

Post-fire debris-flow early warning in the western United States

Dennis Staley, Jason Kean, Rex Baum, and Jonathan Godt

U.S. Geological Survey, Landslide Hazards Program, Golden CO USA





What <u>Aren't</u> Post-Fire Debris-Flows?





March, 2014 Oso Landslide, near Oso WA

May 2014 West Salt Creek Landslide, Collbran CO Photo courtesy of Mesa County, CO

What Are Post-Fire Debris-Flows?

- Do not require a discrete source of material (e.g. landslide), with most material originating from shallow erosion.
- Impact primarily constrained to gullies, stream channels and immediately adjacent areas.
- <u>Probability</u> of occurrence increases with short duration rainfall intensity.
 Not empirically related to antecedent moisture conditions.
- <u>Volume</u> and <u>velocity</u> have been experimentally linked via flume studies to antecedent moisture conditions, but not yet empirically demonstrated.

www.youtube.com/watch?v=k3W-wDIR-Os

Fires: 2000 - 2014

- More than 202 million acres
 [316,000 square miles] burned
 between 2000 and 2014.
- Given sufficient rainfall, any steep, recently burned terrain is susceptible to post-fire flood or debris flow.

Rainfall Intensity Duration Thresholds

Define the rainfall conditions where debris-flow generation becomes more likely.

Requires a rather extensive library of historical occurrence and rainfall conditions, which is time consuming to compile.

Warning Infrastructure

U.S. Geological Survey (USGS) Partnership with National Oceanic and Atmospheric Administration (NOAA) – National Weather Service (NWS)

Provide sound scientific guidance on the physiographic, hydrologic, and meteorological conditions that contribute to landslide and debrisflow initiation and growth.

Annual Program Budget \$3.5 million USD, ~\$1 million USD specific to early warning.

Provide forecasted and real-time monitoring of meteorological conditions, and technical infrastructure for issuance of outlooks, watches, and warnings.

Southern California: 2005 - Present

Warning system based on USGS postfire debris-flow thresholds and NWS flash-flood products.

NWS incorporates USGS thresholds into existing <u>F</u>lash <u>F</u>lood <u>M</u>onitoring and <u>P</u>rediction System (FFMP).

NWS forecasts and monitors rainfall intensities and compares to existing USGS thresholds. NWS issues Outlook, Watch or Warning.

Interest at NWS in expanding the warning system beyond southern California.

Communicating Hazard and Risk: Lessons Learned

- Adaptable approach.
- Buy-in from trusted public official(s).
- Honest discussion of uncertainty.
- Engaging public in the science.

Challenges and Opportunities for Warning Expansion

- Diversity of initiation processes and slide/flow types.
- Labor and data intensive.
- Balancing warning fatigue (false alarms) with under-warning (failed alarms).
- Difficulty maintaining long-term momentum in continued monitoring program and warning.

Contact Info:

Dennis Staley Research Geologist <u>Email:</u> <u>dstaley@usgs.gov</u> Phone: 303-273-8568 Rex Baum Research Geologist <u>Email:</u> <u>baum@usgs.gov</u> <u>Phone:</u> 303-273-8610

Jason Kean Research Hydrologist <u>Email: jwkean@usgs.gov</u> <u>Phone:</u> 303-273-8608 Jonathan Godt Landslide Hazards Program Coordinator <u>Email:</u> jgodt@usgs.gov <u>Phone:</u> 303-273-8626