Potential Use Of Probabilistic Storm Position Forecasts For More Informative Track Forecast Cones

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Outline

- **Topic:** 2-dimensional track forecasts.
- A forecast accompanied by information about uncertainty is inherently superior to single "best guess" (see NRC report).
- The NHC represents track uncertainty with forecast cones.
- **Goal:** Use 2-dimensional probability density functions (PDFs) to improve the information content of NHC cones.

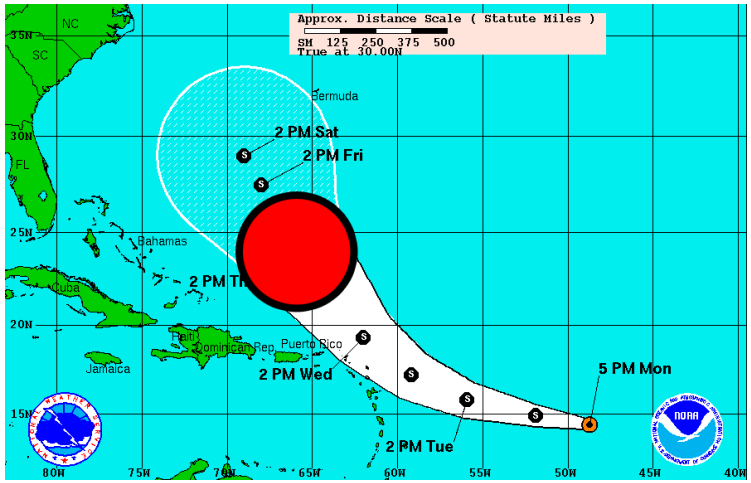


Figure : NHC track forecast cone for Hurricane Earl (2010).

PDF Forecast Methodology

- **Input data:** 20-member GEFS ensemble.
- Place Gaussian kernels at each member to create Storm Position PDF (SPPDF).
- The size of the kernels are based on historical error stats– a generalization of Roulston and Smith.
  - PDF is not calibrated yet.
- Consider the GEFS forecast PDF with the NHC official cone forecast.
- **Question:** Can we stratify cone cases by uncertainty?

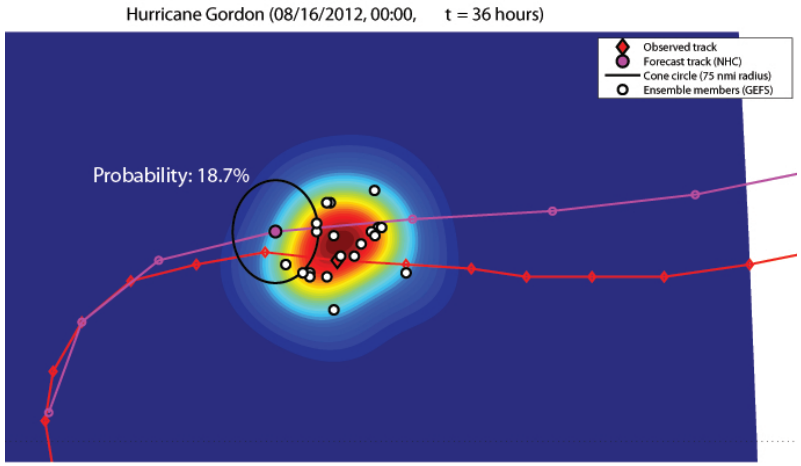


Figure : NHC cone disc, SPPDF, and GEFS ensemble members for Hurricane Earl (2012).

PDF Forecast Methodology (cont.)

- NHC cones
  - Fixed size over an entire year.
  - Can we measure changes in uncertainty between cases?
- Can information from an ensemble indicate more or less uncertainty?
- **Methodology:** Stratify NHC cone cases by uncertainty using information from GEFS ensemble.
  - Consider NHC cone together with SPPDF.
  - Determine SPPDF probability value inside cones (volume under SPPDF surface).

Example: Storm Position PDF

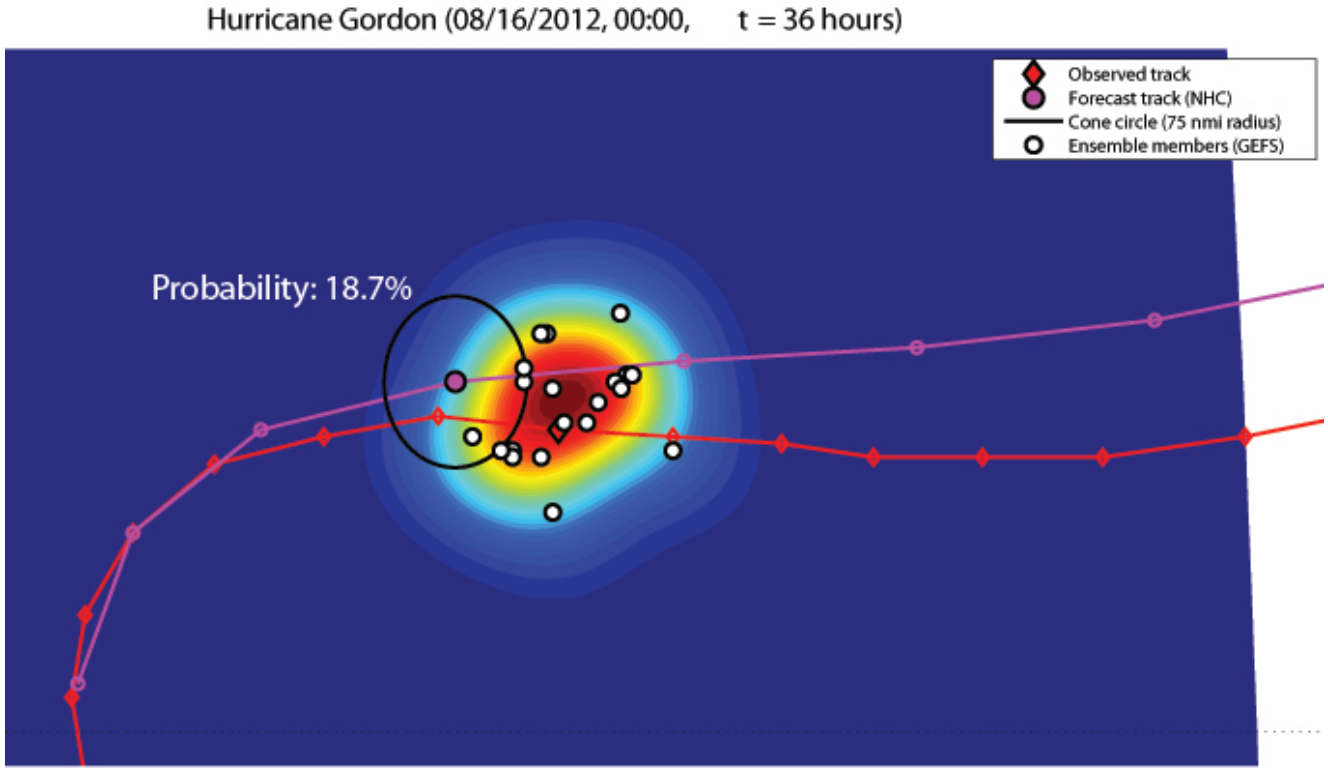
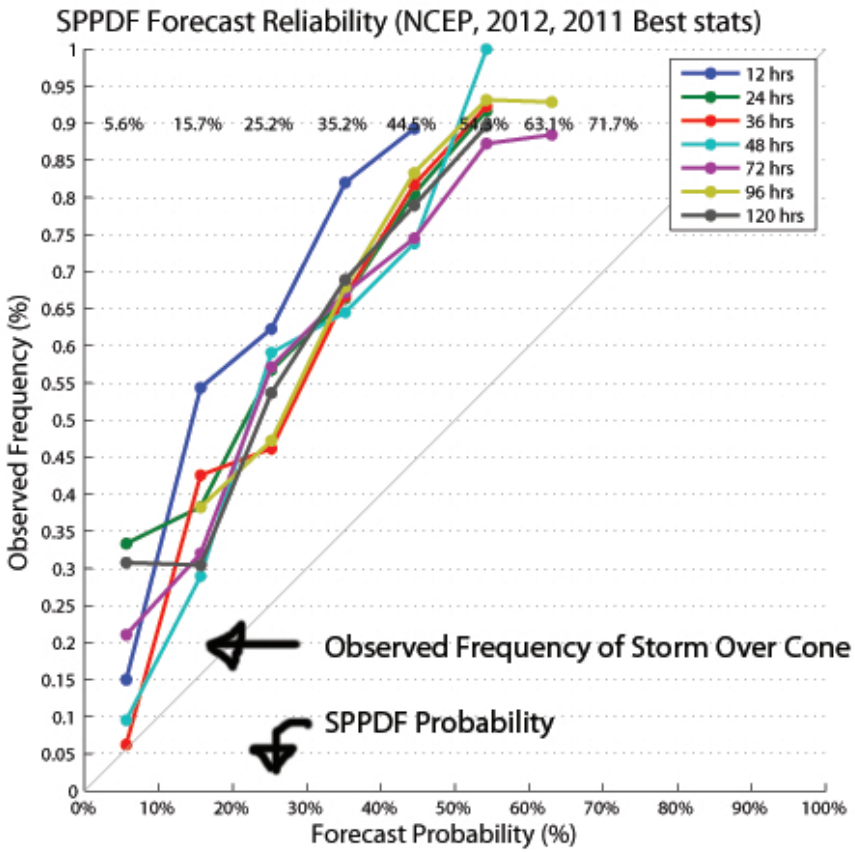


Figure : NHC cone disc, SPPDF, and GEFS ensemble members for Hurricane Earl (2012).

Reliability of SPPDF

- Can the ensemble help identify predicable (or unpredictable) cone cases?
- To check, we look at the frequency of observed storms falling in NHC cone, stratified by SPPDF predictions (reliability diagram).
- **Event:** Observation falls within NHC cone.

Reliability: 2012, 2011 dress



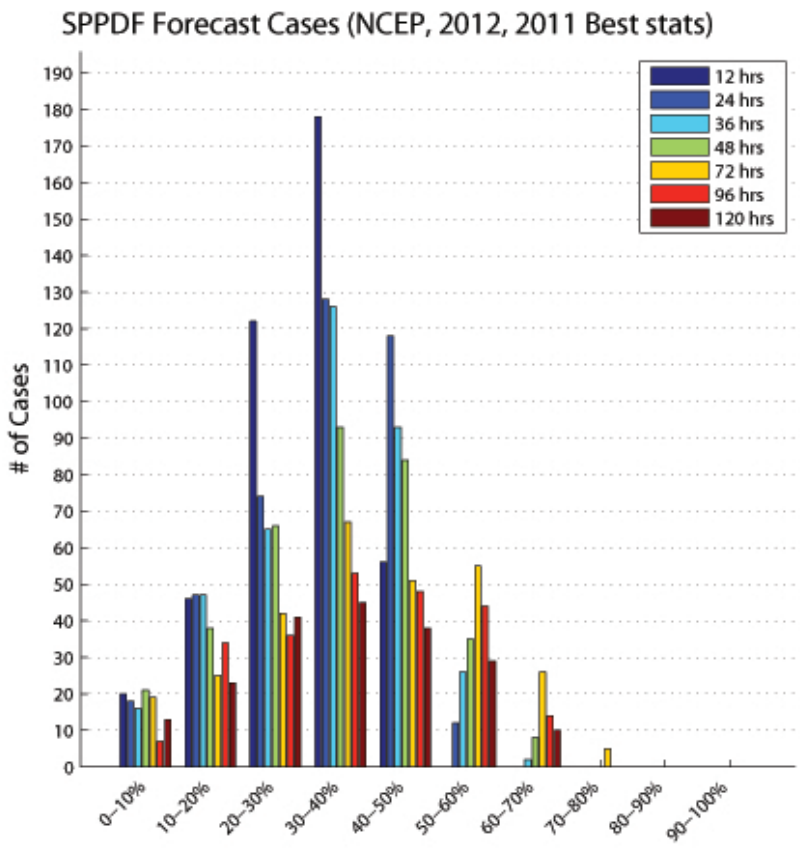


Figure : Reliability diagram and # of cases for 2012 season in the Atlantic, using 2011 GEFS kernels.

Summary

- NHC predicts 67% probability of falling within cone every time.
- When GEFS information is combined with the SPPDF, cone uncertainty can by resolved.
- GEFS adds potentially valuable information to the NHC forecast.
  - The storm is in the cone 20% of the time in the 15% of cases with the lowest SPPDF predictions (2012).
  - The storm is in the cone 90% of the time in the 10% of cases with the highest SPPDF predictions (2012).

Interpretation and Application

- Two possibilities for using an SPPDF:
  1. Change the size of the NHC cones (when the prediction is high/low).
  2. Change the probabilities associated with the cones.
- Which is preferrable?

Example: Application to 2012 Cases

- **Caveat:** SPPDF is not calibrated well.
- In 2011, when the GEFS SPPDF predicts 35%, the storm is observed with the cone circle 67% of the time.
- So if the SPPDF predicts more or less than 35%, storms are observed in the cone more or less frequently than 67%.
- In this example, the cone circle radius can be adjusted when the prediction deviates from 35%.
- This information about the 2011 season can be applied to 2012 cases.

Future Work

- Calibration of the SPPDFs.
- Develop a method to vary the cone size subject to GEFS SPPDF.
- Apply SPPDF methods to consensus ensemble (TVCA) instead of GEFS.
- Define variable size TVCA SPPDF cones.
- Create 67% contours from TVCA SPPDF.
- Real-time display on HFIP website.
  - What information should be shown?

Questions and Comments

Questions?

Background

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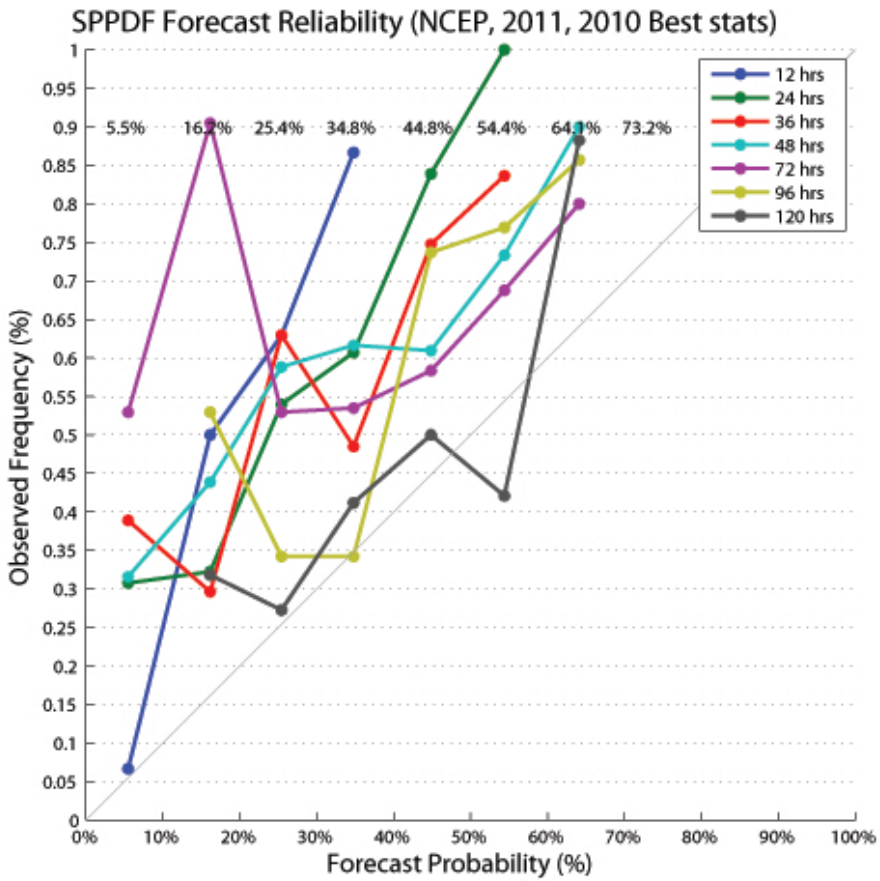
Reliability: 2011, 2010 dress



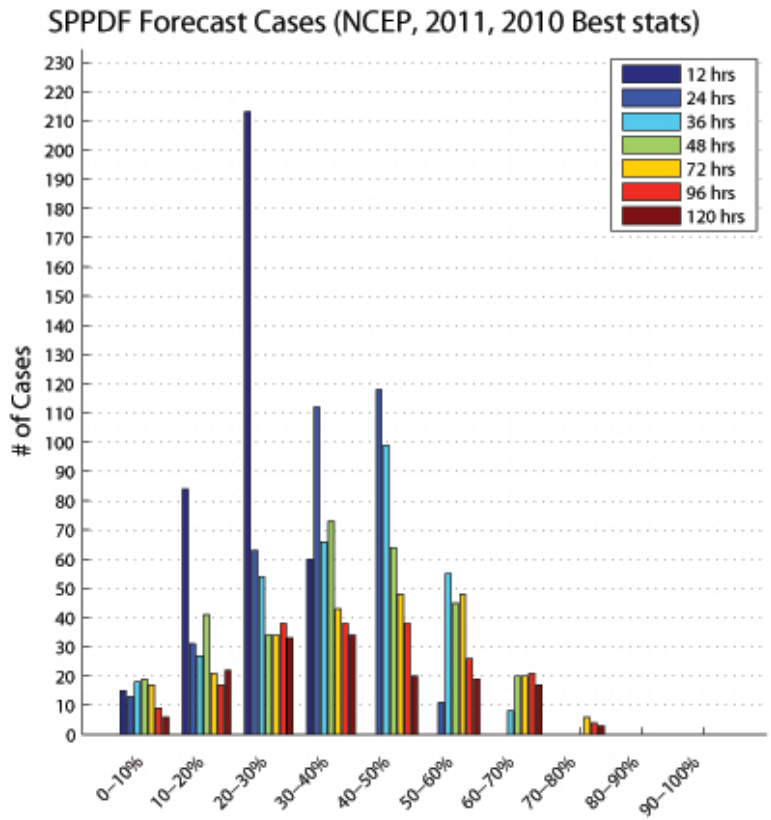


Figure : Reliability diagram and # of cases for 2011 season in the Atlantic, using 2010 GEFS kernels.

Alternative: Ellipse Product

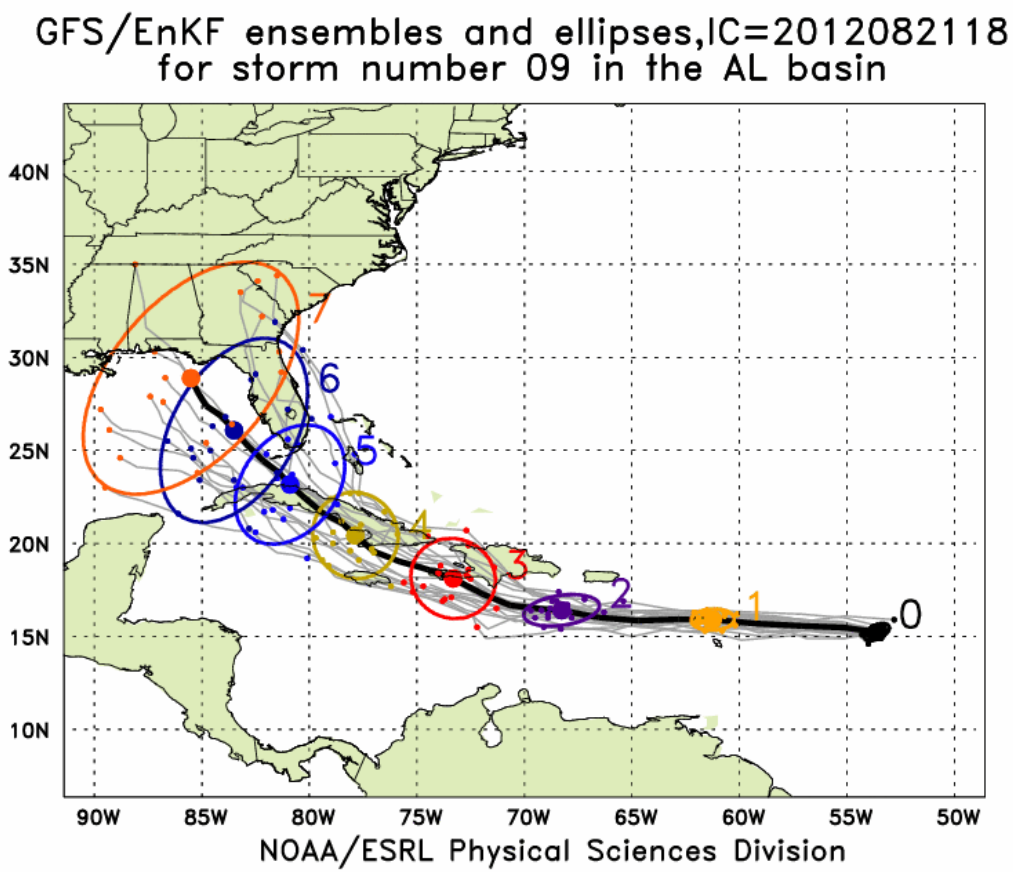


Figure : This ellipse product represents a single wind speed probability contour, whereas the SPPDF is a full distribution.