Washington State on Fire: Using Multivariate Mapping within an Emergency Operations Center

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Abstract

When an emergency causes a disruption to Washington State’s transportation system, it is critical that the affected systems can be quickly restored. The impact of this Emergency Operations Center (EOC) is to establish a system that can manage large-scale events. The EOC serves as the point of contact for affected public and media and as a logistics management center. To fulfill its information requests efficiently within a time constrained environment, EOC needs to provide graphic products that are visually appealing, understandable, and easy to maintain yet maximizes the information contained within.

Well enabled application that allows maps, announcements, and graphic products to be updated in near real-time can address the map updates and dissemination problem but how can we use maps more effectively to communicate information? During the wildfire that occurred in 2016 and during the FEMA sponsored 2016 Cascadia Rising training event the Washington State Department of Transportation experimented with multivariate mapping in an effort to reduce the number of maps required to explain the what, where, and why questions that were asked on a daily basis during the event. These maps were designed to provide a statewide or regional overview of the fire or other hazards and to identify the impacts of the event on our transportation system.

Bivariate and Multivariate Mapping

Bivariate Mapping - maps two variables on a single map by combining two different sets of graphic symbols or colors. This method is a variation of the simple choropleth map that portrays two separate phenomena simultaneously. The main objective is to accurately and graphically illustrate the relationship or correlation between two spatially distributed variables.

Multivariate Mapping - maps three or more variables on a single map. One of the simplest methods for representing multivariate information is to create a single composite variable from the attributes of interest. These composites are typically created using a statistical data reduction method. Other options are to display one variable as a thematic layer on the map and then superimpose the other location specific data (e.g., point data) on the map.

Washington Fire Season 2016

The Predicted Maximum Air Temperature multivariate map is generated each morning if a Red Flag warning is in effect in Washington State. This map shows the maximum predicted temperature for the day (next 24 hours) from the National Weather Service’s 5-Day real-time web services, current Red Flag Warnings and Fire Watch Areas, and the location of recent and active fires. It allows EOC staff to gain an understanding of the fire conditions that the firefighters are working in during the day and the potential for additional wildfires.

Impact Assessment - Green River Valley 100 Year Flood

The Green River High Risk Population Bivariate map was used to identify U.S. Census blocks with high "at risk" populations (i.e., defined as blocks with high numbers of Children under 5 years of age and adults 65 years or older). This population will require longer notification lead time and may also require evacuation assistance.

The Green River Restricted Hospital Service Areas multivariate map is designed to identify hospital service areas which would be impacted by the 17,600-cfs flood. The EOC staff were able to see that the maximum travel time to the nearest hospital had doubled from about 4.5 miles to over 9 miles and that 1405 was flooded. This highlighted how the 17,600-cfs 100 year flood would impact the population of the surrounding area—not just the individuals living in the flood zone.

Cascadia Rising 2016

The Highway Closure Tracking multivariate map was generated as part of the FEMA-sponsored Cascadia Rising training exercise. Maps similar to this are generated by the Washington State DOT EOC on an hourly basis during actual State or Region wide events. The road status data layer is then loaded into an ArcGIS Online Web map to allow for statewide access. These maps are used to track road closure status as well as the key events that caused the closure. In this example, the key event is the magnitude 9.0 earthquake. Other examples of key events are snowstorms, floods, and landslides.