JP1.1 LOCAL AWIPS SOFTWARE DEVELOPMENT ACTIVITIES AT THE NORTHEAST RIVER FORECAST CENTER

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1. INTRODUCTION

The Northeast River Forecast Center (NERFC) received its initial AWIPS prototype equipment in 1995. Since then, a significant effort has been made in developing local applications to supplement the baseline software delivered with the AWIPS system. Several categories of applications have been developed. First are tools to assist in data quality control using graphical displays. These applications have assisted the forecaster in making sound decisions on the data input into the hydrologic models. Second, tools have been developed to provide the forecaster a quick awareness of significant data or system problems. These applications have allowed the forecaster to focus more on significant hydrologic problems rather than having to worry about data flow and system problems. The third category is new graphical displays of data, including forecast hydrographs, river conditions, and observed precipitation and snow. In the past, these data sets have only been available in text format. These applications have significantly enhanced the visualization of existing data sets and have provided increased understanding of hydrometeorological conditions. Many of these graphical products have also been made available on our web site to provide improved information to cooperating agencies and the public. A fourth category of application development is attempting to utilize newer data sets, such as the Revised Digital Forecast (RDF) product to provide improved input into the hydrologic model. The local software uses a variety of development tools, including C, Tcl/Tk, SQL, as well as Geographic Information System (GIS) tools depending on the requirements of the particular application.

2. DATA QUALITY CONTROL

The first category of application developed is for the purpose of data quality control of point observations. Quality control of precipitation, temperature, snow, and streamflow conditions is critical to the successful modeling of hydrologic conditions.

2.1 DataQC Program

In the past, quality control of data has consisted of reviewing large tables of text data and identifying data errors. Several sources of error exist in the data set including improper coding of observation, transposition of data values between two data types, equipment malfunctioning, and communication system errors.

Observation data is coded in SHEF (Standard Hydrometeorological Exchange Format) (Office of Hydrology, 1998). This data is then posted into the Informix database on AWIPS. The DataQC application was written to allow the forecaster to review several data types. Observations are displayed on a map background and are color-coded by data value. This allows the forecaster to quickly assess outliers in the data set. In addition, DataQC will automatically update periodically. This allows the forecaster to leave the application running and as new data is received, the application display is automatically updated.

Data sets that can be displayed in DataQC include precipitation (hourly or daily), maximum or minimum temperature, snowfall, snow depth, snow water equivalent, and present weather. In addition, a variety of basin average values as computed by NWSRFS are also viewable. These include precipitation, both gage and radar based, and antecedent precipitation indices.

After reviewing the data the forecaster has the ability to edit any data value. These edits are then posted to Informix and then used in the hydrologic forecast process.

DataQC was written in C using the ESQL extensions to allow direct access to the Informix database as well as the Xwindows library to generate the graphical displays.

2.2 DataMonitor Program

As part of the data quality control process, it is necessary for the forecaster to be aware of what data and products have been received. Three primary sources of data are routinely monitored. The first is the HADS (Hydrometeorological

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Automated Data System) data stream. This data set contains the majority of the river gage observations that are monitored by NERFC. In addition, some precipitation and temperature data sets are available on the HADS data stream. HADS products are received every 5-10 minutes throughout the day. The second data stream is the daily cooperative observer reports that are called into the forecast offices. One or two of these are typically received each day from each of the eight Weather Forecast Offices that NERFC supports. The final critical data set that is monitored is the ROSA data set which the cooperative observers transmit directly to NWS computers.

The DataMonitor program provides a means for the forecaster to monitor these data streams. The top panel provides a listing of all pertinent products that have been received along with the number of observations that have been processed. The lower panel summarizes this information with information on the number of each product type that has been received. Product identifiers are color coded to indicate whether no products have been received, products have been received but are awaiting processing, or products have been received and processed.

The user interface for DataMonitor was written using Tcl/Tk. A series of Korn shell and awk scripts performs the actual data monitoring process.

3. SYSTEM ALERT TOOLS

AWIPS was delivered with a variety of system and data monitoring tools. However, these tools in many cases did not react to the unique data and system issues for the River Forecast Centers. In addition, the standard AWIPS alarm messages utilize the D2D application interface to alert the user of a problem. At an RFC, D2D may not always be running and therefore the alerts would be lost. As a result, several additional applications have been developed at NERFC to address this need.

3.1 AlarmCheck Program

The first of these applications is AlarmCheck. This application actually consists of two separate applications. The first is a system process that runs continuously in the background. The second is initiated upon user login and checks and displays alerts that have been detected by the background process.

The conditions that the background process monitors include:

- Excessive disk space utilization on several disk partitions
- Background tasks such as the shef decoder process are continuing to run
- River gage observations above flood stage
- Precipitation forecasts that approach flash flood guidance
- Receipt of data from the HADS system

When an error condition exists in any of these areas a popup window appears at each logged in users workstation with a message describing the condition. Typically the user is notified of a problem within a minute of when the problem occurs. This timeliness allows the forecaster to react very quickly to potential problems.

The background process is written as a Korn shell script. The user display is written in Tcl/Tk.

3.2 Riverwatch Program

Riverwatch was written to allow the forecaster to be notified as soon as new river gage observations arrive for locations that are rising rapidly or are approaching or above flood stage. The user can configure Riverwatch to display data either for a specified list of stations, and/or for those stations that are above a specified stage relative to flood stage. Riverwatch provides the forecaster the freedom to focus on other forecast responsibilities rather than having to check to see if an updated observation has been received. As soon as a new observation is received, a pop up window is displayed that shows all the stations that are being monitored along with the latest reading and time of latest observation. New observations are highlighted so the forecaster can quickly focus on the data of interest.

Riverwatch was written in Tcl/Tk. It uses SQL to query the AWIPS database.

4. GRAPHICAL PRODUCTS

With the expansion of services on the Internet, a major push has been made to provide graphical products. This is referred to both in the NWS vision document (NWS, 2000) as well as the Advanced Hydrologic Prediction Services (Ingram, et. al., 1996). In support of these goals, NERFC has been active in providing a graphical display of many of our existing products. These graphics have been useful both for the forecaster who can rapidly review hydrometeorological conditions impacting the forecast operations. They have also

been widely used by visitors to the NERFC web site.

4.1 Graphical RVF

For many years, the core product from the NERFC has been the RVF product, which is the river forecast guidance that is issued at least once per day, and more frequently during periods of flooding. This product, which is encoded in SHEF, provides a 6-hour time step time series for two days of the forecast river stage at each of our daily forecast locations. The forecaster may also provide a variety of annotations indicating locations that are subject to river regulation that may not be reflected in the forecast, the presence of ice in the rivers, missing gage observations or other concerns that may impact the quality of the forecast.

The information in the RVF is now available in a graphical format. This graphic depicts the time series forecast hydrograph from the RVF as well as the past 24 hours of observed river levels. Flood levels are also shown on the graphic so it easy to determine river levels relative to flood stage. In addition, any annotations that were added in the text RVF are also available in the graphical RVF. An example is shown in Figure 1.

The program to generate the Graphical RVF was written in C and utilizes a freeware library of routines for generating the graphic image.

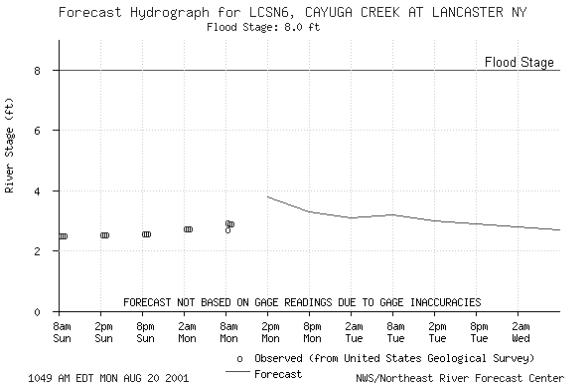

Figure 1 - Graphical version of the river forecast product

4.2 Snow and Precipitation Graphics

Use of GIS, or Geographical Information Systems, has become much more common throughout the National Weather Service. GIS provides many tools for displaying and analyzing the wide variety of data sets available. NERFC has made wide use of GIS over the past several years to develop a suite of products that are available on the NERFC web site.

The current suite of products includes RFC wide maps of the following data sets:

- Daily precipitation accumulation
- Storm total precipitation (figure 2)
- Maximum and minimum temperature
- Flash flood guidance
- Snowfall
- Snow depth
- Snow Water Equivalent (SWE)
- Model estimated basin average SWE
- Percent of normal basin average SWE

It is anticipated that additional products will also be developed over the next several years. Each of the products above was created using a GIS tool that directly queries the AWIPS database.

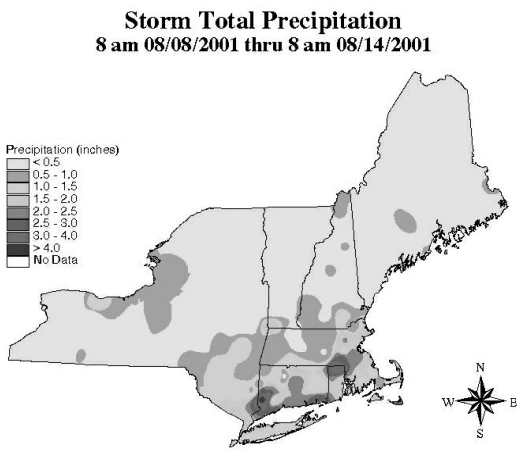

Figure 2 - Example of storm total precipitation map

5. UTILIZATION OF NEW DATA SETS

New data sets are regularly being made available that contain valuable data for RFC operations. Efforts are being made to incorporate some of this new data as quickly as possible into the forecast. An example of this new data is the RDF product that has been issued by Weather Forecast Offices over the past year. During the past winter, NERFC began extracting the forecast temperatures from the RDF and reformatted them so they could be used by the river forecast models. The three hour time steps available in the RDF provide much finer temporal resolution than has been available using the maximum and minimum temperatures used in the past.

We anticipate that as the National Digital Forecast Database is developed over the next several years we will increasingly access this data set for river forecast operations. In particular the precipitation and temperature fields should provide valuable information for RFC operations.

6. SUMMARY

The NERFC has performed a significant amount of local software development in order to supplement the AWIPS baseline software. These applications have served to improve office forecast operations by improving data accessibility and allowing the forecasters to focus more on hydrologic forecast operations and less on system operations. As we look to the future we continue to see the need for more development. The use of GIS in our operations is quickly increasing and will continue to do so as we look to finer scale modeling in the future. In addition, as new developments in science and technology take place on a national scale, local applications will be developed to take full advantage on a local scale.

7. REFERENCES

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