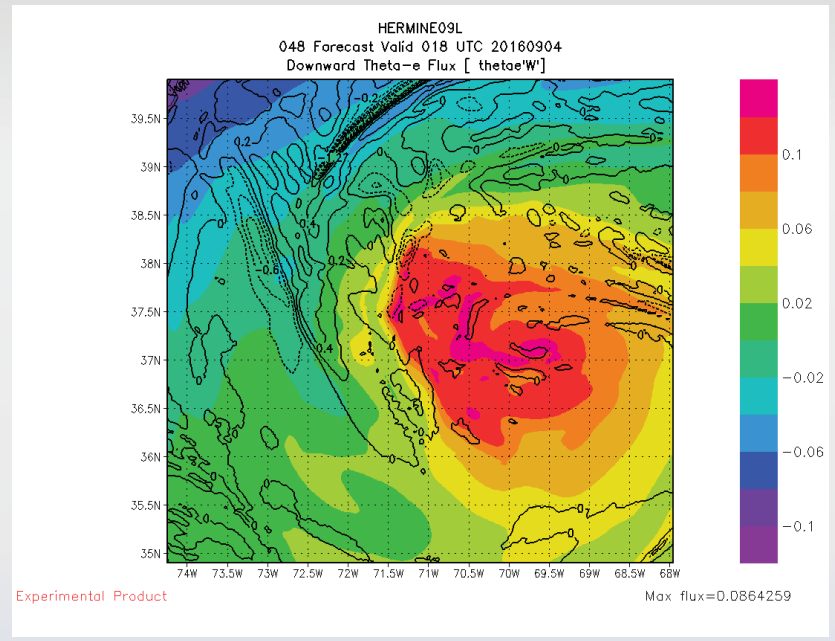
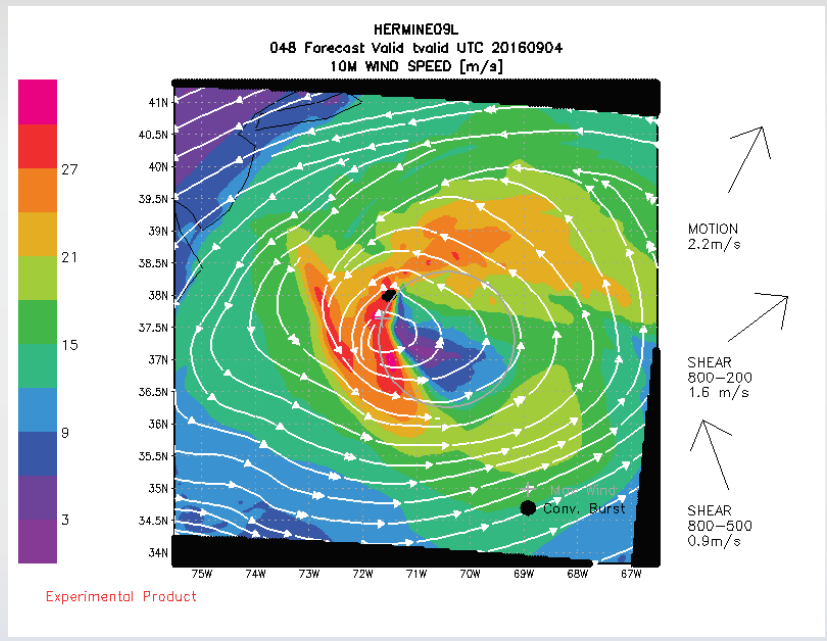
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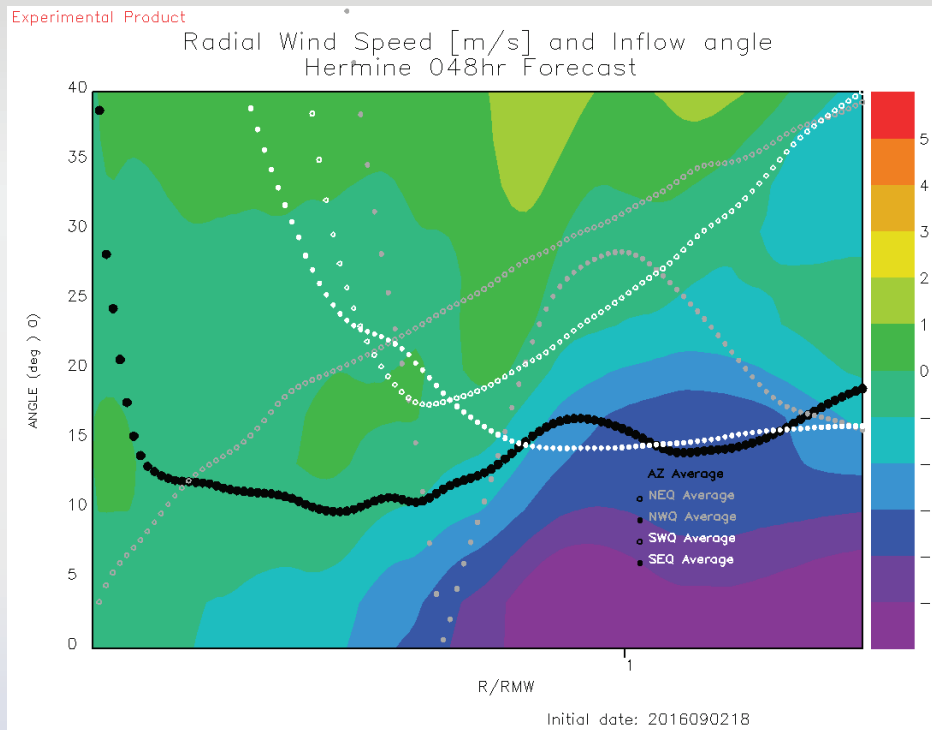


Model-based research: Structural diagnostics for Convective Bursts, Downward Theta-e flux Shear/Motion option



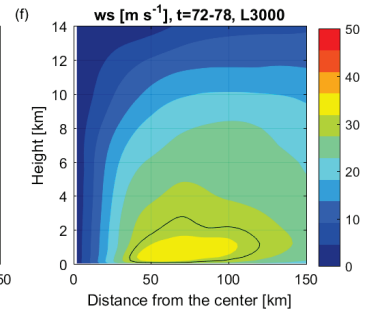
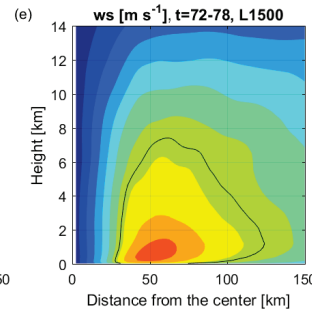
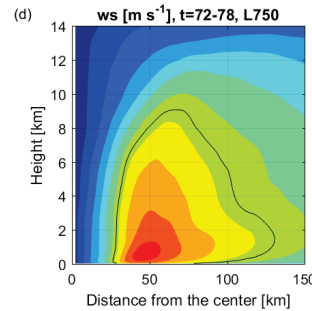
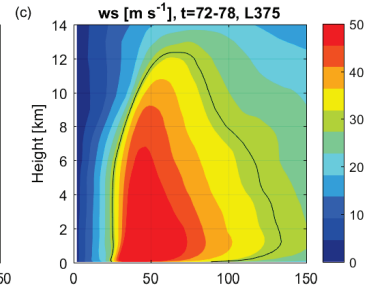
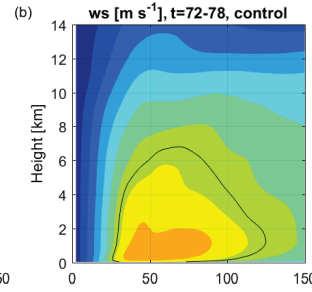
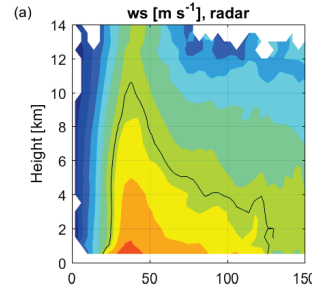
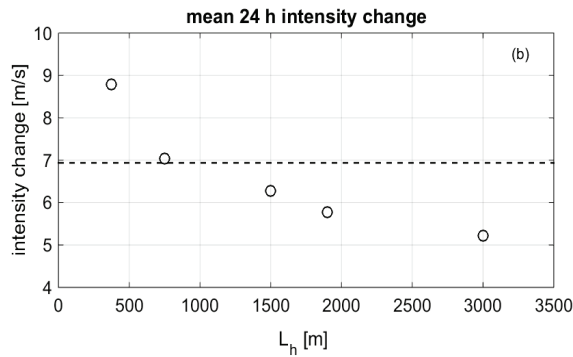
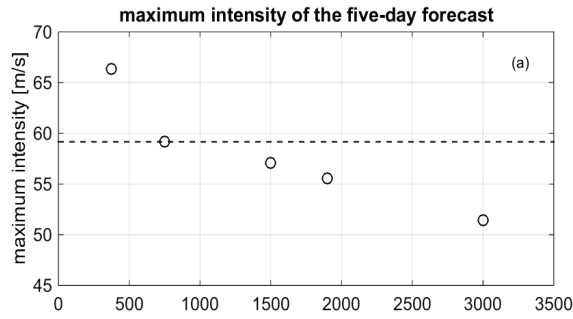


Model-based research: Structural Diagnostics for Inflow Angle



Model-based research: Sensitivity of HWRF forecasts of Hurricane Earl (2010) to horizontal mixing length (L_h)

(Jun Zhang et al. 2017MWR, under review)



- In the control experiment $L_h=1900$ m, same as in the 2015 version operational HWRF model (H215), which is too large based on the sensitivity test. In the 2016 and 2017 version HWRF, L_h is reduced to a value close to observational estimates.

CONTINUED RESOURCE

HFIP products pages continue to be a high priority for the Program

- Popular resource for long range outlook, HFIP community, forecasters off shift, Senior Executives esp during active, high impact events of 2017
- *Increases visibility and recognition of HFIP*
- Added more entry points to various products ...a lot is offered

POTENTIAL

This is a perfect tool to

- Maintain as resource for HFIP, NWS etc
- Involve more modeling groups – increase participation
 - Shows operational products—*matched formats*— a key feature
 - Established scripts allow additional participants to become involved easily as script are stable, changes would be automatically available to participants
- Become a framework for 2018
 - HWRF showcase: all basins, parallel & exp runs, HRD output, HMON results

"We use hfiip.org to provide experimental hybrid wind speed probabilities, as well as model diagnostic text files and more." - CSU CIRA

HFIP.org – Activities 2017

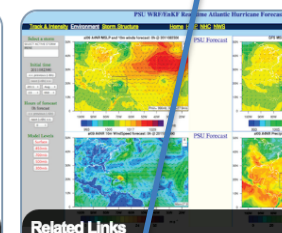
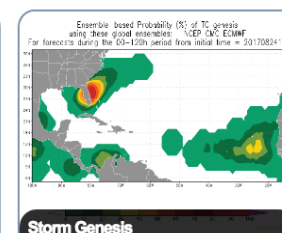
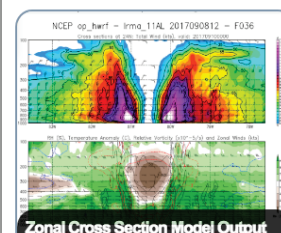
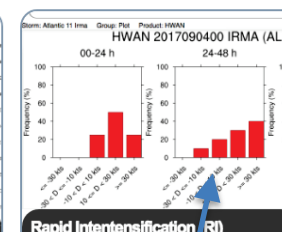
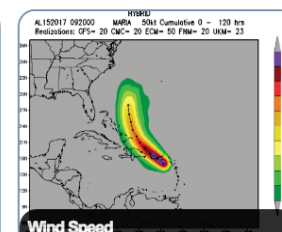
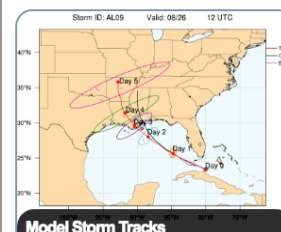
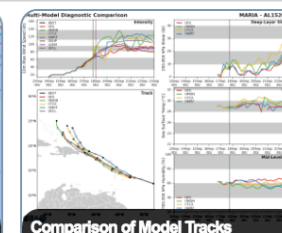
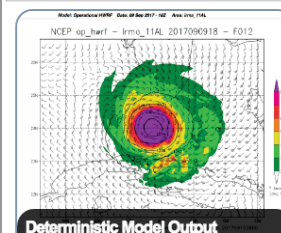
Paula McCaslin & HFIP
Team November 2017

HFIP Experimental Products

Warning: These webpages contain some experimental analysis and forecast guidance of unknown accuracy and reliability. This guidance is not intended to replace official advisory, forecast, and warning products issued by the National Hurricane Center and your local National Weather Service Forecast Office. Outside of the United States, please also refer to products issued by your national meteorological service. For official forecasts consult the National Hurricane Center

----- US HFIP research forecast products are created Aug 1 through Nov 30 -----

→ HFIP Product Overview ←



HFIP TC Products 2017

Addition of RI Products

PRODUCTS & MAINTENANCE

Data Product Pages (hfip.org/products/)

- Showcases experimental forecast, and operational models
- Monitor of data and web services. Occasional data interruption is noted and corrected, reasons can vary, all are solved
- Added RI page 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 TC Tracks Page (ruc.noaa.gov/tracks)

- Added **Multi-Model Ens**, FV3 GFS and EMC's ensemble sets, mean tracks, FIM updated

HFIP.org – Activities

2017

Paula McCaslin & HFIP Team
November 2017

Including the mutli-model ensemble tracks for display with other tracks "is a nice capability."

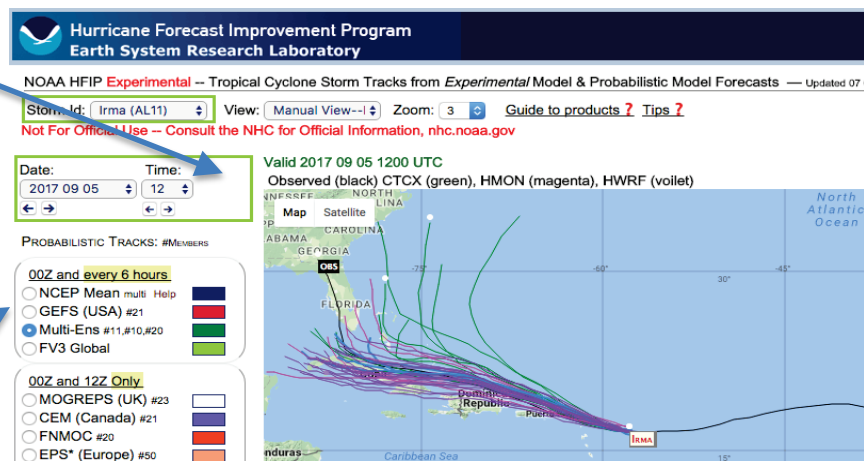
- NRL's Marine Meteorology Division

USAGE BY THE NUMBERS

Google analytics reports show use of HFIP.org website for 2017

In 2017: ~200K page views combined

- 70K views(2016: 42.2K; 2015: 36.5K)
- Track page, Sept-Oct 2017: **90K views, avg visit 5 min, ~11K users**
- Spikes in use associated with TC events with risk of landfall



"Of track sites I know it seems to be the best for overlaying the different ensembles. Plus you have the option of showing intensity as well as getting readouts." - NOAA Researcher

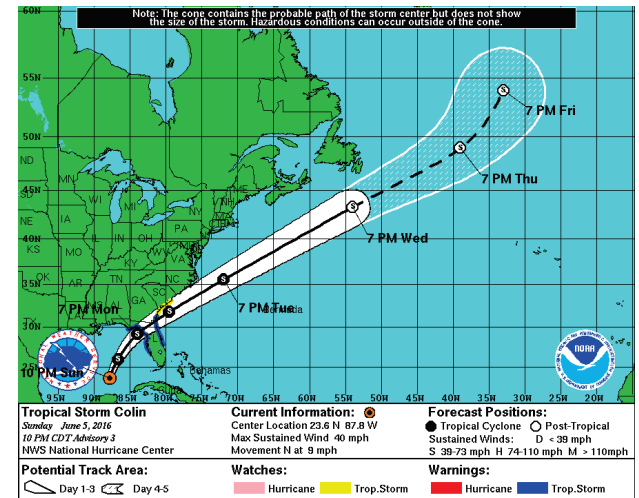
CIRA HFIP Overview

Summary –CIRA Milestones

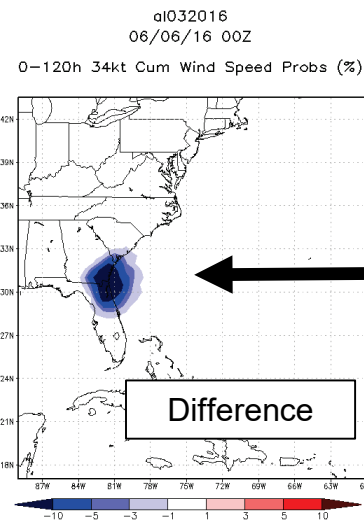
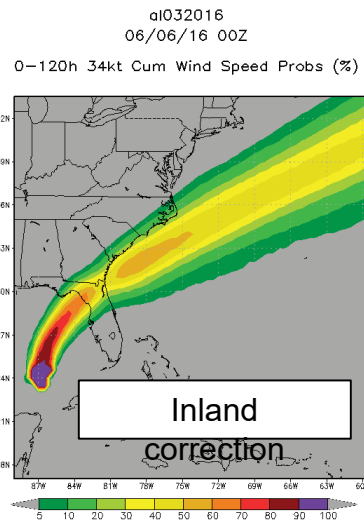
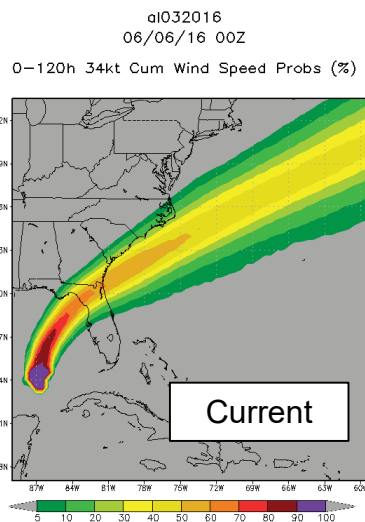
- CIRA HFIP work falls into three main areas:
 - SHIPS/LGEM/RII/SPICE Improvements
 - GOES-16 infrared and GLM data has been collected to perform comparison with GOES-E/W for 2017 season; preparing for implementation of GOES-16 in 2018 SHIPS
 - The latest version of RII has been integrated into SHIPS for the 2017 season
 - The SHIPS developmental database has been updated to include the 2016 season, and expanded back in the global basins
 - As part of updates to SPICE, HMON is being ingested and diagnostics generated and delivered to HFIP products page; partial ingest of NAVGEM and COAMPS-TC has also been implemented
 - In progress: improvements to SPICE; model testing; updates to 2018 SHIPS/LGEM/RII
 - Improving the Monte Carlo Wind Speed Probability Model
 - Two main areas of focus for improving the MCWSP model are improving the representation of TCs moving over land, and investigating the use of global model ensembles to incorporate forecast model uncertainty into MCWSP
 - Over land MCWSP results shown on next slide
 - Ensemble-based MCWSP has been developed and tested, found to be more skillful than statistical MCWSP (manuscript in preparation)
 - Developing Statistical Products for Rapid Intensification Forecasting
 - In progress: RII in SPICE is currently being upgraded to latest version; testing underway for replacement of GFDL
 - Operational RII was processed and delivered during 2017 demonstration period, and e-deck generation was implemented in operational RII for the 2017 season

Wind speed probability – correction for storms that cross over land

- MC model accounts for land at 12-hourly forecast positions
- For cases where 12-hourly forecast positions are both over water but TC crosses land during intermediate times, WSPs are overestimated
- MC model updated to check for land points at hourly time sub-intervals
- Only increases run time by ~2%



Example: Colin 6/5/16 10pm CDT forecast crosses FL peninsula



WSPs now reduced over land - more realistic representation