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ZREO: Critical Zone Observations and Science at the top of the Andes

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The páramo, known as the "water tower" of Northern South America, is a high-elevation tropical ecosystem that develops above the tree line and below the perennial snow line. As such, and due to its rapid reaction to environmental changes, this ecosystem can provide valuable information as an early indicator of global change. It consists of a series of wetlands, grasslands, and lakes/ponds that provide high-quality water that sustains the economic development (e.g. hydropower generation, food production) and the rich biodiversity of the Andean region. However, despite its economic and ecological importance, the processes governing the functioning, feedbacks, and interactions among the hydrological, ecological, and biogeochemical components of the páramo remain poorly understood.

In order to advance the global understanding of these processes in the critical zone and improve the management of natural resources in the region, the Zhurucay River Ecohydrological Observatory (ZREO, 7.5 km2), a páramo catchment located in south Ecuador (3,400-3,900 m a.s.l.), was implemented with a nested monitoring network for the collection of hydrometric (e.g. rainfall, runoff, soil moisture) and biogeochemical (stable isotopes, metals, nutrients) data at different scales (from plot to catchment) since 2011. The ZREO is equipped with a broad range of sensor types, which vary from traditional water level sensors, rain gauges, and weather stations; to more advance technologies such as automatic spectrometers, laser disdrometers, eddy covariance, and weather radar sensors.

This presentation aims to introduce the ZREO critical zone observatory and the main findings and undergoing research obtained through these unique field observations and modeling efforts in the tropical Andes. These findings include the determination of: 1) the main sources of water contributing to runoff; 2) the mechanisms governing rainfall-runoff processes; 3) the influence of landscape features on the hydrology of the ecosystem; and 4) the factors influencing the ecosystem's high water production, regulation, and storage capacities. Undergoing research is related to the monitoring of high-resolution of water quality parameters (e.g., electrical conductivity, BOD, COD, turbidity, water stable isotopes) to be used in hydrological applications, the collection of fog to understand its influence on the ecosystem's water balance, and the monitoring of soil-plant-water relations in the highest tree line of the planet.