Detailed Verifications in Support of HWRF Model Improvements

Results from:

**HWRFx (9:3 km) 2005/07/09 (87 cases)**

**H3GP (27:9:3 km) 2008/09/10 (597 cases)**

**H3GP (27:9:3 km) 2011 (208 cases)**

HRD Contributors: Stan Goldenberg, Sundararaman G. Gopalakrishnan, Thiago Quirino, Xuejin Zhang, Lisa Bucci, & Kevin Yeh

EMC Contributors: Vijay Tallapragada, Sam Tran, Qing Fu, Zhan Zack, & Young Kwon

Acknowledgements to TCMT, HFIP & James Franklin (NHC)
Track & Intensity Forecast Skill: HWRFX (14 storms 2005/07/09)
Impact of Resolution (27:9 vs 9:3 km) and Initialization (GFDL vs HWRF)
Results from Gopalakrishnan et al. 2012

Track forecast Skill

Intensity Forecast “Skill”

Skill for all Forecast Intervals
Marginal skill for numerical models
Stratified Intensity Forecast Skill: HWRFX (14 storms 2005/07/09)
Impact of Resolution (27:9 vs 9:3 km) and Initialization (GFDL vs HWRF)
Results from Gopalakrishnan et al. 2012

Initially Hurricane Strength

Stat Sig Skill for most Forecast Intervals

Initially <Hurricane Strength

No Significant skill for any model
Track & Intensity Forecast Skill: H3GP (31 storms: 2008/09/10)  
Retrospective Runs to test Stream 1.5 (27:9:3 km)  
(Pre-2011 Season)

**TRACK FORECAST SKILL**

**INTENSITY FORECAST SKILL**

**H3GP**: Better than HWRF  
Comparable to GFDL  

**H3GP**: Improved over HWRF  
& Comparable or better than GFDL
Stratified Intensity Forecast Skill: H3GP (31 storms: 2008/09/10)

Pre-2011 Season Retrospective Runs to test Stream 1.5 (27:9:3 km)

Initially Hurricane Strength

Initially <Hurricane Strength

**H3GP:** Improved over HWRF & Mixed with GFDL

**H3GP:** Improved over HWRF & GFDL (But No Significant skill for any model)
Track & Intensity Forecast Skill H3GP (17 storms (A to P): 2011)

2011 Real-Time Season Runs to test Stream 1.5 (27:9:3 km)

**TRACK FORECAST SKILL**

**INTENSITY FORECAST SKILL**

- **H3GP**: Comparable with HWRF
- **Slightly Worse than GFDL**

**H3GP**: Mixed vs. HWRF

Better than GFDL after 60 hr

(But No Significant skill for any model)
Initially Hurricane Strength

Initially <Hurricane Strength

**H3GP:** After 48 hr much improved
Over HWRF & GFDL

**H3GP:** Improved over HWRF & GFDL
(But No Significant skill for any model)
**Stratified Intensity Forecast Skill H3GP (17 storms (A to P): 2011)**

**2011 Real-Time Season Runs to test Stream 1.5 (27:9:3 km)**

**Initially Hurricane Strength**

![Chart showing skill relative to DSHP for initially hurricane strength storms.]

**Initially <Hurricane Strength**

![Chart showing skill relative to DSHP for initially non-hurricane strength storms.]

**H3GP:** After 48 hr much improved over HWRF & GFDL

**H3GP:** After ~72 h improved over HWRF & GFDL
Summary/Conclusions

-- Track:
H3GP Better/Comparable than HWRF +
  Comparable to GFDL
But GFS (AVNO) -- Global Models still best (we are working on the basin scale HWRF)

-- Intensity:
H3GP Better/Comparable than HWRF +
  Comparable to GFDL
All dynamical models (shown here) poor for initially weaker storms (vs. DSHP and LGEM)

-- Interpolation:
Degrades Track slightly but generally IMPROVES Intensity forecasts.
Different schemes affect results
FSP & Bias (Intensity) H3GP (17 storms (A to P): 2011)
2011 Real-Time Season Runs to test Stream 1.5 (27:9:3 km)

FSP
Initially Hurricane Strength

Bias (All Cases)

H3GP: After 60 hr much improved Over GFDL

Extreme Positive Bias: GFDL