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Titel
Fate and effects of silver nanoparticles at the aquatic-terrestrial interface: A floodplain mesocosm experiment

Abstract
The production volume of engineered inorganic nanoparticles (EINP) successively increased over the last years. Once released into the natural environment, these particles may change their size and surface properties in interaction with other substances. This is expected to control their mobility and their impact on biochemical processes. However, the underlying processes are not fully understood yet. Transformation processes and long-term fate of citrate-coated silver nanoparticles (Ag NP) were investigated in an innovative floodplain mesocosm, which was run with river Rhine water and natural soil from an adjacent floodplain for 33 weeks. Flooding events were simulated every three weeks. The Ag NP with a concentration of 5 mg L^{-1} were continuously introduced into the water for three weeks followed by a three-week period without spiking. Every third week the ecotoxicological impact of Ag NP was determined by means of Gammarus mortality and feeding assays. At the end of the experiment, the total Ag concentrations were measured in profiles of the floodplain soil and the sediment as well as in algae that developed in the mesocosm. The total Ag concentration in the aquatic phase in the main zone as well as in the floodplain fluctuated according to the periodic Ag NP pulse. Further, significant amounts of Ag accumulated in algae (up to 4.7 mg g^{-1}) and exposed leaves (up to 170 [mu]g g^{-1}). However, for the applied experimental conditions we did neither observed mortality nor sublethal effects on Gammarus feeding activity. More than 40 % of the Ag remained in the sediment of the main zone and 7 % were transported during flooding into the floodplain soil. Furthermore, 0.5 % of the Ag was still in the water phase. Most of the particles were immobilized in the top layer of the sediments and soil. Only very little transport in deeper soil layers was observed in the soil columns and sediment. Accumulation in algae, sediment, and soil is alarming for long-term environmental impact assessments and the long lifetime in the aqueous phase suggests long-range transport of Ag NP in rivers.