Geophysical Research Abstracts
Vol. 20, EGU2018-2080, 2018
EGU General Assembly 2018

Managing current and future lakes in the deglaciating Andes of the Vilcanota-Urubamba basin, Southern Peru

Fabian Drenkhan (1,2), Lucía Guardamino (2), Christian Huggel (1), Holger Frey (1), and Wilfried Haeberli (1)

(1) University of Zurich, Department of Geography, Zurich, Switzerland (fabian.drenkhan@geo.uzh.ch), (2) Pontificia Universidad Católica del Perú, Department of Humanities, Lima, Peru

Glacier shrinkage has uncovered many glaciated areas below 5000 m asl. in the Andes of Peru. Consequently, lakes are forming and increasing in recently exposed topographic depressions. They bear multiple risks as well as new options for human livelihoods. On the one hand, changing geomorphological and glacio-hydrological conditions might increase the probability of the occurrence of Glacier Lake Outburst Floods and imply a large number of human losses and infrastructure damage. On the other hand, new and growing lakes represent potentially important reservoirs for drinking water, agricultural use and energy supply attenuating negative impacts of shrinking glaciers in the hydrological cycle. This study combines an integrative assessment of current (1988-2016) and possible future (2050/2100) glacier and lake changes with GLOF-related hazards, hydrological risks and water management options of (new) lakes as reservoirs in the Vilcanota-Urubamba basin (Cusco, Southern Peru).

Total glacier area (volume) decreased by 37.1% (20.2%) from 229.5 km^2 (8.326 km^3) in 1988 to 144.4 km^2 (6.644 km^3) in 2016. The process of deglaciation and lake formation underlies strong spatiotemporal variability. While glacier shrinkage was strongest in the lower lying northwest (Cordilleras Urubamba and Vilcabamba), highest growth and lake extent could be identified in the Altiplano region of the southeast (Cordillera Vilcanota and Quelccaya ice cap). Periglacial lakes increased in area (number) by 15.6% (18.5%) from 23.3 km^2 (460 lakes) in 1988 to 26.9 km^2 (545 lakes) in 2016 while corresponding lake volume has grown by 9.7% from 0.637 km^3 to 0.699 km^3, respectively. New, still small lakes have particularly formed in the current deglaciation zone (4800-5200 m asl.). Below that altitude, lakes are hardly forming any longer but previously small lakes have reached considerable sizes over 10,000 m^2.

As estimated using a freezing-level approach together with global climate model data and two Representative Concentration Pathways (RCP) scenarios, future glacier areas could substantially decrease between 39.9% (RCP2.6) and 44.1% (RCP8.5) within the next decades (2031-2060) and between 40.6% and 92.2%, respectively, within this century (2071-2100). Hence, the transformation of mostly glacier-free Andean regions below ∼6000 m asl. would imply a strong loss of permanently stored water. Applying the Glacier bed Topography (GlabTop) model, a development between 14 (RCP 2.6) and 21 (RCP8.5) future lakes is estimated with an area increase between 3.2% and 7.1% and associated volume growth of 0.036 km^3 (4.6%) and 0.053 km^3 (6.9%), respectively. Our findings have particular implications for the urgent identification of robust adaptation measures embedded in local and national policies which tackle with complex hydroclimatic and socioenvironmental intertwining. Therefore, strong emphasis needs to be put on integrated and adaptive water resources planning which includes a framework of risk reduction and water storage options for identified key lakes in the context of long-term water management.