11:00 am 9th September 2024

109116: Wetland contributions to dry season streamflow in a high-Andean glacierised headwater watershed

Tom Gribbin | British Geological Survey / University of Birmingham, UK | United Kingdom

Authors:

Tom Gribbin | British Geological Survey / University of Birmingham, UK | United Kingdom

Jonathan D. Mackay | British Geological Survey / University of Birmingham, UK

Alan MacDonald | British Geological Survey, UK | United Kingdom

David M. Hannah | University of Birmingham, UK

Wouter Buytaert | Imperial College London, UK | Ukraine

Jan R. Baiker | Asociación para la Conservación y Estudio de Montañas Andinas-Amazónicas (ACEMAA), Peru | Peru

Nilton Montoya | Universidad Nacional de San Antonio Abad del Cusco (UNSAAC), Peru | Peru

L. Baker Perry | Appalachian State University, USA | United States

Anton Seimon | Appalachian State University, USA

Maxwell Rado | Universidad Nacional de San Antonio Abad del Cusco (UNSAAC), Peru

Sandro Arias | National Service of Meteorology and Hydrology of Peru (SENAMHI), Peru

Miguel Vargas | Universidad Nacional de San Antonio Abad del Cusco (UNSAAC), Peru | Peru

Over half of the world's tropical glaciers are found in the Peruvian Andes, but 56% of the total surface area has been lost between 1962 and 2020. The ongoing reduction in melt supply means that the buffering capacity of non-glacial stores is of increasing importance especially in areas with highly seasonal precipitation delivery. Across the Andes, high-altitude wetlands are one such store providing potential water resource benefits to downstream communities during dry periods, along with other ecosystem services including carbon sequestration, water quality benefits and

the support of endemic species. Globally, stable isotope sampling and melt modelling have both proved to be effective tools in mountain environments for separating seasonal snow from ice melt contributions to streamflow, with isotopes also particularly sensitive tracers of groundwater undergoing evaporation in wetland networks. However, despite the acute water resource challenges being faced in tropical glacierised headwaters, data scarcity has hindered integrated assessment of the storage and release dynamics of the non-glacial and glacial components using observations and modelling. Here we present the results of an extensive, high-resolution stable isotope sampling effort undertaken in a 53.6 km2, 16 % glacierised catchment in southern Peru. This data, along with concurrent discharge monitoring and remotely-sensed ice albedo datasets, is used to constrain an isotope-enabled glacio-hydrological model driven by a regional climate reanalysis product. Representation of on and off-ice water stores in a consistent modelling framework allows us to quantitatively assess the streamflow contributions of valley-bottom wetlands and the connected groundwater system during the prolonged April to September dry season when water availability is lowest. The results inform discussion of the likely efficacy of adaptation options designed around maintaining or expanding high-altitude wetlands.