Examining the thermal characteristics of a highly diverse Andean mountain ecosystem in southern Ecuador

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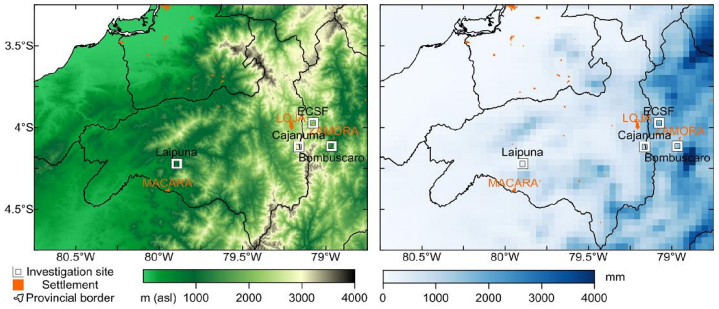
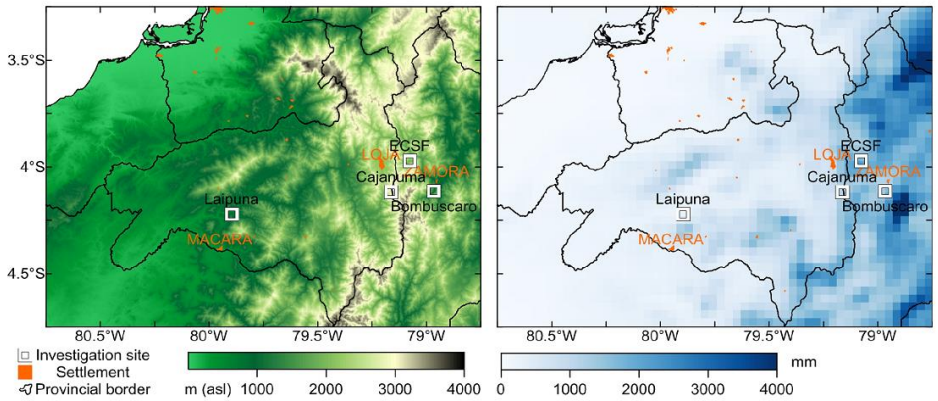


Model set up

In-situ data



Predictors

Elevation

Slope

Aspect

TPI

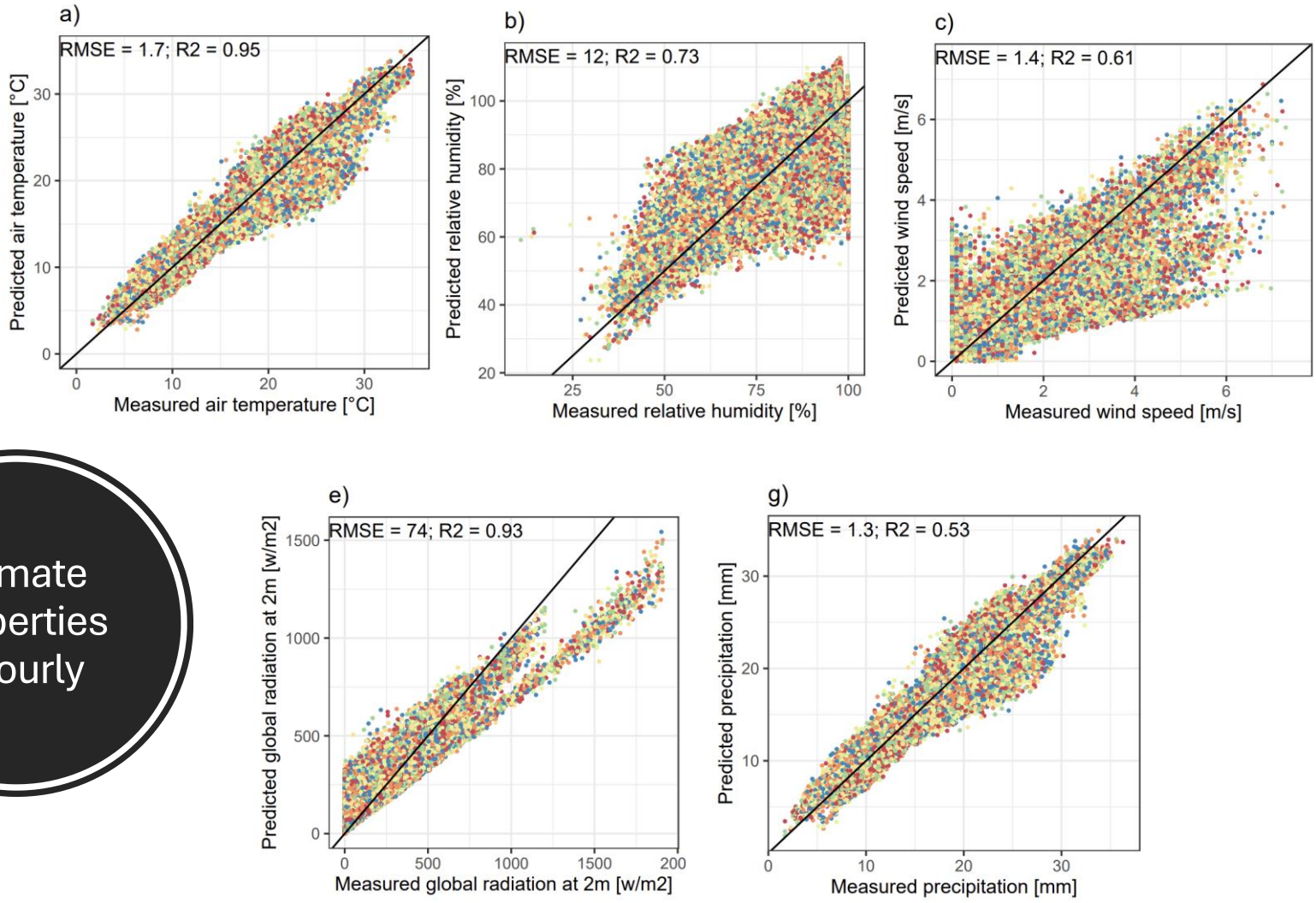
Land cover

Cloud frequency

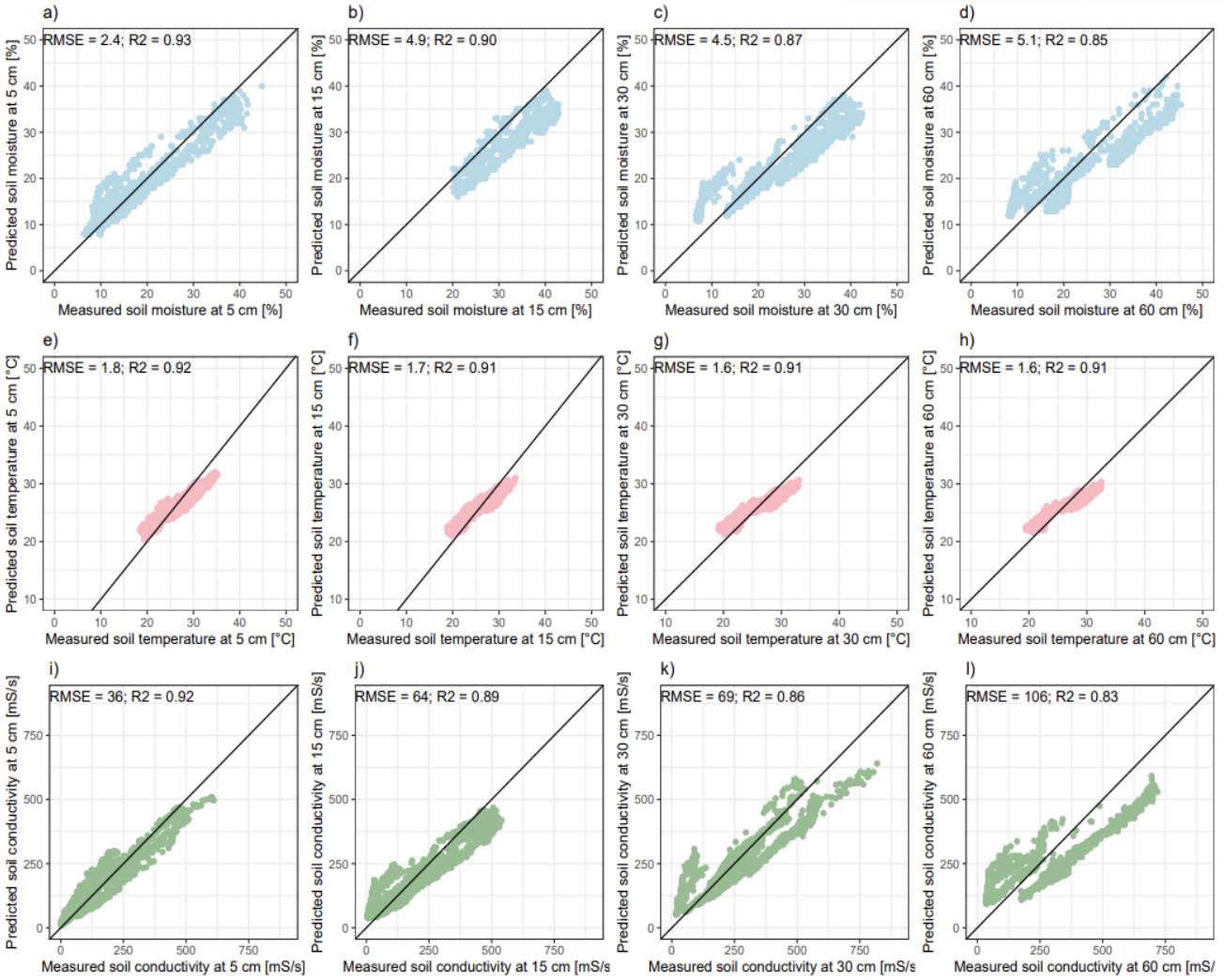
Relative humidity

Partial Least Square regression model

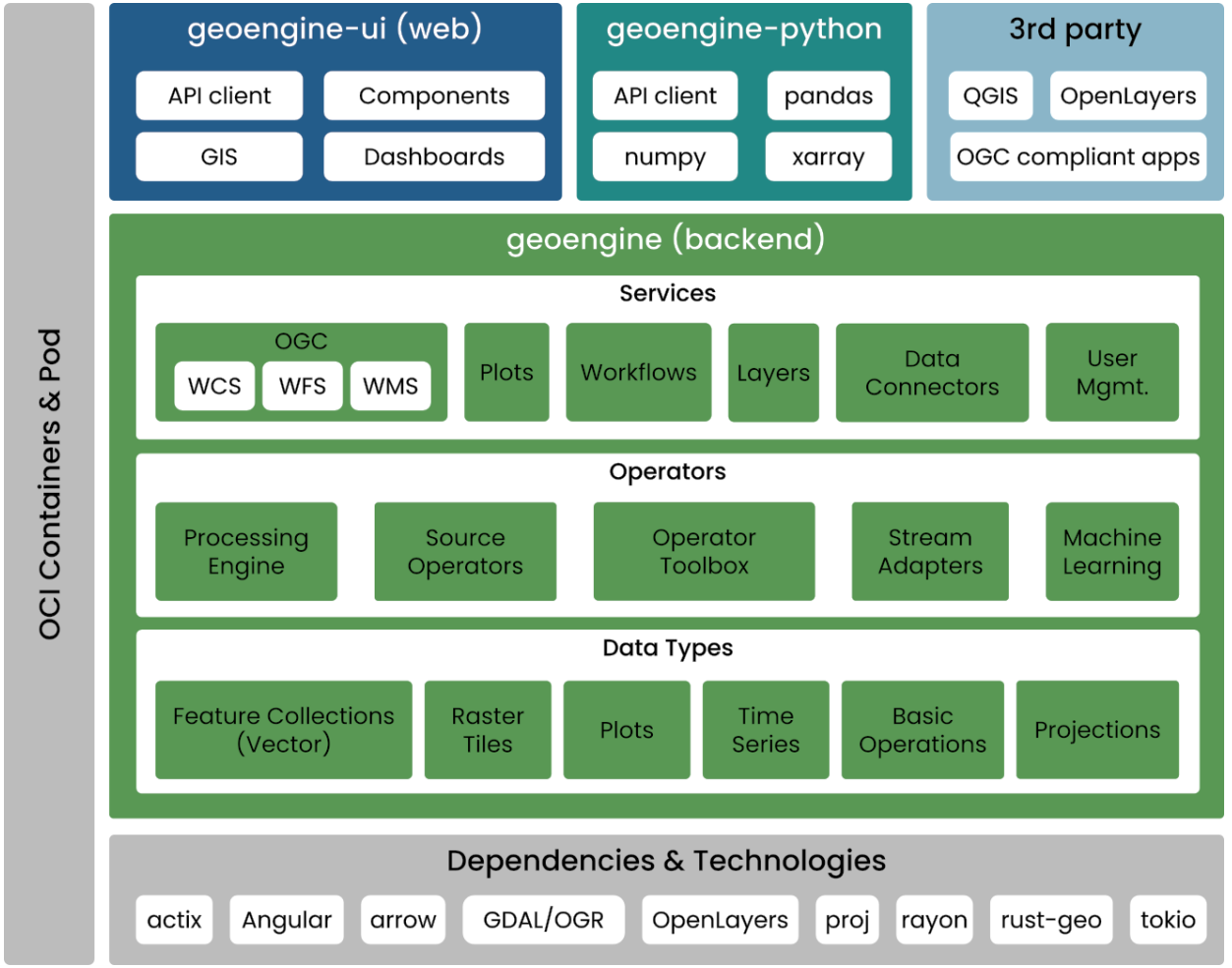
Climate properties - hourly



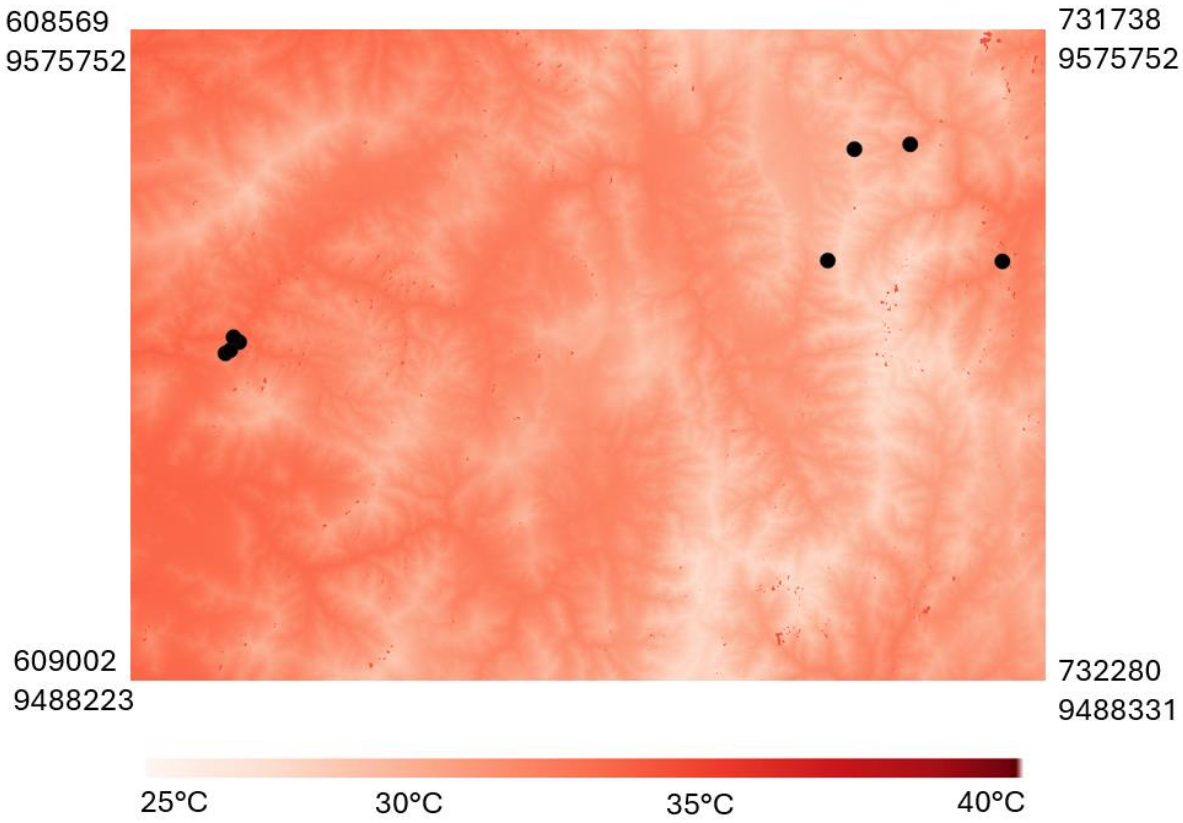
Soil properties - hourly



GeoEngine


OCI Containers & Pod
geoengine-ui (web)
API client
Components
GIS
Dashboards
geoengine-python
API client
pandas
numpy
xarray
3rd party
QGIS
OpenLayers
OGC compliant apps
geoengine (backend)
Services
OGC
WCS
WFS
WMS
Plots
Workflows
Layers
Data Connectors
User Mgmt.
Operators
Processing Engine
Source Operators
Operator Toolbox
Stream Adapters
Machine Learning
Data Types
Feature Collections (Vector)
Raster Tiles
Plots
Time Series
Basic Operations
Projections
Dependencies & Technologies
actix
Angular
arrow
GDAL/OGR
OpenLayers
proj
rayon
rust-geo
tokio

Prediction



- Thermal amplitudes are low during the primary rainy season - However, they become more pronounced in the relatively dry season
- Lower pasture areas experience the most extreme thermal conditions,
-The atmosphere within the mountain forest remains slightly cooler

2. Methods

Climate and soil properties were retrieved from 10 climate stations located in the south of Ecuador: Bombuscaro, ECSF, El Tiro, Laipuna, LAF1200, LAP1200, LAP600, LAM600, LAF600 and Cajanuma Tower. The stations and properties are described in Tables 1 and 2.

Out of each property the hourly, daily and monthly average was calculated. The averages were then predicted into the area of south Ecuador using Partial least square regression (PLS). The predictors were following raster layer: Elevation calculated from project-internal LiDAR data; Slope calculated according to Fleming and Hofer 1979; Aspect calculated according to Ritter 1987; Topographic position index (TPI) calculated according to Wilson et al. 2007; and land cover estimated from Sentinel2 data by conducting supervised classification. The land cover classes were: forest, pasture and paramo. The PLS models were validated using Leave-one-out validation.

Table 1. Summary of climate stations

Station	Coordinates		Data availability
Bombuscaro	725912.164	9544934.973	2007-2024
ECSF	713588.786	9560659.436	2017-2024
El Tiro	706078.830	9559943.367	2017-2024
Laipuna	623701.667	9534051.043	2003-2024
LAF1200	621834.880	9532605.402	2022-2024
LAP1200	621834.880	9533033.000	2022-2024
LAP600	623724.285	9534795.000	2022-2024
LAM600	623756.879	9533850.856	2022-2024
LAF600	623280.242	9539307.031	2022-2024
Cajanuma Tower	702580.029	9545027.880	2022-2024

Table 2. Summary of climate and soil parameters.

Parameter	Height [m]	Units	Time period
Air temperature	2	°C	2020 - 2024
Relative humidity	2	%	2022 – 2024
Wind speed	3	m / h	2022 – 2024
Wind direction	3	°	2022 – 2024
Global radiation	2	w / m	2020 – 2024
Downwelling radiation	2	w / m	2020 - 2024
Precipitation	2	mm	2022 - 2024
Soil temperature	-0.05	°C	2022 – 2024
Soil temperature	-0.15	°C	2022 – 2024
Soil temperature	-0.30	°C	2022 – 2024
Soil temperature	-0.60	°C	2022 – 2024
Soil moisture	-0.05	%	2022 – 2024
Soil moisture	-0.15	%	2022 – 2024
Soil moisture	-0.30	%	2022 – 2024
Soil moisture	-0.60	%	2022 – 2024
Electric conductivity	-0.05	mS / s	2022 – 2024
Electric conductivity	-0.15	mS / s	2022 – 2024
Electric conductivity	-0.30	mS / s	2022 – 2024
Electric conductivity	-0.60	mS / s	2022 – 2024

Table 3. Number of hourly, daily, and monthly models; and their performance.

Figure 1. Measured and predicted climate parameters hourly.

Figure 2. Measured and predicted soil parameters hourly.

Figure 3. Measured and predicted climate parameters daily.

Figure 4. Measured and predicted soil parameters daily

Figure 5. Measured and predicted climate parameters daily.

Figure 6. Measured and predicted soil parameters daily

Figure 7. Example of prediction of air temperature at 2m on the 4.4.2022. The black dots are positions of the climate stations.