SSS9.7 Soil organic, inorganic carbon stocks and dynamics in agroecosystems: mechanism, measurement, and modelling strategies

Evaluating the distribution and mineralization of soil organic carbon pool in relation to soil geochemistry under different land use in volcanic soils

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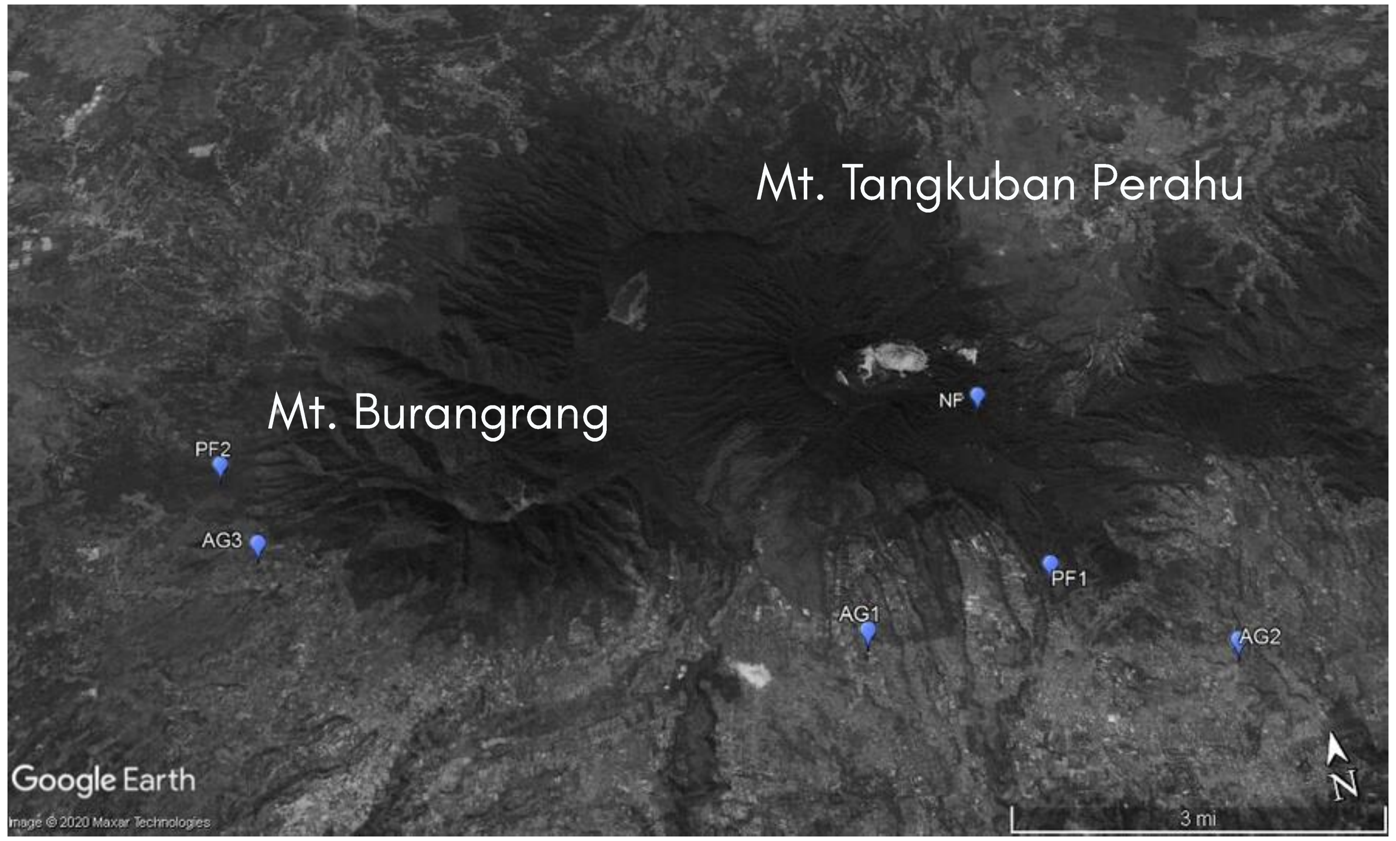
Introduction

Land use through its control on vegetation and fertilization may impact soil geochemistry which in turn influences stabilization of soil organic carbon

Objectives

1. Assessing the distribution (fractionation method by Zimmermann et al. 2007) and mineralization of SOC pool
2. Analyzing the decay rate of SOC with geochemical proxy using process-based soil genesis model, SoilGen2
3. Analyzing the SOC levels under different climate projection scenarios

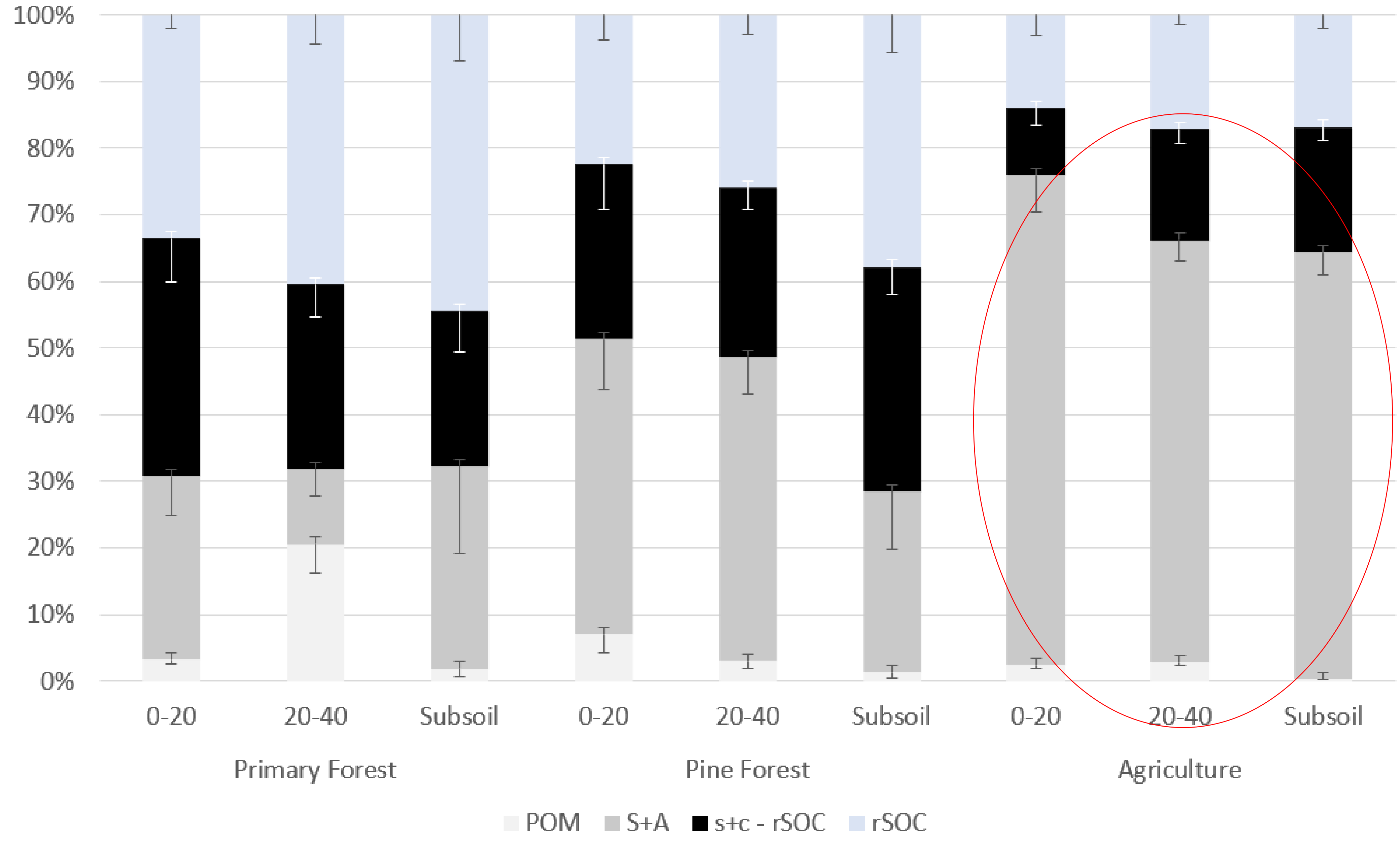
Study site



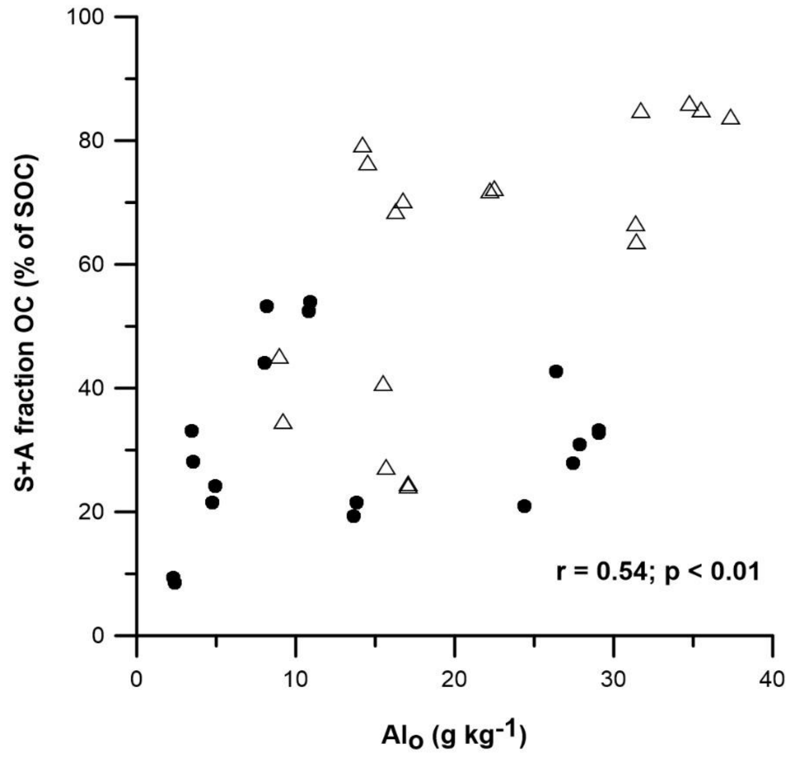
Location: Mt. Tangkuban Perahu and Mt. Burangrang (Sunda volcanic complex), West Java, Indonesia
Mean precipitation: 2000-3000 mm/year
Mean temperature: 19-25° C/year
Land use: primary forest, pine forest, agricultural land

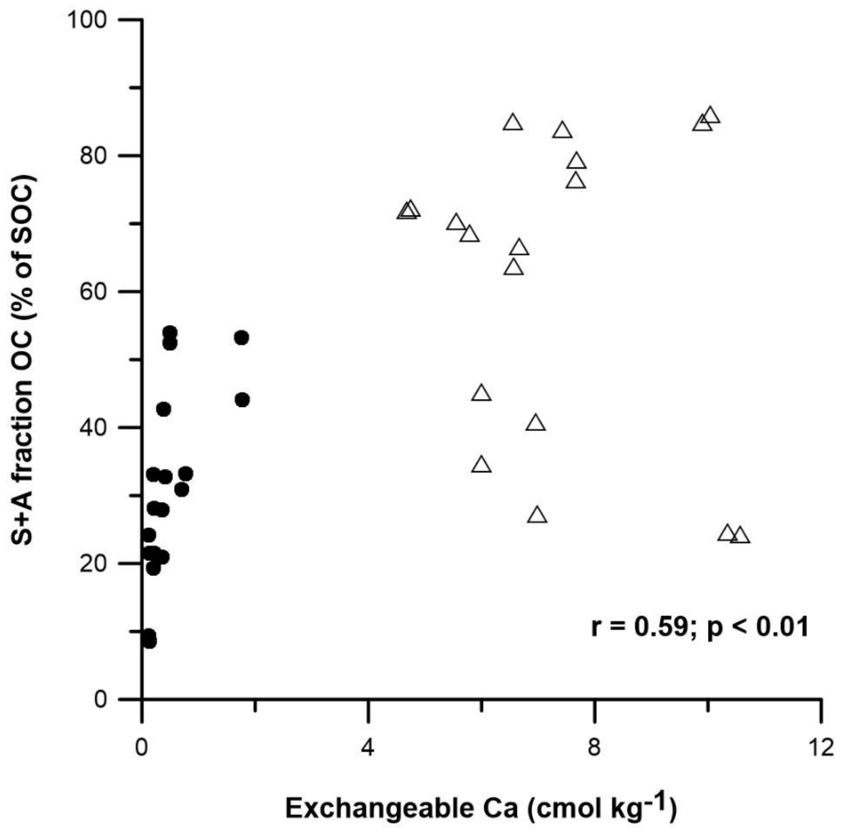
Results

Distribution of soil organic carbon and its relation to geochemical propertes



Agricultural land had > 50% aggregate fractions





Positive correlations between sand-aggregates fractions and amorphous aluminum and exchangeable Ca

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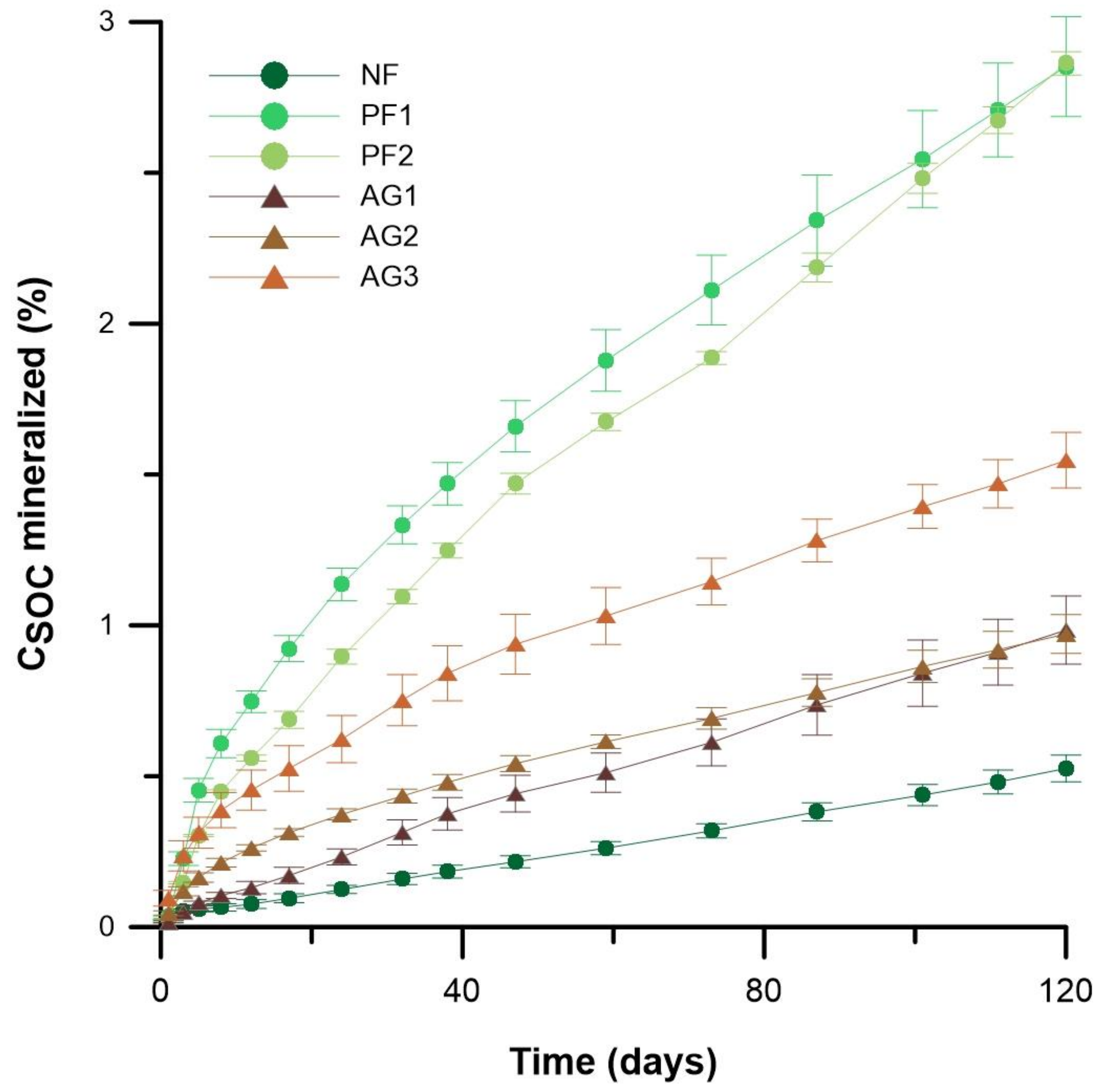
Results

Mineralization of native soil organic carbon



Pine forest soil had higher mineralization of native SOC than agricultural soils

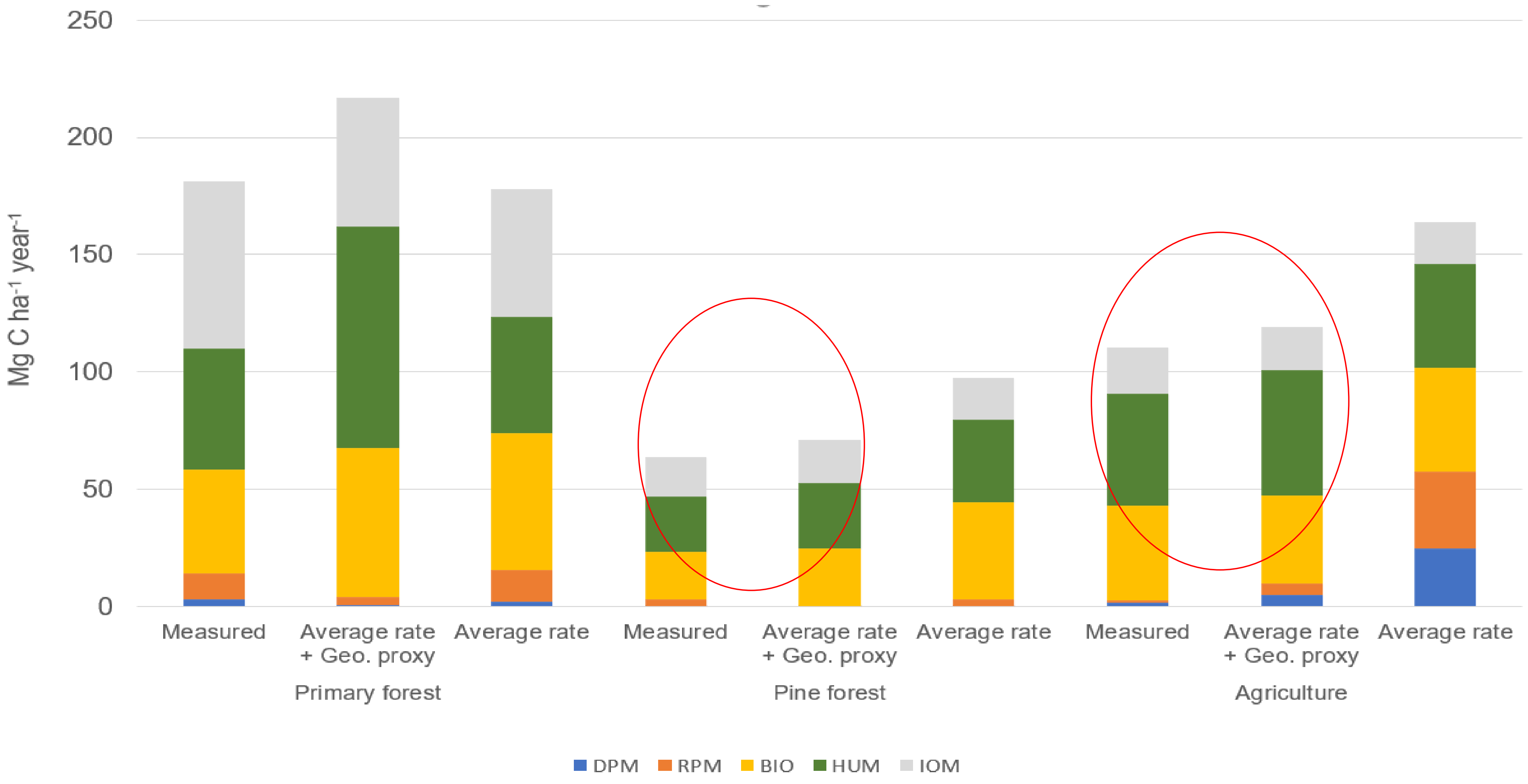
Results

Implementation of geochemical properties to modify decay rate of SOC pools using SoilGen model

<u>SoilGen model:</u> a pedon scale model that simulate vertically change of soil properties as a result of pedogenetic processes and external forces, such as climate and soil management (tillage, fertilizer) (Finke, 2012; Finke and Hutson, 2008; Opolot and Finke, 2015).

Carbon cycling in SoilGen follows the concept and pools of RothC 26.3 model (Coleman and Jenkinson, 1999).
Calibration SOC pools:

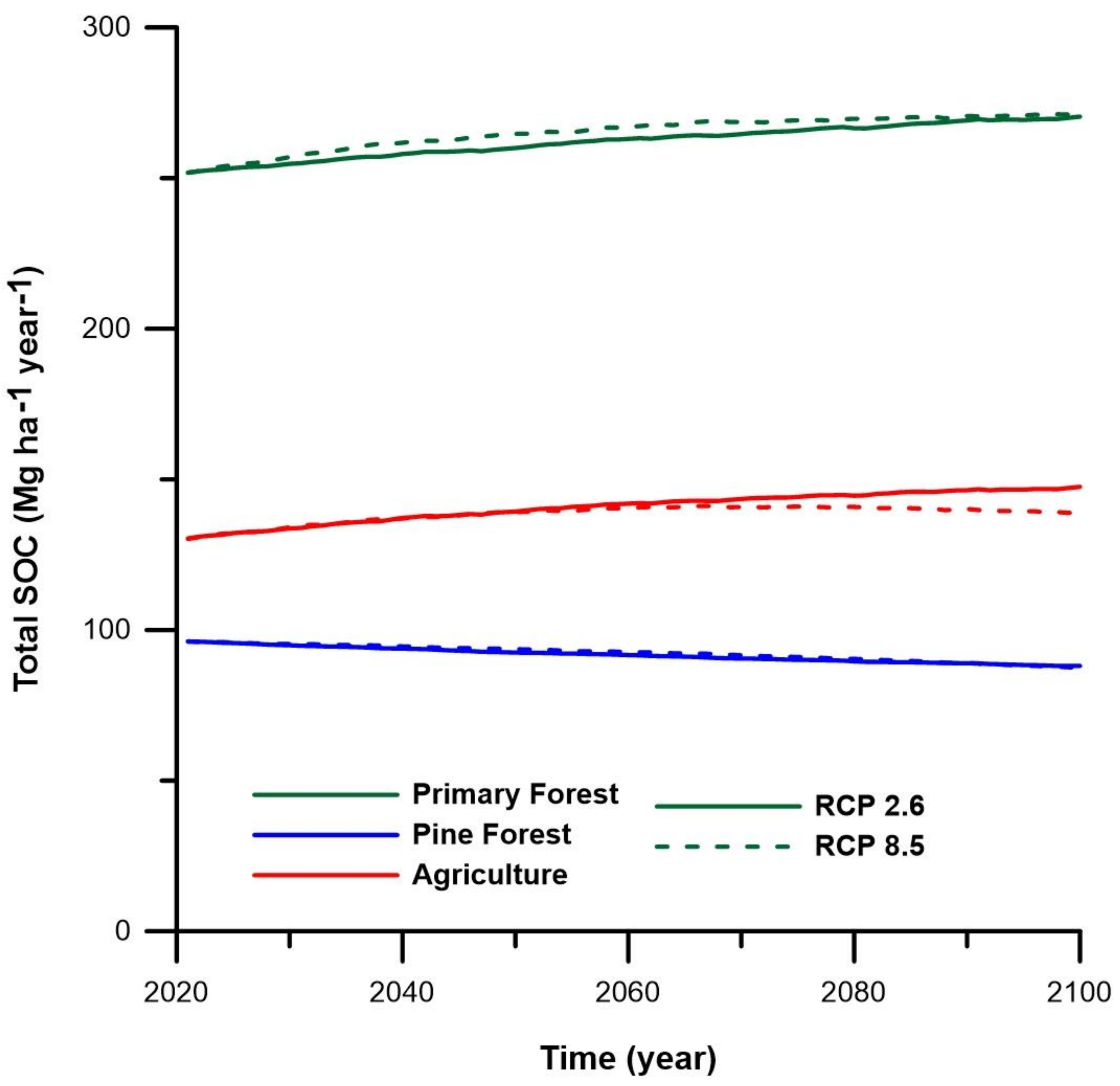
1. Resistant plant material (RPM)
2. Decomposable plant material (DPM)
3. Humified organic matter (HUM)
4. Microbial biomass (BIO)
5. Inert organic matter (IOM)



Better performance in the SOC model by applying geochemical modifier rates in pine forest and agricultural soils

Results

SOC level under different climate projection scenarios using SoilGen model



Climate projection scenarios:
Representative Concentration pathway (RCP) 2.6 and 8.5 derived from Coordinated Regional Climate Downscalling Experiment (CORDEX) for South-East Asia region (MPI-ESM-LR) and downscaled to local climate data.

Total SOC stocks (70 cm depths) are similar in primary and pine forests under RCP 2.6 and 8.5, but a decrease is found in agricultural soils under RCP 8.5.

Summary

- Higher amount of amorphous aluminum and exchangeable Ca in agriculture than pine forest soils, and its positive correlations with sand-aggregate fractions suggests a formation of aggregates and physical occlusion of OC in agricultural soils.
- The physical protection of OC in agricultural soils is consistent with lesser degradability of SOC in agricultural soils.
- The use of geochemical proxy to modify decay rate of SOC in SoilGen model results to better performance than without geochemical proxy in pine forest and agricultural soils.
- The total SOC stocks (70 cm depth) in primary and pine forests are similar under climate projection scenarios RCP 2.6 and RCP 8.5, but a decrease is found in agricultural soil under RCP 8.5.

Thank you

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