



Using Geospatial Technology To Process 911 Calls After Hurricanes Katrina and Rita

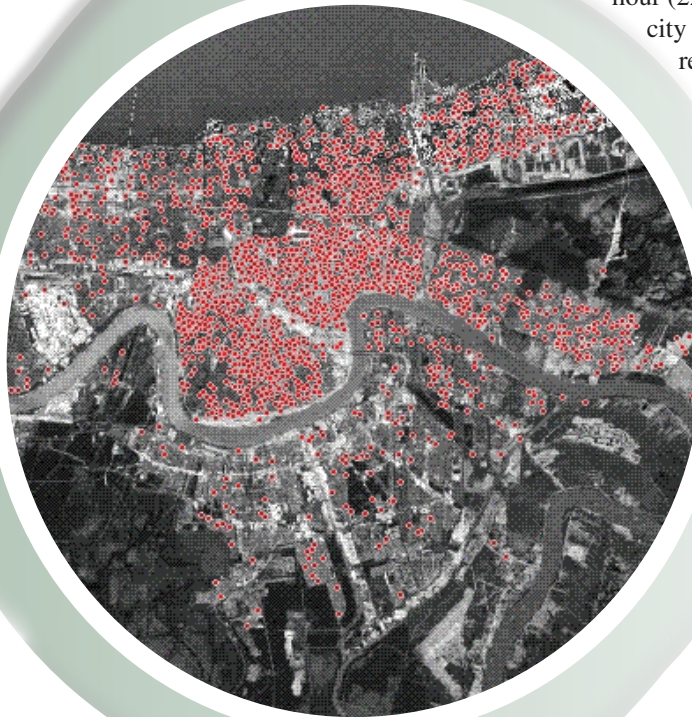
By Craig P. Conzelmann, William Sleavin, and Brady Couvillion

The flooding that ensued in the Greater New Orleans area after Hurricane Katrina left thousands of victims trapped and in need of emergency rescue. This paper describes the processing of raw 911-call data into search and rescue products used by emergency responders after the storm.

Introduction

The primary concern of local, State, and Federal agencies during Hurricanes Katrina and Rita was the safe rescue and evacuation of people from southern Louisiana. These hurricanes placed unprecedented numbers of victims in need of rescue. Even before Katrina struck the Gulf Coast, the Louisiana Department of Wildlife and Fisheries (LDWF) saw the potential for disaster and activated a 1-800 number and companion Web site which could be used to request water rescue. Hurricane

Katrina made landfall
at 6:10 a.m. on



August 29, 2005, as a strong category 3 storm with winds of 140 mi/hour (225 km/hour). Flooding in the city of New Orleans after Katrina reached depths of 13 ft (4 m) and rendered rescue efforts based on street names and addresses useless. Street signs and, in some places, entire homes were under water, causing great difficulty in locating victims. Recognizing that water rescue in a major metropolitan area was not a planned contingency, LDWF and later the Louisiana State Police (LSP) approached the U.S. Geological Survey (USGS) and requested assistance.

With sustained winds of 120 mi/hour (193 km/hour), Hurricane Rita came onshore in southwest Louisiana on September 24, 2005, as a strong category 3 storm. The storm surge that pushed ashore ahead of Rita caused damage so complete that the courthouse was the only building left standing in the small town of Cameron, La. The USGS responded to the request by using a process known as geocoding to convert street addresses into latitudinal and longitudinal coordinates. The result was a

data layer in which each call was represented by a point in a geographic information system (GIS), which is a geographic tool for information management based on location (Ormsby and others, 1999).

Data Processing

On August 31, 2005, LDWF requested USGS geospatial support for the water-rescue effort. The volunteers that ran the 1-800 LDWF phone bank entered call data into a spreadsheet, which was transferred to USGS for processing. When an emergency call was placed, operators recorded such pertinent information as the caller's phone number, description of the situation, and most importantly, a street address. Geoaddressing, or address matching, is the process of determining the latitude and longitude coordinates of a street address (ESRI, 1992). The 2000 TIGER/line® is a reference dataset containing a list of streets and is used in the GIS to approximate the coordinates of a street address. Personnel from the USGS were able to take the street addresses from the emergency calls and convert them to latitude and longitude coordinates. This information was then transferred to paper maps that were distributed to rescue personnel.

The geoaddressing process is reliant on both the accuracy of the source street data and the accuracy of the address to be geoaddressed. Omitted street addresses, spelling discrepancies, or abbreviations (e.g., Street, ST, St.) can have adverse affects on the resulting coordinates, with the most extreme cases resulting in no coordinate production. In the 3 weeks following Katrina, 23,087 emergency calls were placed (fig. 1). The street addresses were completely omitted in 7,487 (32.5 percent) of these cases, which rendered address matching impossible.

The quality of the addresses of the remaining 15,600 emergency calls varied considerably. In many cases, nonspecific descriptors were used in lieu of a valid house number and street name. Although nonspecific descriptors might be of value to a rescue worker on the ground, they cannot be interpreted properly by the geoaddressing software. Problems arising from incomplete address data were most pronounced on days with the largest call volume. During September 1–2, there were 11,945 (51.7 percent of all calls) new emergency calls placed. This massive increase in call volume was coupled with a dramatic decrease in the accuracy of the street addresses. During that time period, 6,757 (56.7 percent) of new calls did not contain any street address entry. Although LDWF and LSP were the original consumers of the point data layer and associated tabular data, by the time USGS received the cease and desist order from LDWF

and LSP, the following agencies were also receiving the GIS data: Louisiana Office of Homeland Security and Emergency Preparedness, Federal Emergency Management Agency, Centers for Disease Control and Prevention, and Louisiana Geological Survey.

Twenty-four days after Katrina made landfall, the USGS geoaddressing effort in the New Orleans area ended on September 20, resulting in coordinate creation for 8,848 (56.7 percent) of the 15,600 calls that did not completely omit a street address. Three days after Rita made landfall, the USGS geoaddressing effort in southwestern Louisiana ended on September 27, 2005, resulting in coordinate creation for 128 (57.4 percent) of the 223 calls that did not completely omit a street address.

Mapping and Deliverables

On the evening of August 29, 2005, USGS began using its new geoaddressed data to produce deliverables for the water-rescue efforts taking place in New Orleans. The Greater New Orleans area was divided into an arbitrary grid that roughly divided the city into 16 blocks, which were given alpha-numeric labels. The New Orleans Police Department districts and a Federal Emergency Management Agency grid were also added to the maps and database as they became available. Figure 2 is an example of an overview poster (34 inches by 44 inches (86 cm by 112 cm)) of the entire city, which included the labeled grid, calls as points, major roads, hospital locations, and Thematic Mapper or Systeme Probatoire Pour l'Observation de la Terre satellite data as the background imagery.

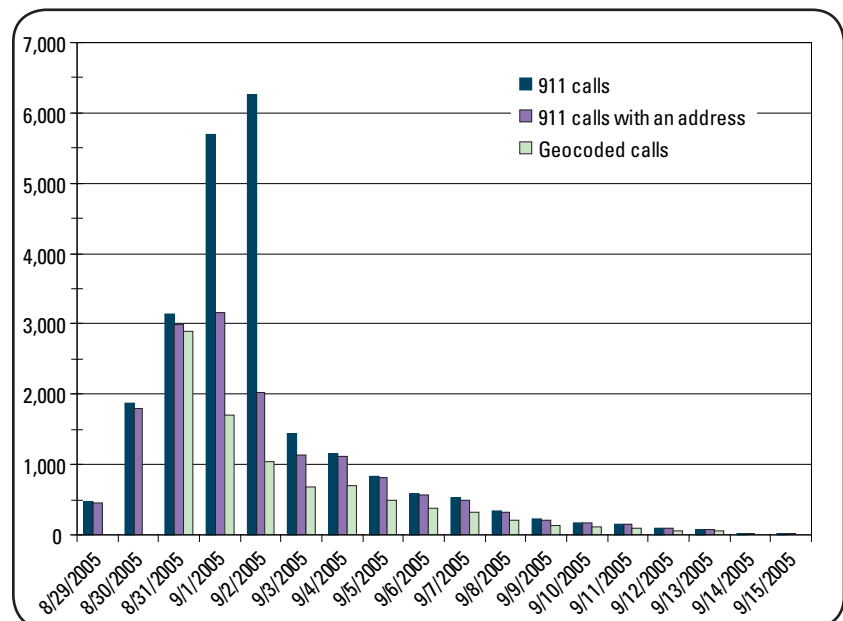


Figure 1. Daily totals for 911 calls, 911 calls with addresses, and 911 calls that were geocoded in the New Orleans, La., area after Hurricane Katrina in 2005.

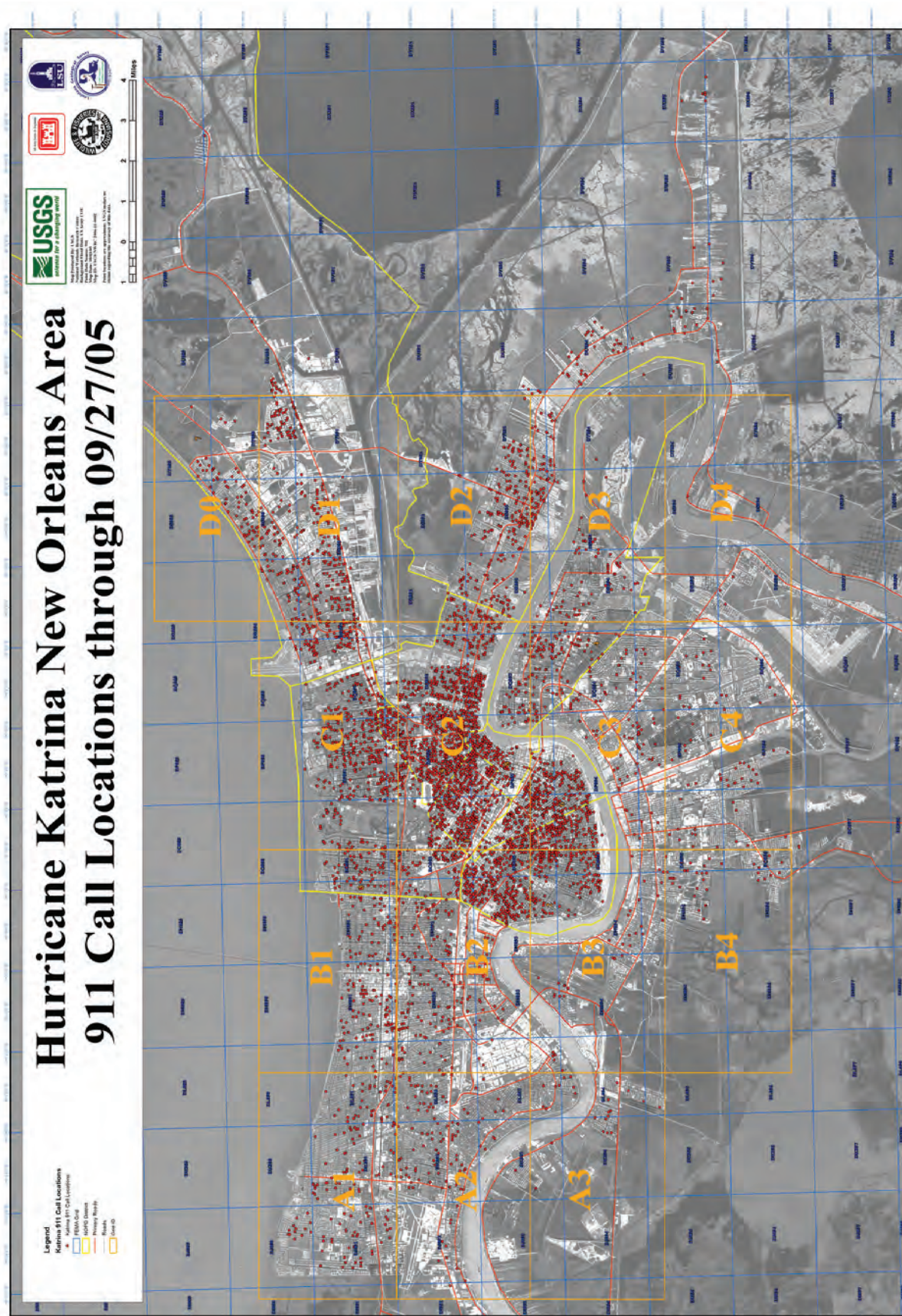


Figure 2. This map represents the 10 a.m. processing of 911-call data from August 31, 2005, to September 6, 2005, in the New Orleans, La., area. This grid-level map includes the following: 911 calls from several sources and times, which are color coded; hospitals; roads; and 2-m digital orthophoto quarter quadrangle imagery.

Each individual grid was also represented by vector data on a tabloid map (11 inches by 17 inches (28 cm by 43 cm)), which included the calls as points with label number, major roads, and hospital locations. The background imagery used for these maps was 2004 digital orthophoto quarter quadrangle (DOQQ), which is camera tilt corrected imagery with ground relief removed (ESRI, 2001). The tabloid maps were accompanied by tabular data used to link the map point numbers with an actual rescue call and street address (table 1).

Ground-based search operations used these maps in conjunction with the emergency call information to locate and rescue countless people trapped in their homes. Airborne operations used onboard computers to fly directly to the coordinate location of an emergency call, where in several instances the pilot could not readily see anyone in need of rescue. In these situations, rescue divers were lowered onto rooftops based on the provided coordinates where calls for help originated, and survivors were rescued. Without the maps and coordinate data provided by USGS, rescue workers might have neglected to search where no overt signs of survivors could be seen from the air. The database contained the important latitude and longitude coordinates produced by the georeferencing efforts of USGS, as well as other valuable information to rescue personnel, including situation and victim name, as shown in table 1.

On the night of August 31, 2005, USGS created map templates that would be used for the next 11 days by a dedicated team that produced an enormous number of maps. The first deliverables were a set of paper maps, which were delivered by USGS to the LDWF staging area on the morning of September 1, 2005. These maps were distributed to the boat drivers performing the actual rescues. Because of the sheer volume of map production required, subsequent delivery was handled by LDWF volunteers.

On September 2, 2005, the Louisiana State Police contacted USGS about receiving geospatial assistance with the 911 call database. Upon observing the products created for LDWF, the LSP expressed a dire need for a similar

product. Staff from USGS secured access to the Louisiana 911 database, and 911-call data was added to the dataset being georeferenced. The combined data set was georeferenced into a point layer, which could then be mapped and distributed to first responders. Source information was maintained in the database so that 911 calls could be distinguished from LDWF calls. For the first few days of the geospatial response, USGS provided only one set of maps and data daily. By September 3, 2005, the first responders requested more frequent delivery of products. The USGS responded by producing maps and GIS data products at the rate of three times per day. After 2 days of being inundated with information, the first responders settled on product delivery twice daily. The USGS response was to pull new call data early in the morning and at mid-afternoon. These georeferenced data were mapped and provided to first responders at 10 a.m. and 4 p.m. daily along with the GIS point data, associated tabular data, and data on calls that had insufficient information to georeference.

On September 24, 2005, as Rita hit the southwest coast of Louisiana, USGS set up map templates for Lake Charles and other surrounding municipalities in cooperation with the Louisiana Geological Survey (LGS); eventually, production of maps rested solely with LGS. Georeferencing of emergency call locations for both hurricanes, however, remained a USGS task and continued through the end of September.

Conclusions

The floods that covered south Louisiana communities after Katrina and Rita made traditional ground navigation and rescue impossible. By using the language of geography, USGS was able to provide the navigation tools that first responders needed to locate survivors. Despite tremendous communication hurdles, USGS was able to assemble an ad hoc network and tool set which took nonspatial information and created spatial data products that saved lives.

Table 1. Representative sample of the 911-call data, which included victim information and geospatial location data.

ID-911	Date	Call time	Priority	Situation	Victim	Victim str	City	Source	Long	Lat	Grid ID
537	9/3/2005	10 AM	HIGH	ELDERLY MAN TRAPPED IN ATTIC	JOHN DOE	21 Smith Dr	New Orleans	911	90 07 26W	30 11 52N	B2
537	9/3/2005	12 AM	HIGH	DIABETIC NEEDS INSULIN	JANE SMITH	22 Smith Dr	New Orleans	911	90 07 20W	30 11 51N	B2
672	9/4/2005	9 AM	MODERATE	SCARED AND NEEDS ASSISTANCE	BILL DOE	23 Smith Dr	New Orleans	911	90 07 27W	30 11 46N	B2
674	9/4/2005	11 AM	HIGH	TRAPPED ON ROOF	SUE SMITH	24 Smith Dr	New Orleans	LDWF	90 07 19W	30 11 45N	B2

Acknowledgments

We would be remiss if we did not acknowledge the people whose combined efforts resulted in a successful geospatial response from the USGS National Wetlands Research Center Coastal Restoration Field Station. The individuals who worked as a team day and night to produce the tools used to save lives in the aftermath of Katrina and Rita are as follows: John Barras, Craig Conzelmann, Brady Couvillion, Karen Eldridge, Michelle Fischer, Christina Hebert, Scott Hemmerling, Clint Padgett, William Sleavin, Glenn Suir, Alison Tarver, and Arin Whittington.

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Service to America Medal Award

Several articles in this book detail the work performed by the U.S. Geological Survey's (USGS) Louisiana Hurricane Team that merited them the Service to America Medal Award in September 2006.

Amid the chaos of Hurricane Katrina's aftermath, USGS scientists—from the National Wetlands Research Center in Lafayette, La., and the Louisiana Water Science Center in Baton Rouge, La.—helped rescue thousands of citizens in the New Orleans area. They rescued people from flood waters via boats and used their technologies to map 911 calls and infrastructure and to gage flooding and dewatering.

Although search and rescue are not the mission of the USGS, its scientists worked with other agencies to rescue a total of 600 people directly from rooftops and porches and gave food, water, and assistance getting off of ferry boats to 2,000 others. The USGS scientists developed mapping techniques to “geaddress” eight thousand 911 calls for Katrina, August 30–September 27 (and 300 for Hurricane Rita, October 16–26).

The USGS worked around the clock, producing maps and digital data daily. The staff used geospatial technologies to map the city's levee system and pumping stations and installed temporary real-time gages in Lake Pontchartrain and Orleans, Plaquemines, and St. Bernard Parishes to learn how quickly the area was dewatering and when reflooding from Rita might occur.

While doing rescue work, these same scientists and their coworkers also donated food, water, blood, homes, and office space to evacuees.

The USGS team vowed to attend to the humanitarian needs first, and they put all of their science, their knowledge of boats, and their geospatial and water-gaging technologies to the ultimate test of saving lives during one of the greatest disasters our Nation has known. Communications were in disarray in Louisiana, with cell phones not working and computers down. Media reports of both true and rumored violence filled the airways. But this team of employees, some in boats, some with computers, some with both, were determined to make a difference, both as scientists and as human beings. And they did.

The articles documenting the work that earned the USGS Louisiana Hurricane Team, led by the Central Regional Director, a Service to America Medal are the following: “USGS Humanitarian and Geospatial Response for Search and Rescue After Hurricanes Katrina and Rita” (Hartley); “Using Geospatial Technology To Process 911 Calls After Hurricanes Katrina and Rita” (Conzelmann and others); and “Data Access and Dissemination for Emergency Response and Long-term Recovery Efforts Related to Hurricanes Katrina and Rita” (Wilson and Cretini).

To learn more about Service to America Medal recipients, go to <http://www.nwrc.usgs.gov/special/serviceamericaaward/serviceamericaaward.htm>.