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Anthropogenic desilication of agricultural soils – Results from a long-term field experiment in NE Germany

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Due to intensified land use (agriculture, forestry) humans directly influence silicon (Si) cycling on a global scale. In this context, especially Si exports by harvested crops (most of them are Si accumulators) and increased erosion rates generally lead to a Si loss in agricultural soils (anthropogenic desilication). Harvesting of field crops can cause Si losses of up to 100 kg Si ha^{-1} per year. On a global scale about 35% of total phytogenic Si is synthesized by field crops due to their relatively high Si contents as well as biomasses and this proportion is going to increase with increased agricultural production within the next decades. In order to avoid (natural) limitations of plant available Si and enhance plant growth and resistance against abiotic and biotic stresses, Si fertilization is widely used, especially in (sub)tropical agricultural systems. In this context, specific Si fertilization, for example, in the form of recycled organic siliceous materials (e.g., straw, biochar), might be a promising strategy for both increasing crop yields and decreasing desilication of agricultural soils. However, most studies focus on rice and sugarcane production and there is still only little knowledge about Si cycling in agricultural systems of the temperate zone. We analyzed soil and plant samples from an ongoing long-term field experiment (established 1963, randomized block design: plots with low, medium, and high mineral NPK fertilization rates, plots with straw fertilization in addition to NPK fertilization, control plots) in NE Germany to answer the following questions: (i) Can we observe a significant desilication (indicated by a decrease in plant available Si in soils) of agricultural systems in the temperate zone in the long term?, (ii) Is this potential desilication affected by NPK fertilization rates?, (iii) Is this potential decrease of plant available Si in soils reflected in Si concentrations of the grown plants (e.g., wheat)?, and (iv) Can we prevent potential anthropogenic desilication by straw fertilization? Here we present our first results to answer these questions. The answers to these questions will help us to obtain a deeper understanding of Si cycling in agricultural biogeosystems in the temperate zone in general and to derive practice-oriented recommendations for a more environmentally friendly and sustainable crop production in particular.