# ATCF Requirements, Intensity Consensus and Sea Heights Consistent with NHC Forecasts Final Report for First Year (2010)

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## Introduction

This report describes progress for the first year of a two-year JHT project addressing requirements for the Automated Tropical Cyclone Forecasting System (ATCF; Sampson and Schrader 2000), evaluating and updating the intensity consensus aids and implementing WAVEWATCH III analyses and forecasts consistent with NHC forecasts. Estimates of the progress on tasks are included in the report.

## ATCF Requirements

NRL addressed approximately xx requirements in the first year. Highlights for 2010 are the six and seven day forecasting capabilities (Fig. 1). It was originally speculated that these capabilities could take significant efforts to implement, but we found that we could implement most of the capabilities within the JHT budget. The six and seven day upgrades include forecasting track and intensity, upgrading the interpolator to produce six and seven day forecasts of track, intensity and wind radii, and upgrading the homogeneous statistics so that six and seven day objective aids can be evaluated by forecasters during and after the season.

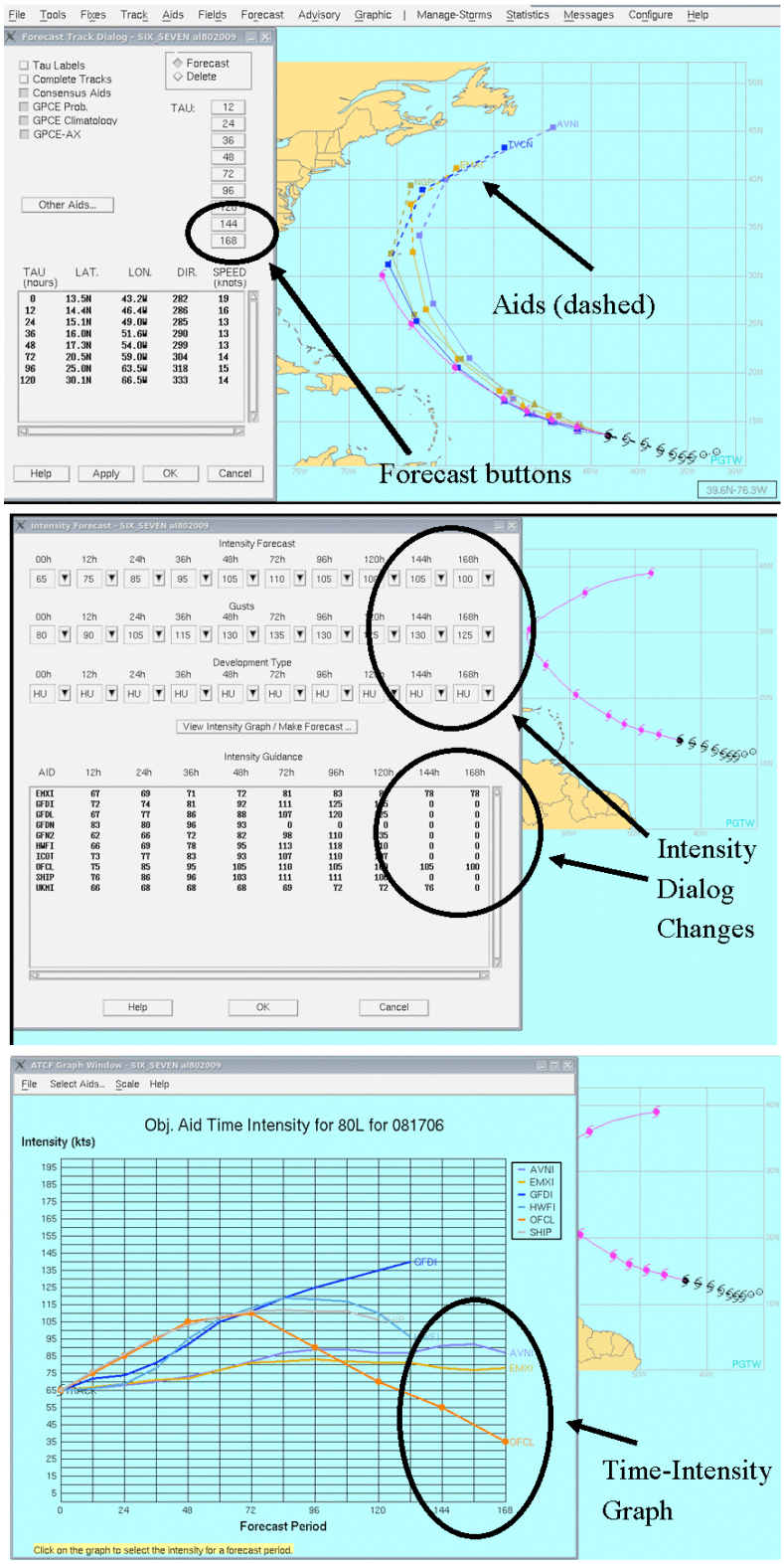


Figure 1. GUI changes for the added six and seven day forecast capability within the ATCF. Top dialog is track forecasting, middle dialog is for intensity dialog and bottom graphic is the Time-Intensity graph. Changes are indicated with black ovals and labels.

Figure 2 shows a head-to-head comparison of available six and seven day objective aids available in the 2007-2009 Atlantic seasons with more than 50 seven day forecasts. Of interest is that the track consensus (TVCN) forecast errors appear to increase at a remarkably constant rate through the entire 7 day forecast period. The top single model interpolated objective aid for six and seven day forecasting appears to be the European Center NWP model tracked with the NCEP tracker (EMXI). The only other objective aid with more than 50 cases for a seven day forecast was the GFS interpolated aid (AVNI).

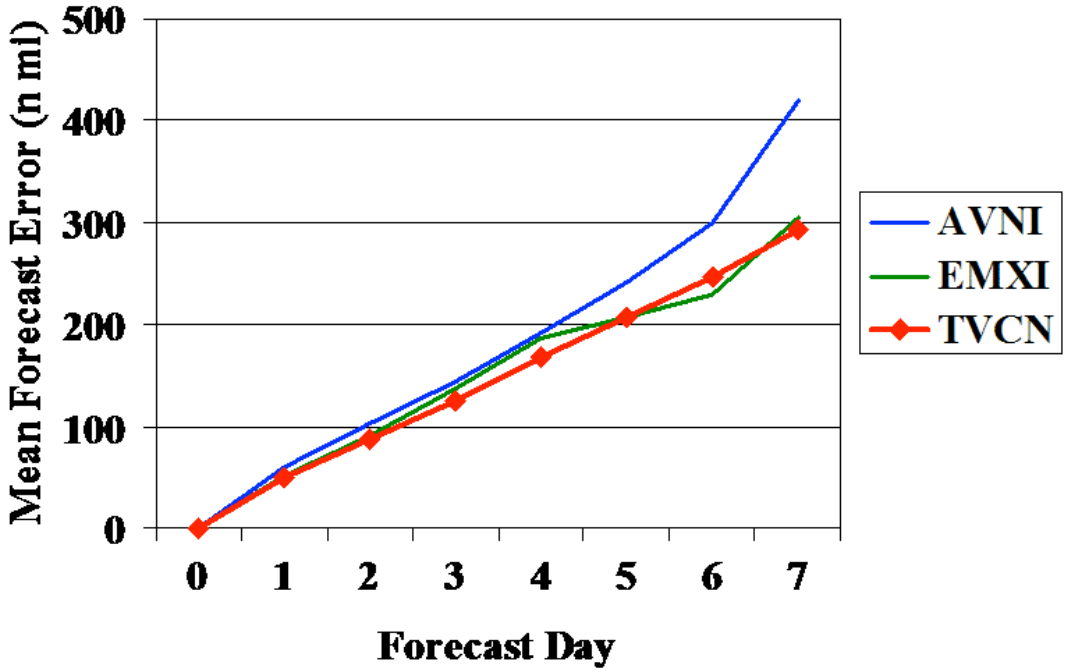


Figure 2. Head-to-head evaluation with respect to TVCN of available interpolated tropical cyclone track forecast objective aids (more than 50 cases) for the 2007-2009 Atlantic seasons.

Another highlight for 2010 is the capability of ATCF to ingest and display large ensembles of up to 1300 members (Fig. 3).

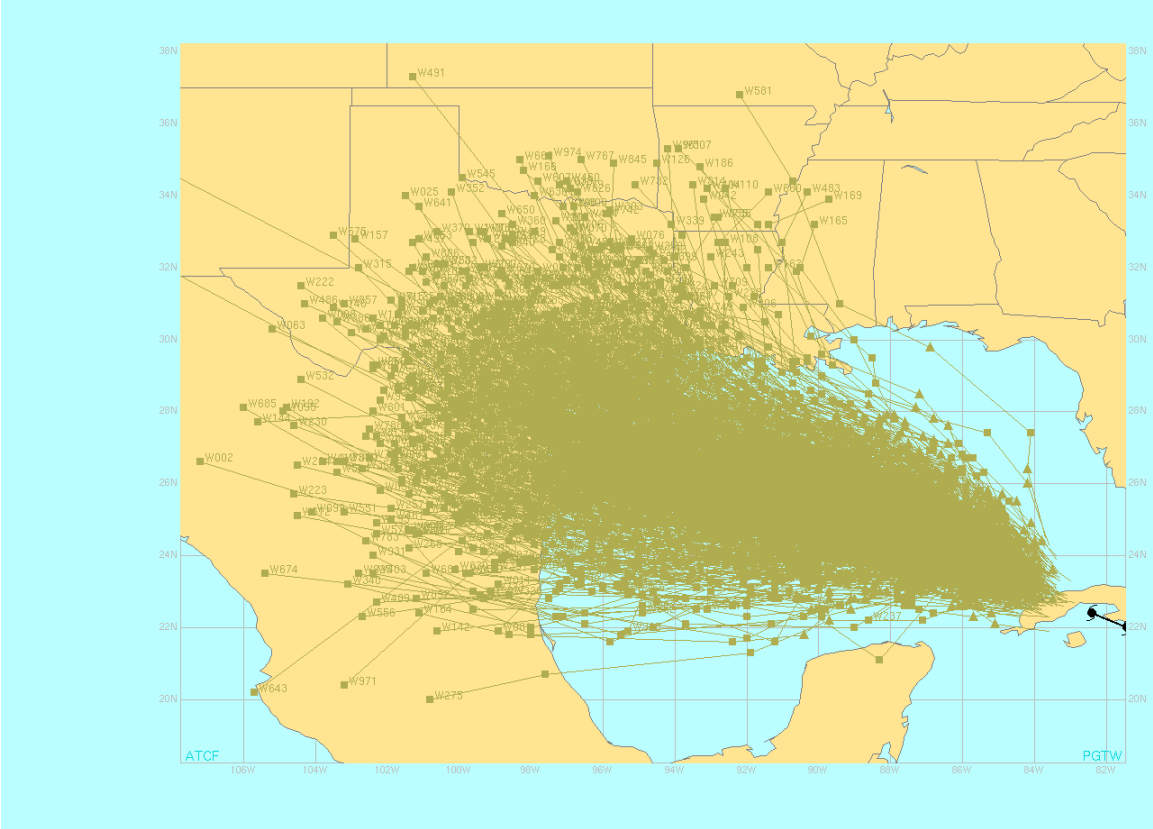


Figure 3. Display of 1000 Monte Carlo Wind Prob ensemble members for Ike, 2008 from Sept. 19 12 UTC.

Also added was the capability to record Tropical Weather Outlook (TWO) disturbance genesis probabilities using ATCF (Fig 4).

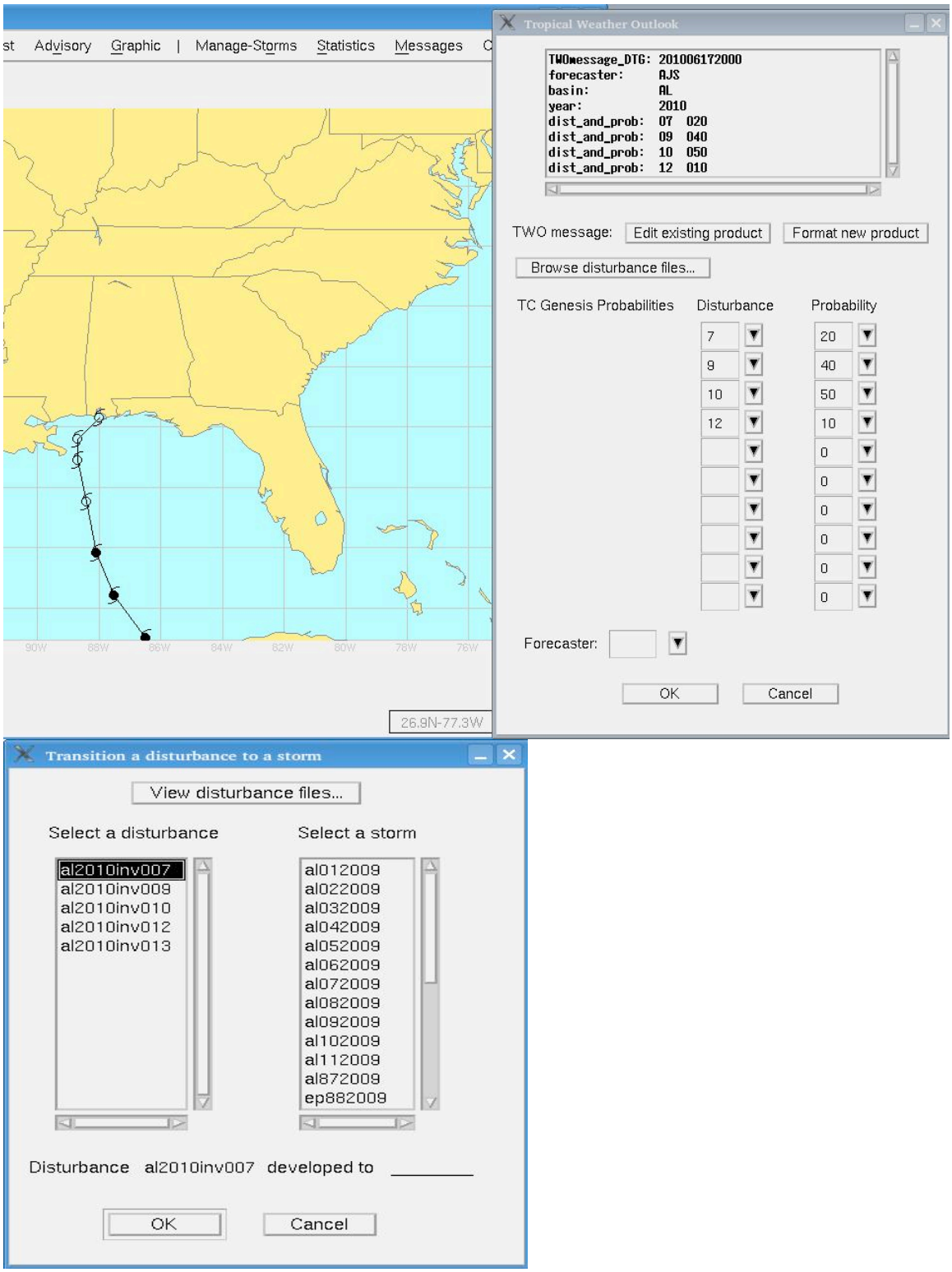


Figure 4. TWO disturbance genesis probability dialogs.

## Intensity Consensus

Two simple intensity consensus aids were originally implemented on the ATCF in 2006 (Sampson et al. 2008) as collaboration between the authors and Chris Sisko at NHC. The original suite of marginally skillful objective aids included GHMI (the GFDL model; Bender et al. 2007), DSHP (the SHIPS model; DeMaria et al. 2005) and GFNI (the Navy version of the GFDL model; Rennick 1999). This set was subsequently expanded to include the newly operational LGEM (Logistic Regression Equation Model; DeMaria 2009) by the collaborators in 2007**.** In 2008, NHC added HWFI (the interpolated HWRF; Surgi et al. 2006) to the consensus and renamed the consensus a "variable consensus" (IVCN =HWFI+GHMI+DSHP+LGEM+GFNI). NHC also defined a four-aid consensus (ICON =HWFI+ GHMI+DSHP+ LGEM) in which all aids must be available to compute the resultant forecast.

In this task NRL evaluated the current suite of models and their affects on consensus aids, and also experimented with other promising guidance (COAMPS-TC, CHIPS) to see if any improvement in skill could be gained by adding these. Figure 5 shows experiments with ICON and IVCN performance against other consensus aids formed with one model removed. ICON was the top performer in the Atlantic for the 2008-2009 seasons combined (Fig. 5a). Other permutations of the consensus are within approximately 10% skill of ICON, with no others performing as well. IVCN was a top performer in the eastern North Pacific, but a consensus of IVCN-HWFI performed slightly better. These two charts hint at possible issues with the GFDN in the Atlantic and H-WRF in the eastern North Pacific, but both have been upgraded and performed well in 2009.

Preliminary experiments with other intensity guidance have primarily involved CHIPS (Emanuel et al. 2004). These forecasts were obtained courtesy of John Knaff (CIRA) and Kerry Emanuel (MIT), processed through the interpolator so that they would appear as they normally would in operations. Then they were evaluated and added into a consensus to determine impact. Figure 6 shows the skill and impact of the interpolated CHIPS (CHII) in the Atlantic for the 2009-2009 seasons. CHIPS is somewhat skillful through 72 h in the Atlantic with respect to the 5-day SHIFOR (SHF5; Knaff et al. 2003); however, its impact on ICON and IVCN skill is minimal. This is entirely expected since the improvement is both a function of skill and independence (Sampson et al. 2008), and the more of these aids are available the less impact each has on the total. These charts were also provided to Chris Landsea and Mark DeMaria for their use.

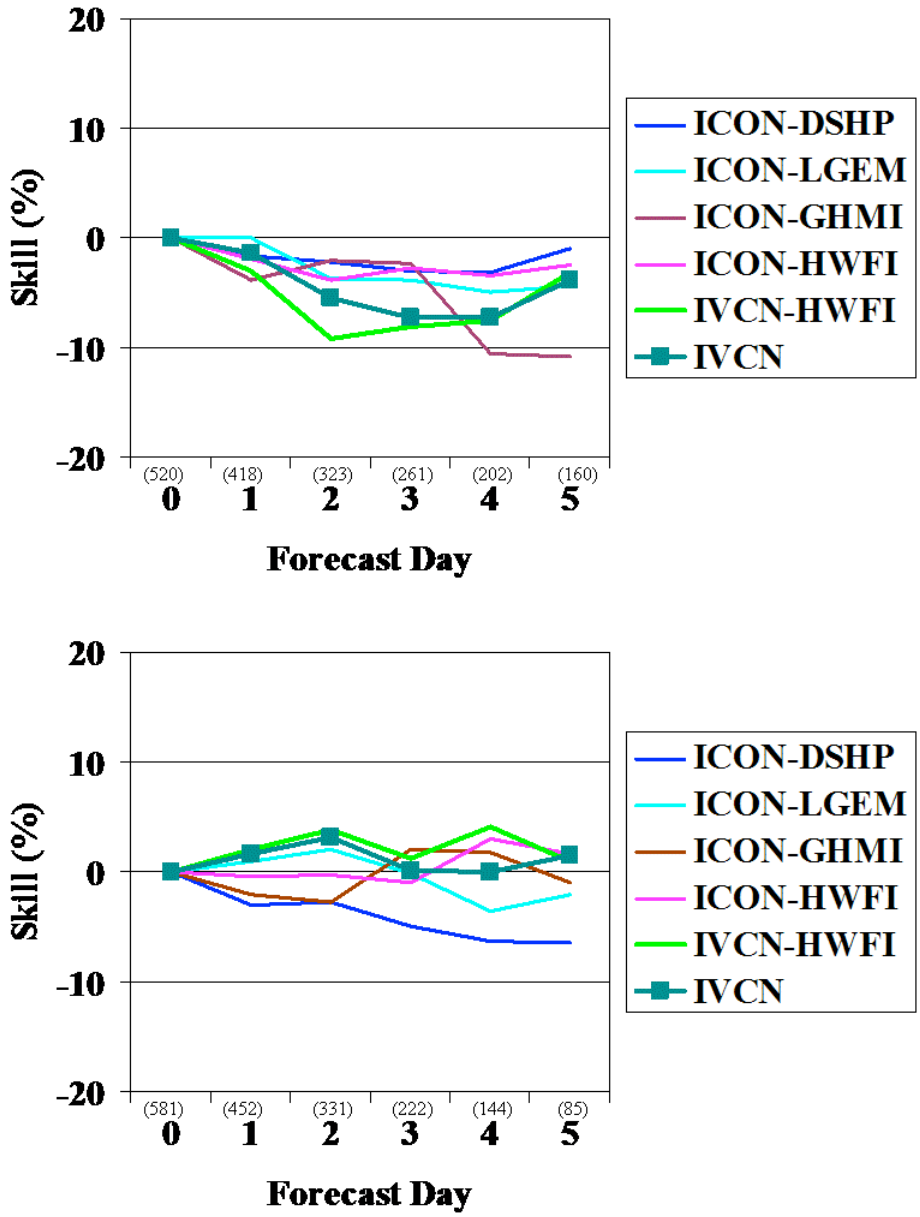


Figure 5. Skill (percent improvement in forecast intensity errors) of various consensus aids relative to ICON for a) the Atlantic and b) the eastern North Pacific basins. The data set is the entire 2008 – 2009 seasons.

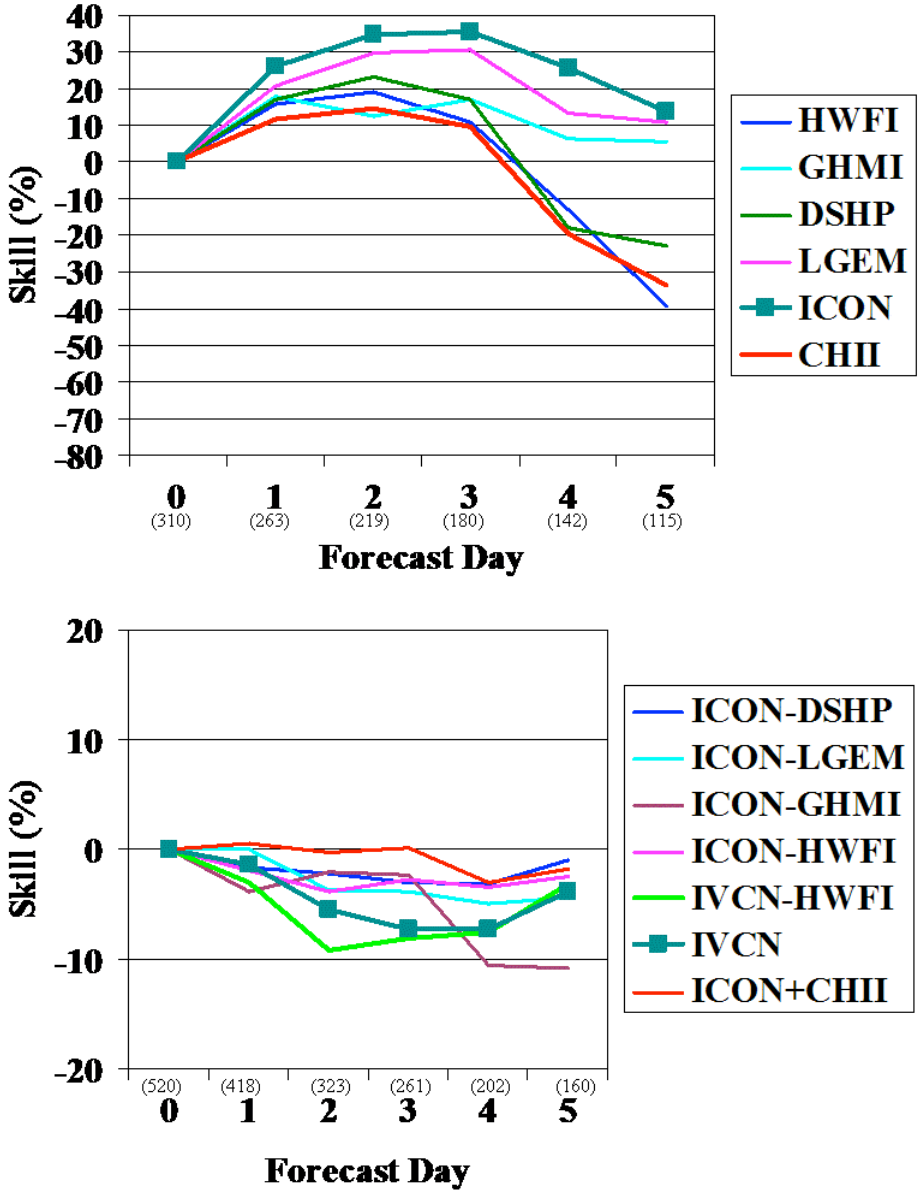


Figure 6. a) Skill of various intensity forecast aids with respect to SHF5 and b) skill of various consensus aids with respect to ICON for the Atlantic 2008-2009 seasons.

## Sea Heights Consistent with NHC Forecasts

This work involves development and implementation of a method to insert the NHC Official Forecast into a GFS background wind field for each forecast period, then run the WAVEWATCH III® on the resulting wind fields to produce significant wave heights consistent with the NHC forecasts. The algorithm is named OFCL/WW3 and more information on the method can be found in Sampson et al. (2010). This task includes four sub-tasks:

1) Run the OFCL/WW3 on the 2010 and 2011 seasons
2) Provide grib output in near real-time for display on N-AWIPS for TAFB
3) Provide ATCF format files for 2011
4) Evaluate the radii of 12-ft seas for 2010/2011
5) Implement the OFCL/WW3 on NHC equipment if algorithm gains approval

Tasks 1-4 are all in progress and have gone as well as can be expected. The OFCL/WW3 initiation has been moved up so that the runs are now available at approximately +5 or +6. With the current computational and connectivity restrictions, this is about the best we can get. If the algorithm is run on site, the process could be somewhat shorter; however it will be difficult to produce output in time for some of the TAFB products without a significant change in the input. Evaluations are being provided through the season by Jessica Clark and some comparisons with Gulf buoys is underway.

## Conclusions

Tasks in the original proposal are on target for completion in 2011. Here is an estimate of the tasks and their completion percentages.

- Address requirements levied during by Chris Sisko and Chris Lauer (45%),
- Update and evaluate intensity consensus (95%)
- OFCL/WW3 (%60)

## Acknowledgements

We wish to acknowledge the staff at NHC, the efforts John Knaff and Mark DeMaria (NOAA/NESDIS), Jim Goerss and Jim Hansen (NRL), Mike Fiorino (NOAA/ESRL) and many other contributors to the JHT. We also wish to thank the members of the Joint Hurricane Testbed for allowing us to do this work.

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