

Jason Sippel & EMC HWRF team  
with contributions from others

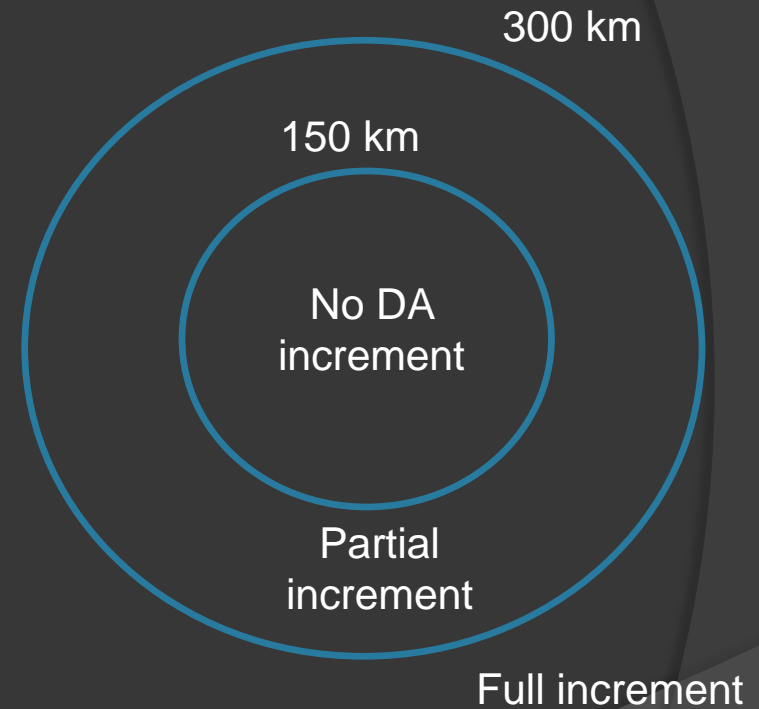
# 2016-2017 HWRF DA TESTING & PLANS

# Outline

- Background & system upgrades
- New data
- Planned testing
- Long-term route

# Background: Blending

- Spindown can occur with GSI increments in strong storms
- Vortex init (first guess) gives less spindown
- Blending zero's GSI increments near center for  $V_{max} > 50$  kt (H216)

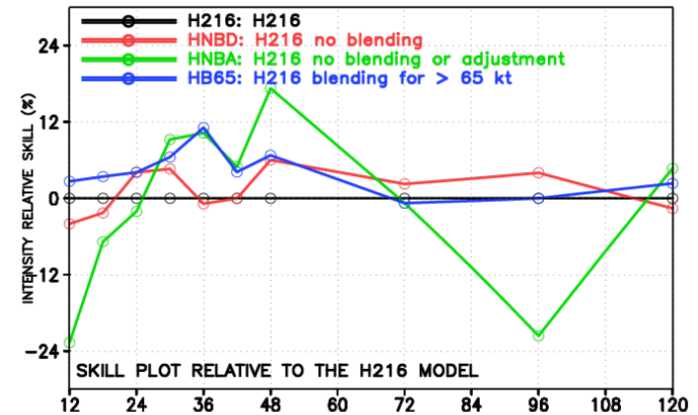


“Blending” initialization  
below 600 hPa

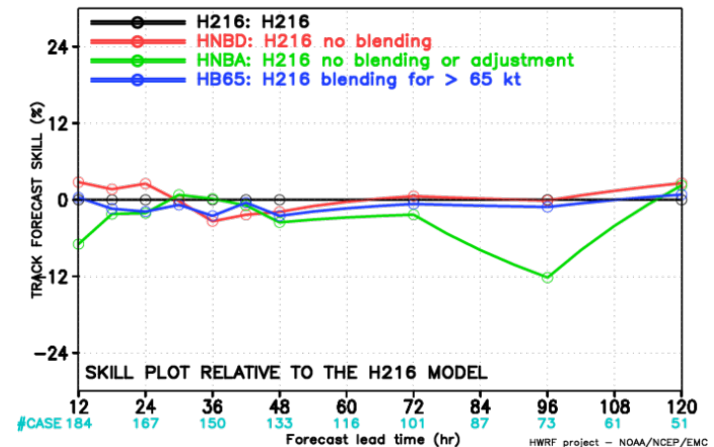
# Upgrades: Blending & Vortex Init

- Vortex adjustment still necessary for track and intensity
- Blending is a double-edged sword
- Increasing blending threshold from 50 (H216) to 64 kt improves AL intensity & EP track

2014 AL Vmax skill



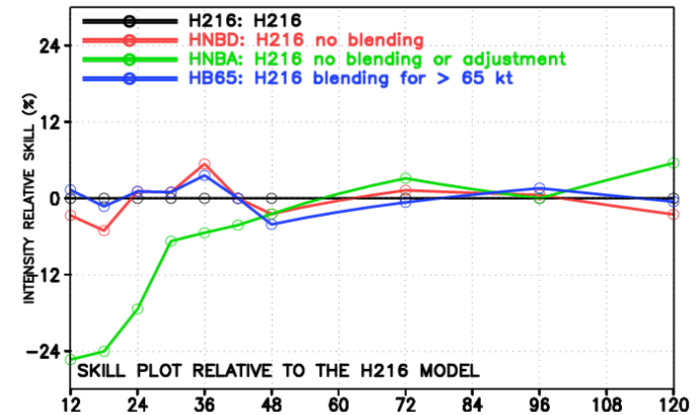
2014 AL Track skill



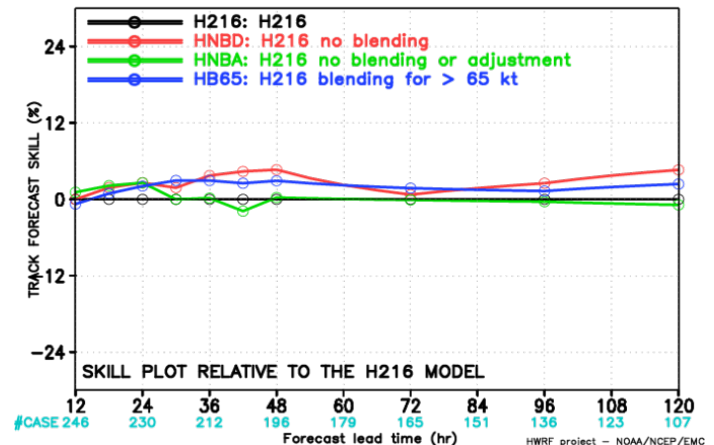
# Upgrades: Blending & Vortex Init

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2014 EP Vmax skill



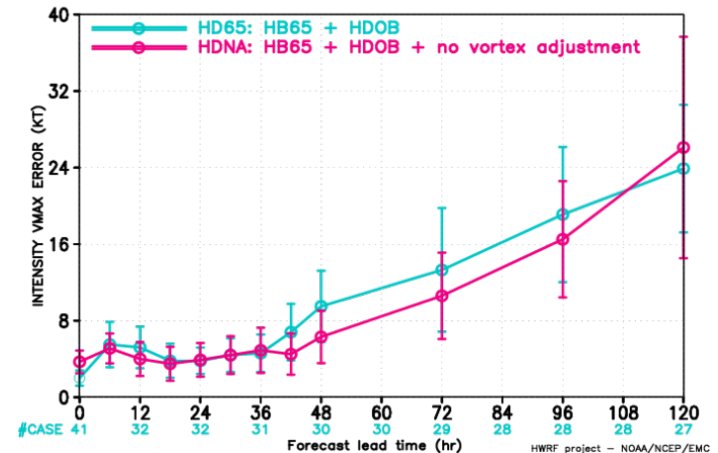
2014 EP Track skill



# Upgrades: Blending & Vortex Init

- Vortex adjustment can contribute to weak-storm bias
- For H217, vortex adjustment in weak systems is limited to low-level vortex
- We are also exploring other options

AL99 vortex init test: Vmax error



*A different way of looking at stats*

**HD65 results (41 cycles):**

Average max Vmax: 68.3 kt

Cycles > 50 kt: 28

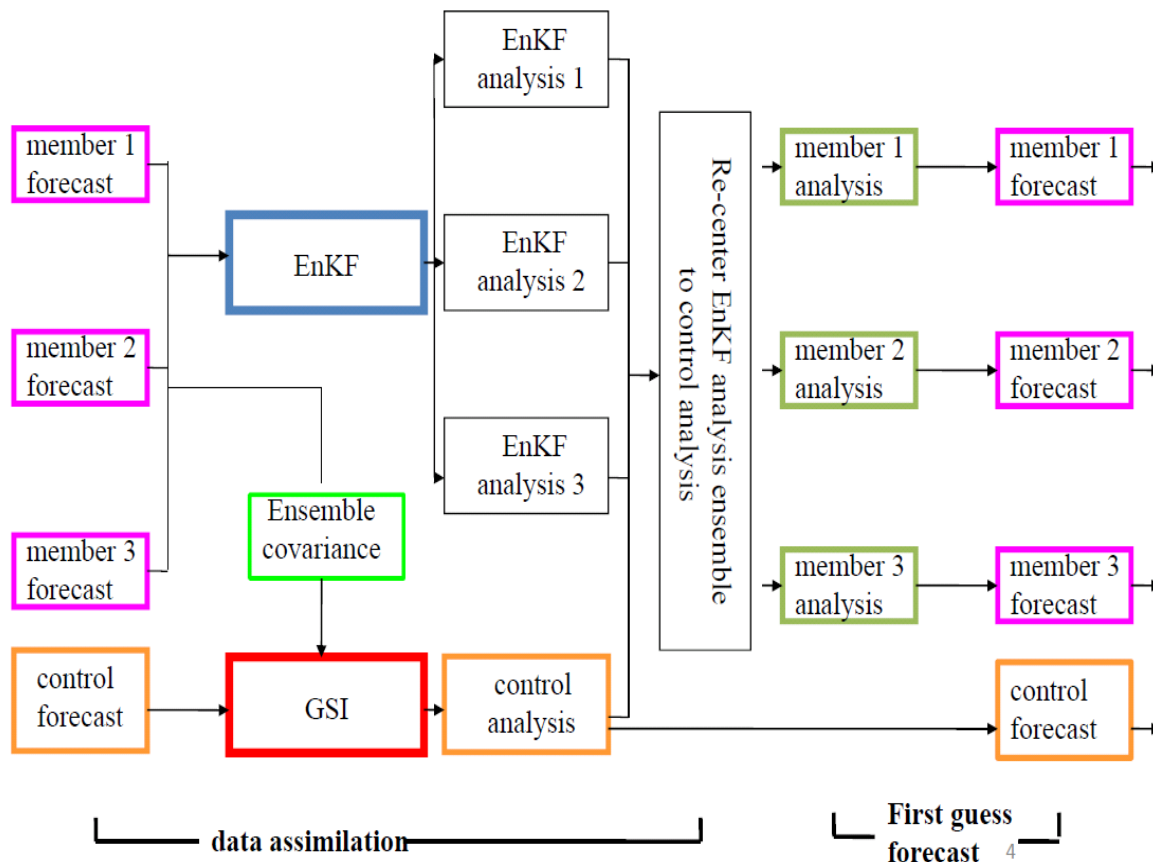
**HDNA results (41 cycles):**

Average max Vmax: 55.5 kt

Cycles > 50 kt: 19

# Upgrades: New DA System

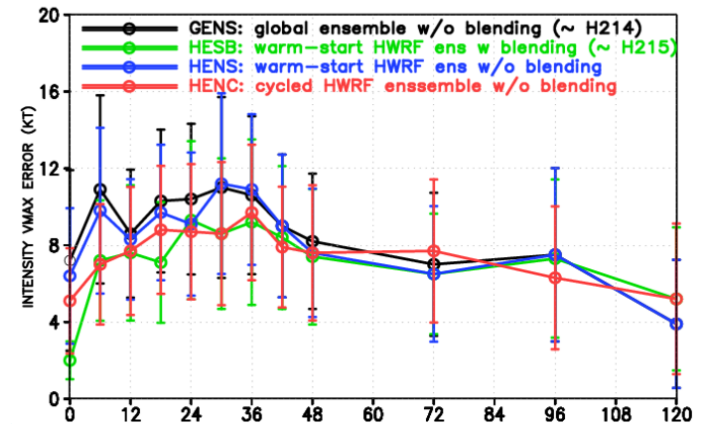
## Hybrid EnKF-GSI DA system: 2 way coupling



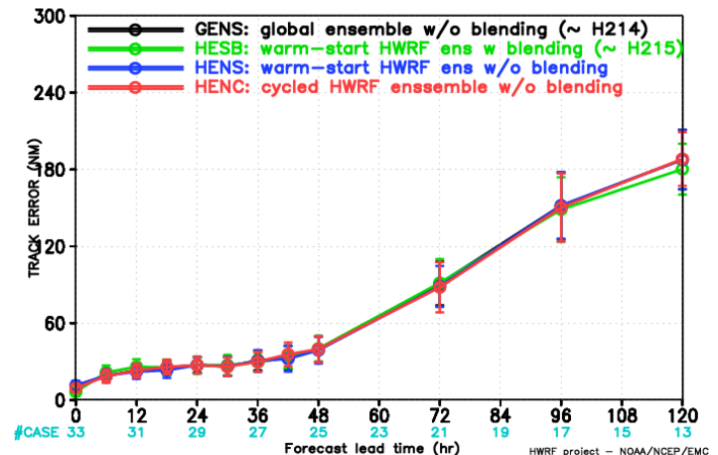
# Upgrades: New DA System

- Warm-start ensemble (H215) provides small benefit upon GDAS
- Cycled system w/o blending as good as old system
- Blending substantially improves Vmax for old and new systems

Edouard (2014) Vmax error



Edouard (2014) track error

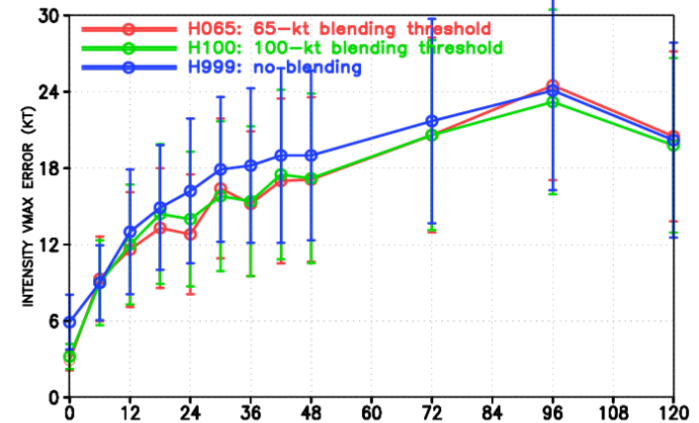




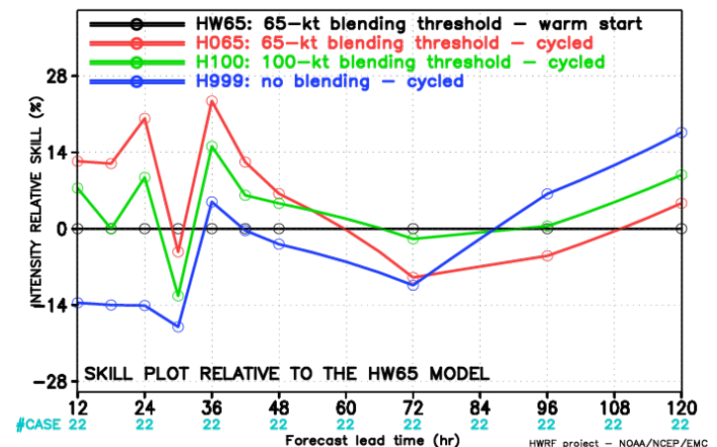
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Matthew Vmax error (full sample)



Matthew Vmax skill (half sample)

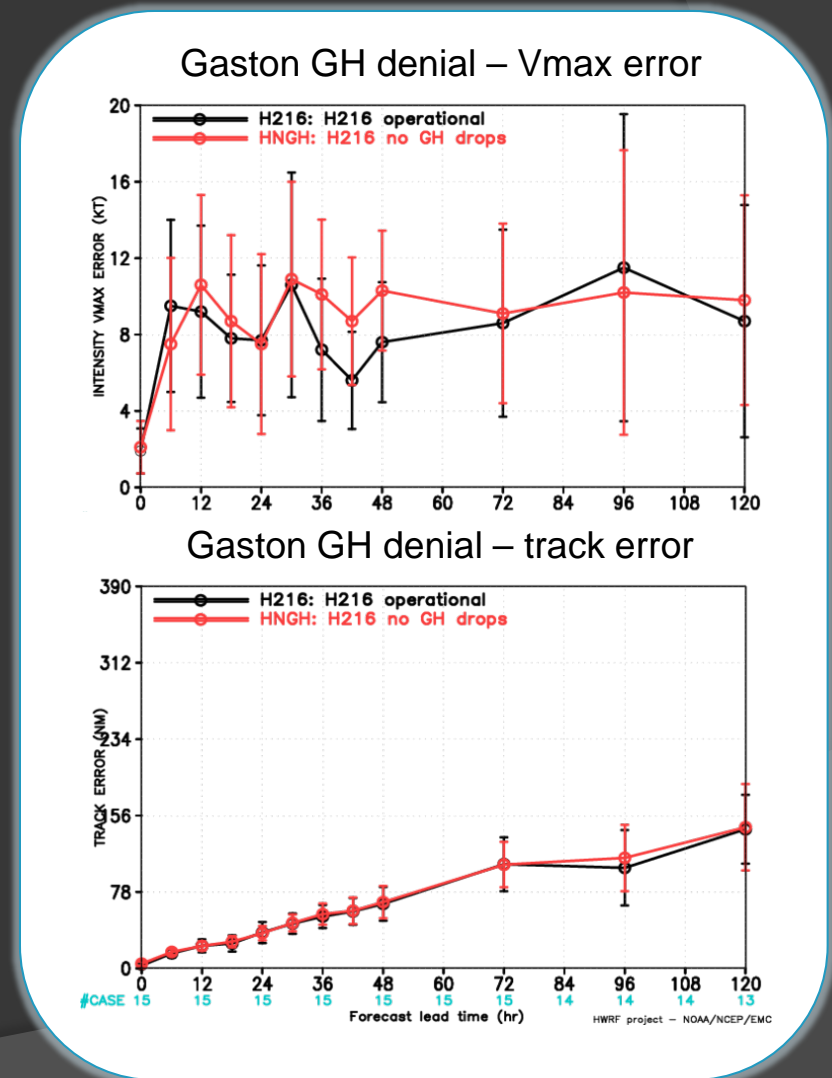


# Upgrades: New DA System

- H216: Warm-start HWRF ensemble only for TDR cycles
- Resources are available/reserved to ALWAYS run DA ensemble for 1 storm
- H217: Fully-cycled system runs continuously after first trigger sent (can be at TD declaration)
- Switching storms accomplished by sending a trigger file from a different storm

# Upgrades: GH Bug Fix

- Assimilating dropsonde u/v near center degrades forecast (even for TS)
- H215-H216 bug allowed GH u/v
- This bug was fixed, and results look promising

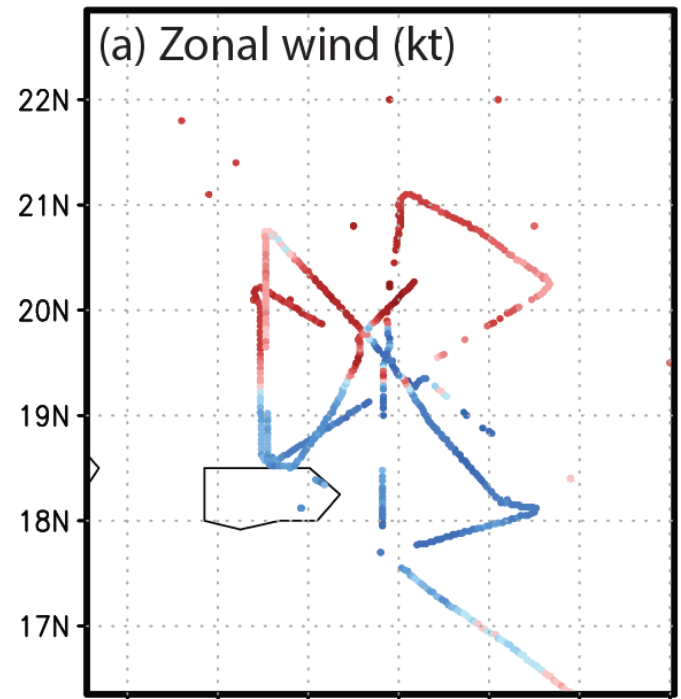


# Outline

- ⦿ Background & System upgrades
- ⦿ **New data**
- ⦿ Planned testing
- ⦿ Long-term route

# New data: HDOBS

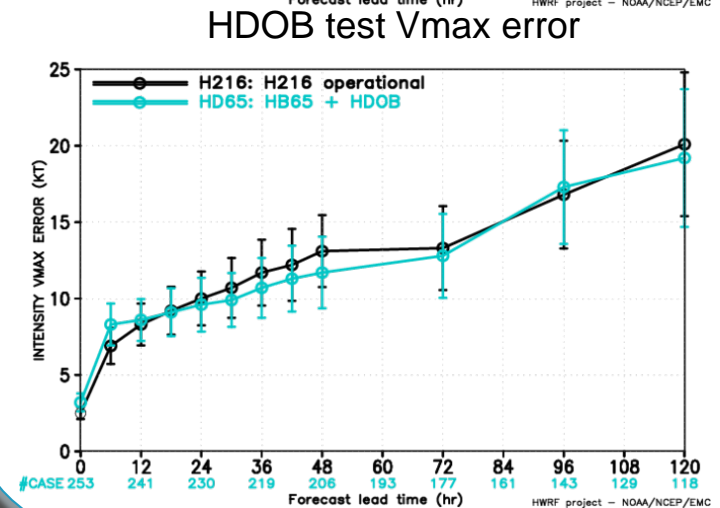
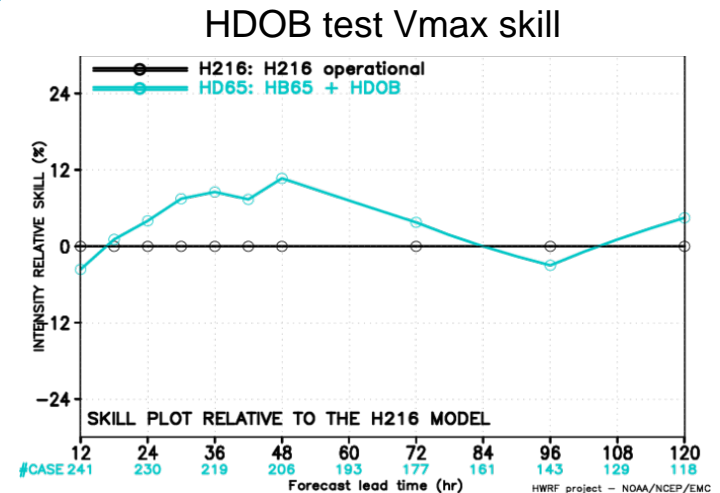
- Far more HDOBS flights than TDR flights
- H213 tests showed HDOBS (FL+SFMR) contributed to spindown and bias
- GDAS and HWRF physics have improved since then



Analysis increments of flight-level  $u$  in H213. Note strong anticyclonic tendency.

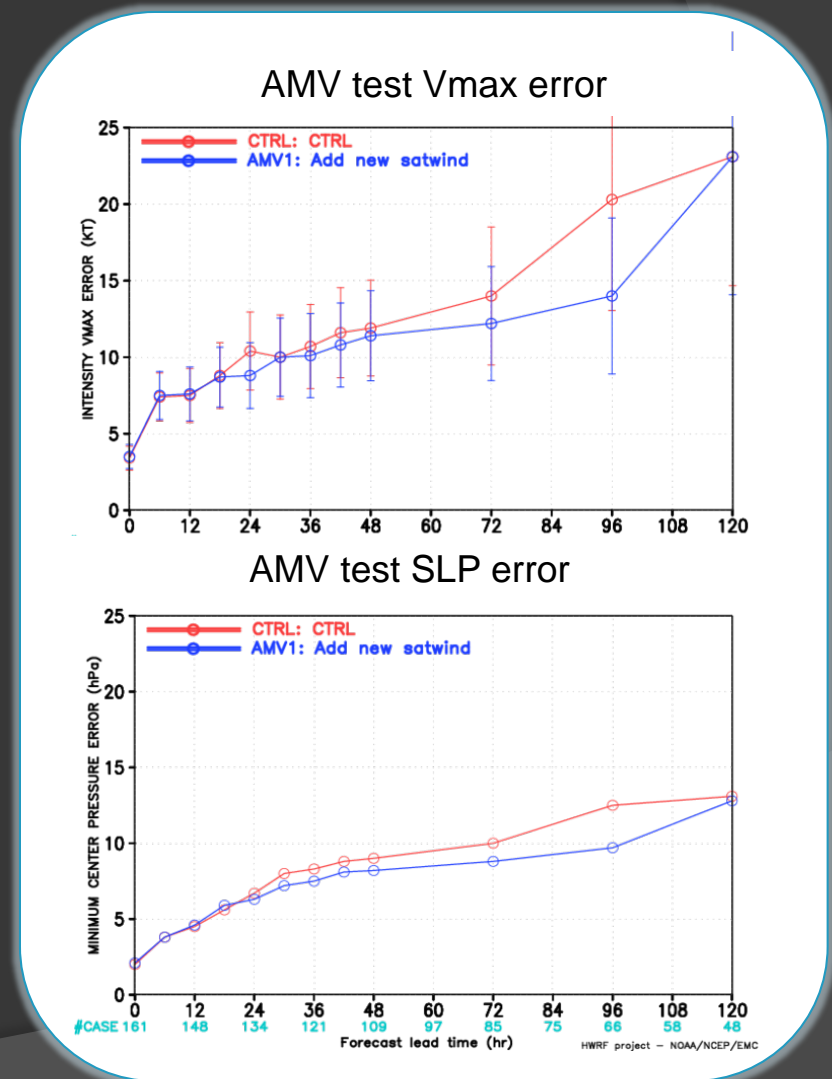
# New Data: HDOBS testing

- Testing done for FL u,v,t,q, no SFMR
- Adding FL data significantly improves intensity
- No impact on track
- Tentatively included in H217



# New Data: Satellite obs

- Initial tests by CIMSS of new AMVs: SWIR, VIS, CAWV
- Initial results are **very good** for intensity
- Little impact on track
- Tentatively included in H217



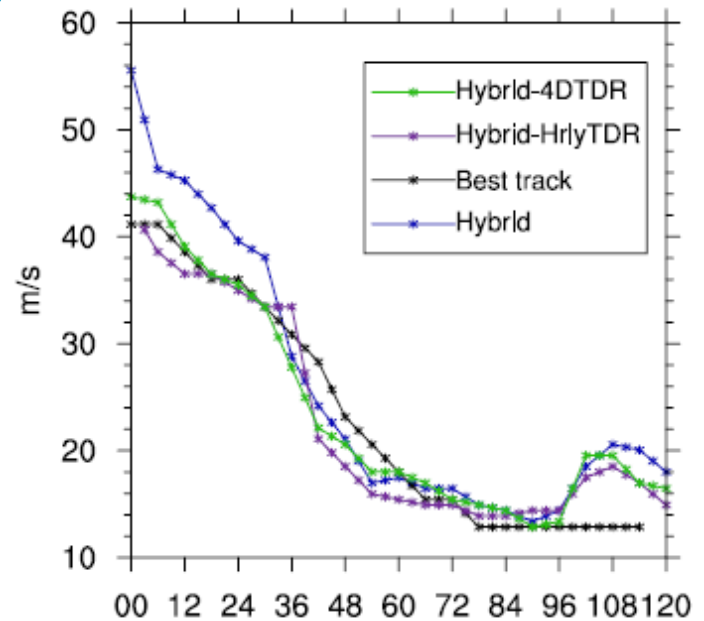
# Outline

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# Planned tests: Hourly cycling

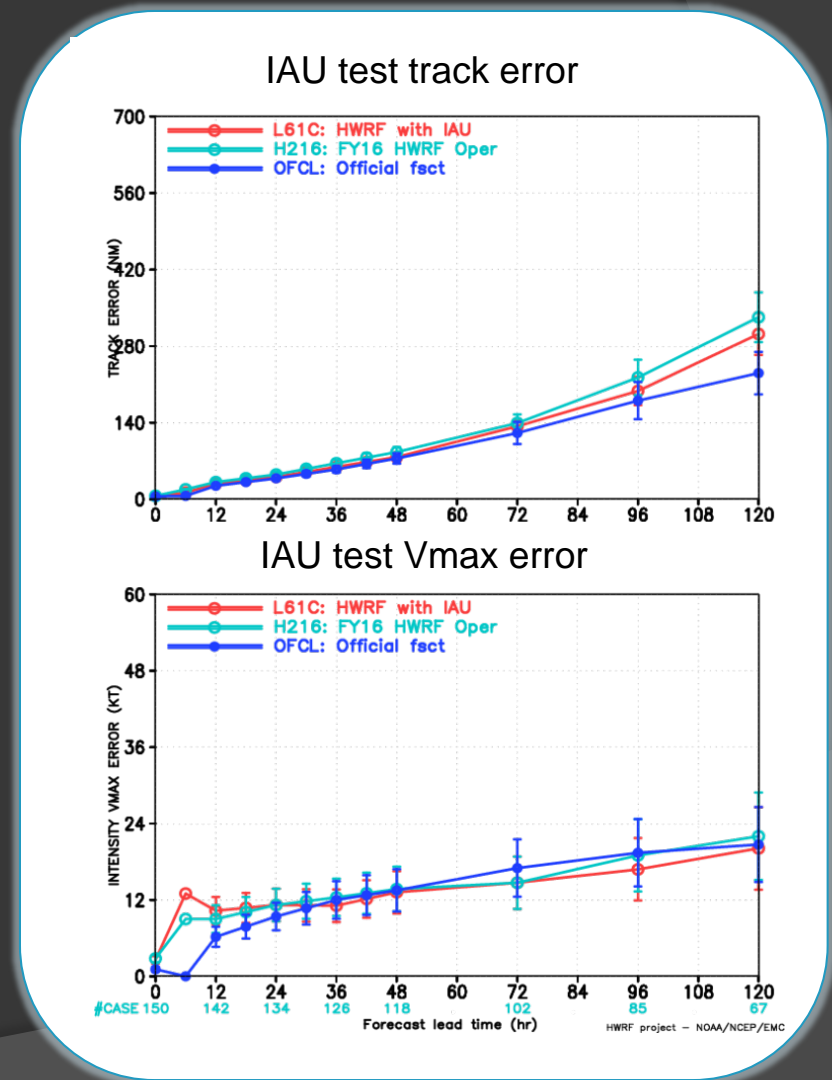
- Results from OU system show hourly cycling helps with inner core balance
- Current priority is to develop/test this for operational HWRF
- This should appeal to researchers as well



Vmax from the 12Z17 cycle of Edouard in the OU hybrid 3DVar and 4DVar systems. Courtesy Xuguang Wang, HFIP partner.

# Planned tests: IAU

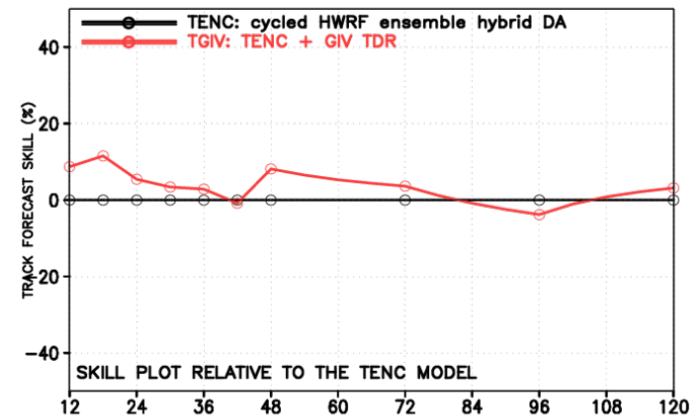
- IAU might help spindown
- EMC is currently developing IAU for HWRF
- Results look good, but spindown worse
- Other challenges remain (WRF/DA)
- EMC/OU collaboration



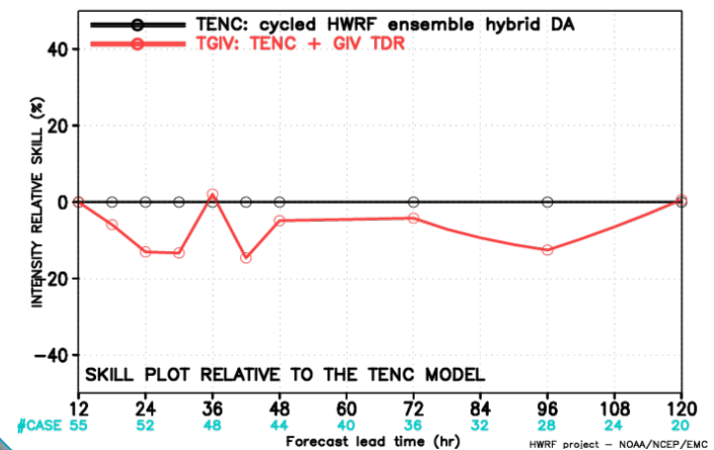
# Planned tests: G-IV TDR

- Initial testing being performed
- Initial results are mixed (slightly better track; worse intensity)
- More testing needed (EMC/HRD coordination)

G-IV TDR test track skill

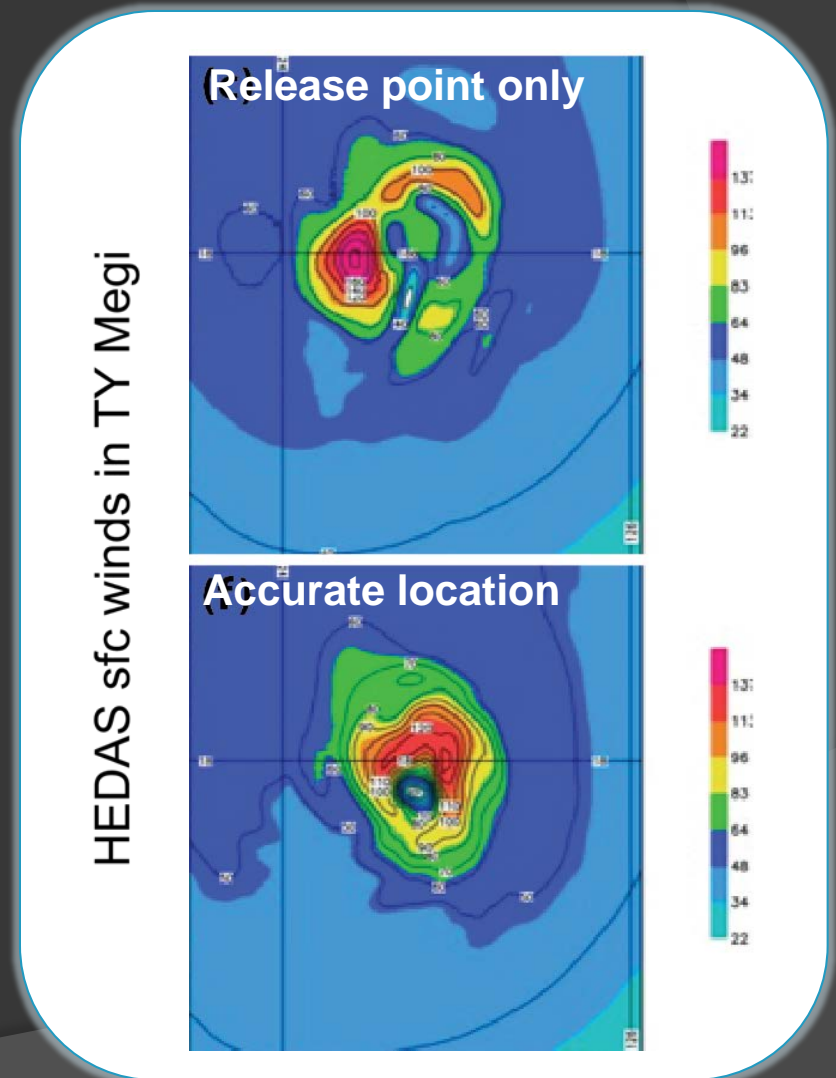


G-IV TDR test Vmax skill



# Planned tests: Sonde telemetry

- TEMPDROP main body only gives sonde release point
- HRD results show benefit of accounting for sonde location
- EMC/HRD will test assimilation of improved sonde data



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# Long-term route

- ⦿ Continue developing hybrid system > 4D-Hybrid w/ IAU
- ⦿ Replace vortex initialization with self-consistent DA of something derived from TC Vitals
- ⦿ Update condensate (and w?) with each cycle
- ⦿ Assimilation of new data like GOES-R AMVs, cloudy radiances, inner-core dropsondes, etc
- ⦿ Coupled atmosphere-ocean DA

# Conclusions

- ⦿ HWRF DA is undergoing dramatic advancements
- ⦿ We will be using more of the available data
- ⦿ Both of the above factors should contribute to intensity improvement in particular
- ⦿ Long term plans address ongoing issues (e.g., spindown, bias) and allow for greater data usage