Temporal fate and (bio)transformations of Cu- and Au-based nanomaterials chronically added in freshwater mesocosms.

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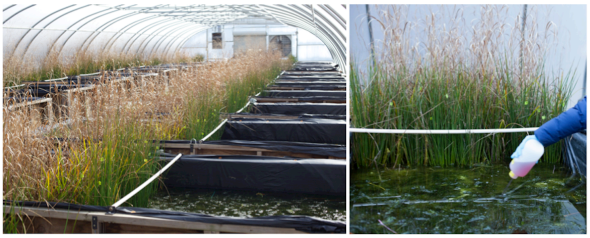
Studying nanoparticle (NP) behavior in the environment using wetland mesocosms provide a good trade-off between real environmental exposure and laboratory experiment. Mesocosms mimic complex environments by (i) incorporating plants, microorganisms and animals and (ii) undergoing seasonal changes.

Experiments with wetland mesocosms (~3.7x1.2x0.8m) were designed to assess the impact of NP chemical stability using Au or Cu-based NP in mesocosms under low vs high nutrient status on their fate and transformation. Mesocosms were exposed chronically (weekly addition), at a low dose (final cumulative dose of ~750mg). Every three months, all compartments were sampled, including soil, water column, aquatic plants, surficial sediment (containing biologically degraded residues), sediment, plants, fish, and benthic macroinvertebrates. Total metals were measured by ICP-MS to identify the accumulating compartments and to determine the variation over time. Transformation of metal phases were determined by X-Ray absorption spectroscopy.

No effects of the nutrient loading on NP location were observed. However, NP colloidal stability induced accumulation in different compartments (in particular aquatic plants vs surficial sediment), resulting in differential (bio)transformation processes.



Left: mesocosm facility at Duke University.
Right : weekly dosing of Au NPs