FIU | Applied Research Center
FLORIDA INTERNATIONAL UNIVERSITY

PROJECT FACT SHEET

Methylation/Demethylation Processes in the Environment

FIU's Applied Research Center (ARC) is experimentally investigating the biogeochemical processes of mercury complexes in the laboratory. The effect of various biogeochemical factors on the rate of methylation/demethylation is being studied. In particular, the research is focused on the involvement of nutrients, organics, and inorganic species (including sulfur) in the fate, transport, and transformation of mercury species.

Laboratory incubation experiments are in progress to study mercury methylation/demethylation processes (M&D) and measure the rates (using the stable isotope addition method). In addition, a number of biogeochemical factors influencing methylation/demethylation processes and mercury cycling, such as pH, redox potential, colloids (with different sizes including nanoparticles), mineral oxides (Fe^{2+}/$Fe^{3+}$and others), nitrogen, and phosphate, are also being evaluated. The analyses are extended to provide information about biogeochemical processes and the sources and cycling of nutrients, sulfur, and organic matter (using an ultrafiltration procedure) in the ecosystem to examine the complex involvement of nutrients, organics, and inorganic species (including sulfur) in methylmercury production and bioaccumulation. Moreover, by implementing the isotope addition method in the lab, adsorption and desorption rates of Hg^{2+} and MeHg in the sediment are measured. The stable isotope addition method was implemented to investigate the degradation of MeHg.

Project Objectives

- Provide information on critical mercury transformation and exchange processes (i.e., M&D, exchange of mercury species between soil, pore water, suspended and colloidal particles and the water column, mercury desorption rate in water and sediment, and the organic carbon partitioning coefficient).
- Investigate the effect of pH, redox potential, colloids, mineral oxides, nutrients, sulfur, and organic matter on the mercury cycle and its biogeochemical processes (i.e., M&D and bioaccumulation).
- Explain the temporal and spatial distribution patterns of methylmercury and other mercury complexes in the ecosystem.

Project Benefits

- Assists in calibration as well as sensitivity and uncertainty analyses of numerical models, and verification of numerical results.

Project Accomplishments

- Assisted in calibration and sensitivity analysis of the numerical model developed for the different ORR watersheds (LEFPC, UEFPC, and WOC), determining acceptable ranges of values for some of the effective parameters (i.e., partition coefficients and desorption rates) in the sedimentation and water quality modules.

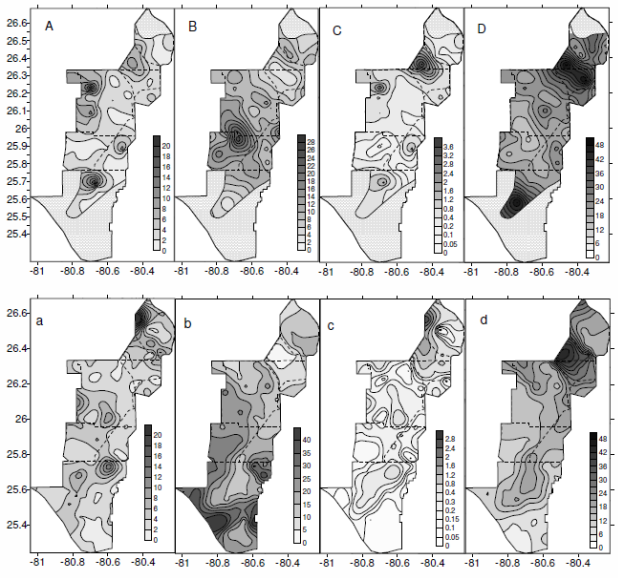

Figure 1. (A,a) Spatial patterns of MeHg photo-degradation rate (ng $m^{-2}d^{-1}$), (B,b) MeHg photo-degradation potential $\times 10^3$ (md^{-1}), (C,c) Aqueous MeHg concentration (ng L-1), (D,d) DOC concentration (mg L^{-1}) in the dry (A,B,C,D) and wet (a,b,c,d) seasons.

- Published several scientific articles in peer-reviewed journals from the experimental results on "Degradation of MeHg due to sunlight", "Effect of degradation of MeHg on the fate and transport of mercury in the ecosystem", "Adsorption of mercury species in aquatic environments", "Interactions between dissolved organic carbon and mercury species in surface waters".

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