4B.6 RIDGE - Radar Integrated Display with Geospatial Elements - Planned Updates and Enhancements to the NWS New Radar Webpage

Keith Stellman*, Paul Kirkwood
National Weather Service Southern Region Headquarters
Fort Worth, Texas*

Jason Burks
National Weather Service
Huntsville, Alabama

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 and implemented as of March 1, 2006 a method to display radar images more efficiently than the previous method (Bunting, et. al). This radar display technique, called 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. Since implementation, the NWS has continued development of the second phase of the RIDGE project. This paper will review the initial RIDGE implementation and the work ongoing for phase 2.

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. During a severe weather outbreak in early April 2006, the NWS RIDGE radar webpages accounted for 70 percent of the total web traffic. 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 generated the imagery up through early 2006 had become dated and very difficult to modify. Several factors can be attributed to that 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 were difficult to update given the old software and the format of the data. Lastly, the architecture of the data flow and image production lead 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 led to a stagnant product and thus the NWS radar information and display have not been updated in over six 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

* Corresponding author address: Keith Stellman,
National Weather Service Southern Region, 819 Taylor St
RM 10A03, Fort Worth, Texas 76102; email: keith.stellman@noaa.gov

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 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 operated in Fort Worth, Texas (Southern Region Headquarters) with expansion to Kansas City (Central Region Headquarter) and Silver Spring (NWS Headquarters) several months before the March 2006 implementation. Data is 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.

The current 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. Phase 2 of RIDGE is designed using object oriented java for multi-platform capabilities which will not tie the software to specific operating systems. The java version will allow us to utilize OpenGL for fast rendering of the data and can output any format supported under JAI (including but not limited to shapefiles, png, jpeg, gif, svg, etc.)

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.

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.

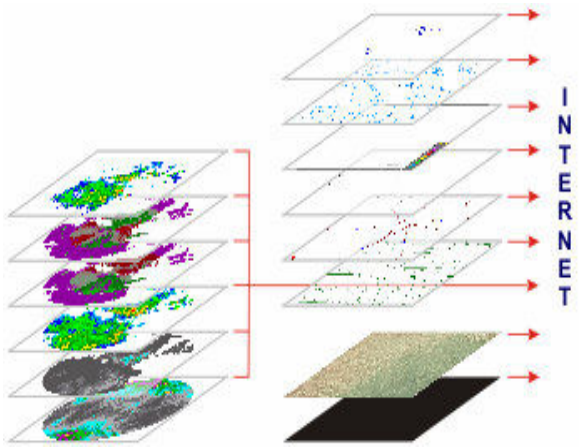

Fig 1. RIDGE uses layers of transparent gifs and the web browser to display the radar information with any number of geographic reference layers.

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.

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.

2.3c KML support

While the RIDGE radar display allows for the use of interactive toggles with the image on the web, RIDGE images can be best utilized with GIS software. The NWS RIDGE developers have taken the next step in providing the RIDGE radar in compressed KML (Keyhole Markup Language) files (kmz files) compatible with several GIS software applications. KML is an XML based language that is accepted by several commercial GIS software applications and because of the RIDGE project, the NWS is currently evaluating KML as an official format for data dissemination.

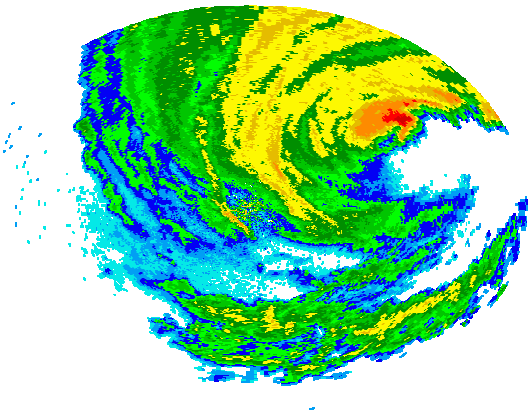

Fig 2. The single layer (image) containing radar information and associated world file allow easy import into GIS software (Fig 3)

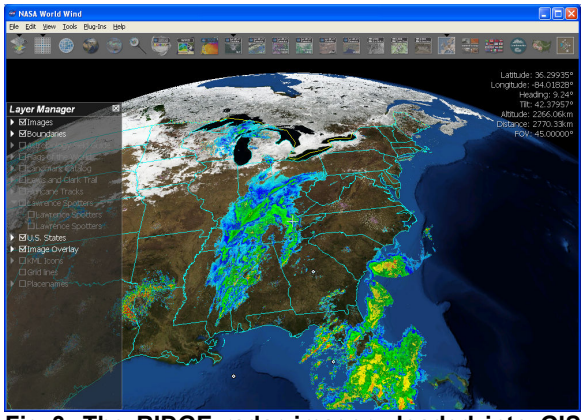

Fig 3. The RIDGE radar imagery loaded into GIS software utilizing the georeference information.

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. Initially, the warning polygon layer was generated in conjunction with the radar image for time matching during loops. However, due to the rapid evolution of severe weather, the RIDGE developers increased that process to 1 minute warning polygon updates with time matching on the loops for all frames except the final frame. Future enhancements of RIDGE will allow the user to click on warnings and the warning text to pop up.

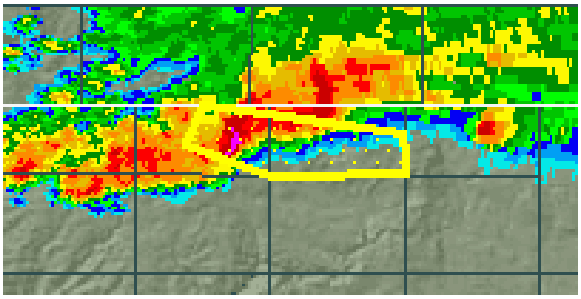

Fig 4. Warning polygon on RIDGE issued by the NWS indicating area of highest threat due to adverse weather.

3. RIDGE-Lite

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, the team has developed a RIDGE-Lite website. This website features no scripting, no layers, and is designed for slower internet connections by removing some less bandwidth friendly geographic references and scripts. This is done by combining the RIDGE image layers all into a single graphic. RIDGE-Lite gives users an option to continue viewing radar at the expense of all of the enhancements and make use of animated gifs for looping.

4. National Mosaics

The initial version of the NWS National Radar

Mosaic featured a 10km composite generated from the Radar Coded Message (RCM) (fig 5).

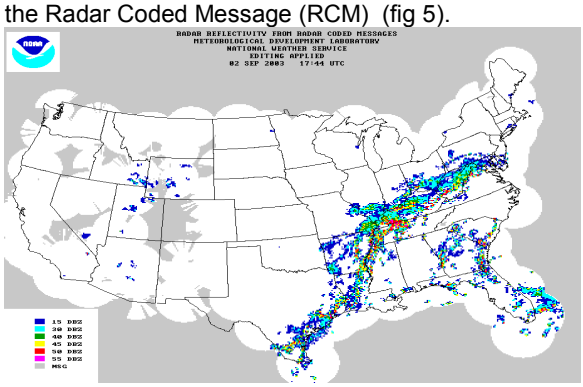

Fig 5. The original NWS Mosaic derived from the 10 KM RCM message.

The RIDGE team was able to institute a 2km mosaic (fig. 6) along with sector mosaics, including a Hawaii and Alaska composite. All of the RIDGE mosaics and sectors are georeferenced as well for integration into GIS software. Future enhancements to the mosaics will include clutter filtering and faster update cycles through the WDSSII program (Lakshmanan, et al).

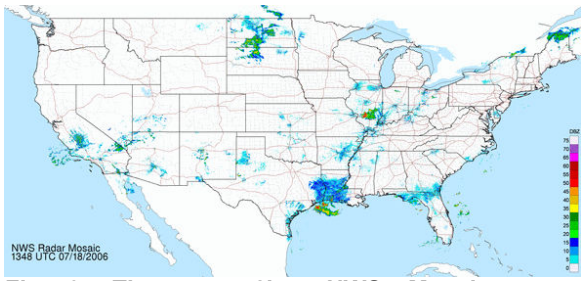

Fig 6. The new 2km NWS Mosaic as a Georeferenced GIF.

5. FUTURE PRODUCTS/ENHANCEMENTS

5.1 Phased Changes

RIDGE went into operational production on March 1, 2006. The implementation had its share of issues, mainly user issues with browser compatibilities and links. Most of those problems abated within a few months. Even after the implementation of phase I, the RIDGE team was developing version 2 (java version).

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. 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, VAD winds 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. And besides being made available with a world file, the RIDGE images are offered out through KML for GIS applications that support KML.

RIDGE is operational and will be continuously improved and updated.

REFERENCES

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

Bunting, B., L. Bucklew, P. Kirkwood, and S. Rae, 2005: The graphical severe weather warning initiative at the Fort Worth National Weather Service. AMS Conference Preprint 2005, P2.27. San Diego, CA.

Lakshmanan, V., T. Smith, K. Hondl, G. J. Stumpf, and A. Witt, 2006: A real-time, three dimensional, rapidly updating, heterogeneous radar merger technique for reflectivity, velocity and derived products. *Weather and Forecasting*, **21**, 802-823