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Runoff sources and flow paths dynamics in the Andean Páramo.

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The dynamics of runoff sources and flow paths in headwater catchments are still poorly understood. This is even more the case for remote areas such as the Páramo (Alpine grasslands) in the Andes, where these ecosystems act as water towers for a large fraction of the society. Temporal dynamics in water source areas, flow paths and relative age were assessed in a small catchment in the Ecuadorian Andes using data from the Zhurucay Ecohydrological Observatory (7.53 km2). We applied End Member Mixing Analysis, Hydrograph Separation and Inverse Transit Time Proxies to a multi-tracer set of solutes, stable isotopes, pH and electrical conductivity sampled from stream and twelve potential sources during two years. Rainfall, spring water and water from the bottom layers of Histosols (located at the foot of the hillslopes and in the riparian zone) and Andosols (located at the hillslopes) represented the dominant sources for runoff generation. Water coming from Histosols was the main contributor to stream water year-round, in line with a hydrological system that is dominated by pre-event water. Rainfall presented a uniform contribution during the year, while in drier conditions the spring water tripled in contribution. In wetter conditions, the relative age of stream water decreases, when the contributing area of the riparian zone expands, increasing the connectivity with lateral flow from hillslopes to the channel network.
Being one of the earliest in the region, this multi-method study improved the understanding of the hydrological processes of headwater catchments and allowed to demonstrate that catchments with relatively homogeneous hydro-climatic conditions are characterized by inter-annual varying source contributions.