9A.1 **USING GRID-BASED FORECAST VERIFICATION TO PROMOTE IMPROVED SERVICE IN NWS/WESTERN REGION**

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1. INTRODUCTION

The transition to digital forecasting in the National Weather Service (NWS) has been one of the most profound changes in the history of the organization. While forecasters have gradually shifted their thinking to focus on the grid-based picture as opposed to individual points, adequate verification techniques for such forecasts have not been developed. A robust grid-based verification system would improve the services offered by the NWS by identifying the most effective forecast methodologies.

To date, NWS verification metrics have assessed how forecaster performance compares to model output statistics (MOS), especially with respect to temperature and probability of precipitation forecasts. This methodology has focused the efforts of the forecaster on performing better than MOS. However, the goal of the NWS forecaster should not be to beat guidance, or any arbitrary standard for that matter, but to issue the best possible forecast.

Even in the digital age, the current verification system used on the NWS's internal National Digital Forecast Database (NDFD) web site is point based (Fig. 1). However, in the digital database, forecasters are making meteorological predictions for thousands of grid boxes. So in a strict sense, an area forecast is being compared to a point forecast to generate forecast errors, while this data is being compared to MOS forecasts for points. This is a method which clearly has limitations, and is unfair to the forecaster.

The methods used to populate grid boxes are diverse and often complex. Different methods may be used depending on the synoptic pattern, and certain methods may be unique to an individual forecast office.

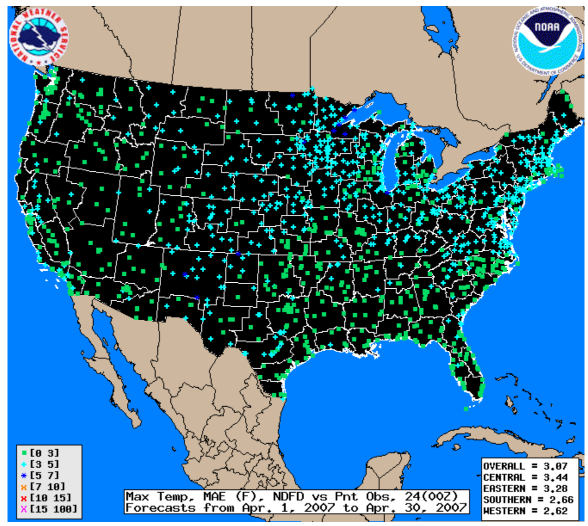

Figure 1. Display of NDFD verification data as shown on NWS internal web page.

For instance, while a forecaster may use a forecast sounding to derive surface temperatures for various points, it is unknown how effective this practice is over each grid box in a forecast area. It is also impractical to expect the forecaster to have a complete understanding of the accuracy of this method simply based on personal experience. A comprehensive grid-based verification program can objectively determine which methods of populating the digital database are most effective.

2. A DIGITAL VERIFICATION PROGRAM

The purpose of a digital verification program is to find an objective way to determine how the best forecast can be created. The fluid nature of the atmosphere will not permit a formulaic approach to forecasting. However, identifying datasets and methods which are consistently the most effective can simplify the decision process for attempting to produce the best possible forecast. This will make it easier for the forecaster to manage the vast amounts of model

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data and forecast methods now available in the Graphical Forecast Editor (GFE).

The streamlining of the forecast process will have the benefit of allowing the forecaster to add value to other areas of the forecast process. Most notably, forecasters would have more time to spend on communicating predicted hazards to emergency managers and the public, or focusing on areas such as research and short-term forecasting.

The Western Region (WR) Verification Project was launched in November 2006 as a way to achieve these goals. The project was designed to have a member of each forecast office to examine verification data. Digital forecast data was gathered using a program called BOIVerify, authored by Tim Barker, the Science and Operations Officer (SOO) at the Weather Forecast Office (WFO) in Boise, Idaho.

In the initial phase of the project, SOO's from each of the 24 WR forecast offices were asked to group verification statistics by weather regime. There were almost no other restrictions placed on the project. Each participant was given the freedom to examine the data he felt was appropriate, and look at portions of his CWA that made the most sense.

In this way, the project was designed to utilize the diverse backgrounds of each of the 24 WR SOO's. With each participant in the project able to choose their own area of interest, the varied findings from this phase is shaping the future of the project, which is expected to exist as long as the current digital forecasting paradigm lasts.

The philosophy of the WR verification program is to use a large sample of data when generating statistics. Results from a case study can be subject to random errors that might not be present the next time a similar scenario presents itself to the forecaster. Compiling results over dozens of similar cases will limit random errors and provide a more rational basis for which guidance or methods are superior and thus should be relied on by forecasters.

3. OBTAINING AN ACCURATE ANALYSIS

Development of a digital verification program in the NWS has been hindered by the lack of a high quality surface objective analysis. While the availability of surface observations continues to increase, there are still areas with little data coverage.

As an example, Figure 2 displays the available observations across the County Warning Area (CWA) of the Weather Forecast Office in Flagstaff, Arizona. There are five observations covering the northeastern portion of the CWA, an area of approximately 50,000 km^2.

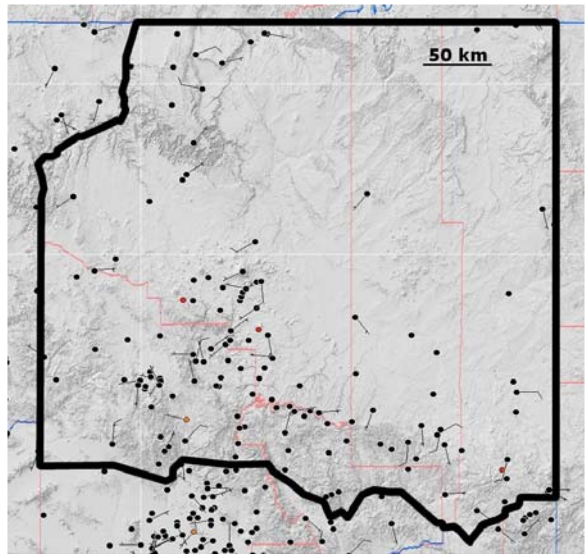

Figure 2. Locations of observations in Northeast Arizona (image from MesoWest web site, http://www.met.utah.edu/mesowest).

While the example in northeastern Arizona is extreme, Myrick and Horel (2006) showed that only 2% of the 5 km NDFD grid boxes in the western United States contained an observation. This makes it difficult to create an accurate analysis, especially considering the changes in elevation that frequently occur over a small distance across the west.

The verification approach employed in the initial phase of this project uses a model-derived field as the background for the verifying analyses which is drawn exactly to the observations. In areas where observations do not exist, adjustments to the background data are made based on the adjustments made to nearby points where observations exist. The farther away one gets from an observation, the more uncertainty that exists in the analysis.

In the future, WR plans to consider using methods such as those summarized by Ebert (2007) that account for uncertainty in the analysis. WR also plans to test verifying forecasts against the Real-Time Mesoscale Analysis (RTMA; Pondeca et al. 2007), a high resolution objective surface analysis available over the CONUS on the NDFD 5-km grid.

4. SUMMARY

NWS WR has embarked on a multi-year program to develop and use grid-based verification to provide improved services to its customers. The first step in this process was undertaken between November 2006 and April 2007. Offices were asked to separate verification data for temperature, dew point, and wind based on weather regime.

The results were encouraging from the standpoint that some datasets appeared to add value to methods currently used by forecasters. Specifically, Gridded MOS developed by the NWS Meteorological Development Lab generally was the most accurate guidance when forecasting maximum and minimum daily temperatures through the seven day forecast period.

Additionally, model bias correction techniques developed by Barker consistently beat their uncorrected counterparts in temperature and dew point forecasts in all cases for the first five days of the forecast except extreme pattern changes.

WR is actively working on incorporating quantitative precipitation forecasts and probability of precipitation forecasts into the verification process. Early results on temperature and dew point indicate that in these areas, both methodology and accuracy can be improved, leading to an overall improvement in service by NWS forecasters.

5. REFERENCES

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