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NOAA/USGS Demonstration Flash-Flood and Debris-Flow Early-Warning System

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Flash floods and debris flows are common following wildfires in southern California. On 25 December 2003, sixteen people were swept to their deaths by debris flows generated from basins in the San Bernardino Mountains that burned the previous fall. In an effort to reduce loss of life by floods and debris flows, the National Oceanic and Atmospheric Administration (NOAA) and the United States Geological Survey (USGS) established a prototype flash flood and debris flow early warning system for recently burned areas located in eight counties of southern California in the fall of 2005. This prototype system combines the existing NOAA's National Weather Service (NWS) Flash Flood Monitoring and Prediction (FFMP) system and USGS rainfall intensity-duration thresholds for debris flow and flash flood occurrence. Separate sets of thresholds are defined for the occurrence of debris flows and flash floods in response to storms during 1) the first winter after a fire, and 2) following a year of vegetative recovery. The FFMP was modified to identify when both flash floods and debris flows are likely to occur based on comparisons between precipitation (including radar estimates, in situ measurements, and short-term forecasts) and the rainfall intensity-duration thresholds developed specifically for burned areas. Advisory outlooks, watches, and warnings are disseminated to emergency management personnel through NOAA's Advanced Weather Information Processing System (AWIPS). The FFMP provides a cost-effective and efficient approach to implement a warning system on a 24-hour, 7-day-a-week basis.

In 2004 the system was advanced to incorporate a web-based procedure developed by the NWS Weather Forecast Office (WFO) in Oxnard, CA that provides information about each fire to forecasters, and displays hazard maps generated by the USGS that show those basins most likely to produce the largest debris flow events within recently burned areas. During four years of operation, the WFOs in Oxnard and San Diego issued 104 warnings, with 45 percent of these verified as having produced debris flows. Local communities and emergency response personnel have used the information provided to guide decisions for equipment deployment and evacuations.

In addition to the prototype system, each year an area within the southern California study area is dedicated to intense instrumentation and research to develop new geologic, hydrologic, and hydrometeorologic methods for precipitation and debris-flow forecasting, measurement, and analysis techniques.

Ongoing research to further advance the system within the USGS is focused on the development of empirical and physically-based methods for generating spatially and temporally explicit forecasts of debris-flow hazards that can integrate real-time field monitoring of hillslope and channel conditions with precipitation forecasts and measurements. Ongoing NOAA research includes improving multi-sensor precipitation estimation (from radar, rain gages and satellites) and the spatial and temporal resolution of precipitation forecasting and nowcasting techniques, and developing high-resolution hydrologic models that include soil moisture accounting procedures.