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

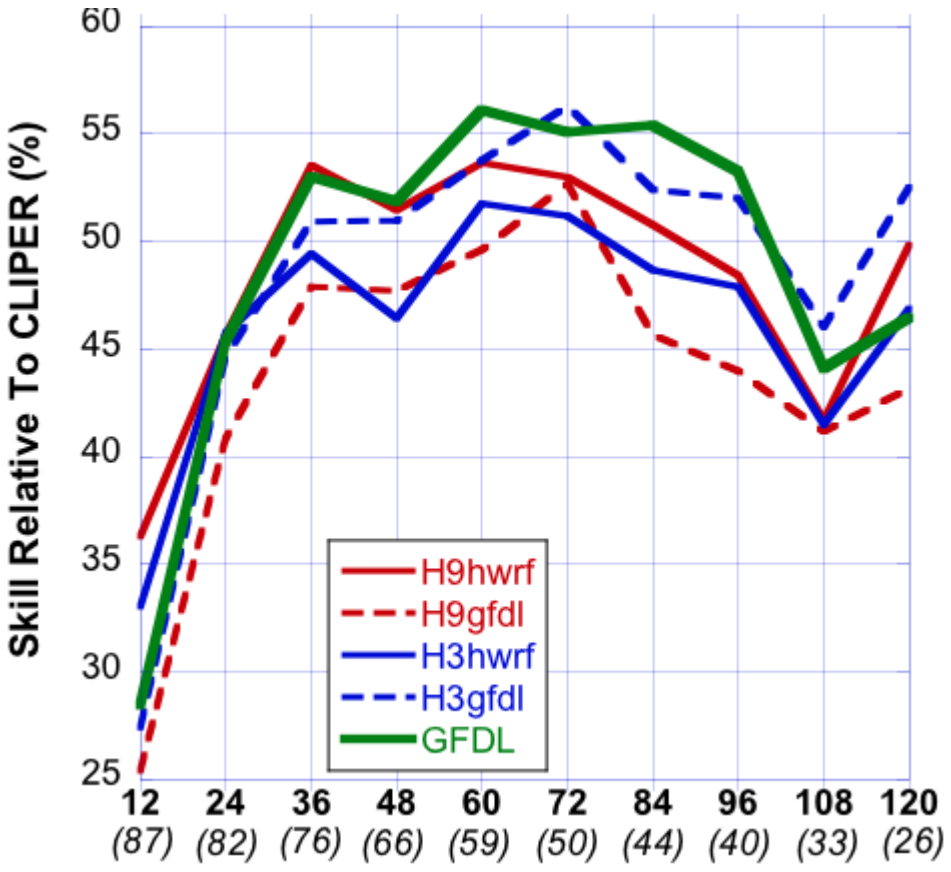**EMC Contributors:** Vijay Tallapragada, Sam Tran, Qing Fu, Zhan Zack, & Young Kwon

Acknowledgements to TCMT, HFIP & James Franklin (NHC)

Track & Intensity Forecast Skill: HWRFX (14 storms 2005/07/09)

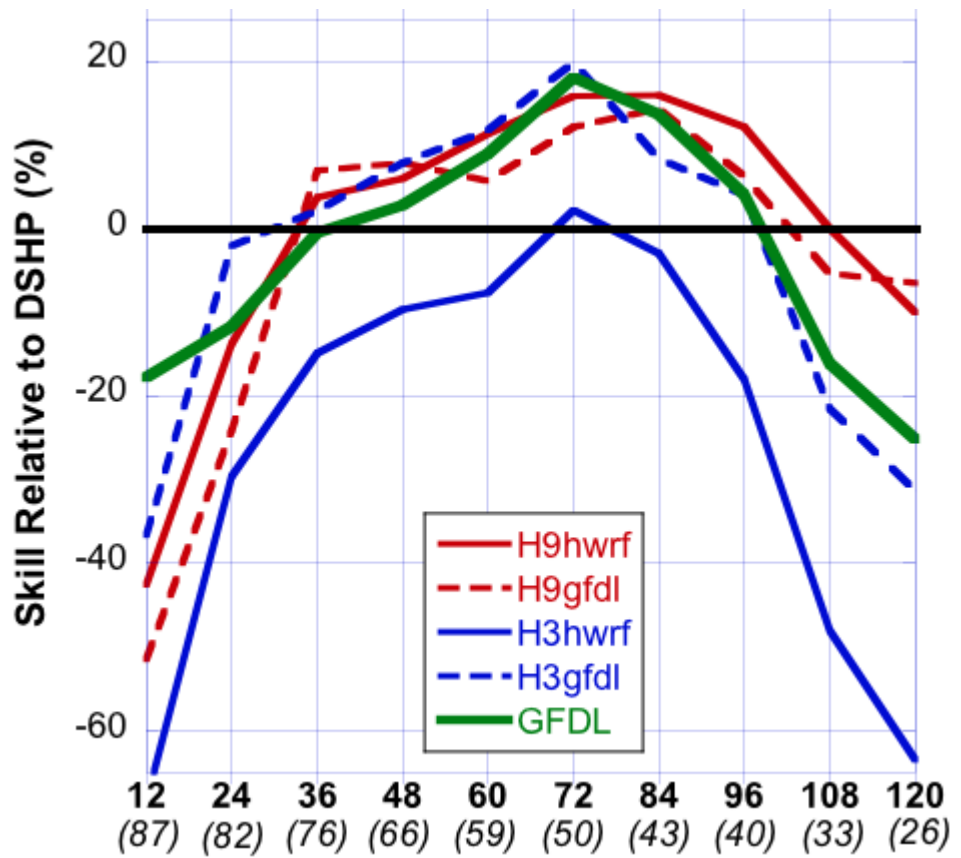## Impact of Resolution (27:9 vs 9:3 km) and Initialization (GFDL vs HWRF)

Results from Gopalakrishnan et al. 2012

Track forecast Skill

Skill for all Forecast Intervals
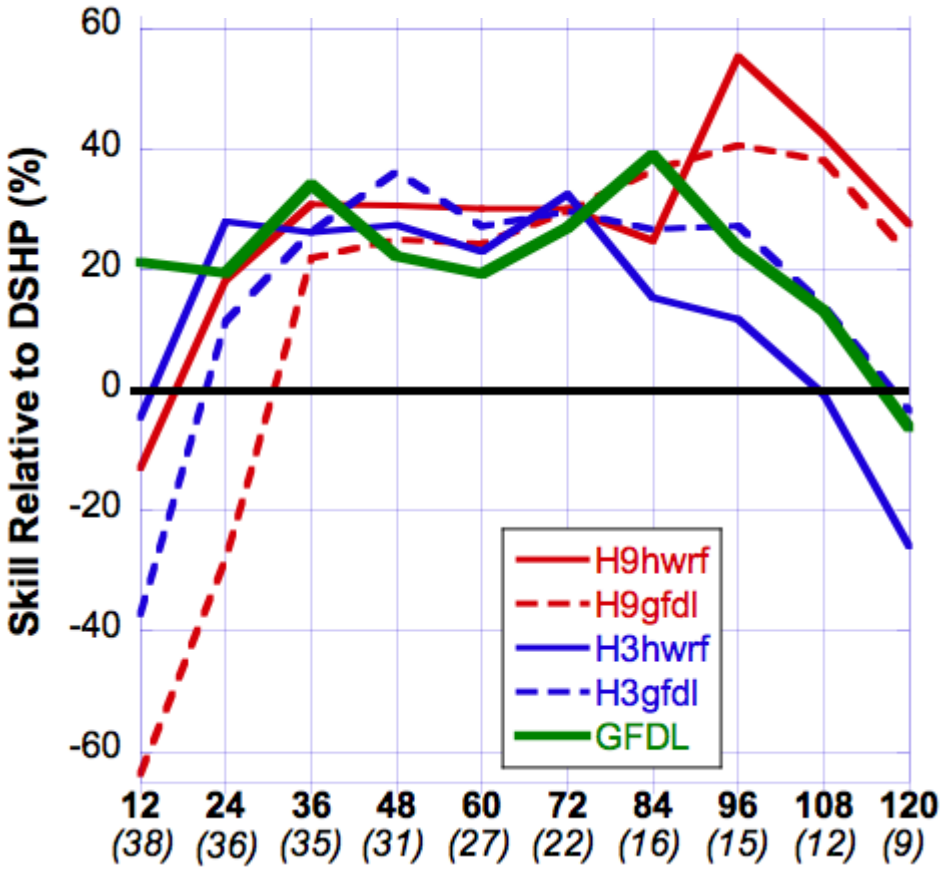
Intensity Forecast "Skill"

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)
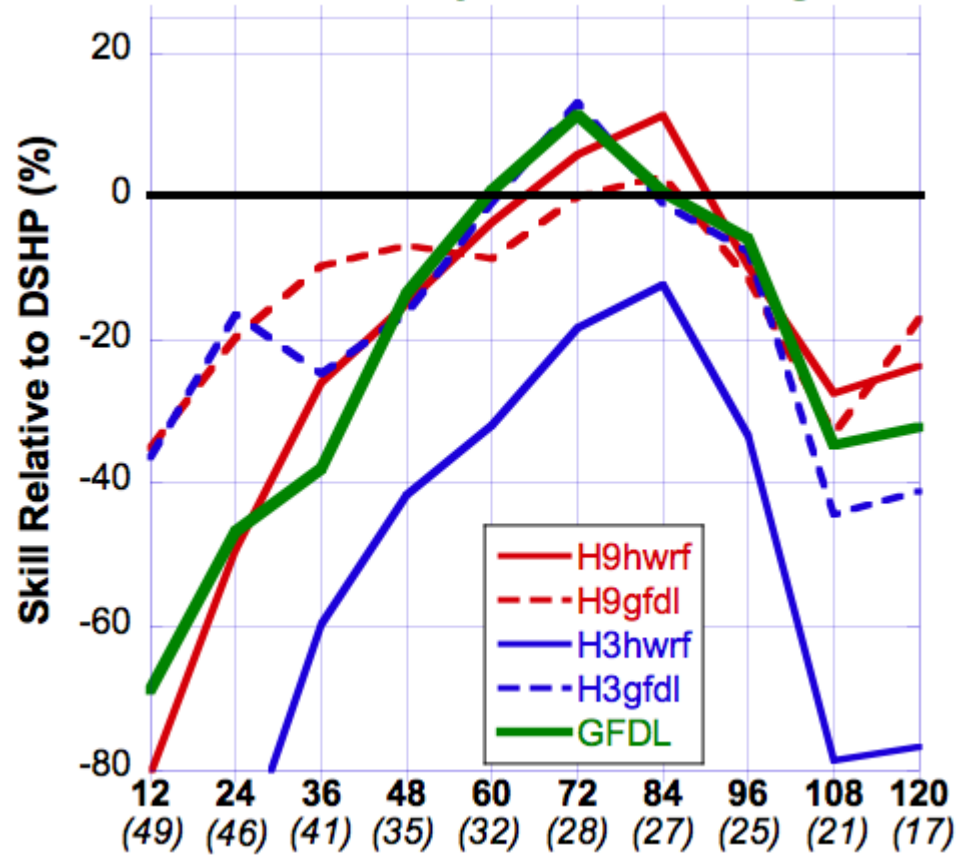### Results from Gopalakrishnan et al. 2012

Initially Hurricane Strength

Initially <Hurricane Strength

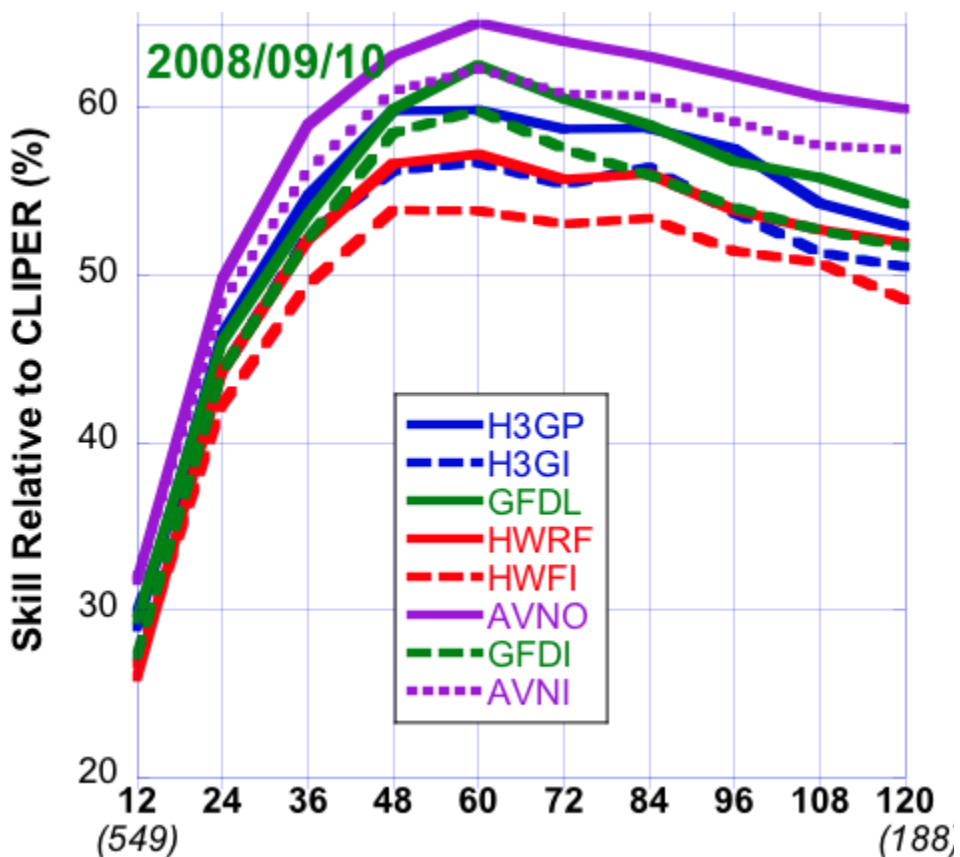*Stat Sig Skill for most Forecast Intervals*

No Significant skill for any model

Track & Intensity Forecast Skill: H3GP (31 storms: 2008/09/10)
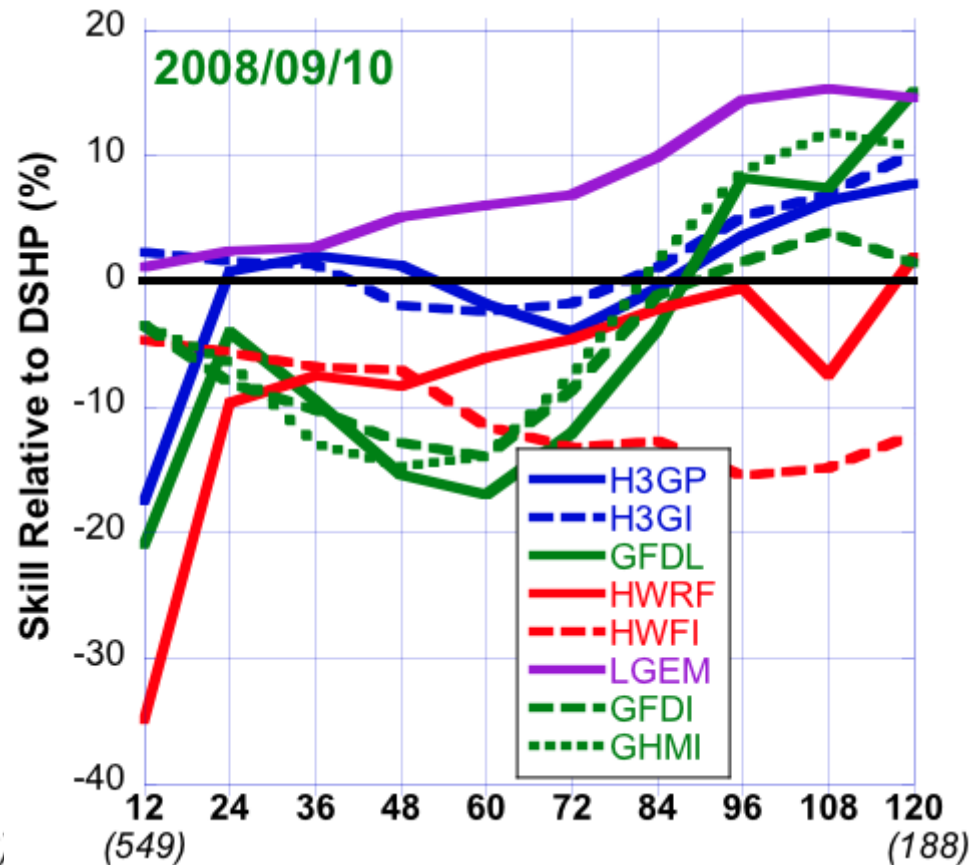## Retrospective Runs to test Stream 1.5 (27:9:3 km)
(Pre-2011 Season)

TRACK FORECAST SKILL

INTENSITY FORECAST SKILL
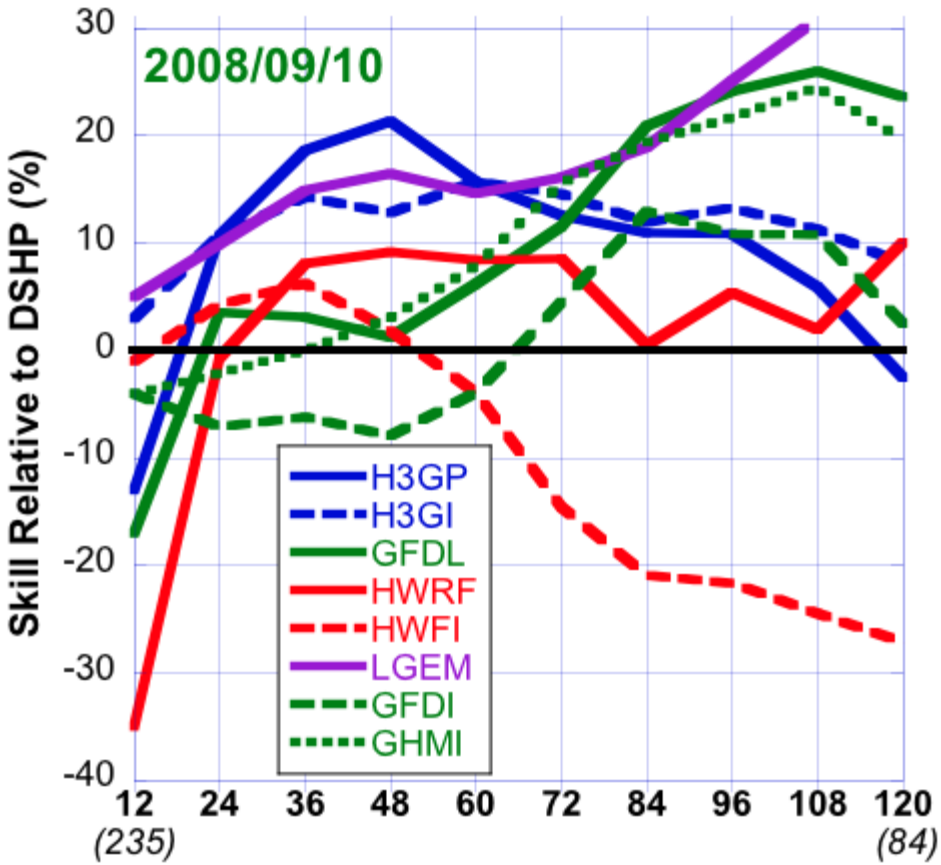
H3GP: Better than HWRF
Comparable to GFDL

H3GP: Improved over HWRF
& Comparable or better than GFDL

Stratified Intensity Forecast Skill: H3GP (31 storms: 2008/09/10)
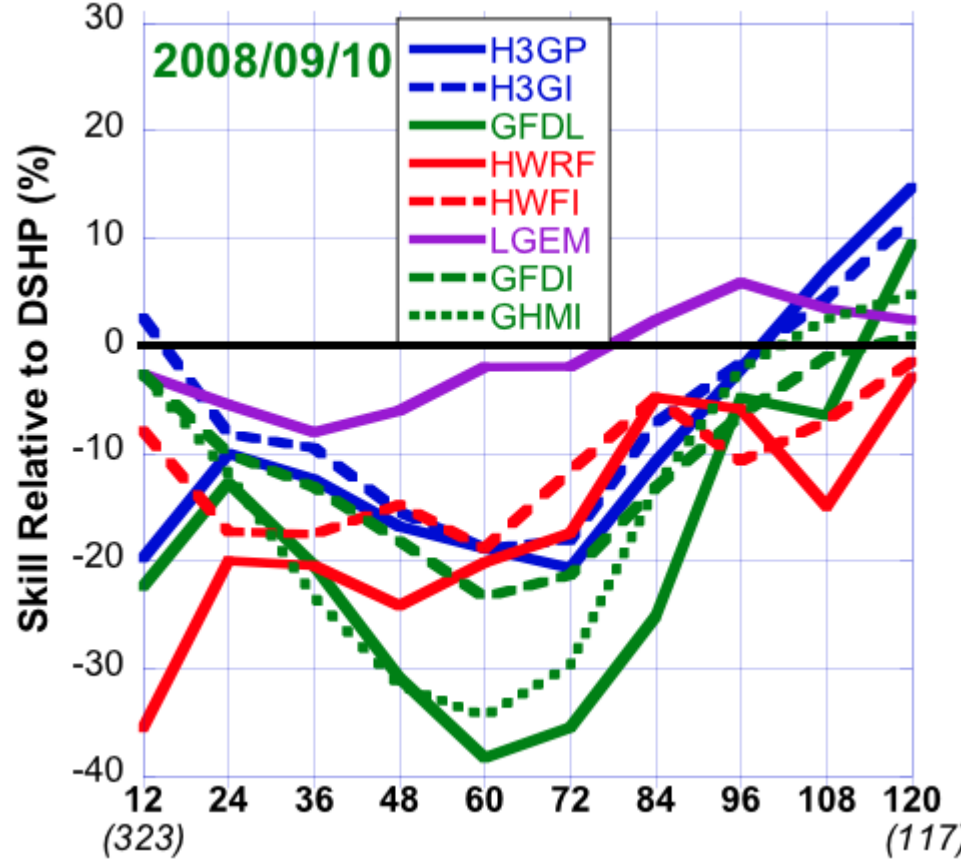## Pre-2011 Season Retrospective Runs to test Stream 1.5 (27:9:3 km)

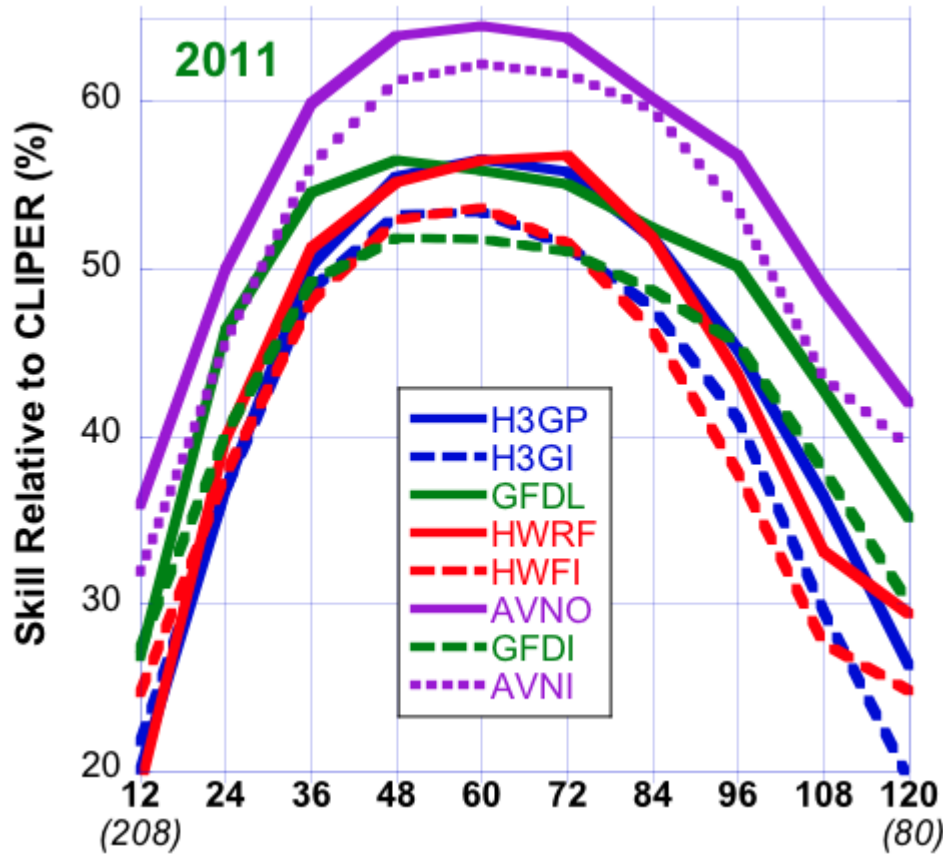*H3GP*: Improved over *HWRF* & Mixed with *GFDL*

H3GP: Improved over *HWRF* & *GFDL* (But No Significant skill for any model)

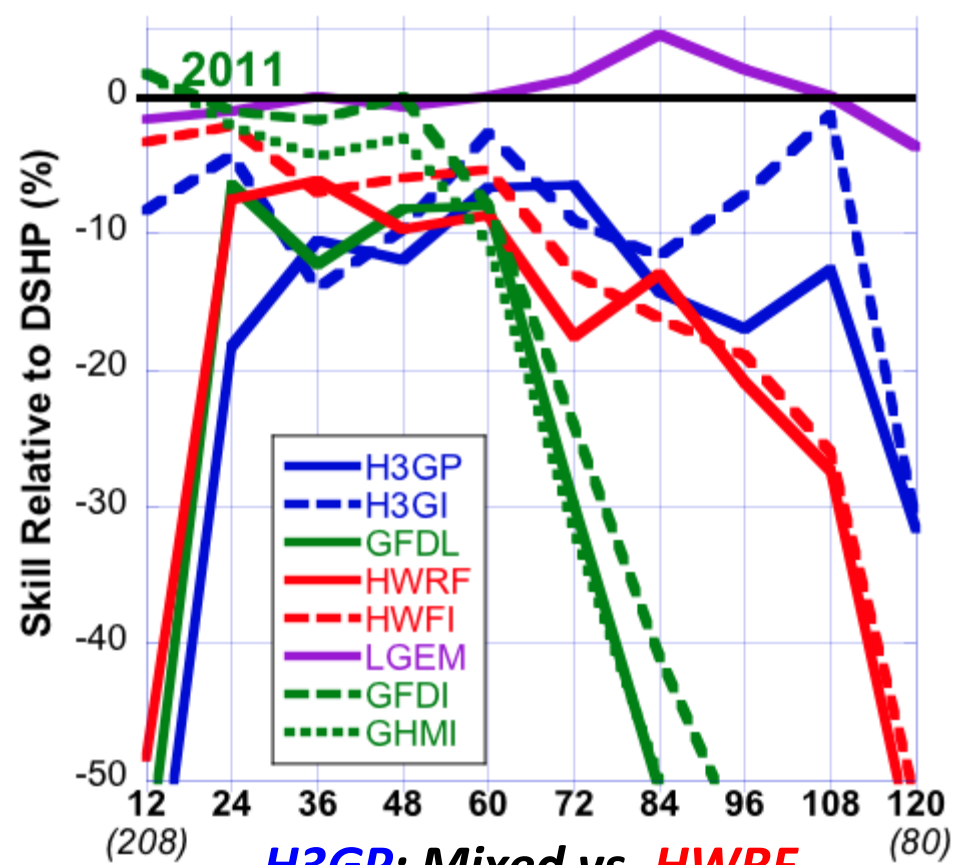# Track & Intensity Forecast Skill H3GP (17 storms(A to P):2011)
2011 Real-Time Season Runs to test Stream 1.5 (27:9:3 km)

TRACK FORECAST SKILL

2011

Skill Relative to CLIPER (%)

| H3GP |
| H3GI |
| GFDL |
| HWRF |
| HWFI |
| AVNO |
| GFDI |
| AVNI |

H3GP: Comparable with HWRF
Slightly Worse than GFDL

INTENSITY FORECAST SKILL

2011

Skill Relative to DSHP (%)

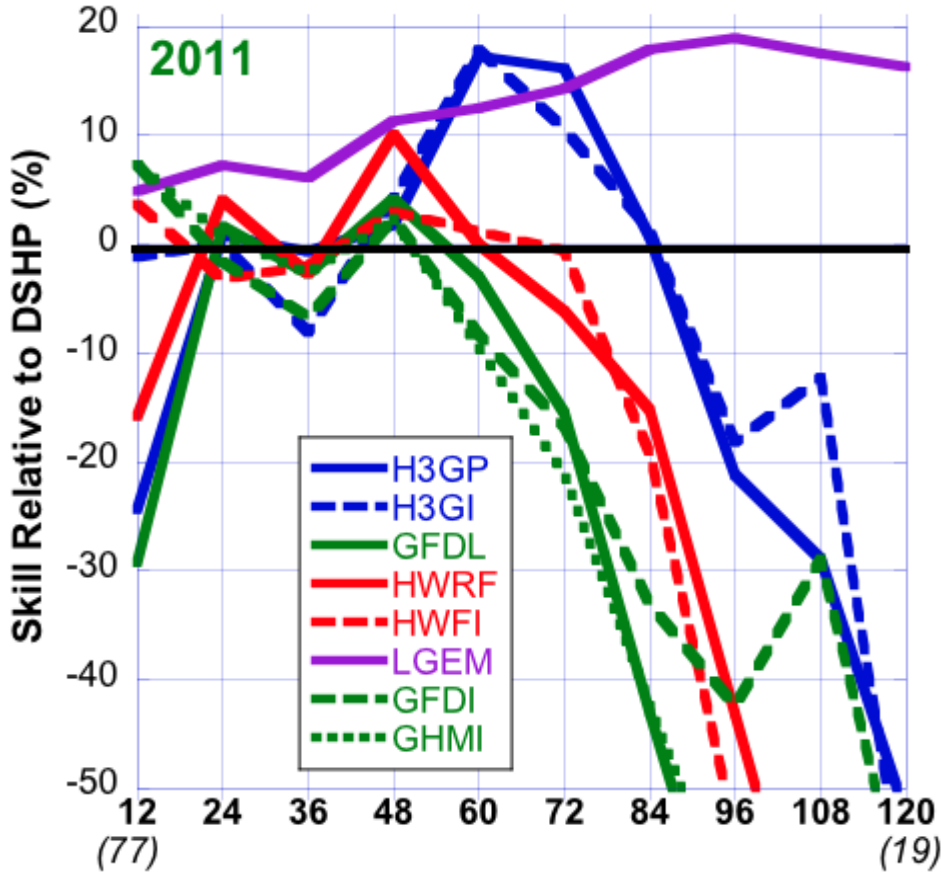| H3GP |
| H3GI |
| GFDL |
| HWRF |
| HWFI |
| LGEM |
| GFDI |
| GHMI |

H3GP: Mixed vs. HWRF
Better than GFDL after 60 hr
(But No Significant skill for any model)

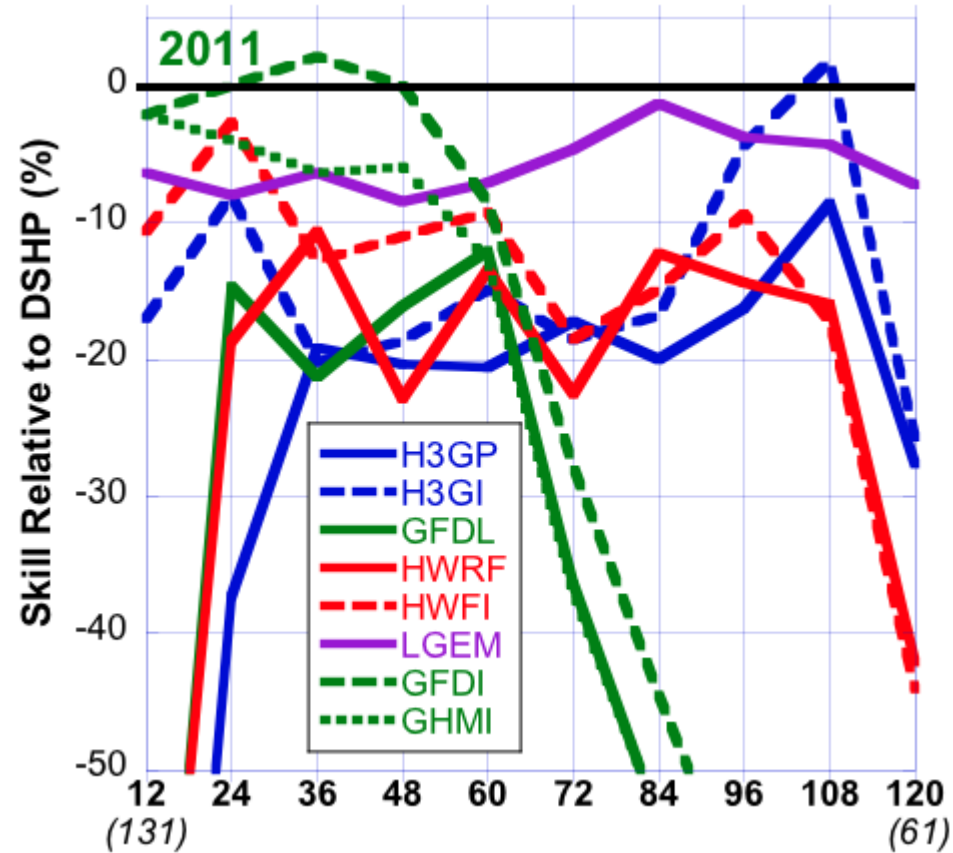# Stratified Intensity Forecast Skill H3GP (17 storms(A to P): 2011)
2011 Real-Time Season Runs to test Stream 1.5 (27:9:3 km)

Initially Hurricane Strength

Initially <Hurricane Strength
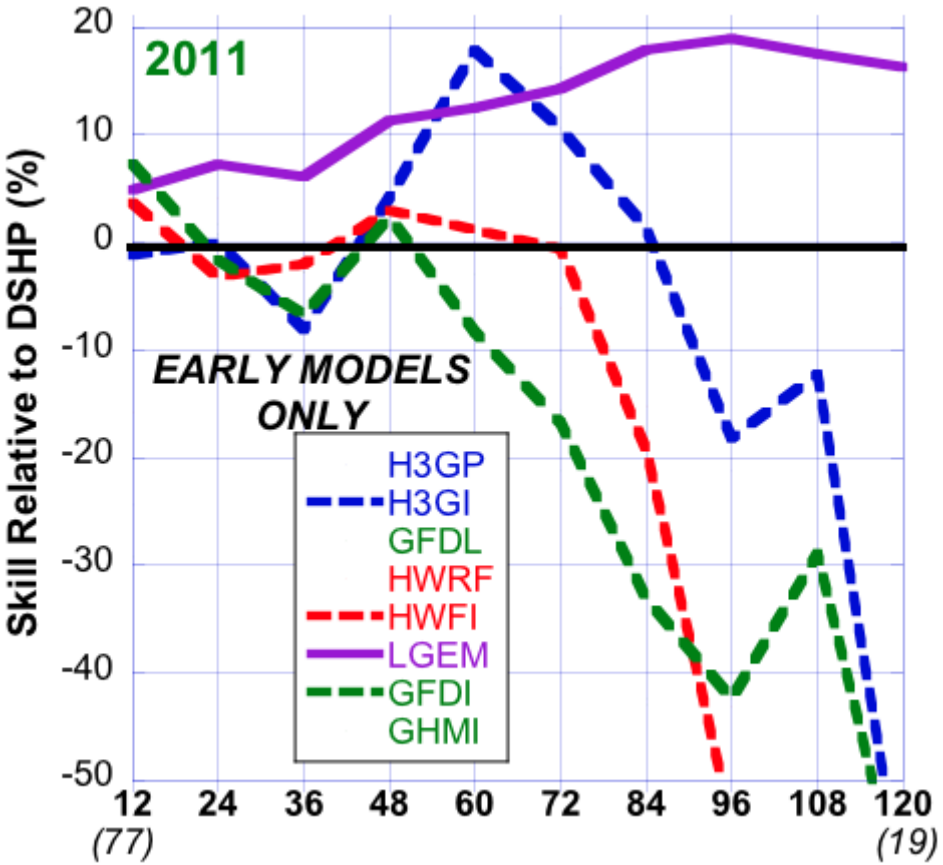
H3GP: After 48 hr much improved Over HWRF & GFDL

H3GP: Improved over HWRF & GFDL (But No Significant skill for any model)

Stratified Intensity Forecast Skill H3GP (17 storms(A to P): 2011)

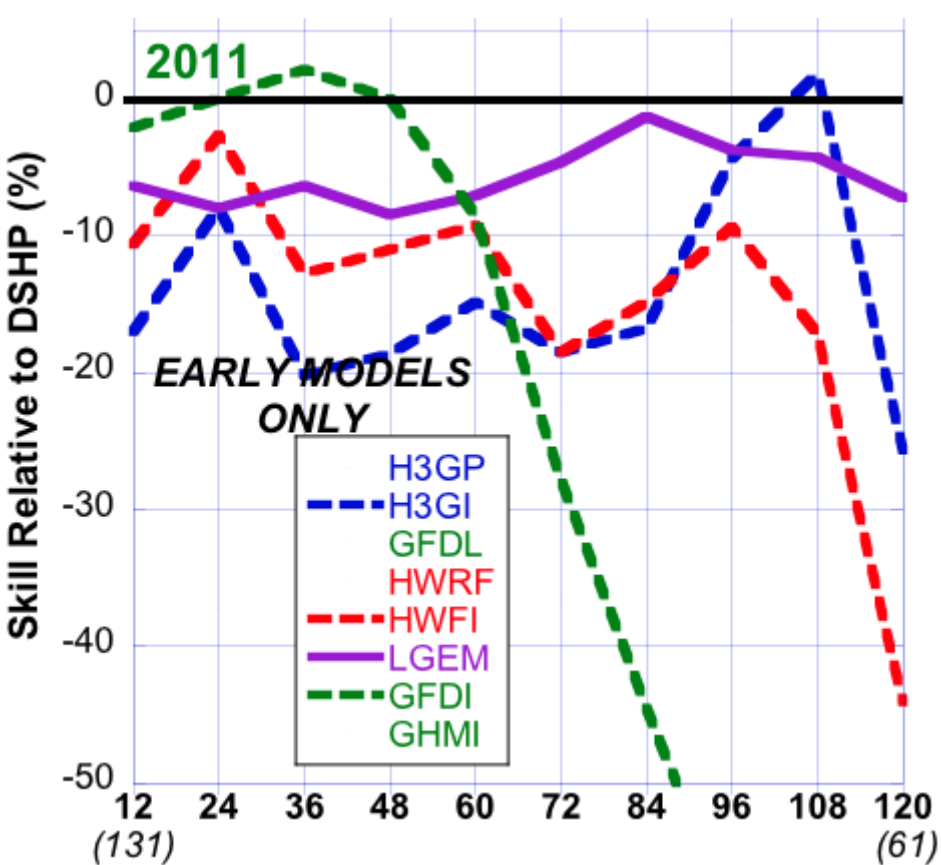## 2011 Real-Time Season Runs to test Stream 1.5 (27:9:3 km)

Initially Hurricane Strength

Initially <Hurricane Strength

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**:

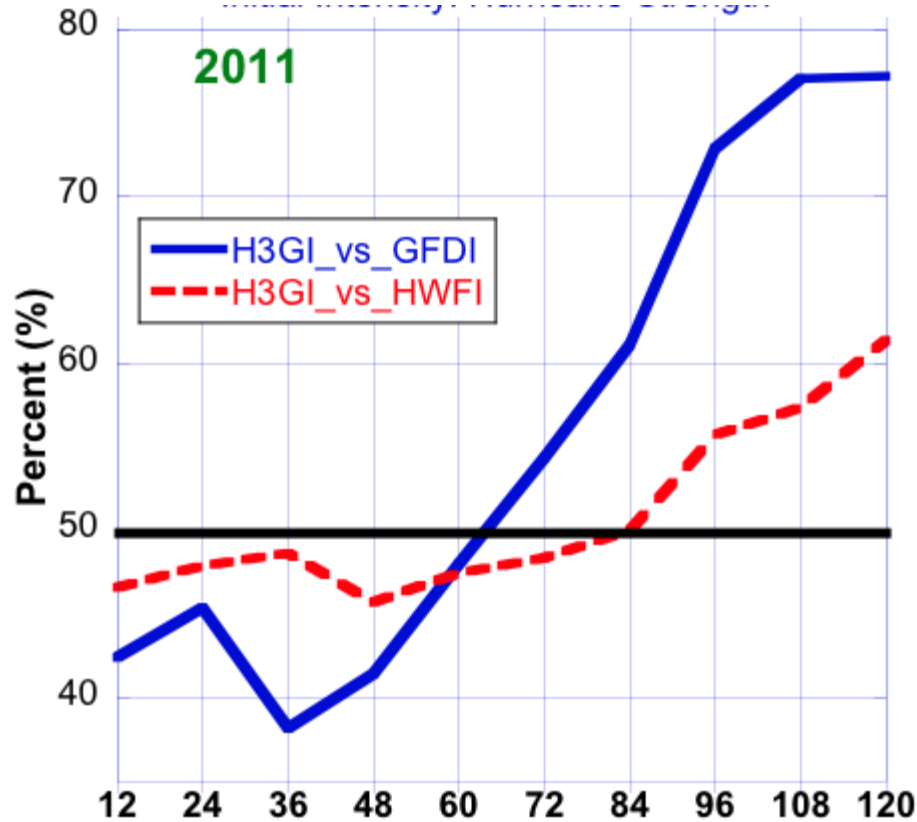Degrades Track slightly but generally IMPROVES Intensity forecasts.

Different schemes affect results

FSP & Bias (Intensity) H3GP (17 storms(A to P): 2011)
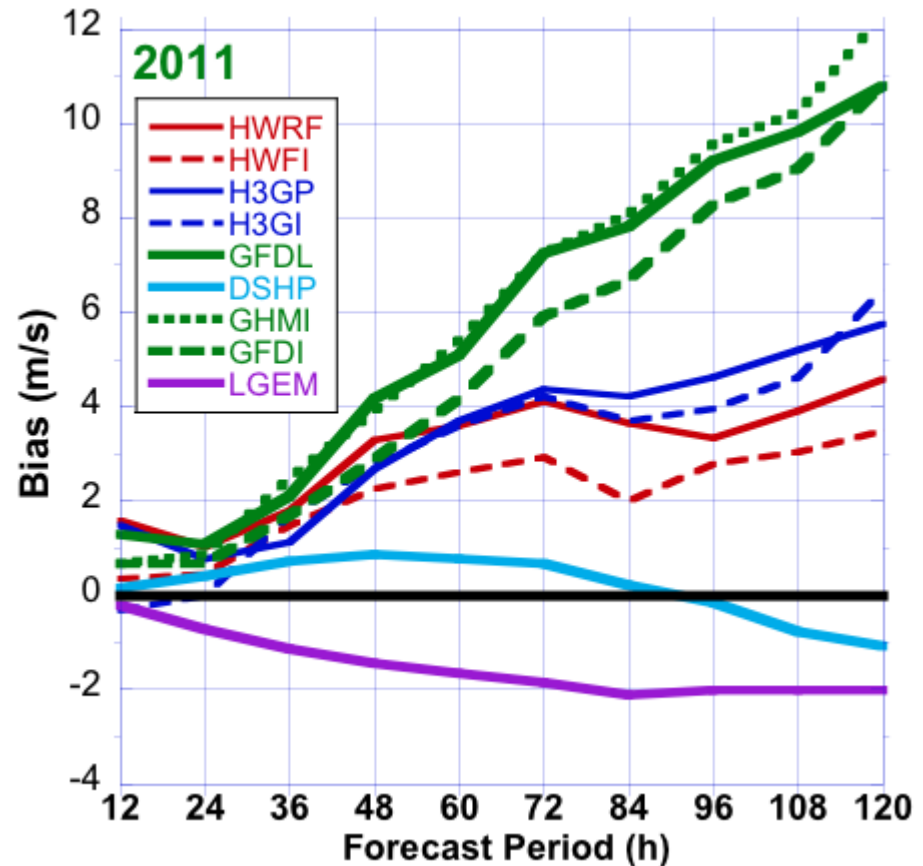2011 Real-Time Season Runs to test Stream 1.5 (27:9:3 km)

FSP
Initially Hurricane Strength

Bias (All Cases)

H3GP: After 60 hr much improved
Over GFDL

Extreme Positive Bias: GFDL