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RESEARCH ARTICLE

Spatio-temporal variations in organic carbon density and carbon sequestration potential in the topsoil of Hebei Province, China

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Abstract

Reliable prediction of soil organic carbon (SOC) density and carbon sequestration potential (CSP) plays an important role in the atmospheric carbon dioxide budget. This study evaluated temporal and spatial variation of topsoil SOC density and CSP of 21 soil groups across Hebei Province, China, using data collected during the second national soil survey in the 1980s and during the recent soil inventory in 2010. The CSP can be estimated by the method that the saturated SOC content subtracts the actual SOC associated with clay and silt. Overall, the SOC density and CSP of most soil groups increased from the 1980s to 2010 and varied between different soil groups. Among all soil groups, Haplic phaeozems had the highest SOC density and Endogleyic solonchaks had the largest CSP. Areas of soil groups with the highest SOC density (90 to 120 t C ha^{-1}) and carbon sequestration (120 to 160 t C ha^{-1}) also increased over time. With regard to spatial distribution, the north of the province had higher SOC density but lower CSP than the south. With respect to land-use type, cultivated soils had lower SOC density but higher CSP than uncultivated soils. In addition, SOC density and CSP were influenced by soil physicochemical properties, climate and terrain and were most strongly correlated with soil humic acid concentration. The results suggest that soil groups (uncultivated soils) of higher SOC density have greater risk of carbon dioxide emission and that management should be aimed at maximizing carbon sequestration in soil groups (cultivated soils) with greater CSP. Furthermore, soils should be managed according to their spatial distributions of SOC density and carbon sequestration potential under different soil groups.

Keywords: carbon sequestration, SOC density, spatial variation, topsoil

1. Introduction

Terrestrial soil play an important role in the atmospheric carbon dioxide budget. Soils contain 1 500 Pg of organic carbon (Batjes 1996), which is 2.5 to 3 times the amount of organic carbon found in the global atmosphere or in terrestrial vegetation (Liu *et al.* 2006). The upper soil layer directly interacts with the atmosphere and is sensitive to land-use conversion, deforestation and human disturbances (Gao

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