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Impact of land use on biological control of silica fluxes: an ecosystem signature study.

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Our understanding of the biogeochemical cycle of Si lags behind our knowledge of other nutrient cycles. However, silica cycling impacts on two of the major global carbon sinks. At first, the weathering of mineral silicates is an important sink for atmospheric CO2. Secondly, the import of Si from the terrestrial environment into coastal zones is essential to sustain diatom growth. Diatoms play a key role in the oceanic C-sink. On top, the ratio in which Si, N and P are delivered to the coastal zone from the continent is a determining factor for the occurrence of eutrophication problems.
Unlike previous assumptions, which consider the silica cycle to be geologically controlled, recent studies have shown that silica mobilization from terrestrial habitats to the aquatic continuum is biologically controlled. However, limited insight of this biological component in terrestrial silica biogeochemistry challenges our ability to predict the effects of land use changes on the silica cycle.

We have recently started a project (2009-2012) that will identify and quantify Si (dissolved Si and amorphous Si) fluxes from forest, grassland and cropland ecosystems. We want to establish "ecosystem Si-signatures" for these land use types by analysing isotope and trace-element/Si ratios.

In a second phase, we will track the transport of the different forms of silica within the aquatic system. Different isotopic signatures and element ratio signatures have been attributed to different Si pools and reservoirs and there is a promising potential to use isotope methods to track the origin of Si. In this research, a small selection of basins is made from an established sampling network of 50 watersheds over a complete gradient of land use types and soil composition in the Scheldt basin. These basins are sampled along a spatial (three locations/basin) and temporal (seasonal) gradient and both isotope and trace-element ratios are determined for each sample. As such, land use signatures will be qualitatively linked to the Si transport through the aquatic system, using ecosystem signatures.

In the end, it is the ratio of C-N-P-Si that will control primary productivity in aquatic ecosystems (next to light conditions, flow conditions . . .). Therefore, it is essential to link (new) insights from the silica cycle with other relevant nutrients. Therefore, concentrations of dissolved inorganic nitrogen (NO3-, NH4+), dissolved organic nitrogen (DON), dissolved reactive phosphate (DRP) and dissolved organic carbon (DOC) are measured using colorimetric analysis on a Segmented Flow Analyzer (SKALAR) on all samples within the project. We hypothesize that DOC and dissolved silica will follow similar flow pathways in ecosystem soils, as both originate mainly from organic matter in soils. As a result, changing DOC and Si fluxes with land use changes will impact on Si-C-N-P ratios through the aquatic system.

As the project and my PhD research has recently started, it is yet not possible to give straightforward results. However, we hope to have some preliminary results at the EGU meeting.