Hurricane Forecast Improvement Project (HFIP)
Verification Team Strategic Plan

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Team Members

Tim Marchok (co-lead), GFDL
Barb Brown (co-lead), NCAR/TCMT / DTC
Ligia Bernardet, DTC and NOAA/GSD
Louisa Nance, NCAR/TCMT/DTC
Mark DeMaria, NESDIS / StAR
Rob Rogers, HRD
James Franklin, NHC
Mike Fiorino, ESRL
Tony Eckel, NWS/OST
Jim Goerss, NRL
Hao Jin, NRL
Vijay Tallapragada, EMC

A. Team overview

The Hurricane Forecast Improvement Project (HFIP) has defined specific goals related to the improvement of numerical guidance for tropical cyclones. These goals are focused on improving track and intensity forecasts, improving prediction of rapid intensity change events, and extending skillful forecasts out to seven days lead time. The Verification Team plays a critical role in assessing progress towards the specific HFIP goals.

The two fundamental tasks of the Verification Team are the performance of model verification analyses and the development and/or adoption of new verification techniques. The verification approaches can be divided into two categories: “benchmark” verification analyses that are targeted specifically at the metrics for the main HFIP goals, and then all other verification studies that may be performed for a variety of model development and evaluation purposes.

The primary focus of the Verification Team is on the benchmark verification analyses and related activities, such as contributing to the organization and coordination of real-time and retrospective runs, with the objectives of: (1) providing reports to management on the progress of the models towards the HFIP goals, and (2) providing forecasters and other decision-makers with the statistics they need to understand model biases and also make informed decisions on potential transitioning of a model to operations.

As resources allow, the Verification Team will also work on other verifications and related activities. These activities may include: performance of verifications for metrics that are not part
of the main HFIP goals, the development of new verification techniques, and the distribution of verification software to the community.

B. Summary of accomplishments to date

In order to help HFIP achieve its ambitious forecast goals, the Verification Team is performing verification analyses using available software, and is also developing software to aid in the verification of new parameters. The following list details some of the Team’s accomplishments in these areas to date.

- Performed an extensive evaluation of forecasts from models that participated in the FY09 HFIP High Resolution Hurricane test and provided a comprehensive report to HFIP management and participants (see Fig. 1).
- Established baseline track and intensity standards for both the Atlantic and Eastern Pacific Ocean basins that will be used to measure future progress in model forecast performance (see Fig. 2).
- Upgraded track and intensity verification software to extend verification analyses out to 7 days.
- Implemented verification software at NCAR for independent testing and evaluation of forecast performance.
- Collected data from 2009 Demonstration.
- Developed testing plan for retrospective evaluations, and worked with modeling groups to implement the plan.
- Developed initial version of software for verifying surface wind structure forecasts.
- Developed initial version of software for verifying tropical cyclone rainfall forecasts.
- Developed initial version of software for verifying forecasts of rapid intensity change.
- Developed initial version of software for verifying run-to-run consistency in model forecasts.

C. Focus areas of development

In order to help HFIP achieve its five-year 20% improvement goals, the Verification Team will focus primarily on these four areas:

(1) Contribute to the planning and coordination of HFIP hurricane model tests for retrospective tests and annual Demo forecast exercises to ensure representative samples will be collected that can be used for meaningful model evaluations.

(2) Perform model verification analyses for annual Demo exercises and retrospective studies and provide results to the community on-line and in summary reports.

(3) Develop, test, and implement new tools for evaluation of hurricane forecasts, including tools for cyclone tracking, as well as tools for the verification of ensemble forecasts and forecasts of TC genesis and TC rainfall. Provide mature tools to the community.
(4) Provide in-depth evaluations of collected hurricane datasets (e.g., HRH test; HWRF) to provide more insight into results from these studies. For cases in which the verification results indicate that more in-depth analysis is needed, coordinate with the HFIP ADD Team to collaborate and share datasets, software and results.

D. Milestones and Deliverables

Specific milestones and deliverables are included below. Expected dates of completion are listed as “ongoing” for those items that the Verification Team will be performing on an annual basis, while other items are divided into ranges of short term (1-2 years) or longer term (3-5 years).

Plan and coordinate tests

1. Plan and coordinate annual retrospective reruns for evaluation of representative samples of forecasts and storms (ongoing).
2. Contribute to the planning and coordination of the annual Demo forecasting projects (ongoing).

Deliverables:
Planning documents and timelines

Perform model verification analyses

3. Perform independent, statistically valid model verification analyses for the annual Demo and retrospective projects and prepare reports for HFIP management and participants (ongoing).
4. Create a testing and evaluation environment on the HFIP computing platform that will be used for evaluation of HFIP model forecasts; facilitate running and testing of models on this platform (1-2 years).
5. Perform in-depth evaluations of hurricane datasets collected from the HRH, retrospective and demonstration project forecasts. For cases in which the verification results indicate that more in-depth analysis is needed, coordinate with the HFIP ADD Team to collaborate and share datasets, software and results (ongoing).

Deliverables:

Development of new tools for evaluation of hurricane forecasts

6. Develop CLIPER and Decay-SHIFOR models that extend out to 7 days in order to provide a skill benchmark for 7-day forecasts (1-2 years).
7. Develop software to detect TC genesis and track new storms. Develop accompanying evaluation system to assess the performance of model genesis forecasts (1-2 years).
8. Develop a portable version of the Marchok, Rogers & Tuleya TC rainfall validation software. Test and implement additional (spatial) methods for evaluation of TC rainfall (1-2 years).

9. Develop tools for evaluation of forecast consistency (1-2 years).

10. Develop tools for evaluation of wind structure. Initially (1-2 years), this will be focused primarily on the 2-D surface wind structure. In the longer term (3-5 years), this will include 3-D wind structure down to the vortex scale.

11. Develop, implement, and enhance tools for evaluation of TC ensemble forecasts (1-2 and 3-5 years).

12. Develop tools for validating forecast-critical ocean parameters (3-5 years).

13. Develop a set of TC forecast evaluation tools that can be distributed to the community. Enhance the toolset as new tools are developed (1-2 and 3-5 years).

14. Perform statistical studies to develop improved, more efficient, comprehensive approaches for testing and evaluation of hurricane forecast performance for use in the transition from research to operations (1-2 years).

15. Develop software to include significance tests and add error bars to hurricane track and intensity forecast error statistics. Make this software available for use by the various HFIP teams and the operational modeling and forecasting centers (1-2 years).

**Deliverables:**
New forecast verification tools available to the community.

![Figure 1](http://www.dtcenter.org/plots/hrh_test/HRH_Report_30Sept.pdf)

*Figure 1.* Example of results from the HRH test, showing distributions of intensity errors for the MMM models. See report [http://www.dtcenter.org/plots/hrh_test/HRH_Report_30Sept.pdf].
Figure 2. Comparison of operational model performance for hurricane track forecasts in 2009 to HFIP targets.