WISCONSIN
UNIVERSITY OF WISCONSIN–MADISON

Performance and Development of the UW-NMS in 2011

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HFIP Annual Review

9 November 2011

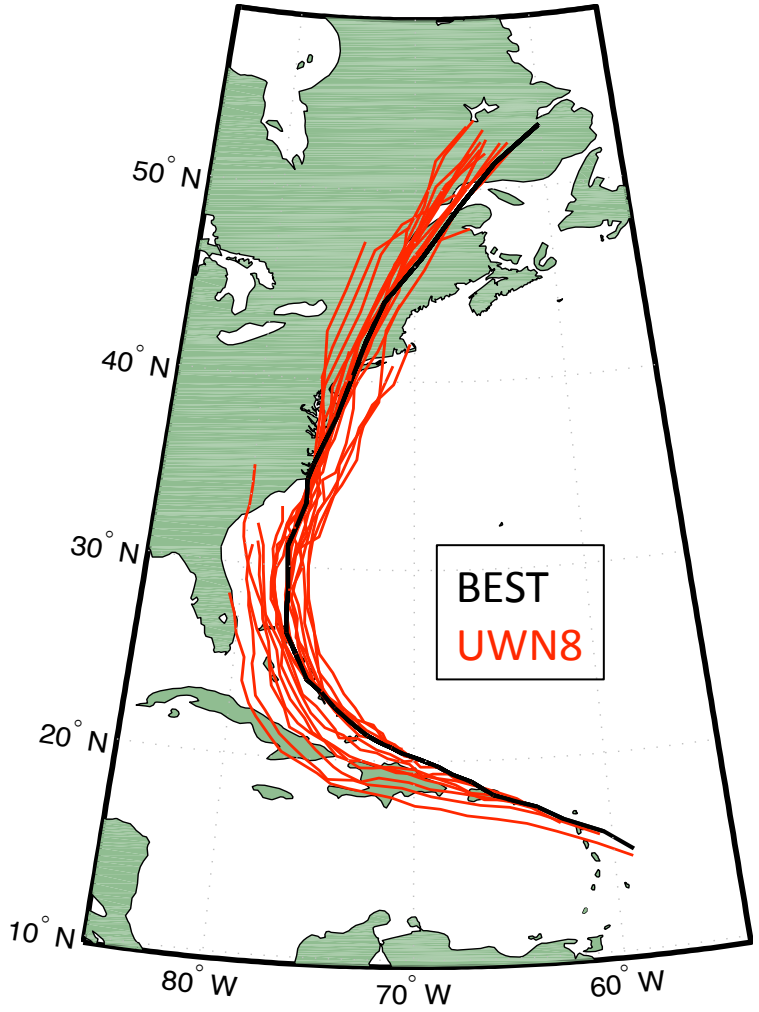
Stream 1.5 Configuration

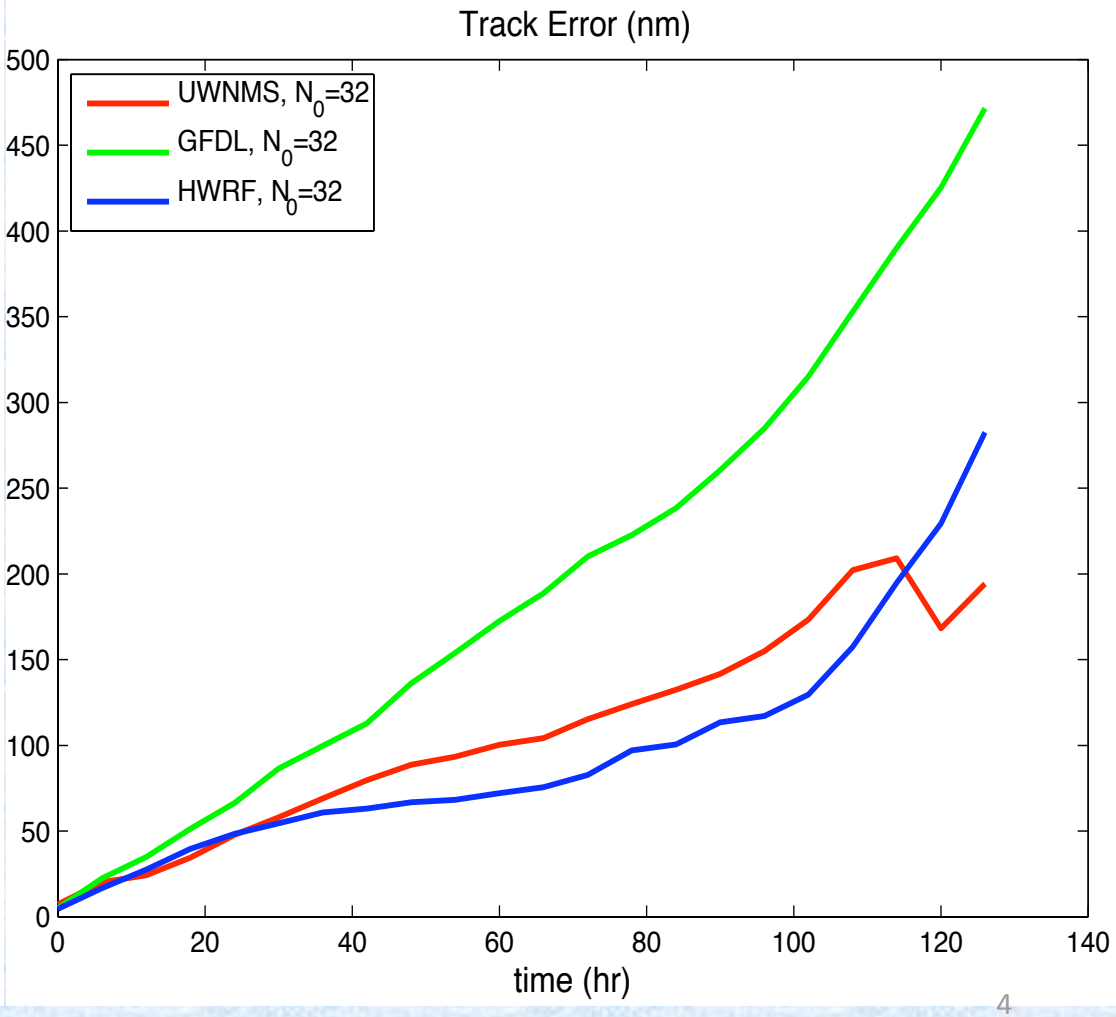
- g1: 205x150 @ 40km spacing
- g2: 92x92 @ 8km spacing (storm-following)
- nz=33 @ 300m stretched to 1000m spacing; model top @ 24km
- Kuo cumulus parameterization (g1 and g2)
- 1-moment bulk micro (rain, snow), 2-moment bulk micro (pristine crystals)
- RRTM LW and SW radiation
- NOAH LSM (CZIL=0.1, default)
- 1.5-layer ocean w/ bulk Richardson turbulence closure (à la Price, 1981).
- 1.5-order TKE closure w/ TKE production derived from filtered kinetic energy loss
- Kwon and Cheong (2010) bogus vortex initialization (only for TC intensity >= 34kt)
- COARE 2.6 + Andreas et al. (2008) sea-spray parameterization

Datasets

- Operational GFS analysis (IC) and forecasts (BC)
- FNMOC GHRSST 9-km SST analysis
- Levitus 1° climatology (1982) for subsurface ocean thermal structure
- TCVITALS (lat, lon, vmax, rmw, r34 input to bogus generation routine)
- No data assimilation

Hurricane Irene (09L)





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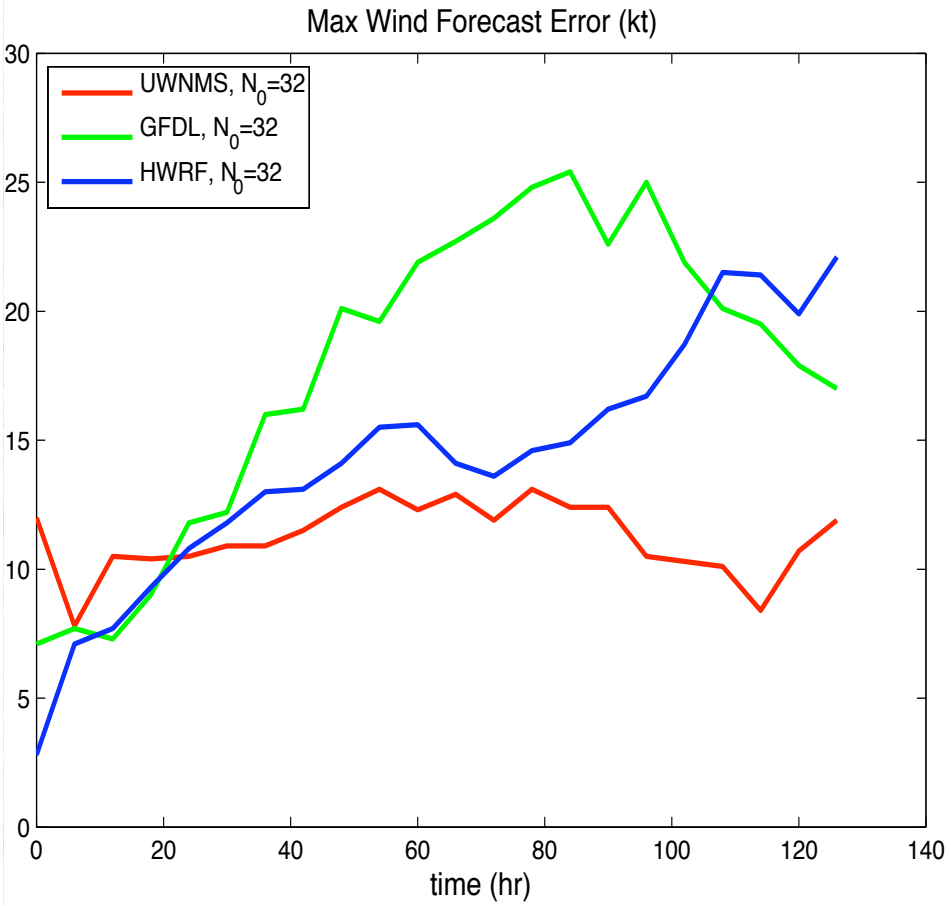
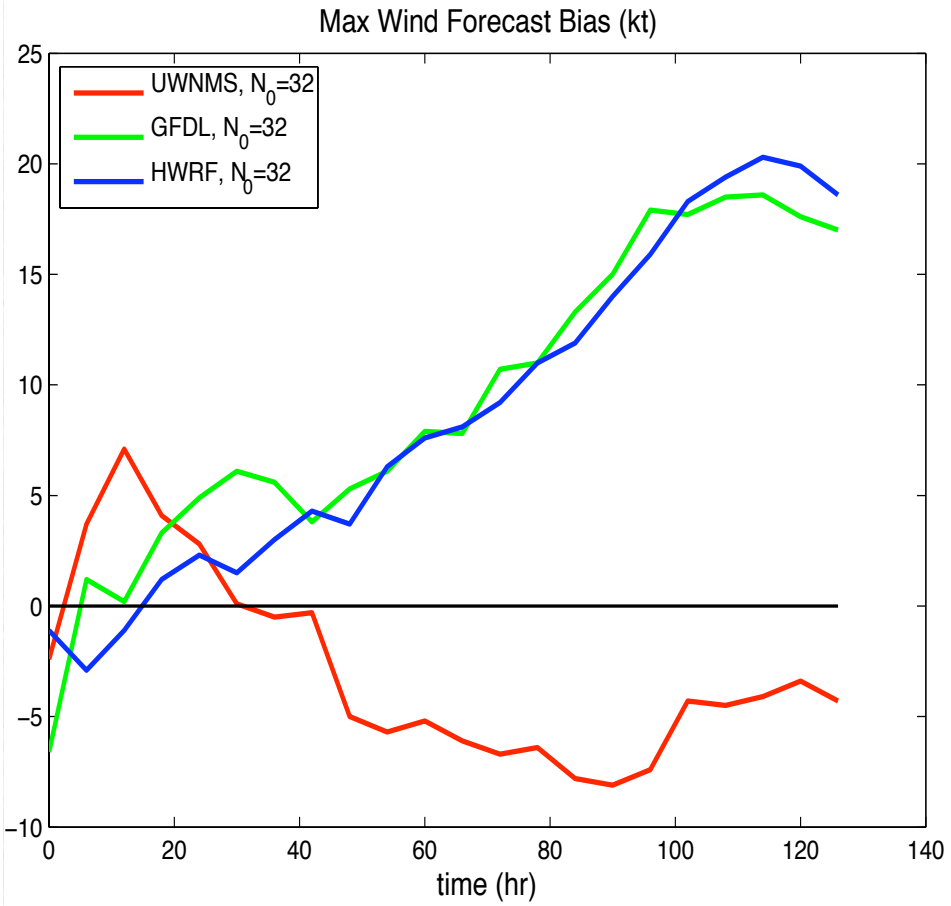
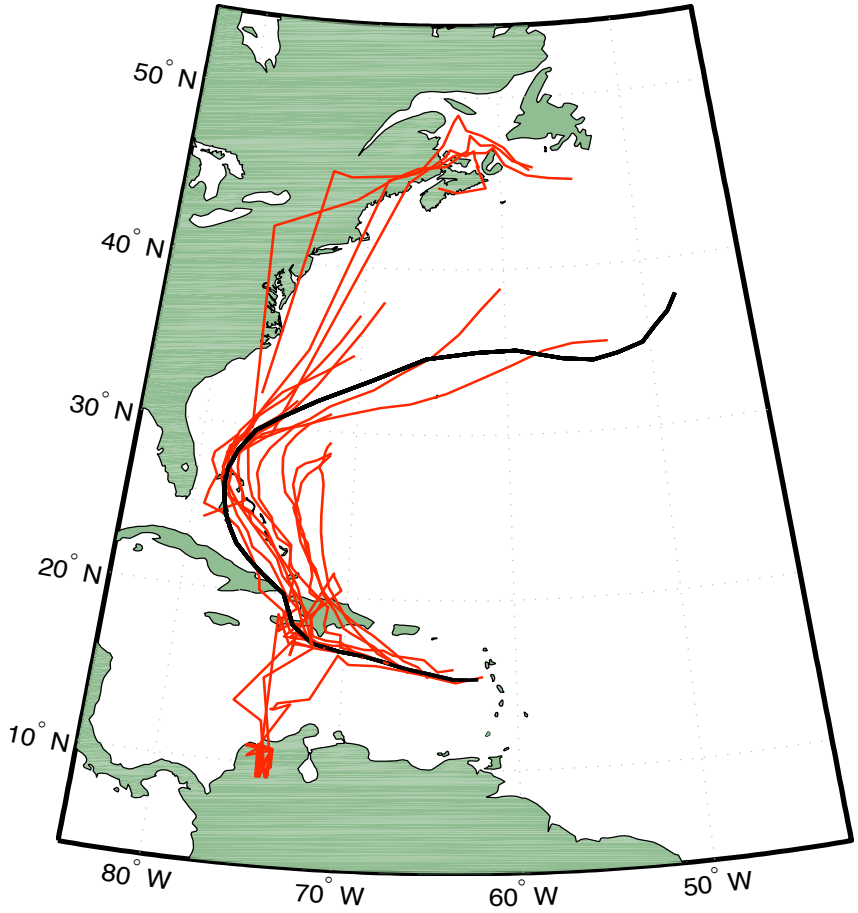
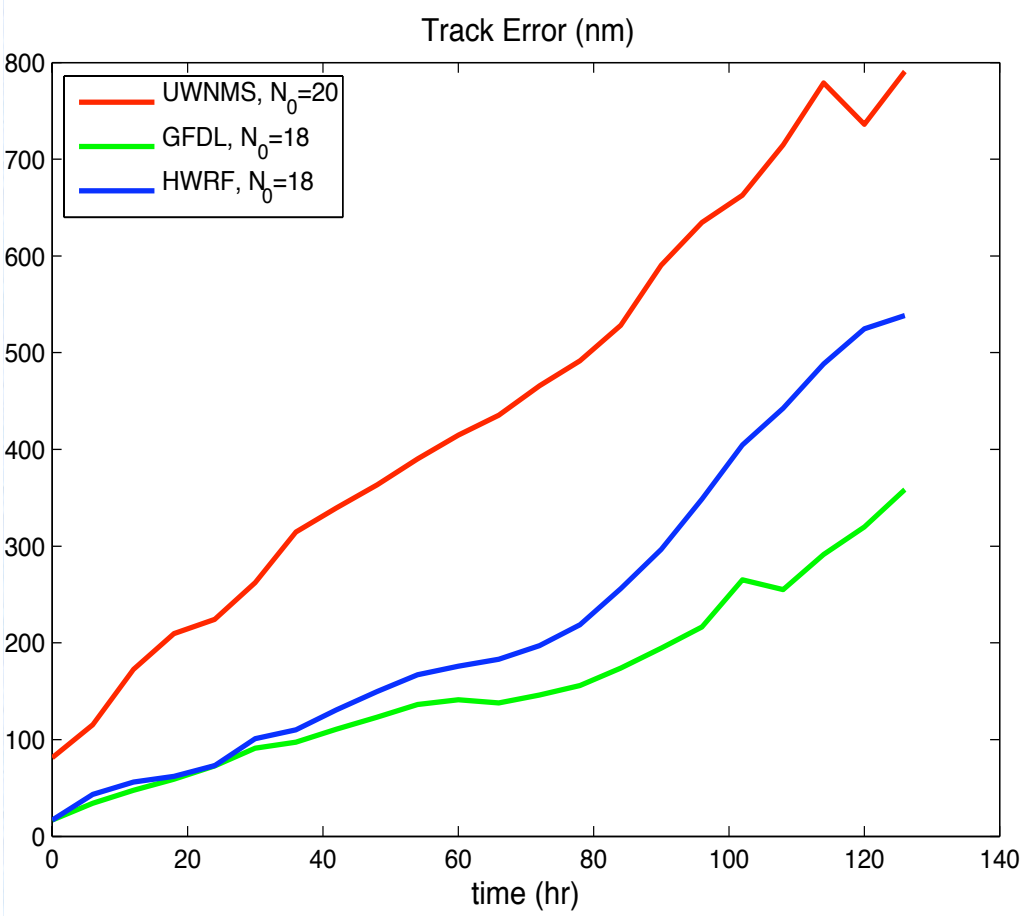




Tropical Storm Emily (05L)





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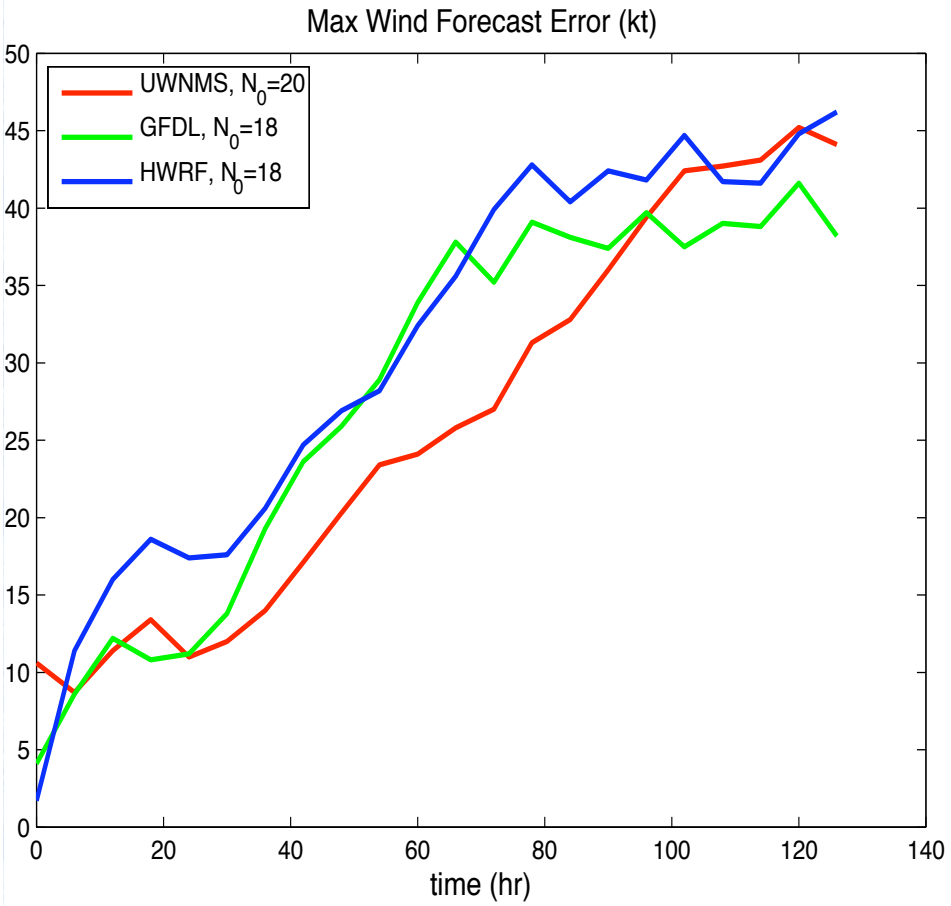
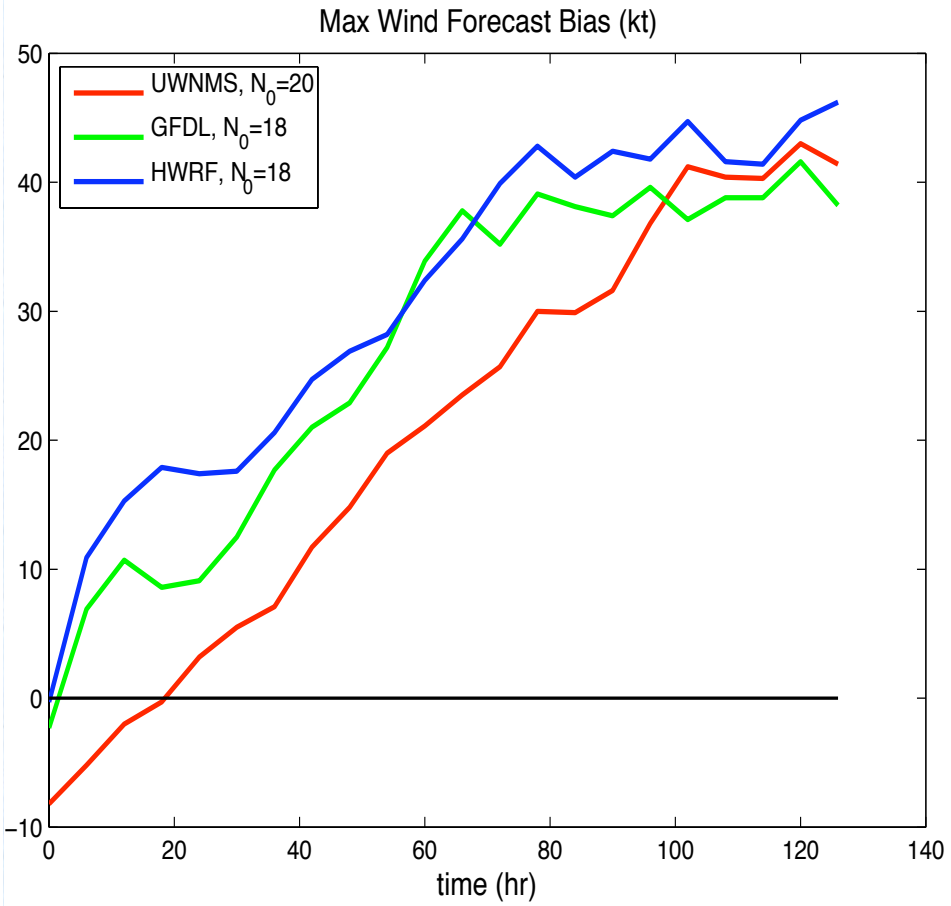
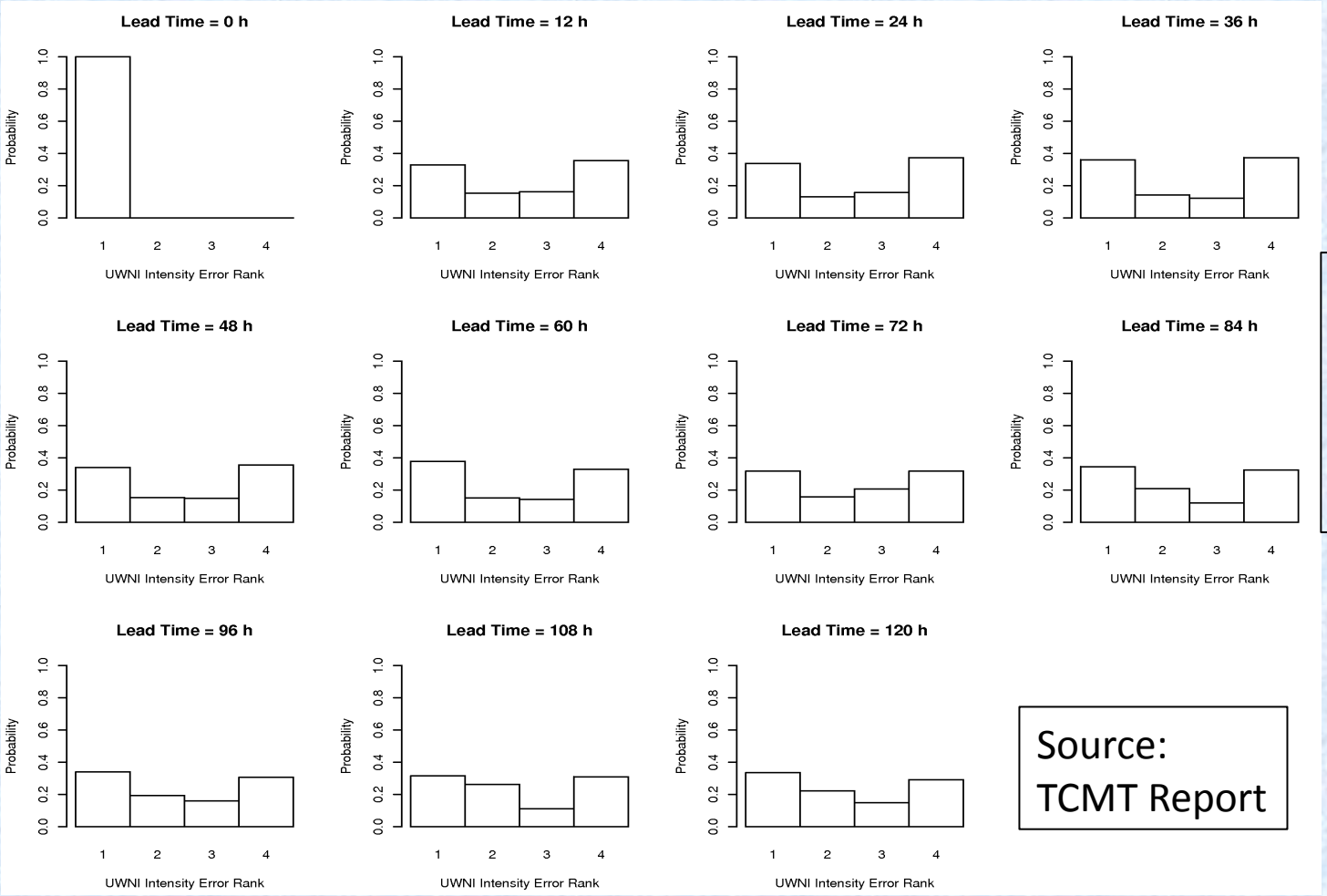




Retro Test Recap

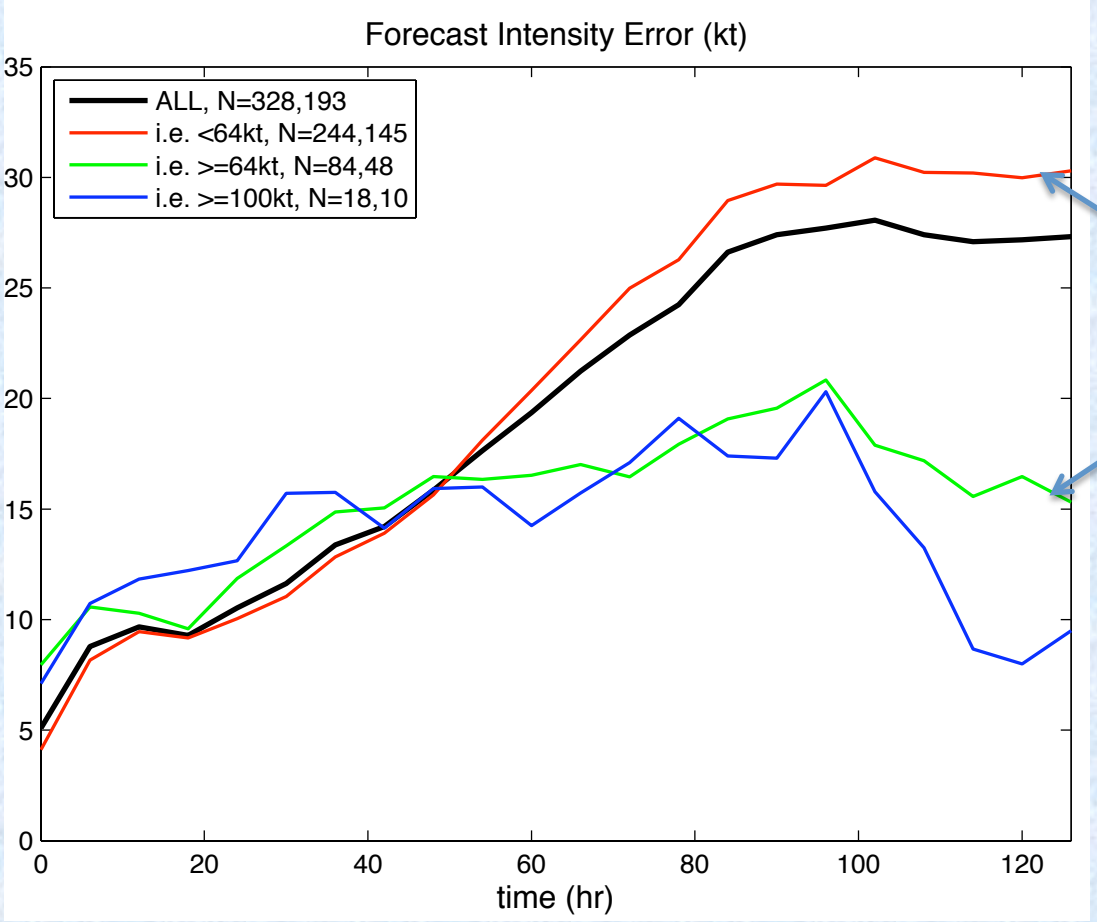


UWNI tended to perform either best or worst vs. top flight models at all lead times.

WHY????

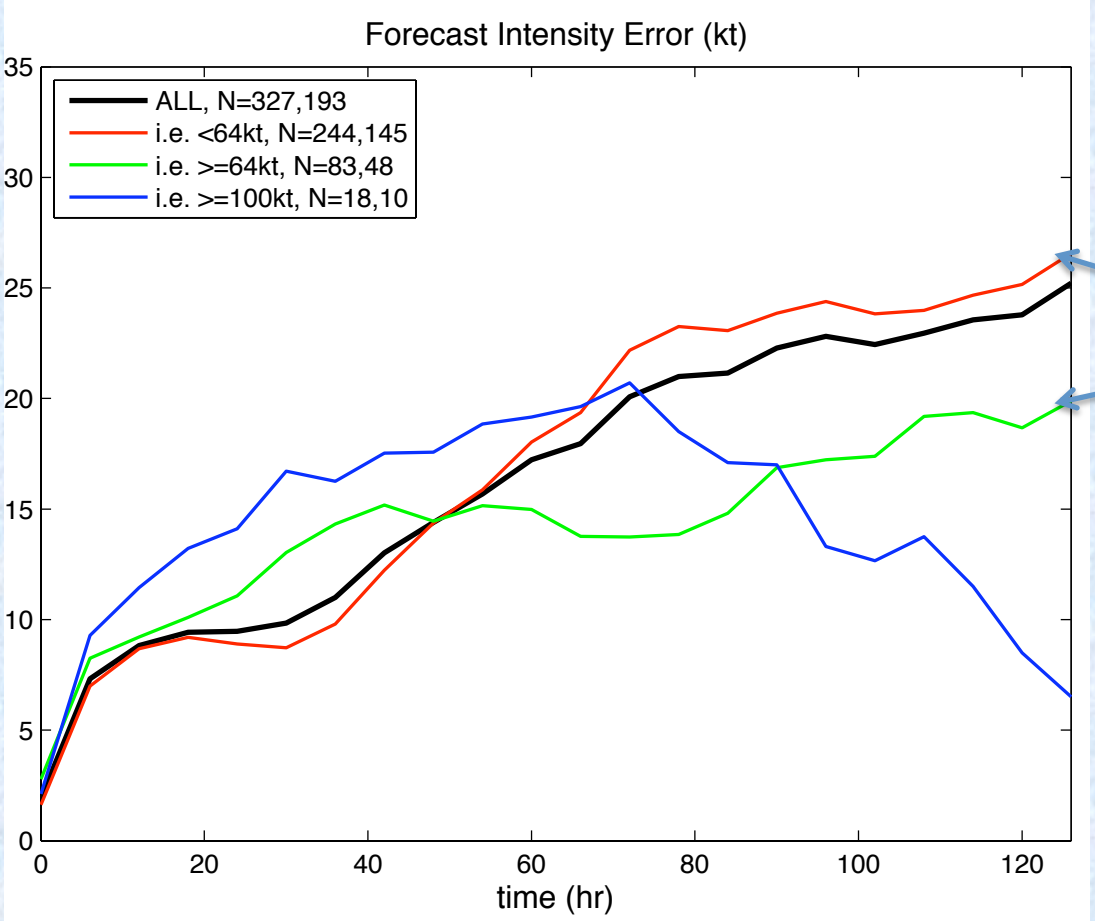
Source: TCMT Report

GFDL YTD (thru Philippe)



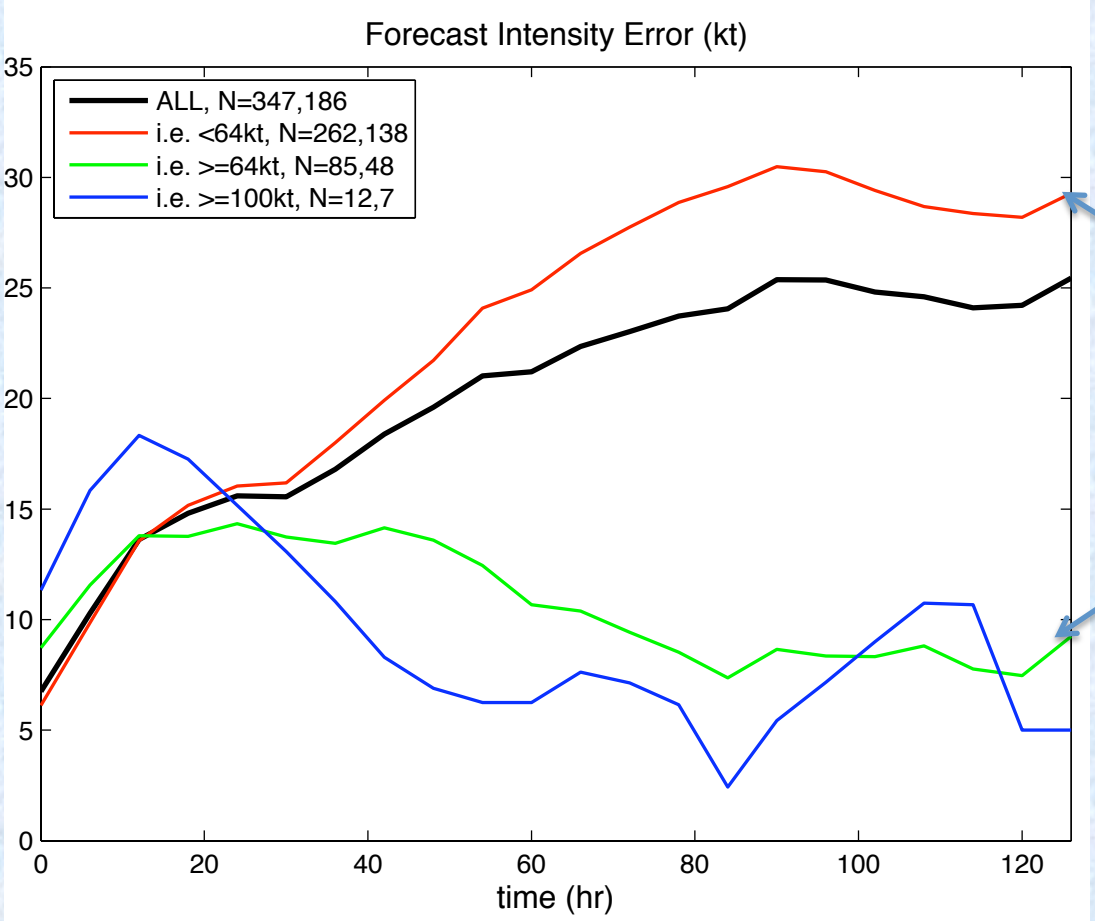
Large separation in performance after 48 hrs

HWRF YTD (thru Philippe)



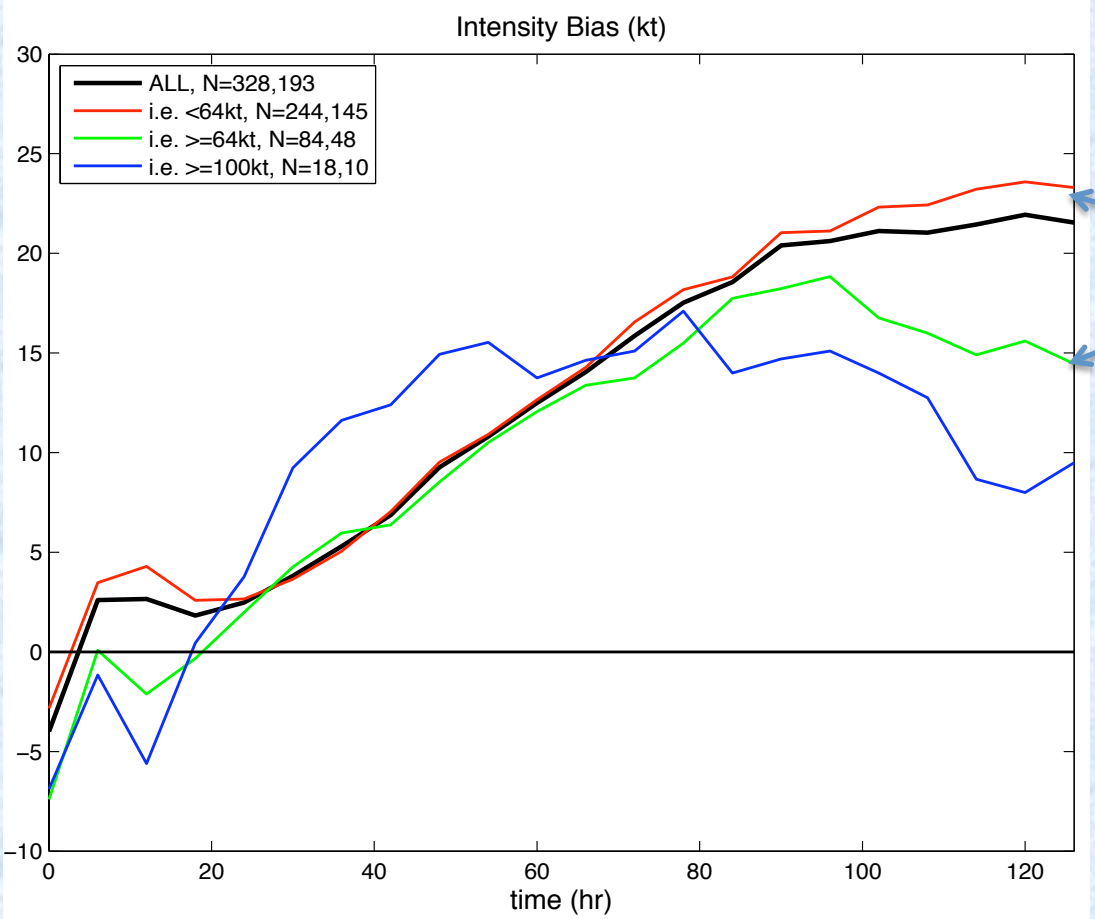
Small separation in performance throughout

UWN8 YTD (thru Philippe)



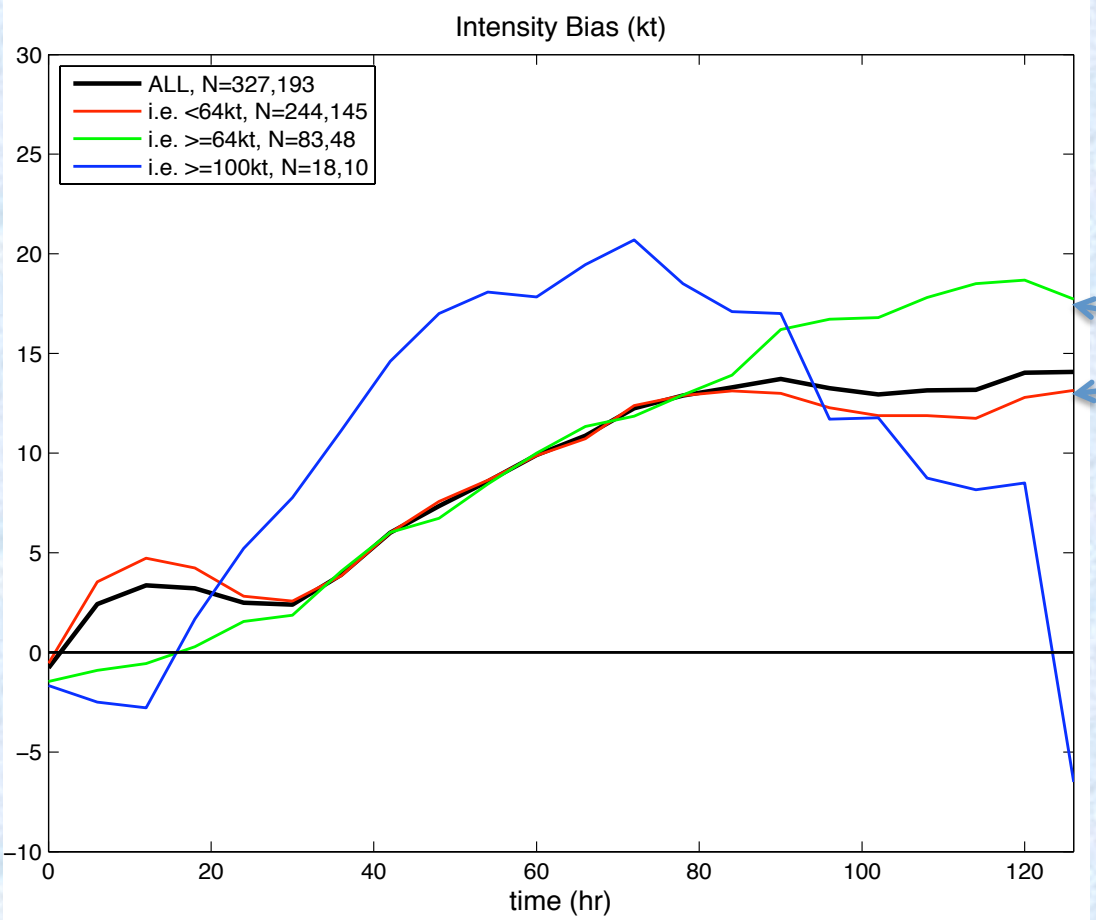
Very large separation in performance after 12 hrs

GFDL YTD (thru Philippe)



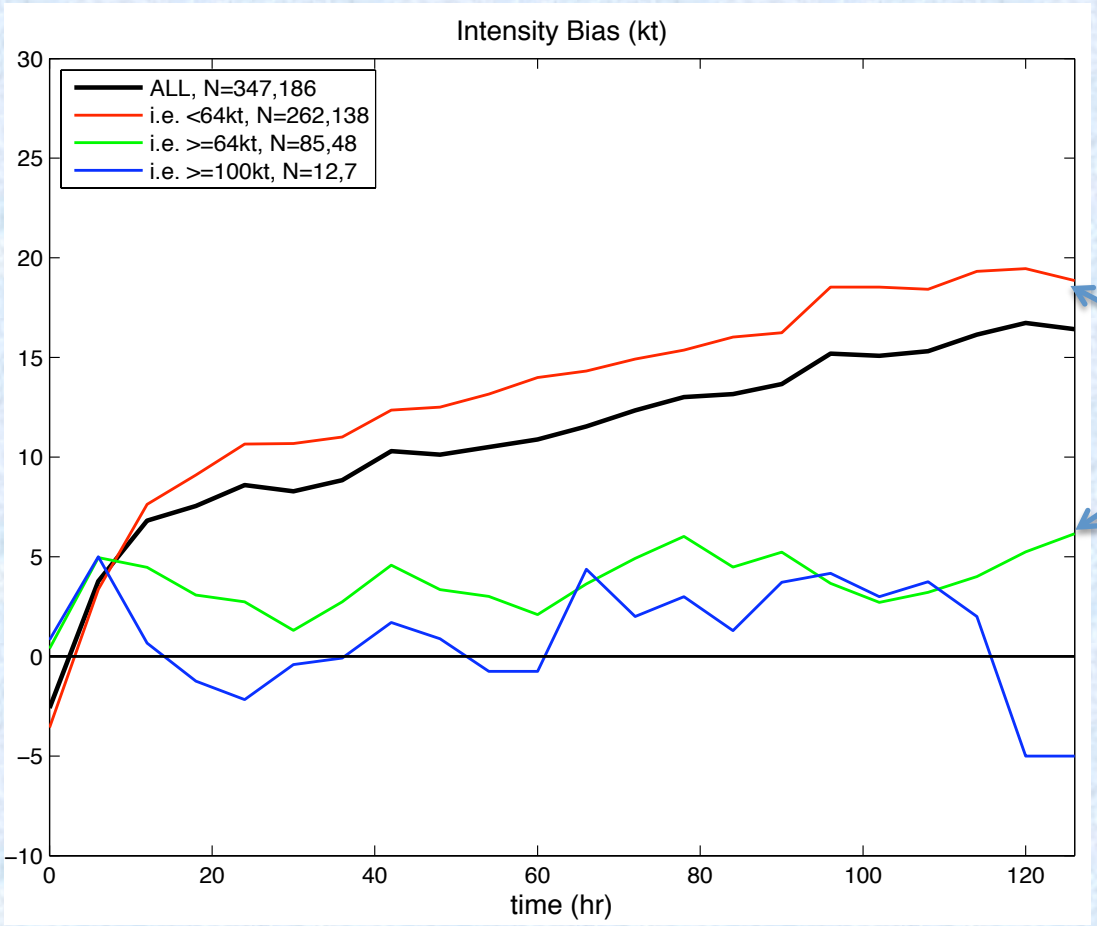
Small separation in performance after 60 hrs

HWRF YTD (thru Philippe)



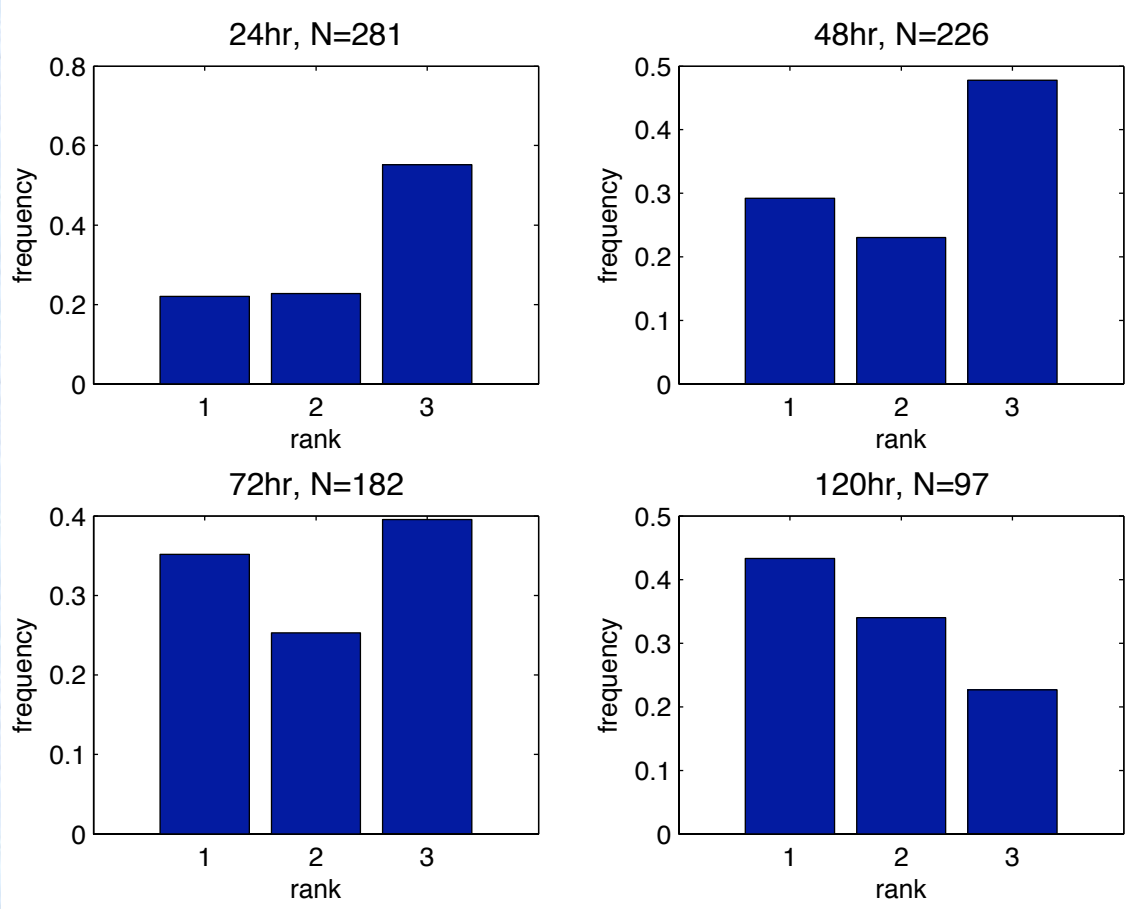
Small separation in performance after 80 hrs

UWN8 YTD (thru Philippe)

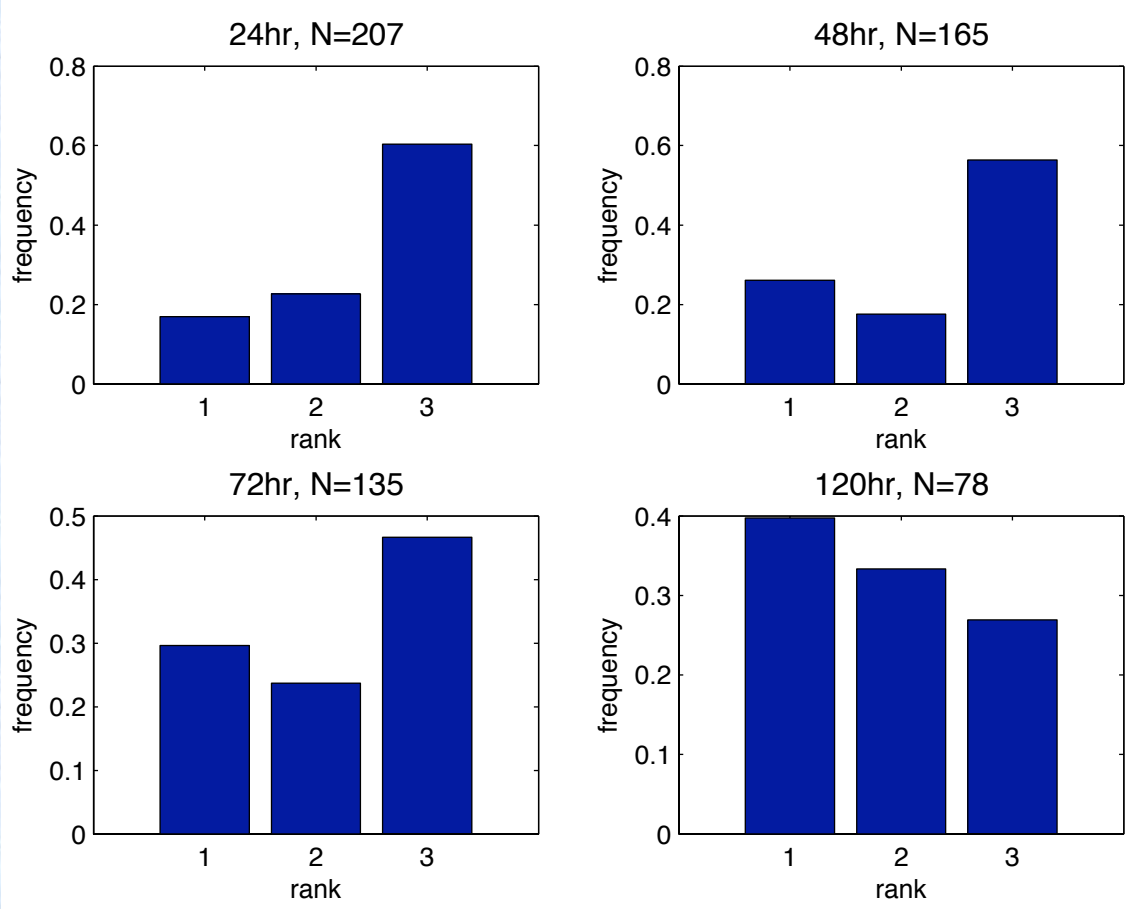


Very large separation in performance after 12 hrs

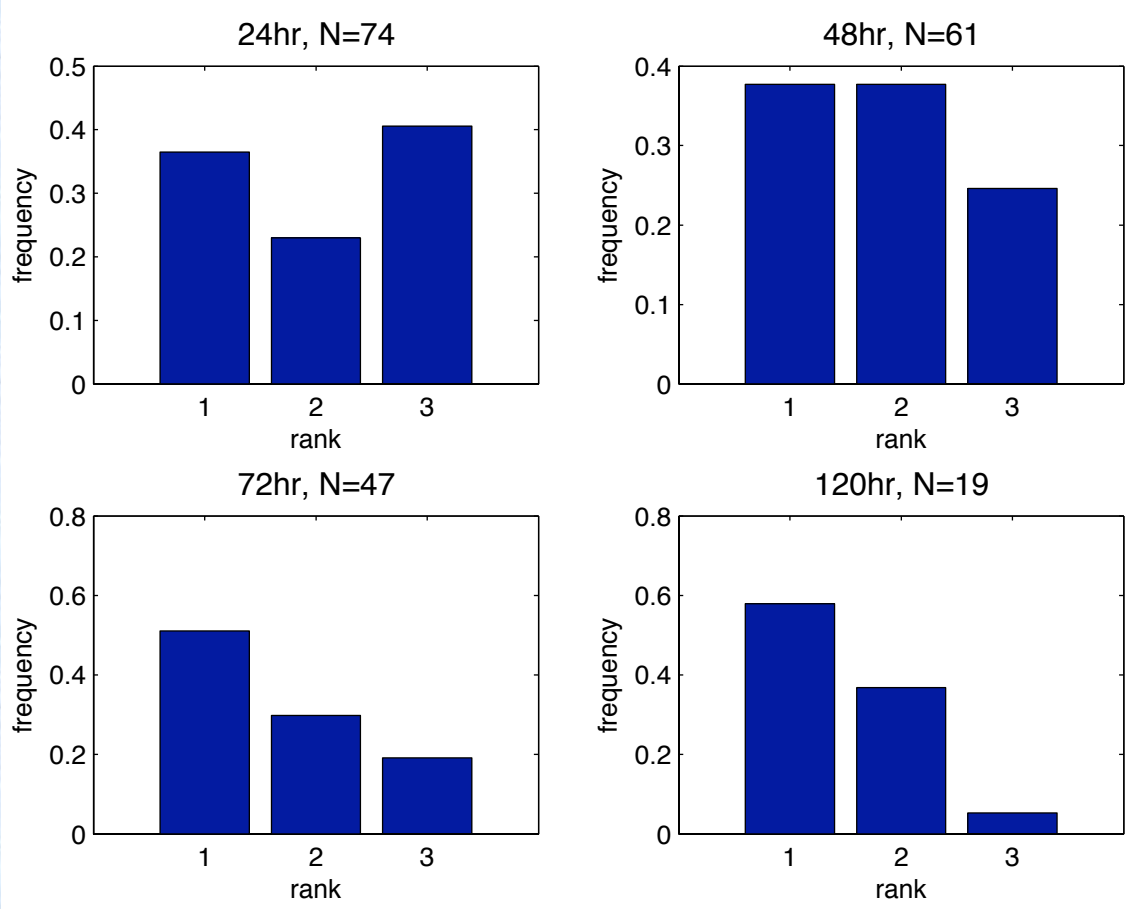
UWN8 Intensity Forecast Rank Histograms 2011 YTD – All Forecasts



UWN8 Intensity Forecast Rank Histograms 2011 YTD – initially < 64kt



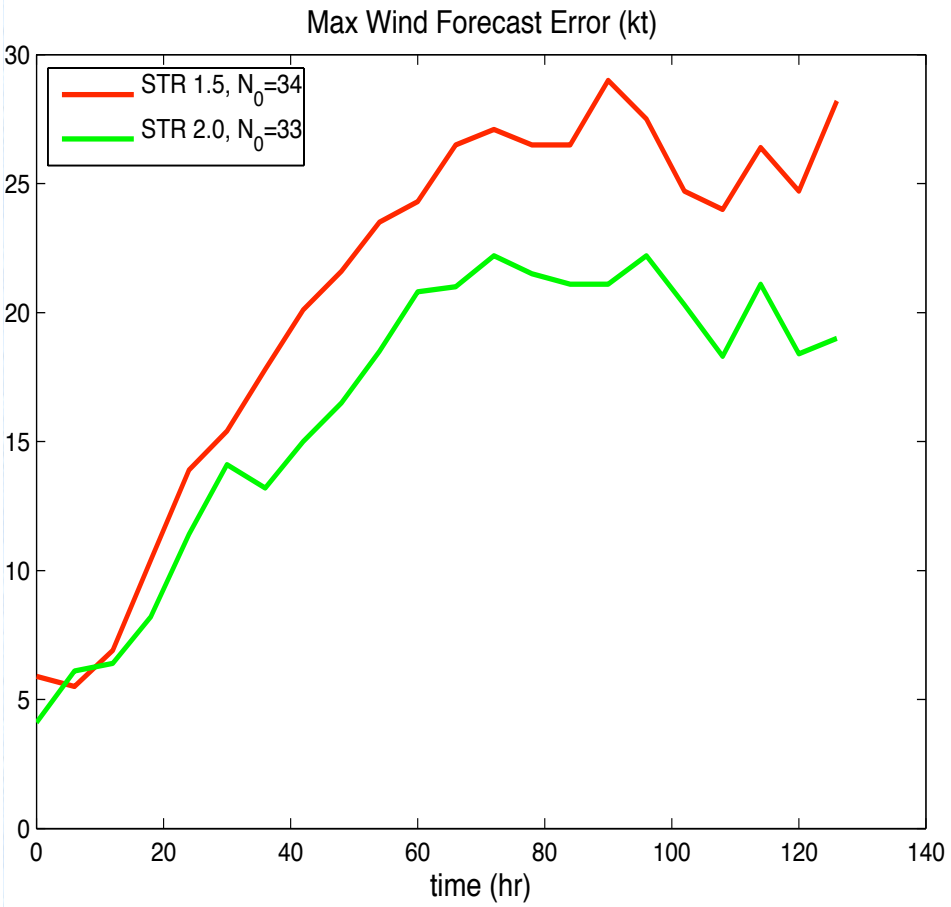
UWN8 Intensity Forecast Rank Histograms 2011 YTD – initially >= 64kt

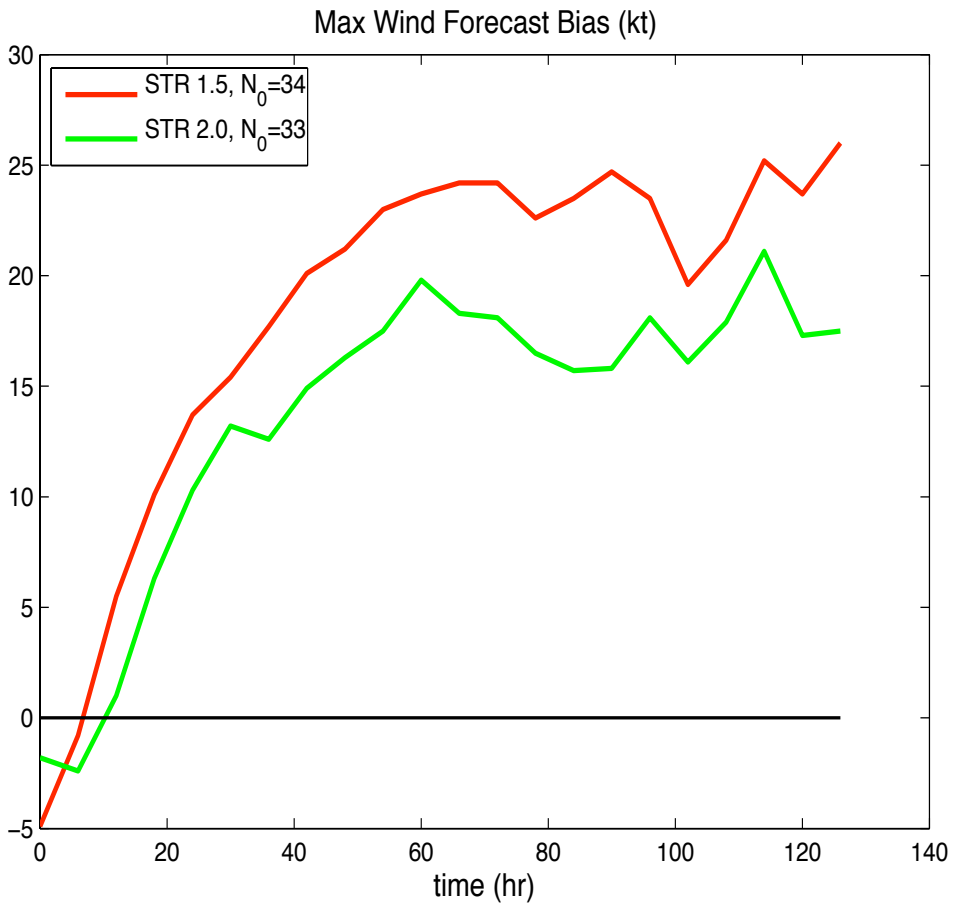


Stream 2.0 Modifications

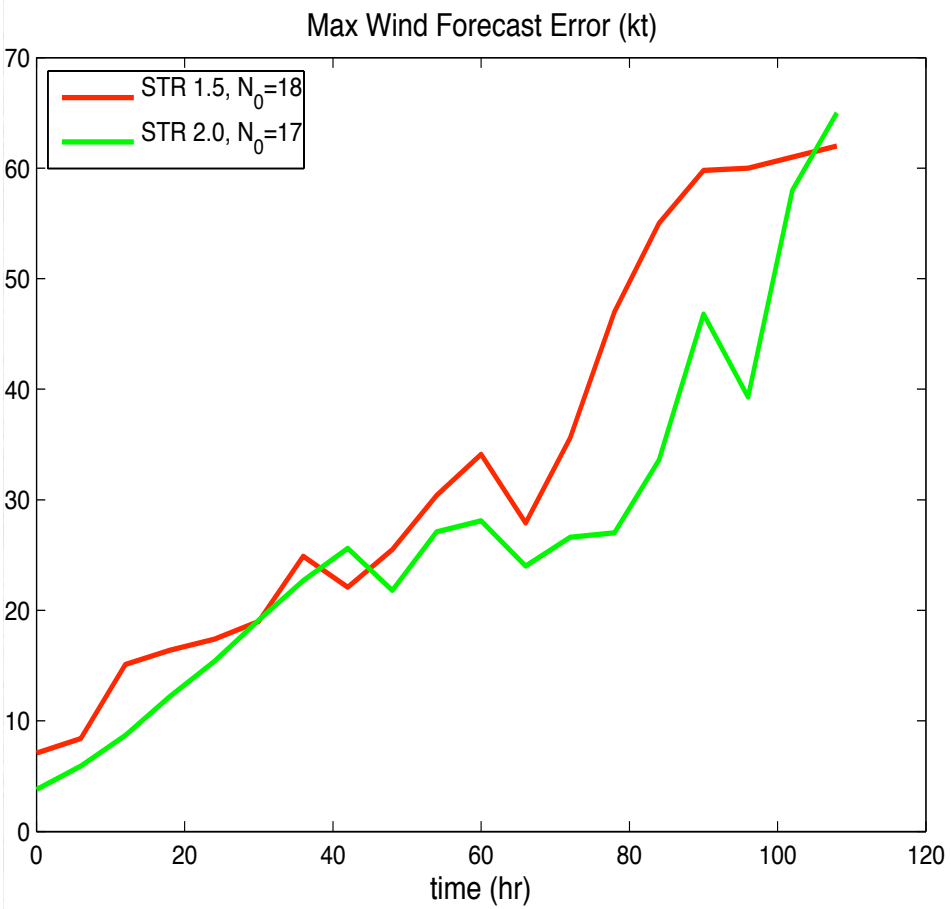
- After Retro runs were completed, several problems with the bogus initialization were discovered and corrected for Stream 2:
  - constraints were implemented for RMW (40km < rmw < 100km, per KC)
  - KC humidity modification turned off (default to GFS moisture analysis).
- Began running S2 rather late in season, so comparisons are rather limited at this point.

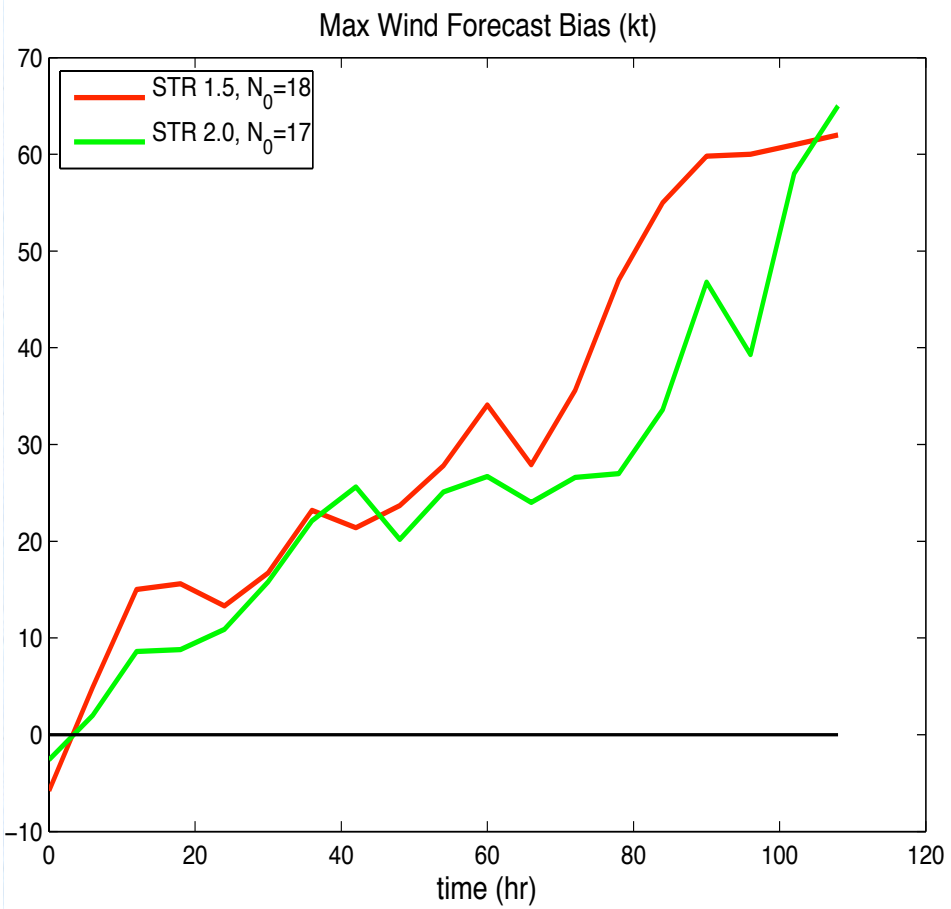
Hurricane Maria (14L)



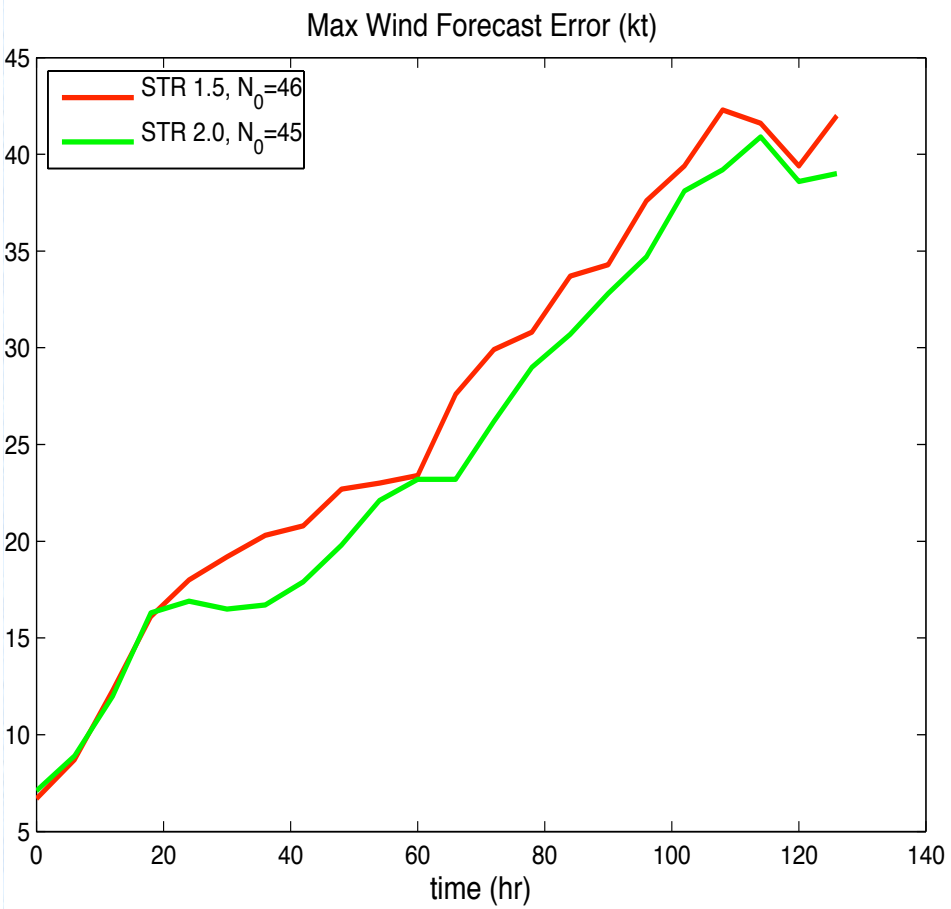


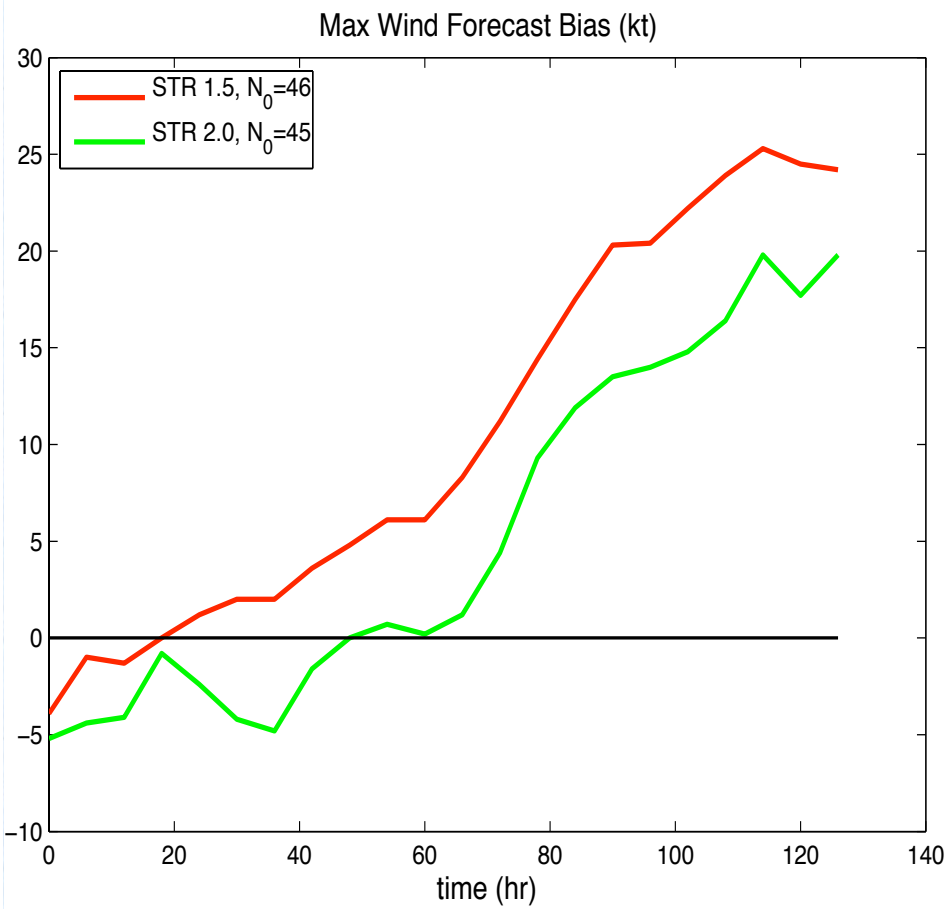
Tropical Storm Nate (15L)



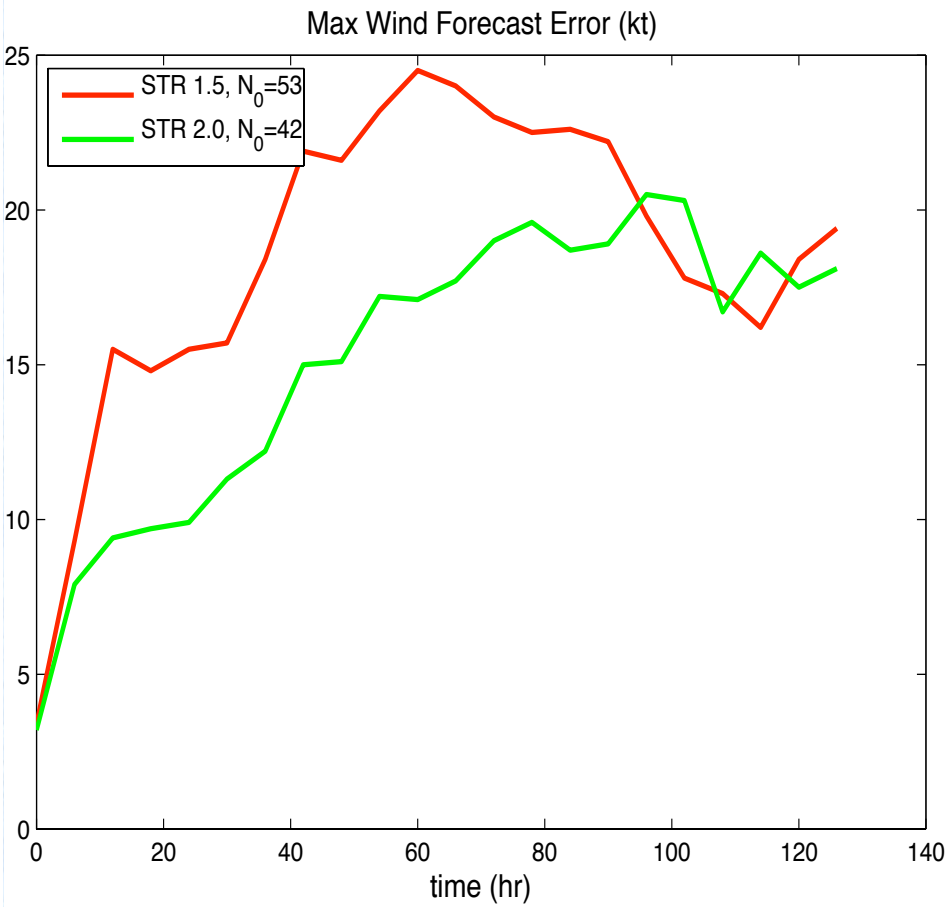


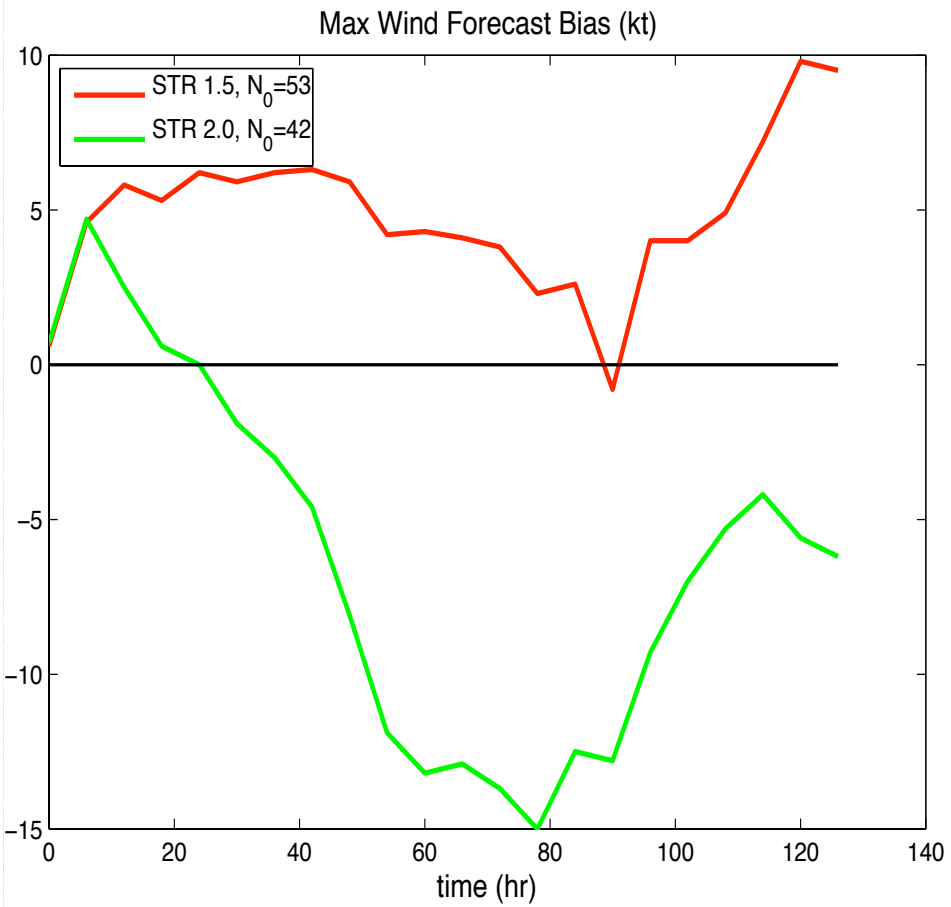
Hurricane Ophelia (16L)





Hurricane Philippe (17L)

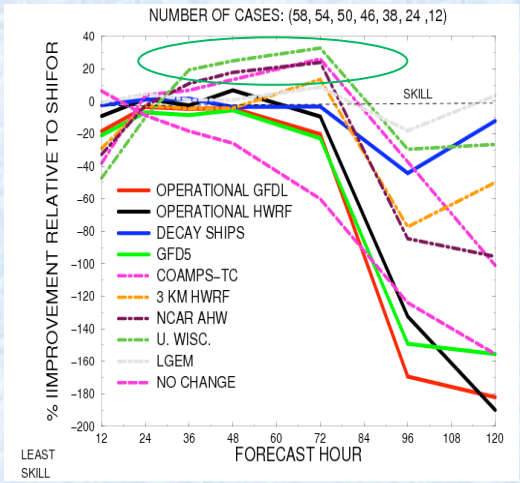




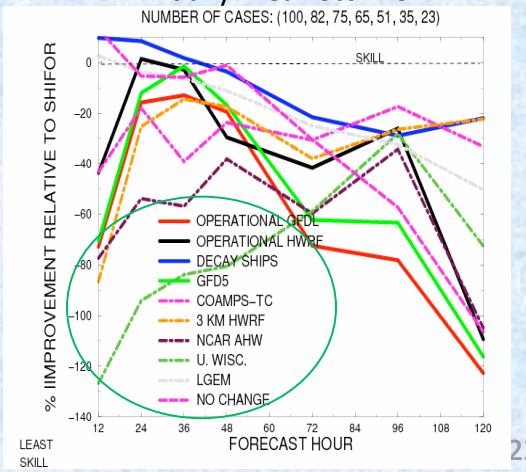
2011 UW-NMS Highlights (& Lowlights)

- Very good intensity performance for max($wind_{t=0}$)≥ 64kt
  - most skillful dynamical model after 30 hr (even after being the worst for $\tau < 24$ hr!)
- Dismal intensity performance for max($wind_{t=0}$)<64 kt.
  - least skillful model for $\tau < 72$ hr, but better thereafter
- Bottom line: poor initialization / spin-up contaminating intensity forecasts in the short range (fixes to bogus help, but returns likely limited).
- No surprise that structure simulation follows similar pattern (demonstrated in following slides).
- For reasons yet to be determined, the error growth after spin-up seems more highly damped than for most other models (tentative: needs further analysis; 2008-2010 retro cases will help clarify)

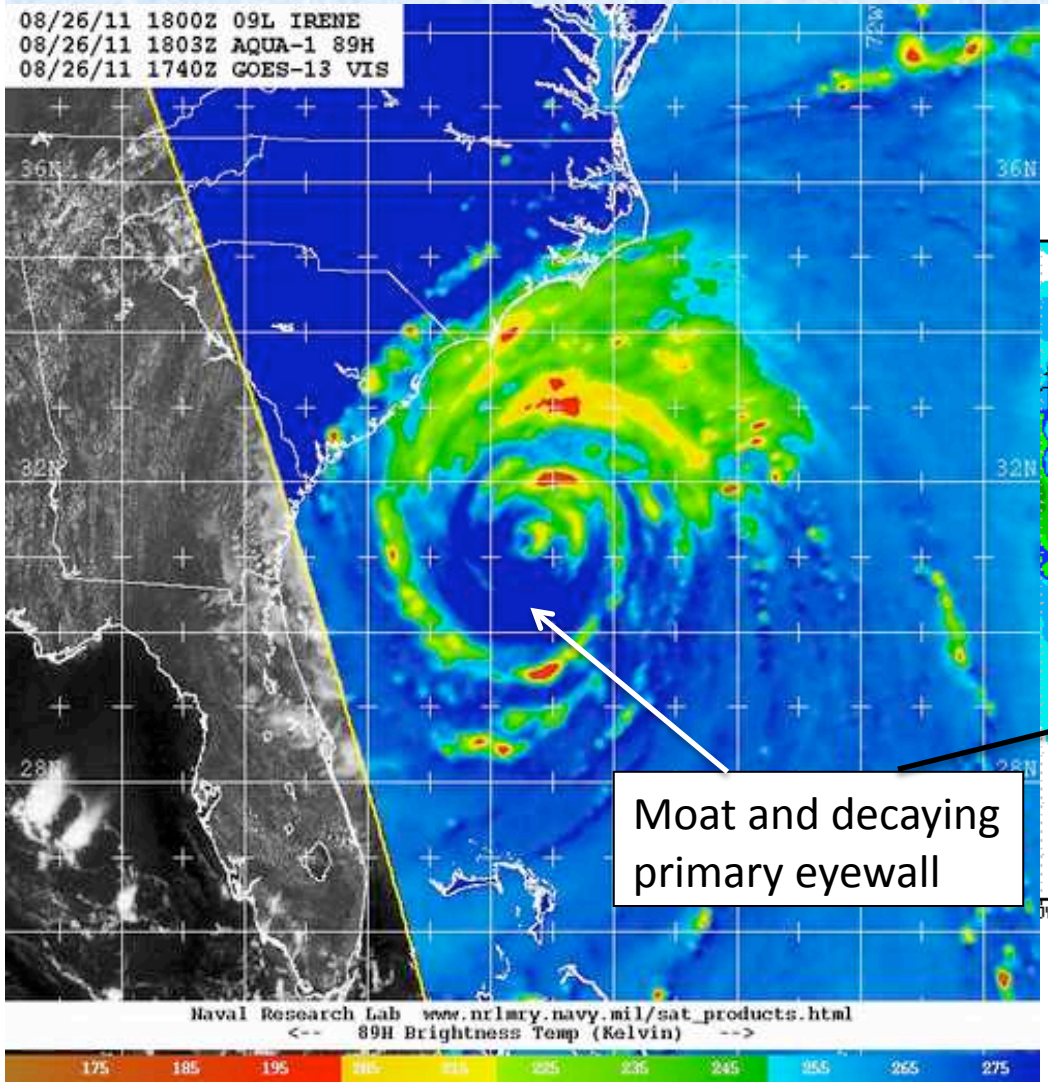
Initially Strong Storms



Initially Weak Storms

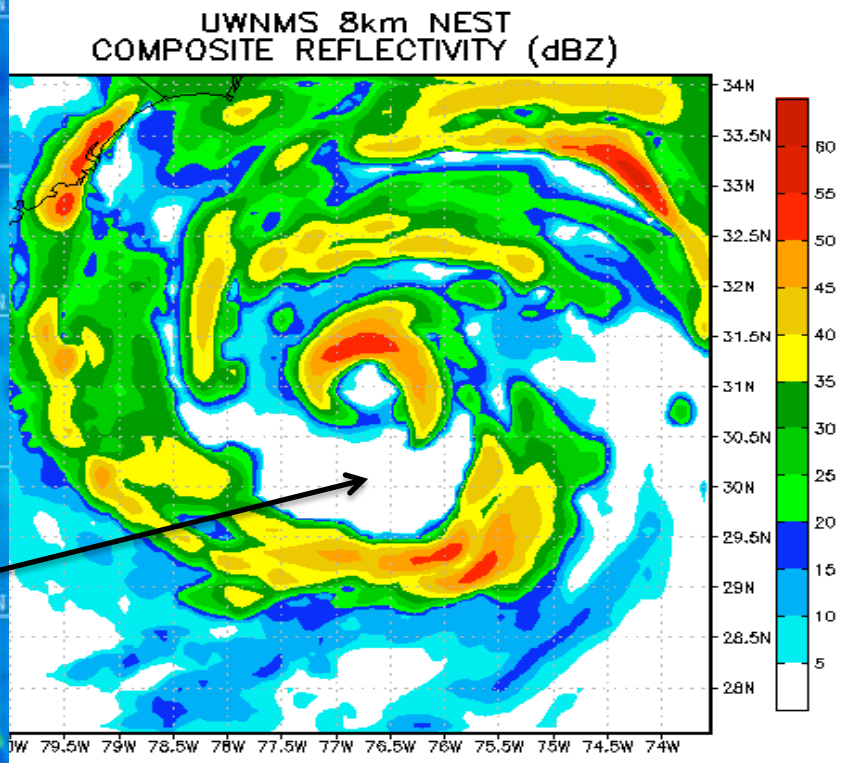


Irene Structure (AMSR-E vs. UWNMS)



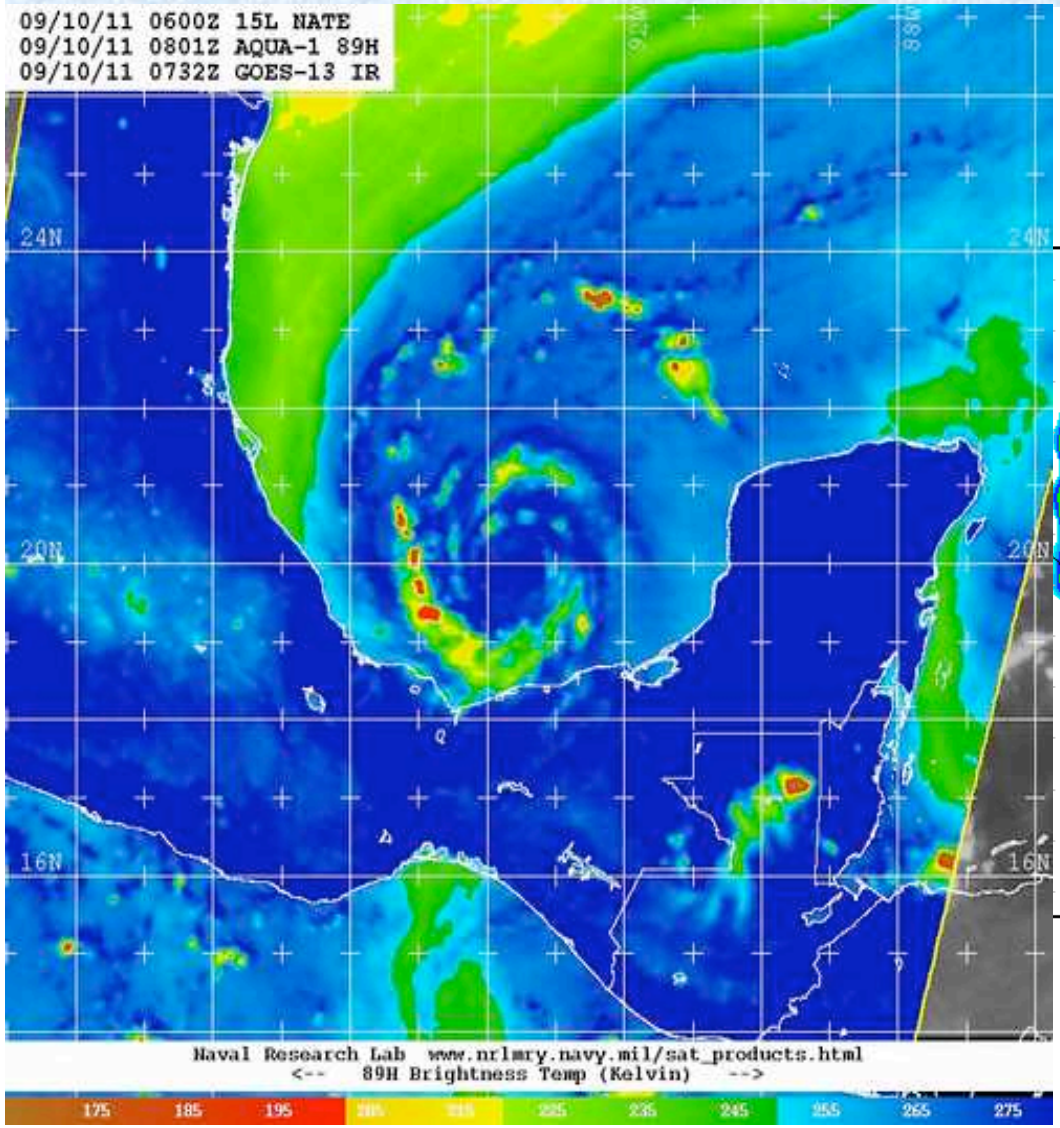
Moat and decaying primary eyewall

UWNMS 66-hr FCST VALID 08/26/11 18Z

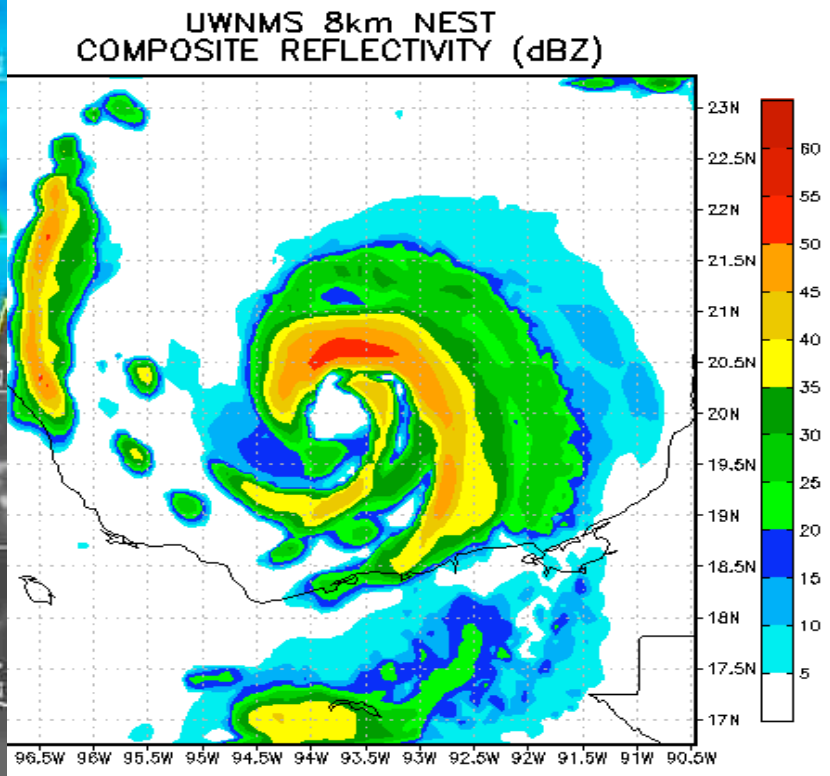


BT = 85kt, FCST = 86kt

Nate Structure (AMSR-E vs. UWNMS)



UWNMS 33-hr FCST VALID 09/10/11 09Z



BT = 45kt, FCST = 90kt

Ongoing Issues

- Initialization / spin-up remains a challenge.
  - KC Bogus improves upon previous method, but will likely require cycling / relocation to produce marginally acceptable short-range results.
  - *DA on high spatiotemporal scales is, of course, preferable and practicable with sufficient resources.*
- Tracking of weak vortices problematic.
- Performance differences b/w weak and strong TCs need to be examined further (our model and all models – controlled intercomparison good place to start).
- Inclusion of sea-spray (Andreas scheme) was beneficial in improving storm structure / evolution relative to HRH results. Further tuning may yield additional improvements.