

CIVILIAN APPLICATIONS FOR THE MILITARY GRID REFERENCE SYSTEM



BROOKS TJ, TERRY N, GUNDRY SC, NAPIER-JAMESON R, SMITH C, GILL H, AND POE R CENTER FOR INTERDISCIPLINARY GEOSPATIAL INFORMATION TECHNOLOGIES, DELTA STATE UNIVERSITY

Abstract

The US emergency management and response community shares with the military numerous common needs for map products and services, geospatial intelligence and analysis, geospatial tool and technique development, and tradecraft. The Center for Interdisciplinary Geospatial Information Technologies at Delta State University occupies a unique position whereby many of its key personnel have extensive experience in the emergency management and response domain, is able to tap into a wealth of resources due to its status as an educational institution, and may conduct activities at significantly lower costs than most other organizations due to its location in rural Mississippi. Synergistic leveraging of these assets by the military geospatial intelligence community has led to the development of highly cost effective education and training programs, methods, and materials. Moreover, the cooperation created amongst the military and civilian emergency response community serves as an ideal environment for the transfer of techniques and technology.

Background

The Center for Interdisciplinary Geospatial Information Technologies was summoned to the Mississippi Emergency Management Agency (MEMA) on 27 August, 2005 and tasked with providing geospatial support for Hurricane Katrina. One primary task involved the translation of the last known position of those who failed to evacuate from street address or landmark to geographic coordinate. The Center was also tasked with mapping the location of assets and resources deployed to the coast for search and rescue, recovery, and damage assessment activities (right). After action reports generated by the



Center indicated numerous difficulties encountered when working with latitude and longitude in angular-formats.

Based on a DSU magazine article, Tom Terry, a Geospatial Intelligence Officer at Headquarters, US Marine Corps (HQMC), contacted Center volunteers shortly after the event to learn more about the challenges faced from both a geospatial support and emergency response perspective. He suggested future use of the Federal Geographic Data Committee's (FGDC) US National Grid (USNG) coordinate system standard. The USNG is a civilian analogue to the Military Grid Reference System. The idea of its use quickly gained traction with MEMA and other emergency responders, but several challenges were quickly identified. They included:

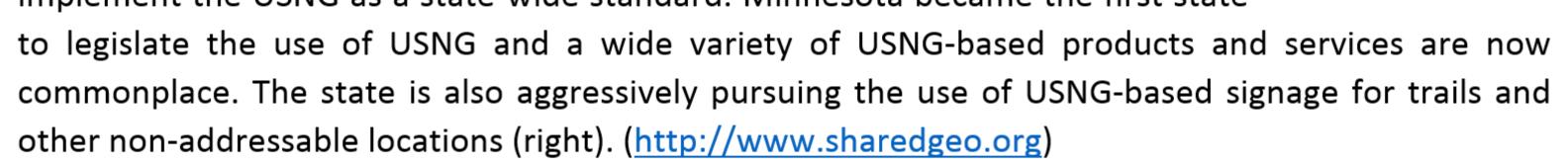
- The need to develop methods and tools to rapidly generate USNG-based map products using civilian geospatial software packages.
- 2. The need to develop a training and outreach program whereby emergency responders could learn how to use the USNG for search and rescue and related land-navigation tasks.
- 3. The need to develop accessible map products and services for the emergency response community.
- 4. The need to further develop policy at the local-, state-, and Federal- levels which supported the use of USNG across a broad community of practitioners from the geospatial, emergency management and response, and infrastructure sectors.

Department of Defense forces would strongly benefit from adoption and use of FGDC's USNG standard within the civilian sector and it would strengthen civil-military interoperability during defense support to civil authorities. The ability to work together using a common coordinate system and map set would significantly promote integrated operations and reduce operational friction among civilian and military resources working joint operations. A program of work was presented to the US Geological Survey (USGS) which, in turn, funded a series of grants supportive of the above objectives.

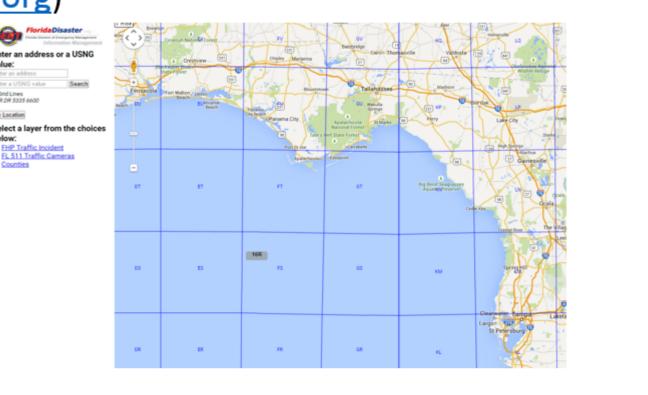
The Center used the base funding from USGS to develop methods and techniques for teaching land navigation to emergency responders and for teaching GIS professionals to make USNG/MGRS-based map products. These materials were taught to more than 100 organizations across the United State from 2006-2009, most notably the Missouri Army National Guard, Metro GIS in Minneapolis, and the Florida State Fire Academy. The outcomes from these latter three activities is significant:

1. Missouri Army National Guard recognized the value of USNG-based map products immediately and, lacking the software and hardware resources, contracted the Center to produce a state-wide county-level USNG-based atlas in 8.5 x 11" GeoPDF format (left). This task was completed for a fee of \$29,000 over the course of 11 weeks. The atlas series has since been used for numerous disasters in Missouri, most notably the Joplin tornado. This work also clearly demonstrated the cost effectiveness of the Center in performing production mapping.

2. Metro GIS invited the Center to present a hands-on map reading course which involved both responders and geospatial professionals. Days after completion of the course, the I-35 Bridge over the Mississippi River collapsed. Significant operational confusion ensued and after-action reports identified the need to fully implement the USNG as a state-wide standard. Minnesota became the first state



3. The Florida Division of Emergency Management requested a USNG course shortly after Katrina. A permanent USNG-based land navigation course was installed at the State Fire Academy at the direction of then State Fire Marshal Rand Napoli. USNG-based training was incorporated into all subsequent search and rescue training and the Field Operations Guide for the State of Florida. Rand Napoli retired from the State of Florida to become the President, Board of Directors, for the National Alliance for



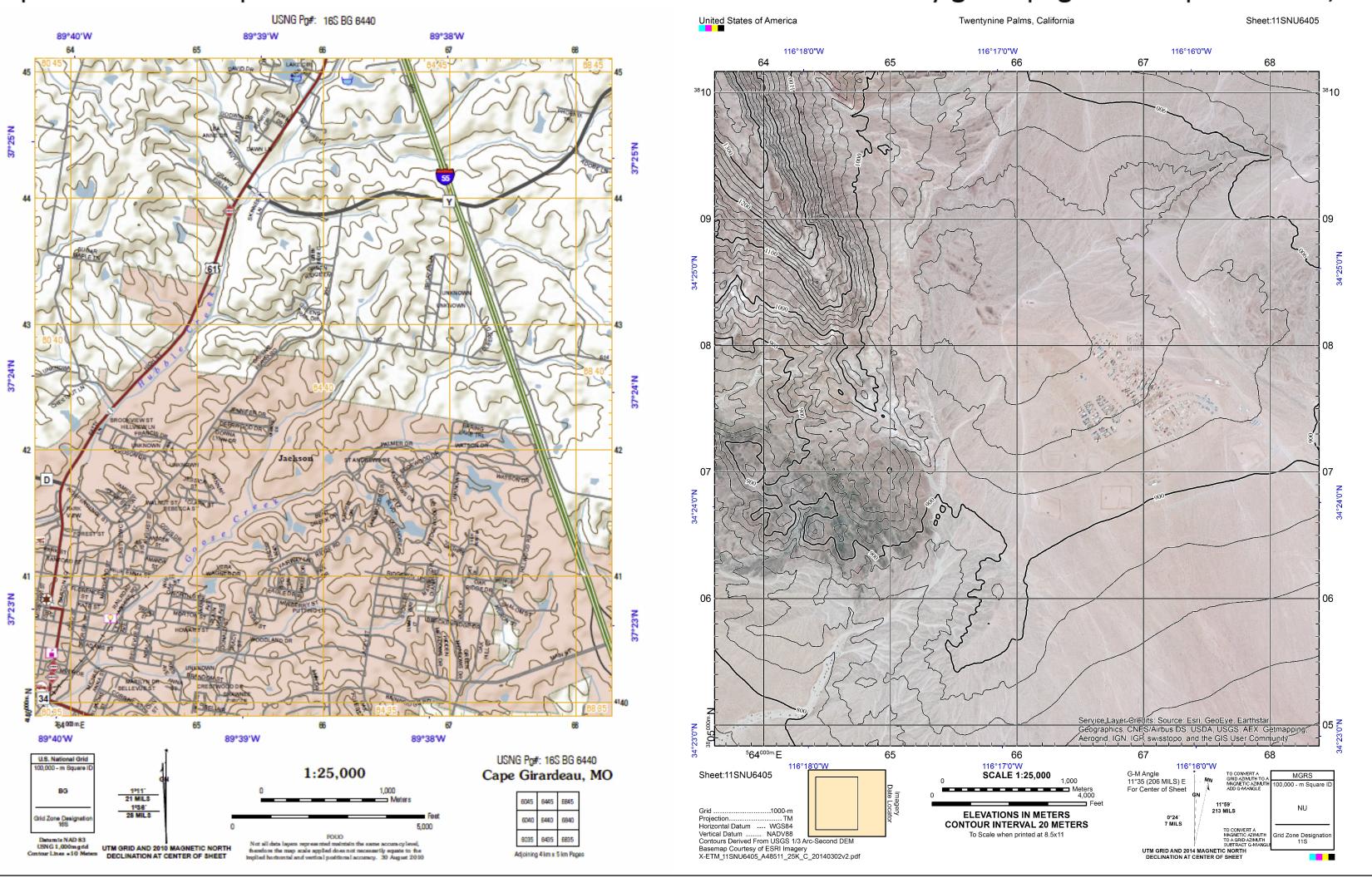
Public Safety GIS (NAPSG). This association has since received funding to continue USNG training with funding support from the US Department of Homeland Security. USNG is now integrated into FLSERT's map viewer (right).

These outcomes were quickly recognized by HQMC and brought to the attention of leadership at the Army Geospatial Center (AGC) and the National Geospatial Intelligence Agency (NGA). The value of a letter-sized, field-printable MGRS-based atlas system which utilized Buckeye, GeoPDF, and ESRI-based commercially-available off-the-shelf technologies was immediately seized upon as a potential high-impact solution for providing access to high-quality image maps in Afghanistan. An AGC contract was let to the Center where a massive production strategy was created and used to produce approximately 450,000 map sheets in what was named the "Warfighter Atlas Series". This contract was completed for approximately 18 months.

Similarly, educators at the NGA schoolhouse recognized that many recent hires lacked experience in military cartography and the fundamentals of land navigation. A training course designed to improve tradecraft was taught at the NGA schoolhouse for Q and G and a permanent land-navigation course was created at NGA's New Campus East (visitors to NCE can find numerous dog-tags affixed to lamp poles and curbs throughout campus). NGA subsequently incorporated the techniques taught into R3 for use in mapping national events such as the Super Bowl. The ultimate "touch-point" was achieved when the Republican National Convention was moved to Minneapolis and both NGA and the State of Minnesota were able to easily and quickly collaborate because USNG served as the basis for most mapping and GEOINT activities.

Methods and Products

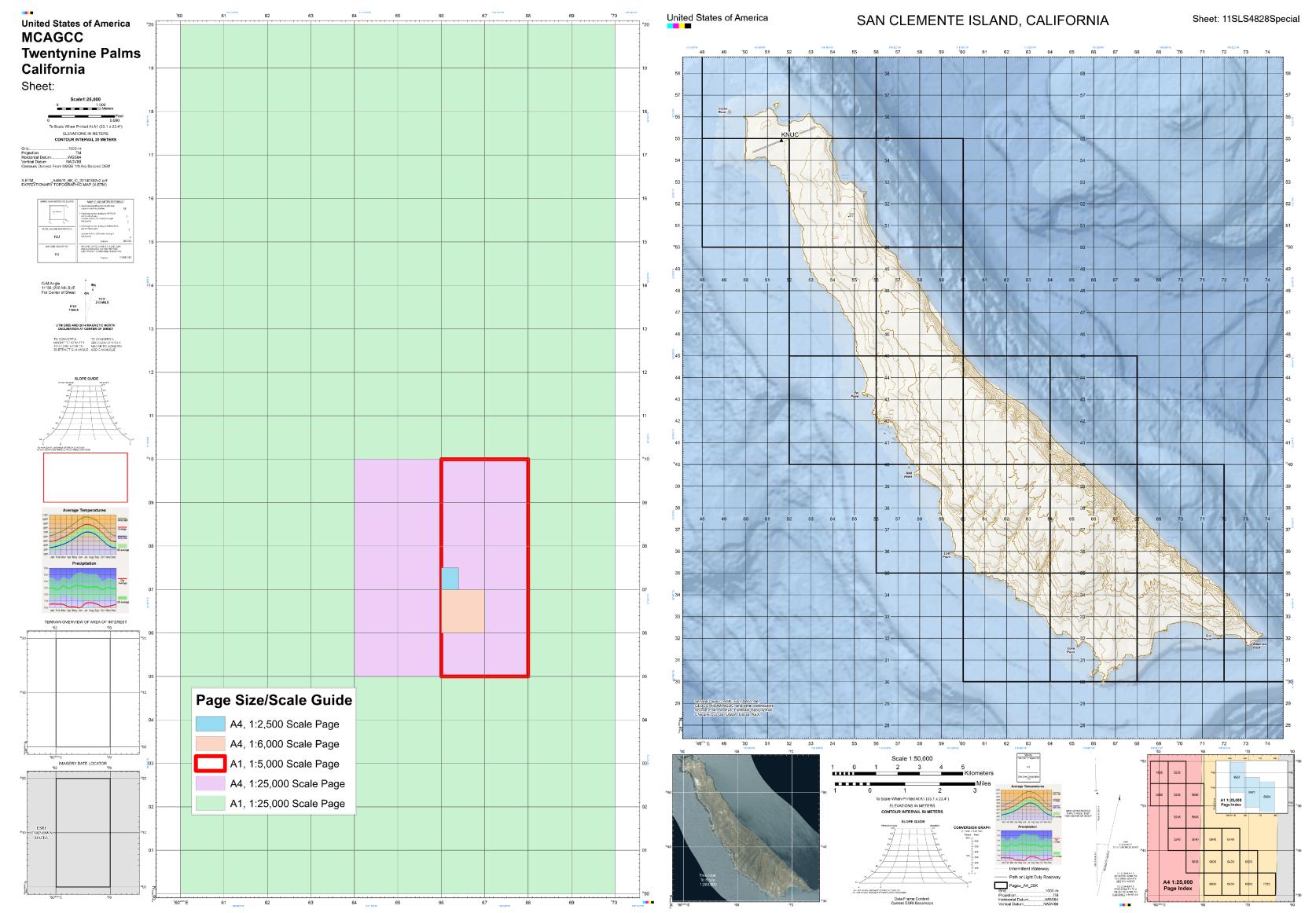
Samples of the 1:25,000 scale MGRS/USNG-based atlases are below. Pagination is driven by coordinate space rather than political or administrative boundaries. The need for any given page is thus predictable,



making automated retrieval easy. The product may be maintained digitally and printed on-demand, thereby keeping paper maps up-to-date. Each page is designed for ISO A-4 sized paper, thereby enabling printing from most devices.

A combination of scales and pages may be combined to create a nested pagination approach. For example, on ISO A1-sized page will contain 4-1:25,000 ISO A4-sized pages. Each ISO A4-sized page will contain 20-1:6,000 sized ISO A-4 sized pages. Thus by maintaining at a variety of complimentary scales and paper sizes, the user may "zoom" in and out of a desired area of interest, compiling and printing only sheet of interest (below).

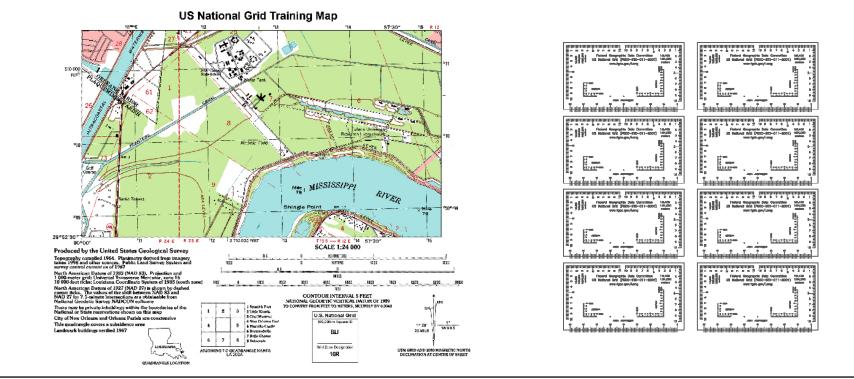
This approach has proven useful for FEMA Urban Search and Rescue (US&R) teams deployed to disasters. They are able to print only what they need on demand and, as the product is scaled, may mark on the printed sheets, return to base, and submit updates or changes for inclusion in the next revision cycle. Moreover, teams also use MGRS/USNG as an area reference system, marking out 100-m or 1,000-m grid squares as "searched" or other status.

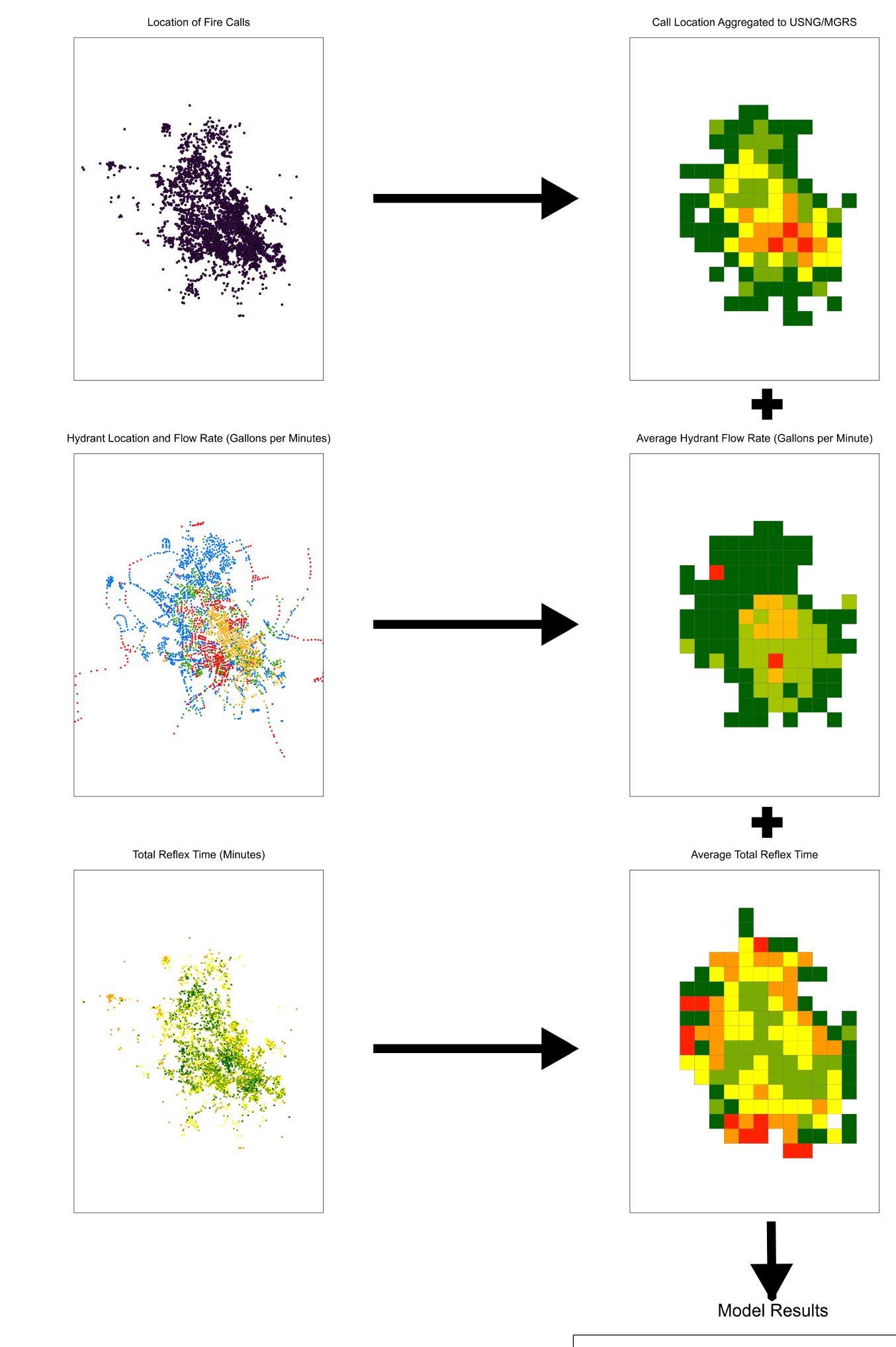


A full suite of training materials are available from Delta State University upon request. Many of these materials were created by Mr. Neri (Tom) Terry and we are extremely grateful for his many contributions. Materials include:

- 1. A suite of demonstration videos detailing the construction of USNG/MGRS-based maps and atlases using Esri software products.
- 2. A style guide, developed in partnership with NGA, provides a desk reference for creating and using scale bars, grid zone designation boxes, declination diagrams, and similar. The guide also contains numerous example maps.
- 3. Wallet-sized romer scales.
- 4. Training maps and a supporting slide deck for reading the grid and multiple scales and at grid zone junctions.
- 5. Handouts detailing how to read USNG/MGRS coordinates and their many uses.

Please contact Talbot Brooks at tbrooks@deltastate.edu or 662-588-8649 with inquiries.





USNG/MGRS may be used as a common analysis grid to create simple models. In this instance, community risk for fire is being modeled. MGRS/USNG grid squares form polygons which may be used to aggregate data. The above three examples show how fire call location, hydrant water flow, and response (total reflex) times are aggregated by sum or average for each grid cell using a spatial join.

The resulting data may be analyzed and re-scaled using a variety of methods while the underlying grid size is maintained. The analyzed layer is converted to raster and then layers may be combined using map algebra. As USNG/MGRS is globally consistent, numerous disparate point data sets may be integrated and modeled across both space and time.

