GIS and Geomorphometry to Pedological Mapping

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Abstract

This work applied a pedological mapping methodology, in an experimental center of "APTA-Frutas" in Jundiaí, SP, using the geomorphometric parameters and GIS tools to elaborate pedologic maps. The aim of the work is show a methodology to obtain a preliminary legend of a soil map, it can guide the pedologists in the field works. The objective is compare the preliminary map with others maps made by tradicional pedological methodologies. The study area is located in a mountainous relief in the Atlantic Plateau. Is a small area with 59 hectares. The original soil map of the area was made in 1:10,000 scale in the detailed level. Was generated a digital elevation model (DEM) with 4 m of spatial resolution based in a topographical map in 1:10,000 scalle, the level curves are equidistant of 5m. Was used the TOPOGRID function with ArcInfo software. Based in the DEM are generated derivated maps like altitude, curvature and slope. Was generate a buffer around the hydrography to map hydromophic soils. Was generated frequency distribution graphics about altitude, curvature and slope maps. After interpretation of frequence distribution were defined classes to predict the soils types. The curvature map was divided in two classes intervals (< or = 0 and > 0), the altitude map was divided in four classes intervals (690 – 703, 704 – 714, 715 – 730, and 731 – 757 m), the slope map was divided in four classes intervals (0 – 9, 10 – 19, 20 – 44, and 45 – 72 %). The maps were reclassified and converted to shapefiles. In the shape file format the function INTERSECT was applied in the maps. All shapefiles were intersected with the otherrs to generate the final preliminary soil map. This methodology presents in this work showed adequate to effect the preliminary mapping of some types of soils.

1. Introduction

This work applied a pedological mapping methodology, in an experimental center of "APTA-Frutas" in Jundiaí, SP, using the geomorphometric parameters and GIS (Geographic Information System) tools to elaborate pedologic maps.

The aim of the work is show a methodology to obtain a preliminary legend of a soil map, it can guide the pedologists in the field works. The literature shows other articles with this aim (Arcoverde et al., 2005; Mühlethaler et al., 2005).

The objective is compare the preliminary map with others maps made by traditional pedological methodologies.

2. Material and Methods

The study area is located in Jundiaí, São Paulo, Brazil, in a mountainous relief in the Atlantic Plateau. The land use and land cover in the area are predominantly apple, vineyard, peach, citrus and natural vegetation. Is a small area with 59 hectares.

The original soil map of the area was made in 1:10,000 scale in the detailed level (Valadares et al., 1971), The map's legend was converted to Brazilian System of Soil Classification (Embrapa, 1999).

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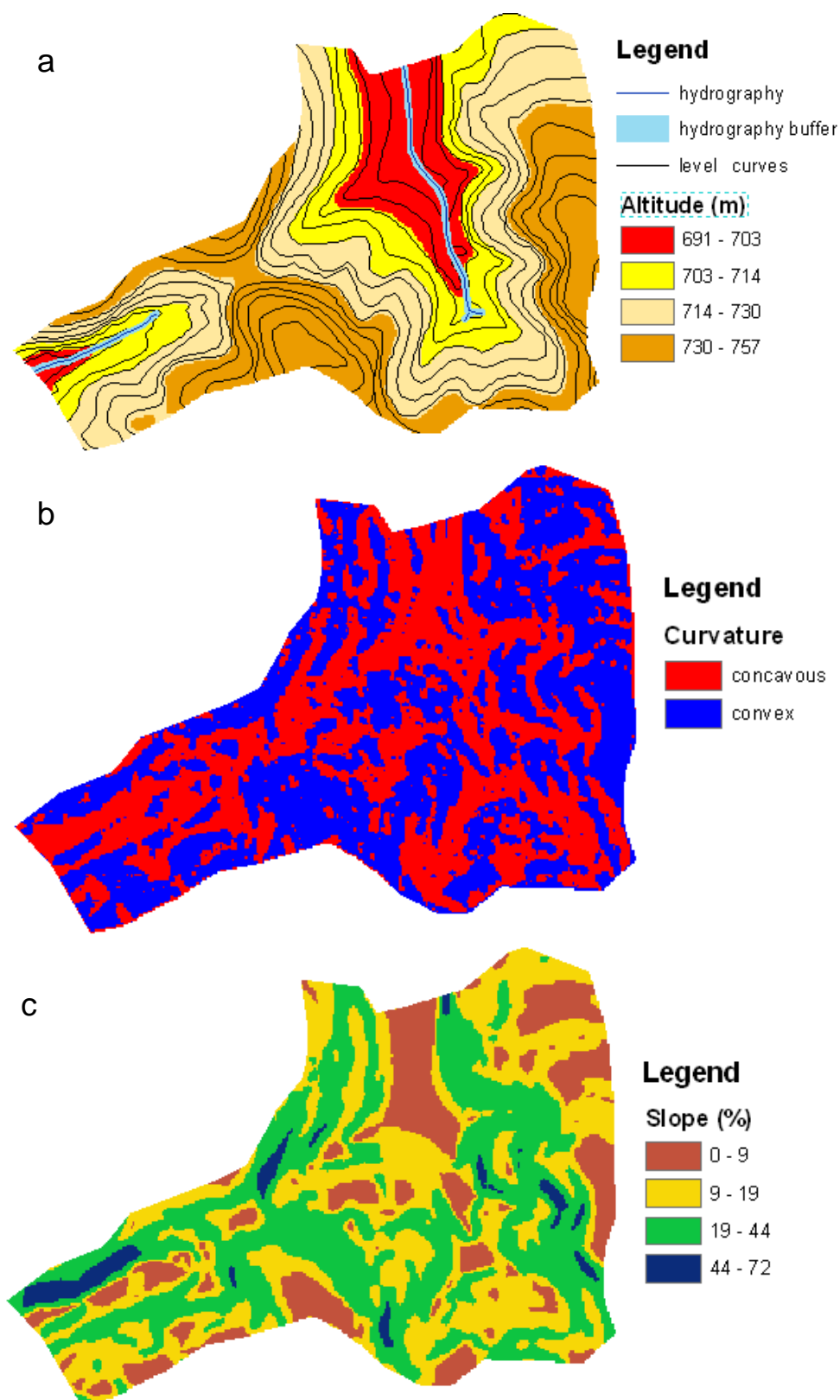E-mail address: gustavo@cnpm.embrapa.br

Fig. 1. Maps derived from DEM of CAPTA-Frutas, Jundiaí, SP, Brazil. (a) altitude with level curves, hydrography and buffer; (b) curvature; (c) slope.

Using the TOPOGRID function with ArcInfo Workstation GIS, was generated a digital elevation model (DEM) with 4 m of spatial resolution (figure 1a) based in a topographical map in 1:10,000 scalle (Melo & Lombardi Neto, 1999), the level curves are equidistant of 5m.

Based in the DEM are generated derivated maps like altitude, curvature and slope (figure 1a, b and c) with ArcGIS software. A buffer around the hydrography (Figure 1a) was made to map hydromorphic soils. Frequency distribution graphics was made about altitude, curvature and slope maps. After interpretation of frequency distribution were defined classes to predict the soils types. The joint interpretation of all the maps and INTERSECT function were necessary to generate the final preliminary soil map.

3. Results and Discussion

The curvature map was divided in two classes intervals, concavous and convex (< or = 0 and > 0), in the study area because the montainous relief plain ground (near 0) are little representative. In the concavous areas are more common soils classified like Gleissolos or Argissolos, and in the convex areas Cambissolos and Latossolos predominate.

The altitude map vary from 690 m to 757 m and was divided in four classes intervals (690 – 703, 704 – 714, 715 – 730, and 731 – 757 m). Figure 2a shows the frequency distribution graphic for altitude, based in these statistics the intervals classes were defined. In the class 690-703 m exists all of Gleissolos and a part of Argissolos, in the last class, higher than 730 m, are verified Cambissolos and Latossolos, and in the two intermediate classes (704-714 and 715-730) are verified Argissolos, Cambissolos and Latossolos. Using only the altitude map are impossible differentiate all soils types.

The slope map vary from 0 to 72 % and was divided in four classes intervals (0 – 9, 10 – 19, 20 – 44, and 45 – 72 %). Figure 2b shows the frequency distribution graphic for slope. Table 1 presents a matrix for interpretation soil types based in altitude and slope classes intervals, without consider curvature.
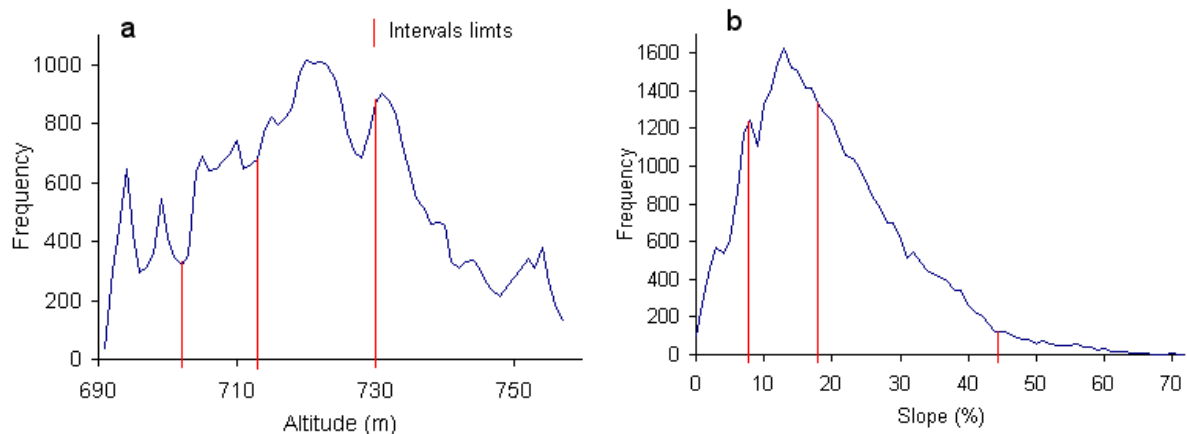

Fig. 2. Frequency distribution for altitude (a) and slope (b).

Table 1. Soil types based on altitude and slope from CAPTA-Frutas, Jundiaí, SP.

Slope classes (%)	Altitude classes (m)			
	690-703	704-714	715-730	731-757
0-9	Gleissolos	Argissolos	Latossolos	Latossolos
10-19	Argissolos	Argissolos	Argissolos	Cambissolos
20-44	Argissolos	Cambissolos	Cambissolos	Cambissolos
45-72	Argissolos	Cambissolos	Cambissolos	Cambissolos

The maps were reclassified and converted to shapefiles. In the shape file format the function INTERSECT was applied in the maps (Figure 3). First was generate a map (psoil_1) with the

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intersection between the altitude and curvature shape files, this new shape file (psoil_1) was intersect with the slope shape file, generating a second version (psoil_2). In the last time psoil_2 shape file was intersect with the hydrographic buffer shape file and generate the final preliminary soil map (Figure 4a).
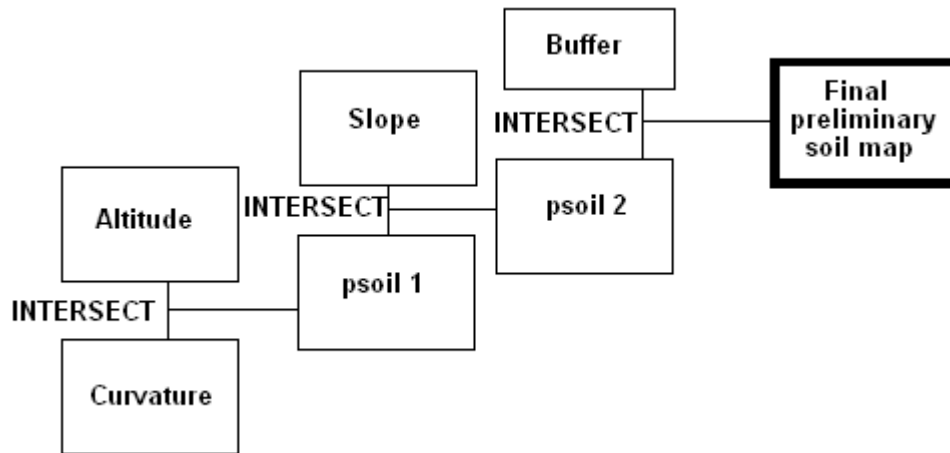
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Fig. 3. Simplified flowchart for elaboration the final preliminary soil map.

The original pedological map (Figure 4b) was crossing with preliminary soil map, in the Cambissolo Háplico the equivalence in area was 76 %, and in the Gleissolo Háplico the equivalence was 74 %, this two soils types the equivalence are high. In the Argissolo Amarelo the equivalence was 55 % and in the Latossolo Amarelo the equivalence was only 15 % in area. The Latossolo had confuse with Cambissolo because occur in the same altitude position, and have similar slope and curvature characteristics.

Soils are function of five formation factors: parent rock, relief, vegetation, climate and time. In this work was considered only the relief factor. For larges areas with lesser scales may be included in the analysis other soil formation factors to obtain satisfactory results.

4. Conclusions

The methodology presents in this work showed adequate to effect the preliminary mapping of some types of soils for detailed scale using GIS, and showed the importance of relief in formation of soils from Atlantic Plateau. To elaborate a final soil map using this methodology is necessary field work like than in traditional soil surveys and mapping.

5. References

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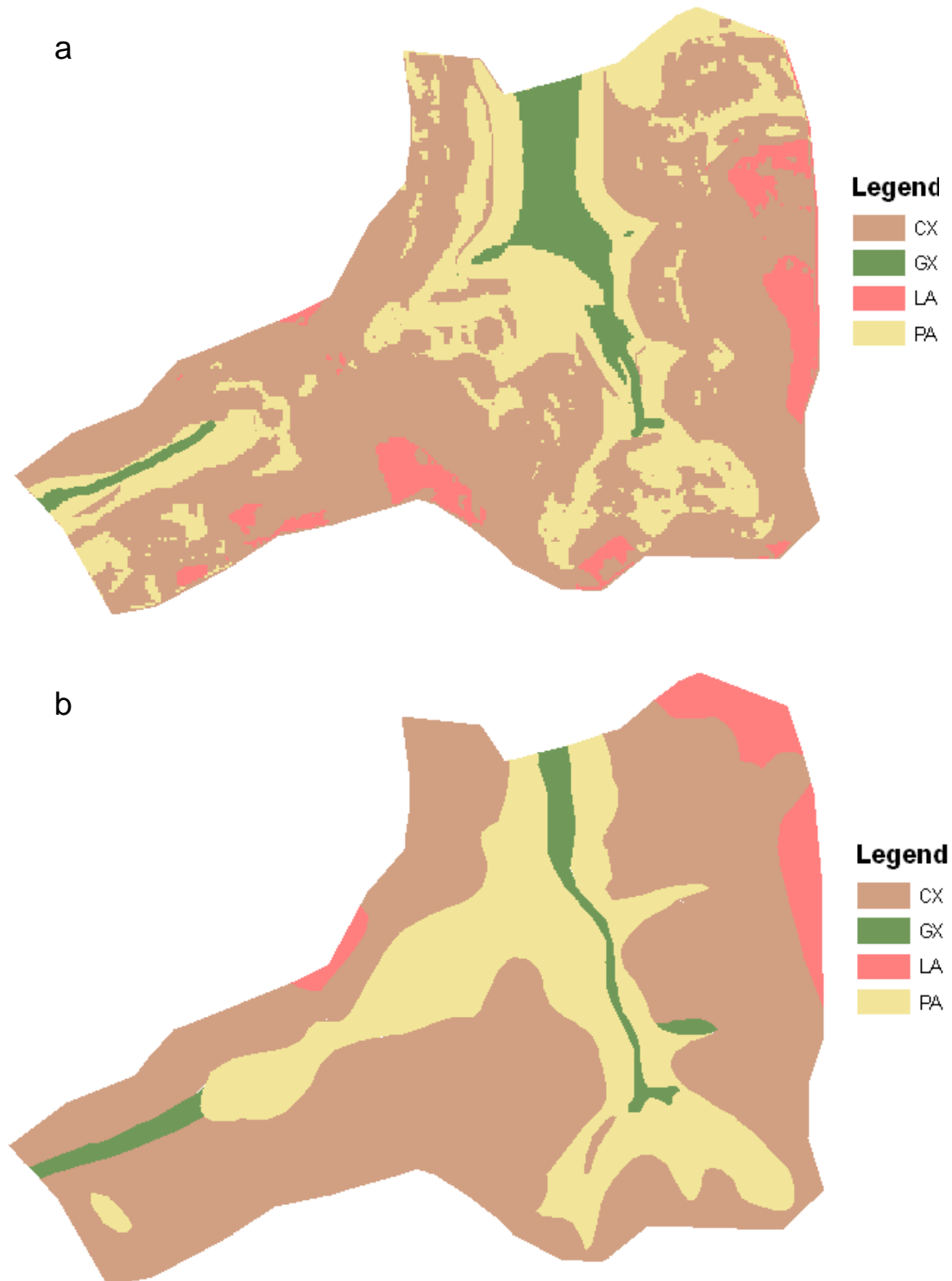
Fig. 4. Preliminary soil map derived from DEM (a), and final soil map elaborated by traditional soil mapping of CAPTA-Frutas, Jundiaí, SP, Brazil. CX: Cambissolo Háplico; GX: Gleissolo Háplico; LA: Latossolo Amarelo; PA: Argissolo Amarelo.