United States Department of the Interior
U.S. Geological Survey
5522 Research Park Drive
Baltimore, MD 21228
443-498-5500

USGS Maryland-Delaware-District of Columbia Water Science Center

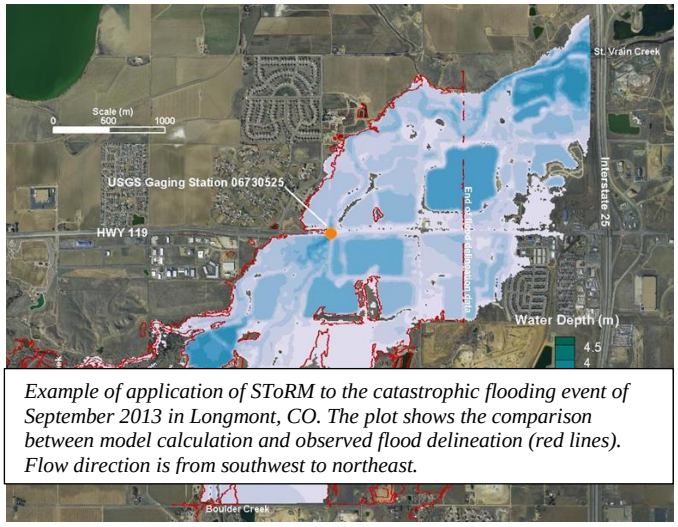
Seminar Series

Wednesday, October 28, 2015 11:00 a.m.

Application of multidimensional modeling to peak flood flow estimation

Francisco J.M. Simões U.S. Geological Survey, Golden, CO 80403 Ph.: 303-278-7956; email: frsimoes@usgs.gov

In September 2013, a slow-moving cold front clashed with unusually persistent and moist warm monsoonal air over Colorado's Front Range, leading to rainfall totals seldom seen in the past century. Record or near-record precipitation was recorded during the event, which was reported as a "1,000-year rainfall" for the Boulder area, based on the NOAA Atlas 14 precipitation frequency analysis. The heavy rains caused severe to extreme flooding across Front Range streams extending from Fort Collins in the north, to Colorado Springs in the south, over a region 200 miles long. Over 16,000 homes were damaged, with more than 1,500 destroyed; 120 miles of state highways damaged, with at least 30 state highway bridges destroyed and an additional 20 seriously damaged; more than 11,000 people had to be evacuated, with 10 casualties; and $2.9 billion in damages were some of the consequences of the floods.



Example of application of SToRM to the catastrophic flooding event of September 2013 in Longmont, CO. The plot shows the comparison between model calculation and observed flood delineation (red lines). Flow direction is from southwest to northeast.

Due to the high discharges and water depths that occurred in many of the affected streams, some of the US Geological Survey gaging stations were submerged or completely destroyed, precluding direct measurement of peak flows. Such was the case at the confluence of the St. Vrain Creek and Boulder Creek near the city of Longmont, northwest of Denver, CO. As a result of high flows, the USGS Gaging Station 06725450 (http://waterdata.usgs.gov/co/nwis/uv/?site_no=06725450), located at St. Vrain Creek at Highway 119 below Longmont, was destroyed and failed to record the stage at the peak of the flood. No high water marks were collected at this location during the later forensic work related to this flood, therefore preventing the use of conventional indirect measurement methods. This presentation will illustrate how computer modeling was used to estimate the peak flow discharge at this gaging station. It will be shown how the computer model SToRM (System for Transport and River Modeling), which is a two-dimensional surface hydraulics model, was set-up to represent the unsteady flooding flows at the confluence of St. Vrain and Boulder Creeks. The full cycle of data preparation, model set-up, and analysis of simulation results will be presented. Also of interest will be the techniques used to estimate and optimize the model parameters and computational set-up to ensure the accuracy of the solutions; and a view of the limitations of the data acquisition methods used in this work (remotely sensed data was used to obtain the flood delineation contour). This application of SToRM offers an example of how multi-dimensional flow models can be used as effective tools in modern flood hydrology.

This presentation will also be available remotely via Webex:
https://usgs.webex.com/usgs/j.php?MTID=m5bebd71fb29ec474c97b42b510655a20
For directions to the USGS MD-DE-DC WSC: http://md.water.usgs.gov/directions/baltimore.html