9.5 RIDGE - Radar Integrated Display with Geospatial Elements. The NWS New Radar Webpage

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1. INTRODUCTION

The National Weather Service is responsible to make its weather, water and climate information widely available to taxpayers using commonly accepted standards and technologies. Currently, the NWS provides weather radar information for all Weather Service Doppler Radars (WSR 88-D) in the United States on the NWS Internet page.

The National Weather Service Southern Region, working in cooperation with North Central Texas Council of Governments (NCTCOG), has developed a method to display radar images more efficiently than the previous method (Bunting, et. al). These radar images, call RIDGE (Radar Integrated Display with Geospatial Elements), allows the radar image to be combined with geospatial elements such as topography maps, highways, and county boundaries. This not only produces a better image, but provides additional reference information for users to understand where they are located. RIDGE also adds the ability to overlay polygon warnings issued by the National Weather Service Forecast Offices

2. PRODUCTS, DATA, AND METHODOLOGY

2.1 Radar Display Background

A NWS radar team was formed in 2000 tasked with making WSR-88D information available on the world wide web. Since their inception in 2000, the NWS radar webpages have become very popular encompassing up to 50 percent of all NWS web traffic during landfalling hurricanes and 20 to 40 percent of web traffic during "normal" weather. In fact, during the week of Aug 24-29 (i.e. Hurricane Katrina), the NOAA-NWS web counters registered 3.4 billion hits. And preliminary numbers for the month of August 2005 show more than 200 million individual users. These numbers are astounding when one considers bandwidth use since the average NWS radar webpage is approximately 110kb. Another comparison to increasing web use can be made using recent and past hurricanes as examples on the Southern Region webfarm based in Fort Worth, Texas. Hurricane Lili made landfall along the Louisiana coastline on Oct 2, 2002. Web counters on the Southern Region webfarm that day registered 19.1 million hits, 1.3 million users, and 141 GB of data transferred. Hurricane Katrina made landfall in eastern Louisiana on Aug 29, 2005. Web counters at SR registered 87.2 million hits, 5.7 million users, and 673 GB of data transferred. Similar numbers were reported during Hurricane Rita 3 weeks later.

Although the NWS radar webpages have become very popular and successful, the sites have had their share of problems. The software that generates the imagery has become dated and is very difficult to modify. Several factors can be attributed to this problem. First, the development team was dissolved after initial webpage deployment in 2000 and several of the original programmers have retired and/or no longer work in the NWS. Roads and highway background information are difficult to update given the old software and the format of the data. Lastly, the architecture of the data flow and image production leads itself to several single points of failure, which given the popularity of the NWS radar page is unacceptable. The above along with no operational funding or support leads itself to a stagnant product and thus the NWS radar information and display have not been updated in over four years. So, in 2003, the Office of Chief Information Officer (OCIO) provided Southern Region seed funding to explore technologies, explore better architecture, and replace the existing displays.

Southern Region in a partnership with NCTGOC and software originally developed at NCTCOG (Bunting et al) developed RIDGE (Radar Integrated Display with Geospatial Elements). The first tests of RIDGE online began in February 2004 and have evolved into what is online today.

2.2 RIDGE Architecture

RIDGE was developed to address several flaws in the existing NWS radar webpage and data flow

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design. By design, the current radar to web architecture has several single points of failure. RIDGE eliminates these single points of failure through redundancy and displacement. Initially, RIDGE will operate in Fort Worth, Texas (Southern Region Headquarters) and in Kansas City (Central Region Headquarter) and data will be collected through the Satellite Broadcast Network (SBN) a.k.a NOAA Port. By adding to the number of data collection points and duplicating image generation locations, the possibilities of a radar website being down is reduced to the radar itself being down.

RIDGE is built using object oriented programming code using the Microsoft .net architecture. The design uses robust hardware and software documentation while being under full configuration management. A future version is currently being designed using java for multi-platform capabilities which will not tie the software to specific operating systems.

2.3 RIDGE Web Structure

RIDGE on the web was built using several strategies.

1. Most web browsers use caching
2. GIS is a growing and expanding field
3. Background/reference information changes
4. Display the latest warning polygons in conjunction with radar information.

2.3a Cache

RIDGE uses layers (transparent gifs) to present the information on the web. Each layer contains specific reference information that is easily updated or removed without affecting the other layers and more importantly without affecting the radar image generation software. Using web scripts that are browser independent, each layer's visibility can be changed at the user's request. Figure 1 illustrates this layering technique.

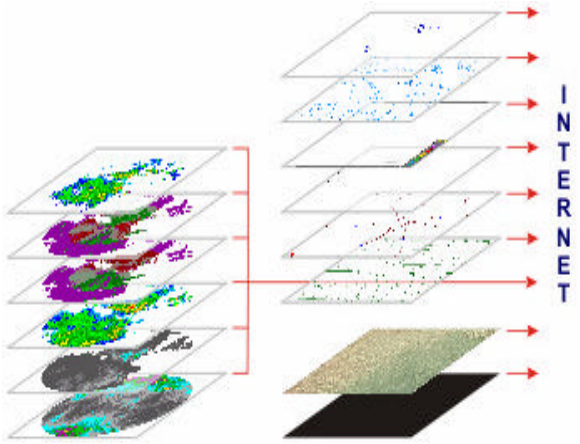

Fig 1. RIDGE uses layers of transparent gifs and the web browser to display the radar information with any number of geographic reference layers.

The layering technique also allows browsers to cache the layers of geographic information (images), scripts, and webpage. And upon a users second visit to a specific radar, only the small (<20kb) changed information (radar image, legend, and warning overlay) is downloaded. This technique also allows the NWS to display other radar products (images) without directing the user to another product specific webpage. For instance, a user initially views base reflectivity and wants to then load storm total precipitation. Instead of directing the user to another webpage designed to host the graphic of storm total precipitation, the user retains the current webpage and layers of geographic information and replaces the base reflectivity and legend with storm total precipitation and corresponding legend.

2.3b GIS

GIS is a science that reaches across all domains, both socio-economic and technologically based (Graffman, et al). With that in mind, RIDGE attempts to bring a rapidly changing dataset to the predominately static GIS world while minimizing bandwidth. RIDGE accomplishes that by separating the radar output image from the remainder of the image and associating the graphic with a real world coordinate file, i.e. georeference the image using a world file. Georeferencing an image is to establish the relationship between page coordinates on a planar map and real-world coordinates. Each RIDGE radar image has an associated world file which contains the information necessary to plot the image using both commercial and open source GIS software.

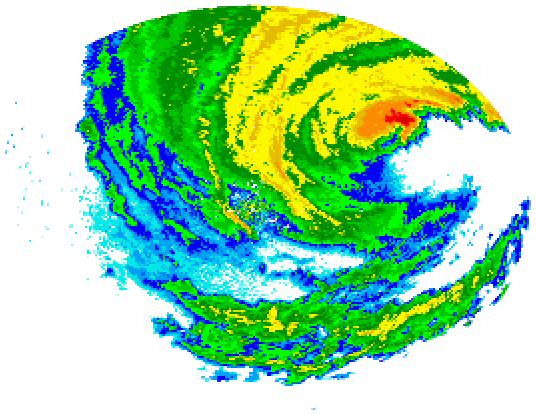

Fig 2. The single layer (image) containing radar information and associated world file allow easy import into GIS software (Fig 3)

Not only does georeferencing an image help GIS users, it enables the RIDGE webpage to contain additional enhancements. One of these enhancements is range-bearing information. Using javascript that tracks mouse movement and GIS information from each image, distance and latitude-longitude information can be displayed on the website

that is specific based on user request. This feature allows users to determine distances between the location of a storm and a point as well as latitude longitude information by simply clicking the mouse.

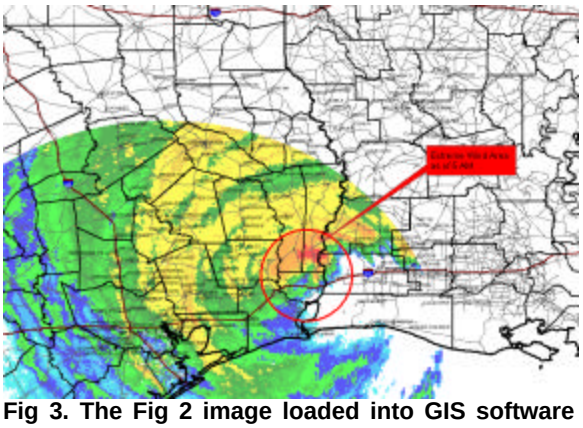

Fig 3. The Fig 2 image loaded into GIS software for uses other than through web based interfaces. This process requires no radar decoding software and uses very little bandwidth.

2.3c Reference Information

Each of the layers containing geographic references is created using shapefiles that are developed and maintained by the responsible agency. For example, road information is maintained and made available by the Department of Transportation and river data is maintained by the United States Geological Survey. The NWS accesses these datasets and generates the background layers independently of the software that generates the radar images. Having the background information in its native form from the authoring agency allows the NWS to maintain the latest changes on the webpage.

2.3d Warning Polygons

The RIDGE web pages are the first to display NWS warning polygons for Tornado, Severe Thunderstorm, Flash Floods, and Special Marine in conjunction with radar data. In addition to county based warnings, the NWS Forecast Offices issue polygon warnings which typically cover a smaller area and focus on the area with the greatest threat of adverse weather. This information is contained within the text of the county warnings in the form of latitude-longitude points. These points, when plotted, are the corner points of a complete polygon representing the high threat area. Since RIDGE is GIS based, the polygons can be easily brought into RIDGE as a layer. Future enhancements of RIDGE will allow the user to click on warnings and the warning text to pop up.

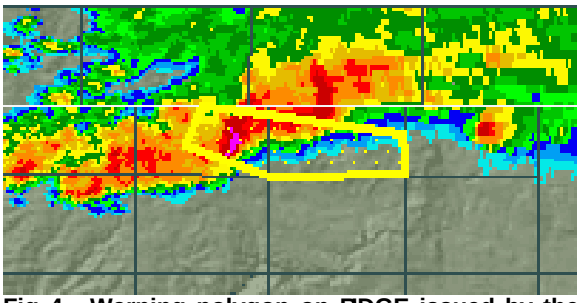

Fig 4. Warning polygon on RIDGE issued by the NWS indicating area of highest threat due to adverse weather.

3. Customer Feedback

Any new product from the NWS must go through an evaluation period that includes both an internal and external review process. This process includes a survey that users fill out and submit freely during a period of no less than 90 days. The RIDGE survey/feedback period started May 23, 2005 and ended September 5, 2005 and included over 23,900 completed surveys as well as several thousand personal email responses. This feedback was used during the experimental phase of RIDGE to tweak or upgrade the user interface as well as make backend changes which improved performance and efficiency. Overall, users responded positively to RIDGE (Fig 5 and 6) with only a small percentage stating a dislike of the product. On a scale of 1 to 10, high end ratings are considered 8, 9 or 10 and low end ratings are considered 0,1, or 2. Question number 1 asked the user to rate the technical quality of the product. 78 percent gave RIDGE a high rating while only 6 percent gave it a low rating. Question number 2 asked the user to rate how easy it is to interpret the product. 80 percent gave RIDGE a high rating while only 4 percent gave it a low rating. While only a small percentage of the surveys were low, the comments provided the most benefit during the survey period and many were used to improve upon the webpage design, efficiency, and ease of use.

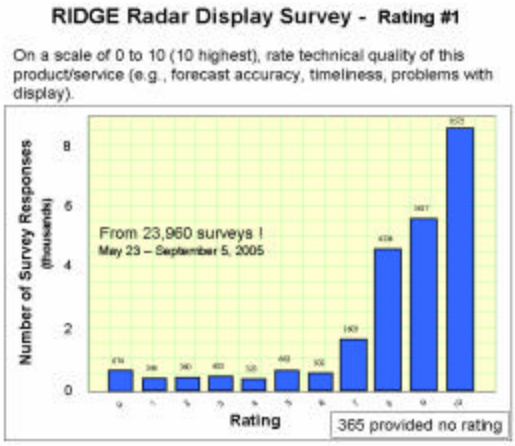

Fig 5. Results of the RIDGE survey question #1.

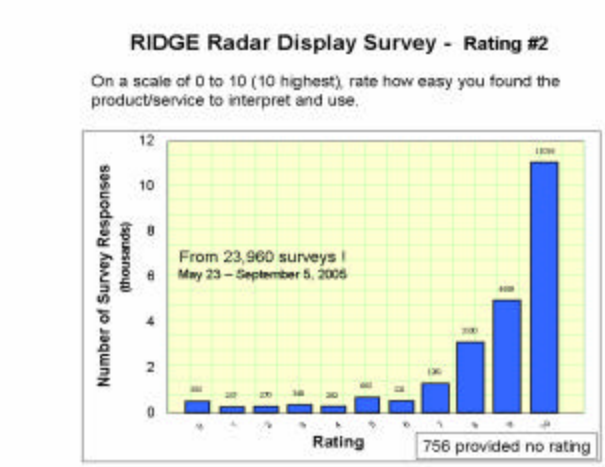

Fig 6. Results of the RIDGE survey question #2.

One very interesting finding, which relates to the original design of RIDGE, is that 75 percent of the users say they use the service more than once per day. Because RIDGE takes advantage of browser caching ability, there is an enormous amount of bandwidth conserved considering most folks who visit are repeat visitors (based on survey feedback).

4. FUTURE PRODUCTS/ENHANCEMENTS

4.1 First Implementation

RIDGE is slated to replace existing NWS radar pages in January 2006. When the switch from the existing radar webpage is made, all links to the traditional NWS radar pages will be directed to the RIDGE radar pages.

Some folks block javascript from use in browsers and not all PDA clients can utilize javacript/java capabilities. As a result of some customer feedback on this issue, RIDGE will also have a companion RIDGE-Lite website. This website will feature no scripting, no layers, and will be designed for slower internet connections by removing some less bandwidth friendly geographic references and scripts. RIDGE-Lite will give users an option to continue viewing radar at the expense of all of the enhancements. As of November 2005, RIDGE-Lite is still under construction.

4.2 Phased Changes

Unlike the original NWS radar web team, the RIDGE team will remain intact after implementation. This combined with yearly funding and support will help maintain and grow the NWS radar webpages. Plans are already under way to transition the RIDGE pages to a php format with features that allow preferences to be saved. Additional resources will allow the NWS to put additional radar products online. The existing RIDGE page features Base Reflectivity 0.5, Base Velocity 0.5, Storm Relative Motion, Composite Reflectivity, Storm Total Precipitation, One Hour Precipitation, and Long Range Reflectivity. Echo Tops, Layer Reflectivity, and VIL are among some of the products slated for future enhancements.

4. CONCLUSIONS

The NWS radar webpages are one of the most widely viewed webpages from the NWS and they are in dire need of a facelift. Background maps, timeliness, image generation software are all becoming a burden and the original team tasked with its development no longer convenes. The new NWS RIDGE radar team is committed to the NWS radar webpages and to making them available to everyone.

The new NWS radar pages utilize browser cache in an attempt to reduce bandwidth. This is accomplished by consolidating webpages and separating the images into layers. Each image layer is a transparent gif that when stacked in the same location appear to be one image. This layering also allows the user to turn on or off layers thus allowing the NWS to add more geographic references for the user to utilize.

NWS warning polygons are displayed for the first time in conjunction with radar data using RIDGE, which for the first time, bring together the traditional text warning describing radar to a real time visual warning. RIDGE also allows GIS users to add radar information to GIS applications by making a world file available with each image. The ability to add radar and warning information to GIS applications without having to acquire and decode radar data will make it much easier for decision makers to access real-time radar and warning information. RIDGE attempts to bring some simple technology to the user without compromising bandwidth through browser enabled scripting. Range-bearing and latitude longitude calculations can be done because of this scripting and because the images are GIS based.

RIDGE is coming and will be operational across all NWS websites in January 2006.

REFERENCES

Graffman, I, 2004 GIS AS A BRIEFING AND PLANNING TOOL IN THE NWS. AMS Conference Preprint 2004, 6.7 Longbeach, CA.

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