HFIP Ensemble Product Workshop
Ensemble "Mechanics" Group

Zoltan Toth, lead
Mark DeMaria, note taker
Richard Pasch, Naomi Surgi, Carolyn Reynolds, Yuejian Zhu, Hitoshi Yonehara

Discussions Topics

- Forecast approach
  - Start with single forecast, add uncertainty information
  - Start with distributions, make products from that
  - Metrics for evaluation
- What ensemble?
  - Simulated ensembles (e.g., MC wind prob model)
  - High resolution deterministic runs from different centers (e.g., TVCN)
  - Single center ensemble (e.g., GEFS)
  - Multi-ensembles from multi-centers
- Methods for improvements
  - Resolution, membership, initial and model perturbations
  - Evaluation methods
- Statistical post-processing
  - Re-forecasts for product development
- Digital ensemble databases

Forecast Approach

- Deterministic forecast from NHC will remain a necessity
  - How is the “best” forecast defined (mean, mode, median, nth percentile of distribution?)
- Requirement for uncertainty information
- Importance of probabilistic metric

What Ensemble?

- Simulated ensemble
  - (+)Easy to calculate, consistent with NHC deterministic forecast
  - (-)Treats nonlinear problem linearly, no situation dependence in uncertainty
  - (+)Some improvements possible using more ensemble input
- TVCN approach
  - (+)High resolution, model/initial condition diversity
  - (+/-) Ensemble of opportunity
  - (-) Small ensemble size
  - (-) Post processing problems, hurt by model changes

What ensemble?

- “Single model” ensemble
  - (+) Designed for ensembles, specified initial condition diversity
  - (+) Easier to generate hind-casts and post-processing
  - (-) Lower resolution, limited model diversity
- Multi-model, multi-center ensemble
  - (+)Combines all available information
  - (-) Uncontrolled changes
  - (-) Post-processing more challenging

Methods for Improvement

- Single model
  - Make competitive with multi-model ensembles
  - Trade offs between resolution and members
  - Minimum resolution needed for intensity
  - Initial condition perturbations
    - Large-scale vs storm scale
    - Ocean perturbations in coupled models
    - Assess effect of storm scale perturbations
    - Consistency with analysis uncertainty
  - Model perturbations
    - Need more exploration, especially physics
    - Stochastic physics
  - Coupling, boundary conditions
  - Choice of metric for evaluation
    - Brier skill score for strike probabilities

Statistical Post-Processing

- Many different approaches
- Decompose error into position and amplitude components
  - Correct for systematic errors in both
- Correct all ensemble members and variables
  - First and higher moments
  - Regime dependent corrections
- Use of climatology and re-forecasts
  - What is a representative re-forecast sample?
    - Part of trade-off
    - Challenges with extreme events
- Combining information from multiple sources
- Downscaling
  - Proxy for truth, especially over oceans

Digital Ensemble Forecast Database

- Incorporate NDFD grid domains
- Storage, format, accessibility, archival
  - Data transfer from originating center
  - Interagency/International coordination
- Interrogation and display
  - User input/modification of database
- Metadata