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Microclimatic variability in diversely used landscapes of the Northern Ecuadorian Andes: an exploratory investigation of the sites Atahualpa and Mojanda

Mountain regions are among the most dynamic climate spaces on Earth. In the tropical Andes of Ecuador, complex topography leads to pronounced differences in temperature, moisture, and radiation over very short distances. These microclimatic conditions are closely linked to vegetation structure, influence local biodiversity, and may buffer or amplify species exposure to broader climatic changes. Therefore, small-scale microclimatic differences are directly relevant to the preservation of regional biodiversity. However, systematic field measurements at the scale of a few hundred metres are largely absent in the Ecuadorian Andes.

This bachelor's thesis aims to ask how strongly and characteristic temperature and soil moisture differ at a small spatial scale in order to comparatively describe microclimatic variability between pastureland, páramo grassland, and mountain cloud forest. To address this, 27 TOMST sensors (model TMS-4) were installed in September and October 2025 at the sites Atahualpa (2,100 m a.s.l.) and Mojanda (4,010 m a.s.l.). These sensors continuously measure near-surface temperature as well as soil moisture at fifteen-minute intervals, enabling high-resolution recording of microclimatic conditions directly within the habitat of organisms. In addition, terrain parameters such as elevation, aspect, vegetation cover, and slope form are recorded, alongside remote sensing data from Sentinel-2 imagery and digital elevation models.

The analysis of the TOMST data is carried out using descriptive statistics as well as variance and correlation analyses in R, employing the myClim package in R. First results will be used to discuss how strongly soil and near-surface temperature and soil moisture vary over short distances between the study sites and which terrain properties drive these differences.

A better understanding of these small-scale microclimatic patterns provides an empirical basis for assessing habitat quality, modelling biodiversity patterns, and developing land management and climate adaptation strategies in the northern Ecuadorian Andes.

The findings furthermore support an ongoing collaboration with local groups. By making small-scale microclimatic patterns legible, the results can provide farmers and land managers with a concrete empirical basis for assessing local drought intensity and temperature trends, thereby informing community level climate adaptation in an area increasingly affected by droughts.