Modeling, Analysis, Predictions, and Projections
Climate Test Bed Research to Advance NOAA's Operational Systems for Climate Prediction

Abstract

Each year tornadoes affect the U.S., with some years and periods being considerably more active than others. Attributing tornado activity to any particular large-scale climate phenomena is understandably difficult given the tremendous disparity between the time and space scales of tornadoes and those of large-scale climate phenomena. However, emerging science suggests that low-frequency (time-scales of a week to months) modes of climate variability may modulate severe weather activity and severe weather environments.

The likelihood of severe convective weather is related to the local atmospheric environment. Information about the environmental "ingredients" associated with severe weather has proved useful to forecasters in interpreting observed soundings and short-range forecasts. These empirical relations, summarized in the form of indices, have recently been shown to capture aspects of the climatology and year-to-year variability of U.S. severe weather on continental and regional scales. Moreover, predicted monthly index values based on the operational NOAA Climate Forecast System version 2 (CFSv2) have been demonstrated to have statistically significant skill.

Given these developments, it is reasonable that operational forecast models may be able to capture meaningful modulation of severe weather environments, and thereby provide forecasters with extended-range guidance about severe weather activity. Two primary obstacles to forecaster use of such tools are the lack of suitable skill assessments and the lack of methodologies with which to identify low-uncertainty forecasts (e.g., on the basis of forecast consistency). The purpose of this project is to provide such assessments and tools for CFSv2 forecasts as well as for medium-range forecast models like the one used in the ESRL/PSD second-generation Reforecast Project.

The main proposed activities are:

- Assessment of systematic model biases as a function of location, start time and lead-time.
- Assessment of skill dependence on lead-time and target period averaging window.
- Development of tools to identify and visualize forecast consistency (across ensemble members and from different forecast runs).
- Case studies examining the relation between forecast skill and consistency for notable events.

This work is highly relavant to NOAA's long-term goal of climate adaptation and mitigation described in NOAA's Next-Generation Strategic Plan (NGSP)–in particular, objective (1) Improved scientific understanding of the changing climate system and its impacts and connections between weather and climate, for instance, how climate affects severe weather events.

This proposal targets the Modeling, Analysis, Predictions, and Projections (MAPP) Competition: Climate Test Bed—Research to Advance NOAA's Operational Systems for Climate Prediction and focuses on the activity 2: "the performance of experimental prediction methodologies." This proposal will directly benefit NOAA products such as the U.S. Hazards Outlook. The U.S. Hazards Outlook is produced daily at NOAA's Climate Prediction Center (CPC) and highlights potential U.S. hazards including extreme temperatures, heavy precipitation, flooding, wildfires, high winds and waves as well as severe weather. The CPC coordinates closely with the Storm Prediction Center (SPC) in identifying hazard areas during the upcoming forecast time period. SPC forecasters currently use a variety of guidance to compile the daily updates to the fire weather and severe weather components. However, little research exists to support forecasts for hazards beyond day 5. The work in this proposal will address the lack of suitable verification metrics and forecast consistency visualization tools and will enhance forecast operations at SPC and CPC.