POTENTIAL EFFECTS OF CLIMATE CHANGE ON DEBRIS-FLOW HAZARDS IN NORTH AMERICA

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ABSTRACT

Global climate-change models for western North America predict warming of the mountainous regions (0.5°–5°C), decreased snowpack, increased winter flooding, and decreased summer runoff during the next several decades. This climate change is expected to result in further glacier shrinkage and retreat, increased wildfire risk, increased water runoff in high latitudes, increased drought in mid latitudes and semi-arid low latitudes, and an increase in the frequency of heavy precipitation in most areas. There are significant geomorphic ramifications of this climate-change scenario with respect to debris-flow hazards for the western mountainous regions of North America.

Climate change affects the potential for debris flows in multiple ways. Glacier shrinkage and retreat are debutressing moraines and bedrock valley walls and exposing unconsolidated and unvegetated sediment and oversteepened slopes to erosion and mass failure. Glacier shrinkage and retreat will likely lead to a temporarily increased frequency of release of glacier-dammed lakes and possibly of glacier outburst floods. Sudden water releases by these mechanisms have the potential to trigger energetic floods that can mobilize sediment and generate debris flows. Increased glacier melting and water runoff combined with permafrost thawing also may lead to increased slope failures and formation of debris flows in high-latitudes. Increased wildfire risks combined with increased frequency of heavy precipitation will likely lead to increased frequency of rainfall-runoff-triggered debris flows in mountainous terrain, especially in low to mid latitudes. Even in the absence of wildfire, increased precipitation intensity, frequency, and a longer rainfall season (shorter snowfall season) have the potential to trigger more frequent shallow landslides, which can lead to debris flows.

Over the past decade, scientists and emergency management authorities in North America have begun focusing sharper attention on geomorphic consequences of climate change for natural hazards. Field-based investigations across a broad spectrum of physiographic regions should be coupled with analyses of atmospheric events and detailed local climate models to fully anticipate and appreciate the scope of debris-flow and landslide impacts and hazards associated with 21st century climate change.

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