6.3 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. Images are made available via the website, however these data (in GIS format) will be made available for download.

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 the Arcivew GIS software package 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 could then be directly compared to show areas in which Stage III was over or underestimating. 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 and 2 demonstrates on a local scale how the Stage III and rain gage analysis images appear using the GIS software.

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.

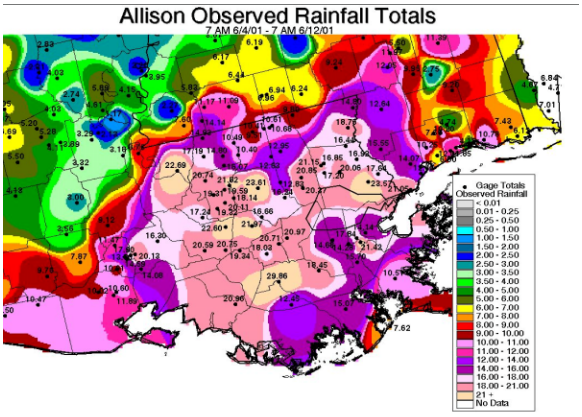

Fig 1 Observed rain gage analysis using spatial analyst which is gridded for comparison with Stage III. The image created is posted to the LMRFC website.

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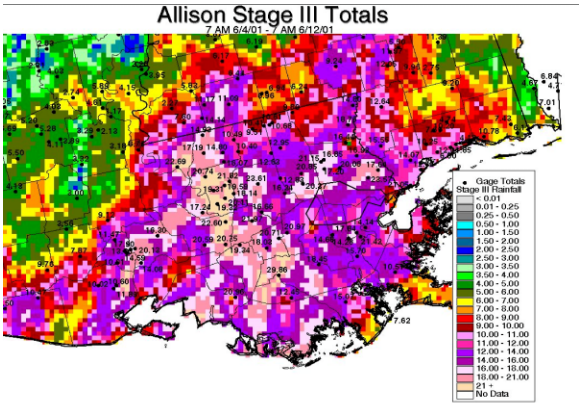

Fig 2 Stage III radar-derived rainfall estimates with the observed values overlayed for comparison. The two grids can also be subtracted (not shown).

A particular product produced using the Stage III data which has been of great interest on the LMRFC website is the use of gridded normal rainfall and StageIII. The product produced is a percent of normal rainfall for various durations including 1,2,3,6, and 12 month periods. The West Gulf River Forecast Center has created an arcview project using avenue scripts that combines the data from 4 Southern Region River Forecast Centers and creates a region wide drought product. Images are created which can be clicked for a zoom or as a future enhancement, the user will be able to download the grids. An example is shown in figure 3

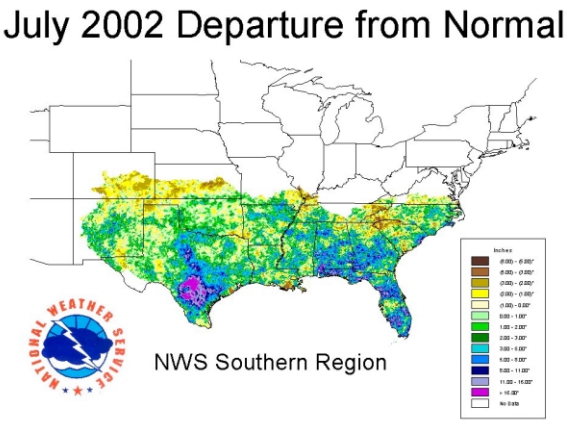

Fig 3. A map of the Southern Region giving a detailed view of departure from normal rainfall for July 2002 (normally in color).

2.2 Interactive Products

Many of the products shown or discussed already are created with the use of a cron, therefore there is little interactivity between forecasters and software. Recently, National Weather Service Headquarters has approved the use of Arcview/GIS as baseline software on the AWIPS network at the river forecast centers. Part of the catalyst for the software is due to the development of the first national product using the Arcview 3.x software. This product, called Flood Outlook Potential, uses interactivity between RFC's and forecasters to produce a 1-5 day flood outlook. Using Arcview, forecasters subjectively draw polygons over areas where moderate or greater flooding is possible over the next 5 days. Also, areas where moderate or greater flooding is occurring would be highlighted. The program, partially developed at the LMRFC, then exports polygon coordinates to a file that is transmitted to the Hydrologic Prediction Center (HPC). At HPC, the 13 RFC files are combined to create a national product. The local product is shown in figure 4.

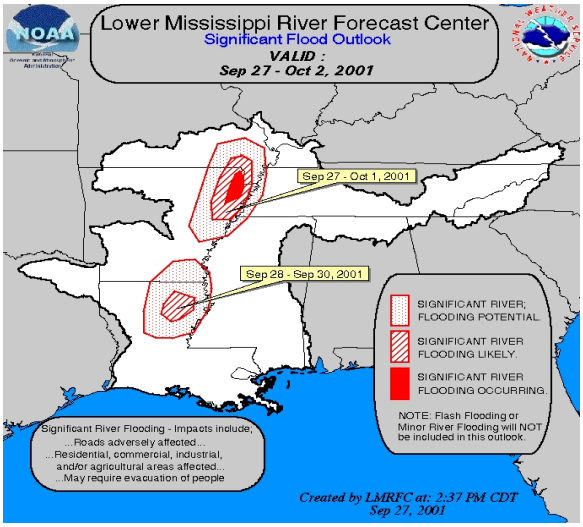

Fig 4. Significant Flood Outlook product depicted significant flooding potential which is produced by individual RFC's and be combined into a national mosaic of all 13 RFC's.

Flash Flood Guidance (FFG) is one of the cornerstones of the River Forecast Centers product suite. 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 LMRFC and Southern Region RFC Web Team have decided to generate a standard display of information using the GIS software. This standard display will contain a zoom for each RFC and a pan of the Southern Region. It was decided to do a larger view so that a user would not have to search for an RFC to get specific information, but instead can click on the area of interest. A sample of what can be expected is shown in Figure 5.

The Flash Flood Guidance and Departure from normal are just the first steps towards combining data and technological efforts at the RFC's into a larger easier to use products. Data such as rainfall estimates from radar, gages, flooding locations, forecast rainfall and many others are targeted for future work.

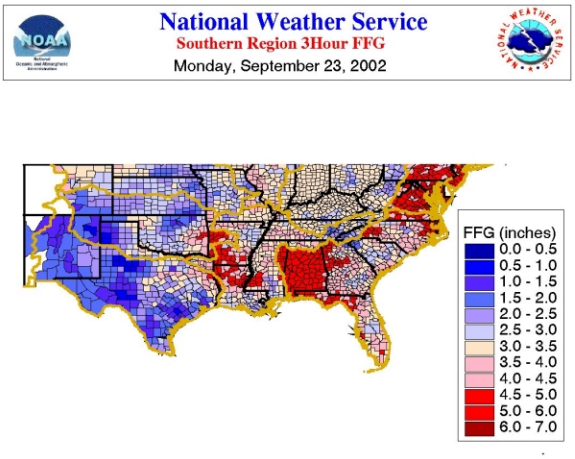

Fig 5. Flash Flood Guidance values by county for Southern Region which is produced by individual RFC's and be combined into a mosaic of all SR RFC's.

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. In June 2002 a team of IT's, Science Officers, meteorologists and hydrologist from several Southern Region National Weather Service Offices gathered to discuss options for serving up IFPS grids on the web. The team (called the Southern Region NDFD Team) decided on 2 levels of interactivity. The first and the simplest will serve up still images of the grids and the information that they convey with links to text containing information such as weather data and forecasts. The second level will be ArcIMS and will be a customized interface that allows the user to zoom in and out of the data and extract the information contained in the grids using the software. The software and data will reside on the Southern Region server and will be available tentatively in 2003.

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 regional/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. Arcview/GIS 8.x now installed at the LMRFC was used to create Fig. 7 showing the terrain and associated streams for a basin in northern Georgia. Any layer file i.e. interstates, street maps, cities, counties etc…. can be overlayed and merged with the elevation data.

A cross section 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).

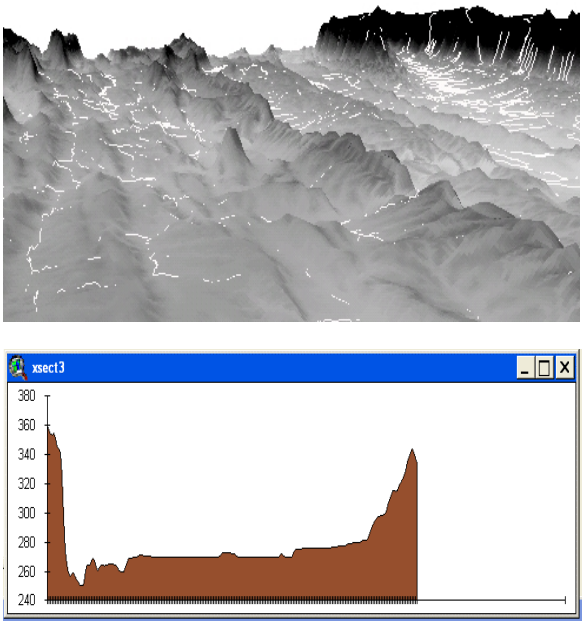

Fig. 7. A 3-D view of terrain over northern Georgia and associated cross section giving forecasters a detailed view of the watershed and how it might

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

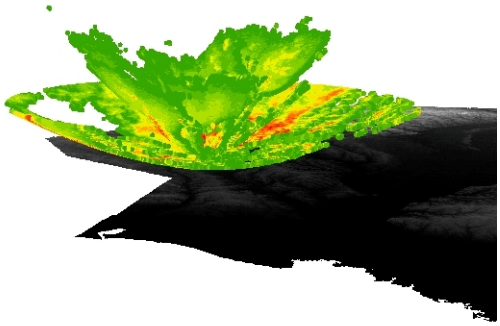

Fig. 7 3-D view of a squall line from the SHV radar in Arcview. Tilts 0.5,3.4,and 6.0 are shown.

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 (and visual basic in the future), ArcView software's built-in object-oriented scripting language, custom tools, interfaces, and 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.