Long term behavior of metal nanoparticles after low dose chronic addition in simulated freshwater wetlands.

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Studying nanoparticle (NP) behavior with chronic additions to complex environments over extended time periods is essential to assessing their ultimate fate and potential for unintended consequences. By incorporating plants, microorganisms, and animals in realistic environmental conditions, mesocosms experiments provide insights into NP behaviors in complex natural systems.

Wetland mesocosms (dimensions ~3.7x1.2x0.8m) were exposed to chronic (weekly addition), low concentrations (final cumulative dose of ~750mg) of CeO_2, Au^0 or Cu-based NPs. Differences in fate, accumulation, and transformation were assessed in the biotic and abiotic compartments with NPs of i) different dissolution rates and (ii) different sizes (large and small CeO_2) and iii) under different nutrient status (low vs. elevated nutrients). Every three months, all compartments were sampled, including soil, water column, aquatic plants, surficial sediment (containing microorganisms and biologically degraded residues), sediment, micro-organisms, plants, fish, and benthic macroinvertebrates. Total metals were measured by ICP-MS to identify the accumulating compartments and to determine to what extent this varied over time. Transformations were assessed by X-Ray absorption spectroscopy. There was no observed effect of the trophic index on NP location. However NP type, size, and solubility resulted in significantly different environmental distributions and transformations between plants and sediments.