Enhancements to the SHIPS Rapid Intensification Index

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1. Background

- SHIPS RI index (SHIPS-RII) is a statistically-based tool that was developed to aid in forecasting RI events which remains a top forecasting priority of the NHC.
- SHIPS-RII uses mainly environmental and a few GOES inner-core SHIPS model predictors to estimate the probability of RI from t=0 to t=24-h utilizing linear discriminant analysis. (Kaplan et al. 2010).
- SHIPS-RII is currently used as an operational forecasting tool at the NHC for both the Atlantic and E. Pacific basins.

2. Project Goals

- Develop new multi-lead time (12-h, 24-h, 36-h, and 48-h) consensus RI models (Rozoff and Kossin 2011).
- Utilize new multi-lead time consensus RI models to develop new versions of the deterministic rapid intensity aid guidance (Sampson et al. 2011).
- *Derive new microwave-based RI models (see previously presented conference poster by Rozoff et al. 2014).*

3. Methodology

- Multi-lead time (12-h, 24-h, 36-h and 48-h) RI models were derived using 1995-2012 SHIPS developmental data for both the Atlantic and E. Pacific basins.
- Consensus RI model is the average of RI probabilities from SHIPS, Bayesian, and Logistics- regression versions of the RI model.
- Multi-lead time RI model was run in real-time at CIRA/CSU from ~August 1 to Nov 30 of the 2013 Hurricane Season (see sample output in Fig. 1).

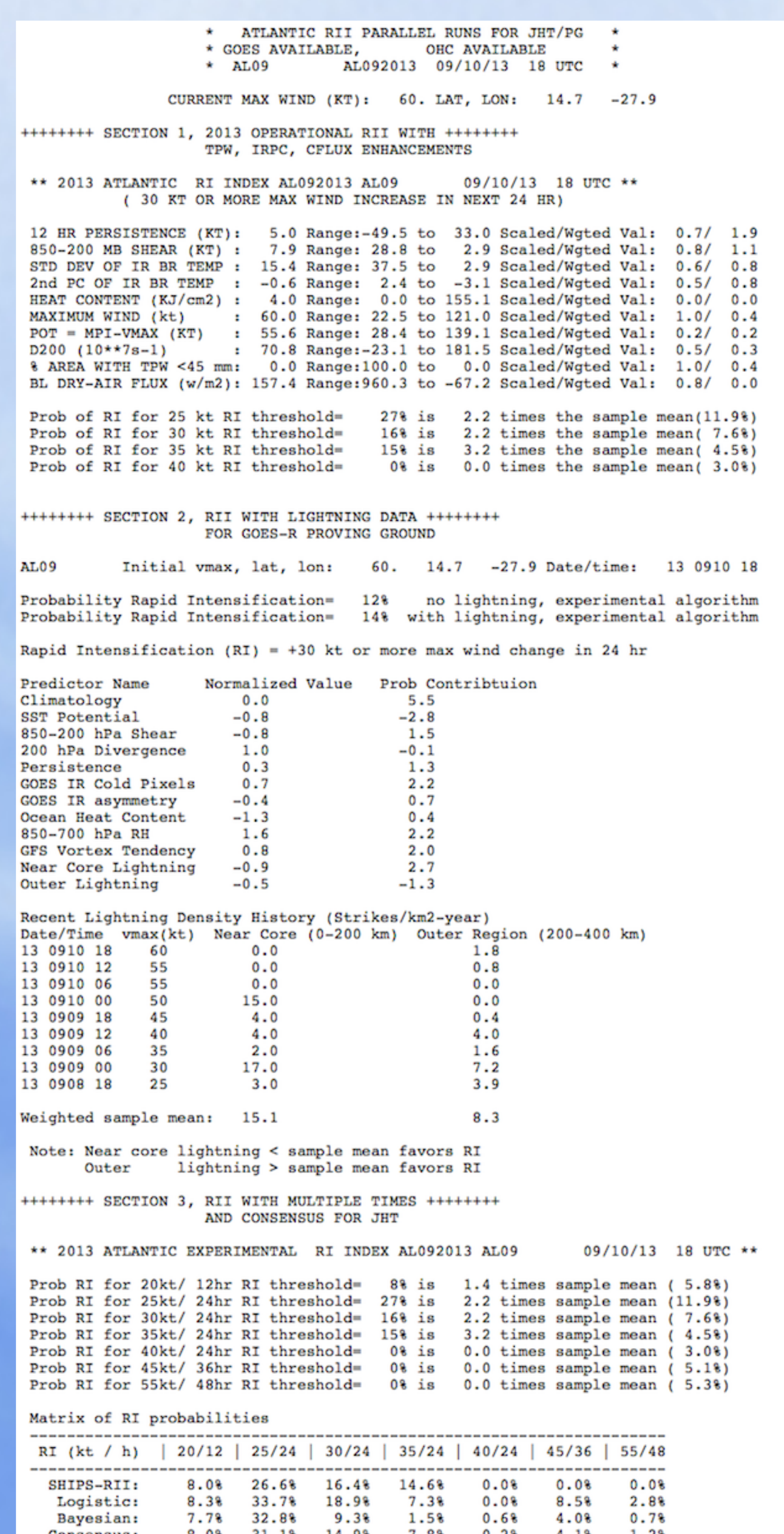

Fig. 1. Sample output from real-time parallel run of SHIPS-RII made for Atlantic basin tropical storm Humberto at 18 UTC on 9/10/2013. Forecasted RI probabilities from operational SHIPS-RII (Section 1), experimental lightning-based RI model (Section 2), and multi-lead time RI model probabilities for each individual RI model and their consensus mean (Section 3) are all depicted.

4. Results

- Multi-lead time independent versions of the RI models were derived for each year between 2004-2013 by first removing all cases from that year and then re-deriving those models using the remaining 9-year sample.
- RI re-run forecasts were performed using operational GFS forecast fields and NHC storm data archived from 2004-2013 using the independent models derived for the 10-year sample .
- All over-water tropical and subtropical forecasts from 2004-2013 verified against climatology based upon a Brier skill score (see Kaplan et al. 2010).

Skill of 2004-2013 independent RI re-run model forecasts

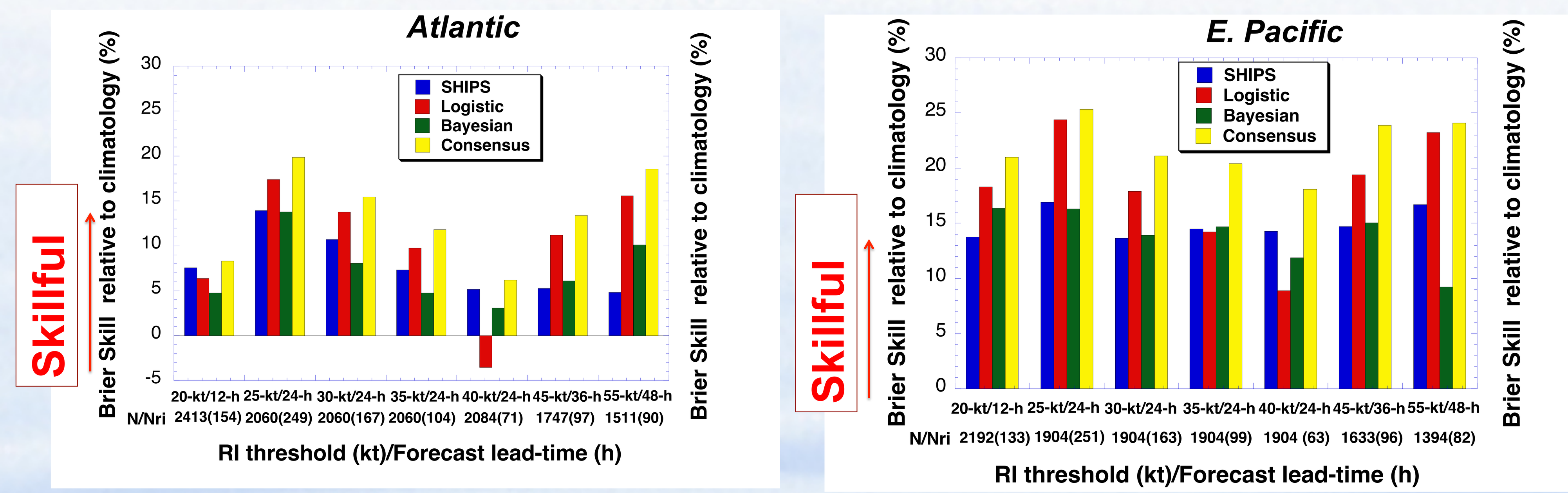

Fig. 2. Skill of 2004-2013 Atlantic basin (left panel) and E. Pacific (right panel) re-run RI model forecasts relative to climatology for the SHIPS, Bayesian, Logistic-regression (logistic), and consensus) RI models for each of 7 RI thresholds. Positive values denote model skill relative to climatology. The number of forecasts (N) and RI cases (Nri) are also shown for each RI threshold.

Reliability of 2004-2013 independent consensus RI re-run model forecasts

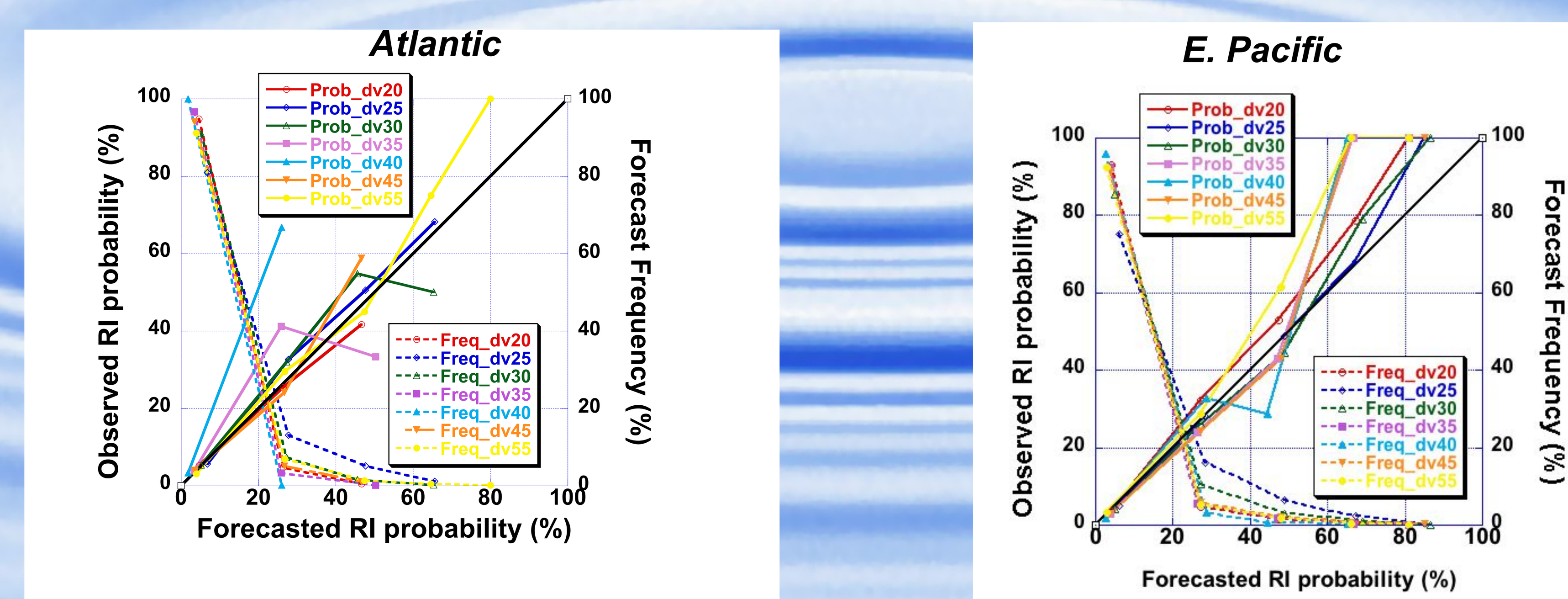

Fig. 3. Reliability diagrams for Atlantic (left panel) and. E. Pacific (right panel) basins depicting the forecasted versus observed RI probabilities for the consensus RI model for seven RI thresholds. The solid lines show the reliability for the 20-kt (red), 25-kt (dark blue), 30-kt (green), 35-kt (magenta), 40-kt (light blue), 45-kt (orange) and 55-kt (yellow) RI thresholds. The dashed lines show the frequency of RI forecasts for each RI threshold and the black diagonal line depicts forecasts with perfect reliability.

Sample RI independent consensus RI re-run model forecasts

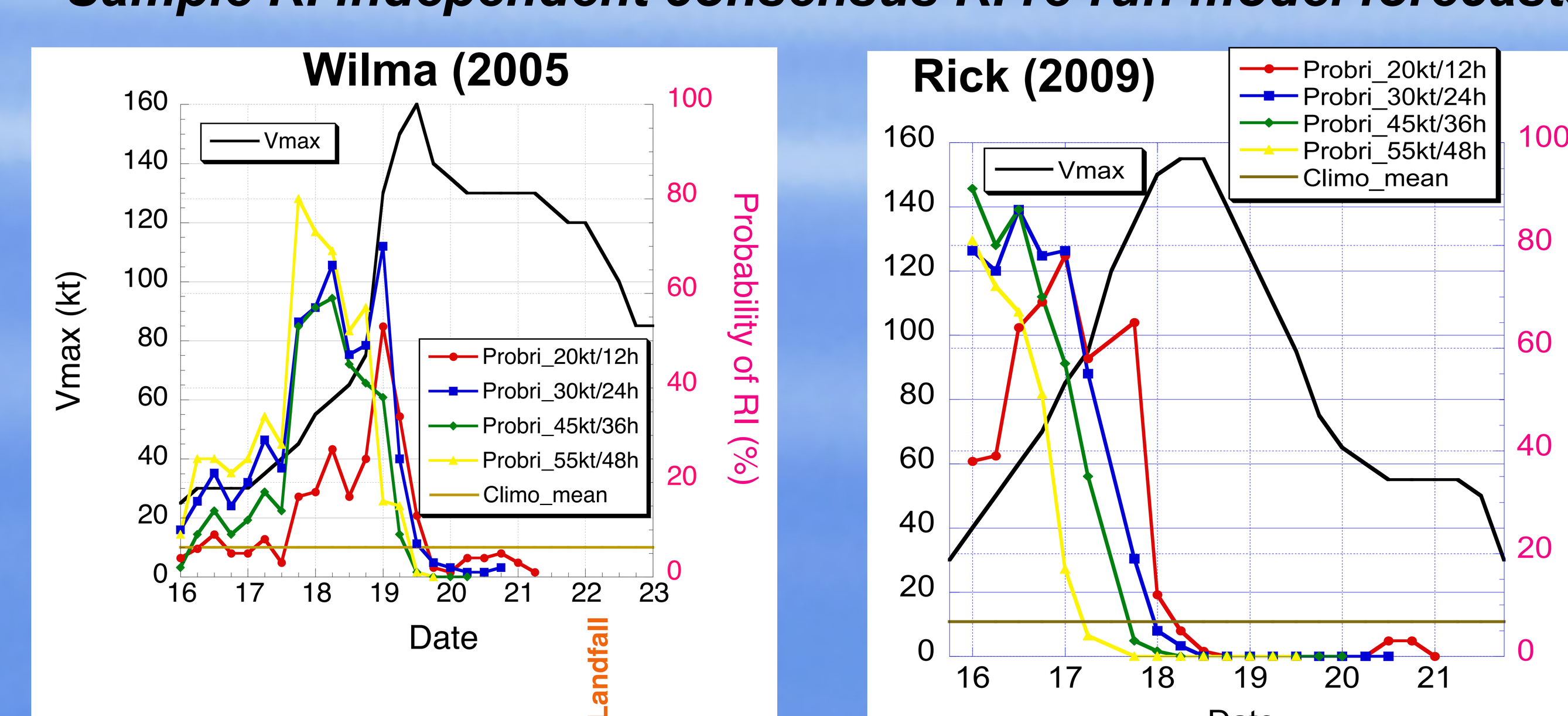

Fig. 4 Sample independent consensus RI-rerun forecasts for Atlantic basin Hurricane Wilma (2005) and E. Pacific basin Hurricane Rick (2009). RI probabilities are shown for the 95th percentile RI thresholds at the 12-h (red), 24-h (blue) , 36-h (green), and 48-h (yellow) lead times.

Deterministic RAPID Aid guidance

- RAPID aid provides deterministic RI intensity forecasts by combining consensus IVCN model (e.g., HWRF,LGEM, SHIPS,GFDL) and probabilistic SHIPS-RII forecasts (Sampson et al. 2011).
- RAPID aid assigns intensification rate when ensemble RI forecasted probability > 40% for a given RI threshold.
- Assigned intensification rate added to existing IVCN model forecasts to obtain deterministic IVRI intensity forecasts for the 2008-2013 independent samples.

Skill of 2008-2013 independent Rapid Aid RI re-run forecasts

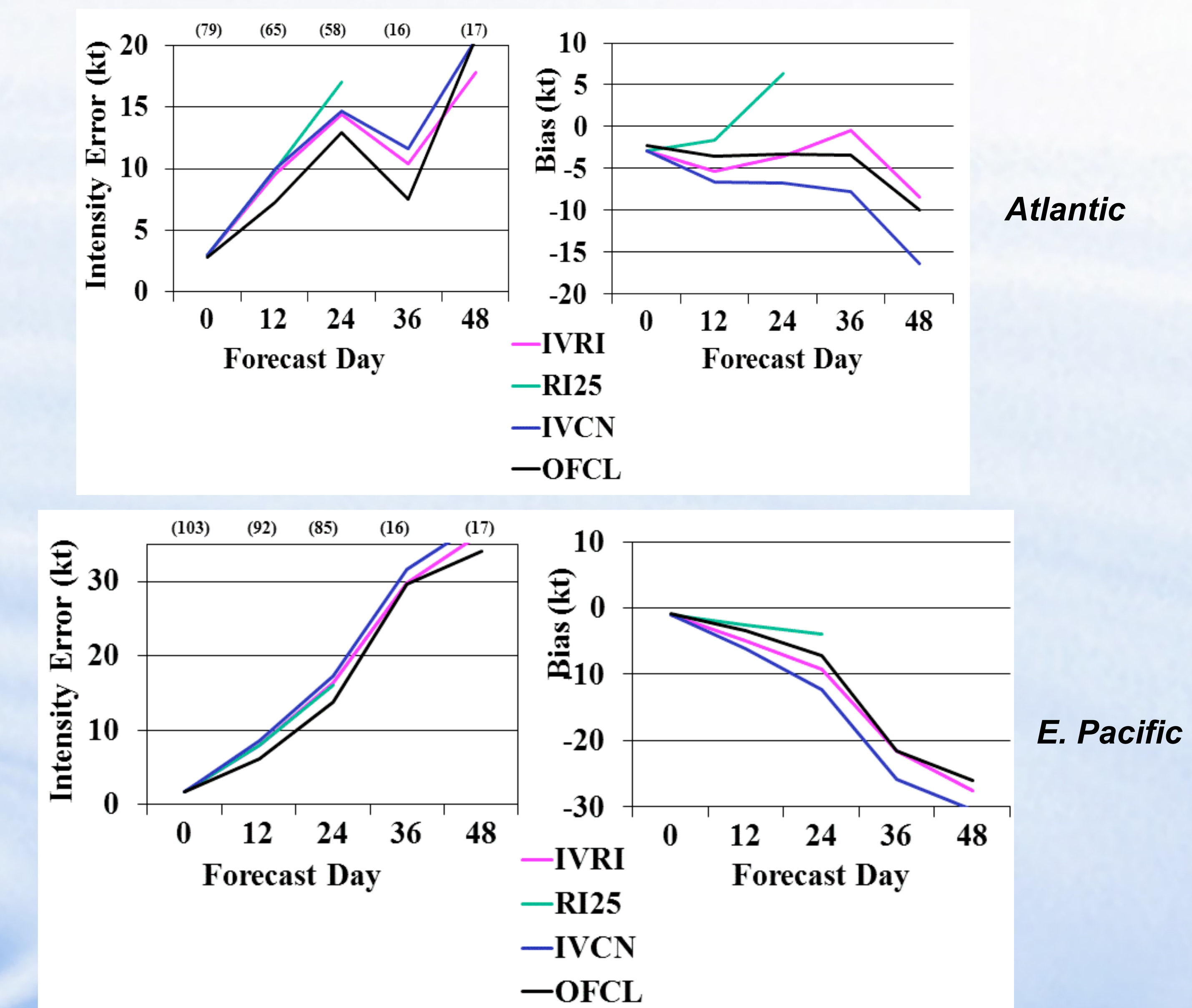

Fig. 5. Results from 2008-2013 Atlantic (top) and eastern North Pacific (bottom) re-runs of the operational NHC intensity consensus (IVCN) and the IVCN with the addition of RAPID aids computed from the consensus RI model (IVRI). RI25 is deterministic RAPID aid computed for a 25-kt RI event.

5. Summary

- New multi-lead time models for estimating the probability of RI at lead times of 12-h, 24-h, 36-h and 48-h were developed (and tested in real-time during the 2013 Hurricane Season) for both the Atlantic and E. Pacific basins.
- Verification of the 2004-2013 independent RI re-run forecasts showed that the individual multi-lead time RI models (SHIPS, Bayesian, Logistic-regression) were generally skillful at each lead-time in both basins with the consensus version proving to be the most skillful overall.
- New versions of the deterministic rapid intensity aid (IVRI) that employs both the probabilistic RI guidance and operational intensity model consensus (IVCN) were developed using the ensemble-based multi-lead RI models for the Atlantic and E. Pacific basins.
- An evaluation of the independent 2008-2013 IVRI re-run forecasts demonstrated that the IVRI forecasts generally had smaller mean absolute errors and biases than did IVCN in both forecast basins.

Acknowledgements

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