J8.1 Radar Integrated Display using Geospatial Elements Version 2 (RIDGE2) and Virtual Globes

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1. INTRODUCTION

In September of 2007, NOAA signed an Enterprise License Agreement with Google* allowing all agencies within NOAA the use Google Map images for business purposes. In February 2009, the National Weather Service unveiled the alpha version of its next generation radar and warning display: Radar Integrated Display using Geospatial Elements version 2 (RIDGE2). The RIDGE2 takes full advantage of the vast amounts of mapping data compiled by Google through the use of an advanced open©\source mapping program called the OpenLayers application programming interface (API), which functions in much the same way as Google's mapping API featured on their Web site ¨C thus eliminating some of the learning curve for the audience. In addition to the new background map layers, the methods by which the radar and warning data are provided to the user have changed. In RIDGE2, the radar and warning data are sent to the OpenLayers API via a Web Mapping Service.

The most pronounced advantage of the methods by which Google serves its maps, and the RIDGE2 handles radar and warning data, is the amount of detail that can be served to the user's browser while minimizing the load on the Web servers that provide the data. The RIDGE 2 beta version initializes the user's browser with a nationwide mosaic of radar and warning data. Since the user initially views the data on a large scale, only low resolution data (and thus, smaller files) are sent to the user's browser. Upon request, the map can be zoomed and/or panned to anywhere in the nation, thereby viewing the data for that limited area at higher resolutions (with a minimum pixel size of 1 km for the radar data).

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 *(Stellman, et al)*. 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

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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 RIDGE1 sites have their limitations. The current sites are populated with static images of the radar data and background layers. These images are stored as flat files on the webservers which restricts some of the capabilities for end users such as zooming with more detail, projections are limited to the format of the image, output formats are limited to the static file type, and the data is not able to be queried because it is not stored in database RIDGE version 2 addresses many of these limitations and should allow for a more interactive experience for end users.

2.2 RIDGE II Architecture

RIDGE II was developed using Java based decoders unlike RIDGE version I which was developed on a windows only platform in VB.net. The development was done on a Spring Framework which is an open source framework for the Java platform. The new code takes advantage of multi-threading which is a programming method which increases utilization of single core processors and is also loosely coupled which means that it provides extensibility to designs. A new concrete class can easily be added later that implements that same interface without ever having to modify and recompile the dependent class (radar decoding objects).

The configuration is entirely XML based making it easy to make changes to the radar decoding process. Probably the most important updates are the inclusion of Geotools as the source for GIS which provides for the transformation of data and gives the ability to store the decoded radar data in a PostGIS database. Storing the data in a PostGIS database enables the front end webserving to be done on the fly and specific to user defined inputs which ultimately gives the front end much more user customization and scale.

The display portion of RIDGE II will be driven by a cluster of Web Mapping Service (WMS) servers which utilize Minnesota Mapserver version 5.4 as the front end web service. Minnesota Mapserver is an Open Source platform for publishing spatial data and interactive mapping applications to the web. Originally developed in the mid-1990's at the University of Minnesota, MapServer is released under an MIT-style license, and runs on all major platforms. In addition to the WMS, tile cache servers will operate to reduce redundancy of requests for data over the same geographic area. Tile cache operate in front of the mapservers in an attempt to reduce the number of requests to the mapservers and thus eliminate some of their workload.

2.3 RIDGE Web Structure

RIDGE I 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.

RIDGE II takes the RIDGE I strategy a step further applying these basic principles to the RIDGE I design:

1. Mosaics provide radar coverage even when radar are down. Many radar overlap and users should not be met with radar down messages if another radar covers the same area.
2. Data displayed on web page via an open source API which enables NWS sites the ability to integrate mapping services into the displays.
3. Radar and Warning data are fed to the API via a Web Mapping Service (WMS)

from the PostGIS database.

2.a. Interface

The web interface will focus on a national mosaic which is generated at a 1km x 1km scale with a user customization interface. Individual radar sites including newly added Terminal Doppler Weather Radar (TDWR) sites are available on the left menu, but will not be a starting location unless a user defines it as a starting location. The mapping component will no longer feature static overlay images but rather take advantage of a NOAA ELA with Google and utilize Google Maps as the engine for maps. Utilizing Google in this manner does several things.
First, it takes mapping responsibility away from the NWS which was the largest source of complaints in RIDGE version 1 and required the most amount of NWS resource to fix. Second, it will reduce bandwidth by pointing users to Google servers for all of the mapping components required to make the page scalable. Figure 1 illustrates a simple data flow and the routes which data takes to get to end users.

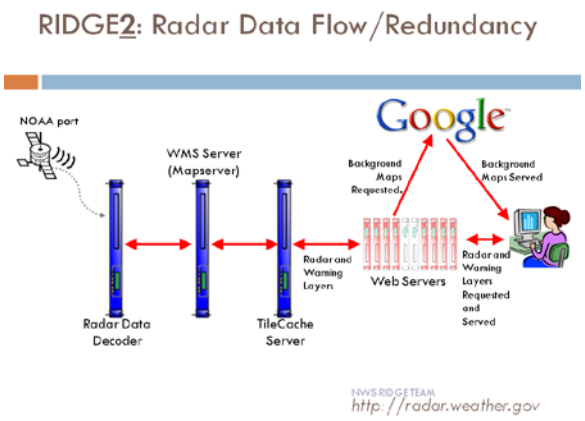

Figure 1. Basic data flow diagram of the RIDGE 2 system and its integration with mapping services such as Google.

2.b KML support

KML support will continue with RIDGE version II however, it will likely be fed directly from the PostGIS database and tile cache servers. Unlike RIDGE version I where the KML files were constructed to point back to a flat file, these KML files will be generated to point back to the WMS service running on the webservers. Figure 2 illustrates the national mosaic radar data onto a virtual globe via a KML.

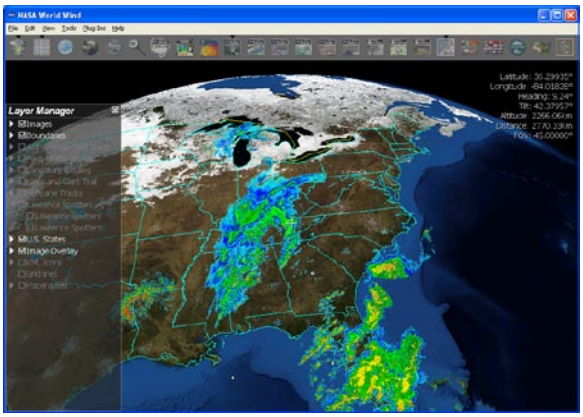

Fig 2. The RIDGE radar imagery loaded into GIS software utilizing the georeference information from the database fed into virtual globes via KML.

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2.3c Watch and warning display

The RIDGE I web pages were the first to display NWS warning polygons for Tornado, Severe Thunderstorm, Flash Floods, and Special Marine in conjunction with radar data. RIDGE version II will not only feature polygon warnings, but also include all watch, warning and advisories from the NWS (Fig 3). For county based information, a polygon of the county will be created in a database which contains the various watch or warning attributes for that polygon. When displayed, the county will be color filled with the appropriate watch or warning. All of the watch or warning information on RIDGE II will be a toggle which can be turned off or a transparency slider will allow the user to increase the transparency of that layer.

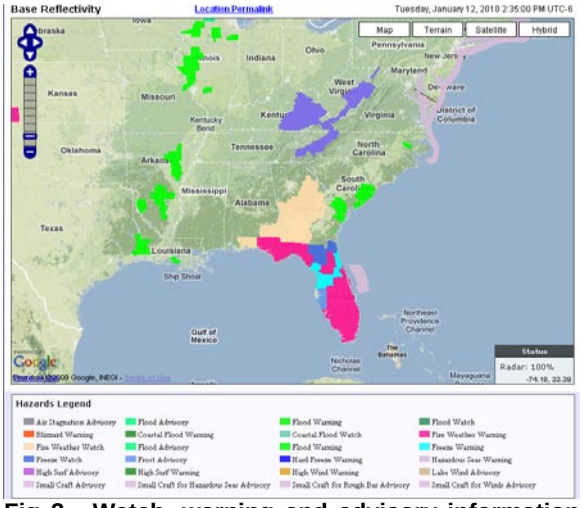

Fig 3. Watch, warning and advisory information

will be added as a layer in RIDGE II

3. RIDGE-Lite

Simple flat file images will continue to be created with RIDGE version 2 due to the demand on mobile devices and other lower bandwidth systems. However, the data will be projected onto the image in a projected format in an attempt to maintain an undistorted look at the data especially areas in the north where geographic projections appear wide and flat.

4. National Mosaics

The initial version of the NWS National Radar Mosaic featured a 10km composite generated from the Radar Coded Message (RCM).

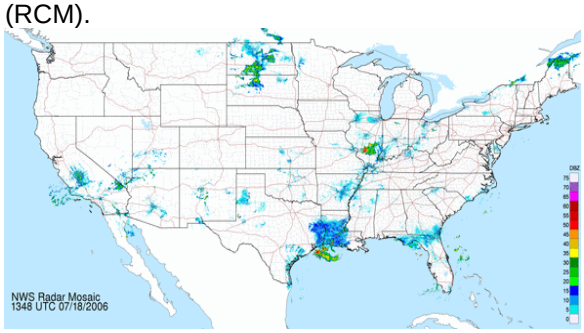

Fig 4. The RIDGE version 1 - 2 KM Mosaic on a Geographic Projection with no zoom ability

The RIDGE I team was able to institute a 2km mosaic (fig. 4) along with sector mosaics, including a Hawaii and Alaska composite in RIDGE I. RIDGE version 2 will feature a higher resolution national mosaic on a 1km x 1km grid with an update time of 5 minutes (Fig 5.) versus the 10 minute cycle currently in place. The national mosaic will be the primary interface with the public and will be driven by the WMS backend and tilecache for faster serving and reduced server loads.

Fig 5. The new 1km NWS Mosaic on a mapping API with more functionality and user interaction.

5. CONCLUSIONS

The NWS radar webpages continue to be one of the most widely viewed webpages from the NWS. Background maps, image generation software, and scalability are all becoming a burden for a variety of reasons. The NWS RIDGE radar team have been committed to the NWS radar webpages and began working the RIDGE II concept shortly after the implementation of RIDGE I based on the feedback received following its implementation.

The new NWS radar pages will utilize server cache and mapping services in an attempt to reduce bandwidth while increasing user interaction and resolution. The basic framework of RIDGE II completely changes the way data is delivered to end users from a flat file based system to a database and service based system.

RIDGE II is slated to become operational in Spring 2010 and will be continuously improved and updated.

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