Theme 2 | Advances in soil mapping and monitoring

EVALUATION OF SPODIC HORIZONS THROUGH UNSUPERVISED LEARNING SUGGESTS THE NEED TO REVISE SOIL CLASSIFICATION SYSTEMS

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INTRODUCTION

Spodic horizons (Bhs) are mineral horizons formed through the process of podzolization, generated by the translocation of organometallic compounds of Aluminum (Al) and Iron (Fe). In Brazil, they are mainly found over sandy sedimentary deposits and coastal areas, being diagnostic for the classification of the Spodosols order, according to the Brazilian Soil Classification System (SiBCS). The criteria for the classification of Bhs were developed in temperate and boreal zones and imported to tropical environments.

OBJECTIVE

- This study aimed to evaluate legacy data of Bhs in tropical soils through Unsupervised Analysis (UA), in order to recognize patterns that help define criteria for the classification of Bhs in tropical environments.

MATERIALS AND METHODS

- Data available from a national environmental information database (IBGE/BDiA), which compiles major soil surveys and mappings in Brazil, as well as data from theses and dissertations, were used;
- In total, 162 samples and 33 Pedological Variables (PV) were tabulated;
- After filtering, harmonization and prediction of missing values using supervised learning (Random Forest), 131 samples, representing 81% of the original database, were retained, with 11 PVs and 3 predicted missing values (figure 1);
- Pattern recognition of Bhs clusters was performed through a UA of Principal Components Analysis (PCA). For data evaluation, the first four components of the PCA were considered, which explained 84% of the data variance;
- All processing was conducted using the R language.

Figure 1. Examples of predicted and observed data after harmonization and prediction.

RESULTS

- The PVs with the highest contributions to the analyzed components were coarse sand, fine sand, and clay contents. Aluminum Saturation (AS), pH, exchangeable aluminum contents and Total Organic Carbon (TOC) also showed significant contributions (figure 2);
- Bhs generally have a sandy texture and low clay contents, which aligns with the genesis and classification of these horizons according to the SiBCS;
- The high contribution of clay is due to the chemical reactions and physico-chemical dynamics of Al and TOC;
- Despite soil classification systems, including the SiBCS, indicating that the dominance of Fe is greater than that of Al for the classification of Bhs, the results indicate that Al contents are more important than Fe for the genesis of Bhs in tropical environments (figure 3);
- Beyond the known relationship between organic materials and metallic cations, the SiBCS does not consider minimum values of Al nor TOC for Bhs classification, making the classification of these horizons confusing and imprecise (figure 4).

Figure 2. Variable contribuitions in PCA.

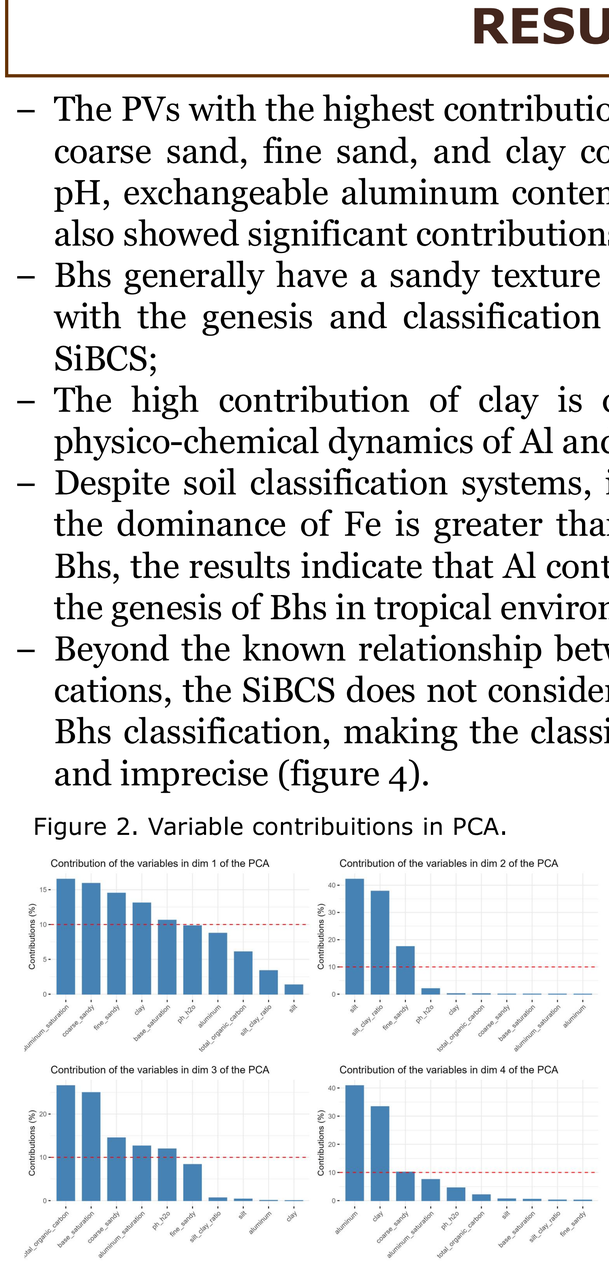

Figure 3. Behavior of variables in PCA.

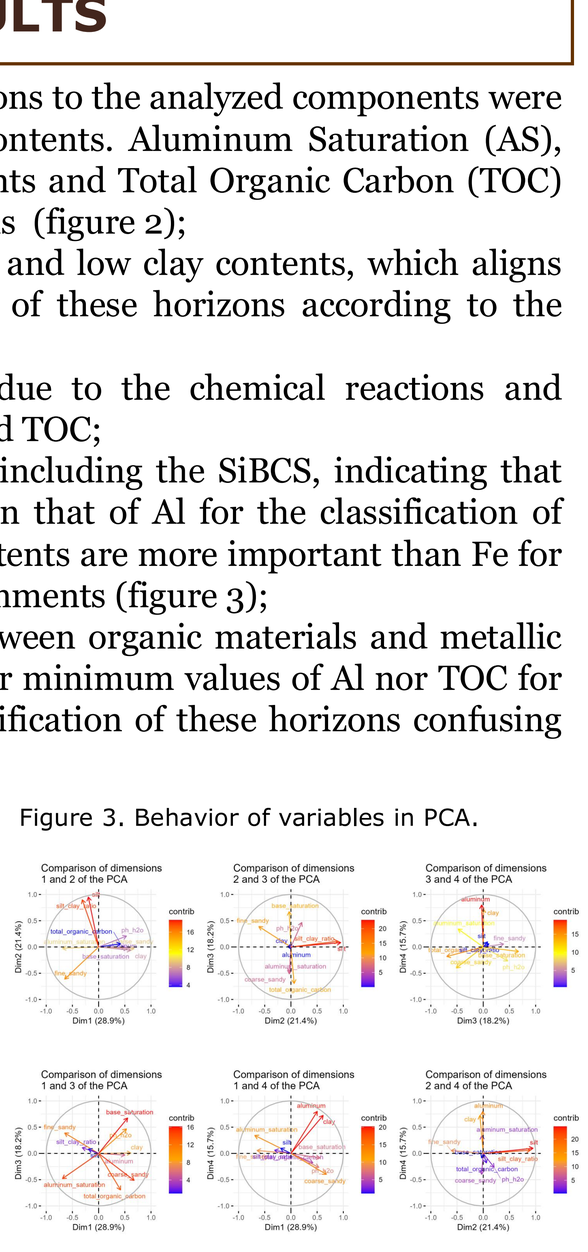

Figure 4. Grouping of Spodic horizons.

CONCLUSIONS

- In general, Bhs in tropical environments present wide chemical diversity and variability, which makes standardization for classification difficult;
- Therefore, the use of legacy data and UA tools for pattern recognition is essential to establish reference values that consider the true chemical and physical characteristics of these diagnostic horizons and assist in their classification in tropical environments.

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CAPES

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