HFIP Annual Workshop

Observations & Future Directions
Modeling Issues Identified by Forecasters

Genesis

- GFS continues to be too fast/aggressive with genesis - especially in the NW Caribbean Sea, eastern Atlantic, and offshore of southern Mexico east of 100W
- ECMWF continues to miss/underplay many TC genesis events, regardless of basin
- Continued challenges with genesis timing/detection in the Gulf of Mexico and off Southeast U.S. coast (PTC1/Alex)
- Poor genesis forecasts (short lead time, low POD) continue to be a problem in the subtropics and mid-latitudes
Modeling Issues Identified by Forecasters

Intensity

- Over-aggressive forecasts in environments of low shear but suboptimal thermodynamic properties in the tropical western Pacific, from both dynamical and statistical models
- TC-resolving models (HWRF, COAMPS-TC) often seem overeager to symmetrize core convection in environments of shear and/or ambient dry air, leading to high-biased intensity forecasts
- Intensity guidance backing off in 12-24 h prior intensification prior to landfall of Ian and Ida
- Difficulty predicting intensification above 115 kt
- SHIPS model lacked skill in the east Pacific beyond 48 h
Modeling Issues Identified by Forecasters

**Track**

- Inconsistent track guidance for pre-genesis systems
- Leftward bias in ECMWF ensembles relative to other models and observed TC tracks was noted in several cases in the Atlantic and western Pacific
- Left-of-track bias for GFS and HWRF for Ian in the Gulf of Mexico
- Continued left-of-track bias for systems near/along the west coast of Mexico for most guidance
- Frequent track correction in the down-shear direction due to poor handling of tilted TC vortices under moderate shear, especially for TCs < 65 kt
- HWRF track skill lags GFS significantly in first 48-60 hours in the Atlantic
HAFS 2022 Challenges

- Challenging storms: Earl 06L, Fiona 07L, Ian 09L
- Cycle-to-cycle variation
- West bias of both HAFS-A and HAFS-S for Hurricane Ian
- Steep terrain induced spurious gravity wave and Model instability
- Internal tracker loses weak storms
- Bug in wind stress into ocean, fixed the issue recently
**HAFS challenges:**

- **HAFS Physics issues/challenges:** All HAFS appear to have a negative intensity bias after 48 h in WPAC, NATL, HAFS-S has weak bias after 48 h, HAFS-A seems closer to HWRF.
- **HAFS impact on consensus** - HAFS models provide big impact in TVCN, & HCCA tracks; HAFS produces slightly less IVCN skill in ATL, but slight positive impact in EPAC; similar RVCN skill in ATL and EPAC as IVCN.
- **Structure** - HAFS appears to have biases in radii compared to HWRF, GFS., HAFS-S has R34 negative bias after 48 h - Is new tracker helping? Are radii defined in a similar way between model and Best Track?
- **Observation impacts are mixed** - DA/VI issues? Evaluation strategies?
# JTWC R&D Priorities

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<th>Priority</th>
<th>Need</th>
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<td><strong>1</strong> TC Intensity Change</td>
<td><em>Basin-specific</em> (WESTPAC, SHEM, NIO, SIO, and SWPAC) probabilistic and deterministic forecast guidance for TC intensity change, particularly the onset, duration, and magnitude of <em>rapid intensity change</em> events (including ERC, over-water weakening, etc.) at 2-3 day lead times.</td>
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<td><strong>2</strong> TC Genesis Timing and Forecast</td>
<td>Guidance to <em>improve</em> the <em>forecasting of TC genesis timing</em> and the subsequent track, intensity and structure of pre-genesis tropical disturbances out to two week lead-times, that exhibits a high probability of detection and a low false alarm rate. Techniques to diagnose and predict the formation of TCs via transition of non-classical disturbances (e.g. monsoon depressions, sub-tropical, hybrids, etc).</td>
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<td><strong>3</strong> Data Exploitation</td>
<td>Techniques, products, or sources that <em>improve</em> the utility and <em>exploitation of microwave satellite, ocean surface wind vectors, and radar data</em> for fixing (center, intensity, radii) TCs, or for diagnosing RI, ETT, ERC, etc. (e.g., develop a “Dvorak-like” technique using microwave imagery). Leverage machine learning methods to maximize automation, and ensure rapid integration into visualization system.</td>
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<td><strong>4</strong> TC Structure Specification</td>
<td><em>Basin-specific</em> (WESTPAC, SHEM, NIO, SIO, and SWPAC) probabilistic and deterministic guidance for the <em>specification</em> (analysis and forecast) of key TC structure variables, including the production of 34-, 50- and 64- knot wind radii and a <em>dynamic</em> (situational) confidence-based <em>swath</em> of potential 34-kt wind impacts</td>
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<td><strong>5</strong> TC Track Improvement</td>
<td>Model and DA enhancements or guidance to <em>improve TC track forecast skill and the conveyance of probabilistic track uncertainty</em>. Includes development of guidance-on-guidance to identify and reduce forecast error outliers resulting from large speed (e.g., accelerating recurvers) and directional (e.g., loops) errors, or from specific forecast problems such as upper-level trough interaction, near/over-land, elevated terrain, and extratropical transition.</td>
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Modeling challenges: Recommendations

- Need a clear definition of storm structure metrics (radii of 34 kt, 50 kt, & 64 kt) to use them in model diagnostics output to make sure R34 verification is using the same definitions for R34 in model and Best Track.
- Set up Tiger Team to address how to get HAFS model output into AWIPS-2. Could we use HOT and cloud-AWIPS to test different strategies that could be used to drive AWIPS 2 improvements.
- Need TC rainfall products that take into account track and structure uncertainty - Excessive rainfall outlook (ERO), probabilistic rainfall products.
- Need more interactions for the National Water Center to address TC rainfall guidance product development and evaluation.
- Need to look at physics diversity and impacts. Must be linked to DA impacts (how do physics changes affect DA performance).
Modeling challenges: Recommendations

- MAE is not sufficient to evaluate forecast guidance for track, intensity, structure, etc. Should use GROOT for all model evaluations. Need to rethink evaluation approach for extremes - RI, rain, etc.

- Need interactions between JCSDA & HFIP DA to accelerate HAFS dev.
  - Recommend joint workshop to accelerate HAFS adoption of JEDI components (IOTA, SOCA, UFO, SABER, etc.). Could benefit from collaboration with RRFS DA team’s efforts & from collaboration with JCSDA/SOCA to address wave model DA effort in JCSDA. Code Sprint?
  - HAFS needs a strong infusion of DA resources - both from personnel & HPC

- Need a strategy to utilize EPIC to support HAFS through UFS Hurricane Application Team - HAFS Containers

- Need to develop NHC, WPC, and WFO messaging needs that can be addressed through our SBES projects under the supplemental
SBES Panel Issues & Discussions

- Triangulation of funded projects had 4 key takeaways related to the tropical products. How can HFIP facilitate and provide means to utilize these takeaways to test & evaluate improved products.

- Should we work from existing products? Develop new products? - 
  **Recommen start to work with existing products if possible**

- How can we facilitate SBES and physical science collaborations -
  - Invite SBES to participate in HFIP bi-weekly meetings;
  - Set up workshop to identify joint projects and collaborations;
  - Take advantage of HOT to test and evaluate improvements to products
  - Involve Super users in evaluations

- How can we support SBES collaborations
  - Work with PMs to add requirement to have SBES participation in proposals supported to do work supported by HFIP