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Compared physical properties of repacked and undisturbed soil samples as assessed by shrinkage analysis: method, interest and limitations

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Field scale is a key scale for soil quality management in cropland, particularly for organic carbon and nutrient contents. To cope with within field variability, composite samples are collected which allows determining inexpensive average analytical properties for purposes such as soil quality monitoring. This is not feasible for most soil physical properties which require the collection of undisturbed soil samples for their determination. Unfortunately, most physical properties show large and unpredictable variability, thus leading to heavy soil sampling, laboratory costs and physical data processing to determine field properties and their time trend. Shrinkage analysis (ShA) provides a characterization of the soil pores, their air and water equilibrium and the soil structure stability, on the full soil water content range. It is usually performed on undisturbed soil samples; however, it was also performed on repacked soil samples from 2 mm size hand-fractioned aggregates. Moreover, it characterizes the physical properties of the two pore systems, namely the structural pores and the plasma pores. The later can be assumed to remain unchanged upon fractionation. Oppositely, the coarser structural pores are obviously destroyed. However, the intra aggregate structure and, therefore, the smaller size structural pores, might be conserved. In the frame of a large scale on-farm diagnosis of soil quality, we hypothesized that a part of the soil physical properties quantified with ShA could be characterized on repacked composite soil samples collected at field scale. This was tested by comparing (i) the physical properties of undisturbed soil samples and repacked soil samples on a wide range of soil types and quality and (ii) the relationships between soil organic carbon content, soil clay content, and the physical properties of undisturbed and repacked soil samples, respectively.