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Real-Time Ensemble-Based Probabilities of Tropical Cyclone Rapid Intensification

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Introduction and Motivation

Rapid Intensification (RI) continues to be one of the most difficult forecasting situations for tropical cyclones, particularly since numerical models have difficulty simulating and predicting these events. Currently, NHC has statistical models that have been developed that provide skillful probabilistic RI forecasts. Another potential method of calculating RI probabilities could be to use output from the various ensemble prediction systems that are produced as part of the Hurricane Forecast Improvement Project (HFIP) Demonstration Project.

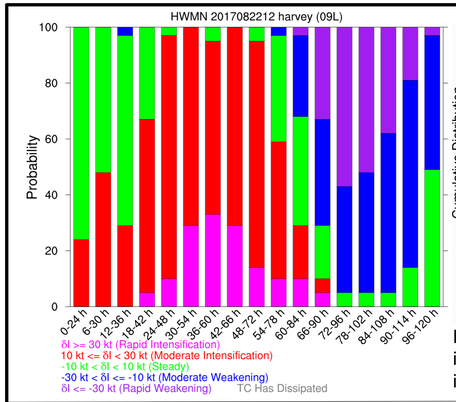
GOAL: To evaluate whether dynamical TC ensemble forecasts provide skillful probabilistic TC intensity change guidance

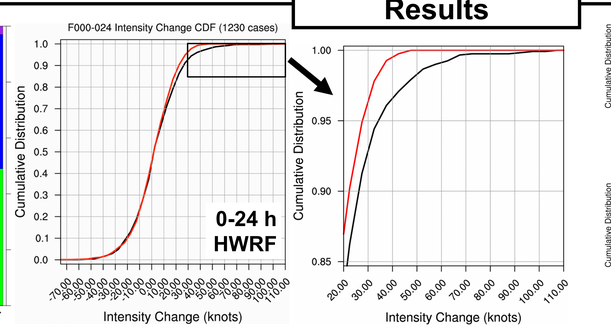
Methodology

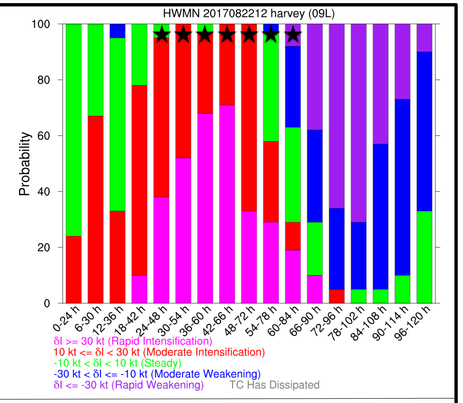
- Compute probabilities of various TC intensity change categories for initialization times when an ensemble is produced (non-homogeneous sample for comparison)
- Probabilities computed assuming that each member has equal weighting
- Cases taken from 2017 as well as 2014-2016 retrospective cases. Verification against NHC best track information
- Apply CDF bias correction to HWRF and HMON ensemble intensity changes (see upper right)
- Multi-model probabilities produced by assuming each member of multi-model ensemble has equal weight

Model	Ensemble Type	Real-Time Offset
HWRF (HWMN)	Dynamical (IC + Physics)	12 h
HMON (HMMN)	Dynamical (IC + Physics)	12 h
COAMPS-TC (COMN)	Dynamical (IC)	6 or 12 h
HWRF Analog (HWAN)	Statistical model based on retrospective HWRF forecasts	6 h
Deterministic to Probabilistic (DTOP)	Statistical combination of dynamical forecasts	0 h
SHIPS RI (RIOD)	Statistical	0 h

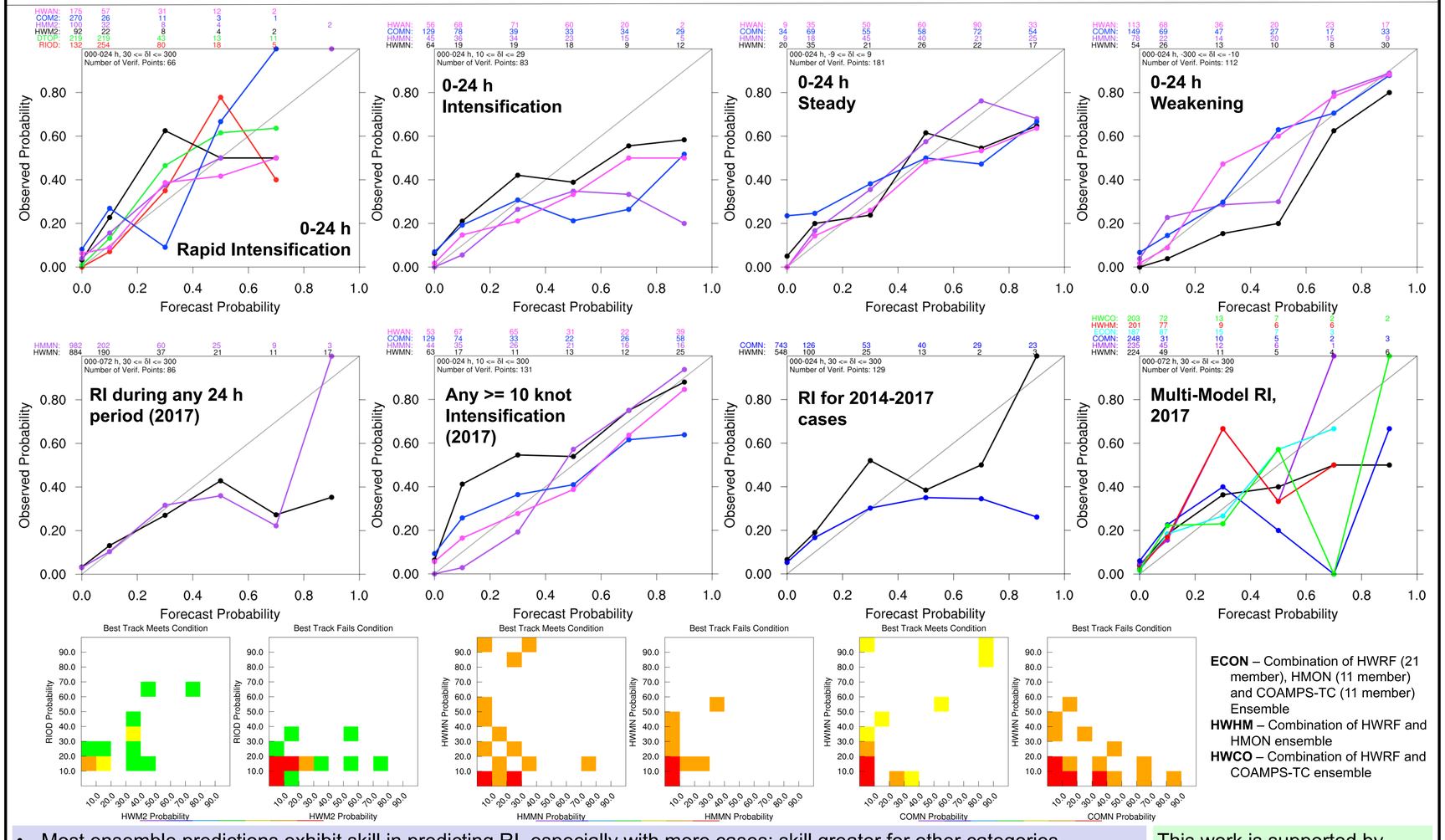
Results







HWRF ensemble-derived ensemble probabilities of various intensity changes for Hurricane Harvey initialized 1200 UTC 22 August. The far left figure is the raw probabilities, while the far right figure is bias-corrected using the intensity change cumulative distribution function (CDF) shown above.



ECON – Combination of HWRF (21 member), HMON (11 member) and COAMPS-TC (11 member) Ensemble
HWHM – Combination of HWRF and HMON ensemble
HWCO – Combination of HWRF and COAMPS-TC ensemble

- Most ensemble predictions exhibit skill in predicting RI, especially with more cases; skill greater for other categories
- Each prediction system seems to give independent information about RI (including HWRF analog ensemble)
- CDF-based bias correction can help when model already fairly skillful (i.e., ECMWF-based estimates not skillful)
- Future work will use the multi-model ensemble, which combines the three dynamical ensembles together

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