

The assessments of climate change impact on global SOC stock by a model intercomparison project

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Although soils form a thin covering terrestrial earth's surface like a skin, soil organic carbon (SOC) is considered to be the largest carbon pool in terrestrial ecosystems. Global SOC stock reach 2 or 3 times higher than the amount of atmospheric CO₂. Therefore, in climate systems, because of the vast carbon pool of SOC, the behavior of SOC is the key to understanding the feedback of terrestrial ecosystems to atmospheric CO₂ concentration in a warmer world. SOC dynamics are critically affected by temperature and precipitation. In this study, we examined the SOC dynamics in 7 biome models obtained from the inter-sectoral impact model intercomparison project, which were simulated using 5 global climate models (GCMs) in the newly developed climate scenarios, i.e., representative concentration pathways (RCPs), aiming at specifying the uncertainty in the projection of global SOC stocks from global and regional perspectives. By the assumption that SOC is a one-compartment of earth system, we assessed global SOC turnover rate and the sensitivities to global mean temperature and precipitation anomalies by steady-state model.

In a higher forcing scenario (HadGEM forced with RCP8.5), inconsistent estimates of impact on the total SOC (2099–2100) were obtained from the different model simulations, ranging from a net sink by 347 Pg C to a net source by 122 Pg C. Cluster tree of the wavelet spectra for the SOC time-series data in all combination of simulations suggested that the uncertainties derived from the biome models overwhelmed those derived from the climate scenarios. Our simplified dynamic model (state-space model) for global SOC stock revealed that primarily balance by the global SOC stock turnover and Input from VegC are quite different among the biome models and further implies the different sensitivities to global mean temperature anomaly of the global SOC stocks among the biome models. On the other hand, global precipitation anomaly did not influence global SOC stock dynamics. Furthermore, the regional differences among ecosystem models will be discussed in this presentation.

Keywords: Soil organic carbon, RCP, GCM, Model intercomparison, Uncertainty