ATCF Requirements, Intensity Consensus and Sea Heights Consistent with NHC Forecasts Mid-Year Report for Second Year (2011)

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Introduction

This report describes progress for the first half of the second year for the 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. Funding for these tasks has been augmented by funding from the Hurricane Forecast Improvement Program (HFIP) and the U. S. Navy. Estimates of the progress on tasks are included in the report.

ATCF Requirements

Highlights for additions from 2011 so far are the 60-h forecast capability (Fig. 1), expanded seas radii capability (e.g., ingest, storage of radii larger than 995 n mi), maximum sea heights and verification of seas forecasts (Fig. 2), verification with or without landfall cases (Fig. 2), a GPCE version of the wind probabilities (Fig. 3) that outperforms the original wind probabilities (DeMaria et al. 2011).

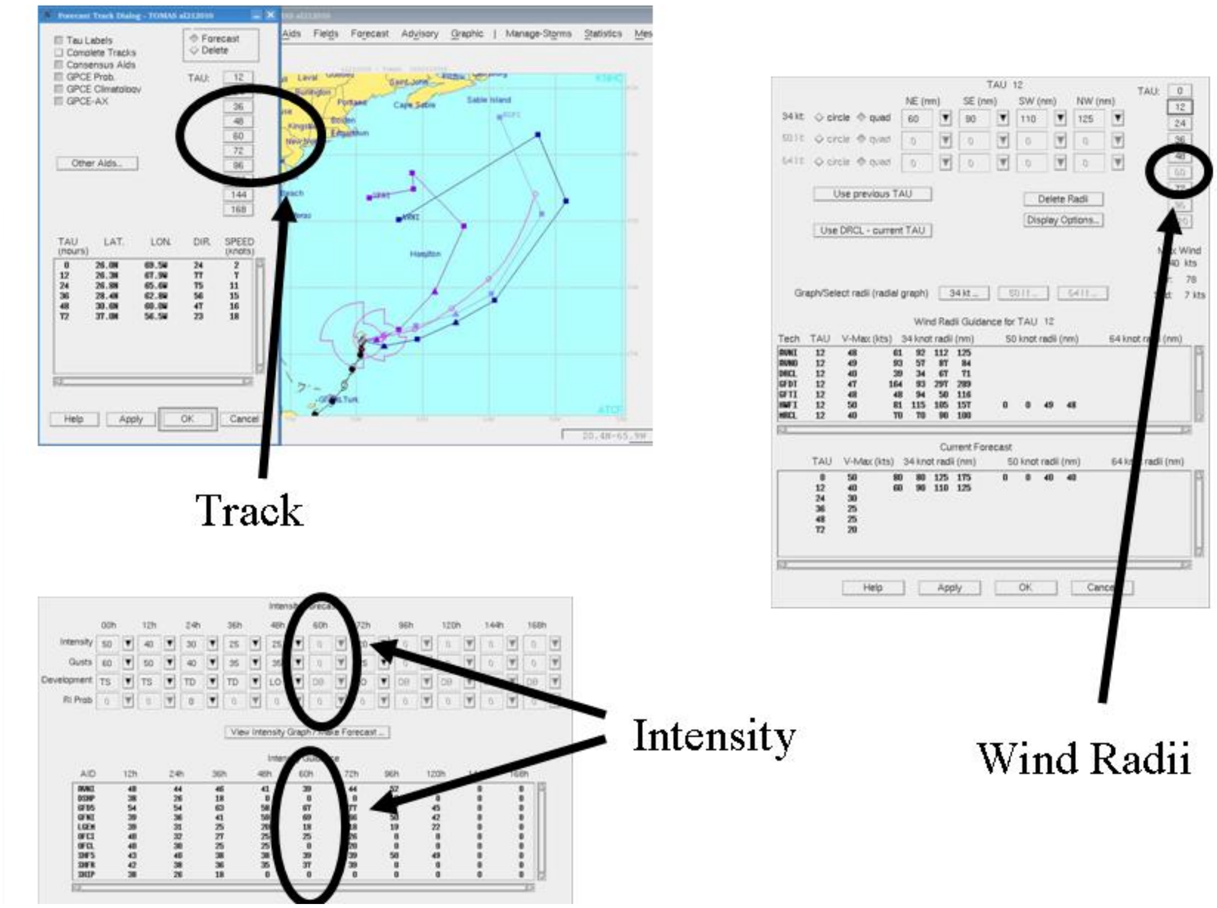

Figure 1. GUI changes for 60-h forecast capability. Top left dialog is for track forecasting, lower left dialog is for intensity forecasting and dialog to the right is for wind radii forecasting. Changes are indicated with black ovals and labels.

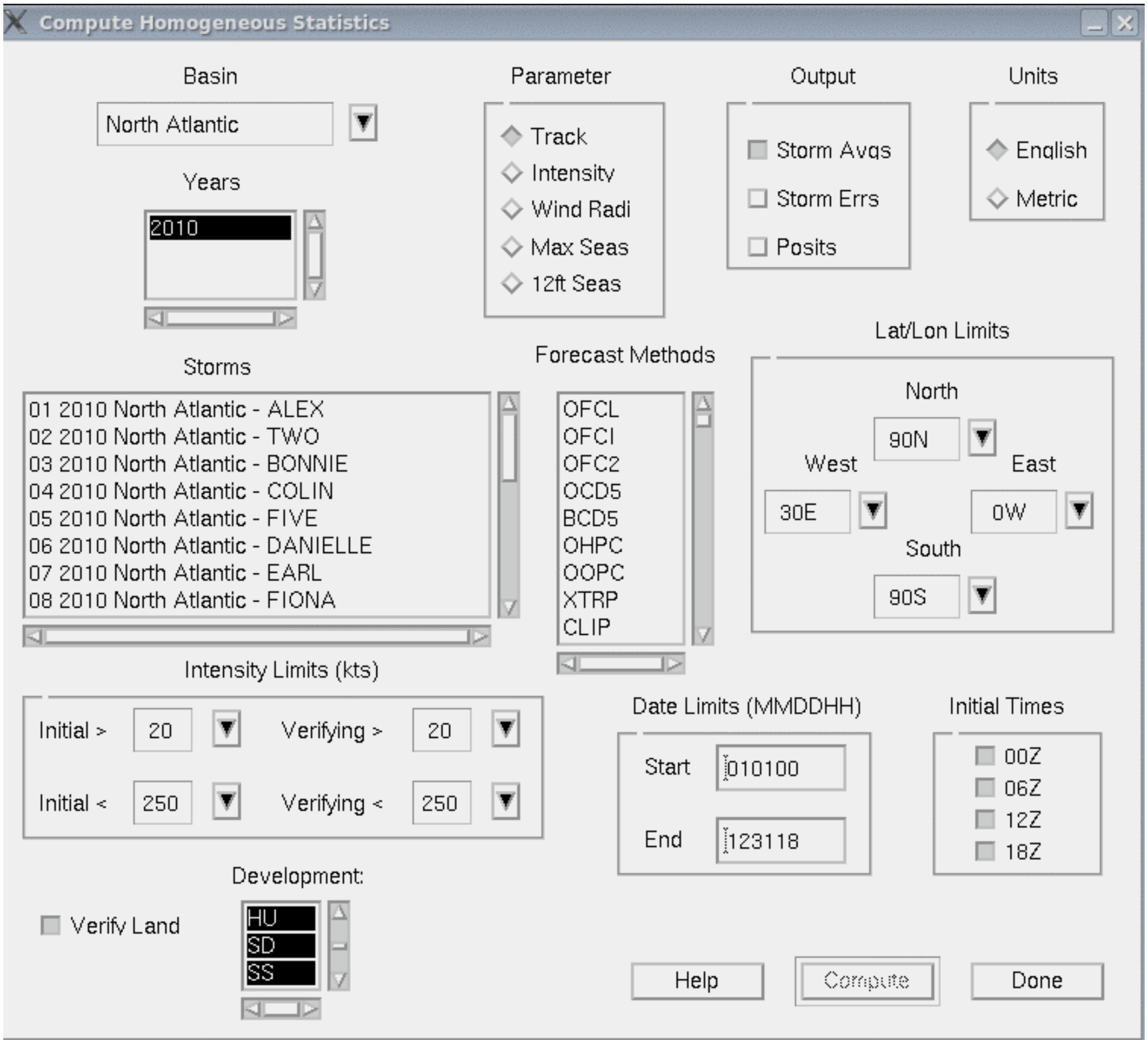

Figure 2. ATCF Homogeneous Statistics Dialog with new “Max Seas” and “12ft Seas” parameter entries. Also shown in the lower left is a toggle for verification with/without landfall cases.

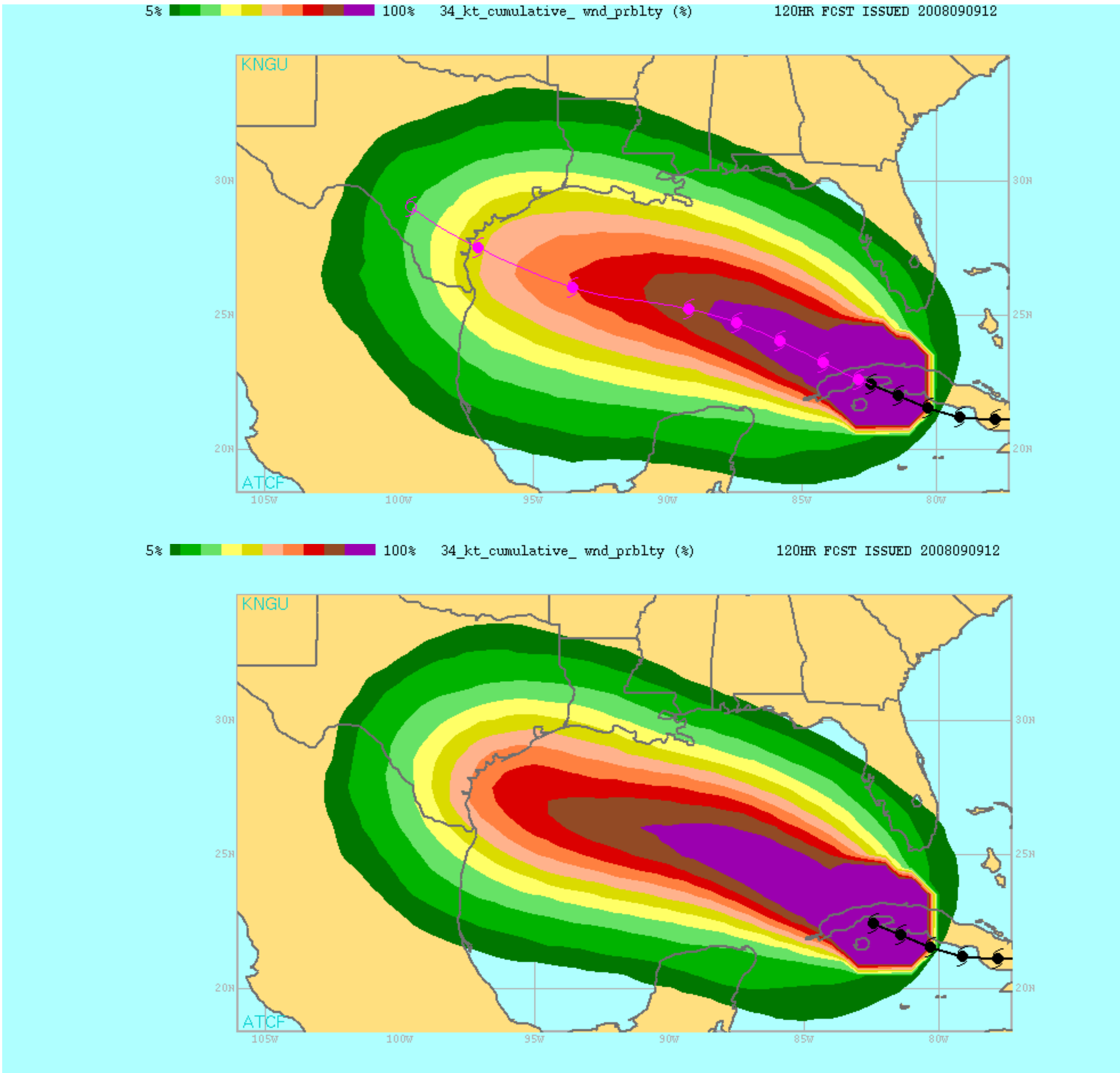

Figure 3. Cumulative 34-kt wind probabilities for a test storm in the Atlantic. The 5% threshold (outer green area) for wind probabilities without GPCE adjustments (above) cover a larger area than those with the GPCE adjustments (below) in this particular case because the GPCE areas are small relative to the GPCE climatology. Note also that the orange area (60% probability threshold) extends all the way to the Texas coast in the GPCE version while the area lies well off the coast in the version without GPCE adjustments.

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.

At the request of the JHT, very little time was spent on this task this year. The effort was limited to completing evaluation of the COAMPS-TC on the intensity consensus (IVCN) using the 2009 reruns and 2010 real-time runs done at NRL. Figure 4 shows the results of including COAMPS-TC in IVCN. Results indicate that COAMPS-TC adds value to IVCN at 1 and 2 days forecast. Removing HWFI for this dataset improves forecasts further (green line), but those improvements are only on the order of 1%.

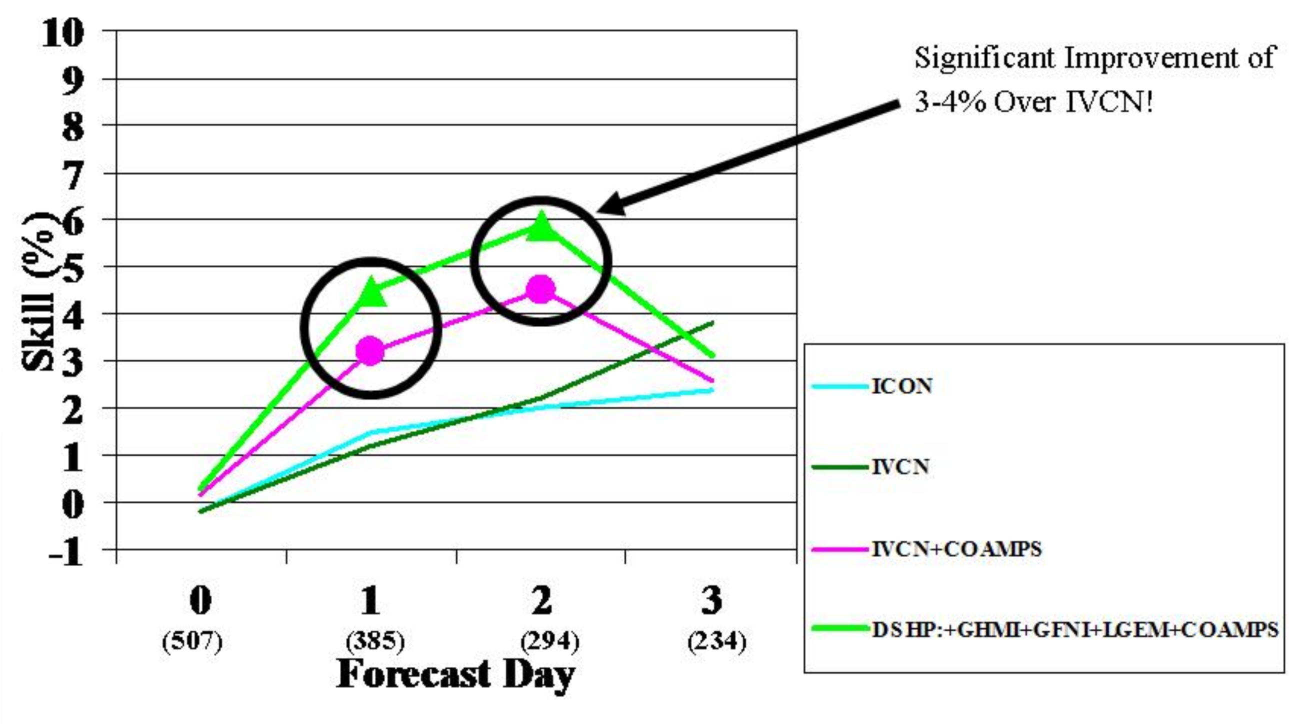

Figure 4. Skill (percent improvement in forecast intensity error) of various consensus aids relative to the 2006 intensity forecast consensus for the Atlantic basin 2009-2010. Evaluation was done without landfall cases and dataset includes 2009 reruns of COAMPS-TC. Significant improvements over IVCN are shown as triangles and dots.

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® (Tolman et. al 2005) 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 complete for the 2010 season. Evaluation of the radii of 12-ft seas for 2011 will need to be done sometime after the completion date of this project.

The algorithm has been implemented within NHC infrastructure and run on the entire set of al212010 forecasts. Still left to be done are: 1) accessing GFS winds resident in NHC (we currently acquire those from the GODAE server at NRL), 2) writing a script to either run on the algorithm as a scheduled job or as a triggered job by NHC advisory packages. Details for these have yet to be worked out for 2011. The server at NRL will also continue to run OFCL/WW3 and produce grib files for N-AWIPS as it did last season.

Extensive evaluation has been done with the 2010 season data as promised. Anecdotal evidence from evaluations done during the 2010 season indicated that the OFCL/WW3 waves were 5-6 ft too low in the analysis (Jessica Schauer, personal communication). This was partly mitigated during the season by recoding the OFCL/WW3 to use consistent warm start files (those from the same storm), if available.

We also investigated the bias using buoys and altimeter passes and found that there was a low bias in those too. Figure 5 shows comparisons of OFCL/WW3 hindcasts and buoy observations. The original OFCL/WW3 run with 10-minute mean winds underestimates the peak significant wave heights in two of the Igor passes over the buoys. Reruns of OFCL/WW3 without the 1-minute to 10-minute wind speed conversion yields results with much less negative bias in those cases; although these reruns over predict the significant wave heights in Earl.

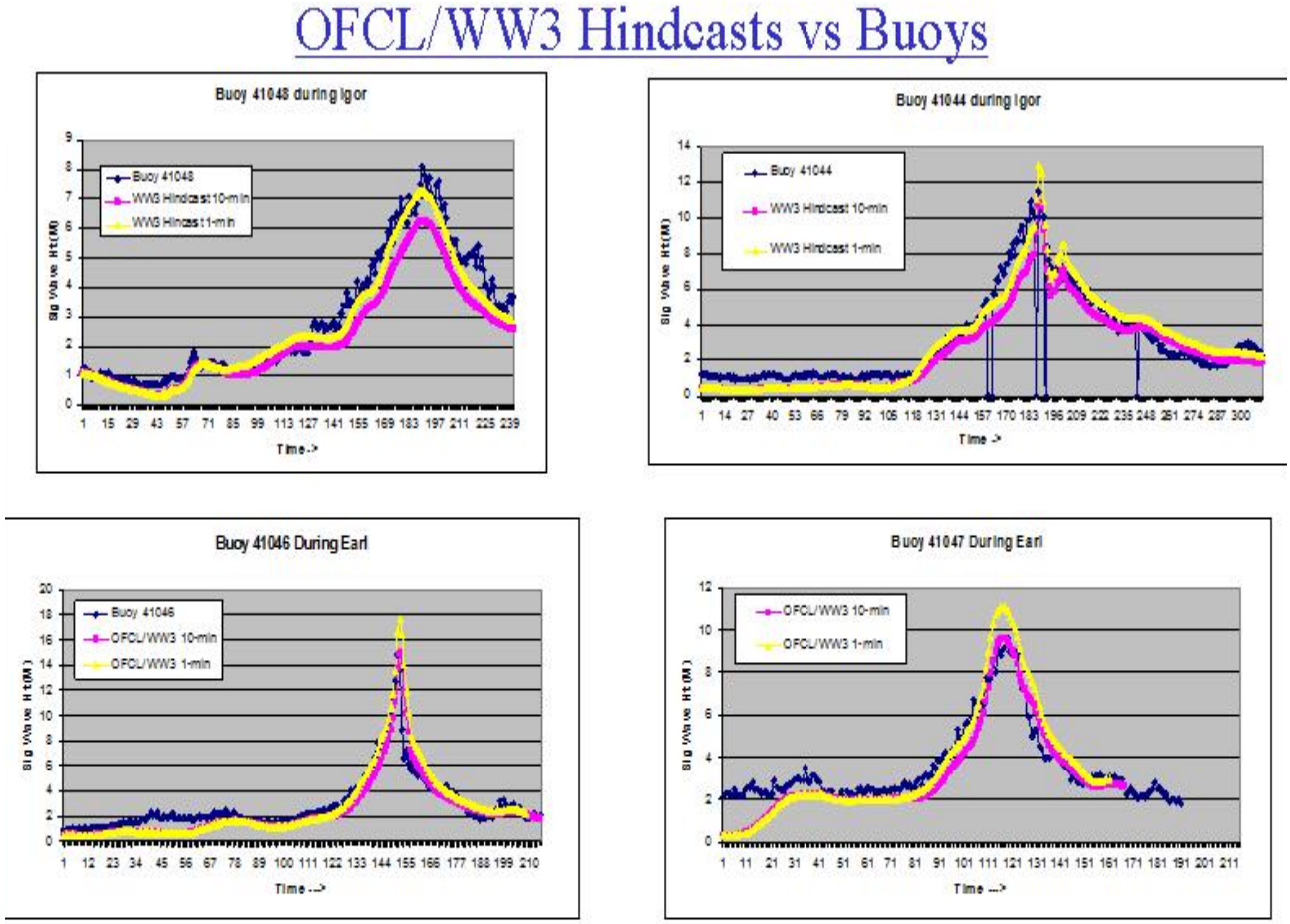

Figure 5. Significant wave heights (m) at buoys for hindcasts of Igor (top) and Earl (bottom). The blue line is the observed significant wave heights (M), the purple line is the OFCL/WW3 hindcast using 10-minute mean wind speeds and the yellow line is the OFCL/WW3 hindcast using 1-minute mean wind speeds.

. Altimeter passes within the radius of outermost closed isobar provide further evidence that the 1-minute mean wind speed version of OFCL/WW3 provides less biased results than the 10-minute mean wind speed version (Fig. 6).

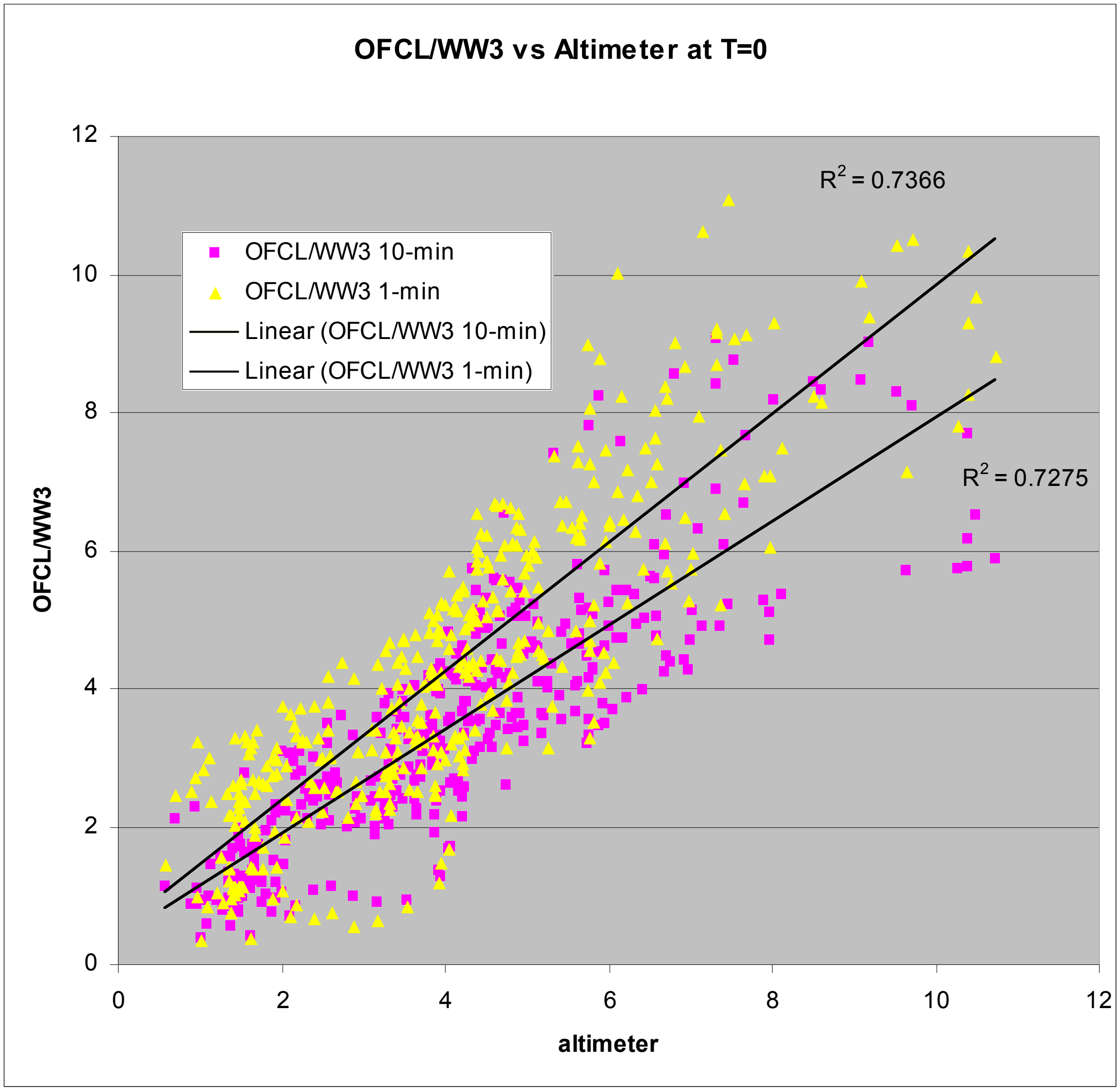

Figure 6. Significant wave heights (m) for 10-minute mean wind speed version of OFCL/WW3 (purple) and the 1-minute mean wind speed version (yellow) compared with wave heights from altimeter passes within the radius of outermost closed isobar for the Atlantic 2010 season.

Finally, the ATCF was modified evaluate the 12-ft seas radii as discussed in the ATCF Requirements section. Results of an evaluation done with this new capability are shown in Fig. 7. The evaluation was done using the TAFB analyses in ATCF as ground truth. As seen in the graphs, the 1-minute mean wind speed runs of OFCL/WW3 have reduced biases with little change in mean absolute errors. As indicated in Fig. 7, we believe that the low biases beyond 72 h could be improved by using the wind radius cliper (DRCL; Knaff et al. 2007).

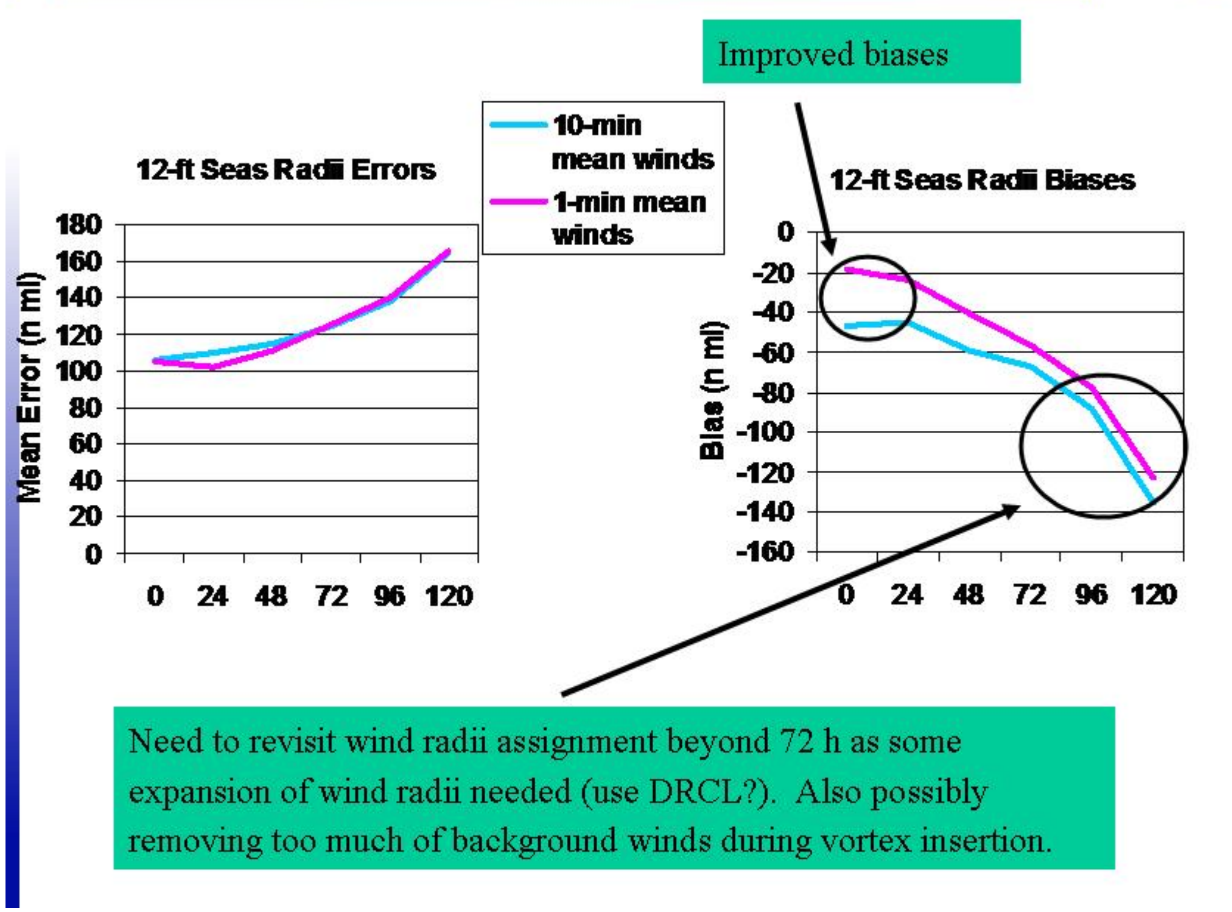

Figure 7. Evaluation of the 12-ft seas radii errors (n mi) using TAFB analyses as ground truth. The blue (purple) lines represent mean absolute errors and biases in the 10-minute (1-minute) mean wind speed version of OFCL/WW3.

Conclusions

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

- Address ATCF Requirements (80%),
- Update and evaluate intensity consensus (100%)
- OFCL/WW3 (%80)

Acknowledgements

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