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# Soil structure turnover under grassland is mainly driven by biotic drivers

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Soil structure is a dynamic property of soils which undergoes continuous changes due to various abiotic and biotic drivers. At the same time, the spatial arrangement of pores, organic matter and minerals influences soil functions, such as storage and filtering of water, nutrient cycling, or habitat for soil organisms and plants. In terms of carbon storage and matter turnover, the rearrangement of soil structure and herewith the change in accessibility of soil carbon for microbial decomposition is highly relevant. However, the turnover of soil structure and its constituents is difficult to quantify. In this study, a new method of structure labelling with inert garnet-particles in combination with X-ray µCT was used to determine the turnover rate of macro-aggregates and their drivers in two field experiments. Trials were conducted in topsoils of a Chernozem and a Luvisol under grassland, both with a silty loam texture but under different climatic conditions (Chernozem = 480 mm precipitation, Luvisol 886 mm). Over the course of 4 years, soil structure was regularly determined by X-ray µCT at two resolutions, 60 µm and 15 µm, to track soil structure development with time and in response to seasons. By excluding roots and soil fauna > 30 µm in half of the samples, it was possible to estimate the contribution of abiotic and biotic drivers. The distribution of garnet particles was determined in order to quantify the rate of soil structure turnover as related to potential biotic drivers. It is shown that soil structure turnover by natural processes is slow and that both abiotic and biotic drivers affect soil structure. Turnover under dry climatic condition was significantly slower due to lower biological activity. When soil is mixed by fauna > 30 µm activity, the distribution of garnet particles originally located at the surfaces of macro-aggregates became increasingly randomised, indicating rearrangement of soil structure and establishment of new pore−soil matrix interfaces.