Geophysical Research Abstracts
Vol. 15, EGU2013-3844, 2013
EGU General Assembly 2013

Soil type-depending effect of paddy management: Organic carbon distribution and stocks

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Paddy soils may originate from many different types of soil but are highly modified by human activities. These soils are mostly managed under submerged conditions, a management which is assumed to favour carbon sequestration. Therefore, the present study aims to investigate the impact of paddy management on soil organic carbon distributions and stocks in major soil types that are typically used for rice cultivation in Asia. Fluvisol and Acrisol sites (sub-tropical monsoon climate, PR China) as well as Andosol, Vertisol and Ferralsol sites (tropical climate of Java, Indonesia) were compared, as they represent a large range of soil properties to be expected in Asian paddy fields. Paddy rice at all of these sites is cultivated under flooded conditions followed by an upland crop. To evaluate the impact of paddy management, paddy soils as well as adjacent agricultural soils which are not used for paddy rice production (non-paddy soils) were chosen. At each site, three soil profiles of paddy and non-paddy soils were sampled horizontally. All samples were analysed for bulk density and organic carbon (OC) concentrations, and the corresponding OC stocks were calculated.
Paddy soils derived from Fluvisols and Acrisols(PR China) showed clearly higher OC concentrations in the top-soils, leading to higher cumulative OC stocks in paddy soils compared to the respective non-paddy soils. However, other soil types did not show the expected higher OC sequestration under paddy management. For example, paddy soils derived from Ferralsols and Vertisols of Java are characterised by very similar OC concentrations and OC stocks as compared to their respective non-paddy soils. Also paddy and non-paddy soils derived from Andosols (Java) showed similar OC concentrations and depth distributions; only the slightly higher bulk density values under paddy management lead to slightly higher OC stocks in these soils.
As clearly shown by our results, we cannot necessarily assume that rice production under submerged conditions always leads to enhanced carbon sequestration. We conclude that not only the soil type, but also the climate region may control the mechanisms of OC accumulation and the impact of management on OC stocks and distributions.