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Modeling dissolved silica retention in the limnic system of North America

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Dissolved silica (DSi) is an important nutrient in freshwater and coastal ecosystems. The availability of DSi is governed by DSi mobilization from the terrestrial system into the limnic system and fluvial transport of DSi to the coasts, respectively. Part of the DSi is retained in the limnic system due to biotic uptake and sedimentation. Anthropogenic influences including eutrophication and construction of dams and locks can lead to an increase in DSi retention (Humborg et al., 2006), with potentially severe consequences for coastal ecosystems (Danielsson et al., 2008). It is here hypothesized that DSi retention can be calculated by subtracting DSi fluxes observed at downstream sampling locations from the amount of DSi mobilized from the terrestrial system into rivers. This strategy to estimate the DSi retention is applied to river systems located in the USA and evaluated.
Hydrochemical data from the USGS programs WQN and NAWQA are used to calculate annual DSi fluxes for more than 500 sampling locations. For each water sampling location the river catchment and catchment properties (lithology, land cover, lake area etc.) are calculated. Emphasize is put on abundance and size of lakes, wetlands, and reservoirs as places of increased DSi retention.
DSi mobilization into rivers is estimated applying an empirical mobilization function developed for the North American region (Jansen et al., submitted). On average, DSi fluxes from the terrestrial system into rivers are higher than observed fluvial DSi fluxes. The difference between mobilized and observed DSi fluxes increases with catchment area. Applying the introduced difference method to a subset of water sampling locations situated near the rivers' mouths (n=89), a discharge weighted average DSi retention of about 26% is calculated. Uncertainties due to the statistical methods are discussed.

References

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