Day 3 Speakers: May 22, 2024

What's next? Risk reduction considerations for post-wildfire debris flows

Speaker: Carie-Ann Lau; BGC Engineering
Co-author: Alex Strouth, Joseph Gartner, Sophia Zubrycky, Emily Mark, Hazel Wong

Post-wildfire debris flows generate risks to people, businesses, infrastructure, and the environment. A risk assessment can be used to quantify this risk with estimations of hazard likelihood, spatial impact probability, temporal probability of occupancy, and vulnerability. Each of these parameters offers an opportunity for risk reduction – for example, spatial impact probability could be reduced through engineered mitigation, or temporal probability reduced with warning systems.

Using examples from recent post-wildfire debris flows in Canada and the United States, we provide an example of a life-loss risk assessment and risk reduction options assessment for individuals living in homes on different parts of a post-wildfire debris-flow fan. The results show that, following a wildfire, the annual life-loss risk to an individual who occupies a home on most portions of a debris flow fan likely exceeds that individual's background risk of death from other causes. When compared to non-wildfire conditions, the annual debris-flow life-loss risk is ten to one hundred times higher in post-wildfire conditions. Individual life-loss risk is influenced by the mobility and flow characteristics (depth, velocity) of post-wildfire debris flows, which can be estimated from runout modelling and/or geomorphic interpretation.

Evolving Strategies to Enhance Post-Wildfire Debris Flow Monitoring and Data Collection in Washington State

Speaker: Kate Mickelson; Washington Geological Survey
Co-authors: Emilie Richard, Mitch Allen, Kara Fisher, Josh Hardesty

Post-wildfire debris flows are a statewide hazard in Washington. Steep terrain, vegetation types, and elevated wildfire risk in the northern portion of the eastern Cascades have historically resulted in a higher frequency of post-fire debris flows and flash floods relative to other parts of Washington. Climate change and drought are increasing the fire hazard to the western Cascades as well, creating a growing concern for post-fire debris flows near more densely populated areas. To improve regional hazard assessments and early warning efforts in the years following a fire, the Washington Geological Survey is actively monitoring 13 burned areas to correlate rainfall rates to the timing of debris flows, hyperconcentrated flows, and flash floods. By collecting data from on-the-ground observations, rain gauges, telemetered weather stations, pressure transducers, and motion-activated cameras, we are building an inventory of geologic hazard events and associated weather conditions. We have developed a database and workflow that streamlines our post-wildfire debris flow monitoring and public outreach efforts. This approach to data management seamlessly integrates office-and field-based data collection when responding to post-wildfire debris flow events and sharing a subsets of those observations publicly using our Post-Wildfire Debris Flow Dashboard (https://wadnr.maps.arcgis.com/apps/dashboards/e7feaba37d1649fa828e38159dd567c2).

Since 2020, we have recorded 44 debris flows and 33 hyperconcentrated flows, and 35 flood events in 8 burn scars. Each year our methods continue to improve following both trials and triumphs with field instrumentation and on-the-ground observations. This talk will focus on our post-wildfire monitoring data collection and field instrumentation with special attention on our successes and lessons learned.

USACE Post-Wildfire Risk Management

Speaker: Ian Floyd, U.S. Army Engineer Research and Development Center (ERDC)

The intensity and frequency of wildfires in the U.S. is increasing with changing climate, bringing immense devastation that may be compounded by typical and extreme precipitation events and debris flows. This is especially true in California were flood risks increase exponentially after a wildfire due to sediment hazards, vegetation loss, soil changes and the reduced capacity of reservoirs and debris basins. Destructive non-Newtonian flows (or debris floods) can be 1,000-times larger than pre-wildfire floods and are common in Californian following wildfires. In the past, a limited understanding of the increased risk left fire-torn communities particularly vulnerable to flooding. Recently, U.S. Army ERDC and U.S. Army Corp of Engineers (USACE) developed a fast and reliable method to assess the risks of wildfire impacts on flood risk management, as well as quantitative approaches to predict changes in streamflow and sediment runoff for planning and designing flood control measures. Incorporating non- Newtonian physics and simple yet effective empirical-based hydrology approaches to account for wildfire effects into existing USACE hydrologic and hydraulic (H&H) numerical modeling systems has significantly increase model simulation time and accuracy. This presentation will describe the research, model development, validation, and demonstration of importance with applications in Southern California.

Evaluating the Evolving Controls on Post-Fire Debris Flows in Western Oregon

Speaker: Ben Leshchinsky; Oregon State University
Co-authors: David Sousa, Peyton Presler, Maryn Sanders, Nicolas Mathews, Josh Roering, Francis Rengers, Benjamin Mirus, Bill Burns, Michael Olsen

Wildfire is known to amplify the likelihood and magnitude of debris flows in steep terrain. In arid climates (e.g. US Mountain West and Southwest), post-fire debris flows typically occur during the wet season, suggesting that rainfall-driven erosion is a strong control on in-channel preconditioning and triggering of these hazards. However, in the cool, wet climates of the Pacific Northwest, there is an apparent lag between cessation of burning and debris flow occurrence that suggests different controls than drier climates. Anecdotally, post-fire debris flows in Western Oregon appear to be associated with the delayed triggering of shallow landslides years after burning. An interagency team of academic and government researchers are working to evaluate the temporal controls on post-fire debris-flow initiation and their impact on transportation infrastructure. This research focuses on (1) monitoring the hydrological and climatic conditions associated with landslides in several burn scars in western Oregon, (2) physical characterization of root strength following wildfire, and (3) interpretation of topographic change in select areas of extensive debris-flow activity.