VERIFICATIONS OF THE NEW OPERATIONAL 27:9:3 km HWRF for 2010-2011 Stratified by: Initial Storm Intensity AND Vertical Shear

Presented by

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SUMMARY OF HWRF VERSIONS

HWRF: PREVIOUS OPERATIONAL HWRF 27:9 km

- **Operational version from 2007-2011**

H3GP: 27:9:3 km TRIPLE NESTED VERSION

- **Real-time testing for 2011 season**
- **Numerous Modifications over HWRF & HWRFX**
- **Verified for 4-years of runs (2008-2011)**

H212: NEW OPERATIONAL HWRF
27:9:3 km TRIPLE NESTED VERSION

- **Operational version starting 2012 (now called HWRF)**
- **Numerous Modifications over H3GP (by EMC)**
- **Verified for 2-years of runs (2010-2011)**

Reference:

Gopalakrishnan, S. G., F. D. Marks, Xuejin Zhang, J.-W. Bao, K.-S. Yeh, and R. Atlas, 2011: The Experimental HWRF System: A Study on the Influence of Horizontal Resolution on the Structure and Intensity Changes in Tropical Cyclones using an Idealized Framework. Mon. Wea. Rev. 1762–1784

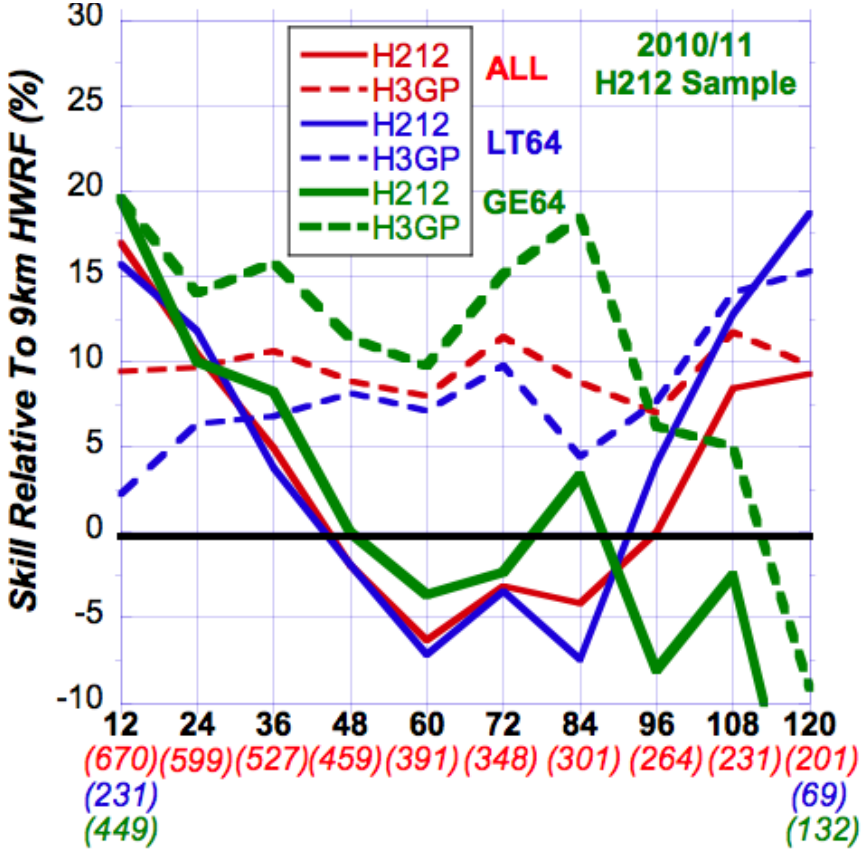
Intensity Forecast Skill Stratified by Initial Storm Intensity

2010-2011 Seasons Retrospective Runs

H212/H3GP (27:9:3 km) relative to HWRF (27:9 km)

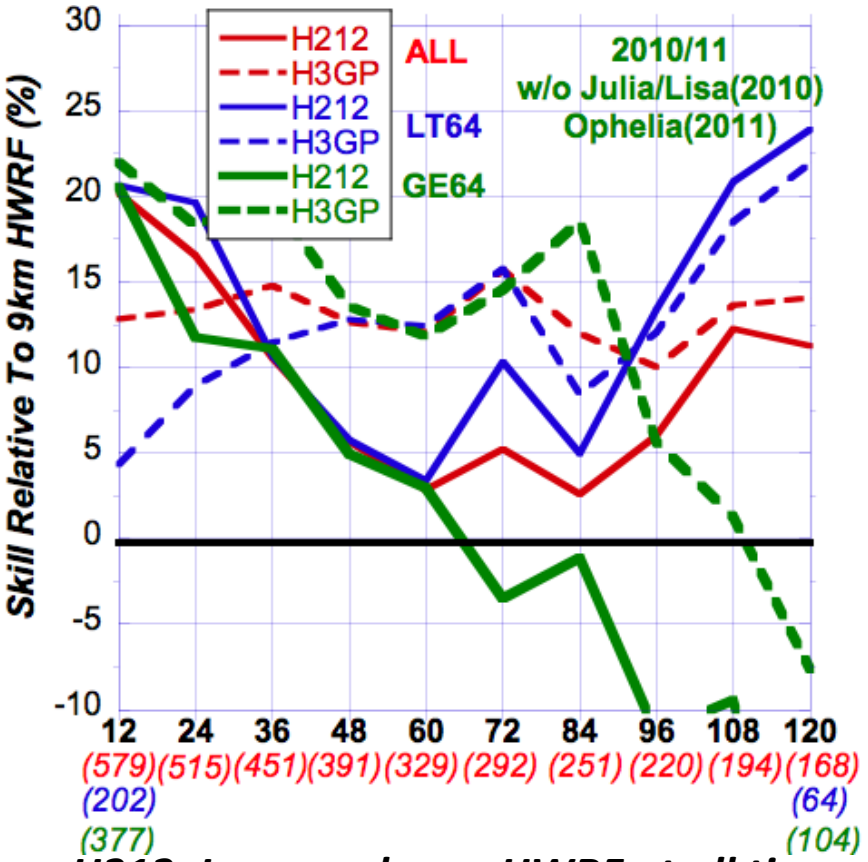
All Cases/Initially <Hurricane/Initially Hurricane

All Storms



H212: Improved over HWRF (esp. thru 36h*)
& except from 48-96h
BUT H3GP better than H212 & HWRF
(*) Much better initialization?

w/o Julia, Lisa (2010), Ophelia (2011)

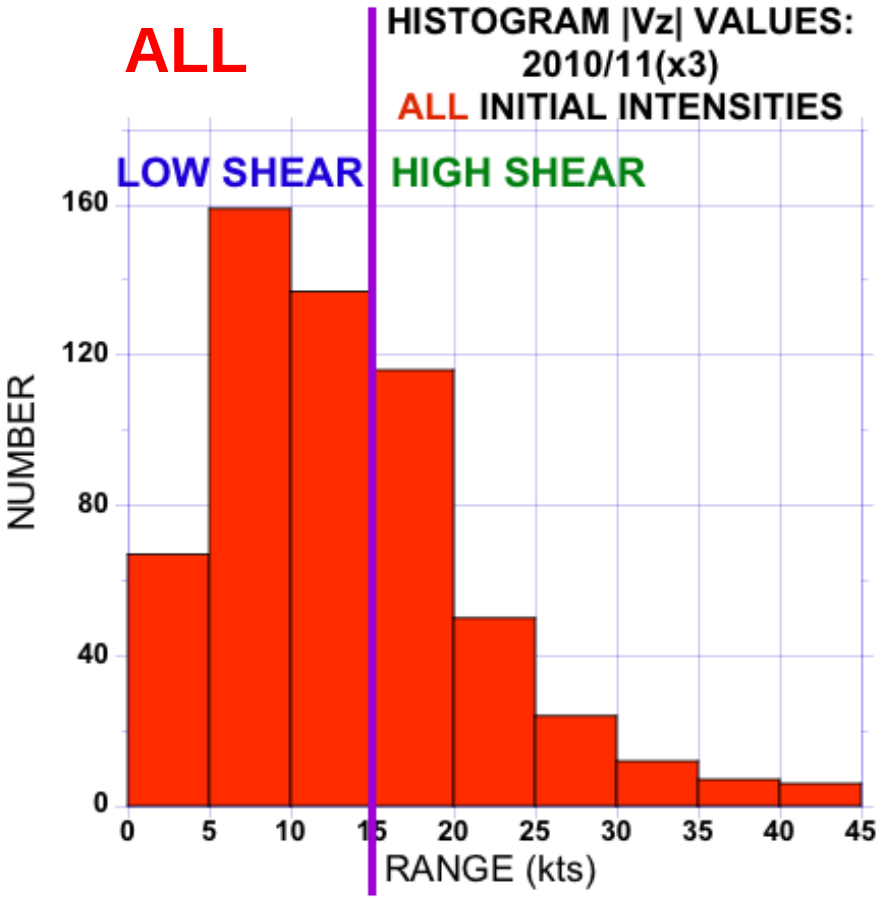


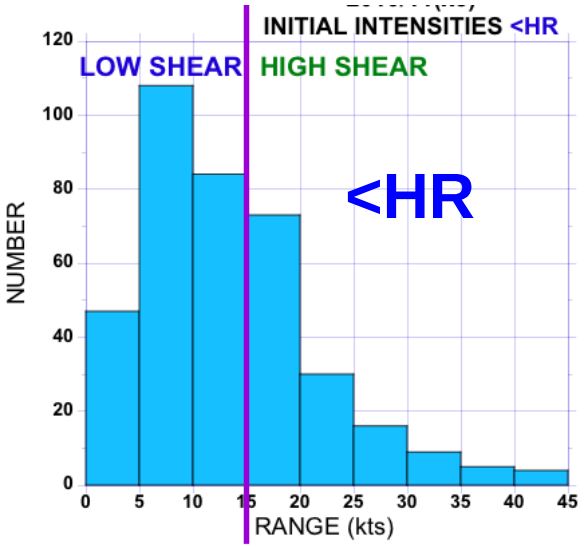
H212: Improved over HWRF at all times
(esp. thru 24h*) esp. for <H
Has problem with HR after 84h
BUT H3GP better than H212 & HWRF

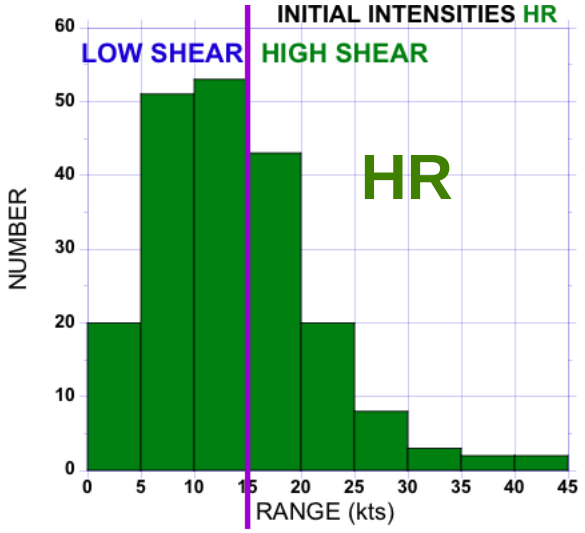
Distribution of Initial Vertical Shear |Vz| *for 200-850mb*

SHIPS Data Base SHDC: vortex removed, averaged 0-500 km (using 850 mb center)

2010/2011: INITIAL INTENSITY: All Cases/<HR/HR







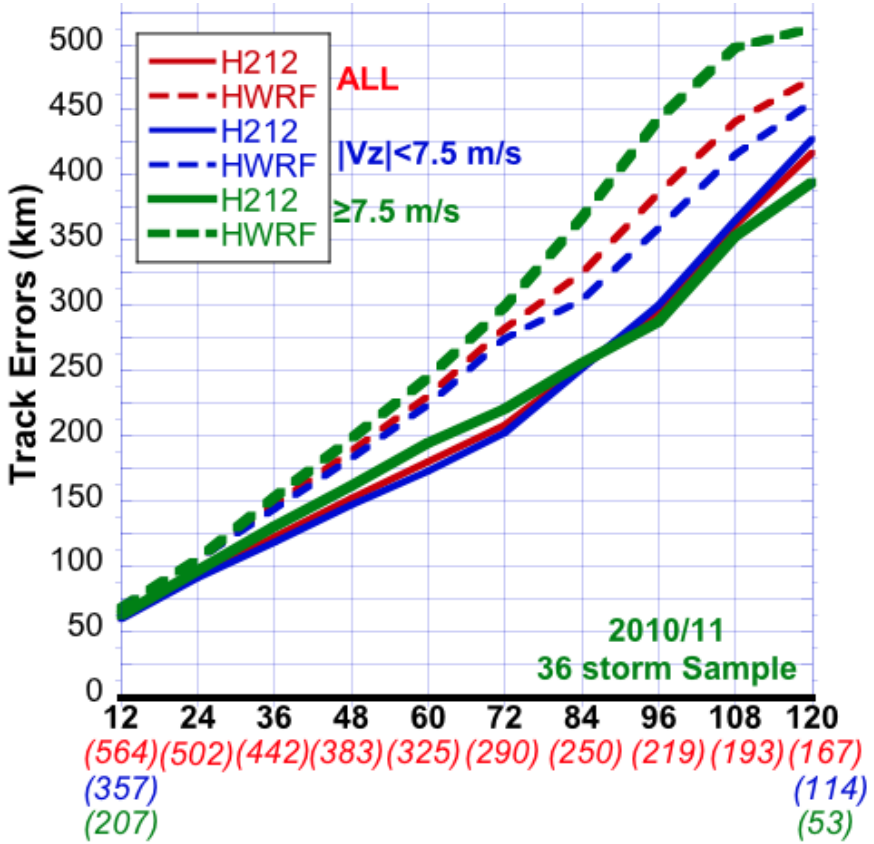
Track Forecast Errors Stratified by Initial Vertical Shear |Vz|

2010-2011 Seasons Retrospective Runs

H212/H3GP (27:9:3 km) relative to HWRF (27:9 km)

All Cases/|Vz|<7.5m/s/|Vz|≥7.5m/s

w/o Julia, Lisa (2010), Ophelia, Sean (2011)



H212: Better Overall, not difference
For Low & High Shear
HWRF: Much worse for High Shear

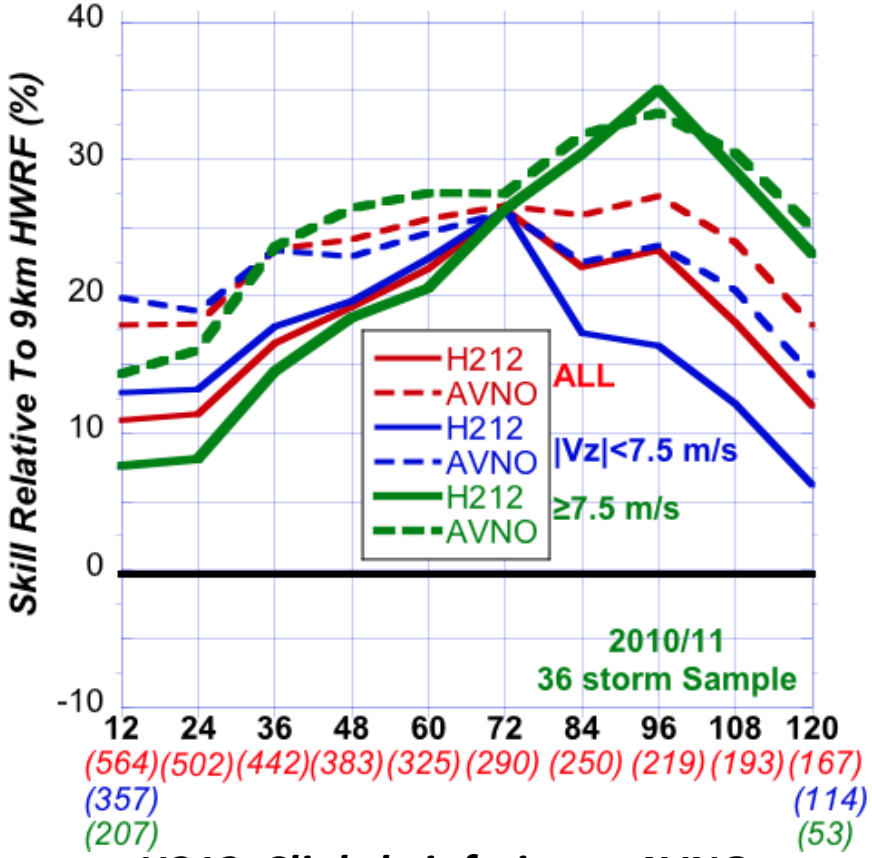
Track Forecast Skill Stratified by Initial Vertical Shear |Vz|

2010-2011 Seasons Retrospective Runs

H212/H3GP (27:9:3 km) relative to HWRF (27:9 km)

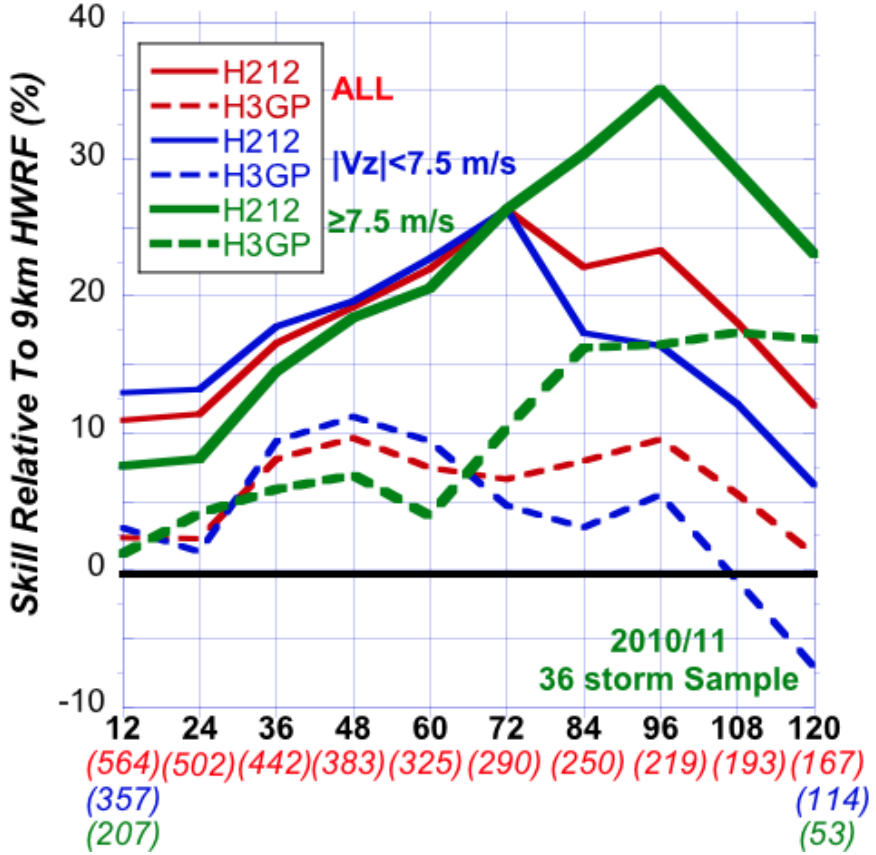
All Cases/|Vz|<7.5m/s/|Vz|≥7.5m/s

w/o Julia, Lisa (2010), Ophelia, Sean (2011)



H212: Slightly inferior to AVNO

But closest for High Shear (72-120h)



H212: Much better than HWRF & H3GP

H3GP best (vs. HWRF) for high shear! (84-120h)

All 3 numerical models (H212, H3GP & AVN0 show best skill (vs. HWRF) for HIGH shear cases

Mainly because HWRF does the worst for the HIGH shear cases

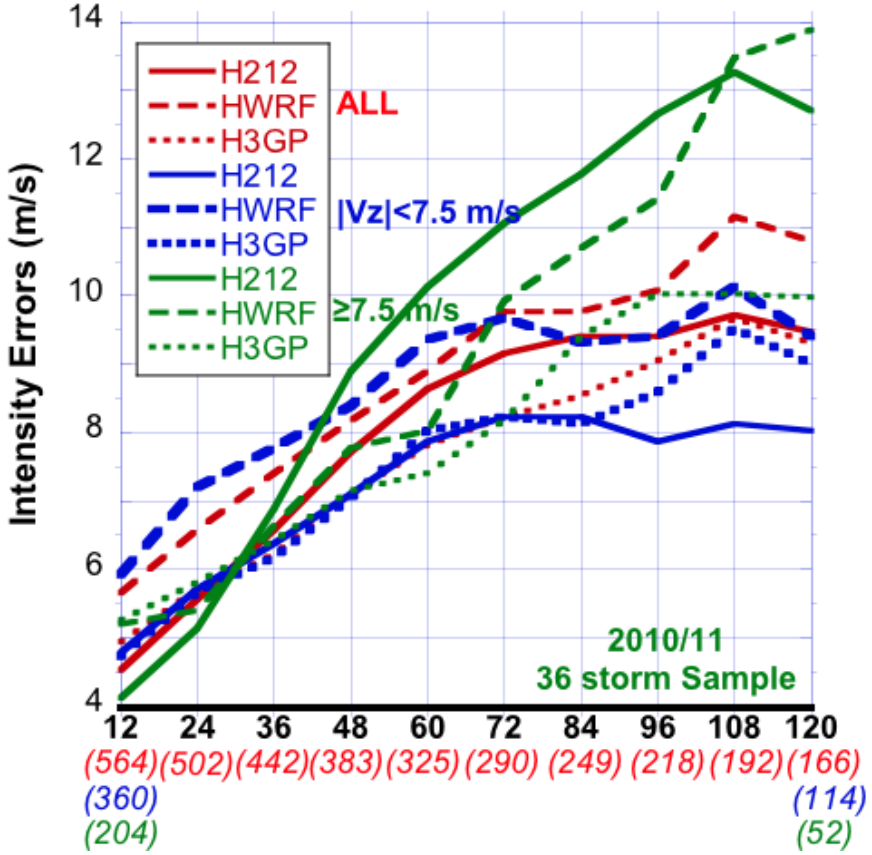
Intensity Forecast Errors Stratified by Initial Vertical Shear |Vz|

2010-2011 Seasons Retrospective Runs

H212/H3GP (27:9:3 km) relative to HWRF (27:9 km)

All Cases/|Vz|<7.5m/s/|Vz|≥7.5m/s

w/o Julia, Lisa (2010), Ophelia, Sean (2011)



H212: Better than HWRF

Comparable to H3GP for Low Shear

But Much worse for High Shear!

|Vz| for 200-850mb

SHIPS Data Base SHDC

vortex removed

averaged 0-500 km

(relative to 850 mb vortex center)

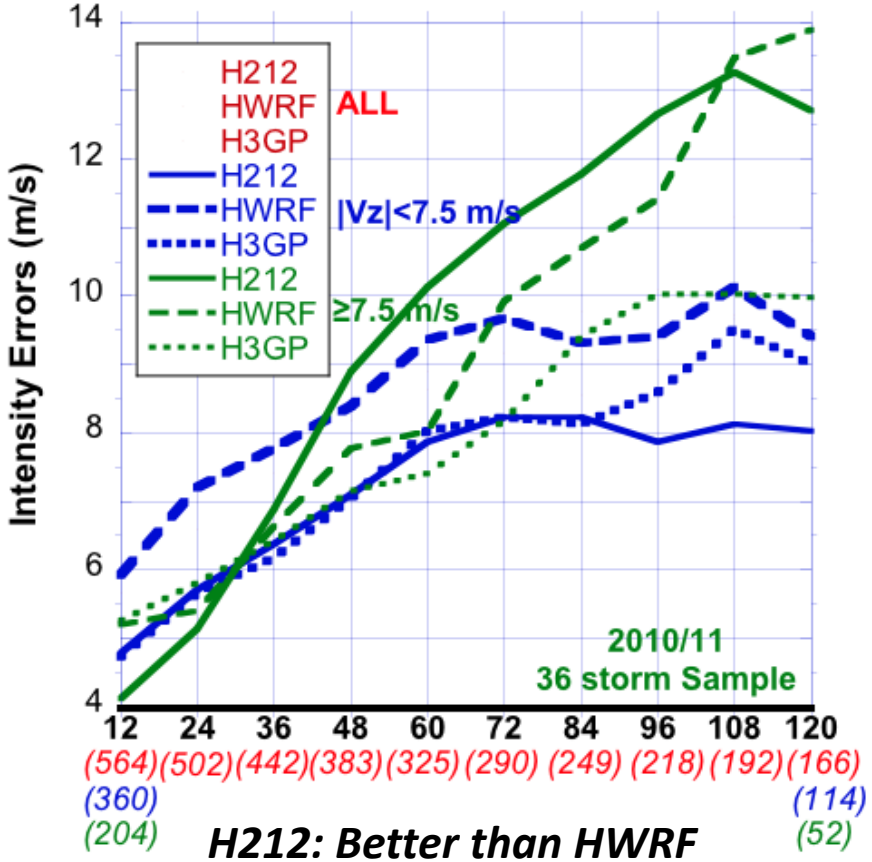
Intensity Forecast Errors Stratified by Initial Vertical Shear |Vz|

2010-2011 Seasons Retrospective Runs

H212/H3GP (27:9:3 km) relative to HWRF (27:9 km)

All Cases/|Vz|<7.5m/s/|Vz|≥7.5m/s

w/o Julia, Lisa (2010), Ophelia, Sean (2011)



H212: Better than HWRF

Comparable to H3GP for Low Shear

But worse than HWRF &

Much than H3GP for High Shear!

|Vz| for 200-850mb

SHIPS Data Base SHDC

vortex removed

averaged 0-500 km

(relative to 850 mb vortex center)

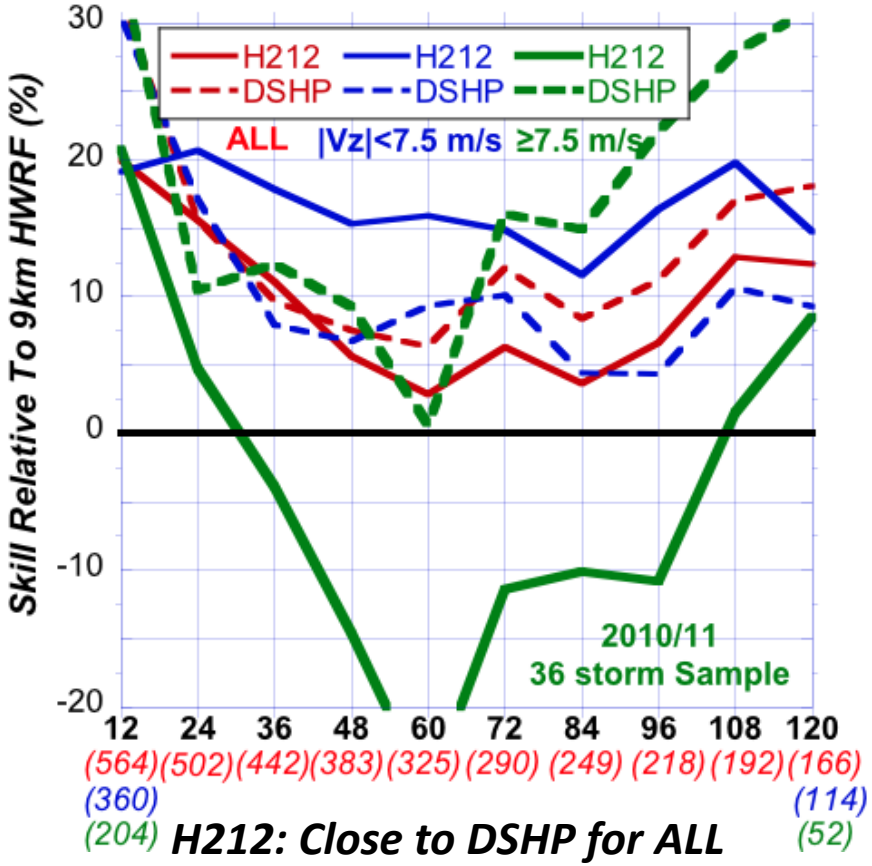
Intensity Forecast Skill Stratified by Initial Vertical Shear |Vz|

2010-2011 Seasons Retrospective Runs

H212/H3GP (27:9:3 km) relative to HWRF (27:9 km)

All Cases/|Vz|<7.5m/s/|Vz|≥7.5m/s

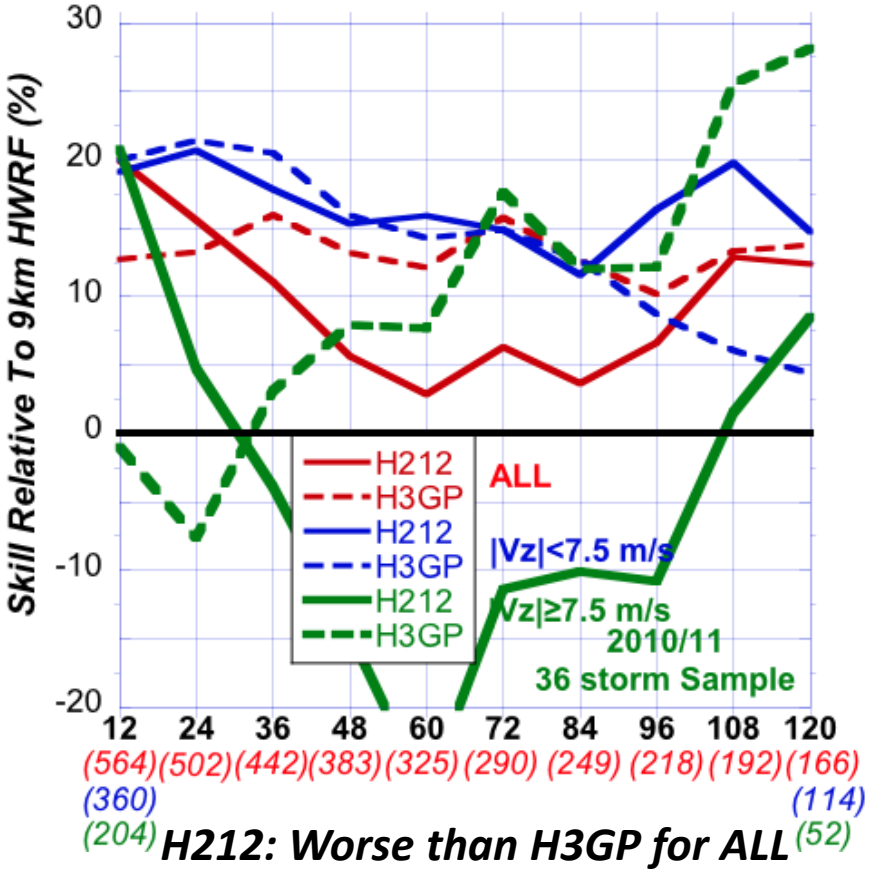
w/o Julia, Lisa (2010), Ophelia, Sean (2011)



H212: Close to DSHP for ALL

Better than DSHP for Low Shear

But Much worse for High Shear!



H212: Worse than H3GP for ALL

Comparable to H3GP for Low Shear

But Much worse for High Shear!

H212 better than HWRF except for High Shear (w/ exception of 12-24 + 108-120h)

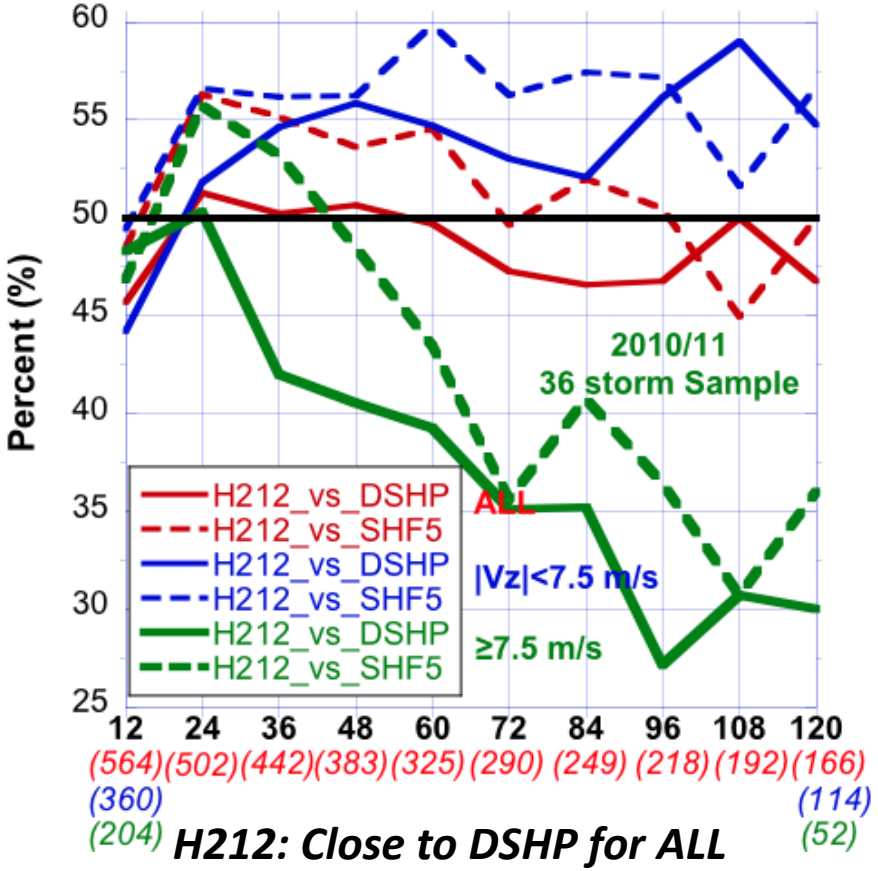
FSP Stratified by Initial Vertical Shear |Vz|

2010-2011 Seasons Retrospective Runs

H212/H3GP (27:9:3 km) relative to HWRF (27:9 km)

All Cases/|Vz|<7.5m/s/|Vz|≥7.5m/s

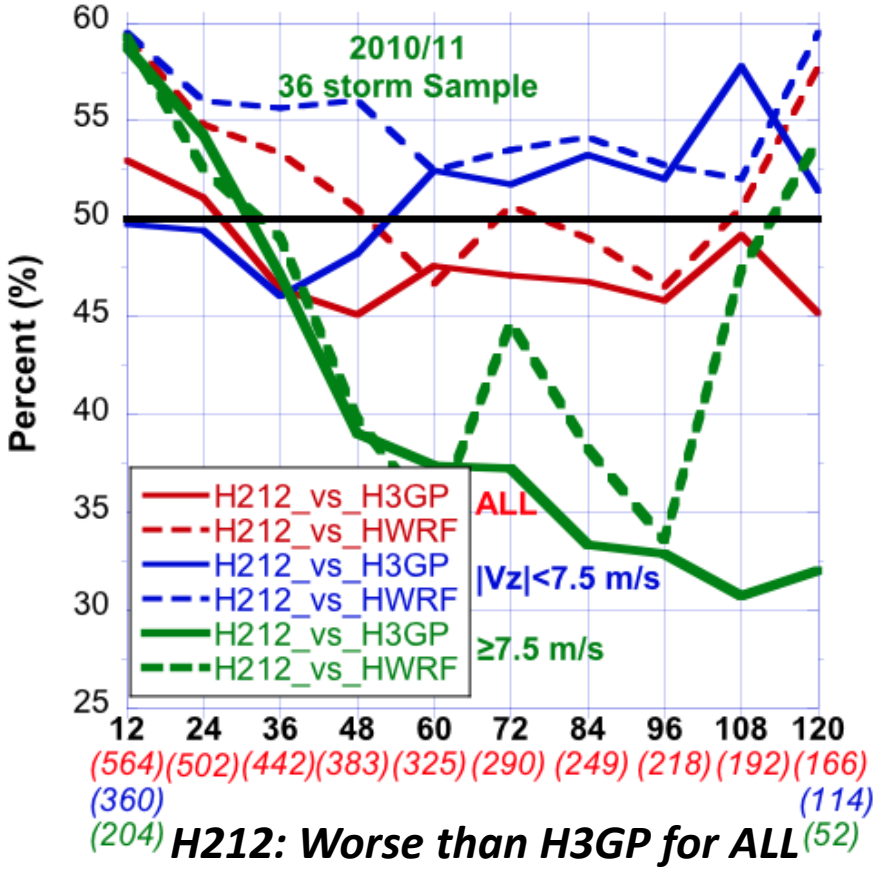
w/o Julia, Lisa (2010), Ophelia, Sean (2011)



H212: Close to DSHP for ALL

Better than DSHP for Low Shear

But Much worse for High Shear!



H212: Worse than H3GP for ALL

Closer to H3GP for Low Shear

But Much worse for High Shear!

H212 better than HWRF except for High Shear. NOTE H212 (High Shear) good at 12 h

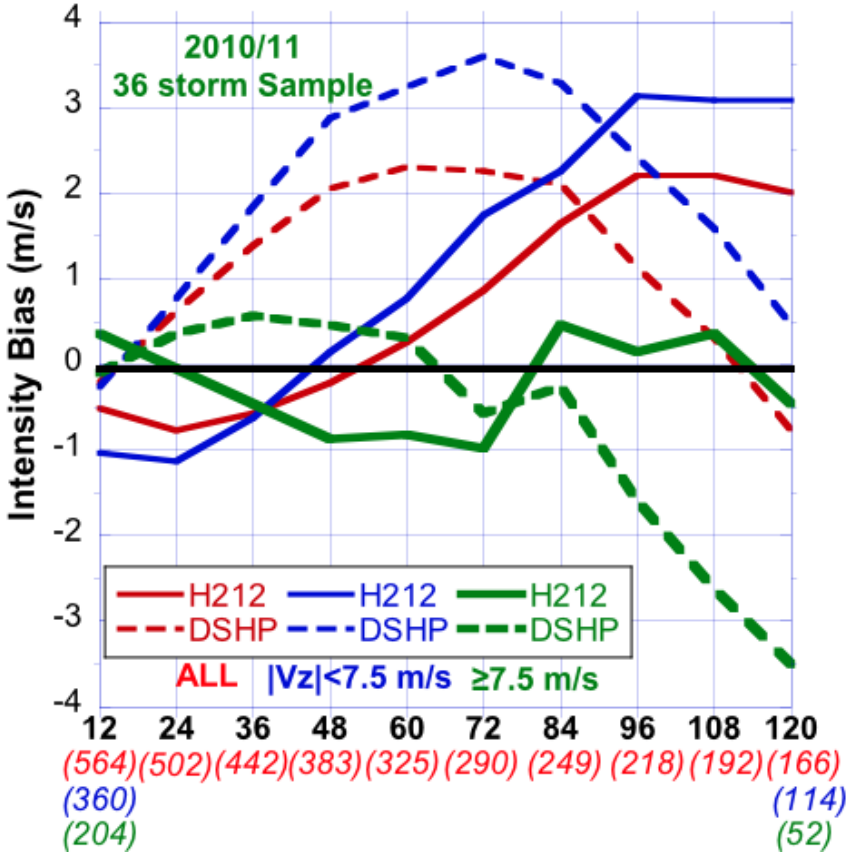
Intensity Error Bias Stratified by Initial Vertical Shear |Vz|

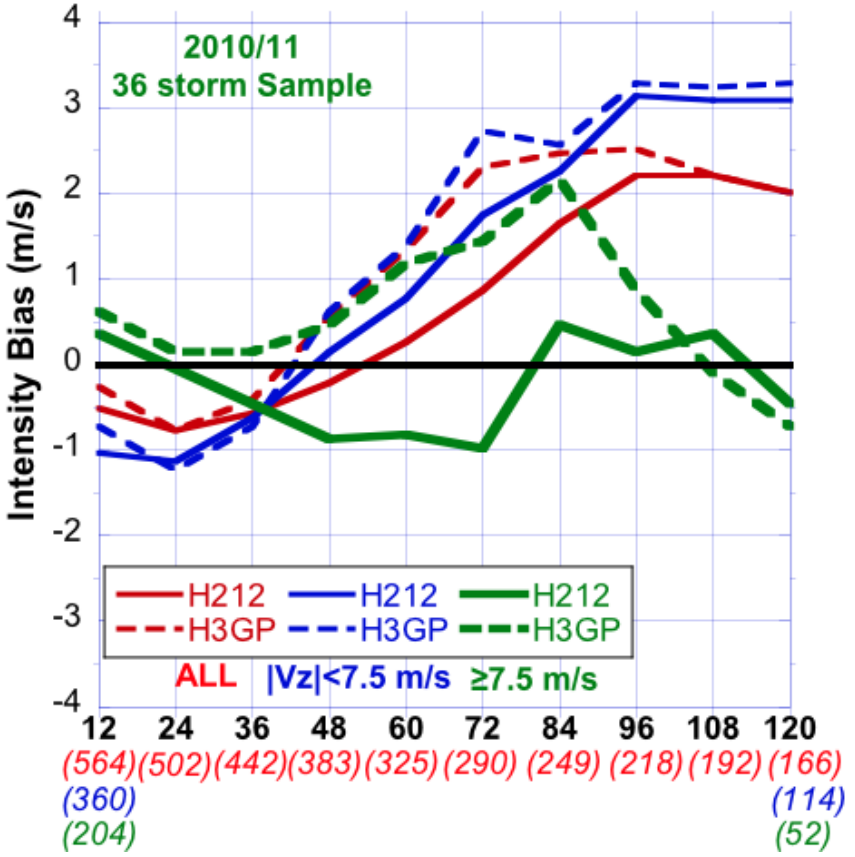
2010-2011 Seasons Retrospective Runs

H212/H3GP (27:9:3 km) relative to HWRF (27:9 km)

All Cases/|Vz|<7.5m/s/|Vz|≥7.5m/s

w/o Julia, Lisa (2010), Ophelia, Sean (2011)





H3GP & H212-- increasing + Bias for low shear; H3GP Mixed for high shear

H212 -- For high shear -- basically the lowest Bias of the various models

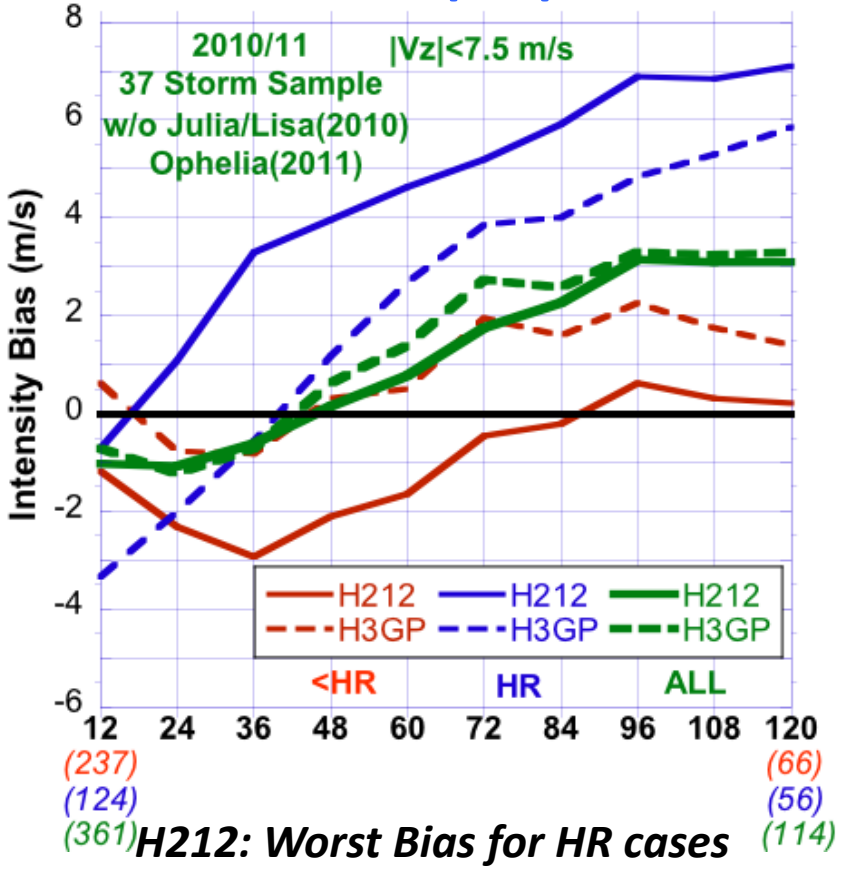
Intensity Error Bias Stratified by Initial Vertical Shear & Intensity

2010-2011 Seasons Retrospective Runs

H212/H3GP (27:9:3 km) relative to HWRF (27:9 km)

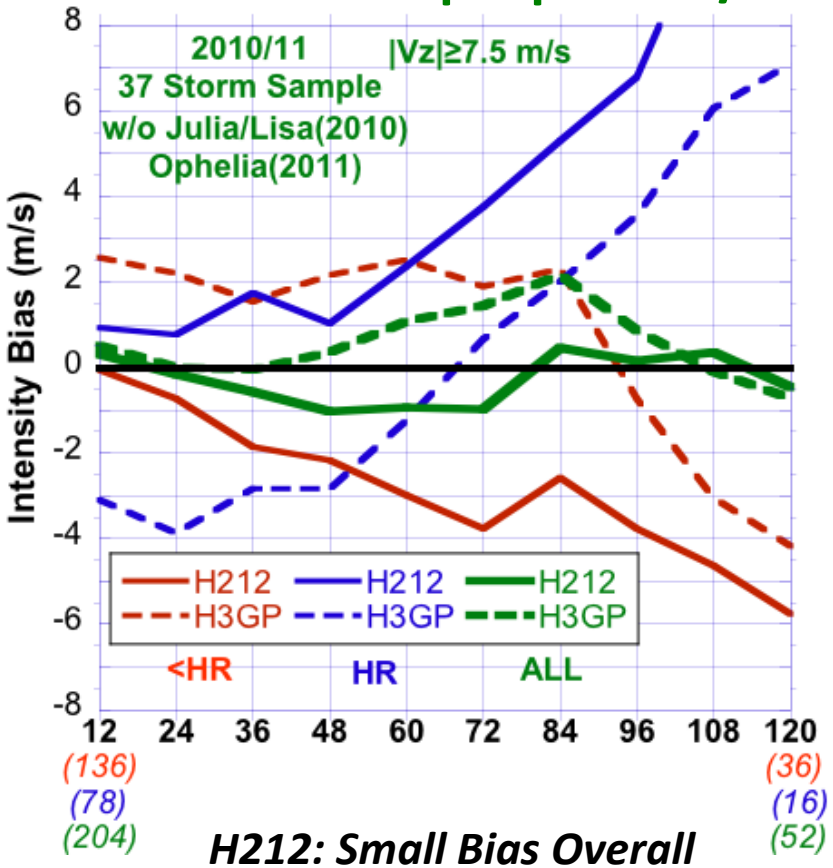
<HR /HR /All Cases

LOW SHEAR |Vz|<7.5m/s



H212: Worst Bias for HR cases

HIGH SHEAR|Vz|≥7.5m/s



H212: Small Bias Overall

Increasing + Bias HR Cases

Increasing - Bias <HR Cases

Summary of Intensity Bias Results

- **Weak Initial Vertical Shear <7.5 m/s**
  - Over-intensifies initially stronger storms (HR)
  - Does better with initially weaker storms (<HR)

- **Strong Initial Vertical Shear ≥7.5 m/s**
  - Over-intensifies initially stronger storms (HR)
    - Is shear itself weakening with time, or is initially strong vortex too resistant to high shear?
  - Under-intensifies initially weaker storms (<HR)
    - Initially weak vortex can't handle the strong shear?

Scope for Future Tests/Improvements

- **FUTURE TESTS**
  - Examine what is happening in high Vz cases
  - Look at different Vz layers
- **TRACK and STRUCTURE improvements**
  - Significant (WHAT caused the big improvement?)
  - Basin Scale shows promise
- **INTENSITY *(Why is H3GP better for intensity?)***
  - Why did we loose some skill in transitions from 1.5 to 1.
  - Changes to physics ? Initial conditions ?