16.5 GRIDDED FORECAST PRODUCTS AND SERVICES UNDER DEVELOPMENT AT FSL

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1. INTRODUCTION

Anticipating an opportunity to improve the efficiency of the weather forecasting process, the National Weather Service (NWS) Office of Meteorology (OM) developed a new operations concept as part its overall modernization. When implemented, this concept will significantly alter operational forecasters' duties. Rather than express the forecast in words, the forecaster would initialize and maintain a set of gridded digital forecasts over the forecast area. From this forecast database, routine forecast products would be generated, examined by the forecaster, and disseminated to interested users.

To support this concept, the NOAA Forecast Systems Laboratory (FSL), in conjunction with the NWS Techniques Development Laboratory (TDL), has been tasked to build the AWIPS Forecast Preparation System (AFPS). The AFPS concept (NOAA, 1993) and development work comprise three broad categories: initializing gridded depictions of weather elements, editing those depictions, and generating forecast products.

Expressing the forecast as a set of gridded weather elements offers numerous benefits to forecasters. Programs that automatically compare forecast parameters (e.g., temperature and dew point) will alert the forecaster to any meteorological inconsistencies. Since the forecast is defined in far greater detail, comprehensive monitoring and verification systems can alert forecasters when the forecast deviates from observations. Once the set of gridded forecast elements is defined, products can be generated automatically with little or no forecaster intervention. This greatly reduces the amount of time spent typing text products, many of which are redundant.

Forecasters are not the only group that will enjoy the benefits from a gridded weather forecast database. There is enormous potential for the users of these data to benefit as well. Once the forecast is expressed as a set of gridded weather elements, users can view this information in virtually unlimited ways, while tailoring products to match their specific needs. For example, people traveling by car are most interested in weather parameters that affect driving conditions such as precipitation, wind, and visibility. Anyone interested in recreational sailing would be most concerned with wind and waves. A system that disseminates forecast data in this way not only gives users the information they need, but also avoids cluttering products with irrelevant information that might be confusing.

With the AFPS initialization and editing components nearing completion, we have turned our attention to ideas and concepts regarding the dissemination of gridded forecast data. Even after AFPS is operational, weather forecast offices will continue to release alphanumeric products based on these grids on a regular schedule. But with recent advances in communications technology such as the World Wide Web (WWW), an opportunity arises to fundamentally change the way forecast information is delivered to consumers. Rather than disperse a fixed set of products from each forecast office, users interested in the forecast could invoke interactive applications that query the forecast database. These applications would let the user precisely specify the type of forecast information desired and then generate a graphical or textual representation of the forecast. In this paper we discuss some of these applications from a user perspective.

At this point, some of these ideas are purely hypothetical and are yet to be realized. Others have been implemented on the WWW using the Java programming language and can be accessed via the URL:

http://www-md.fsl.noaa.gov/EFTHome.html#misc

We invite those with WWW access to explore our Web site and send comments via the address below or send E-mail via afps@fsl.noaa.gov.

2. GRAPHICAL PRODUCTS

Because gridded datasets contain a large amount of detail, graphical products are generally the best way to view them since they can accurately represent this detail. Graphical products can take on many forms, such as image, contour analysis, time-series, or as combinations of these types.

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Over the past few months, we have been developing such displays and made them available on the WWW. The Graphical Forecast Viewer (GFV) integrates animated imagery and time-series data in a single display. Another program presents a map and displays a worded forecast at any point selected by the user. The next few sections briefly describe these graphics-based applications.

2.1 Spatial Display - One Time Period

All gridded weather parameters can be rendered into 2-D images by representing each grid point value by small colored rectangle. Each color represents a value or range in value. A single image consists of a matrix of these rectangles and is valid over specific time period. When these images are displayed in time sequence, even novice users can easily interpret them. Figure 1 displays an image of temperature that was taken from the GFV prototype system being developed by the Enhanced Forecaster Tools branch at FSL.

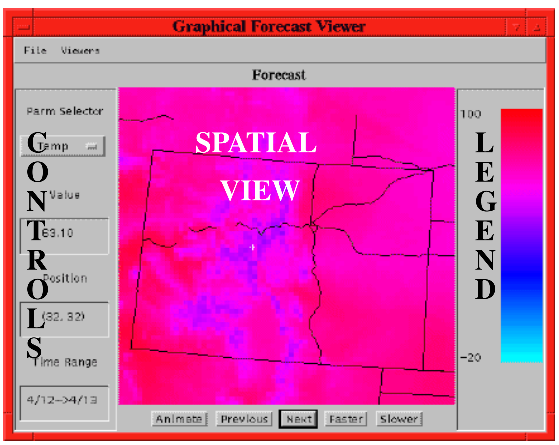

Figure 1. A spatial forecast viewer

The GFV spatial viewer has three main parts: a set of controls, the actual spatial view, and a legend.The spatial view is a 2-D plot of the weather data accompanied by a map background. In our prototype system the data are plotted over an area slightly larger than the state of Colorado. The controls let the user adjust parameters such as forecast time, animation speed, and weather element type. The legend at the right of the Spatial View displays the relationship between color and value. When the GFV is started it connects to a database server over the Internet and loads weather data for a specific weather parameter (e.g. temperature). Once the data are loaded, the data values are mapped to colors and the grids are rendered into images and displayed.

Users can interact with the spatial view in a number of ways by manipulating the controls found at the left of the spatial view. Simply moving the mouse pointer over the spatial view will cause the controls display to be updated. The controls continuously display the value and location at a user-defined coordinate even during animation. The user can also instruct the GFV to display a different grid. They can single-step forward or backward through the set of grids to view a parameter at different time periods. As the user moves from one grid to another, the controls update the display of the time period over which the current grid is valid. The controls also allow the user to select a new weather element to be displayed (e.g. dew point).

Currently the GFV can only display scalar data such as temperature, but work is under way to allow the GFV to display all types of forecast data, including wind, visibility, quantitative precipitation forecasts, and weather type and intensity.

More interactive features are planned for the GFV as well. For example, the display will allow zooming so users can focus on a specific region to better view details in the forecast. New features will be added to let users better specify the set of weather parameters to be displayed. For example, windsurfers may want to know where and when favorable winds will occur and skiers want to know which ski area is going to get the most powder.

Graphical displays can easily be attached to other applications. The 2-D spatial view is an excellent way to allow users to select a random point or area. The user can simply use the mouse pointer to designate the area of interest and receive a forecast (in text or graphic form) for that exact area.

2.2 Time-series Display: Point versus Time

A time-series display is another useful method for presenting the gridded data. Users interested in weather parameters at a single point can view a multiday forecast on a single display as illustrated in Figure 2 below (also taken from the GFV prototype).

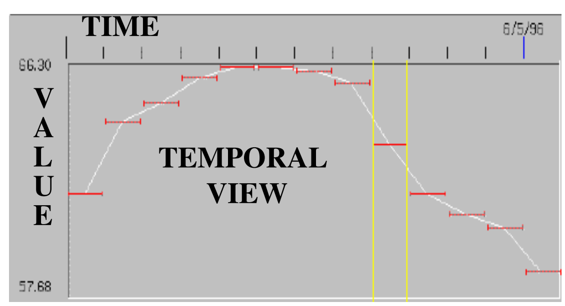

Figure 2. A temporal forecast viewer

The same technique can be applied to nonscalar data such as wind and visibility. A time-series plot is also very useful for displaying weather and obstructions. Each time period in the plot can be labeled with the weather value (e.g. rain, snow, etc.) allowing the user to clearly see when the weather is changing rapidly.

In the current system, whenever data are loaded into the GFV, the images are displayed in the spatial view and a time-series of that data is automatically plotted at a user specified grid location. The user can change the location for the plot simply by clicking the mouse in the Spatial View. The Temporal View automatically plots a new time-series at that location.

It is also possible to display multiple weather parameters on the same plot (e.g., temperature and wind). Users select from the set of available parameters and view just those parameters in the display.

2.3 Travelling Forecast

Applications are not limited to the features offered by the GFV. A forecast that covers a path through space and time would be useful for planning a trip. The traveller's route may cross several forecast zones and cover more than one forecast period. Using forecast products currently offered by the NWS, a consumer would have to look at several zone forecasts and figure out what period of time would be spent in each zone. An automatically generated product would be much more convenient and better convey the forecast.

For example, a users could extract the relevant information from the forecast by specifying the route they are considering. A forecast for that route over some period would then be generated by extracting weather parameters out of the forecast grids that apply to the proposed route. Using such a forecast product, the traveller could determine if an alternate route would avoid unpleasant or potentially dangerous weather that might delay their travel schedule.

Figure 3 shows a map on which a route from Grand Junction to Denver, CO, has been specified. The

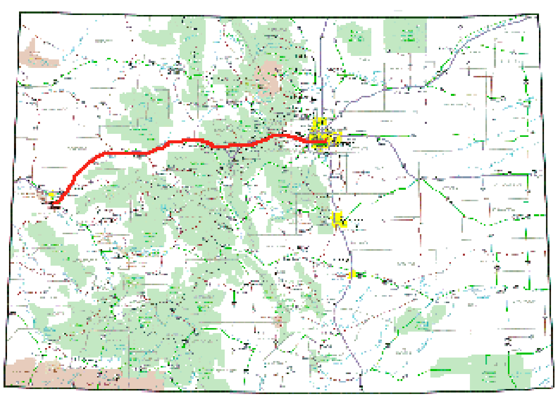

Figure 3. Map illustrating a traveller's route

map is an interface that allows the user to select a route. The route could either be chosen automatically based upon a starting and ending location or explicitly specified by the user through this user interface. The system could even be capable of suggesting alternate routes that avoid bad weather or optimize the time spent on the road based on expected road conditions. An interactive interface such as this can be provided using existing technologies found on the WWW or new technologies that are planned for the near future such as interactive TV.

After a route has been determined, the application would query the relevant weather forecast grids and produce a display that illustrates weather conditions along the route. Figure 4 illustrates one possibil-

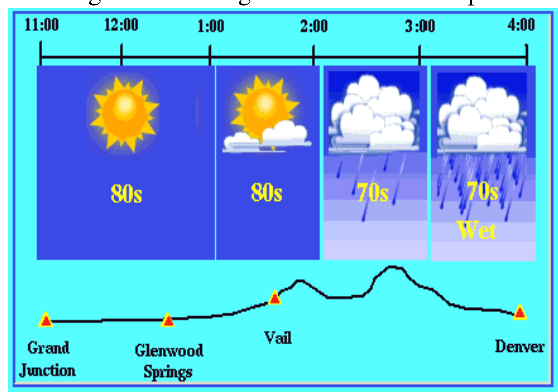

Figure 4. An example of a traveller's route forecast

ity for a traveller's route product. It includes a time scale which estimates the time of arrival at significant points. The temperature, sky conditions, expected road conditions and precipitation type are displayed in graphic panels. The width of each panel is used to indicate the period of time for which the weather parameters will remain constant. A plot of elevation changes to be encountered along the route is included in cases where terrain is a factor. It is also labeled with cities and towns that will be encountered along the way.

This is just one way that such a travelling forecast could be presented. Other types of travelling forecasts may include different forecast information. For example, a traveller planning a sailing trip would be interested in winds and currents but not about elevation changes or road conditions.

2.4 Ticker Tape

By using technologies that exist on the WWW, it is possible to present current products, such as a zone forecast, in a more interesting way. A web page can be constructed which allows the user to select a zone of interest. Then the forecast, and any warnings for those zones, would be displayed on the page as text which scrolls across a rectangular region. When updates are made to the gridded forecast, new text can be automatically generated. The ticker tape displays all of these changes without any need for user intervention. An example of how this would look is shown below(Fig 5).

Like many of the other new products, the ticker tape forecast could be configured by the user to include

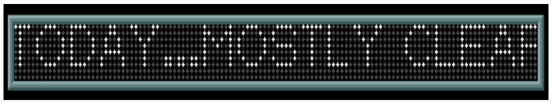

Figure 5. Illustration of Ticker Tape product

only those weather parameters in which the user is interested. In addition, the ticker tape could apply to an area the size of a single point or any user-specified area.

3. TEXT PRODUCTS

Despite this gridded approach to forecasting, text products will continue to be distributed from every forecast office. This does not necessarily imply that every product received by users originates from the prescribed list. The concept of querying the forecast database still applies, even for text products. The following idea illustrates this concept.

Computer generated text products could be disseminated to interested users via an automated telephone system. With such a system, anyone interested in a forecast would dial a local telephone number and press an additional button to indicate the type of forecast desired. Then the user would enter a code to indicate the forecast location, such as a zip code. This forecast type and location information is sent to an application which extracts the appropriate gridded weather data, generates words that accurately reflect the forecast, and uses a computer synthesized voice system to announce the forecast to the user.

4. SUMMARY

Expressing the forecast as gridded weather parameters offers advantages to forecasters and consumers as well. Forecasters realize time savings, since much less time will be spent formatting worded forecasts. With the help of application programs, consumers can tailor products to precisely meet their needs.

The resources required to develop the types of applications discussed here are minimal when compared to the benefit realized by users. FSL has developed some of these applications in as little as a few months. Once developed, these applications can be deployed to all forecast offices so users nationwide can enjoy their benefits.

5. REFERENCES

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