

NOAA Joint Hurricane Testbed Project
Year-2 Mid-Year Progress Report
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“Updating the Secondary Eyewall Formation Probabilistic Model, Completing New Climatologies of Intensity and Structure Changes Associated with Eyewall Replacement Cycles, and Construction of New Forecast Guidance Tools based on the New Climatologies”

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Report:

All proposed Year-1 milestones were met.

Year-2 milestones/results:

- Appended model training/testing dataset with 2011 and 2012 data. The data now span 2008–2012.
- Performed cross-validation (operational) on the Bayesian probability model, the optimized Bayesian probability model, the logistic regression probability model, and a model ensemble (simple average).
 - The Brier Skill Scores are shown in Table 1. The models have been performing skillfully in a consistent and robust manner. In 2012, the Brier Skill Scores were quite high because there were so few ERC events and the models were providing low probabilities of ERCs. Still, it is difficult to claim too much success in 2012 as the one observed ERC event in Hurricane Michael was not forecasted well and was missed. After-the-fact analyses showed that anomalously low MPI and ocean heat content lowered the model probability substantially. Here, the environment that Michael was in when the ERC occurred was highly anomalous with respect to the training data the models are based on, and updating the models with the expanded training data from 2012 is expected to help.
 - The Attributes Diagrams are shown in Fig. 1. The Bayesian and optimized Bayesian models have performed skillfully at all forecast lead times and have been skillful at providing both low and high probabilities, but the logistic regression model has not been skillful at providing high probabilities at the longest lead time (36-48h).
- New models to predict intensity and structure changes during an ERC were constructed from the ERC climatologies (described by Sitkowski et al. 2011). The new models are described in Kossin and Sitkowski (2012) and are summarized in Fig. 2.
 - The new models have been converted to FORTRAN subroutines and transitioned into SHIPS, but remain disabled for the time being. The utility of these models needs to be discussed further with NHC personnel. The models are expected to provide additional objective guidance preceding and during ERCs that may help forecasters when they are subjectively adjusting the usual numerical and statistical intensity guidance.

Tables and Figures

Table 1: Brier skill scores from operational testing on the years 2008-2012 for the Bayesian probability model, the optimized Bayesian probability model, the logistic regression probability model, and a model ensemble (simple average) for all model lead times.

Operational Model Verification 2008-2012 (Brier Skill Scores)

Year	N (TS)	N (HUR)	N (ERC)	00-12 hr	12-24 hr	24-36 hr	36-48 hr
2012	19	10	1	+57	+58	+58	+57
				+54	+53	+54	+54
				+54	+51	+42	+35
				+56	+54	+52	+49
2011	18	6	5	+21	+18	+14	+19
				+22	+16	+13	+16
				+10	+11	+6	+11
				+20	+17	+14	+18
2010	19	11	9	+27	+23	+11	+10
				+41	+20	+17	+17
				+25	+25	+15	+8
				+38	+28	+20	+17
2009	9	3	3	-6	-2	-1	+5
				-6	-8	-6	+6
				+11	+6	+28	+36
				+7	+3	+17	+27
2008	16	8	4	+14	+12	-5	+2
				+11	+4	-7	-6
				+2	-7	+0	-4
				+10	+4	+0	+0
2008-2012	81	38	22	+20	+17	+9	+11
				+26	+16	+13	+15
				+22	+18	+15	+12
				+27	+21	+17	+17

Bayesian

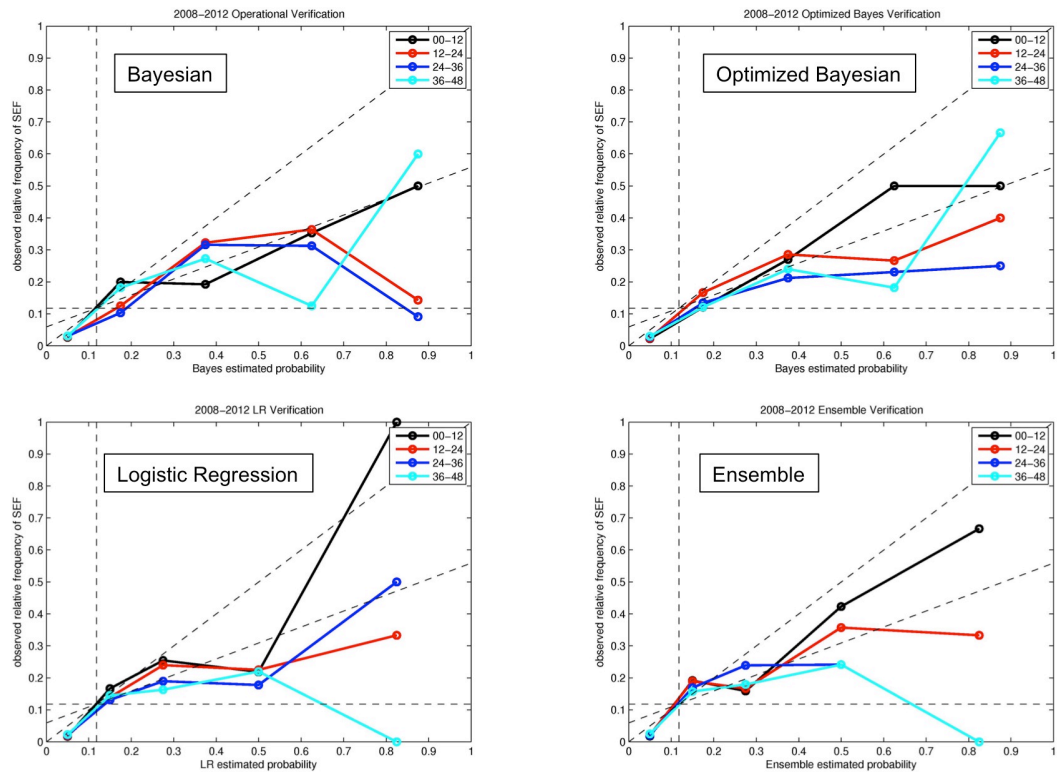
Optimized Bayesian

Logistic Regression

Ensemble



Operational model verification 2008-2012 (attributes diagrams)




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Figure 1: Attributes diagrams for the models.

Can we use this climatology and the SHIPS features (**F**) to create useful predictive models?

<u>Phase II ΔV:</u>	mean = -20 kt, STDev = 18 kt
$\Delta V = f(\mathbf{F})$	$R^2 = 68\%$, RMSE = 3.6 kt
<u>Phase II ΔT:</u>	mean = -17 hr, STDev = 9 hr
$\Delta T = f(\mathbf{F})$	$R^2 = 49\%$, RMSE = 6.2 hr
<u>Phase III $\Delta V / \Delta T$:</u>	mean = +0.8 kt hr ⁻¹ , STDev = 2.3 kt hr ⁻¹
$\Delta V / \Delta T = f(\mathbf{F})$	$R^2 = 47\%$, RMSE = 1.3 kt hr ⁻¹
<u>Total expansion of RMW :</u>	mean = 22 km, STDev = 13 km
$\Delta \text{RMW} = f(\mathbf{F})$	$R^2 = 51\%$, RMSE = 9.9 km



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Figure 2: Summary of the models created using the ERC climatology of Sitkowski et al. (2011). The first (topmost) model predicts the amount of weakening expected during the ERC, the second model predicts the duration over which the weakening is expected to occur, the third model predicts the re-intensification rate expected at the completion of the ERC, and the third model predicts the expansion of the RMW during the ERC.

Bibliography (acknowledging this project)

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