5.2 EVALUATION AND UTILIZATION OF SCRIPPS ECPC FIRE WEATHER FORECASTS

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1. Introduction

During the spring of 1999, the Redding and Riverside Interagency Fire and Forecast Warning Units (IFFWU) expressed an interest in having model derived operational seven-day forecasts of fire weather variables (i.e., temperature, relative humidity, wind speed and precipitation). As part of a collaborative effort between the SCRIPPS Institution of Oceanography Experimental Climate Prediction Center's (ECPC's) California Applications Project (CAP) and the Desert Research Institute (DRI) Program for Climate, Ecosystem and Fire Applications (CEFA), experimental prototype fireweather forecast products were developed for the 1999 summer fire season. The value of these products are that 1) they provide guidance information for longer time periods than typical 24- to 48-hour forecasts, and 2) they provide site specific forecast information based directly on model output. This paper briefly describes some verification results for temperature forecasts, and provides discussion on the overall evaluation and utilization of these products for operational fire weather forecasting.

2. Background

ECPC is using the Regional Spectral Model (RSM; Juang and Kanamitsu, 1994), originally developed at the National Centers for Environmental Prediction (NCEP) to provide regional details from the global spectral model (GSM), to produce high-resolution, long-range experimental global to regional fire weather forecasts (Chen et al., 1998; Roads et al., 1998). The RSM is run daily at a 25 km resolution over California, generating 6-hourly forecasts out to seven days. Forecast products being used for this project are forecasts for 2 meter temperature, 2 meter relative humidity, 10 meter wind speed and precipitation for 29 Remote Automatic Weather Station (RAWS) sites across California (Figure 1). Forecast data are sent to DRI via ftp, reformatted, and displayed on the CEFA web site. RAWS observations for verification are available from the Western Regional Climate Center (WRCC). The project began in early June, 1999, allowing for forecast production and RAWS observation data gathering throughout the bulk of the summer 1999 and continuing into the fall fire season. Thus, the evaluation process is currently ongoing including both quantitative verification and user assessments of the products.

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Figure 1. Location of RAWS sites used in producing RSM forecasts and verification analysis.

3. Verification

The method used to transfer the RSM gridded model output to a point forecast is a simple nearest grid point approach. While this technique may work well over generally flat terrain, it can have problems over the complex terrain of California and the western U.S. The forecast site elevations in California vary from approximately 90 to 2300 meters. The issue of model grid points and complex terrain will be further discussed below.

Most of the initial verification analysis has been focused on temperature. First, the 6-houly time periods in each day were averaged for both RSM and RAWS to obtain a daily average temperature for days 1 through 7. Forecast minus observation (RSM minus RAWS) values were then calculated to determine any bias in forecasts (the tendency for the RSM to over- or under-forecast). On average over all sites and all days, the RSM tended to under-forecast by 4°C. This may be due largely to the need for developing an improved transfer function from the model grid to the site forecast point.

Forecast skill was determined for each of the seven days using

$$\text{skill}=\sqrt{1-\left(\frac{\sum e^2}{\sum f^2-\sum o^2}\right)}, \qquad (1)$$

where f is the RSM forecast, o is the corresponding RAWS observation and

$$e^2 = \sum (f - o)^2 .$$

Both *f* and *o* are anomalies (the forecast and observed seasonal means subtracted, respectively), and any forecast bias was removed from the forecasts prior to calculating the anomalies.

Figure 2 shows boxplots of skill for all sites combined as computed from (1). The box represents the middle 50% of the data. Days 1 and 2 are generally similar, with median skill around .85, though there is considerable spread over all of the sites (~.70-.90). As typical for longer-range forecasts, skill drops off when going out further in time. By day 7, median forecast skill is around .62.

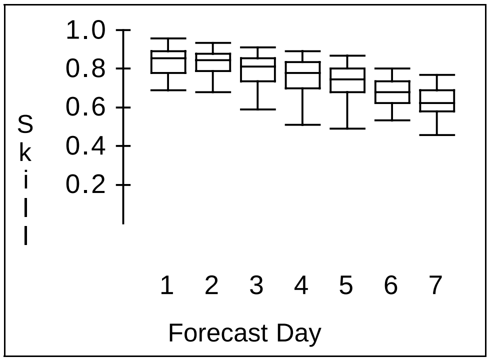

Figure 2. Boxplots of RSM forecast skill for each day combining all sites.

Figure 3 shows boxplots constructed similar to Figure 2, except for persistence forecasts. Persistence is computed as calculating the daily average temperature for day 0, and using this value as the forecast temperature for the next seven days. Skill is then calculated using (1). As expected for persistence, skill is highest on day 1 and drops off steadily to day 7. The median persistence skill values on days 1 and 2 are comparable to the RSM skill. In fact, persistence skill on day 1 is slightly larger than RSM skill, and both are about the same on day 2. Starting with day 4, the skill spread is much larger than RSM, suggesting a much higher degree of site to site variability when using persistence. A comparison of the two sets of skill indicates that the RSM forecasts are much improved over persistence. However, we currently only have a limited number RSM forecasts for this comparison.

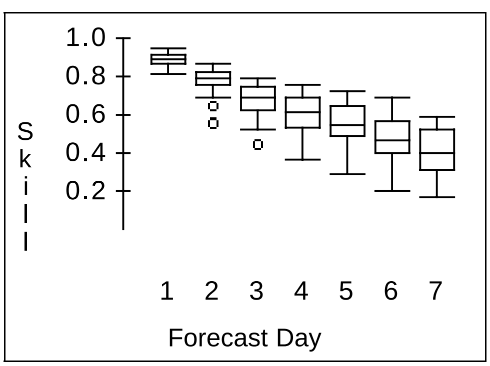

Figure 3. Same as Figure 2 except for persistence.

4. Discussion

The results of the temperature verification analysis suggest that the RSM is capable of producing reasonable skill out to 7 days. However, the issue of improving the translation of model output values to the forecast sites needs addressing. This is not a trivial point and the subject of numerous model papers. It is doubtful that a simple interpolation using surrounding grid points is completely sufficient for complex terrain. More likely, some transfer function accounting for elevation and other site characteristics seems most needed.

Work in progress includes more detailed analysis of temperature (e.g., diurnal and seasonal characteristics), along with verification of relative humidity, wind speed and precipitation. It would also be of interest to compare RSM output to RAWS forecasts produced by other methods (i.e., Gibson et al., 1998). The ultimate goal is to produce a forecast product that users feel comfortable working with operationally, while adding value to decision-making and planning.

5. References

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