South River Working Hypotheses Update

South River Science Team Meeting

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Working Hypotheses

A. External Sources of mercury to the river
B. Internal Sources of mercury to the river
C. Methyl mercury in the river system
D. Mercury loading and transport
    - Baseline Flow Conditions
    - Storm Flow Conditions
E. Distribution of mercury in the floodplain
F. Mercury in Biological Tissue

Working Hypotheses and Observations:

A. External Sources of Total Mercury to the River

- A1: The largest inventory of mercury in the system is in the 5 year flood plain
- A6: The floodplain from RRM 0 to 12 contains more mercury mass than the floodplain from RRM 12 to 25
- A3: Floodplain soils have a higher fraction of exchangeable Hg than sediments
- A2: THg is introduced to the river from floodplain soils primarily through eroding banks
- A5: Plant site outfalls are the first sources of mercury to the river (Observation)

Working Hypotheses and Observations:

B. Internal Sources of Total Mercury to the River

- B1: The volume of fine-grained river deposits in the upstream reach of SR is greater than in the downstream reach, and fine-grained particles upstream are enriched in mercury compared to downstream.

- B4: Some of the fine-grained deposits were accreting during the period of mercury use at the site and a subset of these “age-release” deposits are currently eroding.

- B6: In-stream gravel bars/beds have mercury sorbed to the (entrained) fine-grained sediments. The mercury is released through partitioning to pore water / hyporheic flow or bed turnover.

Working Hypotheses and Observations:

C. Methyl Mercury in the South River

- C1: The filtered fraction of Hg is an indicator of exchangeable Hg. The bioavailable pool of Hg is a fraction of the filtered fraction of Hg.
- C2: Current MeHg production rates are at a system maximum.
- C4: The decline of MeHg production in summer relative to spring is due to:
  - Increase in demethylation rates
  - Change in mercury speciation to non-bioavailable forms
  - Shift in the types of microbial organisms, or
  - Decrease in periphyton.
- C7/8: Sites within the South River that may be conducive to MeHg production are patchy areas, just below the sediment water interface, within periphyton biomass, or within biofilms.

Working Hypotheses and Observations:

DA. Mercury Loading and Transport - Storm Flow

- DA3: During higher flows when bank full conditions are nearly met (1000 to 2000 cfs), total mercury increases in the water column as a result of bank soil erosion/ entrainment and Hg dissolution through a wetting/ drying redox cycle.
- DA4: During storm events a dilution effect is seen on the concentration of Hg on TSS due to an influx of fine ”clean” particles
- DA6: During storm events, the majority of filtered mercury is loaded above RRM 9.9 (Observation)
- DA7: During storm events, total mercury loading occurs at RRM 5.1 and RRM 9.9 (Observation)

Working Hypotheses and Observations:

DB. Mercury Loading and Transport – Baseline Flow

- DB.5: Baseline flow conditions are more significant for ecological exposure because low- to moderate-flow conditions predominate over the course of a year.
- DB.4: At baseline flow conditions, the majority of MeHg loading occurs between RRM 3.0 to RRM 11.8 (Observation)
- DB.3: As discharge rate in the river increases, the location of the maximum filtered THg loading migrates downstream (0bservation)

Working Hypotheses and Observations:

E. Distribution of Mercury in the Floodplain

- E2: Distribution of Hg in the floodplain is determined by geomorphic setting and distance from the plant site.
- E3: In places, river bank soils are enriched in Hg within a discrete zone approximately 1 to 2 ft. below the top of the bank. This interval may represent a time period of peak Hg release (ca. 1945)
- E4: In general, Hg concentrations in soil decrease with distance from the river, and overall Hg distribution is patchy partially due to local depressions in the floodplain where fine-grained flood sediments can accumulate.

Working Hypotheses and Observations:

F. Mercury in biological Tissue

- F.1: Methylmercury concentration in biological tissue increases with trophic position
- F.2: Feeding behavior influences methylmercury concentrations in the South River aquatic food web.
  - Clam tissue methylmercury concentrations show seasonal trends that are similar to those seen in surface water concentrations
  - Crayfish tissue, however, show little seasonal variation (Observation)