Theme 3 | Soil data for policy and decision-making

Pedoclimates control responses of SOC to long-term land uses: a legacy soil data approach and implications for policies on carbon sequestration

Pereira, Luís Flávio[1]*; Miranda, Hycaro[1]; Gomes, Lucas C.[2]; Knaip, Julia B.[1]; Cruz, Gabriela B.[1]; Francelino, Márcio R[1]; Fernandes-Filho, Elpídio I.[1]

[1]Federal University of Viçosa, Brazil; [2]Aarhus University, Denmark
*luis.flavio@ufv.br

Introduction

Land use effects on soil organic carbon (SOC) have been intensively investigated, but the comparative responses of SOC to land uses in tropical environments at a landscape level is not yet well known. We aimed to compare long-term effects of land use on SOC across tropical environments.

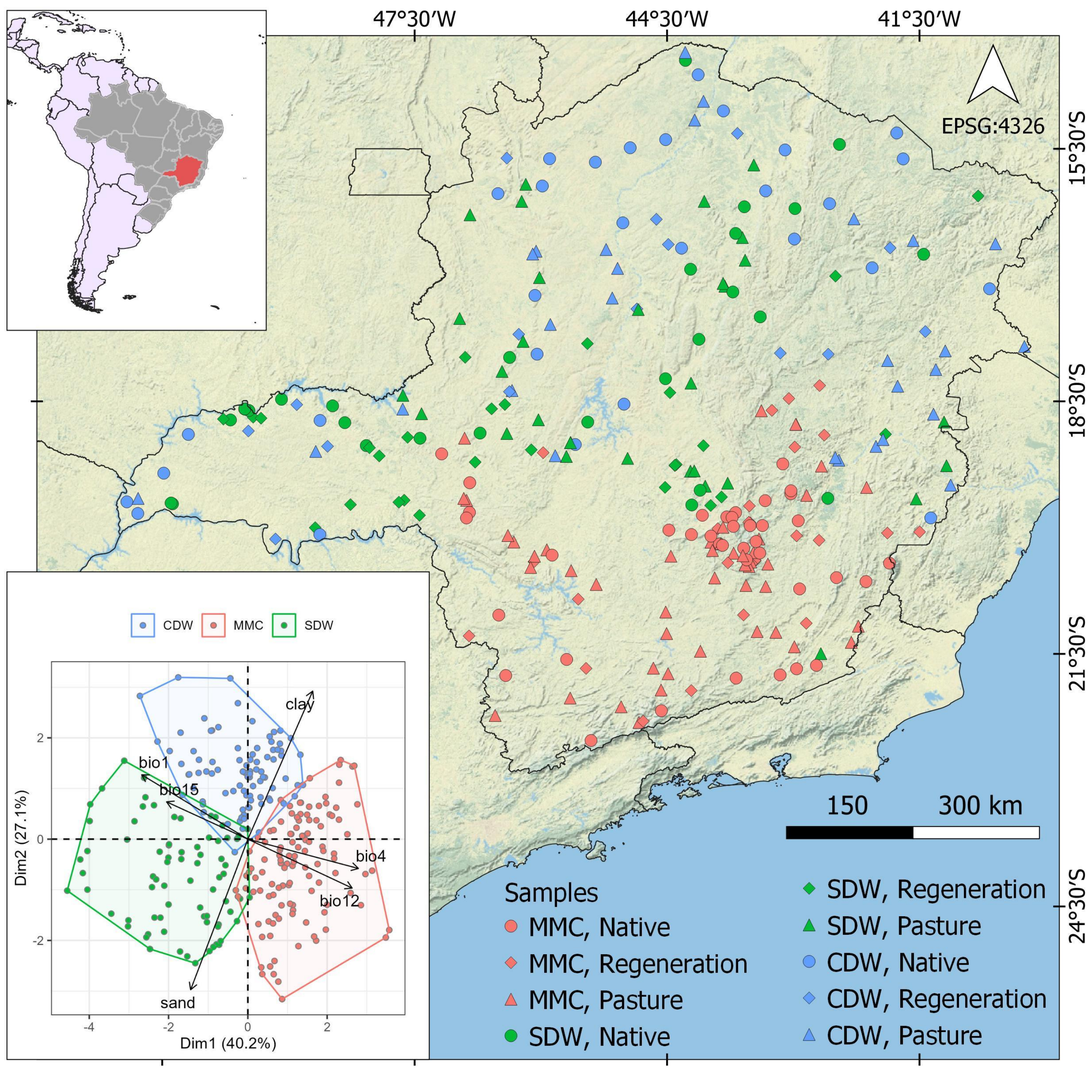

Fig. 1: Samples and their pedoclimate types and land uses in the Minas Gerais state, Brazil

Material and Methods

- Landsat, Google Earth imagery and MapBiomas data (https://brasil.mapbiomas.org/) to build land use time series (1985-2022) for all sample locations (667) in the soil bank of Minas Gerais state, Brazil (sampled in 2010-2014) (de Souza et al., 2015).
- Selection of samples under native, pasture, or in progressive natural regeneration land uses across the 1985-2014 period (279, Fig. 1).
- k-means clustering considering clay and sand contents, annual mean temperature, annual precipitation, and temperature and precipitation seasonality (Fick; Hijmans, 2017)
- Comparison of SOC contents throughout land uses and pedoclimate types.

References

Fick, S.E. and Hijmans, R.J. 2017. WorldClim 2: New 1-km Spatial Resolution Climate Surfaces for Global Land Areas. International Journal of Climatology, 37, 4302-4315. https://doi.org/10.1002/joc.5086

de Souza, J.J.L.L. et al., 2015. Geochemistry and spatial variability of metal(loid) concentrations in soils of the state of Minas Gerais, Brazil. Science of the Total Environment 505, 338–349.

Results and Discussion

We found three pedoclimate types: **clayey, seasonally dry, warm (CDW)**, **sandy, seasonally dry, warm (SDW)**; and **medium-textured, moist, seasonally cold (MMC)** (Fig. 1). CDW and MMC can store the same amount of carbon, being almost twice carbon-richer than SDW pedoclimates, what may be explained by high clay protection of SOC in CDW against higher organic inputs and lower SOC degradation due to colder conditions in MMC. Native and long-term regeneration also similarly store carbon, meanwhile pastures intensively reduced SOC contents. On the other hand, land uses presented contrasting effects on SOC according to the pedoclimate type. In SDW, SOC contents are equally low for all land uses, meanwhile the preservation of native forests is crucial for maintaining high carbon stocks that are not recovered by natural regeneration in MMC. In contrast, the natural regeneration in CDW pedoclimates might be more effective in carbon sequestration than stable native areas and pasturelands at this pedoclimate type.

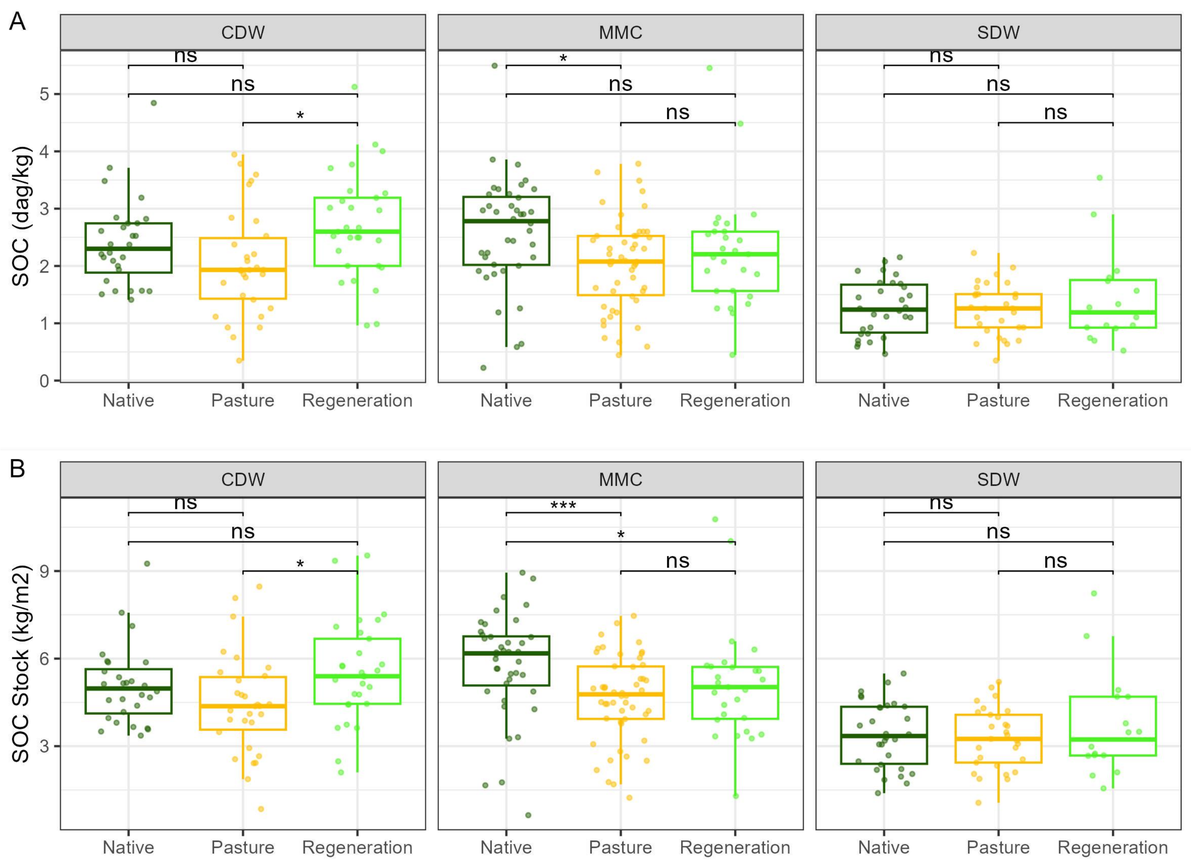

Fig. 2: Disaggregation of SOC in pedoclimate types and Land Uses. A – SOC %; B – Sock stock

Conclusions

Our results show that:

- The consideration of pedoclimate types is essential for a data-driven formulation of policies of SOC sequestration at landscape level.
- Pedoclimate types may be obtained by legacy data and must be seriously regarded by policymakers to design robust policy frameworks for boosting SOC storage in tropical environments.

LABgeo DPS - UFV | PPGSNP – UFV Pós-Graduação Solos e Nutrição de Plantas Graduate Program in Soil Science and Plant Nutrition | UFV