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Towards a simple and sensitive size-density fractionation approach for determining changes in soil organic matter

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Fractionation of soil organic matter (SOM), i.e. the separation of SOM into discrete fractions, can elucidate the temporal responses of soil organic carbon (SOC) to land-use and management changes. In order to reduce the workload and uncertainties associated with fractionation, we optimized and tested a simple size-density fractionation approach, containing a limited number of fractions and using relatively mild soil dispersion. We compared size-density fractionation, which isolated non-occluded particulate organic matter (POM), stable aggregates and silt- and clay-sized fraction, with aggregate size fractionation, i.e. an established method for aggregate separation, and with SOC content in the bulk soil. These methods were tested on soil samples collected from the mineral soil (0-20 cm) of a land-use and management gradient examining forest colonization on grassland in the Southern Alps (Italy). Differences in SOC stocks among successional stages were detected both by size-density fractions, aggregate size fractions and SOC content in the bulk soil. However, size-density fractions were better suited than aggregate size fractions for the detection of changes in SOC allocation within the study area. Therefore, the tested size-density fractionation approach may be preferred over aggregate size fractionation, considering its higher sensitivity to SOC differences in the land-use gradient. Stable aggregates obtained by size-density fractionation detected both changes in SOC allocation and stocks, and have the potential to be used as indicators of SOC changes in soils that express aggregate hierarchy. Further testing of the developed procedure across soil types, environmental conditions and land uses is required to confirm its repeatability and sensitivity to SOC changes.