

Microclimatic variability in diversely used landscapes of the northern Ecuadorian Andes: An exploratory investigation of the site Atahualpa

Introduction

Tropical montane ecosystems of the northern Ecuadorian Andes are a **global biodiversity hotspot** and increasingly affected by climate and land-use change (De Frenne et al., 2021). Standard weather stations capture **macroclimate** rather than the small-scale **microclimatic** conditions near the ground or beneath the canopy. However, topography and landcover generate substantial microclimatic variability over short distances, with important consequences for biodiversity and species distributions (Klinges et al., 2024). Small-scale empirical data from this region remain **limited**.

➤ **Objective:** Quantifying the influence of land use and topography on microclimatic variability, using sensor-based measurements and landscape characterization.

Questions and Hypotheses

- Research questions**
- How does land use influence microclimatic conditions across the study plots?
 - Is microclimatic buffering associated with vegetation structure?
 - Do topographic variables explain variation in microclimate?
- Hypotheses**
- H1: Microclimatic buffering increases with vegetation structural complexity.
 - H2: Forests show lower microclimatic variability than open land-use types.
 - H3: Topographic position significantly affects microclimatic conditions, with sheltered sites showing lower variability than exposed sites.

Study area

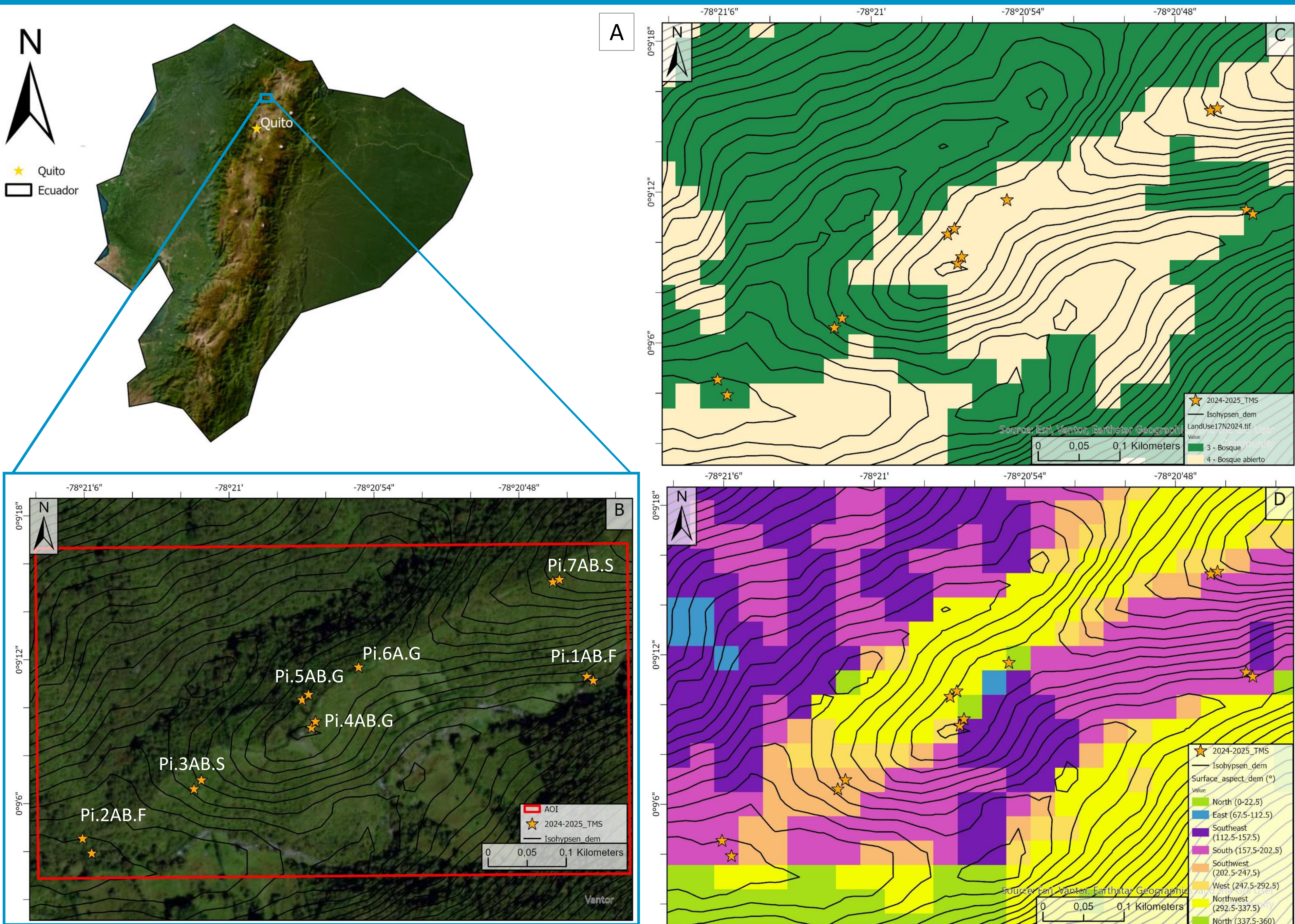
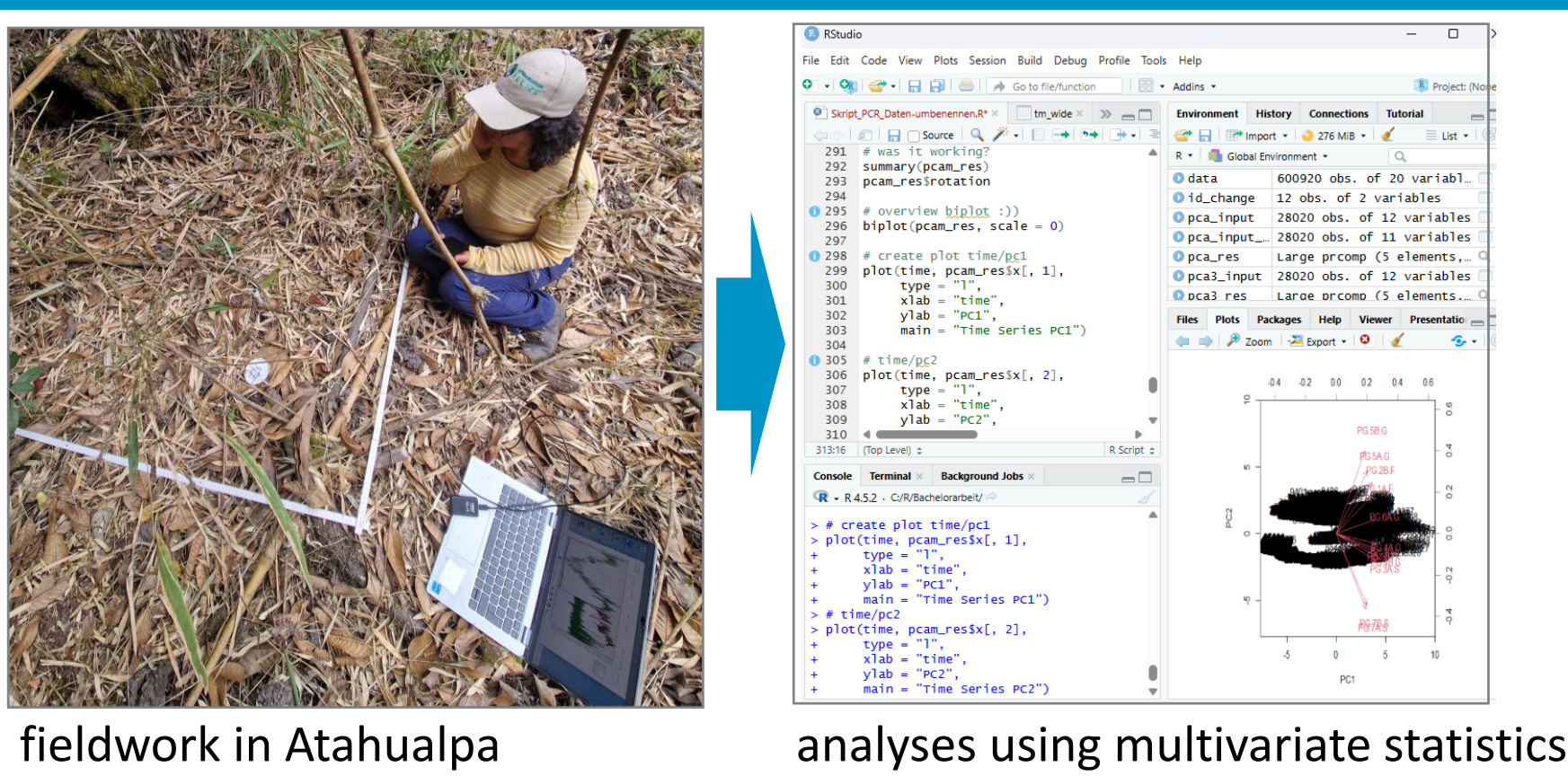


Fig. 1: A. Overview map of Ecuador to locate the study area. B. Study area Atahualpa, a forest region within the Rio Piganta catchment. C. Atahualpa divided in land use types. D. Atahualpa divided in surface slopes.

Methods

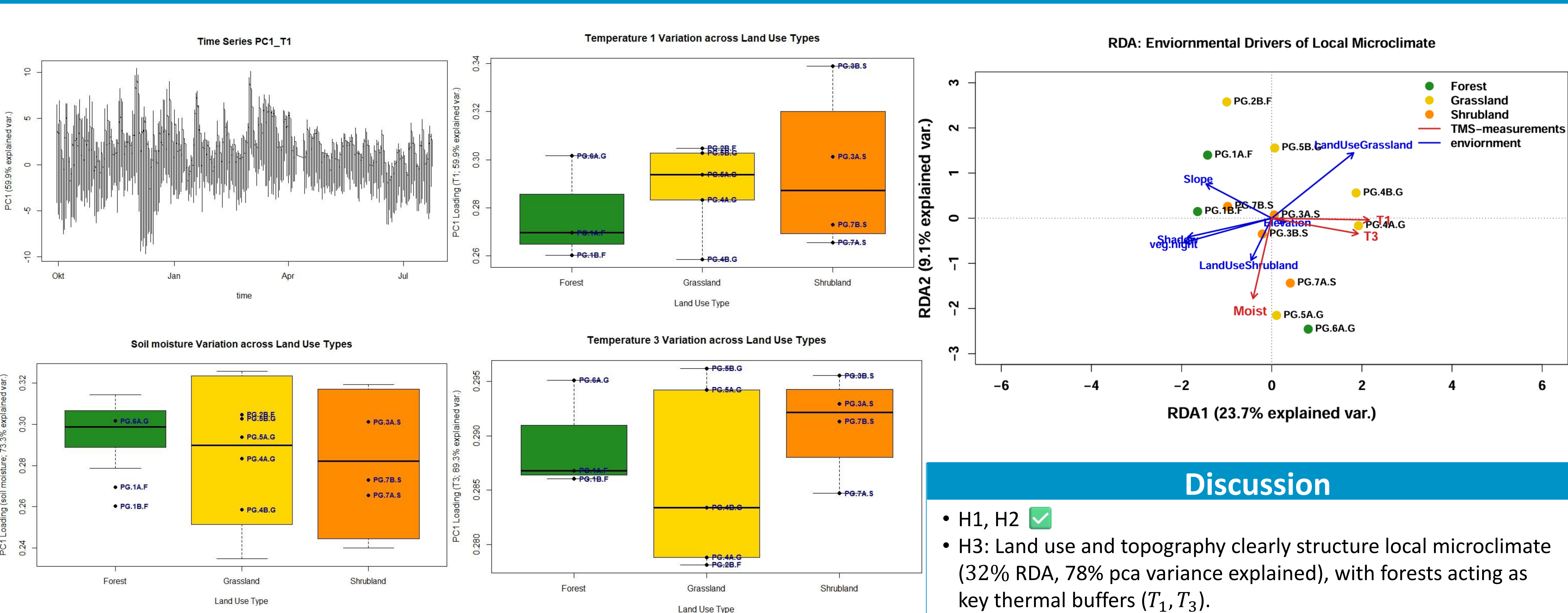


- Sensor network (Fig. 1)**
- 13 TOMST sensors (model TMS-4) installed on 6 plots in Sept. 2025 → 10 months data (24/7/26)
 - plots across a hypsometric gradient: 2271m a.s.l. – 2411m a.s.l.
 - record temperature and soil moisture at:
 - 6 cm: subsurface (-T1 and soil moisture)
 - +2 cm: above ground surface (T2)
 - +15cm: above ground surface (T3)

- Landscape characterization (1m²)**
- i) **Topographic characterization (compass, GIS)**
- elevation (m a.s.l.)
 - slope, exposition/aspect
- ii) **Land use and landcover characterization (in situ)**
- vegetation stratification, dominant vegetation
 - soil type
 - shadowing (by surrounding vegetation)

- Data analyses (R)**
- multivariate statistics (PCA, RDA)

Preliminary Results



Discussion

- H1, H2 ✓
- H3: Land use and topography clearly structure local microclimate (32% RDA, 78% pca variance explained), with forests acting as key thermal buffers (T_1 , T_3).

