17.12 GIS DATA AND APPLICATIONS AT THE LOWER MISSISSIPPI RIVER FORECAST CENTER

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1. INTRODUCTION

Technology and its rapid advancement over the past few decades have led us into a world of high resolution/better quality data and information. The world of Geographic Information Systems (GIS) is expanding at a rapid pace and several independent companies have developed software to disseminate the various datum. Typically GIS is thought of as a hydrologic tool, but we have found many other uses.

The Lower Mississippi River Forecast Center (LMRFC) collects, processes, and analyses a large amount of data. To keep its users informed, the LMRFC prepares a significant number of products using ArcView/GIS. These products are used internally at LMRFC and within the NWS. Many are now being posted to the LMRFC webpage. Some products prepared using ArcView include: precipitation estimates from the NWS WSR-88D Radar for time periods ranging from hourly to yearly; contoured observed precipitation for time periods ranging from daily to yearly; monthly normal precipitation maps and departure from normal; forecasted precipitation in 6-hour increments for 24 hours in the future including gridded model output; and maps displaying the status of river forecast locations to name a few. Currently, the LMRFC generates 3,663 images a day of the various data sources for the LMRFC as well as other Southern Region RFC's. Images are made available via the website, however these data (in GIS format) are slowly being made available for download and are supplied to National Weather Service Headquarters for an internet map server.

Now that other neighboring river forecast centers have acquired GIS software, we are working together to combine individual RFC data sets into regional views and data sets. This effort includes the display of the data using images as well as an internet map server.

2. PRODUCTS, DATA, AND METHODOLOGY

2.1 Rainfall

The LMRFC began using GIS software packages in early 1999 as a method of displaying the LMRFC river/rain gage network on the AWIPS platform. Eventually, the spatial analyst extension was added for the display and/or manipulation of grids. At first, 24 hour rainfall reports routinely gathered by the LMRFC were displayed, contoured and gridded for use by LMRFC staff in the quality control process. Over time, spatial analyst was used to grid the rain gage data on the same projection (HRAP) as the Stage III radar-derived product. These two products are now being directly compared to show areas in which Stage III was over or underestimating. Through easy manipulation of the software, specific projects are being created to allow forecaster interaction with the data in a quality control environment. In an operational environment, specifically river forecasting, knowing the amount and areal extent of a rainfall event is crucial in determining
the amount of runoff that can be expected. Therefore, comparing an observed rainfall grid to the Stage III estimated grid helps forecasters adjust the amount of input runoff. Figure 1 demonstrates, on the RFC scale, how the interactive project appears using the GIS software.

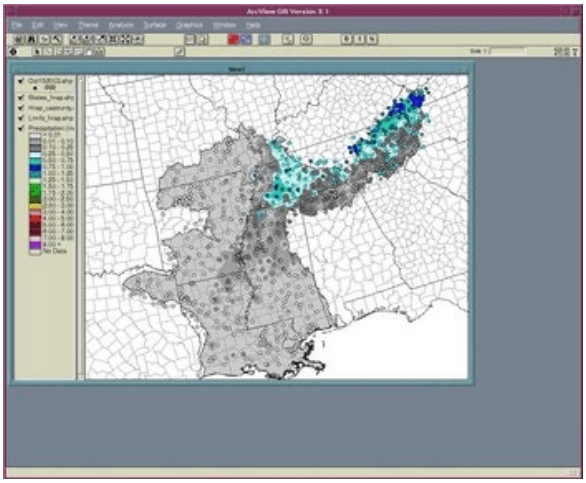

Fig 1. Contour/QC program designed for forecasters to edit daily rainfall summary product

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with ease as well as directly compare gage analysis with radar rainfall estimates.

This particular project which contours and grids daily rainfall amounts also generates the daily rainfall summary product (NWS afos header NEWHYDSIL) which gets transmitted across the AWIPS network.

Other rainfall products the LMRFC produces include cumulative totals of rain gage analysis and stage III from 2 days up to a year. Each of the products is currently used for display on the LMRFC homepage but future work includes utilizing the data in calibration and GIS based distributed modelling.

2.2 Climate Data

Within the past year through a collaboration of efforts at the Southeast RFC, Arkansas-Red RFC, West Gulf RFC, and the Lower Mississippi RFC, multisensor precipitation estimates (MPE) from each RFC have been combined into a singe suite of products viewable at a single source. In the past, one wanting to view rainfall estimates or climate info over a vast area would have to jump from website to website to find this information. Now, this website/link http://www.srh.noaa.gov/rfcshare/p_SR.php provides a single point of access to the data and its derivatives. The derived products produced include percent of normal rainfall and departure from normal for various durations including past 24 hours, 7 and 14 days, current month and current year. The program runs at the West Gulf River Forecast Center and combines the data from 4 Southern Region River Forecast Centers and creates a region wide climate product utilizing the PRISM datasets as a 30 day average. Images are created which can be clicked for a state or RFC zoom and the user can download the grids as point shapefiles. An example is shown in figure 2

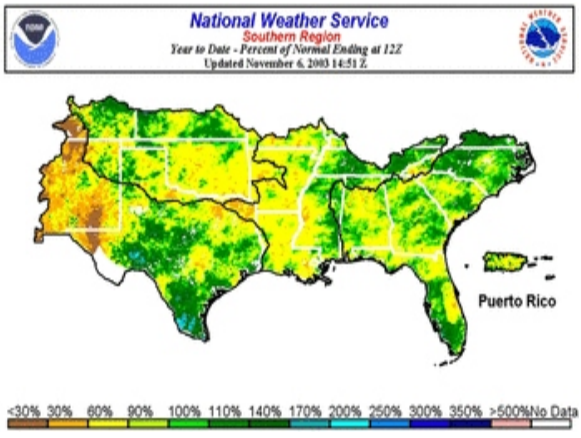


Fig 2. A map of the Southern Region giving a detailed view of percent of normal rainfall for 2003.

2.3 Flash Flood Guidance

Flash Flood Guidance (FFG) is one of the cornerstones of the River Forecast Centers product suite. FFG values represent the amount of rain, in inches, required to generate flash flooding on streams within the specific county or zone for a specified duration (i.e. 1, 3, 6, 12 or 24 hour). Every day, each of the RFC's issue a text product containing flash flood guidance values to each weather forecast office for each county or zone in their area of responsibility. Each RFC also has the ability to generate a graphic for internet purposes. The Southern Region RFC Web Team in cooperation with Central and Eastern Regions have begun to generate a standard display of this information using GIS software. This standard display contains a zoom for each Region, RFC, state and a pan of the combined Southern, Central and Eastern Regions. A regional view was implemented so that a user would not have to search for an area to get specific information, but instead can click on the area of interest. A sample of graphic of the regional view is shown in Figure 3.

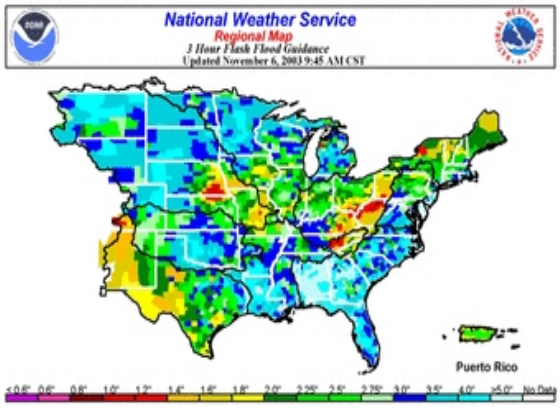
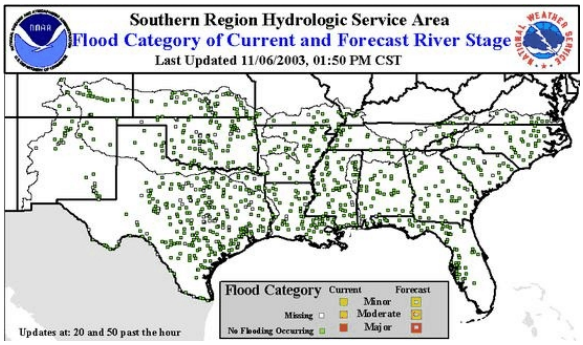


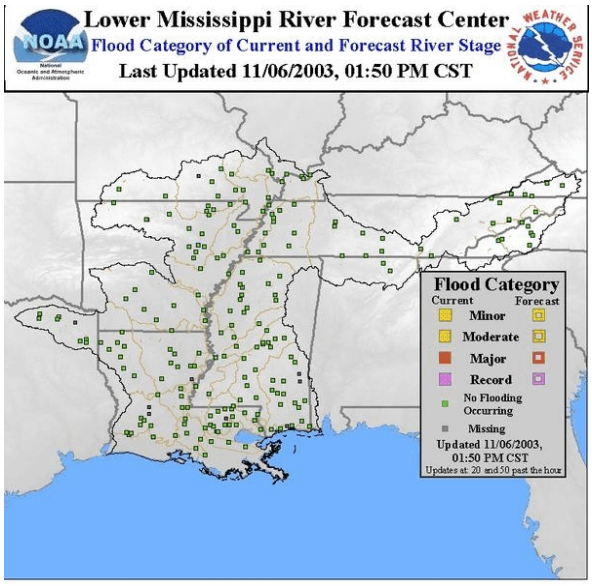
Fig 3. Flash Flood Guidance values by county for the U.S. which is produced by individual RFC's and be combined into a mosaic of the eastern half of the country.

2.4 River Status Maps

The most recent accomplishment of the Southern Region RFC Web Team is the production of a Southern Region river status map located at http://www.srh.noaa.gov/rfcshare/status/riverstatus.html. This graphical product shows the flood category of the highest forecast stage as an outer, color-coded square shaped symbol surrounding a smaller color-coded square symbol representing the current flood category. The graphic is created with a stand-alone Visual Basic executable using ArcObjects and ArcGIS 8.2. The executable runs very quickly, in under a minute, and is currently set up to update the web product twice an hour (figure 4). The regional status map contains links to each of the Southern Region



RFC status maps, some of which then link to forecast group drill-downs or directly to individual gage information and forecasts. The LMRFC River Status map (figure 5) is also created using a Visual Basic executable with ArcObjects and ArcGIS 8.2 and is



updated twice an hour as well. Future projects of the Southern Region Web Team may include gage rainfall and QPF.

Fig 4. A map of the Southern Region River Status map showing the flood category of current and forecast stages.

Fig 5. A map showing the drill-down to the LMRFC River Status Map from the Southern Region map.

3. FUTURE PRODUCTS/ENHANCEMENTS

3.1 Internet Map Servers

With future enhancements/upgrades of the GIS software from ESRI combined with a National Weather Service move to support the software, the future products and capabilities within the operational and research community will vastly improve. Of particular interest to the National Weather Service as well as Emergency Management and other public officials is the deployment of ArcIMS. ArcIMS provides the foundation for distributing high-end geographic information systems (GIS) and mapping services via the Internet. The software enables users to integrate local data sources with Internet data sources for display, query, and analysis in an easy-to-use Web browser. Efforts at the national and regional levels are ongoing to implement this software which will serve up the same data used to create the current images on the web.

The data used by the internet map server will also be available for download. This will shed some of the load on the map server and allow the end user to overlay the data on their own map backgrounds.

3.2 3D Display of Information

A few other areas of future work include 3-D analysis of rainfall data over mountainous terrain, improved cross-sectional data for current operational dynamic models, work with other RFC's to concatenate radar/percent of normal grids into national mosaics, fully distributed streamflow modelling, and possible generation of future products using the GIS Software packages.

A 3-D analysis of elevation data will aid in the forecasting of mountainous terrain by allowing forecasters to view spatial rainfall patterns and its relationship to terrain. Any layer file i.e. interstates, street maps, cities, counties etc. can be overlain and merged with the elevation data (figure 6).

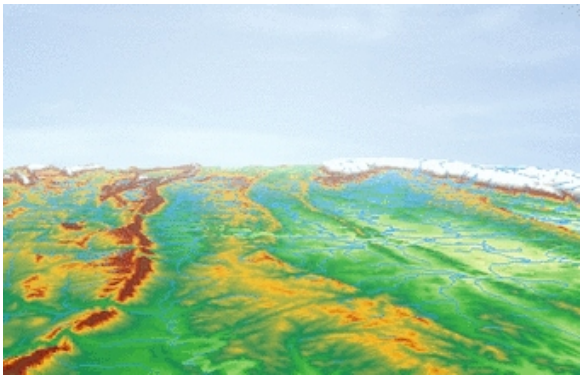


Fig. 6 A 3-D view of the terrain over north GA giving forecasters a detailed view of the watershed and how it might affect runoff.

A cross section (figure 7) can be derived from topographic data giving forecasters additional data at locations away from surveyed areas. This information can then be used for flood inundation mapping and hydrologic modeling. Efforts are ongoing at the national level to incorporate the technology on a real-time sense into the operational community (Cajina et al. 2002).

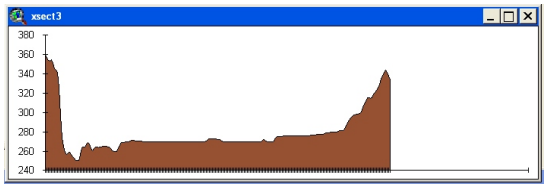


Fig. 7. The cross section can provide information at locations where data is sparse as well as use in inundation mapping.

Radar imagery can also be imported into the GIS suite and viewed on a 2 or 3 dimensional level. This data could help forecasters in a training mode to show where beam blockages might be occurring as well as how a storm is structured. Figure 8 illustrates the radar data is seen using 3D Analyst.

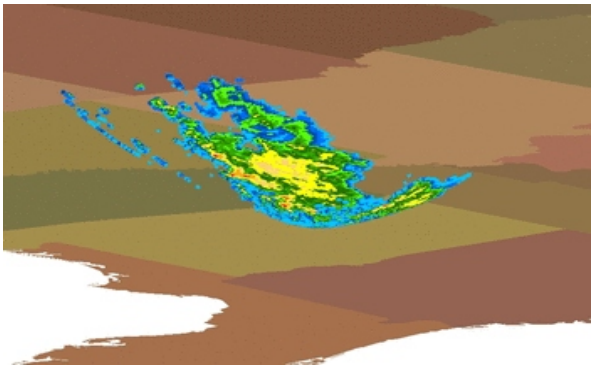


Fig. 8 3-D view of a 0.5 scan from the BHM radar in GIS software.

4. CONCLUSIONS

The addition of the Arcview/GIS software has enabled the LMRFC to produce high quality graphics to compliment and/or replace traditional text products. Using Avenue, visual basic, custom tools, and interfaces, complete applications can be easily developed to suit the product or products it is designed for.

The software has also aided in ideas and design due to the fact that it is made available to anyone. Many websites contain projects and scripts already designed for specific tasks which can be included into projects being designed locally or nationally. The program language is directly transferrable from one project to another.

The LMRFC has also utilized the software and its ability to run from a cron. This technique allows the production of grids, images, and various other datasets automatically. Forecasters can then save time and effort in the creation of the products while still creating high quality graphics for web users.

Many projects are still under way at the LMRFC and as the software expands in capability so will the products produced. Only recently have we entered into the realm of a national interactive program for creating products utilizing the software's capabilities and certainly it will not be the last.

REFERENCES

Cajina, N., J. Sylvestre, E. Henderson, M. Logan, and M. Richardson, 2002: FLDVIEW: The NWS Flood Forecast Mapping Application. AMS Conference Preprint 2002, J7.5 Orlando Florida.