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Coupling of hydrodynamic and biogeochemical processes at aquatic interfaces

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The overall aim of this contribution is a general conceptual framework for aquatic interfaces that is applicable to a wide range of systems, scales and processes. Aquatic interfaces are characterized by steep physical, chemical and biological gradients due to the contrast between the two adjacent environments. Investigating the spatially heterogeneous and temporally variable hydrodynamic and biogeochemical processes requires innovative monitoring technologies and sophisticated measurement techniques that can cope with different spatial scales. Although enhanced biogeochemical processing rates are inherent to aquatic interfaces due to their steep biogeochemical gradients and their intensive structural and compositional heterogeneity, the effective turnover depends strongly on the residence time distribution along the flow paths with their particular biogeochemical milieus and reaction kinetics. Thus, identification and characterization of the highly complex flow patterns in and across aquatic interfaces are crucial to understand biogeochemical processing along exchange flow paths and to quantify transport across aquatic interfaces; i.e. hydrodynamic and biogeochemical processes are closely interlinked. But interface processing rates are not only enhanced compared to the adjacent compartments that they connect; also completely different reactions might occur if certain thresholds are exceeded or the biogeochemical milieu differs significantly from the adjacent environments. Single events, temporal variability and spatial heterogeneity might increase overall processing rates of aquatic interfaces and thus, should not be neglected when studying aquatic interfaces. Aquatic interfaces are key zones relevant for the ecological state of the entire ecosystem and thus, understanding interface functioning and controls is paramount for ecosystem management.