High resolution digital soil mapping using Soil Survey and electrical conductivity maps in the argentinean pampas

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Introduction

Increasing scale of soil map using conventional technics results in a high cost of human and economic resources, hard field working and qualitative results poorly applied in other areas (Lagacherie et al., 2006)**.**

Apparent Electrical Conductivity (ECa) can be used for high resolution digital soil mapping (DSM) (Myers et al., 2010)**. Soil ECa equipment can integrate information of soil spatial, temporal and depth variability. Geospatial measurements of ECa are quick, easy, reliable and cost-effective** (Corwin and Lesch, 2005a)**.**

The productive potential in Pampas of Argentina depends on the water storage capacity, organic matter and clay content but also effective depth (Sadras and Calviño, 2001)**. There are few reports that have used ECa to study the spatial variability of these soil properties, and thus increase the scale of conventional soil maps in the Pampas of Argentina** (Castro Franco et al., 2012; Domenech et al., 2012)**.**

The objectives of this study were to (i) develop a method for scaling up of traditional cartography, using ECa maps, soil survey and DSM methodology, and; (ii) determine the relationship between types of soils described by traditional cartography and ECa zones maps.

Materials and Methods

The study site was a 65-ha field located on the southeast of Buenos Aires Province in south Pampas of Argentina (Lat:-37.9152, Lon:-59.1321) **(Fig. 1). The R project "aqr"** (algorithms for quantitative pedology) (R Development Core Team, 2013) **was used for quantitative description of soil series. ECa was measured using Veris 3100 Soil Mapping System** (Veris Technologies, Salina, KS) **(Fig. 2).**

Soil sampling was developed using a grif of 100x50m. A total of 126 samples were collected. Organic matter (OM) **and texture were analyzed. A gird of 40x40m was developed to determine spatial variability of effective depth** (ED)**.**

GeoR by R project was used for geostatistical analyst (Diggle and Ribeiro, 2007)**. Experimental semivariograms were analyzed to establish the degree of spatial dependence of the variables, and calculate spatial autocorrelation Index of Moran. Under the assumption of spatial independence, the minimum and maximum limits of the empirical variograms were determined, through permutations of coordinate's data. From the geostatistical methods for interpolation, ECash and ECadp variables were delimited in 3 areas: ECa high, middle and low (ZECa).**

An ANOVA was run to compare OM, ED and As results by ECash and ECadp zones using R project. Models with and without statistical significance of the estimated spatial error parameters were evaluated. Differences were declared significant at the 0.05 level.

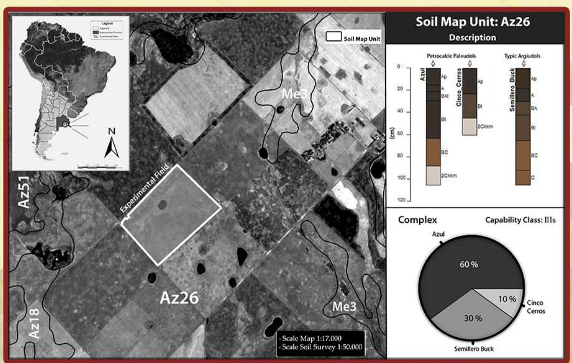
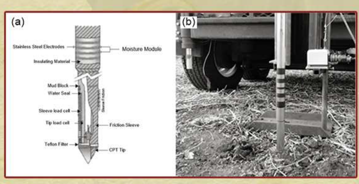
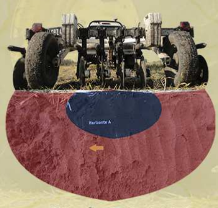


Fig 1. Experimental field and soil map unit description.



Cone Penetration Test



Veris EC 3100

Results and Discussion

Through an exploratory dendrogram was observed to a depth of 0-20 cm, series Az and CC (Petrocalcic Paleudoll) had higher As and OM content, while serie SB (Typic Argiudoll) had lower contents of both. Higher ED and lower OM and As content, were observed in the low ZECa. For medium and high ZECa As and OM contents were higher. However, these properties had no significant difference.

The lowest ED was determined in the high ZECa. These results suggested that ZECa medium and high could correspond to Az and CC series, while low ZECa to SB series.

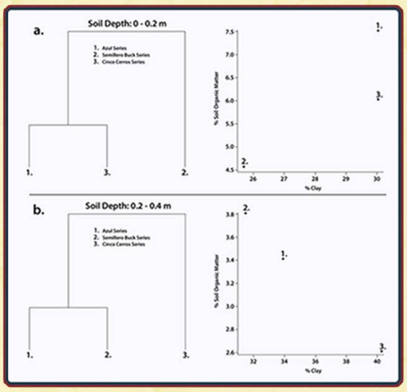
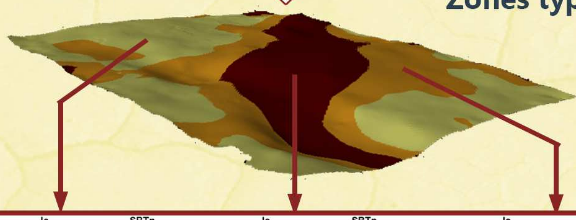


Fig 2. Description of CPT. Veris equipments and dendrograms.

Zones type areas



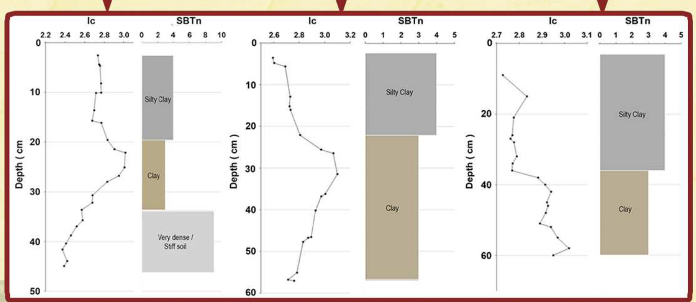


Fig 3. Stratigraphy of soil horizon layer for soil types.

Conclusion

The use of soil cartography and ECa maps allowed to determine the distribution and spatial relationships of OM, As, and the ED on a large-scale.
OM and Clay content mainly determined ECa. Vertical spatial variability of the argillic horizon was identified.

For future work would be interesting to evaluate techniques of measurement and stratigraphy of the vertical spatial variability of the argillic and petrocalcic horizons.

References

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