# 7A.2 How Geographic Information System Software is Improving the Effectiveness of the National Weather Service

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## 1. Introduction

In September of 2007, NOAA signed an Enterprise License Agreement with Google™ allowing all parts of NOAA the use of both the Google™ Earth Pro software and Google™ Maps Application Program Interface…for business purposes. The National Weather Service (NWS) has used this technology in such a way to not only make a better presentation of its information but also for warning verification. The Google™ Earth Pro software combined with the ability to integrate NWS datasets into Google™ Earth has enabled forecasters to access information on businesses, schools, addresses, and phone numbers, to help verify warnings. There have been numerous cases of warnings than would not have been verified using traditional methods. This has been confirmed due to the improved availability of contact information within the warned area.

The Google™ software has proved useful in post storm analysis, and in the generation of a wide variety of maps. The software allows meteorologists and hydrologists to overlay multiple weather data layers, such as radar rainfall estimates, surface observations and the like, on readily available layers such as terrain, river basins, infrastructure, population, etc. The result is improved situational awareness, better weather warnings and decision making. Such data sharing has also improved collaboration between local NWS office staff and emergency managers.

The Google™ Maps Application Program Interface has allowed the NWS to focus its resources more on the issuance of warnings and less on the maps that are required to convey the information effectively on the web.

## 2. Products, Data and Methodology

### *2.1. Warning Verification*

Typically, local NWS offices are responsible for the verification of warnings issued. However, unless reports are sent in by spotters in the field, most reports come in hours or even days later. Due to the lag involved, forecasters are sometimes left wondering if the storm they warned on produced severe weather which in some cases might sway a decision to warn downstream. Most NWS offices have a limited subset of contacts to help verify severe weather which is usually comprised of law enforcement, emergency management, COOP sites, and spotters. And not all of these contacts are available 24 hours a day. As a result, there

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have been numerous cases of warnings that would not have been verified using traditional methods being confirmed due to the improved availability of contact information. One such story of this type of use occurred at the NWS Shreveport office after the midnight hour on a Saturday night in April 2008. Several non-tornadic severe thunderstorms were developing in areas with very little population. Most people were asleep and no spotters were out to report back any severe weather. The forecaster on duty utilized Google™ Earth to overlay the radar and did a quick search for establishments in the area of the core of the storm. After finding an establishment and acquiring the phone number (similar to what is shown in figure 1), the forecaster on duty called and spoke to the establishment owner who promptly and tiredly said that quarter sized hail had fallen as he was closing the establishment at 2 AM.

In fact, a recent review of the 2008 NWS Shreveport verification scores and local storm reports show a 10% increase in Tornado and Severe Thunderstorm Warnings verified over 2007, to a total of 60% for 2008. Upon further investigation, approximately 40 warnings were verified using the Google™ Earth software as a search tool for businesses and locations in the "core" of the storms. Assuming those 40 warnings would not have been verified would reduce the 2008 numbers to the 2007 level of 50%. From experiences thus far using the software in this manner, it is apparent to be most useful when trying to verify or discover hail reports. This is true especially for hail of 1.00 inch or less since damage is minimal and the area impacted is usually smaller.

*2.2. Post Storm Surveys*

The Google™ software has proven useful in post storm analysis and in the generation of a wide variety of maps. The software allows meteorologists and hydrologists to overlay multiple weather data layers, such as radar rainfall estimates, surface observations and the like, on readily available layers such as terrain, river basins, infrastructure, population, and even photographs from surveys, etc. The result is improved situational awareness, better weather warnings and decision making and improved post storm analysis and accuracy. Such data sharing has also improved collaboration between local NWS office staff and emergency managers. Figure 2 shows how storm survey teams collected photographs of damage from Hurricane Ike and integrated them into a Keyhole Markup Language (KML) file and shared it with users.

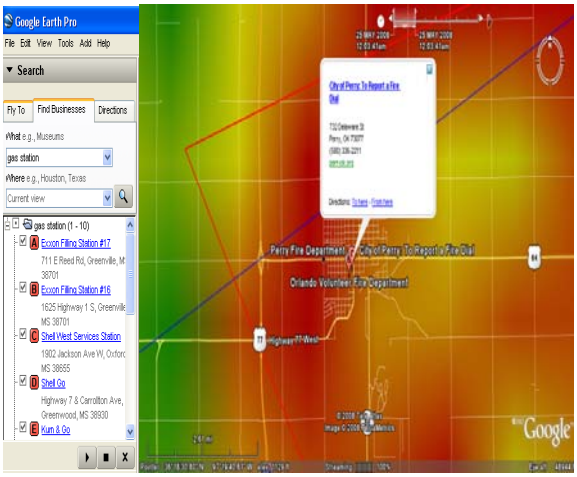


***Figure 1.*** *Shows an overlay of RIDGE radar on Google™ Earth, with a search for businesses in the core of the storm to help with verification and real-time feedback.*

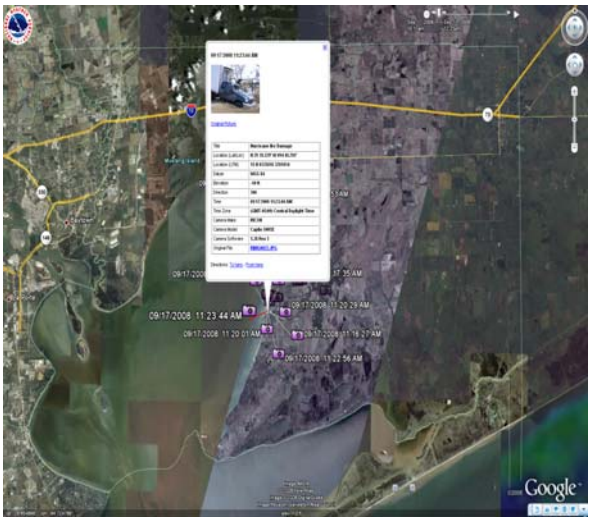


**Figure 2.** *Shows a Keyhole Markup Language (KML) file with links to photographs of damage taken during a Hurricane Ike survey. The file and photos can be share by emailing the KML file. Data collected by Steve Piltz – MIC WFO Tulsa, OK.*

Tornado and damage surveys can also be better analyzed and mapped using the software. Data can be collected in the field using standard GPS devices and/or GPS digital cameras and plotted in Google™ Earth. The surveyor can then utilize the simple measurement tools to calculate distance and width. This technique saves time,

paper, and allows for a more accurate track depiction while also allowing the output to be shared and displayed on the web.

*2.3. KML Standard*

On April 14, 2008, the members of the Open Geospatial Consortium, Inc. (OGC) announced the approval of the OpenGIS® KML Encoding Standard (OGC KML), marking KML's transition into an open standard which will be maintained by the OGC. Developers will now have a standard approach for using KML to code and share visual geographic content in existing or future web-based online maps and 3D geospatial browsers. KML is an XML-based programming language, originally developed to manage the display of geospatial data in Google™ Earth. It's still used heavily in Google™ Earth but is also supported by a variety of vendors' tools and mapping websites.

The OpenGIS KML 2.2 Encoding Standard formalizes the KML 2.2 model and language while remaining backwards compatible with existing KML 2.2 files and tools. In comparison with the Google™ KML 2.2 Reference, the standard defines:

- the KML 2.2 geometry encoding and interpolation model
- an extension model in support of application profiles
- conformance requirements and test cases

The NWS has started making available numerous traditional datasets and products using KML. Some of these include but are not limited to: Radar, warning polygons, river status, rainfall reports, current surface observations, past hurricane tracks, and severe weather reports to name a few. A more complete list of data and products can be found at http://www.weather.gov/gis. These data offered in this manner have not only helped the NWS internally with situational awareness, but also external partners by allowing them to integrate their own data as well.

## 3. Web Mapping

The Google™ Maps Application Program Interface (Maps API) has allowed the NWS to focus its resources more on the issuance of warnings and less on the maps that are required to convey the information effectively on the web. The Google™ Maps API allows user to embed Google™ Maps into their own webpage with an ability to integrate data through javascript, Flash, or KML. Figure 3 shows an example data flow and how NOAA benefits from enhanced mapping capabilities on the web while offloading the mapping component to the Google™ infrastructure by using the Google™ Maps API.

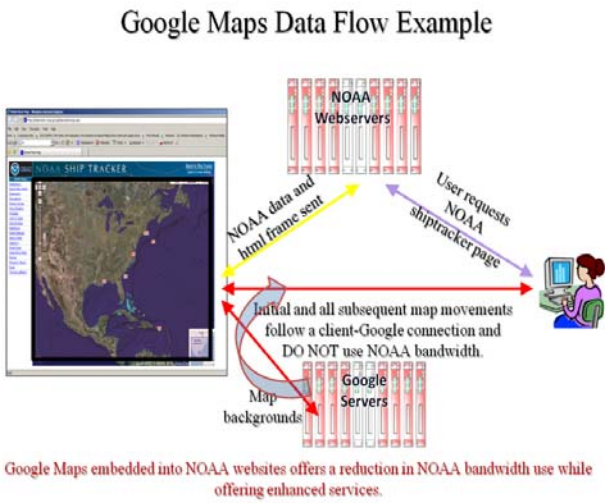


**Figure 3.** *Utilizing the Google™ Maps API offers NOAA the ability of enhanced web services at lower bandwidth and server load to the NOAA internet framework.*

Because of the enhanced mapping capabilities of the Maps API, the NWS can now offer better depictions of the data it has to offer. For example, NWS warning polygons can be shown on the maps API allowing users to interact with the map and better determine if they are in the warning. Figure 4 shows an example of a NWS warning polygon on the API. This service is being tested at three offices currently but is in the process of becoming a nationwide test. The Google™ Maps API allows the NWS to easily generate interactive maps on the website showing tornado surveys and images similar to what can be done in figure 2. Figure 4 shows an example of a tornado track using this technique. The main benefits of the API are that the map is hosted on Google™ servers rather than the organization servers thus reducing bandwidth and increasing our ability to create data mashups. Already, many NOAA and NWS sites have started using the Google™ Maps API as a method for displaying data on an interactive mapping platform. A short list of websites utilizing this technology can be found here:

http://www.epic.noaa.gov/talks/nns/forums/Google™-maps-api.html

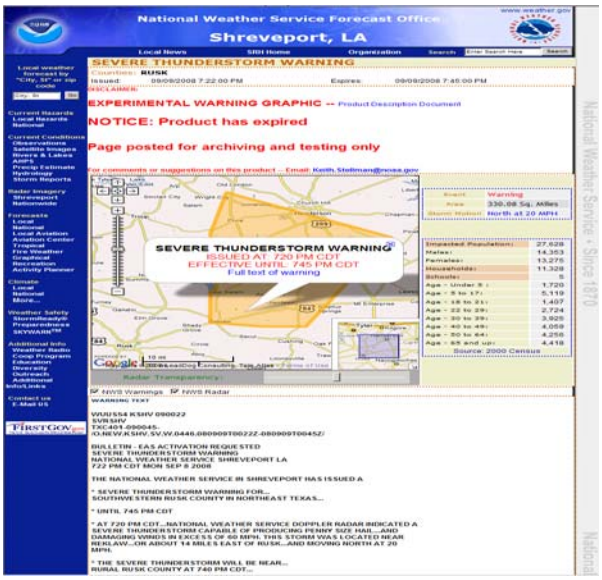


**Figure 4:** *Utilizing the Mapping application can provide a better depiction of warning information on NWS websites. This service is currently experimental at the NWS offices in Shreveport, Jacksonville and Miami.*

## 4. Summary

The Google™ Enterprise Agreement is the first step in the direction of GIS integration for the agency and it helps take the internal focus off of the mapping of the data but rather on the data itself and the data delivery. The agreement has already made an impact on the way the NWS creates and shares data. Many offices have started creating and sharing KML files and the NWS GIS site (http://www.weather.gov/gis) has been updated to provide a list of data available for viewing in GIS programs like Google™ Earth. More recently, internal NOAA training sessions were provided through webinar technology by NWS personnel on how to use Google Earth™ and Maps with an estimated 1100 people attending the sessions. More sessions are planned for the future to help train and inspire others to work with Google and GIS in general.

## 5. Acknowledgements

The NOAA contract is being renewed in March of 2009 through March of 2010 thanks in part to the hard work of the NOAA Google™ working group and the NOAA line office OCIO's. A special thanks goes out to the NWS Google™ training team for their hard work putting together training used by all of NOAA.

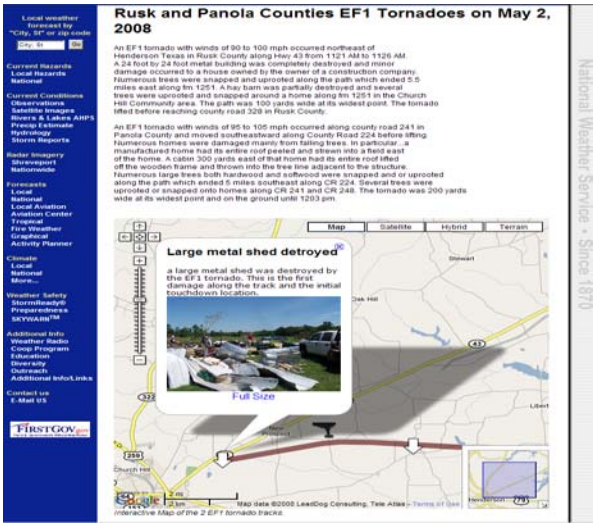


**Figure 5:** *Utilizing the Maps API to more easily provide a tornado track map with links to photos and information taken from the survey.*

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