EGU21-10130
https://doi.org/10.5194/egusphere-egu21-10130
EGU General Assembly 2021

Impacts and solutions associated with glacier-driven river toxicity in the Cordillera Blanca, Peru

Moya Macdonald[1], Jemma Wadham[1], Fiorella La Matta Romero[2], Jon Hawkings[3], Bram Willems[4,5], and Raul Loayza-Muro[2]

[1]School of Geographical Sciences, University of Bristol, Bristol, United Kingdom
[2]Laboratory of Ecotoxicology, Department of Biology, Universidad Peruana Cayetano Heredia, Lima, Peru
[3]Earth, Ocean & Atmospheric Science Department, Florida State University, Tallahassee, United States of America
[4]Centro de Competencias del Agua, Lima, Peru
[5]Faculty of Science and Philosophy, Universidad Peruana Cayetano Heredia, Lima, Peru

Approximately 70% of the world's tropical glaciers are found in Peru, with 40% of these in the Cordillera Blanca (CB). Here, glaciers are an important source of meltwater to downstream people (~0.25 million) and ecosystems, supporting 40% of streamflow in the dry season. However, the CB has experienced high levels of glacier retreat and mass loss in recent decades, which has influenced the quantity and quality of water supply. During this time, some meltwater-fed rivers have become 'toxic', characterised by low pH and high metal concentrations. This toxicity has been linked to exposure of sulphide- and metal-rich rock types as glaciers retreat, and has implications for clean water supply (SDG 6), subsistence farming (contributing to SDG1 and 2), and freshwater biodiversity (SDG 15). Here, we present a comprehensive spatial analysis of water quality in the CB to understand the key drivers of worsening water quality and to predict which catchments may be vulnerable in the future. We sampled 18 glacierised catchments in the CB for geochemical and biological parameters during the dry and wet seasons. River pH ranged from 2.5 to 8.3, with two catchments highly acidic (~pH 2.5-3.8). The concentrations of several riverine metal species (including manganese, nickel, copper and a suite of rare-earth elements) were strongly negatively correlated with pH in the catchments. Additionally, most of the 40 metals analysed in rivers with low pH were present in a truly dissolved phase (>90% of 0.45 µm filtered concentrations were <0.02 µm), indicating high potential bioavailability and biotoxicity. Indeed, shifts in community composition of benthic macroinvertebrates indicated a replacement of sensitive benthic macroinvertebrate taxa (Limnephilidae, Hyaleliidae) in pristine rivers by more tolerant taxa (Chironomidae) in acidic rivers. We suggest that metal leaching and altitude may be important factors influencing diversity, richness and abundance of benthic macroinvertebrate communities. Here, we synthesize data on water quality and glacier retreat, offer predictions of future river toxicity and introduce a novel citizen-science, green-infrastructure initiative being developed to combat water quality degradation in the region.