

An integrated socio-environmental framework for glacier hazard management and climate change adaptation: lessons from Lake 513, Cordillera Blanca, Peru

Climatic Change

June 2012, Volume 112, Issue 3–4, pp 733–767 | Cite as

Mark Carey (1) Email author (carey@uoregon.edu)

Christian Huggel (2)

Jeffrey Bury (3)

César Portocarrero (4)

Wilfried Haerberli (2)

1. Robert D. Clark Honors College, University of Oregon, , Eugene, USA
2. Department of Geography, University of Zurich, , Zurich, Switzerland
3. Department of Environmental Studies, University of California, , Santa Cruz, USA
4. Unidad de Glaciología y Recursos Hídricos, , Huaraz, Peru

Article

First Online: 23 November 2011

3 Shares

2.5k Downloads

[84 Citations](#)

Abstract

Glacier hazards threaten societies in mountain regions worldwide. Glacial lake outburst floods (GLOFs) pose risks to exposed and vulnerable populations and can be linked in part to long-term post-Little Ice Age climate change because precariously dammed glacial lakes sometimes formed as glaciers generally retreated after the mid-1800s. This paper provides an interdisciplinary and historical analysis of 40 years of glacier hazard management on Mount Hualcán, at glacial Lake 513, and in the city of Carhuaz in Peru's Cordillera Blanca mountain range. The case study examines attempted hazard zoning, glacial lake evolution and monitoring, and emergency engineering projects to drain Lake 513. It also analyzes the 11 April 2010 Hualcán rock-ice avalanche that triggered a Lake 513 GLOF; we offer both a scientific assessment of the possible role of temperature on slope stability and a GIS spatial analysis of human impacts. Qualitative historical analysis of glacier hazard management since 1970 allows us to identify and explain why certain actions and policies to reduce risk were implemented or omitted. We extrapolate these case-specific variables to generate a broader socio-environmental framework identifying factors that can facilitate or impede disaster risk reduction and climate change