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New study examines 2017-2018 Thomas Fire debris flows

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Shortly before the beginning of the 2017-2018 winter rainy season, one of the largest fires in California (USA) history (Thomas fire) substantially increased the susceptibility of steep slopes in Santa Barbara and Ventura Counties to debris flows. On 9 Jan. 2018, before the fire was fully contained, an intense burst of rain fell on the portion of the burn area above Montecito, California. The rainfall and associated runoff triggered a series of debris flows that mobilized ~680,000 cubic meters of sediment (including boulders larger than 6 m) at velocities up to 4 meters per second down urbanized alluvial fans. The resulting destruction included 23 fatalities, at least 167 injuries, and 408 damaged homes.

The tragic outcome in Montecito underscores the challenges of rapidly identifying post-fire hazards and risks. Given projected increases in wildfire size and severity, precipitation intensity, and development in the wildland-urban interface, the need to address those challenges is growing.

As part of an effort to improve methods for post-fire risk assessment, the U.S. Geological Survey (USGS) and the California Geological Survey (CGS) spent 12 days immediately following the Montecito debris flows collecting field data to characterize the inundation, flow dynamics, and damage along the five main runout paths. These data provide rare spatial and dynamic constraints for testing debris-flow runout models, which are needed for advancing post-fire debris-flow hazard assessments. They also used the observations of damage in Montecito to develop unique "fragility curves" for wood frame construction. These curves link the probability of damage to measures of debris-flow intensity.

The USGS-CGS team found that the patterns of debris-flow inundation differed substantially from the flow paths expected for ordinary water floods. They also found that road culverts and bridge underpasses, which became choked with debris, played a significant role in causing the widespread damage, because they redirected flow away from the main channels and into neighborhoods. The complexity of the flow paths on the developed fans makes the event a particularly challenging test case for runout models.

It is hoped that subsequent testing of runout models using this data set and combining model results with the fragility curves developed here will help communities better identify their risks following future fires.

More information: Inundation, flow dynamics, and damage in the 9 January 2018 Montecito debris-flow event, California, USA: Opportunities and challenges for post-wildfire risk assessment, DOI: 10.1130/GES02048.1 , pubs.geoscienceworld.org/gsa/g … -and-damage-in-the-9

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