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The Montes del Plata Soil Spatial Inference System

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Soil is one of the prior components of a forest site, hence determining its final productivity. Effective soil management requires an understanding of soil distribution patterns within the landscape. The ability to accurately predict and map soil properties over Montes del Plata (MDP) landholdings can improve silvicultural management decisions that can result in higher and sustainable forest productivity. Today's decisions are based mainly on interpreting conventional soil maps (discrete semi-detailed) produced from local empirical experts' knowledge. Creation of conventional soil maps is a high time-consumable non-parametrizable process which result does not represent soil heterogeneous diversity, both in location and depth. In this work, we applied Digital Soil Mapping (DSM) techniques to produce continuous soil maps showing different soil-predicted property values with a concomitant measured uncertainty grade over 1,200 hectares. We were able to produce continuous soil properties maps with an average precision accuracy of 60% by developing a DSM protocol in three representative farms of MDP landholdings, in areas to be forested with *Eucalyptus* on its second cycles. A set of 53 environmental covariates was developed and harmonized at 30 m² of spatial resolution. A field sampling strategy was defined based on the Latin Hypercube sampling method, and 180 soil profiles were collected. In laboratory conditions, we perform textural and chemical analyses on 345 soil samples from A and B horizons. Vertical harmonization was applied, and properties were estimated at three standardized depths (0-30, 30-60, and 60-100). A Random Forests Model (RMF) is fitted to predict texture, organic matter, organic carbon, pH_H2O, pH_KCl, N, P, K, Ca, Mg, Al, Na, cation exchange capacity, base saturation, and profile soil depth. Our results demonstrate that DSM techniques can be successfully applied to representative MDP's landholding soils. We anticipate our preliminary work as the starting point for using DSM techniques that result in acceptable soil continuous maps in less time. However, the developed protocol performance must be tested in similar soil conditions, and an approach must be undertaken to look for a lesser sampling density. These results, in addition to focusing on only those soil parameters linked to operative silvicultural decisions (viz. P, K, Ca, and soil depth), may lead to lower final associated costs.

Keywords: Digital Soil Mapping, forest site, soils, random forests