Responding to Landslide Emergencies: Communicating with Stakeholders and the Feedback Loop of Preparation, Response, Analysis and Lessons Learned

Abstract

An important component of the North Carolina Geological Survey's (NCGS) geohazards program is its response to requests for technical assistance on landslide events from emergency managers and the public. Since 1990 the NCGS has responded to over 160 landslide events involving ~350 landslides in the Blue Ridge Mountains of western North Carolina, including those that resulted in the loss of life, injuries, destroyed or severely damaged homes, and threatened regional infrastructure. Most of these landslides coincided with periods of heavy rainfall from tropical cyclones, low pressure systems (e.g., atmospheric rivers), and warm weather convective storms, especially when these storm events occurred during periods of extended above normal rainfall.

A primary response objective is to provide stakeholders with timely, unbiased scientific information to help protect public safety and property, and thereby reduce losses from landslides. A key response function is to help increase situational awareness for emergency responders during rescue and recovery operations. Post-landslide response efforts include assisting emergency managers with damage assessments, contingency planning if unstable slopes remain a threat, and providing documentation to support funding for recovery and mitigation efforts. Emergency landslide situations involve communicating with first responders, the public and media to convey information about the nature of landslides and recovery efforts, and in some cases giving expert witness testimony.

Our investigations revealed that damaged homes and other critical facilities in many instances unknowingly had been built in areas vulnerable to landslides. Slope modifications by human activity were contributing factors in many cases, including fill failures that mobilized into destructive debris flows. Correlations between rainfall and debris flow occurrences indicate that debris flows originating on slopes modified by human activity can be triggered by rain events with lower rates and durations than those needed to trigger debris flows on unmodified slopes. These findings show that smart development can help reduce landslide losses and improve communities' resilience after landslide events.

Field computers, lidar digital elevation models and orthophotography used in conjunction with a landslide geodatabase have improved pre-response preparation, data collection and analysis, and delivery of geospatial data to stakeholders. The advent of uncrewed aerial systems ((UAS) technology has greatly improved landslide response capabilities. Rick's talk will highlight case examples, lessons learned, and challenges in responding to landslide events as a state agency.

Biography

Richard M. Wooten, P.G.

Rick has over 40 years of experience in applied geology in the Cascade Mountains of Washington State, and applied geologic research in the Piedmont, and Blue Ridge Mountains of North Carolina. He earned his B.S. and M.S. degrees in geology at the University of Georgia in 1973 and 1980. Rick recently retired from the North Carolina Geological Survey where he was the Senior Geologist for Geohazards and Engineering Geology from 1990 to 2021. His previous work includes mapping geologic resources and conditions for land-use planning, landslide investigations and applied geotechnical geology for the USDA-Forest Service on the Gifford Pinchot National Forest in Washington State from 1980 to 1990. His work with the North Carolina Geological Survey includes the scientific regulatory review and field investigations for a low-level radioactive waste disposal project, and bedrock geologic mapping in the Piedmont and Blue Ridge Mountains. Since 2003 his main focus has been on landslide hazard mapping and research, and responding to landslide events North Carolina Blue Ridge. He has a special interest in the relationships of ductile and brittle bedrock structures with geomorphology and landslides processes, and communicating landslide hazards information with stakeholders.