The use of GIS and additional information to check soil classification maps

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Abstract

The aim of this work was to check the limits of the soil classification map using GIS tools and additional information. The information from the geology map, the digital elevation model, Aster images and the detailed soil classification map was used to establish the criteria for automatic classification, using some classification attributes as local elevation, slope and pixels values in images. The new reclassified soil map was compared to the original, and sampling was performed in points in field where the maps didn't match to access the quality of results. The results showed that this method is a promising tool to obtain better quality in digital soil information and to direct sampling, but the accuracy may be limited by the resolution of the available data, and field validation is necessary.

1. Introduction

Classical methods for soil classification relay on photo interpretation, field sampling and laboratory analysis. Soil classes' borders are identified based on image similarities, vegetation types and researcher's experience, followed by the check out in field (Clarke, 1957). Usually, field work is limited by time and resource constraints, and sometimes by accessibility to many points in field. Hypsometry and slope are useful information to estimate the soil borders in unsampled points, if an adequate soil distribution model exists for the area. The availability of freely distributed digital elevation models, from the Shuttle Radar Topographic Mission (http://www2.jpl.nasa.gov/srtm/), opens the opportunity for the use of this data source to aid soil survey programs. It makes possible to use automated procedures for soil sampling planning, and to outline soil borders in unsampled areas, with current GIS software, adding quantitative information to the soil databases (Dobos et al., 2002). The aim of this work was to test the feasibility of the use of this information source, with additional data, to help soil classes identification, and to compare it to a soil survey map made by the standard procedures.

2. Material and Methods

The work area is located in the Embrapa Milho e Sorgo experimental station, on the coordinates 19° 26' S and 44° 10' W, in the city of Sete Lagoas – MG, Brazil (Figure 1). The source data were the SRTM image S20W045.hgt (downloaded from ftp://e0srp01u.ecs.nasa.gov/srtm/version2/SRTM3/South_America/), the geologic map (CPRM, 2003), the soil map (Panoso et al., 2002), and one Aster image (Abrams et al., 2006). The work was performed using the softwares ArcMap® 8.3 (Environmental Systems

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Research Institute, 2005), MapInfo® 4.2 (MapInfo Corporation, 2006), 3DEM 18.9 (Horne, 2006) and SPRING 3.4 (Camara et al., 1986).

From the digital elevation model, a hypsometric map and a slope map were generated. A thematic map of land use was created from the Aster image. These maps, and the digitized geologic map, were intersected to produce a new synthetic map, with classes that were assumed to represent areas with homogeneous soil characteristics in field. These areas were compared to the soil classification polygons in the soil map (Figure 2), and discrepant areas, with are supposed to represent ill classified patches, were assigned, and their area measured and compared to the original polygons. Some points were sampled in field for validation.

3. Results and Discussion

The synthetic map, with the main discrepant areas is presented in the Figure 3. These areas are in the contact between the main soil types for the highland areas. The lowland areas presented minor apparent errors. Table 1 shows the estimated classification errors, based on the digitized difference polygons and the original soil type polygons. The errors are high, over 50% for the first soil class, which suggests that the model used was inadequate in this case or the original soil classification needs revision. An exploratory field sampling was tried, but the number of points collected (8) wasn't enough for the validation of the model. Some problems in this classification scheme are related to the small scale of the available information. The SRTM DEM map has a pixel size of approximately 90 meters, which causes loss of resolution and distortion in the details of the maps. The geology map is in a 50.000 scale, and many borders were inferred. Error in these inferences may lead to incorrect classification of the areas. Also, diffuse boundaries in classes (intergrading) are supposed to complicate the precise delineation of the map limits. Additional field sampling is in course to validate the results.

Table 1 - Estimated classification errors. Areas in hectares.

Soil type*	Area of polygon in ha (1)	Area of discrepancy (2)	% of the area (1/2)x100
Cambissolo	198.4	103.2	52%
Neossolo	128.5	52.7	41%
Argissolo	78.0	32.3	41%

*Soil names are presented in the original Brazilian classification system.

4. Conclusions

The use of GIS with additional information is a very promising additional tool for soil survey and classification, but with the resolution nowadays available for the free access data sources, as the SRTM, it still lacks capability for high quality map border delineation. Nevertheless, tentative classification with this information may help to direct sampling in field, and to delineate the soil borders in a more objective way.

5. References

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