Summary of the Hurricane Mitch Relief Program of the U.S. Geological Survey

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INTRODUCTION

In October 1998, Hurricane Mitch slammed into Central America with sustained winds of 180 miles per hour. The countries of Honduras, Nicaragua, El Salvador, and Guatemala were hardest hit. Hurricane Mitch was a Category 5 storm on the Saffir-Simpson scale and ranks as one of the strongest storms on record based on its sustained winds, barometric pressure, and duration (National Climate Data Center, 1999). The measured rainfall resulting from the storm totaled as much as 6 feet in some areas (National Climate Data Center, 1999). The resulting flooding and landslides killed more than 9,000 people and left thousands more missing (Smith, Phillips, and Spahr 2002). In Honduras, an estimated 75 percent of the transportation infrastructure was rendered useless, and 50 years of economic development was destroyed (Smith, Phillips, and Spahr 2002). Economic losses in the region were estimated at more than 7.5 billion dollars (U.S. Agency for International Development, 1999).

THE USGS RESPONSE

The U.S. Geological Survey (USGS), in cooperation with the U.S. Agency for International Development (USAID) and other federal and international agencies, led an immediate and aggressive effort to respond to the needs of the affected countries through the Hurricane Mitch Relief Program. This effort was designed to strengthen the affected countries' ability at both national and local levels to mitigate, prepare for, and respond to future natural disasters by:

- Facilitating access to basic data and information such as maps and aerial photography
- Installing stream-flow monitoring systems
- Conducting flood and landside risk assessments
- Providing biological assessments of coastal resources
- Developing an internet data clearinghouse in each country
- Providing geographic information system (GIS) hardware and software
- Strengthening the capacity of counterpart agencies by training their specialists in project activities

MAPS AND AERIAL PHOTOGRAPHY

In cooperation with the National Imaging and Mapping Agency, and national mapping agencies in Honduras, Nicaragua, El Salvador, and Guatemala, the USGS has provided complete coverage with digital topographic maps at scales of 1:250,000 and 1:50,000. These maps provide a critically needed base for national information systems for disaster preparedness and response and also support assessment and planning activities at the local level.

The USGS has compiled pre- and post-Mitch satellite imagery of Central America from the Landsat 4, 5, and 7 satellites. This imagery provides a useful regional-scale base for mapping, vegetation and landcover assessments, and other activities.

The USGS has acquired more than 28,000 frames of aerial photography at scales ranging from 1:40,000 to 1:5,000. This photography is an important tool for fine-scale analysis and mapping of landslides and flood inundation patterns, and is the base for municipal information systems being provided to 70 towns in Central America.

STREAM-FLOW MONITORING SYSTEMS

Thirty-four hydrologic monitoring stations, each transmitting real-time hydrologic data via satellite, have been installed in the four-country region. These stations are integrated with the National Oceanic and Atmospheric Administration River Forecast System. These gages provide early warnings of potential flooding to local officials and agricultural managers, and also collect data that will be used for the analysis of key watersheds in each country. The USGS has involved specialists in each country in the installation of the gages, and has also conducted formal training programs on gage installation, maintenance, data processing, and analysis. The USGS has also provided a supply of spare parts for the gages to allow for continued maintenance by counterparts in the future.

FLOOD AND LANDSLIDE RISK ASSESSMENTS

The USGS is utilizing LIDAR (a laser-based elevation measurement system) and analysis of historical hydrologic data to prepare detailed flood-risk maps for areas in Honduras that suffered substantial damage from flooding during Hurricane Mitch. Similar to flood-risk maps prepared in the United States by the Federal Emergency Management Agency (FEMA), these maps will allow local officials to identify areas at greatest risk for future flooding and to take appropriate measures to mitigate the danger.

The torrential rains during Hurricane Mitch caused hundreds of thousands of landslides, which destroyed houses, blocked roads, and choked rivers with millions of tons of sediment. USGS geologists have used aerial photography and

field reconnaissance studies to develop landslide inventory maps for the four-country region. These maps will be used by national and local authorities to develop mitigation strategies to reduce the risk of future landslides and will be useful in urban planning and in the design of new road networks.

The steep slopes of the many volcanoes along the Pacific coast of Central America pose a great risk of slope failures and resulting debris flows during periods of high rainfall. A massive debris flow triggered by the intense rainfall during Hurricane Mitch completely destroyed two villages in Nicaragua, killing more than 2,500 people. The USGS worked with Central American geologists in Nicaragua, El Salvador, and Guatemala to produce computer-modeled maps delineating areas potentially at risk from debris flows near 10 selected volcanoes. Local authorities will use these maps to make better development decisions and mitigate the risk to populated areas.

BIOLOGICAL ASSESSMENTS OF COASTAL RESOURCES

The Pacific coast of Central America supports substantial shrimp and fishing industries, both of which were threatened by the massive flooding and sediment released into coastal areas, and the damage to coastal mangrove areas, which provide critical breeding grounds for shrimp and many species of fish. Coral reefs on the coast were also threatened by the influx of sediment-laden waters during the storm. USGS biologists have conducted extensive studies of critical ecosystems along both coasts, working closely with national and local agencies and with local shrimp industry groups. These investigations provide important benchmark data on the health of these areas and assist Central American agencies in making more informed decisions on the use of their coastal resources.

INTERNET DATA CLEARINGHOUSE

The USGS has provided computer hardware, software, and training to selected counterpart agencies throughout Central America to establish internet nodes (servers) to archive and provide access to maps, aerial photography, risk assessments, and other information relevant to disaster mitigation, preparedness, and the effective use of natural resources. This network will encourage and facilitate broader access to data and information needed by national and local officials, universities, and the general public.

GEOGRAPHIC INFORMATION SYSTEMS

A geographic information system allows multiple layers of spatial information to be combined and analyzed in a uniform geographic context. The USGS has provided GIS computer hardware, software, and training to Central American disaster-response agencies in the four-country region. These systems will be

used to evaluate hazard assessment data and to develop better response and mitigation plans.

TRAINING AND CAPACITY BUILDING

Training is a key part of the USGS program in Central America and is critical to the goal of achieving sustainable technical capacity and ensuring maintenance of equipment and systems. Since the beginning of the program in January 1999, more than 400 people have been trained from national and local government agencies. Training has included streamgage installation and maintenance, hydrologic data management and analysis, assessment of landslide and flood risk, and application of GIS technologies to disaster preparedness and development. The USGS has also strengthened the capacity of Central American counterpart agencies by providing them with computers, software, and other equipment needed for hazard assessment and data analysis.

SUMMARY

On October 25, 1998, Hurricane Mitch, the fourth most intense Atlantic Ocean hurricane on record, slammed into the Central American coastline. The hurricane packed sustained winds of 180 mph and triggered 4 days of incessant rains. The regionwide death toll was estimated at more than 9,000 and economic losses totaled more than 7.5 billion dollars.

In response to the disaster, the USGS, along with other federal and international agencies, began the Hurricane Mitch Relief Program in cooperation with the USAID. The objectives of this program were to improve the availability of basic data and information and to provide information for improved damage assessment, hazard mitigation, and management of natural resources. Objectives also included the development and distribution of base maps, aerial photography, and satellite imagery of affected countries into an integrated, computer based GIS format and the development of regional strategies for mitigation, preparedness, and response to natural hazards.

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Table of Contents