



Glacier change and glacial lake outburst flood risk in the Bolivian Andes

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Glaciers of the Bolivian Andes represent an important water resource for Andean cities and mountain communities, yet relatively little work has assessed changes in their extent over recent decades. In many mountain regions, glacier recession has been accompanied by the development of proglacial lakes, which can pose a glacial lake outburst flood (GLOF) hazard. However, no studies have assessed the development of such lakes in Bolivia despite recent GLOF incidents here. Our mapping from satellite imagery reveals an overall areal shrinkage of 228.1 ± 22.8 km² (43.1%) across the Bolivian Cordillera Oriental between 1986 and 2014. Shrinkage was greatest in the Tres Cruces region (47.3%), followed by the Cordillera Apolobamba (43.1%) and Cordillera Real (41.9%). A growing number of proglacial lakes have developed as glaciers have receded, in accordance with trends in most other deglaciating mountain ranges, although the number of ice-contact lakes has decreased. The reasons for this are unclear, but the pattern of lake change has varied significantly throughout the study period, suggesting that monitoring of future lake development is required as ice continues to recede. Ultimately, we use our 2014 database of proglacial lakes to assess GLOF risk across the Bolivian Andes. We identify 25 lakes that pose a potential GLOF threat to downstream communities and infrastructure. We suggest that further studies of potential GLOF impacts are urgently required.