Conceptual Site Model: Analysis of Mercury Loading Dynamics in South River

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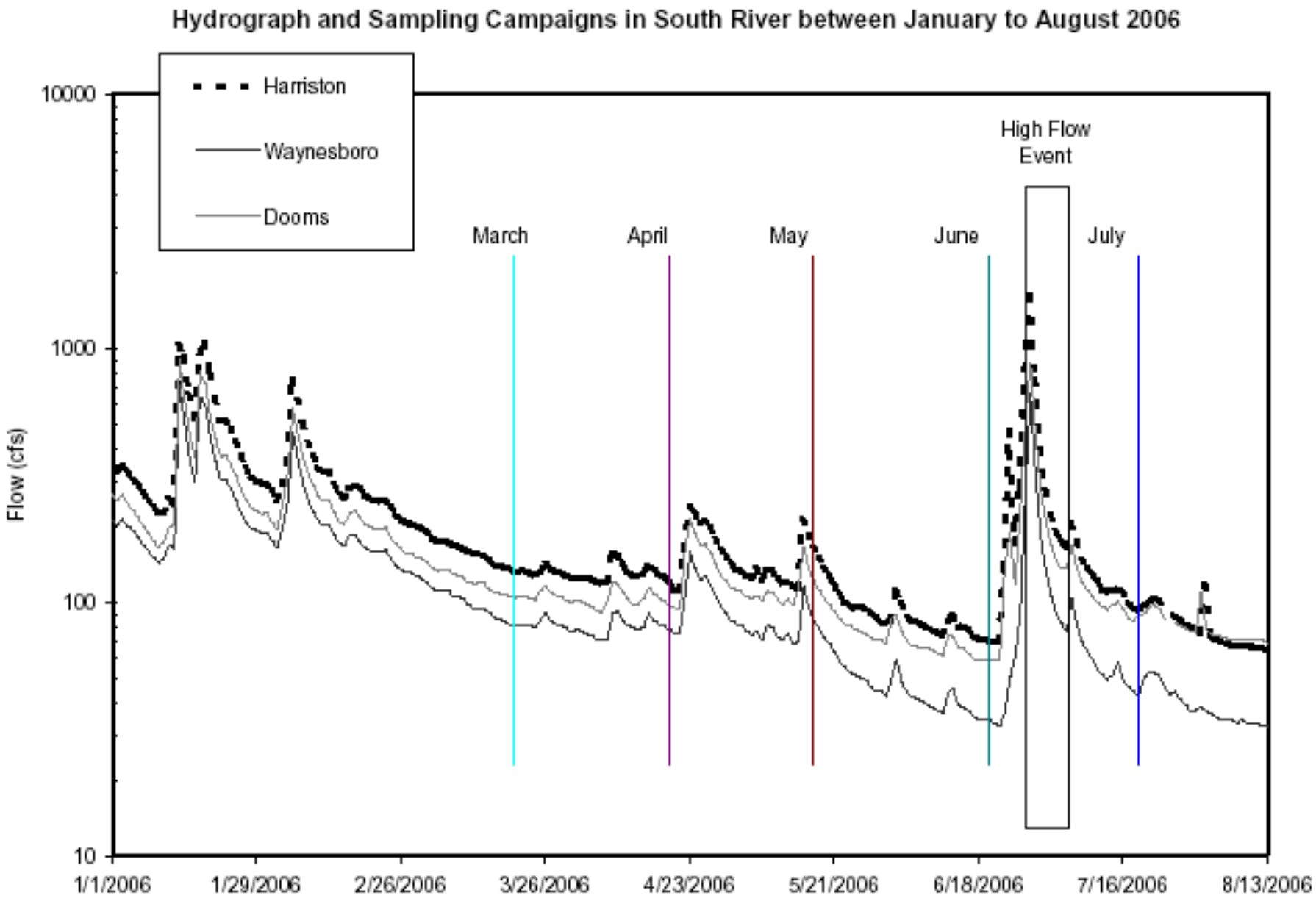
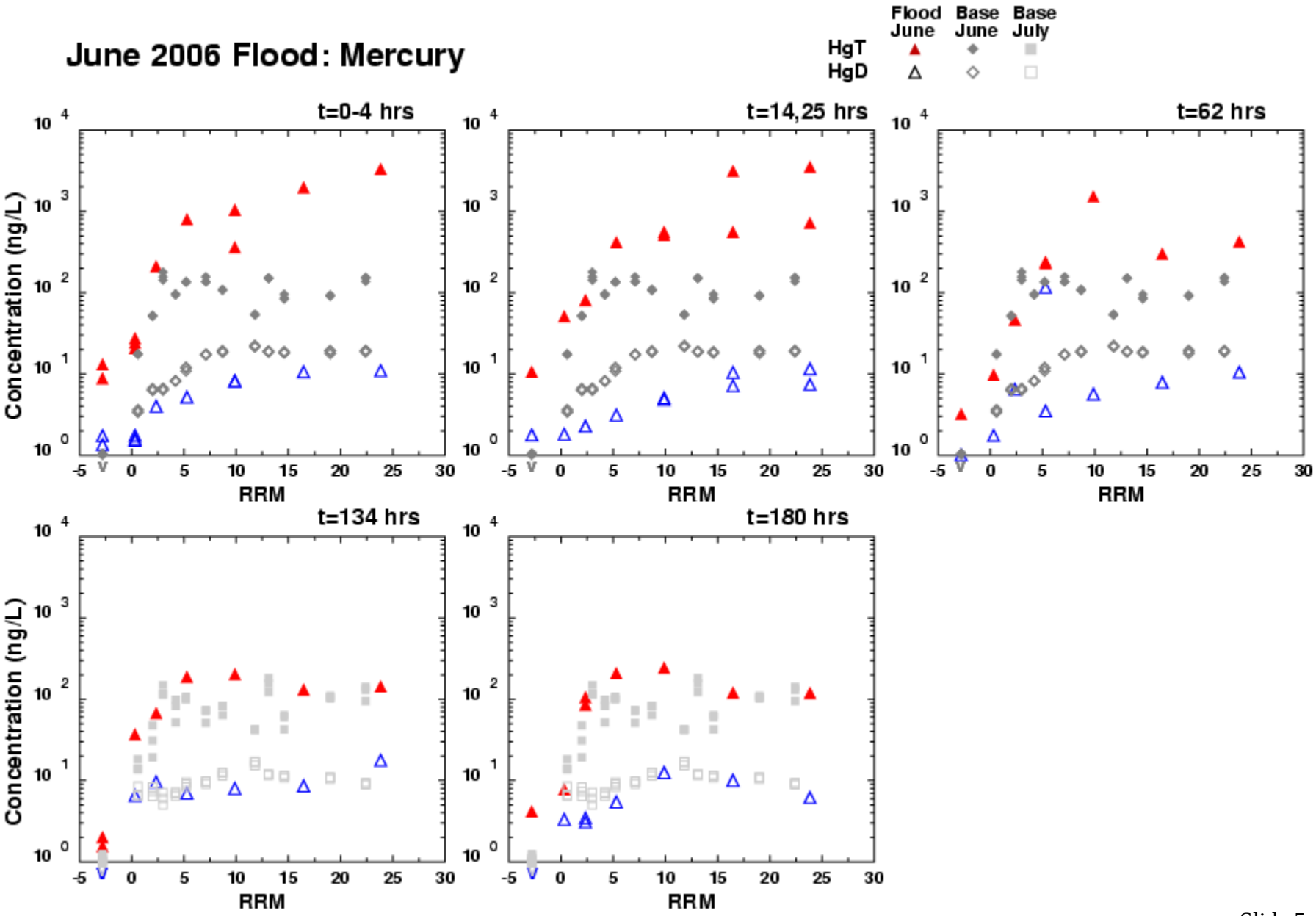
Data and Loading Analyses

- Suggested trends at baseflow:
  - Hg
    - Filtered is 10% of unfiltered
    - Net positive load between RRM 0-10, net negative load downstream
  - meHg
    - Filtered meHg is 50% of unfiltered meHg
    - Net positive load throughout River, peak between RRM 0-10

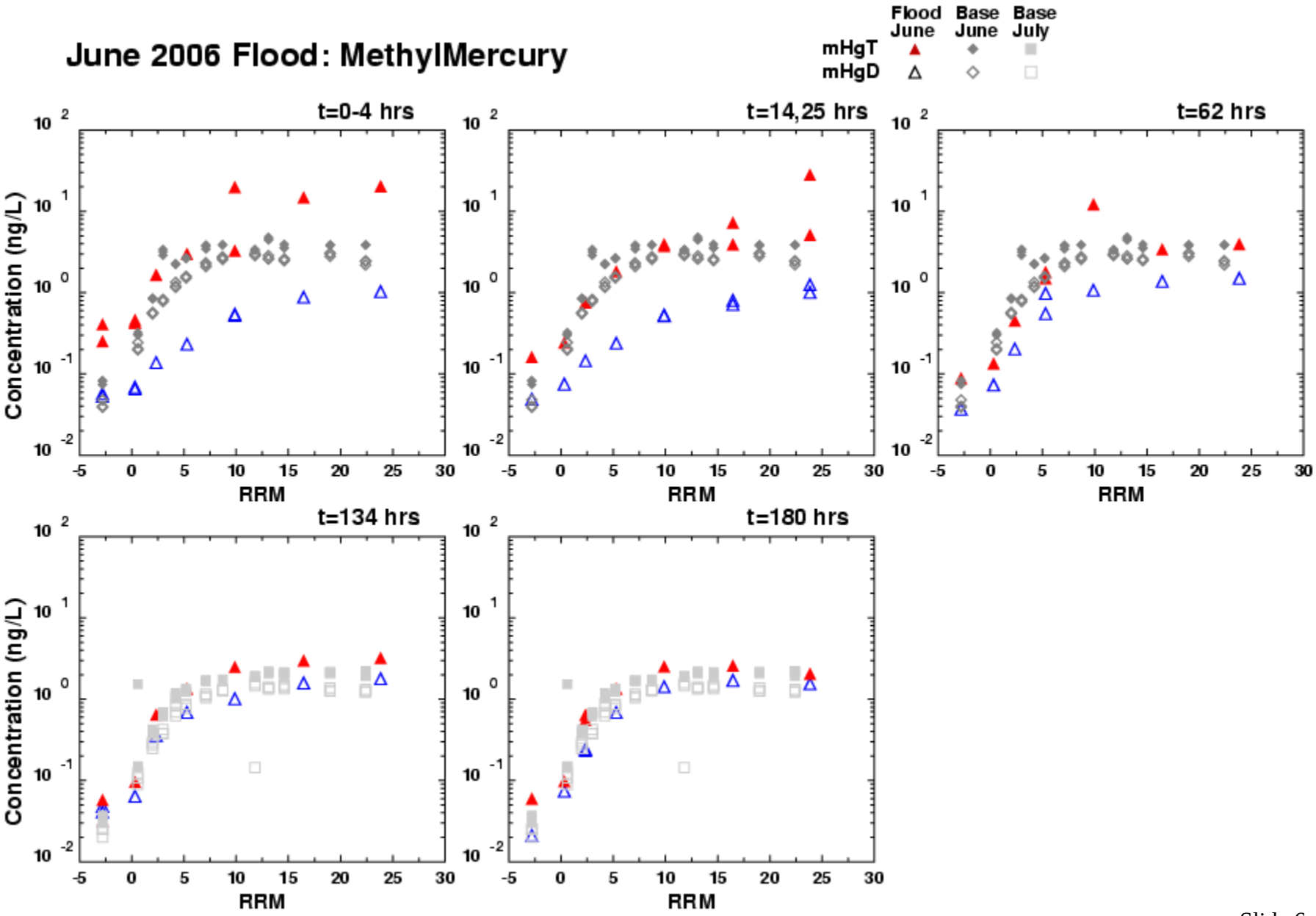
Data and Loading Analyses

- Suggested trends at high flow:
  - Loads
    - Large net positive load that peaks at RRM 10-15 that migrates toward RRM 5 as the flow (and subsequent loadings) decrease with time after the flood
  - Hg
    - Filtered ranges from 0.1% of unfiltered at highest flows (related to high TSS) and approaches baseflow profiles as stream approaches normal flows
  - meHg
    - Filtered ranges from 5% of unfiltered at highest flows and approaches baseflow profiles as stream approaches normal flows

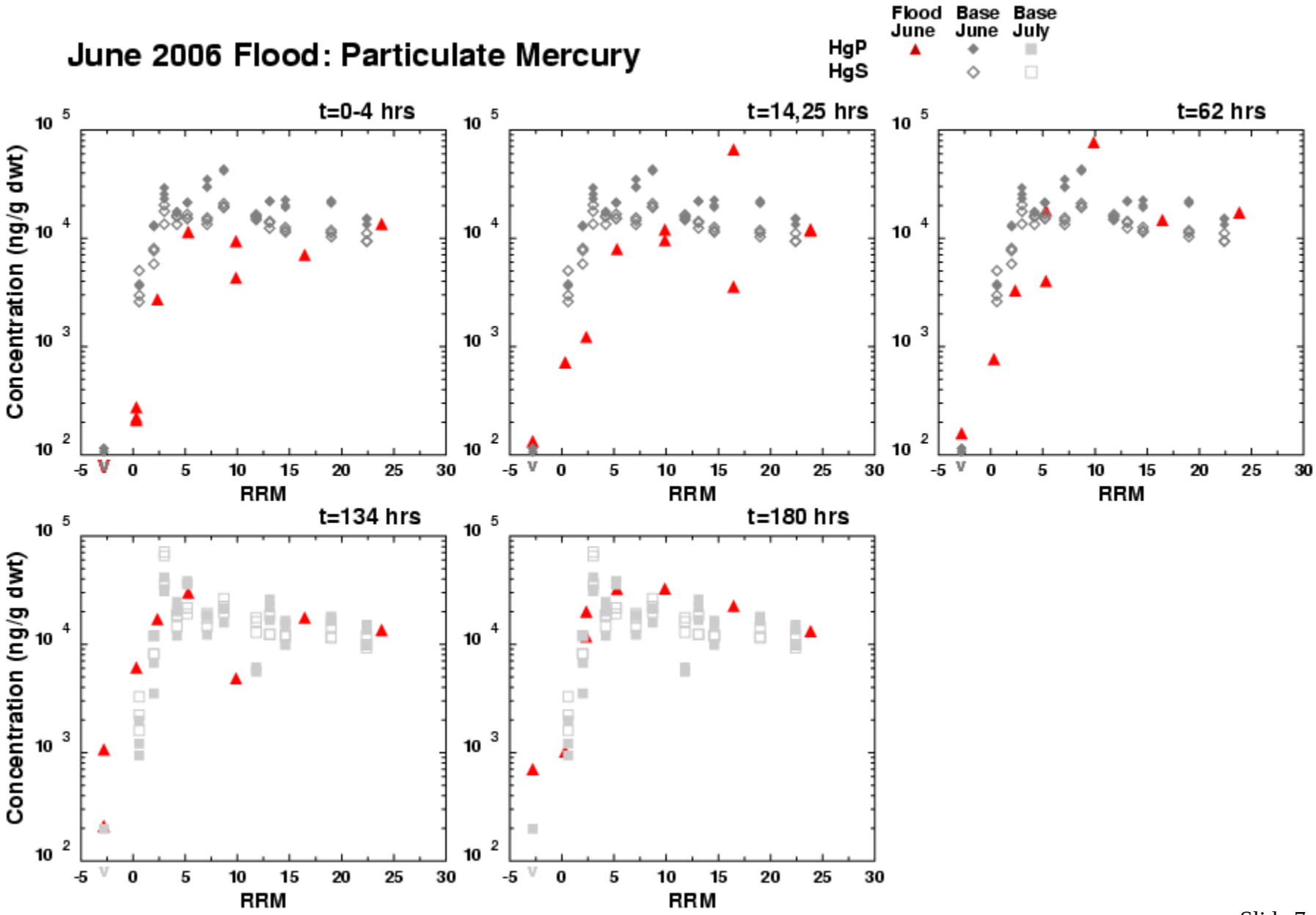

Hydrograph and Sampling Campaigns in South River between January to August 2006
Harriston
Waynesboro
Dooms
High Flow Event
March
April
May
June
July
Flow (cfs)
10000
1000
100
10
1/1/2006
1/29/2006
2/26/2006
3/26/2006
4/23/2006
5/21/2006
6/18/2006
7/16/2006
8/13/2006

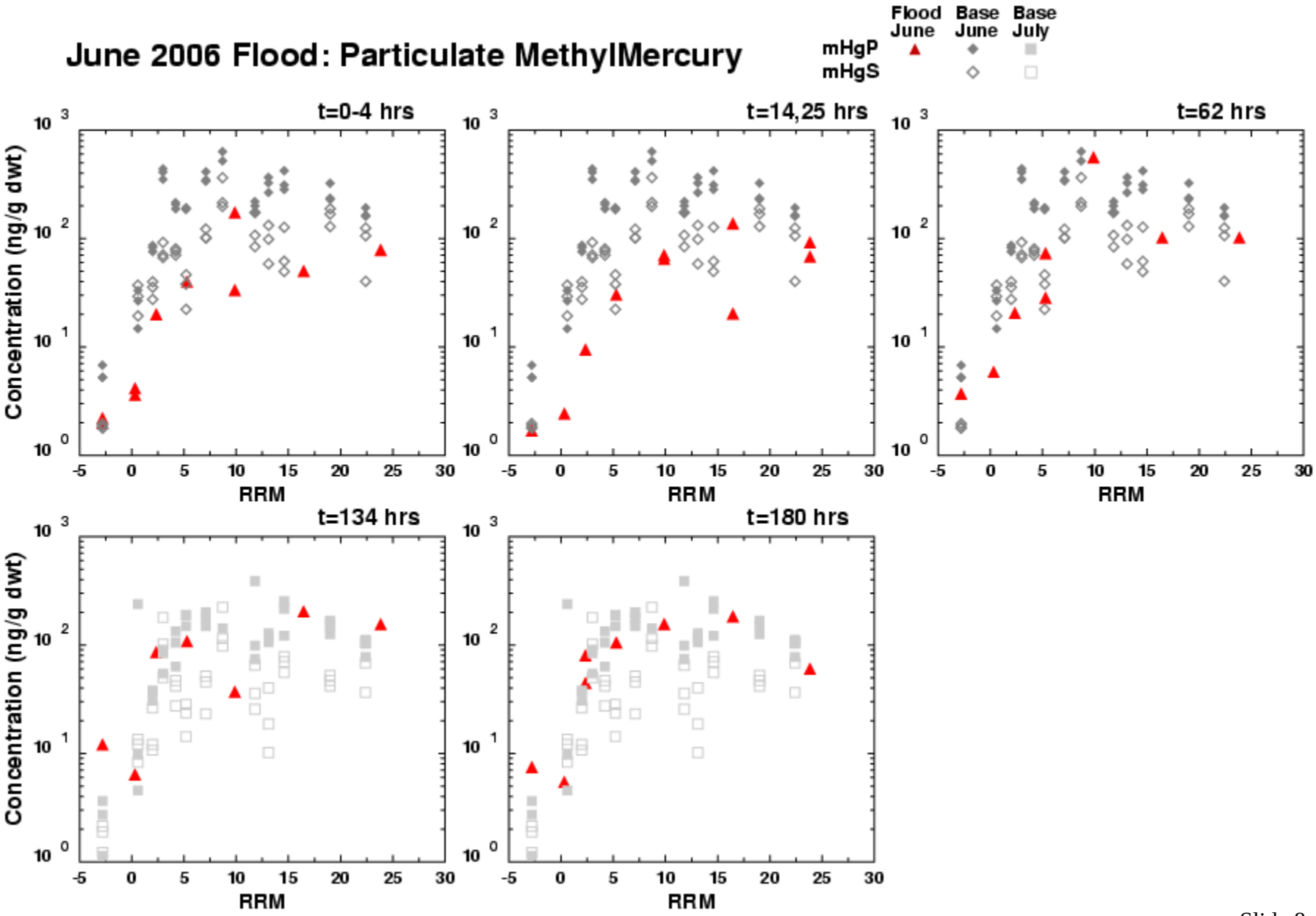

June 2006 Flood: Mercury
Flood June
Base June
Base July
HgT
HgD
t=0-4 hrs
t=14,25 hrs
t=62 hrs
t=134 hrs
t=180 hrs
Concentration (ng/L)
RRM

June 2006 Flood: MethylMercury

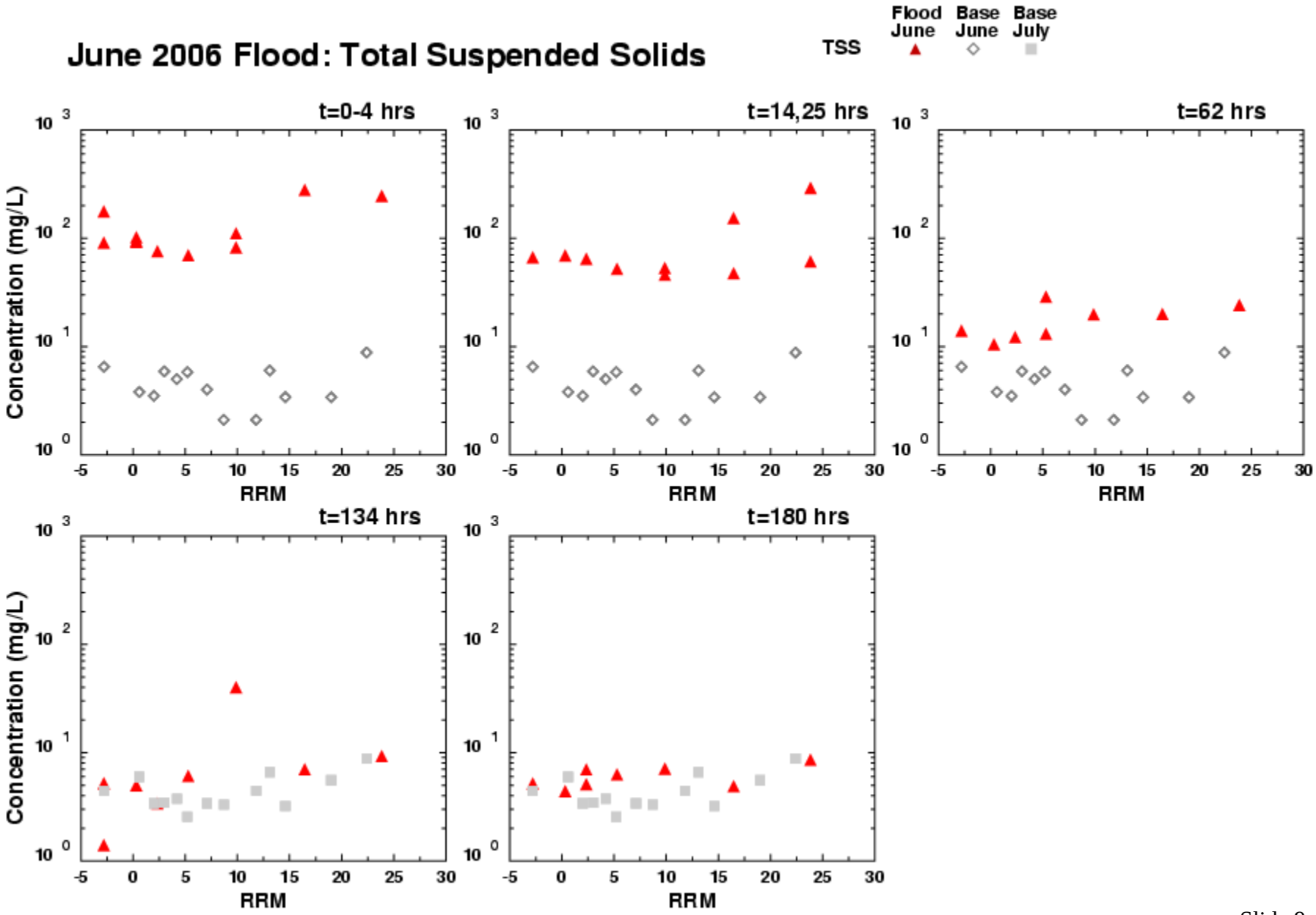


June 2006 Flood: Particulate Mercury



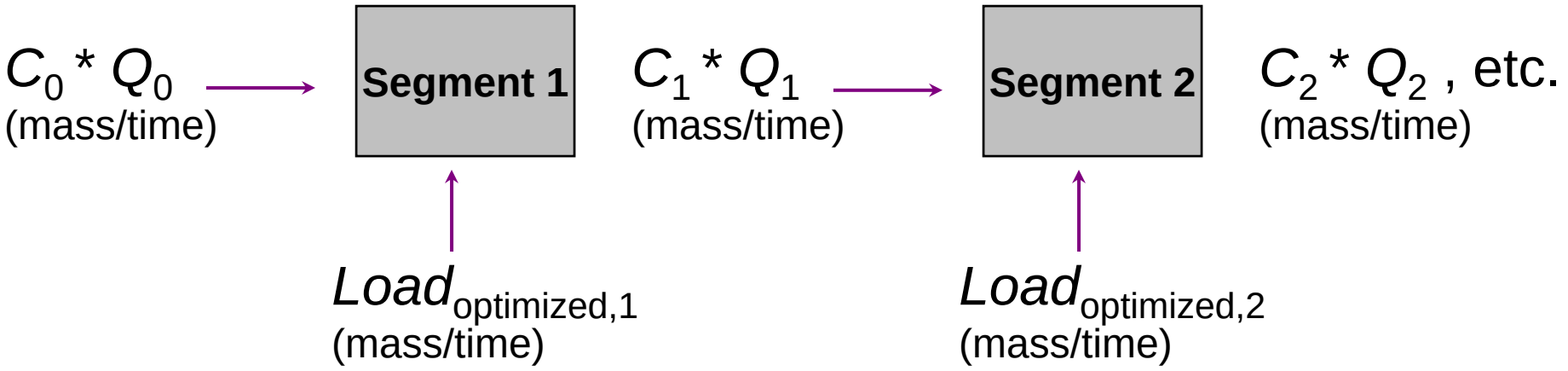

June 2006 Flood: Particulate MethylMercury
Flood June
Base June
Base July
mHgP
mHgS
t=0-4 hrs
t=14,25 hrs
t=62 hrs
t=134 hrs
t=180 hrs
Concentration (ng/g dwt)
RRM

June 2006 Flood: Total Suspended Solids

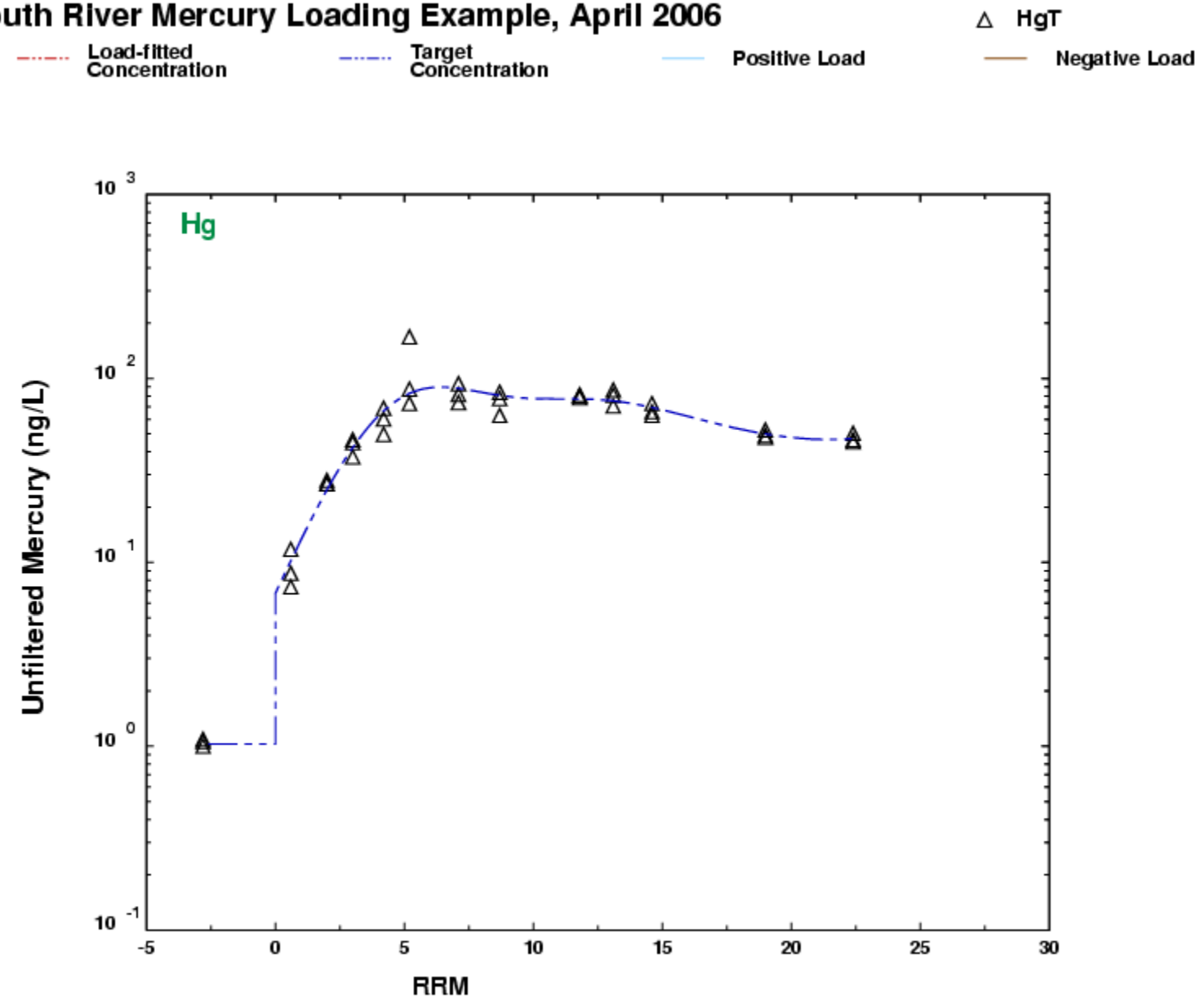


Loading Calculation:

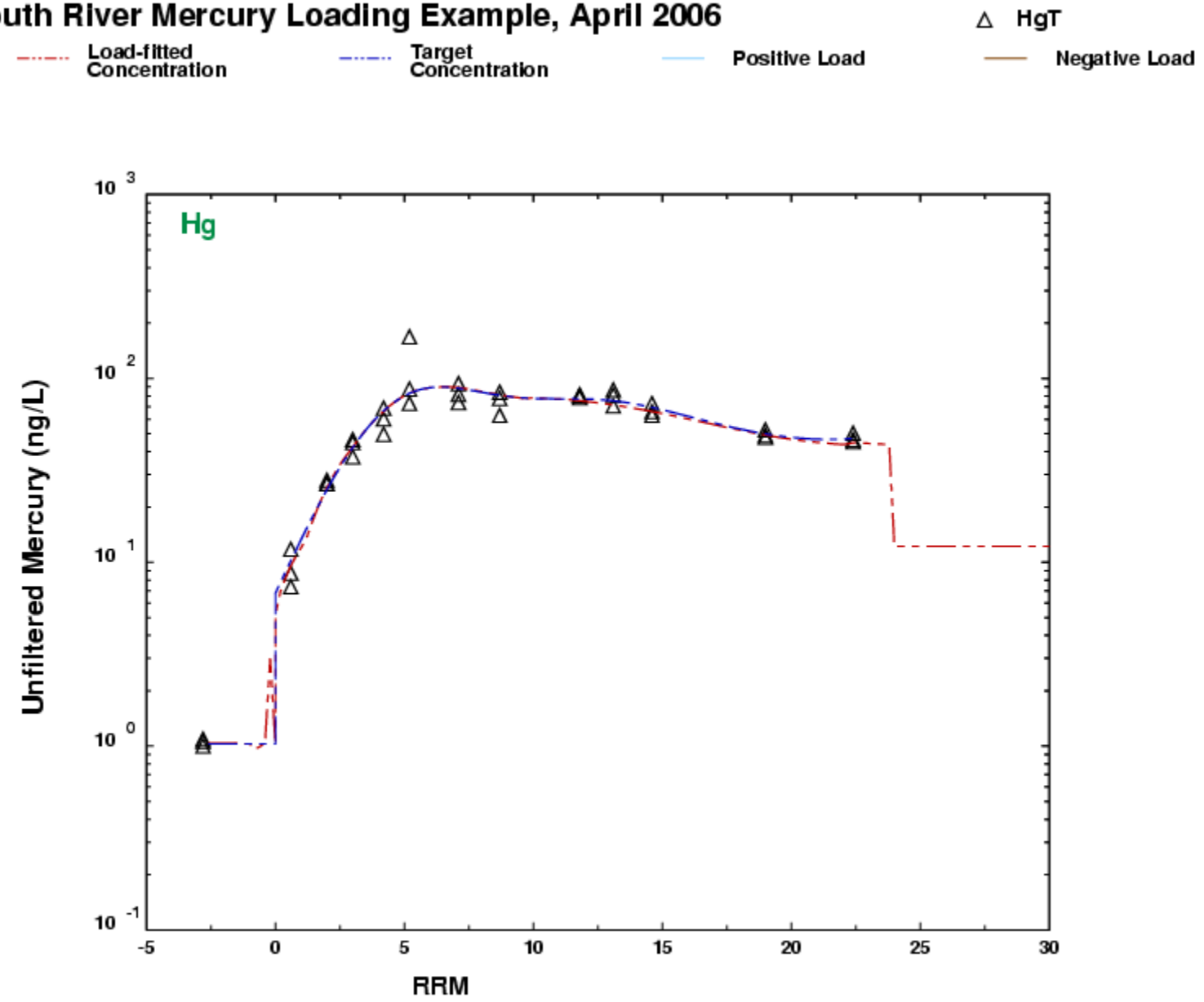
- Linear interpolation of flows between USGS stations
- Focus on unfiltered measurements → total loads
- Samples not taken simultaneously and changing concentrations during rapid flows may not be sampled consistently
- Answering: "What is Hg load required to produce differences in observed concentrations?"
  - Determined by optimization with Solver™



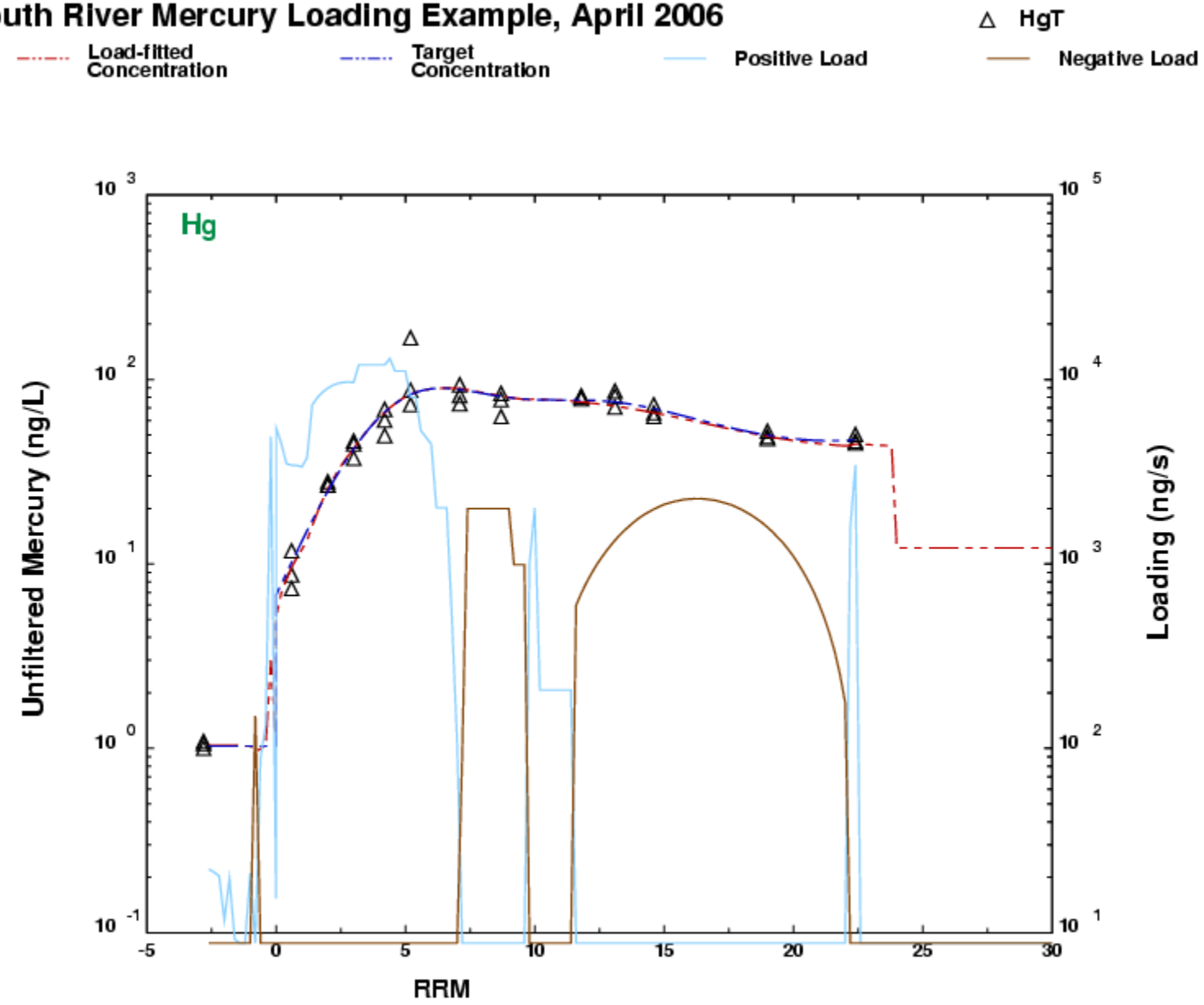
South River Mercury Loading Example, April 2006

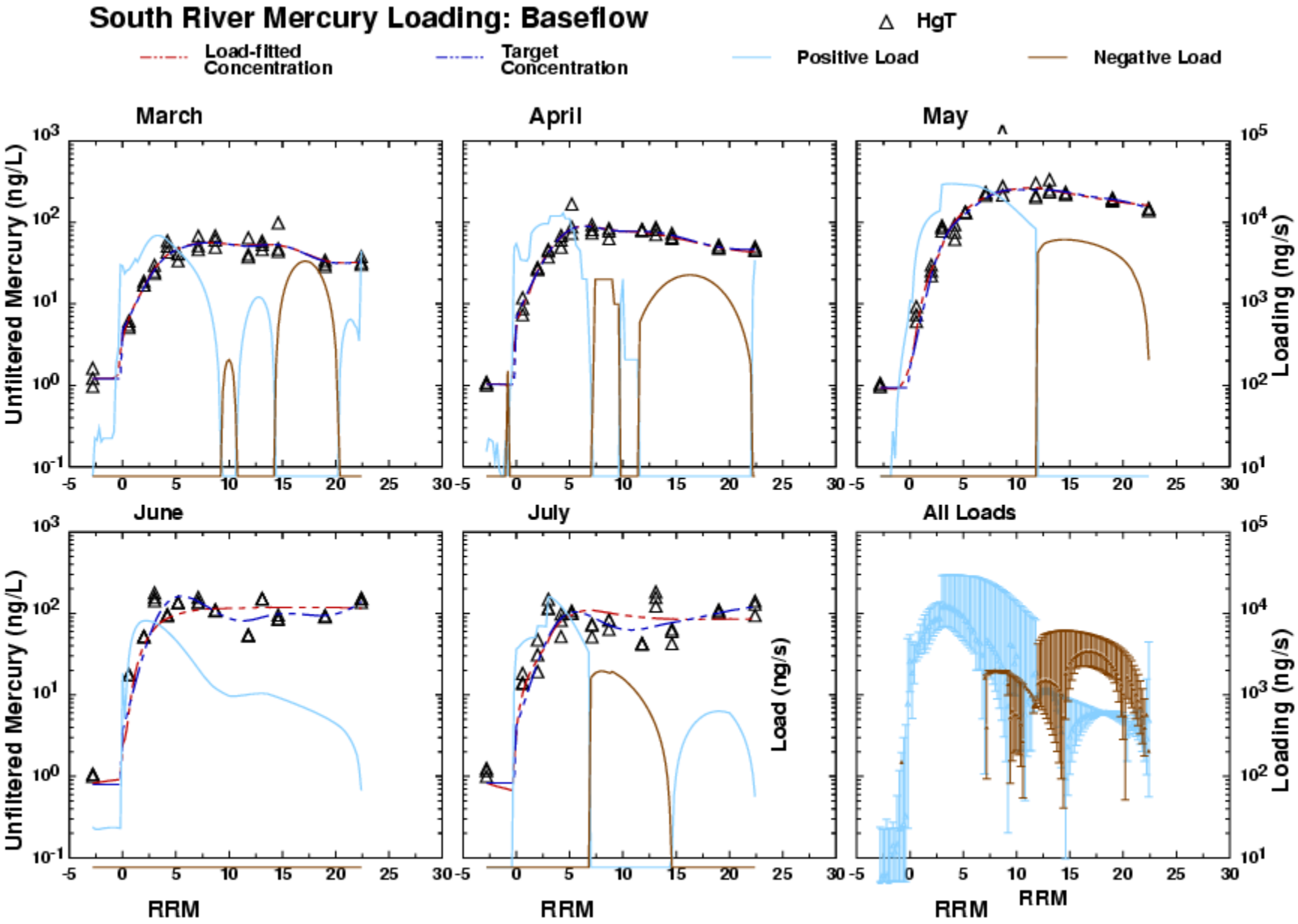


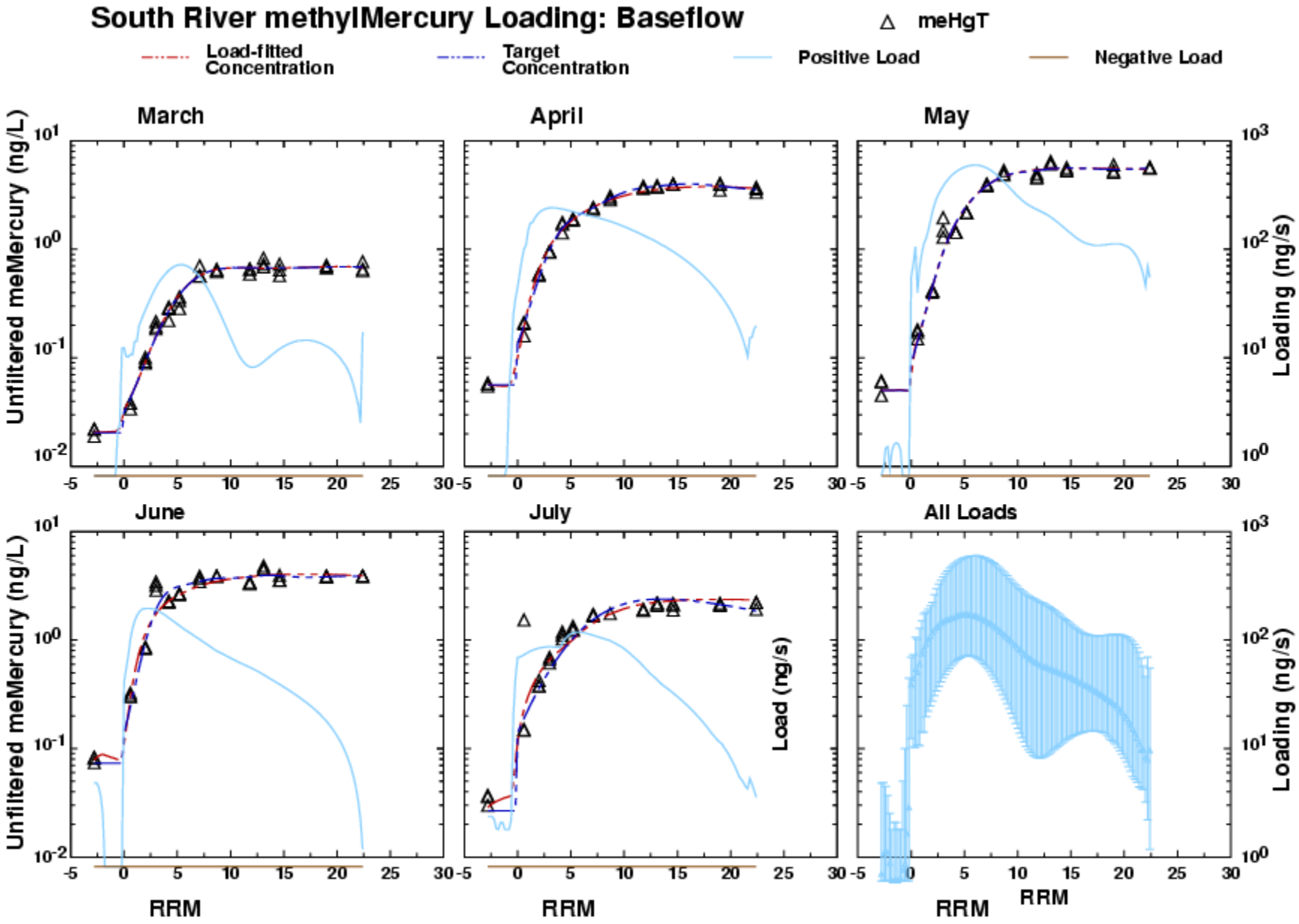
South River Mercury Loading Example, April 2006

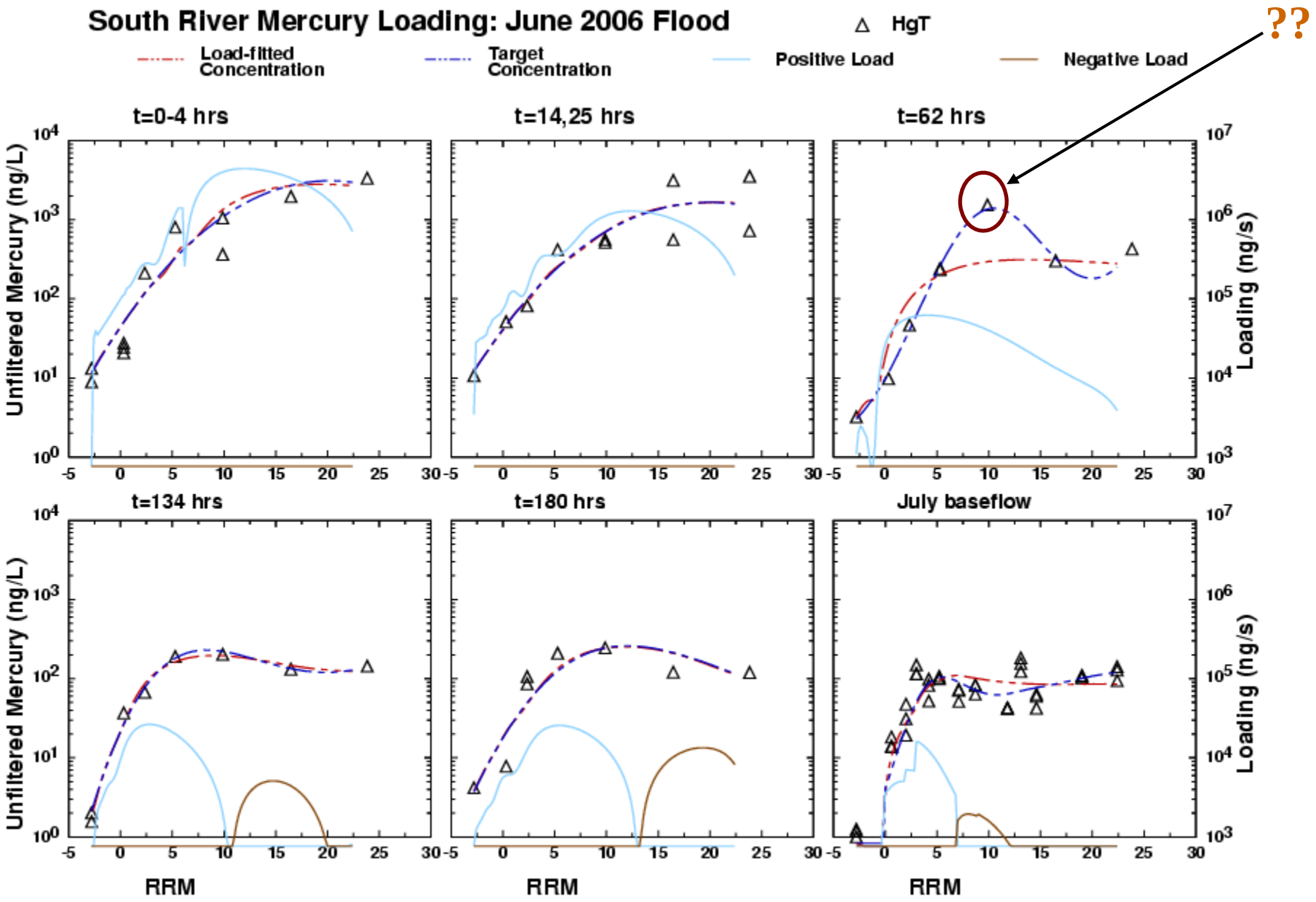


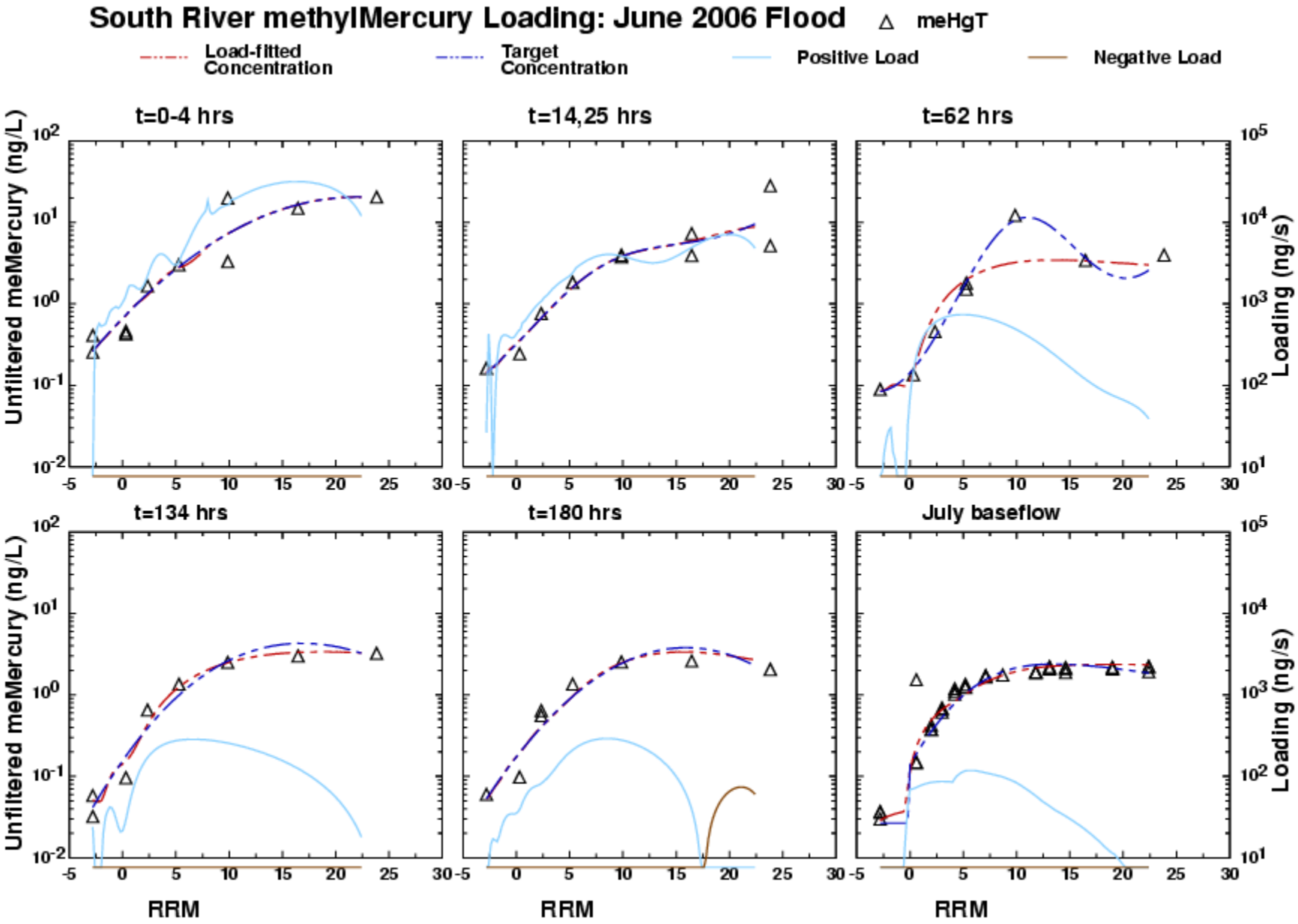
South River Mercury Loading Example, April 2006




South River Mercury Loading: Baseflow
HgT
Load-fitted Concentration
Target Concentration
Positive Load
Negative Load
March
April
May
June
July
All Loads
Unfiltered Mercury (ng/L)
Loading (ng/s)
Load (ng/s)
RRM


South River methylMercury Loading: Baseflow
meHgT
Load-fitted Concentration
Target Concentration
Positive Load
Negative Load
March
April
May
June
July
All Loads
Unfiltered meMercury (ng/L)
Loading (ng/s)
Load (ng/s)
RRM


South River Mercury Loading: June 2006 Flood
HgT
Load-fitted Concentration
Target Concentration
Positive Load
Negative Load
??
t=0-4 hrs
t=14,25 hrs
t=62 hrs
t=134 hrs
t=180 hrs
July baseflow
Unfiltered Mercury (ng/L)
Loading (ng/s)
RRM


South River methylMercury Loading: June 2006 Flood
meHgT
Load-fitted Concentration
Target Concentration
Positive Load
Negative Load
t=0-4 hrs
t=14,25 hrs
t=62 hrs
t=134 hrs
t=180 hrs
July baseflow
Unfiltered meMercury (ng/L)
Loading (ng/s)
RRM

Initial Conclusions

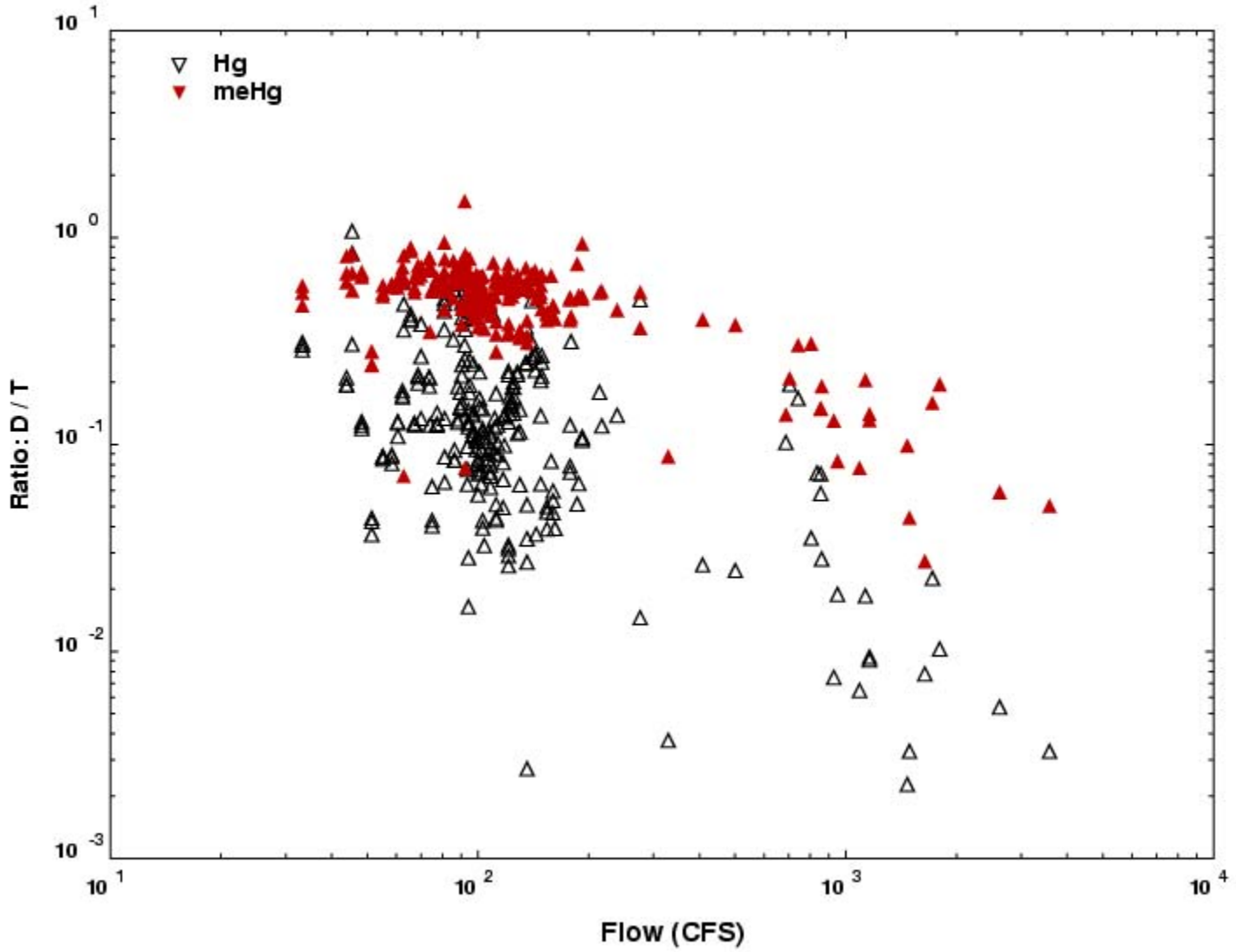
- Flood: Initial dilution of Hg and meHg on suspended particles by cleaner upstream solids
- Possible downstream source that participates only during high flow events (peak between RRM 10-15)
- At baseflow apparent peak Hg and meHg input between RRM 0-5
- Apparent peak loads at high flow between RRM 10-15

Other ongoing work

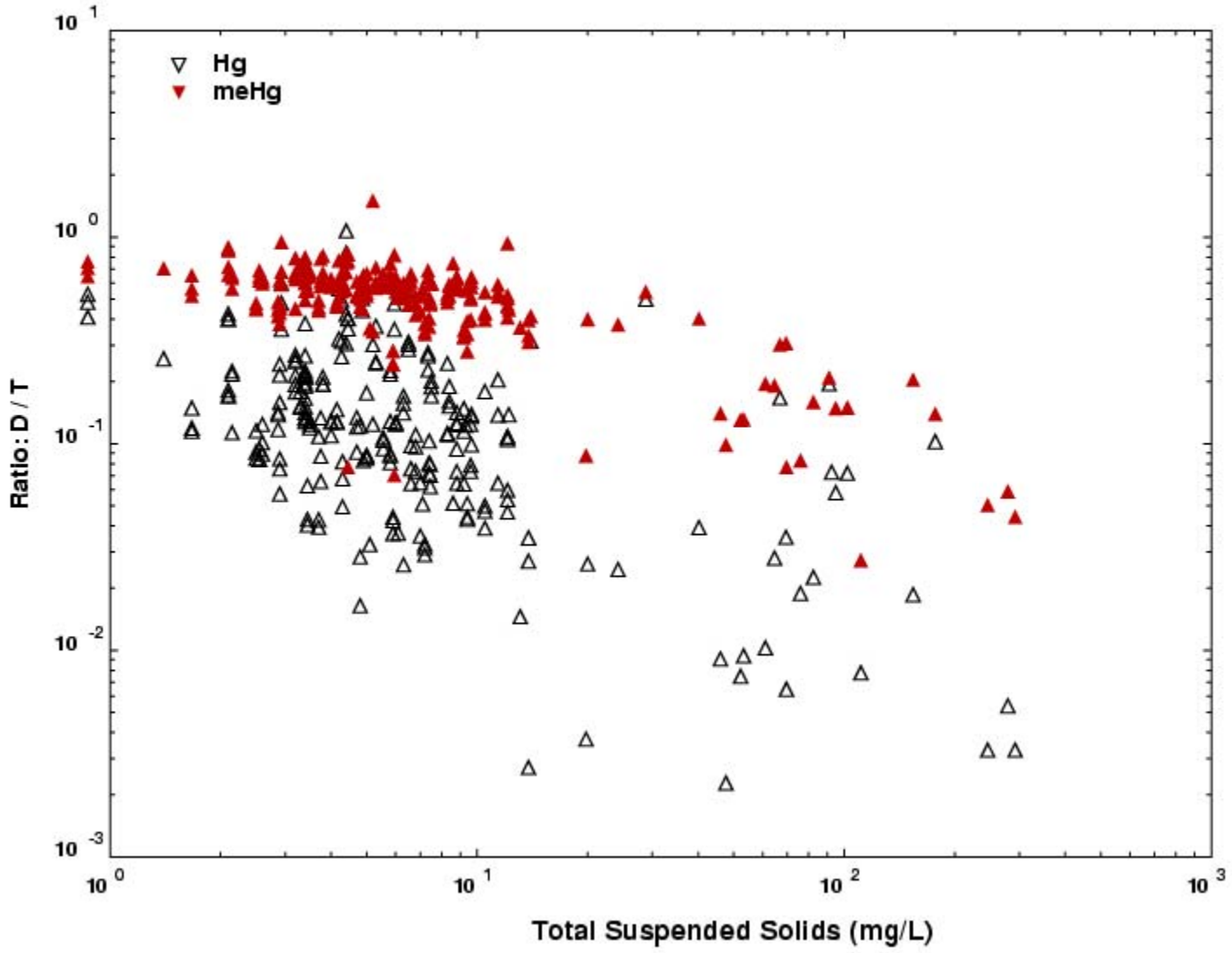
- Speciation calculations
- Review Mason's report on Hg release due to resuspension of sediment and soil material
- Evaluate other baseflow (Aug, Sept) and high flow (Sept, Nov) events with same approach
- Analyze fish and prey Hg concentrations including preliminary bioaccumulation calculations

Appendix: Ratio of water column Filtered/Unfiltered Hg and meHg compared to Flow, TSS, pH, and Temperature

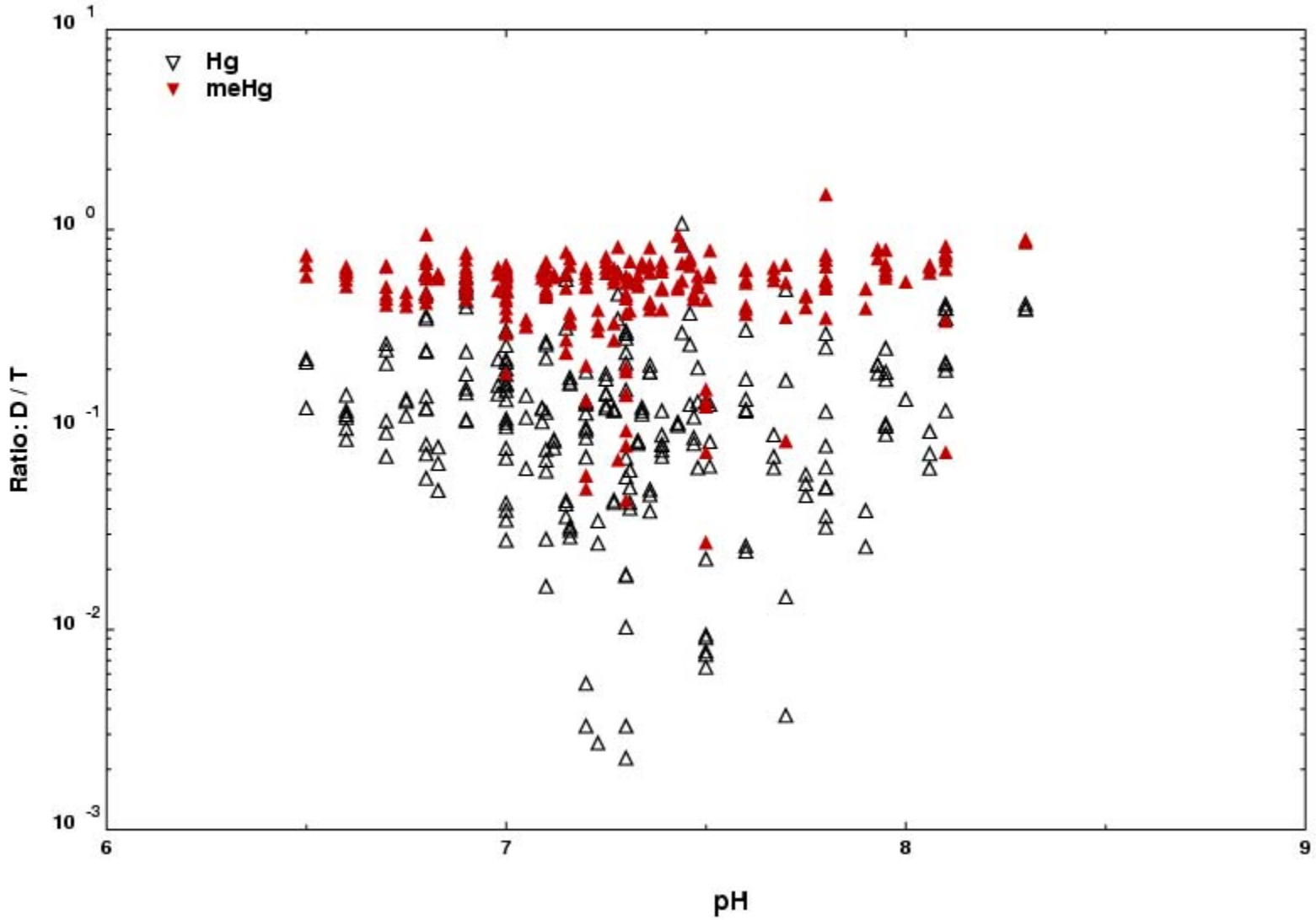
All 2006 Data: Ratios of Hg, meHg vs Flow



All 2006 Data: Ratios of Hg, meHg vs TSS



All 2006 Data: Ratios of Hg, meHg vs pH



All 2006 Data: Ratios of Hg, meHg vs Temperature