Anthropogenic Desilication of Agricultural Soils – Results from a Long-Term Field Experiment in NE Germany

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Introduction
- Intensified land use → Humans directly influence silicon (Si) cycling on a global scale
- Si exports by harvested crops generally lead to a Si loss in agricultural soils → Anthropogenic desilication
- On a global scale about 35% of total phytopgenic Si is synthesized by field crops due to their relatively high Si contents and biomasses → Increased agricultural production within the next decades
- Need for long-term field experiments → Detailed understanding of anthropogenic desilication of agricultural systems

Research 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)?
- (iv) Can we prevent potential anthropogenic desilication by straw fertilization?

Study Site
- ZALF’s long-term field experiment (LTFE) V140, Albic Luvisol, 561 mm, 9.4°C → Effects of management on Si pools since 1963
- Randomized block design → Plots with low, medium, and high mineral NPK fertilization rates, plots with straw fertilization in addition to NPK fertilization, and control plots

Methods
- Si inputs → Straw fertilization (2.0 t DM ha⁻¹ yr⁻¹)
- Si outputs → Aboveground biomass (t ha⁻¹ DM) x (min. and max.)
- Si concentration in plants (%)
- Netto Si output → Si output – Si input
- Si in plants → HF digestion and subsequent ICP-OES
- Si in soils → CaCl₂ extraction and subsequent ICP-OES

Results
- Si inputs and outputs
- Conclusions
- Anthropogenic desilication is mainly driven by harvested plant biomasses → Plant biomasses in turn are controlled by NPK fertilization rates
- Straw fertilization prevents anthropogenic desilication of agricultural systems → No decrease of plant available Si in soils (indeed plant available Si increases in the long term)
- Si in soils is directly reflected in Si concentrations of plant materials → Especially plant parts with high Si concentrations (husks) seem to be well-suitied indicators

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