The reconstruction of a glacial lake outburst flood using HEC-RAS and its significance for future hazard assessments: an example from Lake 513 in the Cordillera Blanca, Peru

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Abstract

In April 2010, an ice/rockfall into Lake 513 triggered a glacial lake outburst flood (GLOF) along the Chucchun River in the Cordillera Blanca of Peru. This paper reconstructs the hydrological characteristics of this as yet undocumented event using a 1D flood model prepared with HEC-RAS. The principle model inputs were obtained during detailed field surveys of surface characteristics and topography within the river and across the adjacent floodplain; a total of 120 cross-sections were surveyed. These inputs were refined further by eyewitness accounts and additional geomorphological observations. The flood modelling has enabled us to constrain the extent of the water surface and its elevation at each cross-section in addition to defining the peak discharge (580 m3 s−1). These modelling results show good agreement with other information about the flood including: flood marks and minimum flood levels; the lake displacement wave height; the extent of the flooded area; and the travel time from Lake 513 to the confluence with the Santa River. This demonstrates that the model offers a reliable reconstruction of the basic hydrological characteristics of the GLOF. It provides important information about the flood intensity and significantly improves our ability to model future flood scenarios along both the studied river and within neighbouring catchments. The flood hazard, defined by the flood depth during peak discharge, shows that the majority of the damaged infrastructure (houses, bridges, and a drinking water treatment plant) was only subjected to low or medium flood intensities (defined by a maximum water depth of less than 2 m). These low flood intensities help to explain why the flooding caused comparatively minor damage despite the significant public attention it attracted.