2015 PPAV Team Report

2015 HFIP Annual Review

November 18 2015

Team Leads:

Mark DeMaria, Tim Marchok, David Zelinsky

Milestones Key

- Each milestone numbered (1-N) and listed by organization
  - NHC-1 = NHC milestone #1
- Status of each milestone indicated by checkmark or X
  - ✓ (green) = Milestone completed
  - ✓ (yellow) = Milestone ongoing
  - ✗ (red) = Milestone cancelled

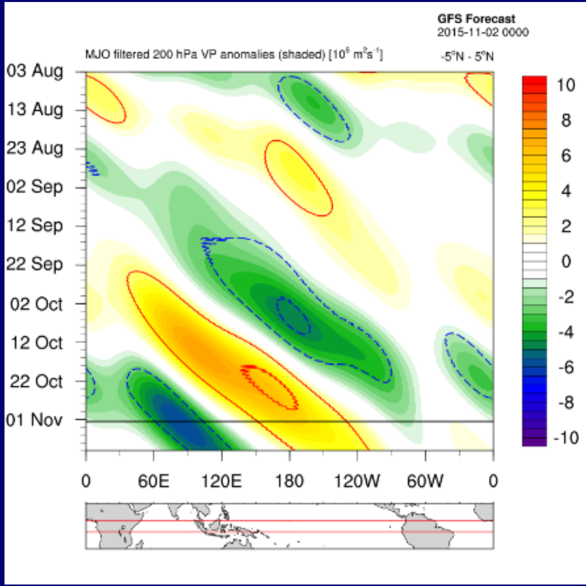
NHC Milestones

NHC HFIP Team: Mark DeMaria, Casey Ogden, Andrew Penny, Ed Rappaport, Anu Simon, Kevin Yeh, David Zelinsky

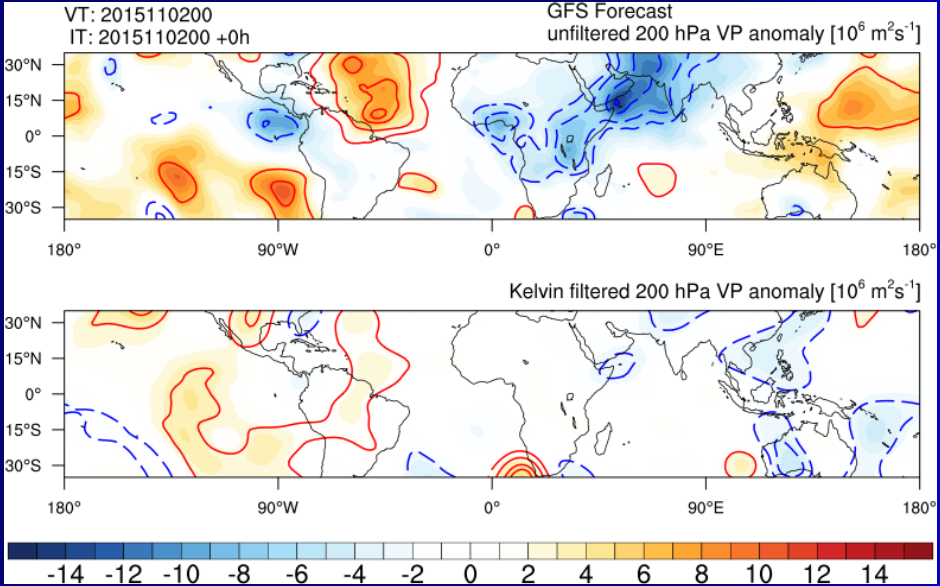
1. Improve the graphics and text of the 5-day Graphical Tropical Weather Outlook products on the NHC website
2. Develop new GIS products, including a time-of-arrival product
3. Assist with the evaluation and verification of the 2015 implementations of the GFS, GFS ensemble, and HWRF models, and develop aids to analyze outlier cases with respect to track and intensity error
4. Implement convectively-coupled Kelvin wave diagnostic and prognostic forecast aids to assist with tropical cyclogenesis forecasting
5. Develop tropical cyclogenesis verification aids for global models
6. Complete phase 1 of the development of ATCF capabilities in AWIPS2, as outlined in the project charter. Depending on the outcome of phase 1, either begin software development (phase 2) or discontinue the project.

Implemented Convectively-Coupled Kelvin wave/MJO forecast aids to assist with tropical cyclogenesis forecasting

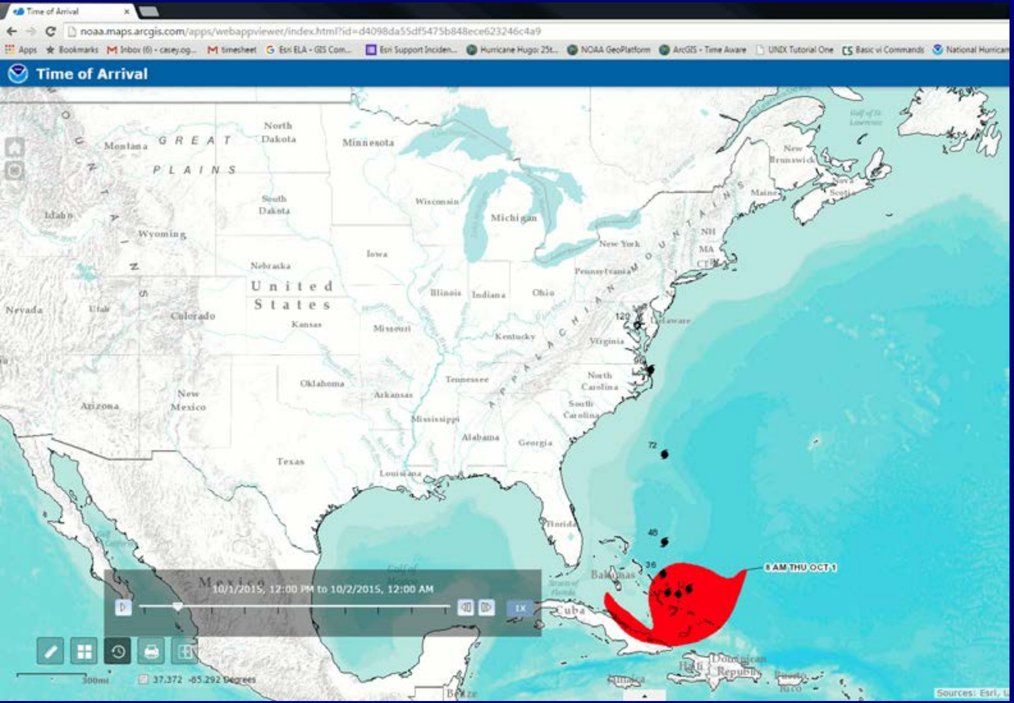
MJO (GFS)

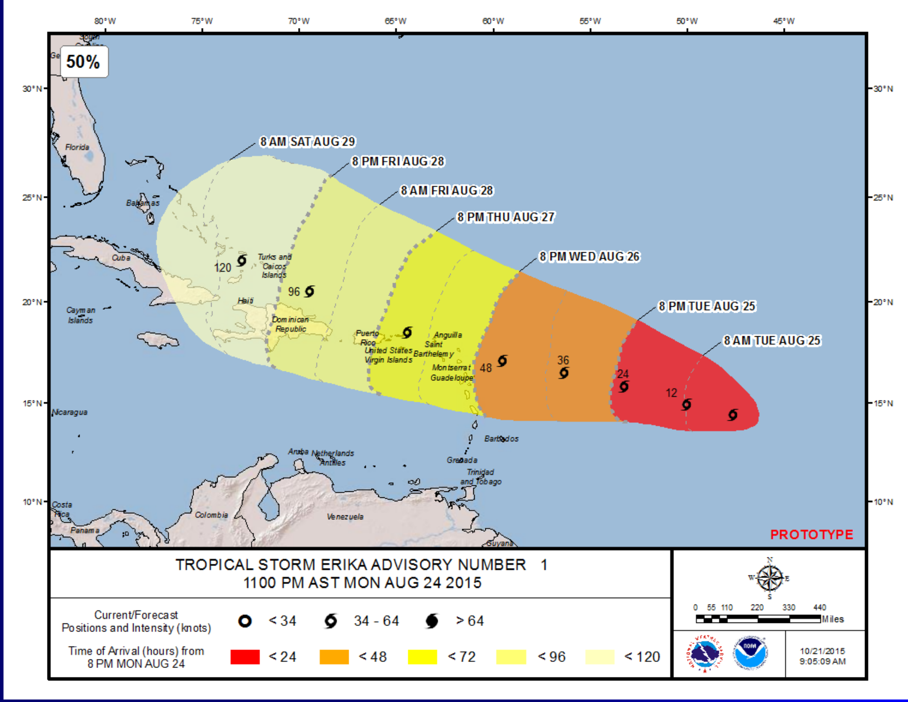


CCKW (GFS)



Prototype Time of Arrival of 34 kt wind graphics



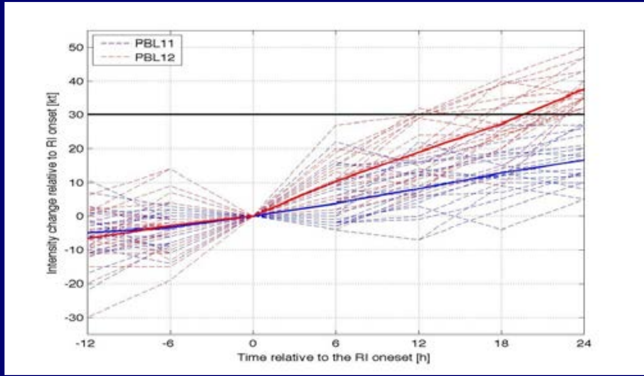


NHC-2, CIRA-1

AOML Milestones

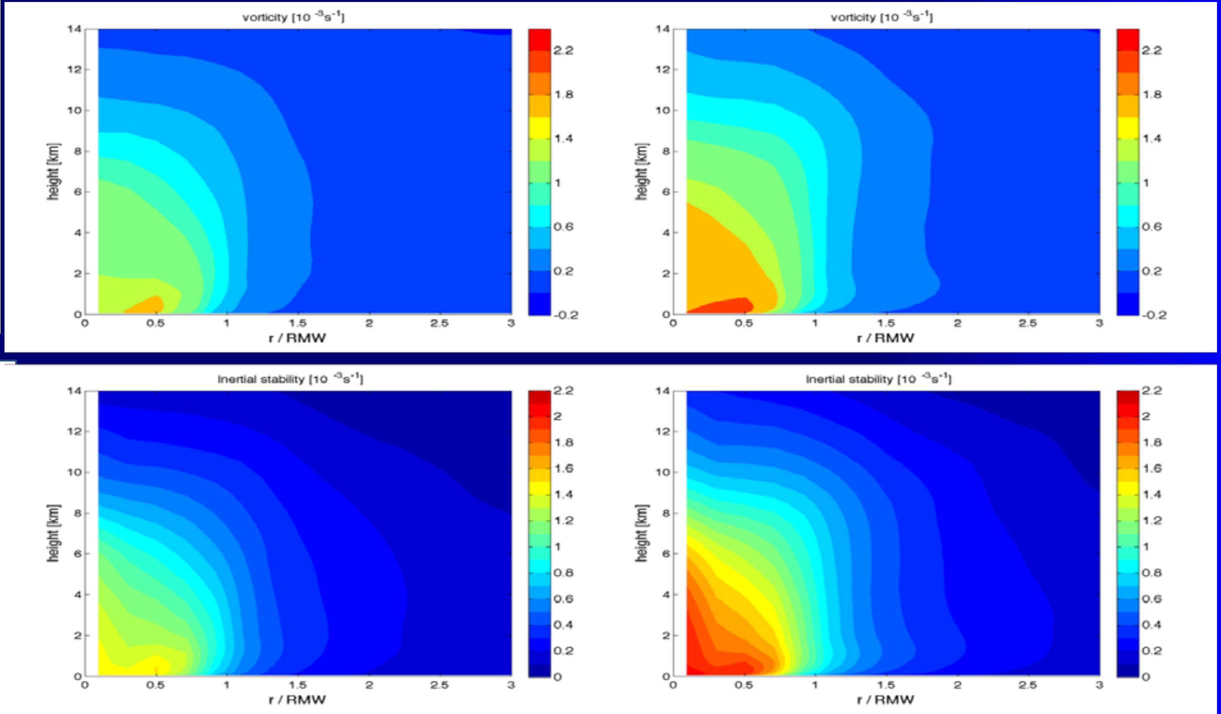
1. Evaluate operational HWRF performance using IFEX and HS3 aircraft observations from Edouard and other well sampled/documented hurricanes. Compare observed versus modeled: vortex-scale diagnostics including tilt, hodographs, symmetric and asymmetric metrics, and convective-scale diagnostics including CFAD, vertical velocity, mass flux, hydrometeor concentrations, convective burst counts and precipitation distributions
2. Identify outlier events and evaluate operational HWRF forecasts using available data
3. Make diagnostic tools available for researches through contributed codes for evaluating future hurricanes

Effects of vertical diffusion on RI forecasts



PBL11 (left panels)

PBL12 (right panels)



Observed

PBL12		**Yes**	**No**
	Yes	Hit 16	False Alarm 8
	No	Miss 2	---

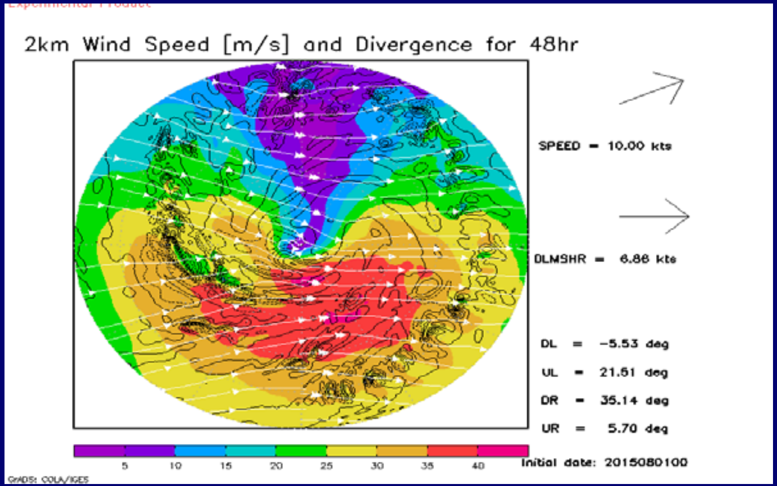
Observed

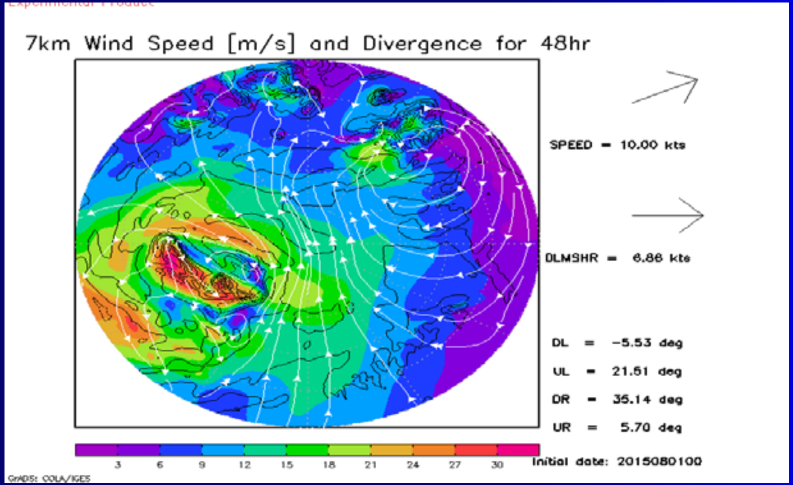
PBL11		**Yes**	**No**
	Yes	Hit 4	False Alarm 0
	No	Miss 14	---

J. Zhang and R. Rogers AOML-1

HWRF vortex response to shear

Storm-relative flow fields at different altitudes plotted relative to the shear vector

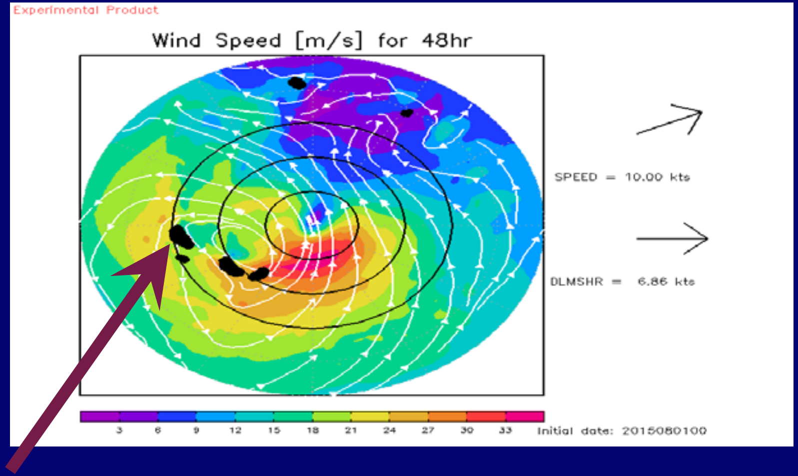


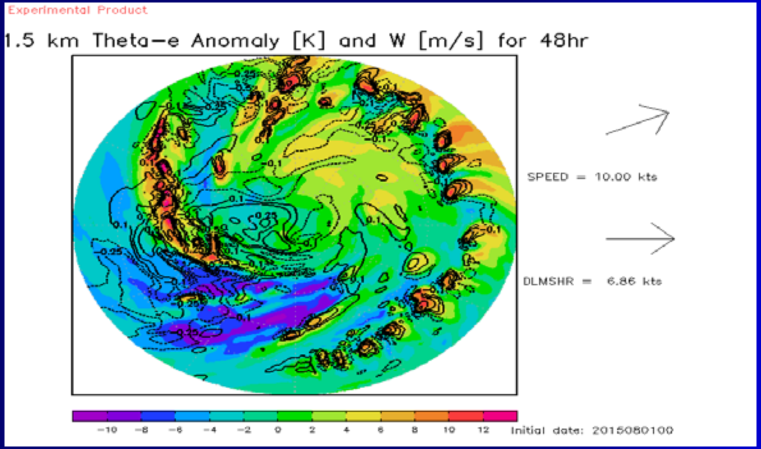


DLM shear

HWRF vortex response to shear

Convective distribution, PBL thermodynamics relative to shear vector





convective burst locations

CIRA/NESDIS Milestones

1. Upgrade the windspeed probability product
2. Evaluate satellite and boundary layer data for improving rapid intensification prediction
3. Develop an HWRF Total Precipitable Water (TPW) verification system using the blended satellite TPW product as ground truth
4. Improve SHIPS/LGEM/RII intensity statistical models using consensus versions with multiple model and enhanced satellite data inputs

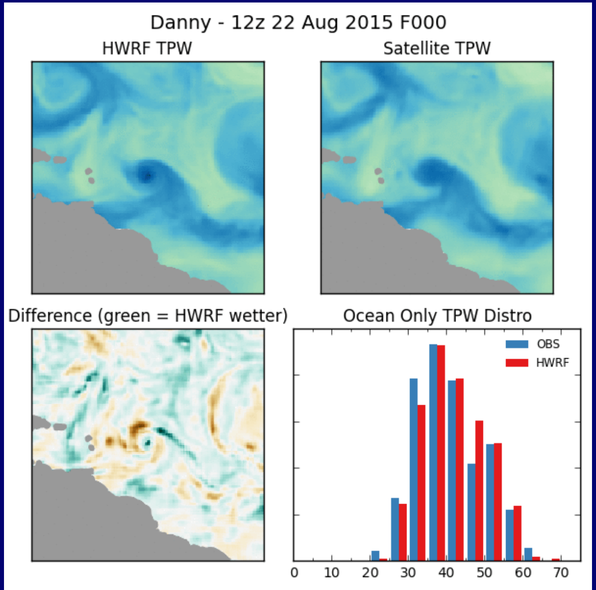
2015 Precipitable Water Verification

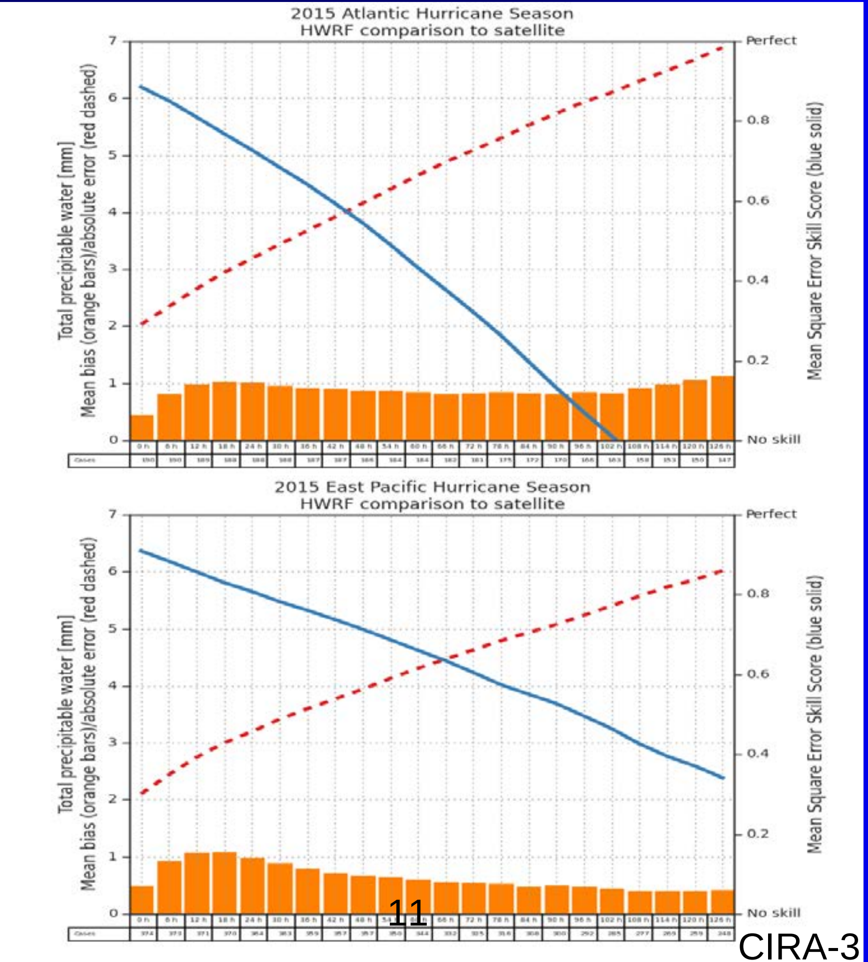
Why? Environmental moisture plays a critical role in TC evolution

What? Validate HWRF synthetic precipitable water using the NESDIS operational product

With MAE, bias, & MSE Skill Score, found:

- Positive bias in both AL & EP
- AL TPW not skillful by 102 hr fcst



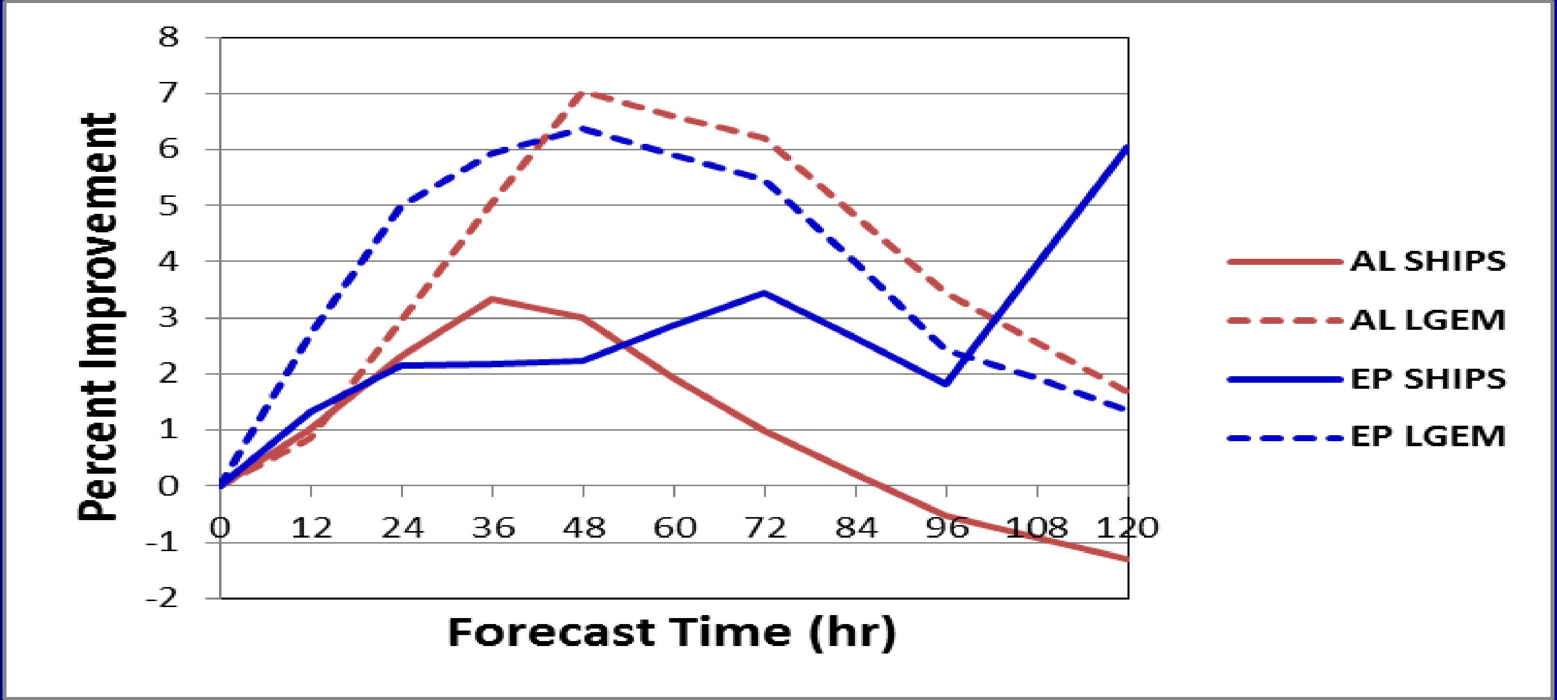


CIRA-3

SHIPS/LGEM Improvements with Enhanced Satellite and Other Inputs

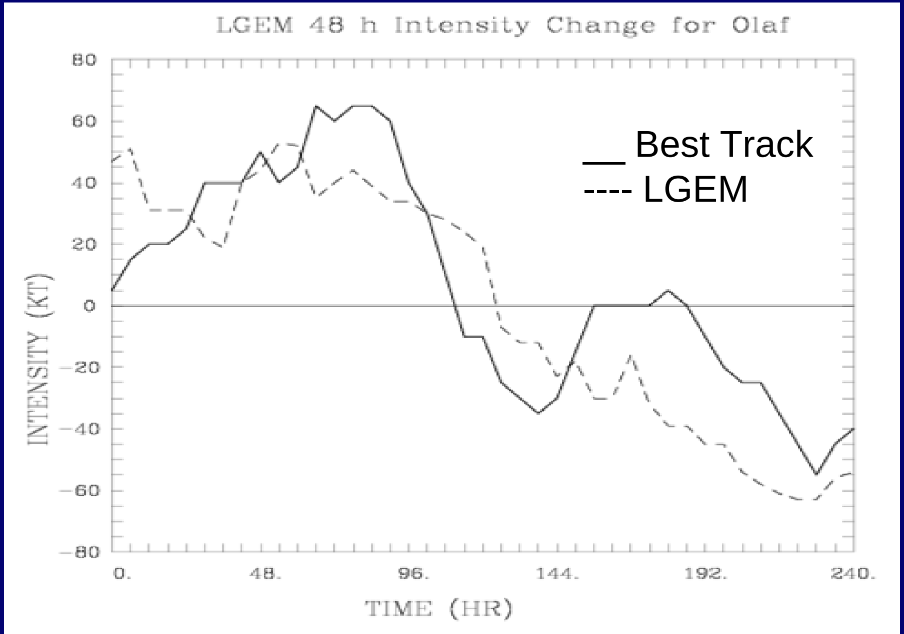
- RII much more sensitive to GOES data than SHIPS or LGEM
  - Add RII probability to modify LGEM growth rate
- Add CIRA-reprocessed GOES imagery
- Replace NCAR/NCEP reanalysis with CFSR
  - Former JHT project
- Add correction for model upper level warm core
- SHIPS/LGEM can sometimes explicitly forecast RI

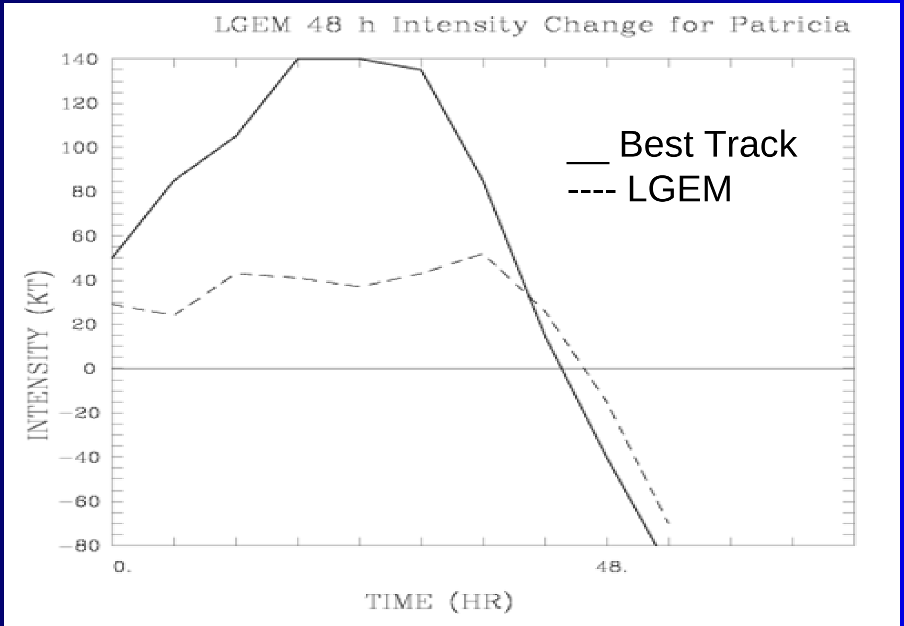
2015 SHIPS/LGEM Improvements
2010-2014 Retrospective Forecasts



CIRA-4

LGEM and Observed 48 hr Intensity Changes for Hurricanes Olaf and Patricia





CIRA-4

NRL, ESRL, GFDL Milestones

1. **NRL**: Upgrade ATCF addressing requirements from operational centers. Develop a plan for pre-genesis watches and warnings. Begin software implementation.
2. **ESRL**: Update GrADS scripts used by the HFIP products website for the display of deterministic model fields
3. **ESRL**: Maintain Products Webpage
4. **ESRL**: Make HFIP Product pages available on hfip.org with the following models: GFS, HWRF, GFDL
5. **ESRL**: Make HFIP products pages available to hurricane community with regional models and new products
6. **GFDL**: Maintain and provide support for the GFDL community tropical cyclone tracker

PPAV Emphasis for 2016

- Products that provide insight to modelers on how to improve their forecasts
- Products that provide NHC with model reliability information
- New products for pre-genesis watches/warnings
- Work towards unification of wind fields for probabilistic storm surge and wind speed probability products
- Phase 2 of ATCF in AWIPS
- Continued improvement of statistical-dynamical intensity models
  - Incorporate ECMWF SHIPS/LGEM into consensus models

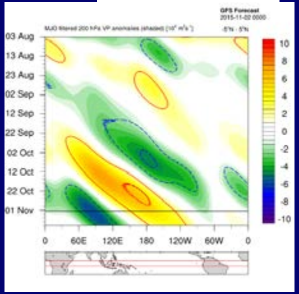
Questions for Discussion

- How do we make sure R2O of post processing applications for NHC is successful?
  - Products need to be useful to NHC
  - Products need to be compatible with NHC computing environment
  - Products need to be sustainable
- How can HFIP participants contribute to AWIPS development?

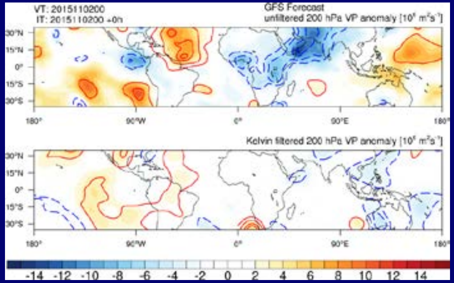
Extra Slides

Implemented convectively-coupled Kelvin wave / MJO forecast aids to assist with tropical cyclogenesis forecasting

MJO (GFS)



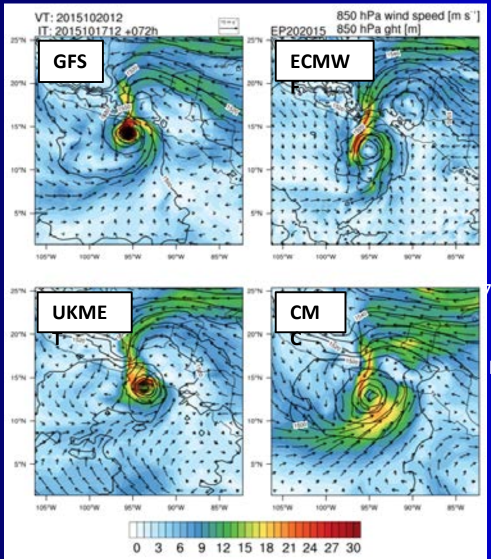
CCKW (GFS)



NHC-4

Evaluation of global model forecasts of tropical cyclogenesis

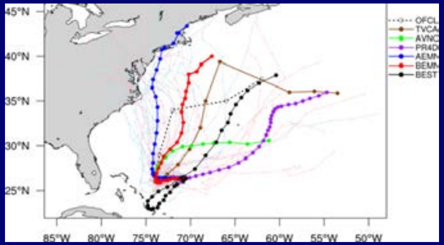
NHC-5



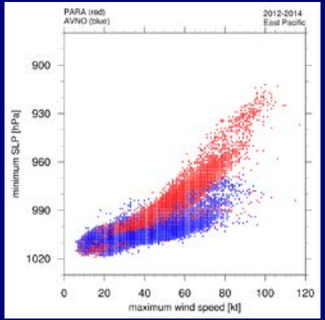
forecasts verifying at genesis time and initialized 72 h prior to the genesis of Hurricane Patricia (EP20)

NHC-3

Assisted with the evaluation and verification of recent model upgrades (GFS, GEFS, HWRF, GFDL)

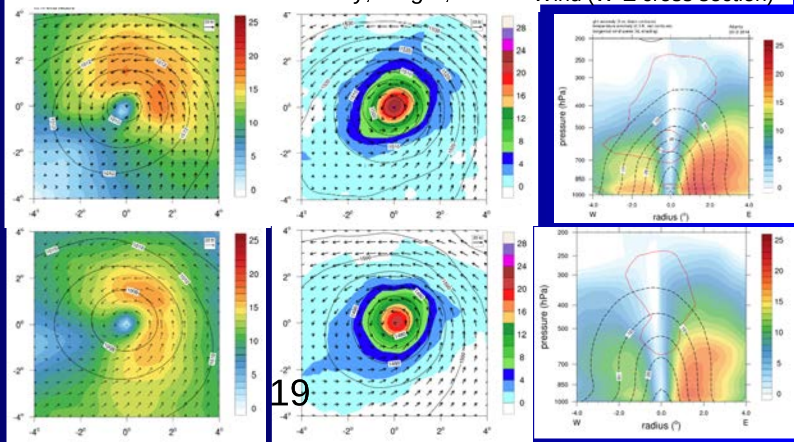


forecast tracks for Hurricane Joaquin (AL11) initialized at 1200 UTC 29 September



minimum sea-level pressure vs maximum 10 m wind speed from the previous GFS implementation (blue) and current GFS (red)

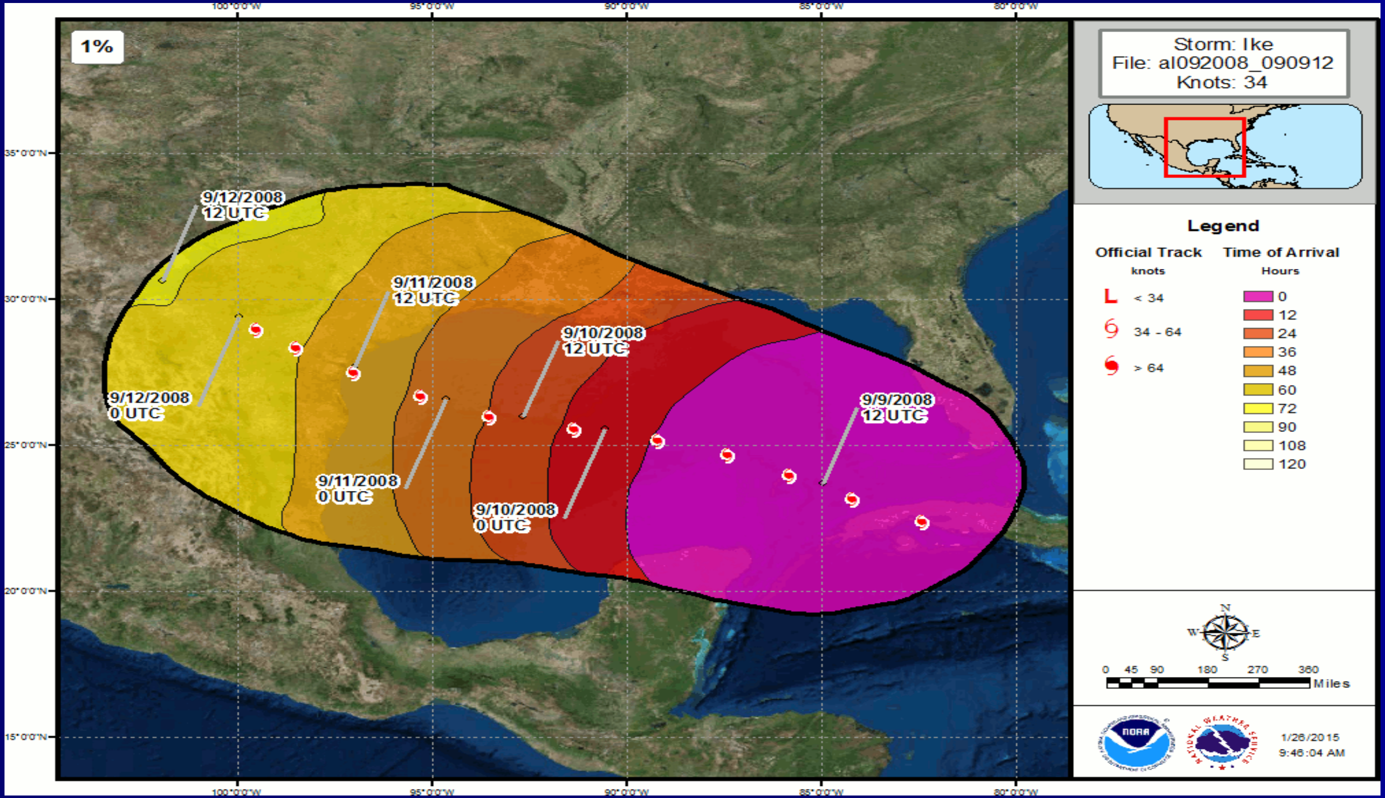
2012-2014 genesis composites (GFS)



Upgrade wind speed probability product

- Updated track and intensity error distributions for 2015
  - Based on 2010-2014 official forecast errors and GPCE values
- Estimating time of arrival / departure of 34, 50, and 64-kt winds
  - Realizations created by MC model can be used to provide estimates of the time of arrival & departure of 34, 50, and 64-kt winds for various threshold (e.g., 10th, 50th, 90th, 95th percentiles)
  - Numerous uses for TOAs/TODs
    - Emergency managers (e.g., road closures, evacuation timing)
    - Utilities (e.g., response planning)
  - Capability has existed via external GUI interface (HuLPA) for several years, but required post-processing step
  - Code that estimates TOA/TOD has been incorporated into the main MC Model Fortran routine (nhc_wndspd_mcprblty.f)
  - MC Model also upgraded to Fortran 90, modularized, and installed and tested on WCOSS and ATCF by TSB staff (run time ~ 2 minutes)

Upgrade wind speed probability product (cont…)



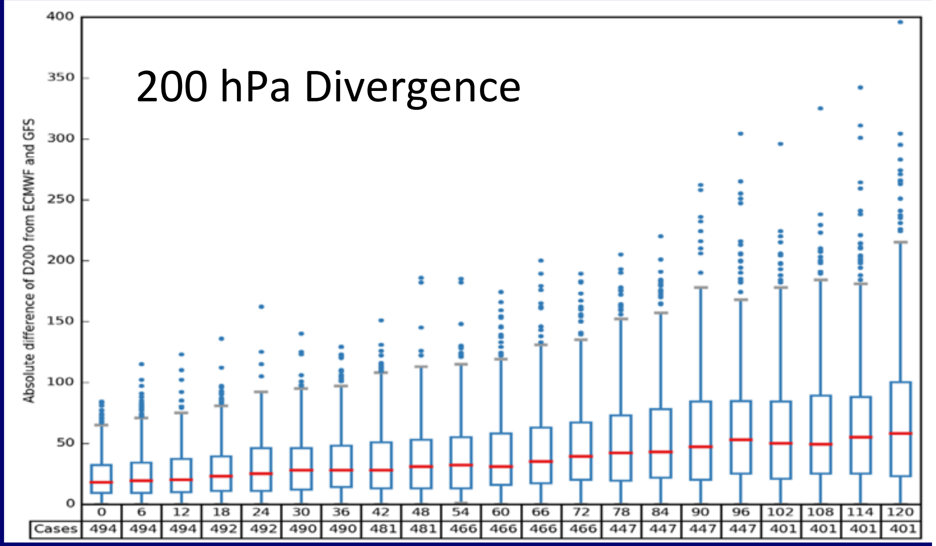
Example of time of arrival estimates for 34-kt winds, Ike 2012
(Courtesy of Casey Ogden)

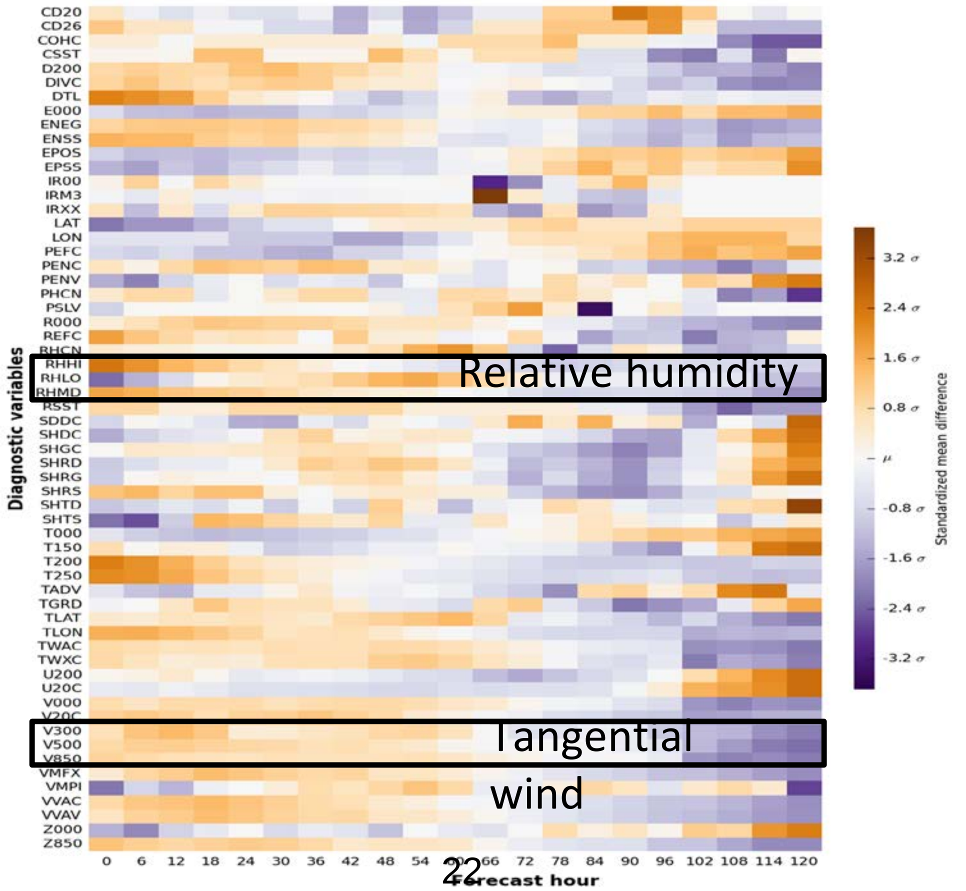
NHC-2, CIRA-1

2015 GFS/ECMWF diagnostic comparison

Notes on predictor differences

- ECMWF divergence/vorticity initially stronger than GFS
- Initial low-level RH higher in GFS but mid/hi greater in ECMWF





CIRA-4

Effects of boundary layer shocks

What? Slab boundary layer model

Initialized with? Idealized

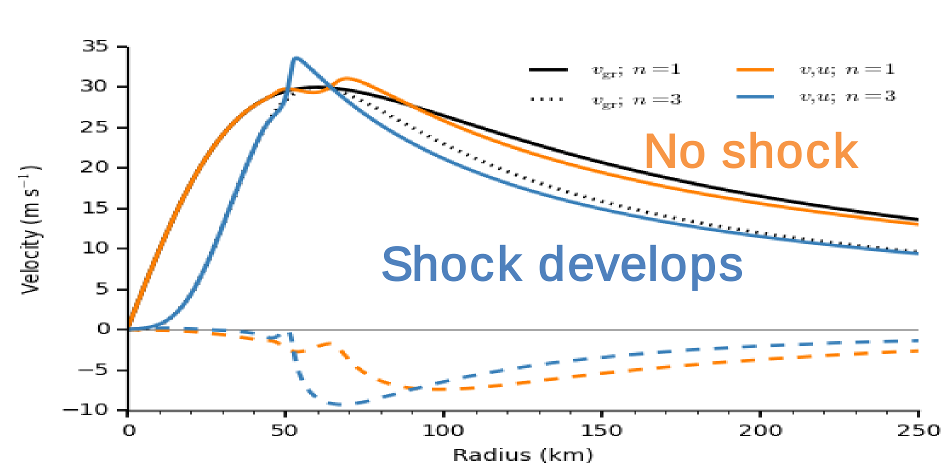
Why? Shock dynamics influence Ekman pumping location/strength, impacts storm intensity, and inflow

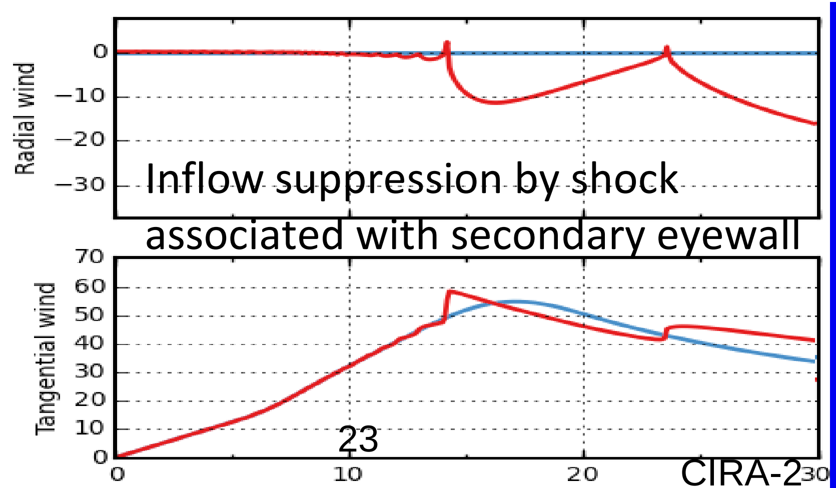
Initial findings?

- Not all wind profiles develop shocks which would impact vortex development
- Inner eyewall inflow suppressed during SEF

Next steps?

- Evaluate role in RI and secondary eyewall formation with aircraft data
- Develop three layer framework to evaluate the impact of boundary layer shocks on the overlying vortex.





CIRA-2

Effects of vertical diffusion on boundary-layer heights

(Jun Zhang, D. Nolan, R. Rogers, and V. Tallapragada, 2015 MWR)

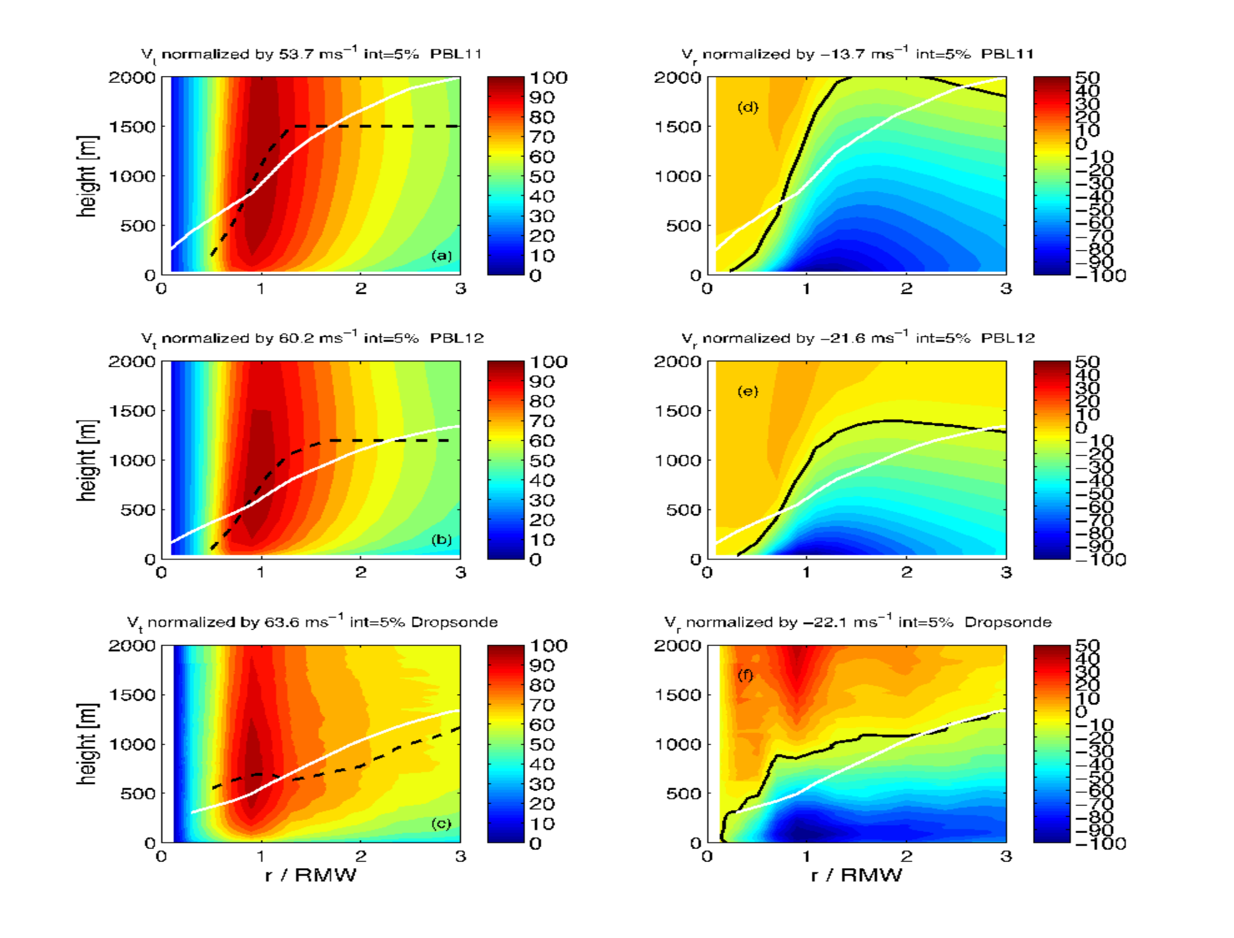
Composites of 122 HWRF forecasts of four storms

PBL11 :

PBL12 :

Dropsonde Composite :

(Jun Zhang, R. Rogers, D. Nolan and F. Marks, 2011 MWR)



Effects of vertical diffusion on the distribution of vertical velocity

(Jun Zhang, D. Nolan, R. Rogers, and V. Tallapragada, 2015 MWR)

PBL11 :

PBL12 :

Doppler radar Composite :