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Titel
Detecting small-scale spatial heterogeneity and temporal dynamics of soil organic carbon (SOC) stocks: a comparison between automatic chamber-derived C budgets and repeated soil inventories

Abstract
Carbon (C) sequestration in soils plays a key role in the global C cycle. It is therefore crucial to adequately monitor dynamics in soil organic carbon (?SOC) stocks when aiming to reveal underlying processes and potential drivers. However, small-scale spatial (10-30 m) and temporal changes in SOC stocks, particularly pronounced on arable lands, are hard to assess. The main reasons for this are limitations of the well-established methods. On the one hand, repeated soil inventories, often used in long-term field trials, reveal spatial patterns and trends in ?SOC but require a longer observation period and a sufficient number of repetitions. On the other hand, eddy covariance measurements of C fluxes towards a complete C budget of the soil-plant-atmosphere system may help to obtain temporal ?SOC patterns but lack small-scale spatial resolution.
To overcome these limitations, this study presents a reliable method to detect both short-term temporal dynamics as well as small-scale spatial differences of [Delta]SOC using measurements of the net ecosystem carbon balance (NECB) as a proxy. To estimate the NECB, a combination of automatic chamber (AC) measurements of CO_2 exchange and empirically modeled aboveground biomass development (NPP_{shoot}) were used. To verify our method, results were compared with [Delta]SOC observed by soil resampling.
Soil resampling and AC measurements were performed from 2010 to 2014 at a colluvial depression located in the hummocky ground moraine landscape of NE Germany. The measurement site is characterized by a variable groundwater level (GWL) and pronounced small-scale spatial heterogeneity regarding SOC and nitrogen (Nt) stocks. Tendencies and magnitude of ?SOC values derived by AC-measurements and repeated soil inventories corresponded well. The period of maximum plant growth was identified as being most important for the development of spatial differences in annual [Delta]SOC. Hence, we were able to confirm that AC-based C budgets are able to reveal small-scale spatial differences and short-term temporal dynamics of ?SOC.