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Introducing Diagnostic Variables Towards Extending the SHIPS Algorithm for Hurricane Intensity Forecasts

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The SHIPS algorithm developed by Mark DeMaria is well known as one of the best current statistical methods for the prediction of hurricane intensity. This is a multiple regression method that regresses the hurricane intensity change (at 6 hourly intervals) as a function of a number of variables such as observed maximum intensity, persistence, the observed 12 hour intensity change, 850mb-200mb vertical wind shear, etc. The regression was carried out by DeMaria since the seasons of 2008 using 6 hourly data sets. The regression coefficients were next used for real-time hurricane intensity forecasts.

SPICE (Statistical Prediction of Intensity from a Consensus Ensemble) has been developed as a combination of the official SHIPS and LGEM (logistic growth equation model) Intensity Guidance, as well as SHIPS and LGEM runs based on the large-scale environments in the GFDL and HWRF regional models. The six total forecasts are combined into two unweighted consensuses: one from the three SHIPS forecasts and one from the three LGEM forecasts. The two unweighted consensuses are then combined into one weighted consensus, with the weights determined empirically from the 2008-2010 official SHIPS and LGEM sample. These weights favored the SHIPS consensus in the early time periods, shifting to the LGEM consensus being weighted more heavily after about 36 hours. Retrospective tests of SPICE over the 2008-2012 Atlantic hurricane seasons indicated that SPICE outperformed both SHIPS and LGEM at all lead times, and the improvements were statistically significant at almost all times. SPICE was run real-time during the 2011and 2012 seasons as part of the Hurricane Forecast Improvement Project (HFIP).

Our research group at FSU makes use of the SHIPS and SPICE products with a statistical extension. The extension includes four dynamical parameters such as the vertical distribution of heating (in the context of the potential vorticity equation), the transformation of shear vorticity into curvature vorticity, the transformation of divergent kinetic energy into rotational kinetic energy and the advection of angular momentum into the inner core of a hurricane. We use several hurricane cases from 2008 to 2009 for the training phase to extract the regression weights. The weights thus obtained are applied for forecast to hurricanes of the last four seasons.

In this report we address the performance of the modified SHIPS for the intensity forecasts covering the named storms of the 2012 season. This includes the four FSU diagnostic parameters , their time tendencies , SHIPS and SPICE 12 hourly data for the training are included here. Close to 300 forecasts were included in the training database that utilized hurricanes of the years 2010 and 2011. We show here the real time forecast results on intensity forecasts, Figure 1 a, b, c and d, for Hurricanes Isaac and Sandy. These illustrations show the absolute errors for intensity forecasts. Basically the performance from the modified SHIPS are superior to these other statistical models through hour 60 of forecasts. Thereafter the results from the modified SHIPS are comparable to SPICE. The performance of the modified SHIPS are generally superior to those of SHIPS.

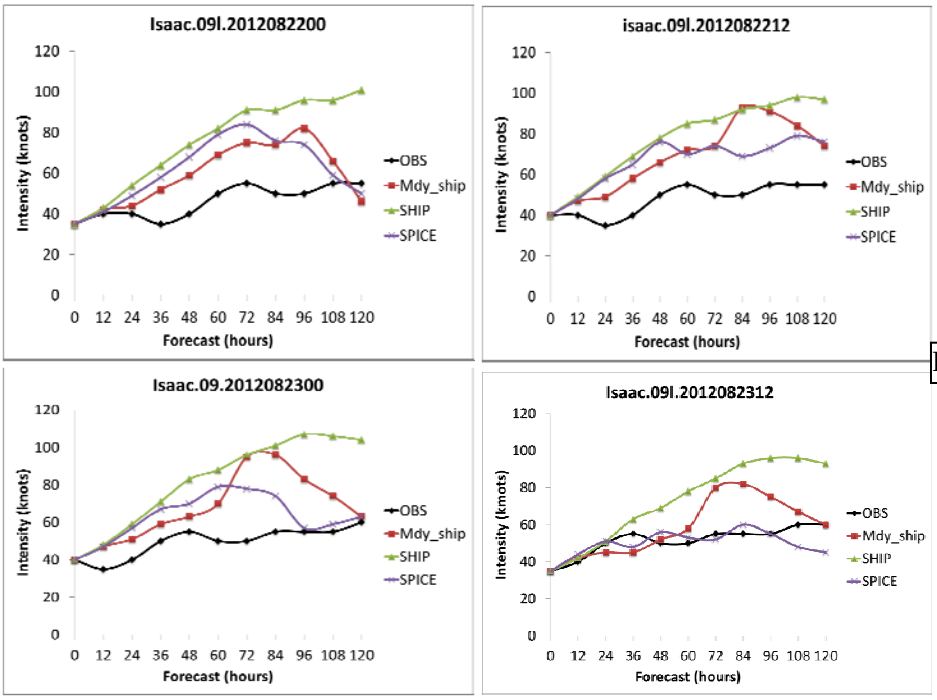
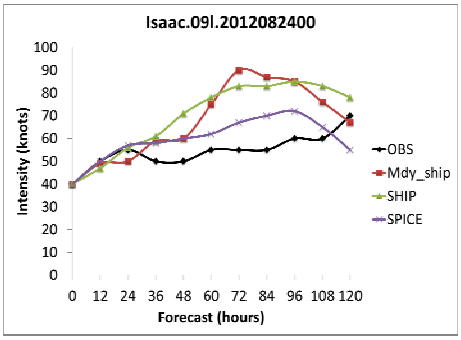
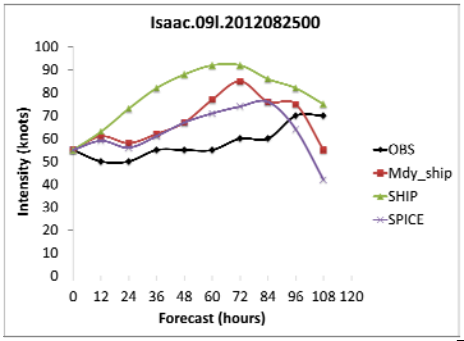
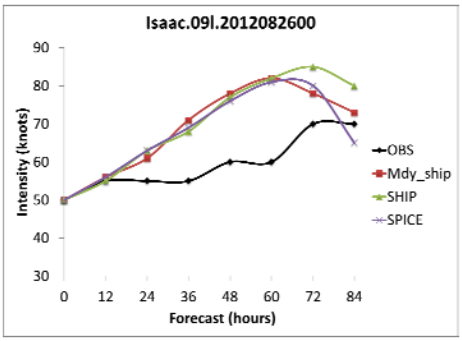


Fig 1a


Isaac.09l.2012082400
Intensity (knots)
Forecast (hours)
OBS
Mdy_ship
SHIP
SPICE


Isaac.09l.2012082500
Intensity (knots)
Forecast (hours)
OBS
Mdy_ship
SHIP
SPICE


Isaac.09l.2012082600
Intensity (knots)
Forecast (hours)
OBS
Mdy_ship
SHIP
SPICE

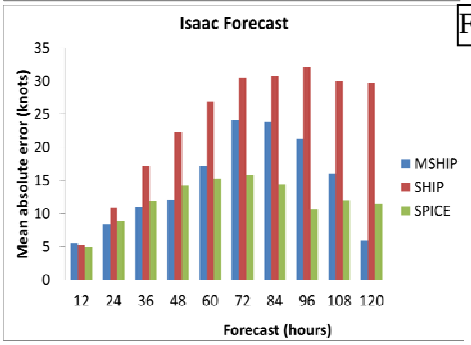
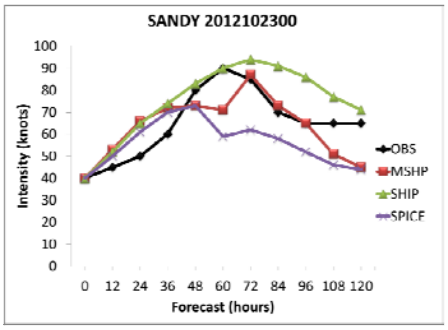
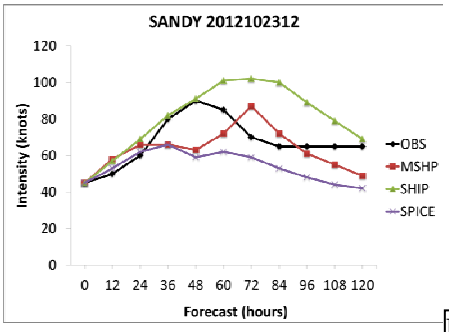
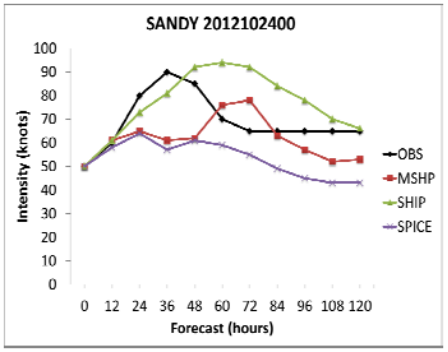

Isaac Forecast
Mean absolute error (knots)
Forecast (hours)
MSHIP
SHIP
SPICE

Fig 1b


SANDY 2012102300
Intensity (knots)
Forecast (hours)
OBS
MSHP
SHIP
SPICE


SANDY 2012102312
Intensity (knots)
Forecast (hours)
OBS
MSHP
SHIP
SPICE


SANDY 2012102400
Intensity (knots)
Forecast (hours)
OBS
MSHP
SHIP
SPICE

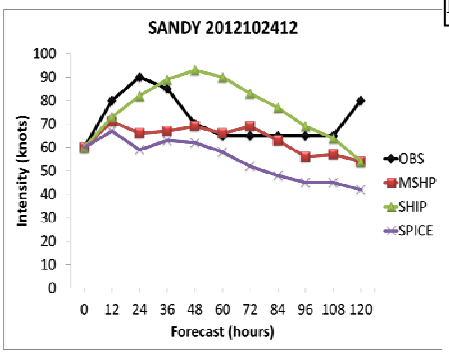
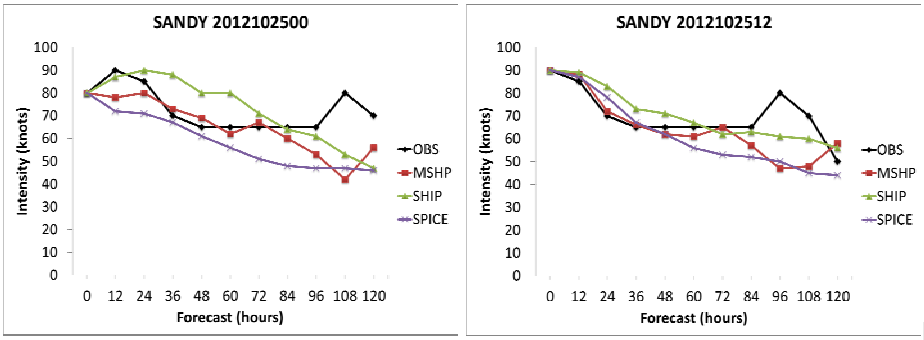

SANDY 2012102412
Intensity (knots)
Forecast (hours)
OBS
MSHP
SHIP
SPICE

Fig 1c



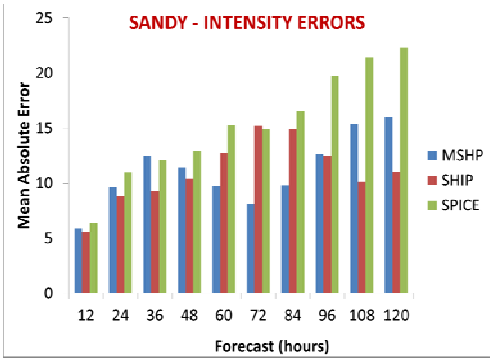


Fig 1d

In this ongoing work, we are still trying to improve our results. That is possible now since we have better ways to remove outliers and those have a great impact on the final results. We will report on our improved results in July 2013 when the project ends.