15.4 GFE-Based Temperature Verification-One Approach

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1. Introduction

Forecast System Laboratory's (FSL) Graphical Field Editor (GFE) Smart-Tool methodology makes it possible to advance from traditional point-based verification to areal, grid-based verification, in which forecast grids are compared to analysis grids for accuracy. This article shows one approach as applied to a maximum temperature forecast.

2. Methodology

GFE provides a framework to create grids of many weather elements. After ingesting and adapting model data to its own finer grid mesh and higher resolution topography, grid edit tools and Smart Tools allow the forecaster to make further refinements to those grids.

Eventually, "verifying" grids become available. These may consist of zero-hour model grids, or grids from an independent source (e.g., ADAS). Boise WFO has taken a step in this direction by creating max/min temperature analysis grids from about 100 observations reported in our Regional Temperature and Precipitation (RTP) summary (a table). RTP data are point values, but they can be contoured spatially via a GFE Smart Tool to form a grid of their own. A mathematical function well-suited to this purpose is the serpentine function (CRC, 1964), which is the two-point inverse-square distance weighting function. This function can be generalized to any number of points, and modified to prevent max and min values from always occurring on the observation sites (which would otherwise happen). Another modification compensates for unequal weighting caused by data clustering in the RTP (several sites near each other), which often occurs in more populated areas.

Verification is defined as the difference between the forecast grid and the verifying grid (f-v), forming a grid of its own .

Errors at every point on the difference grid can also be collected and grouped into a frequency distribution. For example, Boise, ID's (BOI) County Warning Area (CWA) contains about 7500 grid points. Collecting errors in whole degrees (F) might show a thousand of them between -2 and -1, 800 between -1 and 0, 620 between 0 and +1, etc. Fig 1 shows a distribution at intervals of 0.1 degree, ranging from 10.0 degrees too cold on the left end to 10.0 degrees too warm on the right. The number of points with errors worse than +/- 10 is also printed on the graph. The vertical axis shows the number of points (of the 7500) that fall into each error interval on the horizontal axis. A perfect forecast would have all 7500 points at zero error. Any other distribution indicates variance. The horizontal bar rates the forecasts "good" or "bad" according to average MAE of all 7500 points (including the outliers). The left (bad) end corresponds to MAE of about 8 degrees.

The original tabulated RTP values can now be merged into the forecast as follows: After positioning each RTP site on the GFE domain, its value is compared with the forecast there. Differences are then analyzed (using the serpentine function) to a "work" grid and subtracted from the forecast grid. The result

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is a new grid that fits all the RTP values exactly while retaining the details of the original forecast. This "improved" forecast can be used as a starting grid for a new forecast.

It is interesting to verify the original forecast to the improved forecast using the latter as "truth". In general, scores improve since part of the original forecast is used to verify the original forecast, i.e., the two grids are not independent. Often one finds a local spike in the frequency plot, probably corresponding to those GFE points far away from any RTP site, and least influenced by them.

3. References

CRC, 1964: Standard Mathematical Tables. The Chemical Rubber Co., Cleveland, OH, 561pp.

NOAA Forecast Systems Laboratory, 2000: GFE Training Guide, Boulder, CO.