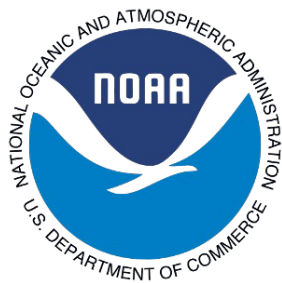# Planned 2015 HWRF Upgrade
NOAA NCEP EMC

Overview

- Resolution and Physics Upgrades

- Initialization Upgrades

- Scripting Upgrades

- Worldwide Forecast Guidance

- Product Upgrades

- Summary and Future Work

Resolution and Physics Upgrades
Overview

	2014	2015
Parent Model NCEP GFS	NCEP GFS model **27km spectral**	NCEP GFS model **13.5km semi-lagrangian spectral**
HWRF Resolution	**27, 9, 3 km** (approximate)	**18, 6, 2 km** (approximate)
Surface	MPIPOM-TC Ocean **GFDL Slab (Land)**	MPIPOM-TC Ocean **NOAH LSM (Land)**
Clouds	SAS in 27, 9km **Ferrier MP**	SAS in 18, 6 km **Ferrier-Aligo MP**
Boundary and Surface Layer	GFDL Surface Layer GFS Boundary Layer **Observational-based exchange coeff.**	GFDL Surface Layer GFS Boundary Layer **Improved obs-based exchange coef.**

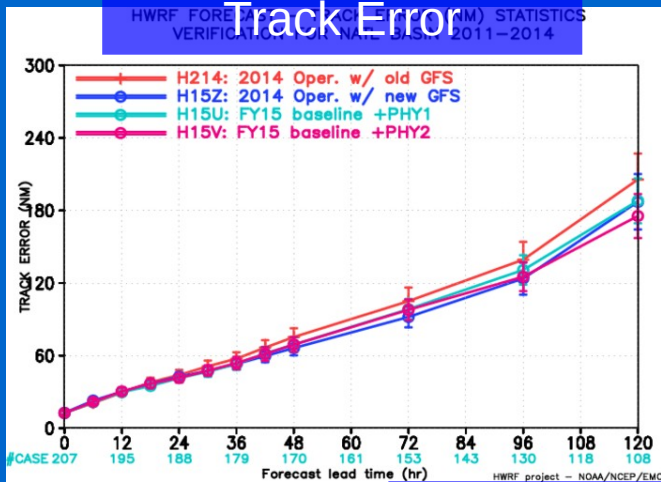# Resolution and Physics Upgrades
Exchange Coefficients

- C_d, C_H – momentum and enthalpy exchange coefficients

  - HWRF tuned to CBLAST findings, but

    - Recent papers suggest significant spread in CBLAST observations

- University of Rhode Island

  - C_d calculations in HWRF subgridscale parameterizations changed to better match observations

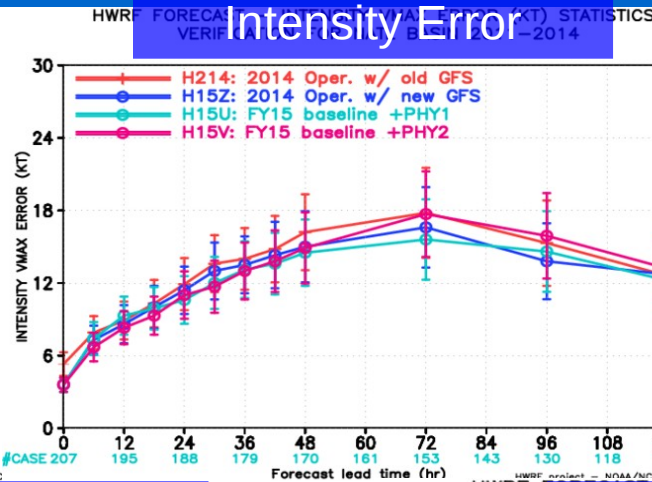 - C_H changes were rejected due to over-intensification of strong storms.

Resolution and Physics Upgrades
Atlantic Forecasting Skill

5

Resolution and Physics Upgrades
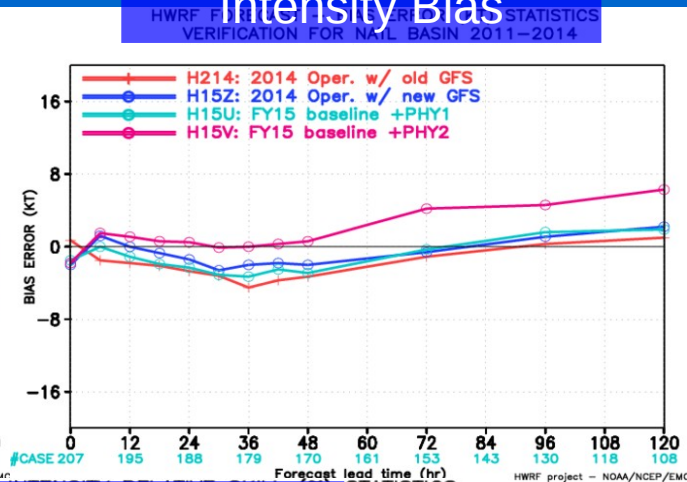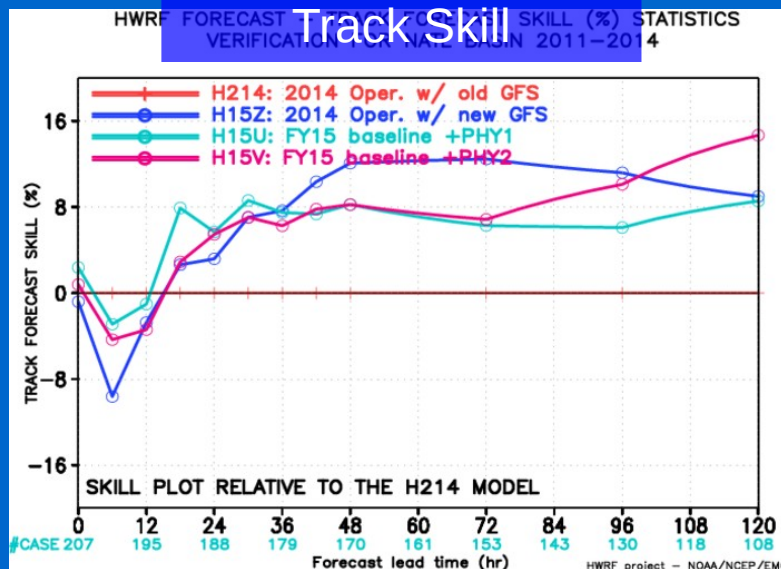## East Pacific Forecasting Skill
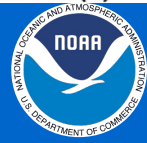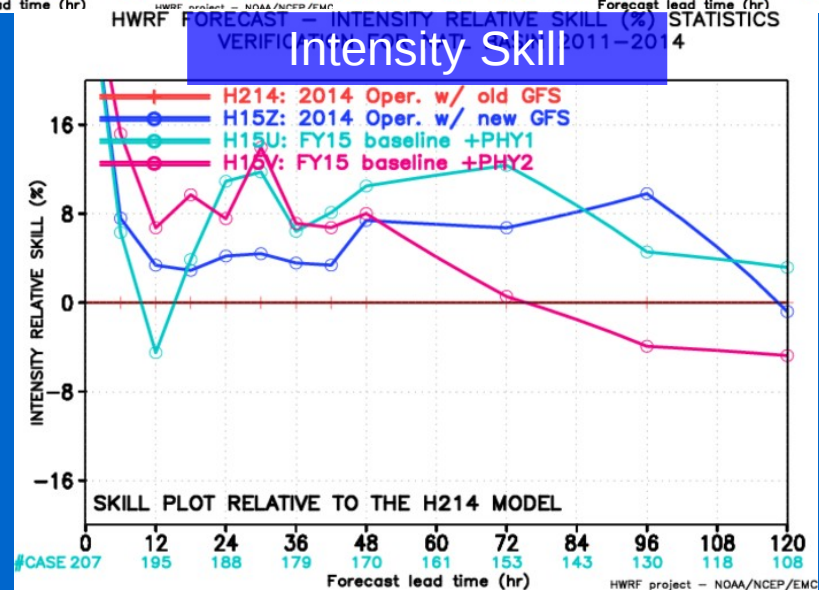

Track Error
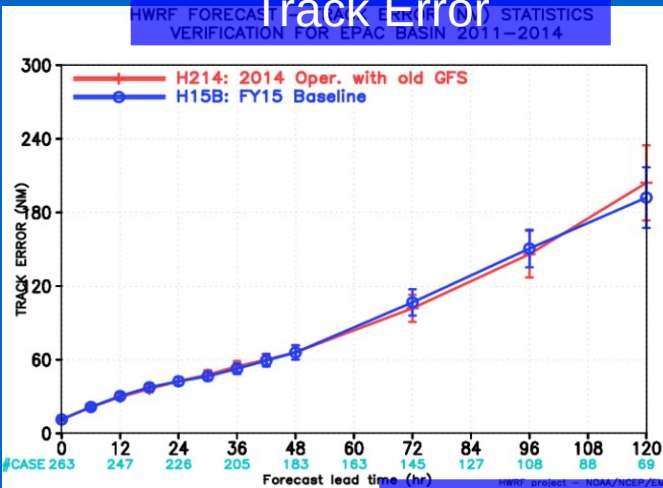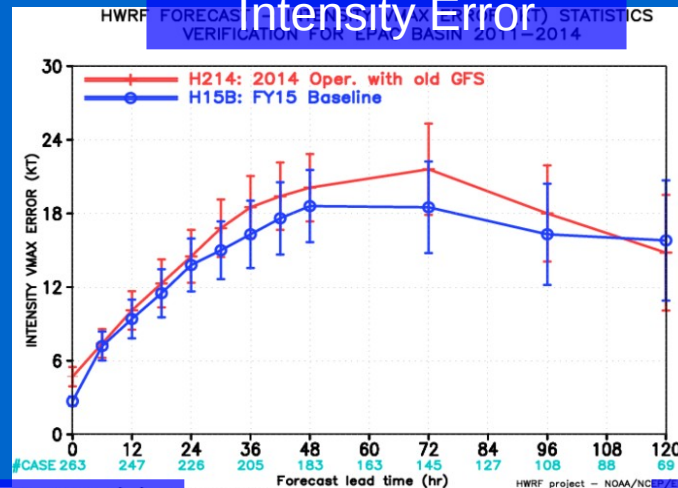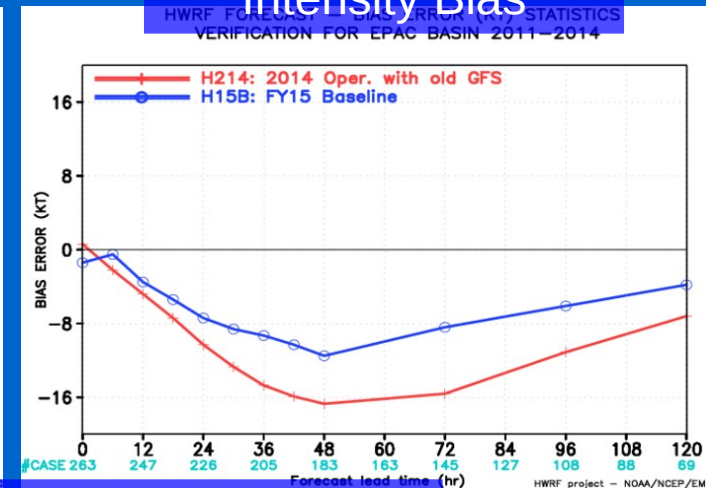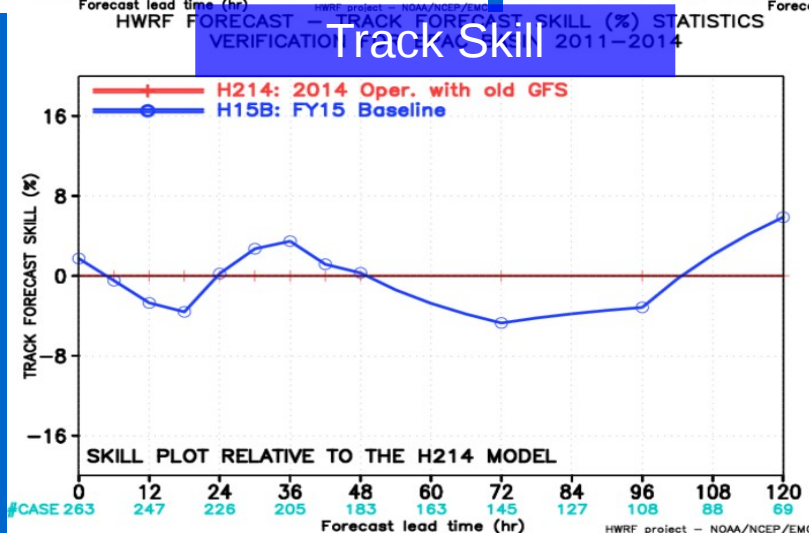
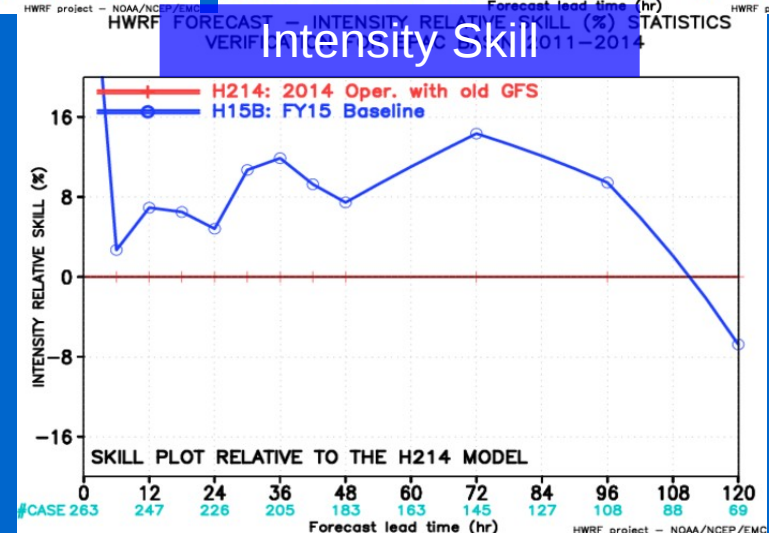Mean Absolute Intensity Error

Intensity Bias

Track Skill

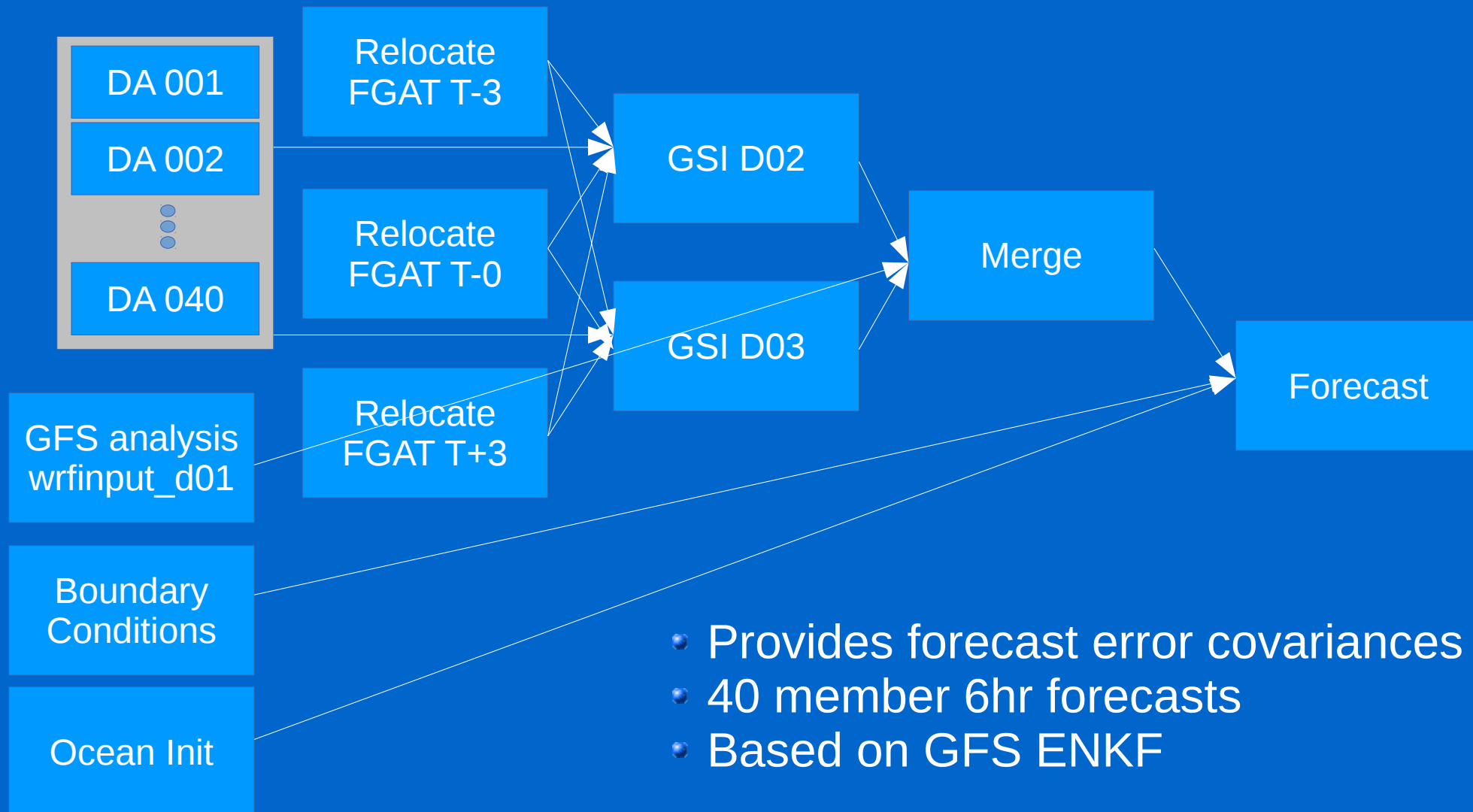Intensity Skill

Initialization Upgrades
Overview

- Vortex Relocation
  - Tuning for new GFS
  - Better filtering for higher resolution HWRF
  - Numerous minor changes for worldwide support.
- Data Assimilation
  - HWRF 40 member ensemble based on GFS ENKF
  - Additional inner core observations
  - Larger data assimilation domains

Initialization Upgrades
HWRF ENSDA

Flowchart:

- DA 001, DA 002, ⋮, DA 040
- GFS analysis wrfinput_d01
- Boundary Conditions
- Ocean Init
- Relocate FGAT T-3
- Relocate FGAT T-0
- Relocate FGAT T+3
- GSI D02
- GSI D03
- Merge
- Forecast

- Provides forecast error covariances
- 40 member 6hr forecasts
- Based on GFS ENKF

Worldwide Forecast Guidance

- Provide numerical forecast guidance in all tropical cyclone basins.

- Have been doing this experimentally for

  - 2.5 years in North Hemisphere

  - 1.5 years in South Hemisphere

- Unreliable due to use of research resources

- JTWC, NWS PR and others requested NCEP moves this to a highly reliable NCEP Central Operations (NCO) environment
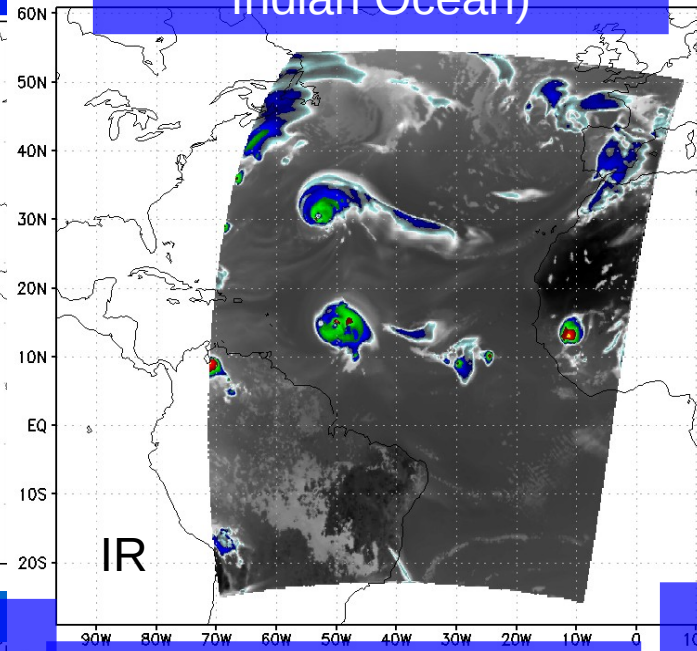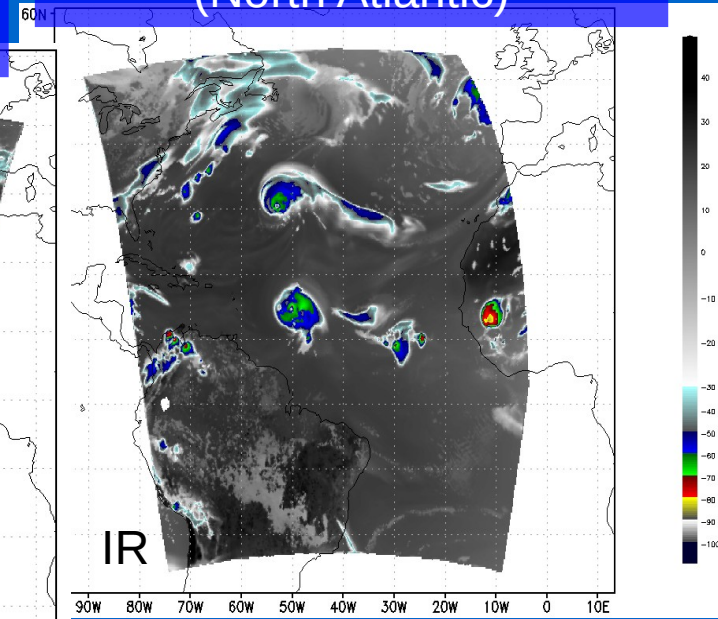
Product Upgrades (SSWC, EMC)

HWRF GOES-15 (SSWC)
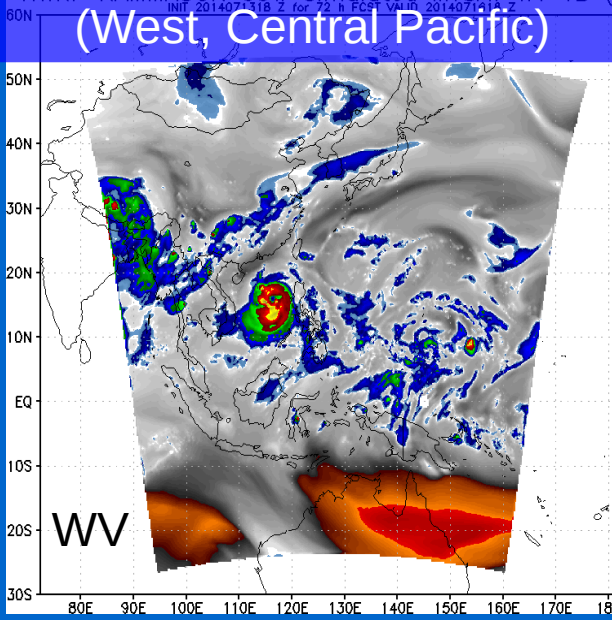(East, Central Pacific)
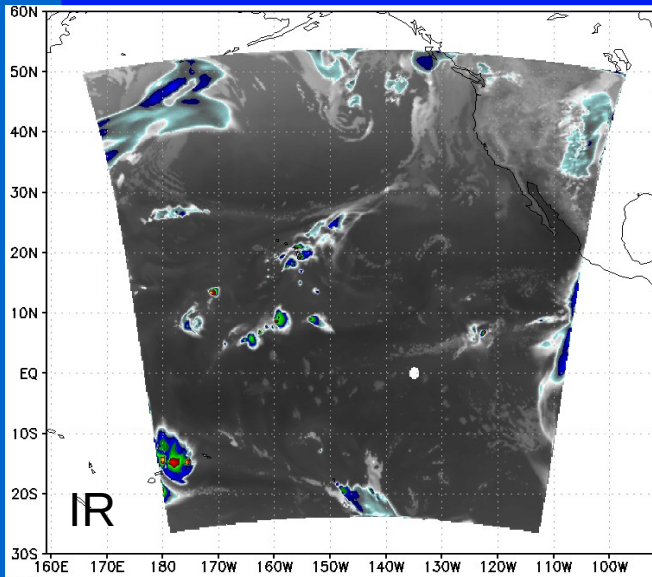
HWRF SEVIRI (SSWC)
(South and East Atlantic,
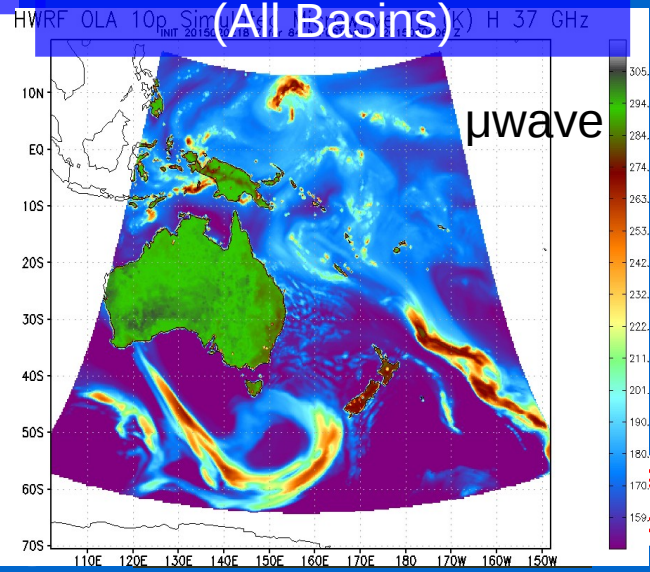Indian Ocean)

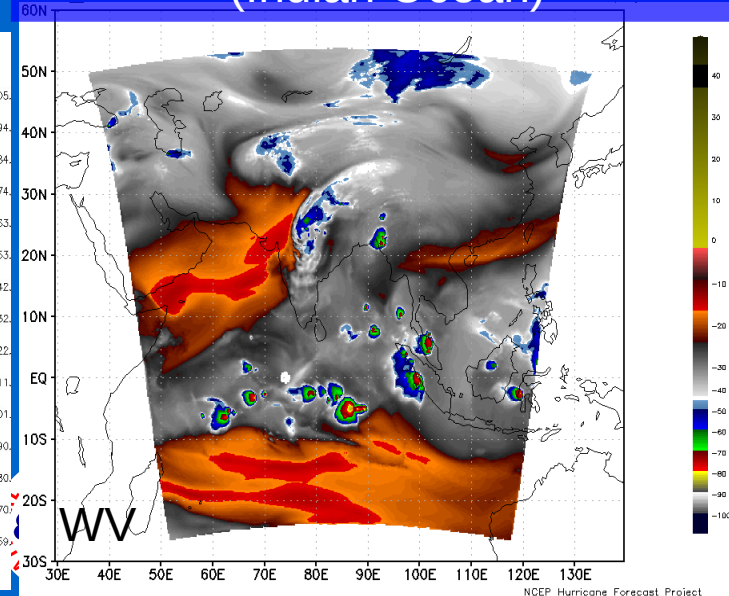HWRF GOES-13 (SSWC)
(North Atlantic)

HWRF MTSAT-2 (EMC)
(West, Central Pacific)

HWRF F17 SSMIS (EMC)
(All Basins)

HWRF Insat-3D/Kalpana (EMC)
(Indian Ocean)

Scripting Upgrades
Python

- Unified Python-based scripting system for operations, research, public collaborators.

- ~3x smaller code, more portable.

- Reduced resource requirements.

NCO	Old EMC	New EMC
Human Operator	HHS	**Rocoto**
ecFlow	kick_scripts	
ksh J-Jobs	ksh J-Jobs	**XML**
Python ex-Scripts	**ksh** ex-Scripts	**Python** ex-Scripts
Python ush	**ksh** ush	**Python** ush

Conclusions and Future Work
Additional Upgrades In Progress

- Combine DA, physics and resolution upgrades
- Retain non-hydrostatic state after nest move
  - Will improve tornado genesis products and vertical wind
- Alternative vertical structure for basins near Asia
  - Needed due to higher terrain.
- More improvements to vortex relocation
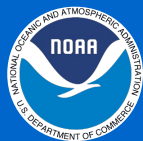
Conclusions and Future Work
Planned 2015 Real-Time Demos

- HFIP-supported real-time demos on NOAA Jet supercomputer
  - Ocean coupling and DA in additional basins
  - Multi-storm basin-scale HWRF (AOML HRD)
  - HWRF Ensemble
  - NEMS NMM-B-based hurricane forecasts

Questions?