15A.1 Accuracy of Tropical Cyclone Intensity Forecasts in the North Pacific and Atlantic

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1. Introduction

In recent years, track forecasts by dynamical models have improved, and subsequently, the consensus track forecast has become a reliable "starting point" for the forecaster. However, Blackerby (2005) and Lambert (2005) have shown that improvements of intensity forecasts have been slower in coming (Fig. 1). Given the lack of skill of intensity forecast techniques, a consensus of such techniques does not perform as well as a consensus of track forecasts, and the lack of a good consensus makes the forecast of intensity a daunting task.

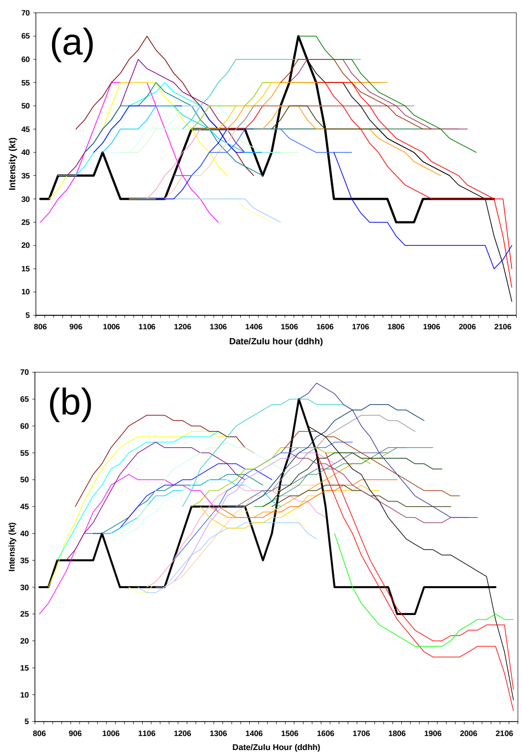

Fig. 1. (a) National Hurricane Center official intensity guidance for Hurricane Isis (September 2004). The heavy line represents the observed storm intensity, and the thin lines illustrate intensity forecasts every 6h. These errors may be described as: early over-intensification; missed 'rapid' intensification; missed decay; missed secondary decay; and missed 'rapid' decay. (b) As in (a), except for Statistical Hurricane Intensity Prediction Scheme (SHIPS).

2. Data

Consensus methods require that the techniques have no bias and have skill. The accuracy of six statistical and dynamical model tropical cyclone intensity guidance techniques was examined for western North Pacific, eastern North Pacific, and North Atlantic tropical cyclones during the 2003-2004 seasons using the climatology and persistence techniques called ST5D or SHF5 as measures of skill. A framework of three phases: (i) formation to a named tropical storm (34 kt), (ii) early intensification after becoming a named storm with possible decay/reintensification cycles; and (iii) decay was used to examine the skill.

3. Results

a. Western North Pacific

From an initial study for the 2003-2004 western North Pacific seasons, only about 60% of the 24-36 h forecasts during both the formation and intensification stages were within +/- 10 kt, and the predominant tendency was to under-forecast the intensity (Fig. 2). None of the guidance techniques predicted rapid intensification well. All of the techniques tended to under-forecast maximum intensity and miss decay/reintensification cycles. Whereas about 60-70% of the 12-h to 72-h forecasts by the various techniques during the decay phase were within +/- 10 kt, the strong bias was to not decay the cyclone rapidly enough. In general, the techniques predict too narrow of a range of intensity changes for both intensification and decay.

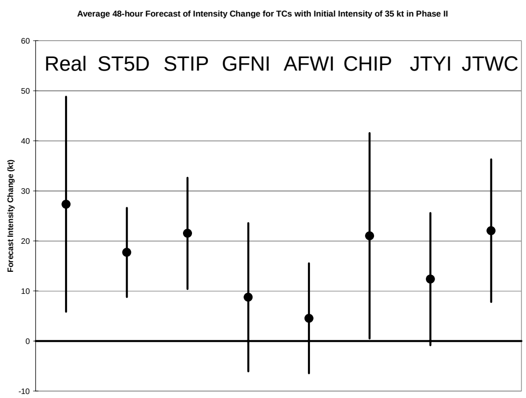

Fig. 2. Average 48-hour observed (Real) and forecast intensity change for TCs with initial intensity of 35 kt during intensification. The bar indicates one standard deviation. On average, all of the six techniques and the official forecast (JTWC) underforecast the amount of intensification, and with the exception of CHIPS, none of the forecasts exhibit the range that actually occurs.

b. Eastern North Pacific and Atlantic

From an initial study for the 2003-2004 eastern North Pacific and Atlantic seasons, the Decay Statistical Hurricane Intensity Prediction (DSHIPS) technique was the best technique in both basins during the formation phase. When the forecast errors during formation exceed +/- 10 kt, the statistical techniques (SHF5, SHIPS, DSHIPS) tend to over-forecast and the dynamical models (GFDI, GFNI) tend to under-forecast (Fig. 3). Whereas DSHIPS was also the best technique in the Atlantic during the early intensification stage, the Geophysical Fluid Dynamics Laboratory model was the best in the eastern North Pacific. All techniques under-forecast periods of rapid intensification and the peak intensity (Fig. 4), and have an overall poor performance during decay/reintensification cycles in both basins. Whereas the DSHIPS was the best technique in the Atlantic during decay, none of the techniques excelled during the decay phase in the eastern North Pacific. All techniques tend to decay the tropical cyclones in both basins too slowly, except that the DSHIPS performed well (13 of 15) during rapid decay events in the Atlantic.

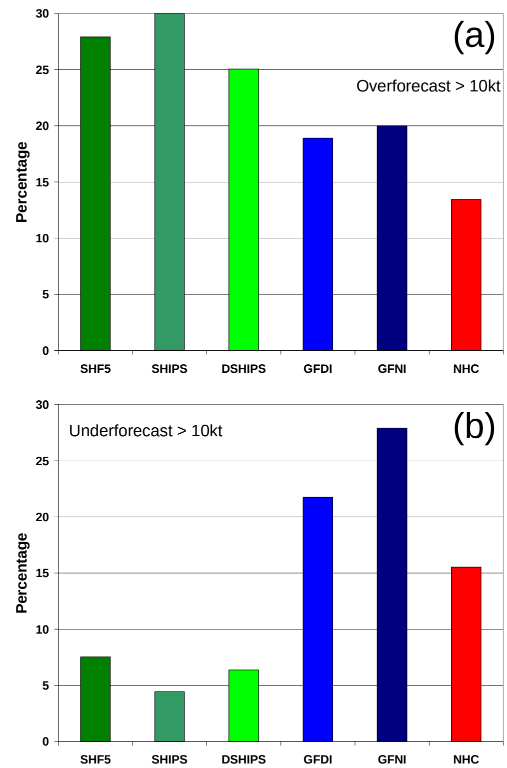

Fig. 3. (a) Percentage of times that the techniques and official forecast (NHC) overforecast the intensity by more than 10 kt at all 12-hourly forecast intervals out to 120 h for forecasts initiated during formation in the Atlantic. (b) As in (a), except for underforecasts.

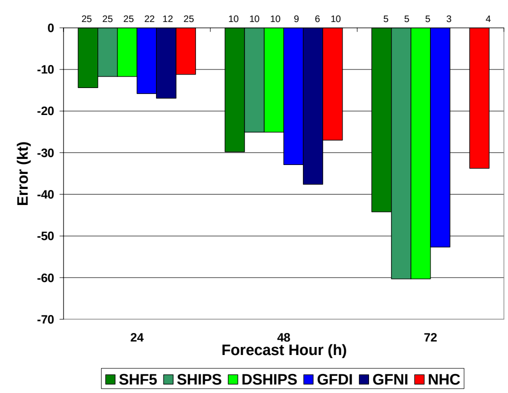

Fig. 4. Forecast intensity errors for eastern North Pacific TCs verifying at the peak intensity for three statistical techniques, two dynamical models, and the official forecast. Numbers of cases for each technique in this non-homogeneous sample are at the top. Note that at 24 h before the peak intensity, all forecasts underforecast the intensity by at least 10 kt.

4. Discussion

Specifically regarding the intensity guidance available to the NHC forecasters, the following deficiencies are observed: (i) Transition from tropical depression to tropical storm over forecast intervals as short as 24 h; (ii) Rapid intensification (>30 kt per 24 h) at 48 h in advance; (iii) Peak intensity at 48 h and 72 h in advance; (iv) Decay and re-intensification cycles involving changes of at least +/- 10 kt, which for hurricanes of > 100 kt is frequently associated with contracting eyewall cycles; and (v) Rapid decay, except for the DSHIPS, which requires that the NHC accurately forecast the timing of landfall. Intensity guidance available to the JTWC forecasters exhibits similar deficiencies.

5. References

Blackerby, J. S., 2005: Accuracy of western North Pacific tropical cyclone intensity guidance. M.S. thesis, Naval Postgraduate School, Monterey, CA, 107pp. Available at http://theses.nps.navy.mil/05Mar_Blackerby.pdf

Lambert, T. D. B., 2005: Accuracy of Atlantic and Eastern North Pacific tropical cyclone intensity guidance. M.S. thesis, Naval Postgraduate School, Monterey, CA, 119pp. Available at http://theses.nps.navy.mil/05Mar_Lambert.pdf