Web-based visualization and evaluation of convection-allowing ensembles in the 2018 HWT Spring Forecasting Experiment

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Overview of SFE Activities and Web Interface

The Spring Forecasting Experiment (SFE) is conducted annually for five weeks during the spring in the NOAA Hazardous Weather Testbed (HWT) in Norman, OK. Each week, a new group of participants – researchers, forecasters, and other meteorologists – examines cutting-edge NWP guidance and uses it to create experimental convective outlook products in real time. Some key activities in the 2018 SFE included:

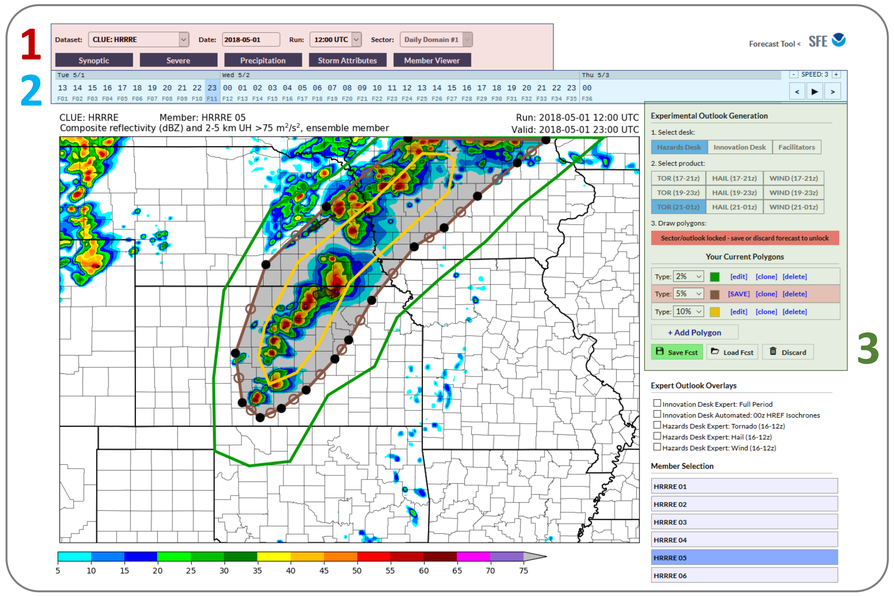
- **4-hour Hazard Outlooks** – participants drew SPC-style probabilistic outlooks for tornadoes, hail, and wind. However, these outlooks covered specific 4-hour periods (17-21Z; 19-23Z; and 21-01Z), rather than an entire convective day. This was a real-time exercise in which participants used NWP data as it arrived to forecast the current day's threats.
- **Severe Timing Outlooks** – participants drew polygons identifying which 4-h period contained the maximum severe potential (irrespective of hazard type) during the convective day in different areas. This was also a real-time exercise.
- **Model Evaluations** – on the day following a severe event, participants examined and compared numerous NWP datasets to evaluate their subjective performance relative to observed storm reports, radar, etc.
- **Outlook Evaluations** – in addition to evaluating model data, participants also rated the experimental outlook products they had generated the previous day.
- **NEWS-e Activity** – from 3-4pm daily, participants viewed output from NSSL's Experimental Warn-on-Forecast System for Ensembles (NEWS-e) and used it to produce short fuse probabilistic outlooks for the 0-3 hour period.

For 2018, most SFE activities (including all those listed above) were conducted in part using a new web interface.

URL: https://hwt.nssl.noaa.gov/sfe/2018

SFE Forecast Tool

PURPOSE: *allow participants to draw experimental outlooks while viewing NWP and observational data.*



- The forecast tool serves as a simple web-based implementation of an operational workstation.
- Participants can toggle through dozens of datasets and fields during the process of constructing their outlook polygons without reloading the page; nearly all the functionality is implemented in JavaScript.
- When a participant submits a completed outlook product, their forecast is saved to a JSON file on the server. From there, participant forecasts are plotted for evaluations the following day, and may also be verified objectively in future work.

1 – Dataset selection

Dropdown menus are provided to toggle between datasets (CAMs, CAM ensembles, radar, and other obs); date; model run time (where applicable); geographic sector; and product (blue tabs). Depending on which product is selected, other UI elements may change – for example, the member selection menu (bottom right) appears for member viewer products, but not ensemble mean.

2 – Forecast time rollover bar

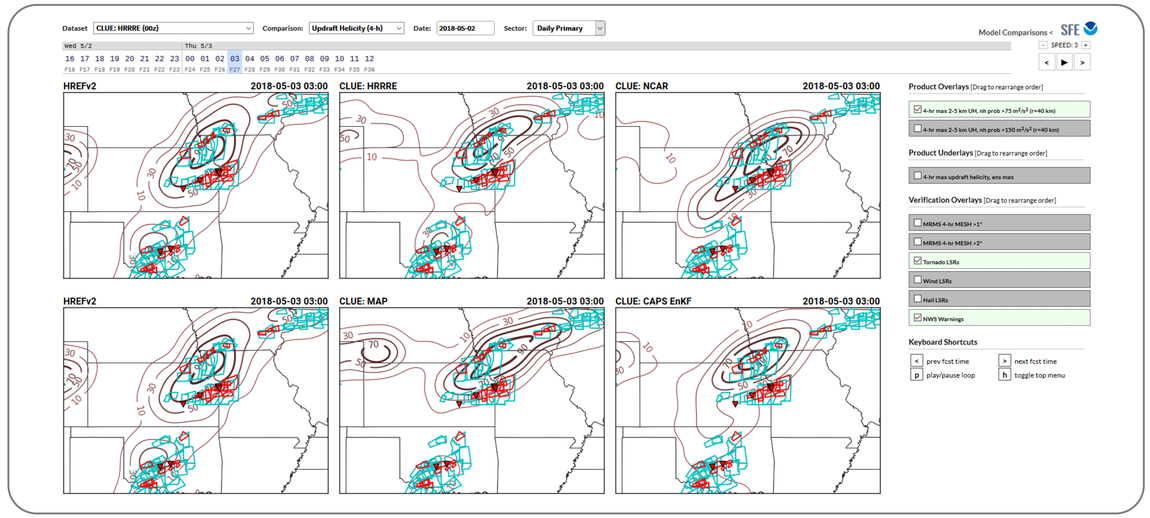
Once a dataset is loaded into the tool, participants can hover over a forecast time to display that data. Looping functionality is also provided with the controls on the right.

3 – Outlook generation pane

Menu allows participants to select which outlook product to draw. Once a product is selected (e.g., 21-01Z tornado outlook), polygons can be added, edited, or removed from the outlook. When completed, the outlook is saved to a JSON file on the server that contains all polygons (as a series of lat-lon pairs) and additional metadata.

Model Comparisons and Evaluations

PURPOSE: *facilitate subjective comparisons of datasets in formal experiments.*

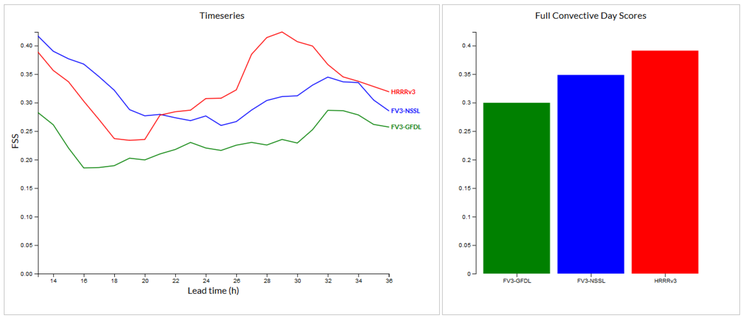


- This interface extends the data display functionality of the SFE Forecast Tool to include **synchronized multipanel** visualizations. Toggling controls such as the forecast time and product overlays/underlays applies changes to all panels.
- To facilitate verification, synchronized **storm reports, NWS warnings,** and **MRMS products** valid for the display time can be overlaid.

Objective Verification

Cumulative stats for SFE 2018: FSS for REFC [25]

Model	F13	F14	F15	F16	F17	F18	F19	F20	F21	F22	F23	F24	F25	F26	F27	F28	F29	F30	F31	F32	F33	F34	F35	F36	All
FV3-GFDL	0.282	0.261	0.220	0.185	0.186	0.189	0.202	0.199	0.210	0.218	0.230	0.220	0.216	0.225	0.230	0.226	0.235	0.229	0.253	0.286	0.286	0.278	0.262	0.257	**0.300**
FV3-NSSL	0.417	0.390	0.377	0.368	0.346	0.322	0.288	0.277	0.279	0.273	0.268	0.277	0.260	0.267	0.287	0.304	0.311	0.312	0.331	0.345	0.336	0.335	0.305	0.286	**0.349**
HRRRv3	0.389	0.356	0.337	0.302	0.270	0.237	0.234	0.235	0.278	0.284	0.287	0.307	0.308	0.322	0.385	0.414	0.424	0.407	0.399	0.367	0.345	0.337	0.328	0.319	**0.391**



- **DTC Model Evaluation Tools (MET)** was used during the SFE to calculate objective statistics for some NWP datasets.
- CSV files from MET are processed and loaded into a web display application based on **D3.js**.
- Cross-model comparisons are generated dynamically as tables, time series, and bar charts for multiple fields, metrics, and thresholds.

Summary of Software Design

- Behind the scenes, a backend implemented in Python post-processed the numerous disparate SFE datasets within a unifying framework; plots were then created using this framework. Thousands of images were generated each day via multithreading (primarily overnight).
- The JavaScript-based application for displaying these images relies heavily on an AJAX approach, pulling data from the server on demand as participants interact with various UI elements (e.g., when loading a new model, the application retrieves its available runs, plot types, etc.).
- To support the interface participants used to draw experimental polygon-based outlooks, a new JavaScript library ("*drawforecast.js*") was developed. It allows polygons to be drawn and manipulated on an SVG canvas while tracking vertex lat-lons (may be useful for other apps).

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