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, organized teams respond and establish an Incident Command Post (ICP) to manage the incident. In large events inquiries from the news media, the community, employees, and local officials can quickly overwhelm a ICP. Because of this Emergency Operations Centers (EOC) are established to manage large or region wide events. The EOC serves as the point of contact with the public and media and as a logistics management center. To fulfill information requests efficiently within a time constrained environment an EOC must provide graphic products that are visual appealing, understandable, and easy to maintain yet maximize the information contained within them.

Web enabled application that allow maps, announcements, and graphic products to be updated in near real-time can address the map update and dissemination problem but how can we use maps more effectively to communicate information? During the wild fires that occurred in 2016 and during the FEMA sponsored 2016 Cascadia Rising training event the Washington State the 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 fires 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. Bivariate mapping is a variation of simple choropleth map that portrays two separate phenomena simultaneously. The main objective is to accurately and graphically illustrate the relationship or correlated 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 superimposed 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 nowCoast real-time web service, current Red Flag Warnings and Fire Watch Areas, and the location of recent and active fires. This allowed EOC staff to gain an understanding of the conditions that fire fighters are working in during the day and the potential for additional wildfires.

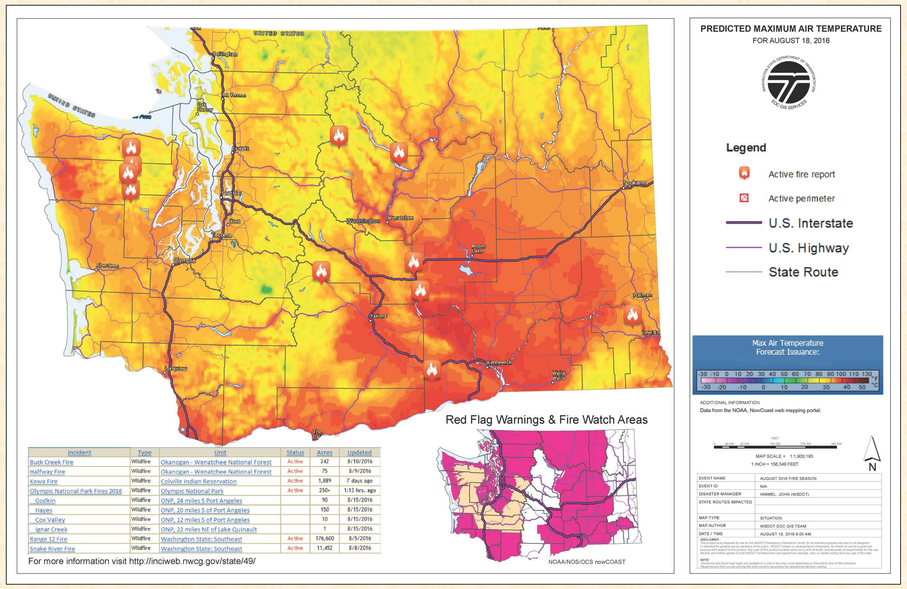
Impact Assessment - Green River Valley 100 Year Flood

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 required longer notification lead-time and may need evacuation assistance.

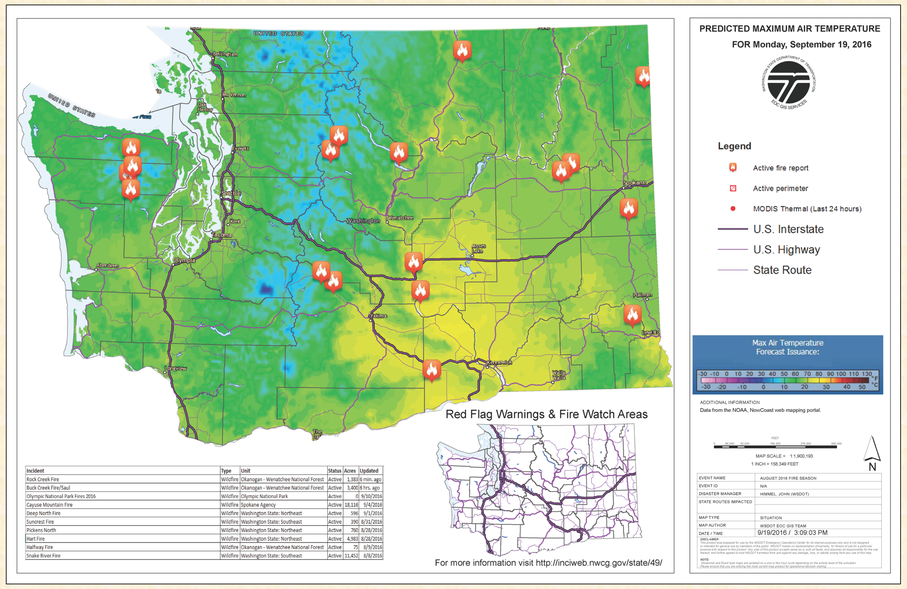
The *Green River Restricted Hospital Service Areas* multivariate map is designed to identify hospital service areas would be impacted by the 17,600 cfs flood. The EOC staff were able to see that the maximum travel time to the nearest hospital had doubled from about 4.5 miles to over 9 miles and that I-405 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 event(s) 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.



Incident	Type	Unit	Status	Acres	Updated
Buck Creek Fire	Wildfire	Okanogan - Wenatchee National Forest	Active	242	8/10/2016
Halfway Fire	Wildfire	Okanogan - Wenatchee National Forest	Active	75	8/9/2016
Kewa Fire	Wildfire	Colville Indian Reservation	Active	1,389	7 days ago
Olympic National Park Fires 2016	Wildfire	Olympic National Park	Active	250+	1:13 hrs. ago
Gockin	Wildfire	ONP, 24 miles S Port Angeles		90	8/15/2016
Hayes	Wildfire	ONP, 20 miles S of Port Angeles		150	8/15/2016
Cox Valley	Wildfire	ONP, 12 miles S of Port Angeles		10	8/15/2016
Ignar Creek	Wildfire	ONP, 22 miles NE of Lake Quinault		1	8/15/2016
Range 12 Fire	Wildfire	Washington State: Southeast	Active	176,400	8/5/2016
Snake River Fire	Wildfire	Washington State: Southeast	Active	11,452	8/8/2016



Incident	Type	Unit	Status	Acres	Updated
Buck Creek Fire	Wildfire	Okanogan - Wenatchee National Forest	Active	1,300	6 min. ago
Buck Creek Fire/Saul	Wildfire	Okanogan - Wenatchee National Forest	Active	3,400	8 hrs. ago
Olympic National Park Fires 2016	Wildfire	Olympic National Park	Active	0	9/20/2016
Cayuse Mountain Fire	Wildfire	Spokane Agency	Active	18,116	9/4/2016
Deep North Fire	Wildfire	Washington State: Northeast	Active	196	9/1/2016
Sunnicrest Fire	Wildfire	Washington State: Southeast	Active	395	8/31/2016
Pickens North	Wildfire	Washington State: Northeast	Active	760	8/28/2016
Hart Fire	Wildfire	Washington State: Northeast	Active	4,983	8/28/2016
Halfway Fire	Wildfire	Okanogan - Wenatchee National Forest	Active	75	8/9/2016
Snake River Fire	Wildfire	Washington State: Southeast	Active	11,452	8/8/2016