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Beyond infrared spectroscopy and spatial analysis: SOC stocks mapping in volcanic soils of Reunion island.

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As high carbon content soils with high human carrying capacity, volcanic soils of Reunion island highlight the importance of “carbon hotspots” to face the challenges of climate change and food security trough carbon sequestration. In addition, the ‘4 per mille’ initiative demonstrated that agricultural soils can play a crucial role for these global issues but knowledge on soil organic carbon (SOC) stocks of agricultural soils is still needed in tropical areas. Reunion is a young tropical volcanic island in the Indian Ocean, 700km east of Madagascar, with three major agricultural land uses (sugarcane crops, pastures and gardening) on a volcanic rock weathering gradient from Andosols to Ferralsols. A stratification method has been used to map SOC stocks in Reunion. First, 1000 soil samples (0-30cm depth) on the major agricultural land uses across the island from a huge database containing more than 45 000 soil analyses since 1993, have been selected. Mid-infrared spectra were acquired on these dried and thieved 1000 soil samples using a portable spectrophotometer. Spatially homogenous soil units have been defined by a clustering method (K-means) from laboratory analyses (SOC content, CEC, N, ...) and mid-infrared spectra of these 1000 soil samples. Secondly, since 2016, soil samples have been collected in the field on the major agricultural land uses per spatially homogenous soil units to developed a mid- and near- infrared (MIR and NIR) spectroscopy method, both in the field (fresh soil samples) and in the laboratory (dried and thieved samples) to predict SOC stocks on 0-30 cm depth. Overall, SOC stocks can be predicted with satisfactory accuracy and directly by NIR and MIR spectroscopy in volcanic soils. In order to spatialize these results, an average SOC stock has been calculated for each combination of soil unit and agricultural land use. Then, each average SOC stock has been attributed to every agricultural field to map SOC stocks of the whole agricultural area in Reunion. The proposed methodology will produce a strong spatial baseline that will enable simulations of impacts of land use changes on SOC stocks at the island scale.

Keywords: Soil organic carbon (SOC) stocks, infrared spectroscopy, volcanic soils, spatial analysis, clustering.

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