U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

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Plate 9

Map of Landslides Triggered by Hurricane Mitch
Part of the Rio Tithuapa (2457 II), Sensori (2557 III), El Puente Cuscatalan (2456 I) and Jucuapa (2556 IV) Quadrangles, El Salvador

This map is one of 11 plates showing areas that were affected by landslides caused by heavy rainfall associated with Hurricane Mitch in October and November 1998. These landslides occurred on steep slopes in terrain that has diverse geology, geomorphology, vegetation, and microclimates. When combined with data on the physical properties of the material on hill slopes, the hillslope form, and rainfall intensity and duration, these maps can provide a basis for evaluating the landslide susceptibility of other similar areas.

For these plates, the term "landslide" is used to describe all types of slope failures, including slow-moving earth flows, rotational and translational slides (Varnes, 1978; Cruden and Varnes, 1996) and fast-moving debris flows composed of mud, sand, gravel, boulders, and organic debris (see Pierson and Costa, 1987, for classification of debris flows). Most of the landslides shown on the 11 plates are debris flows and related landslide scars that were caused by the intense rainfall from the storm. Many of the debris flows probably initiated as rotational or translational slumps that started at the preserved scars and mobilized into muddy flows, some of which traveled hundreds of meters to as much as several kilometers from their point of origin. Some of the larger debris flows increased in volume as they traveled by collecting additional unconsolidated material from hillslopes and channels along their flow paths. The larger debris flows transported large rocks and boulders more than two meters in size. Because of their high velocity and their ability to transport large boulders, debris flows can be extremely destructive and hazardous.

The landslides shown on these plates were mapped using 1:40,000-scale and 1:15,000-scale black-and-white aerial photographs. Much of the photography was taken a few months after the storm, but additional photography was taken in late 2000. See the text in the accompanying report for further details of the photography.

The photographs were visually examined using 4X mirror stereoscopes, and the landslides were plotted by hand on mylar overlays that were registered to topographic maps. The landslides were plotted on 1:25,000-scale maps where these high-quality maps were available; for other parts of the country, we used 1:50,000-scale maps. The plotted landslides were then manually digitized and registered to digital raster graphic (DRG) images of 1:50,000-scale topographic maps. Some of the maps shown on these plates are composites of parts of two or more 1:50,000-scale topographic maps; for these composites, the edges of the quadrangles were digitally adjusted to assure continuity between adjacent maps. These adjustments were also necessary to resolve differences in the resolution between 1:50,000-scale and 1:25,000-scale topographic maps. After these adjustments, the areas of each plate were cut from the merged DRGs, and the digital landslides were then plotted on the DRG images of the map areas.

These maps portray the shapes, relative location, and size of landslides and the associated downslope channel deposits caused by the hurricane. It is difficult to precisely determine the accuracy of the landslide locations shown on the maps. For those features that were originally mapped on 1:25,000-scale topographic maps, we estimate that their locations are accurate to within less than 100 m and probably to within 50 m. For features that were originally mapped on 1:50,000-scale topographic maps, their locations are probably accurate to within 100-200 m.

References Cited

Cruden, D.M. and Varnes, D.J., 1996, Landslide types and processes, in Turner, A.K. and Schuster, R.L., eds., Landslides–investigation and mitigation Washington, D.C., National Academy of Sciences, Transportation Research Board Special Report 247, p. 36-75.

Pierson, T.C. and Costa, J.E., 1987, rheologic classification of subaerial sediment-water flows, in Costa, J.E. and Wieczorek, G.F., eds., Debris flows/avalanches–process, recognition, and mitigation: Geological Society of America, Reviews in Engineering Geology, v. 7, p. 1-12.

Varnes, D.J., 1978, Slope movement types and processes, in Schuster, R.L. and Krizek, R.J., eds., Landslides: analysis and control: Washington, D.C., National Academy of Sciences, Transportation Research Board Special Report 176, p. 12-33.

ARC/INFO coverages and a PDF file for this map are available at http://geology.cr.usgs.gov/greenwood-pubs.html