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TRANSFORMING OPERATIONS TOWARD AN IFPS/NDFD ENVIRONMENT AT NWS STERLING, VA

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1. INTRODUCTION

The National Oceanic and Atmospheric Administration (NOAA) National Weather Service (NWS) has worked over the past several years at developing the capability to produce forecast information in a digital format, in order to take advantage of technological advances and to improve distribution of high resolution data to our partners and customers. During the fall of 2003, a milestone in this process was achieved as the NWS began releasing a limited number of forecast elements to interested users in the form of the National Digital Forecast Database (NDFD) (Glahn and Ruth 2003).

The implementation of the NDFD and digital forecasts has resulted in a tremendous paradigm shift for forecasters at the NWS forecast offices. They have had to change their routine of manually typing text based forecasts to one of producing graphical weather information for a digital database from which all text and other forecast products can be extracted. The impact of this change has been even more apparent at field offices whose area of responsibility involves large variances in topography, such as locations with a coastal plain, a mountain range, or both. This paper documents some of the training and development activities taken on at the NWS Baltimore/Washington (LWX) forecast office, with a special emphasis on steps taken to improve the quality of forecast information in locations near the Chesapeake Bay and along the eastern slopes of the Appalachian Mountains.

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2. SOFTWARE TRAINING ACTIVITIES

Software training activities for the forecasters at the LWX office were not unlike those of other NWS forecast offices. Implementation of certain aspects of the Interactive Forecast Preparation System (IFPS) began in late 2000. While the forecasters struggled at times using a software package that was still undergoing development, this relatively early start date allowed for a more relaxed transition toward producing digital forecasts, and in the end is looked at as being beneficial. Various methods of training were utilized, including one-on-one training between a forecaster and the IFPS focal point using software job sheets developed by Forecast Systems Laboratory (FSL) and Eastern Region Headquarters (ERH). Various training materials were presented in group training sessions, which also provided a forum to discuss the how the transition of IFPS would impact forecast operations as a whole. Through the various training activities, forecasters identified several tools and resources to help with the creation of the digital database, which will be discussed throughout the rest of this document.

3. INTEGRATION OF NEW DATASETS

Before the implementation of IFPS and the NDFD, forecasters were tasked with typing zone forecasts depicting average weather conditions over an entire county or forecast zone. Mesoscale details were rarely, if ever, presented in the zone forecasts. The new digital database of weather elements for the NDFD contains information at a horizontal resolution of 5 km. Thus, forecasters were forced to begin considering details of their weather forecasts on a smaller scale. To help facilitate this at the LWX forecast office, additional data sets were sought and ingested into the Advanced Weather Interactive Processing System (AWIPS) for display by the forecast staff and for integration into IFPS operations.

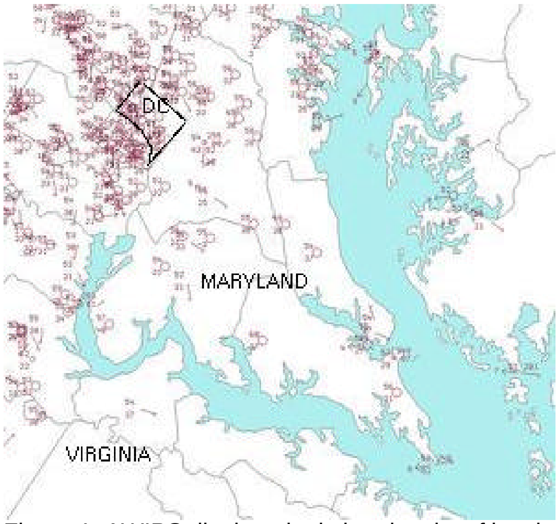

Figure 1: AWIPS display, depicting density of local observations network. Displayed is Washington, DC metro area and lower Southern Maryland.

There are a variety of data sets available across the LWX office's county warning area (CWA), and programming was completed to ingest all of the mesonet observations into AWIPS. The first data set that was upgraded was the set of mesonet observations being collected from outside sources and processed into AWIPS. Many of the observations were collected by FSL through the Meteorological Assimilation Data Ingest System (MADIS) (Barth et al. 2002), while others, specifically, the observations from the platforms operated by the Virginia Department of Transportation (VDOT) and Maryland Department of Transportation (MDOT), were being collected with computer programs written on-station. A collaborative project with National Ocean Service brought in additional mesonet observations for sites along the Chesapeake Bay and lower Potomac River. In total, over 350 mesonet sites inside the LWX area of responsibility are available locally in AWIPS on an hourly basis (Fig. 1). Many of these observation sites are located in areas where, previously, no data was available, and areas that provide significant challenges to forecasters. Some examples include an Automated Weather Source Convergence Technologies site at Big Meadows Visitor Center in Shenandoah National Park at an elevation of 1011 m, a MDOT site located west of Frostburg, MD in the far northwestern corner of the LWX CWA, VDOT sites along the top of the Blue Ridge, and numerous sites at waterfront locations along the Chesapeake Bay.

Another dataset that was integrated into IFPS was a locally-developed mesoscale forecast model. The Workstation ETA model was implemented locally beginning early in 2003. Data from this model were immediately ingested into AWIPS for use in IFPS. The model is being run locally at a horizontal resolution of 8 km, which is comparable to the 5km grid that the forecasters utilize in IFPS. Preliminary interrogation of the data from the Workstation ETA model suggests that the model resolution is small enough to provide forecast detail over the higher terrain and coastal plain areas in the LWX CWA (Fig. 2).

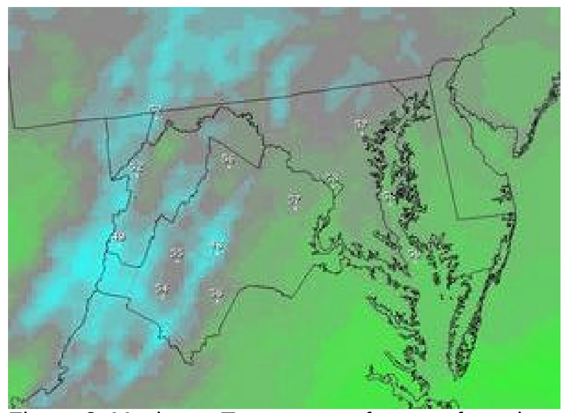
Figure 2: Maximum Temperature forecast from the Workstation Eta model at LWX, demonstrating the finer model resolution by its detail in the higher terrain of the western portion of the CWA.

4. SMART TOOLS AND PROCEDURES

The NDFD includes data representing forecasts of temperature, dew point, wind, sky cover, snowfall and precipitation probability, type and quantity. With the large variety of weather elements that forecasters need to produce in the digital database, and with the 5 km horizontal resolution of the maps, it quickly became necessary to find ways to streamline the forecast production process. This can be accomplished with the use of Smart Tools (STs), which are computer programs in the GFE that allow a forecaster to easily modify a grid in a scientific manner. STs and GFE procedures were implemented for a number of reasons, but the two main goals were to streamline the forecast creation process and to provide scientific methods for the forecasters to produce mesoscale effects in the forecast database.

Several STs were written locally, while others were written at other NWS locations and, if necessary, configured locally. Several procedures are available to create grids for certain weather elements from already existing grids. For example, since the relative humidity can be derived from the temperature and dew point, the forecasters use a procedure to automatically create the relative humidity grids from existing temperature and dew point forecast grids. A similar process is used to create grids for the wind chill, heat index, and other elements. Another ST creates forecast wave height grids based on an existing study of wind/wave correlations on the Chesapeake Bay and Tidal Potomac River. This ST allows a forecaster the opportunity to create gridded wave heights for the marine forecast area based on the current wind forecast. While this ST does not account for fetch or other localized effects, it does provide a good base from which to start. The use of STs and procedures in this way has streamlined the forecast process to the point that the forecasters can manually prepare 7 or 8 different weather elements, then quickly derive the additional 10 to 12 weather elements necessary for the database.

The addition of the mesonet locations has aided in the local development and configuration of STs. For example, LWX runs a ST named DiurnalTFromMaxMinT", written by Steve Nelson (Sohl 2003), that creates hourly temperature grids based on grids for maximum and minimum temperatures, and a climatological curve representing local diurnal trends in temperatures at different times of the year. The soundness of this climatological curve has been verified by comparing the output of the ST to hourly observations from the mesonet stations.

A number of STs were implemented to give the forecasters the capability to take advantage of the 5 km horizontal resolution in the gridded database. Among these is a locally-developed ST that applies a forecaster-selected lapse rate to an existing temperature grid, to assure that temperatures in the higher elevations in the forecast area are accounted for. Another locally-developed ST provides the forecasters the capability to handle air temperatures over the coastal locations, and modify air temperatures for land locations near the Chesapeake and Potomac based on how much of an effect the water would have on the air temperatures inland (Fig. 3).

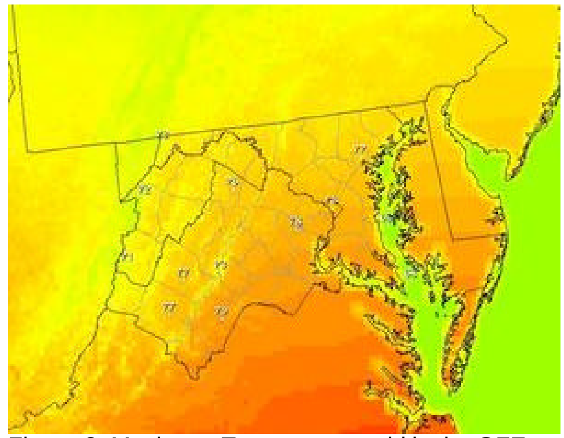

Figure 3: Maximum Temperature grid in the GFE at LWX, achieved through the use of local STs.

5. FORECAST PRODUCTS AND VERIFICATION

In order to illustrate to the forecasters the benefits of being able to including mesoscale details in their forecast grids, a transition to generating products directly from the forecast database was accomplished as quickly as possible. Text formatters within the Graphical Forecast Editor (GFE) provided the means to create the products directly from the digital database. A text formatter for the creation of the LWX Recreation Forecast Product, for the Virginia mountains at elevations above 2000 feet, was implemented late in 2002. This proved to be an ideal way to encourage forecasters to work with the terrain in their graphical weather elements, as the extra effort they put into their work over the higher terrain translated into a better result from this text formatter.

Late in 2002, the LWX office was selected as one of 3 offices in the NWS Eastern Region to participate in a NWS Central Region (CR) program. The LWX gridded database in IFPS was sent to a CR web server, which contained computer programs that would allow a user to generate a 7-day forecast based on a grid point in the 5km grid used in IFPS. In addition to generating a legacy text forecast, a user can create a forecast meteogram (Fig. 4) or a tabular forecast (not shown). This experiment demonstrated, to the forecasters and to the users of our web page, the advantages of working with this digital database. For example, on a warm spring day where a zone forecast for a county near the Chesapeake Bay may have had a general statement about temperatures being "cooler near the bay", a user now could generate a forecast for a point along the water and a point further inland to get more specific details about how much cooler the temperatures would be near the water. A similar situation resulted when users would consider forecasts for locations in the higher terrain. Specific forecast details for locations in the valleys or on the ridge tops could be achieved through this test, whereas a zone-averaged text-based forecast could provide only generalities.

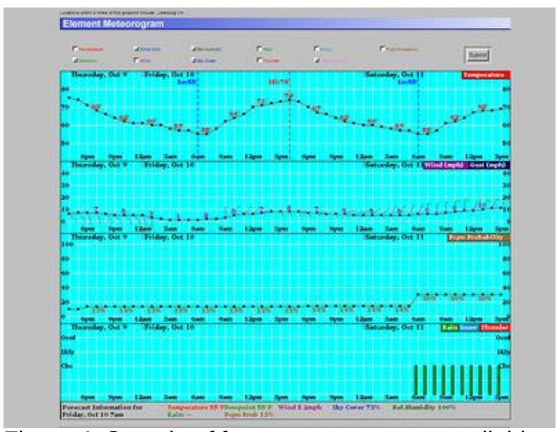

Figure 4: Sample of forecast meteogram available on NWS LWX web site.

With this high level of detail being created in the digital database and available to our users, the forecasters quickly questioned their forecast accuracy in the remote locations across the CWA. In the past, verification statistics were compiled for only a few selected sites across the area. Since forecasters are providing mesoscale detail in their forecasts for locations where little, if any, observation or climatological data had been available, let alone verified, the verification methods needed to be reexamined. Upgrading the local mesonet addressed a large part of this problem. The observations that are available locally provide an adequate representation of weather conditions as they vary over the terrain, and demonstrate to the forecasters how weather conditions differ based on elevation or proximity to the Chesapeake Bay.

With the observational data in place, the forecasters needed a means to verify their forecast accuracy. In late 2002, the GFE baseline software introduced an application, the Daily Forecast Critique (DFC), that provides verification data for a limited number of weather elements by providing graphical comparisons between official forecasts, predictions from a variety of computer models, and observed weather conditions (Fig.5). Locally, the DFC was configured to compare data for about 50 different stations scattered throughout the entire CWA. With this many stations available in the DFC, forecasters can verify the accuracy of forecasts at locations in the higher terrain, near the coastal plain, and in the more traditional airport observation locations.

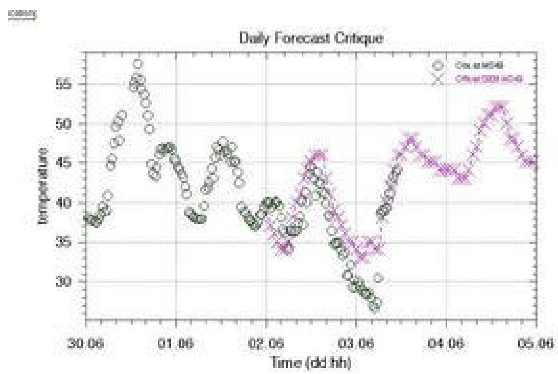

Figure 5: Sample from the Daily Forecast Critique within the GFE. This example compares observed temperatures to official forecasts at the MDOT site near Frostburg, MD.

6. RECOMMENDED FUTURE ACTIVITIES

A great deal of time and effort has been spent on IFPS software configuration and staff training, so that the goal of producing forecast data in a gridded format by the fall of 2003 could be met. One aspect that has not been considered as heavily during this transition period is the injection of local forecasting knowledge and techniques into IFPS operations. Local climatological studies, designed to improve mesoscale forecast knowledge in the area, would lead to the development of an improved set of STs for use in IFPS. For example, STs are available to apply a lapse rate to a temperature grid, to account for the difference in elevation. However, there has been little local research done on how temperature lapse rates vary during given weather conditions or during various seasons of the year. Another possible area for research would involve a climatological study of air temperatures over our marine areas, and how temperatures vary from our locations near the coastal to those further inland. A detailed climatology of how precipitation amounts and type vary by elevation across the LWX forecast area is another possible area for research. One of the by-products of research endeavors such as these would be the development of GFE STs or procedures that would help forecasters inject this type of local knowledge into their work on the forecast database.

The implementation of IFPS and the NDFD has been a topic of discussion at local workshops for the media, and at other outreach activities conducted by staff members. Over the coming months, work will continue with the local media outlets and other interested users to promote the capabilities of the NDFD. This will involve the production of our basic local forecast from the IFPS software in a variety of experimental products, and the evaluations of these experimental products. In addition, staff members will have to provide information to some of the more technical users in the forecast area, who need assistance in understanding and applying the raw data sets available through the NDFD.

7. ACKNOWLEDGMENTS

The author would like to acknowledge the operational staff at the NWS Baltimore/Washington forecast office. They have undergone a difficult transition period over the past couple of years, and through it all have worked hard to maintain the standards of quality of the forecast products they disseminate to the public.

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