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Supporting community-based climate change adaptation by a low-cost microclimate observation network in the northern Ecuadorian Andes

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Abstract

The Northern Ecuadorian Andes (NEA), a critical global biodiversity hotspot, faces acute socio-ecological risks resulting from intensive land use and climate change. In 2024, a severe drought facilitated the spread of fires in urban and rural areas around Quito. Only a few months later, the same region experienced intense precipitation events that caused flooding of infrastructure and soil erosion, e.g., by landslides. However, the imprint of these extremes varied strongly from valley to valley, reflecting sharp contrast in topography and land use. Country-wide syntheses revealed that past extreme events left contradicting signals in the high-elevation transition zone between the Pacific and the Amazon slopes where the Metropolitan District of Quito with 2 Mio. inhabitants is located.

To support local climate-change adaptation, we need a better understanding of the sensitivity of local landscapes to climatic extremes, especially to what extent the presence and condition of forest vegetation can buffer local microclimate compared to more open land uses. The sparse coverage of weather stations and the limited spatio-temporal resolution of gridded weather and climate observations such as from the Climate Hazards Group Infrared Precipitation with Stations (CHIRPS), complicate community efforts to integrate climate data in land-use adaptation planning.

In 2024, we therefore established a first network of around 25 low-cost soil moisture and temperature sensors (TOMST TMS) in different land-use types between c. 2000 and 4000 m a.s.l. north and east of Quito, designed for long-term community use. We will present first results from the transition from the dry to the wet season in 2025 across land-use types in comparison to existing weather data and a new weather station in the upper Rio Piganta catchment. Using simple plot-scale metrics of vegetation structure derived from mobile laser scanning (MLS), we will test the effect of vegetation for buffering the microclimate. Overall, we aim to provide a first assessment of the sensitivity of local landscapes and land-use systems in the valleys near Quito and to discuss to what extent these easy-to-handle observational data can support local communities and decision makers in integrating climate and microclimate information into land-use planning.

Keywords: Andes mountains, climate change adaptation, community work, droughts, Ecuador, forest fires, land use change, microclimate, soil moisture, vegetation structure

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