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NSSL Briefings

A newsletter about the people and activities of the National Severe Storms Laboratory and Cooperative Institute for Mesoscale Meteorological Studies collaborative researchers

Figure 1: A boulder on the road near La Conchita, CA on Jan. 10, 2005

NOAA-USGS team formed to create debris flow forecasting system

Extreme rainfall over California during January and February 2005 has brought much-needed attention to the danger of flash flooding and mudslides. Major highways and commuting routes were washed out or covered by mudslides and debris flows while several communities were isolated by road closures. Cost estimates of road repairs are more than 30 million dollars. The excessive rainfall between January 7-11, 2005, directly and indirectly caused 22 deaths. Total crop damage in Ventura County alone was estimated to be near 52 million dollars according to the county Office of Emergency Services.

The National Weather Service (NWS) invited NSSL researchers David Jorgensen and J.J. Gourley (CIMMS) to serve on an interagency team to create a debris flow, or mudslide warning system for southern California. Although some do not meet traditional "flash-flood" criteria, rapidly-moving debris flow, triggered by severe rainstorms, are among the most numerous and dangerous types of landslides, particularly in California. Debris flows can begin suddenly, accelerate quickly, reach velocities up to 60 km/hr, and flow down streams or other channels for distances of several kilometers. They can smash homes and other structures, wash out roads and bridges, sweep away cars, knock down trees, and, finally, lay down thick deposits of mud, rock, and other debris where they come to rest, obstructing drainages and roadways (See Figure 1).

For example, a catastrophic rainstorm over the San Francisco Bay area in January 1982 deposited nearly half the normal annual rainfall in 32 hours and triggered more than 18,000 landslides -principally debris flows-causing 25 fatalities and $66 million in property damage. Although the NWS had forecast heavy rainfall and issued several special weather statements, the destructiveness of the debris flows and other landslides triggered by the storm were unexpected.

Following this disaster, the U.S. Geological Survey (USGS), in cooperation with the NWS, experimented with a prototype warning system for alerting the public when rainfall conditions reach or approach critical levels for triggering debris flows. The system operated on a daily basis and used precipitation fields observed and/or forecast by the NWS San Francisco Weather Forecast Office (WFO). Those fields were forwarded to the USGS' Menlo Park Office where geologists applied them to local basin-specific mudslide forecasting models. Based on the model results, the geologists recommended areas where mudslide warnings were warranted, and the corresponding warnings were issued by the WFO, following the standard warning dissemination procedures. After budget cuts in 1985, the experiment was terminated.

The NWS and USGS are now interested in reviving the service. Improvements to observing technology (e.g., see Fig. 2 for the distribution of special rain gauges and WSR-88D's in southern California) and hydrologic modeling capability hold great promise that the warnings will be much more effective than those produced by the prototype system in the 1980's. Moreover, recent severe wildfires in southern California have increased the risk of debris flows near high population centers. The interagency team will provide guidelines for the warning system including developing a research plan for improved Quantitative Precipitation Estimation (QPE) over the southern California Mountains. Accurate QPE is a challenge over mountainous terrain due to radar beam blockage of low-level scans (Fig. 2). Utilizing the NSSL national radar mosaic for gridding and quality control of WSR-88D for use with multi-radar, multi-sensor QPE techniques for input to USGS regional distributed hydrologic models would likely be beneficial to California residents as well as a fruitful NSSL research endeavor. ◆

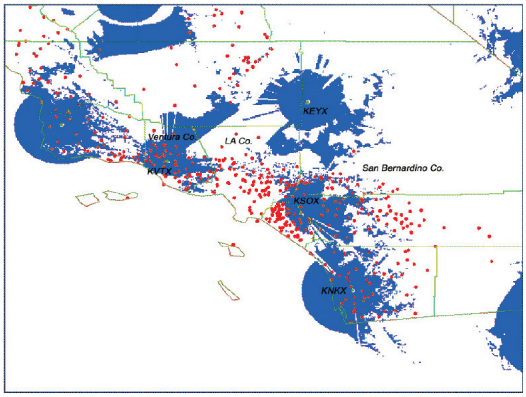

Figure 2: Distribution of Southern California ALERT rain gauges (red dots), WSR-88D radars (green dots). Green lines are county boundaries and the blue regions denote areas where radar coverage is below 1km above the ground.