The Importance of Concurrent Monitoring and Modeling for Understanding Mercury Exposure in the Environment

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2008 National Water Quality Monitoring Conference

Monitoring: Key to Understanding Our Waters

May 20th, 2008

Concurrent Monitoring and Modeling

Goal: Demonstrate importance of combining monitoring and modeling programs

Approach: Examples of challenges and successes.

Talk Outline

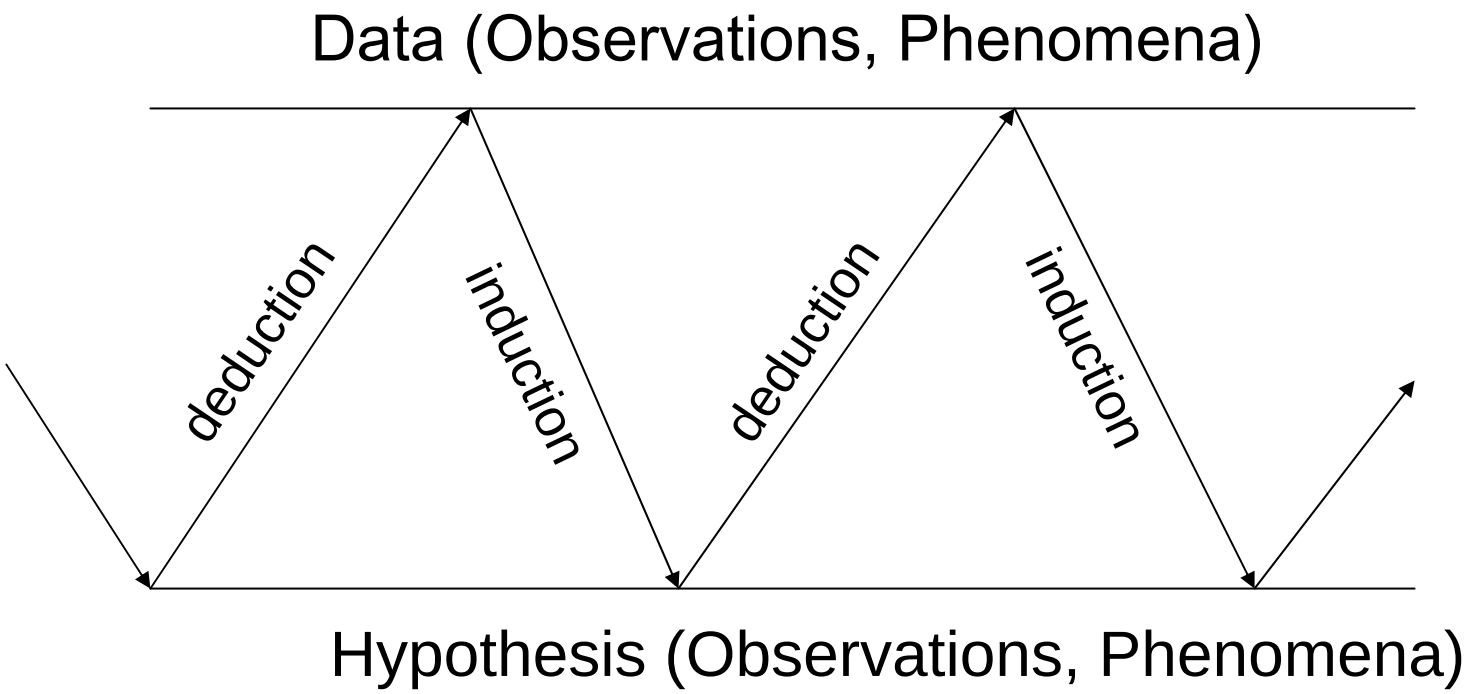
I. Introduction
II. Mercury in the Environment
III. Monitoring
IV. Modeling
V. Comparisons
VI. Conclusion

Introduction

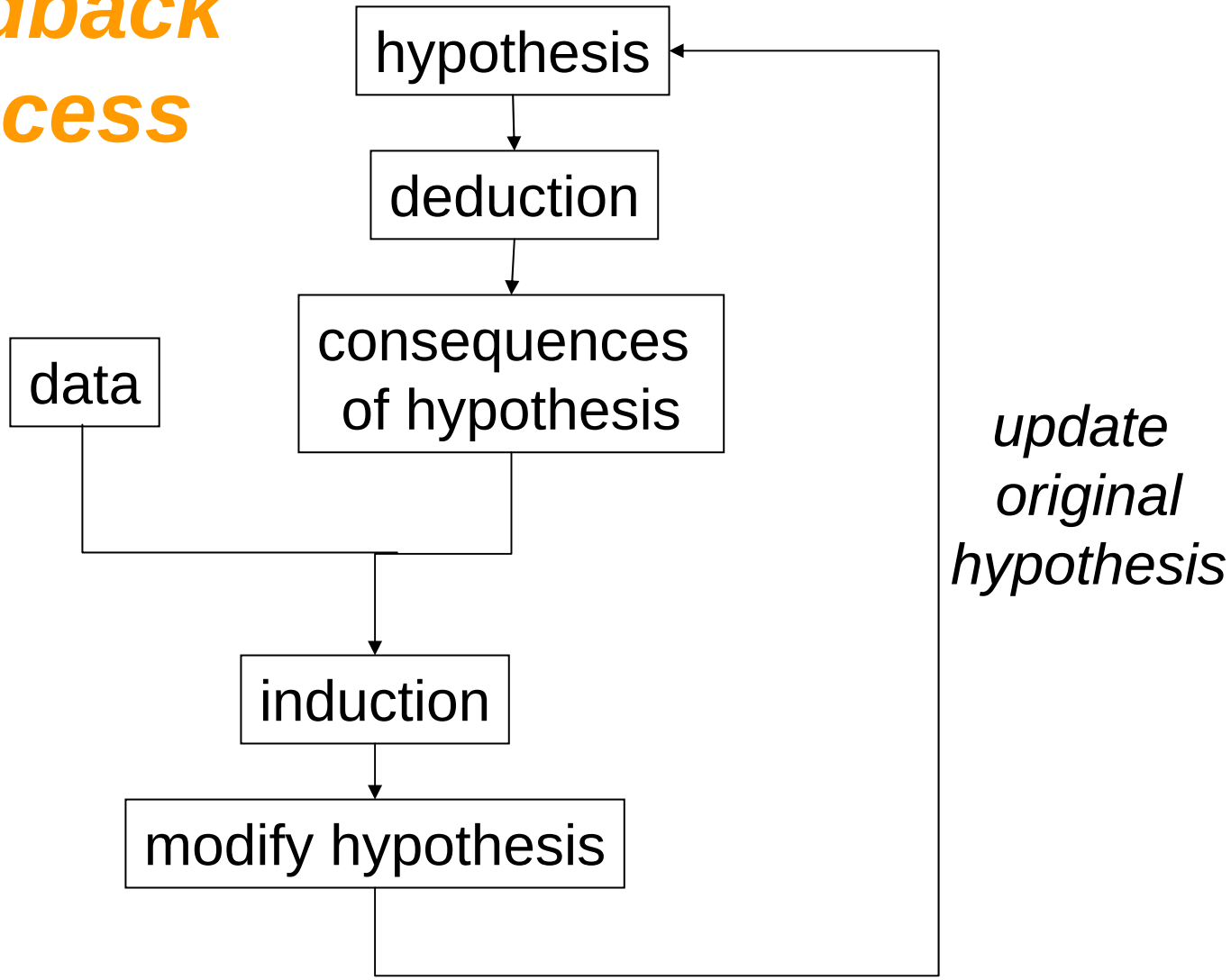
National Research Council:
Committee on Models in the Regulatory Decision Process

- Many US EPA regulations based on computer model results
- Historically, models help
  - explain scientific phenomenon
  - predict outcomes and behaviors
- Models are generally simplifications and approximations
- NRC Committee recommends EPA increase dialogue between modeling and monitoring

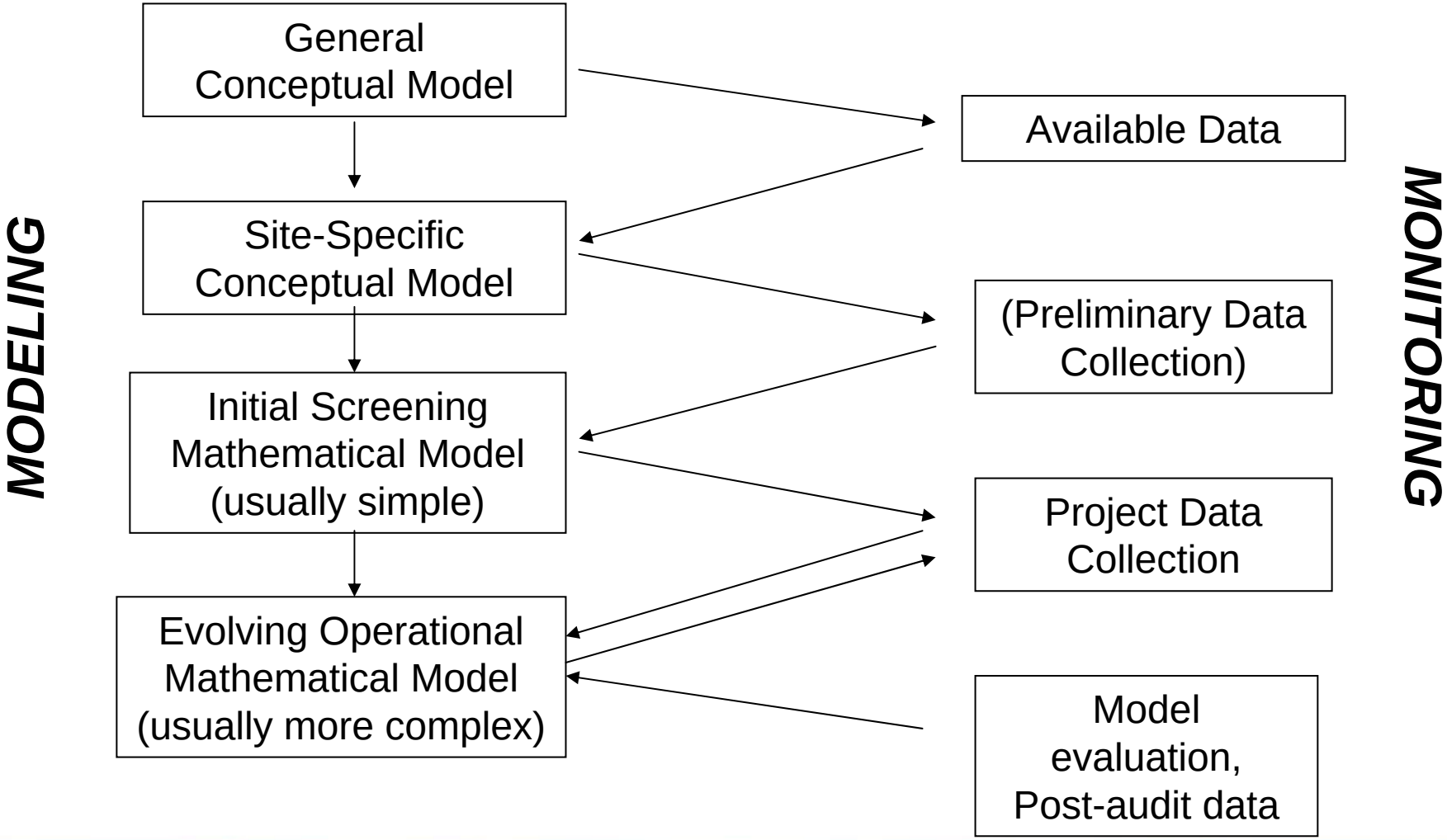
The Iterative Learning Process



Learning as Feedback Process



Relationship between Monitoring and Modeling



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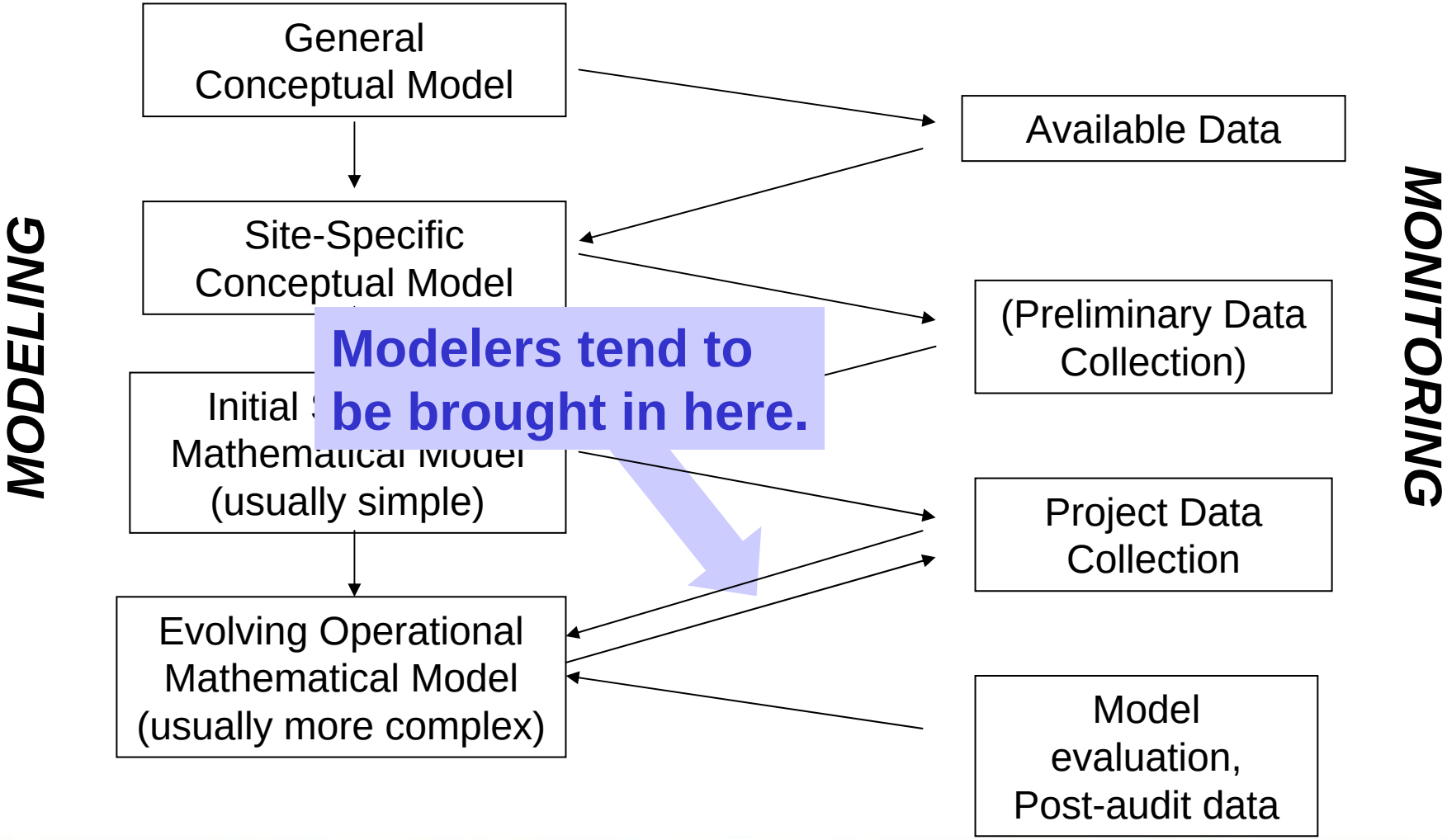
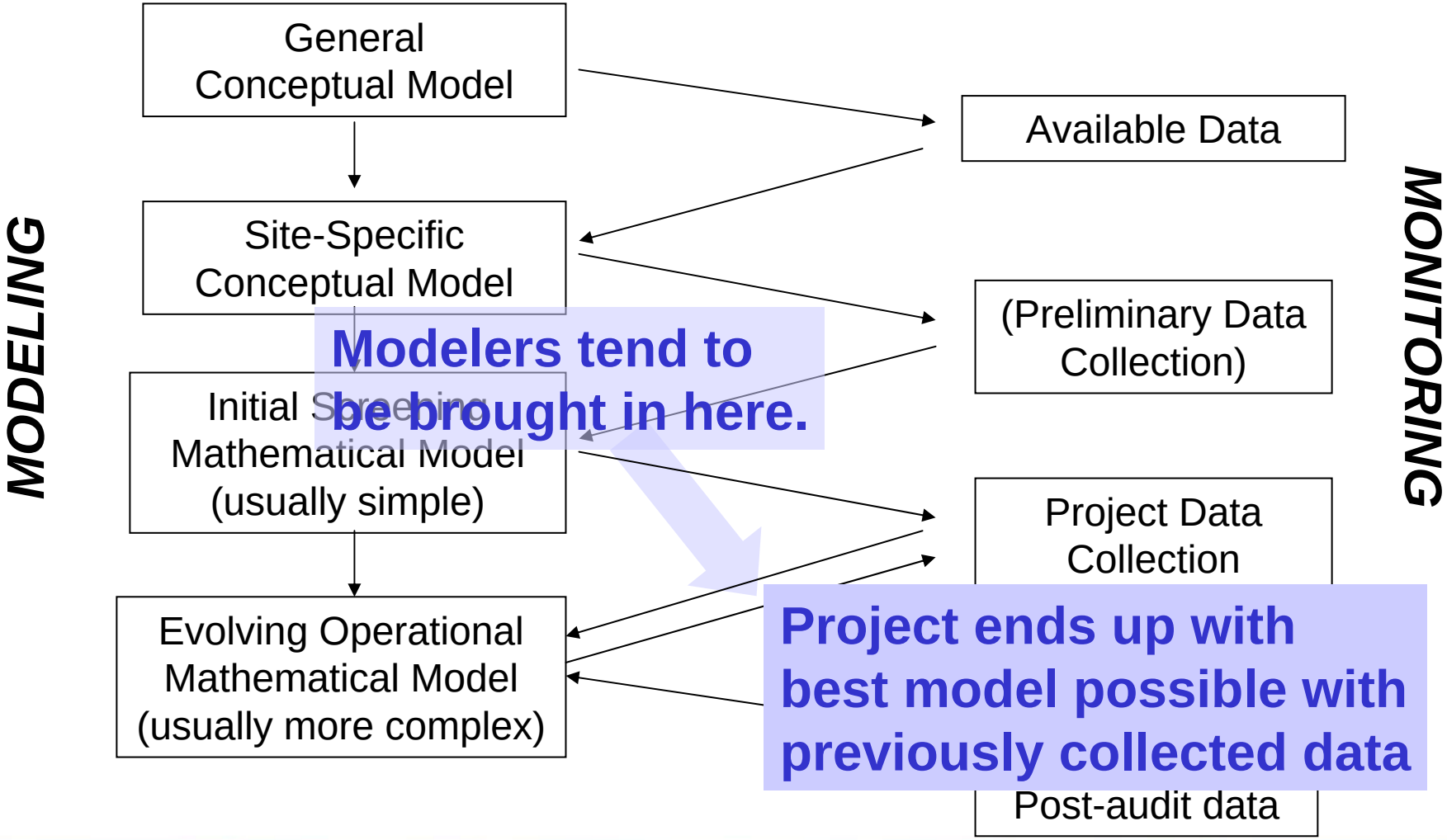
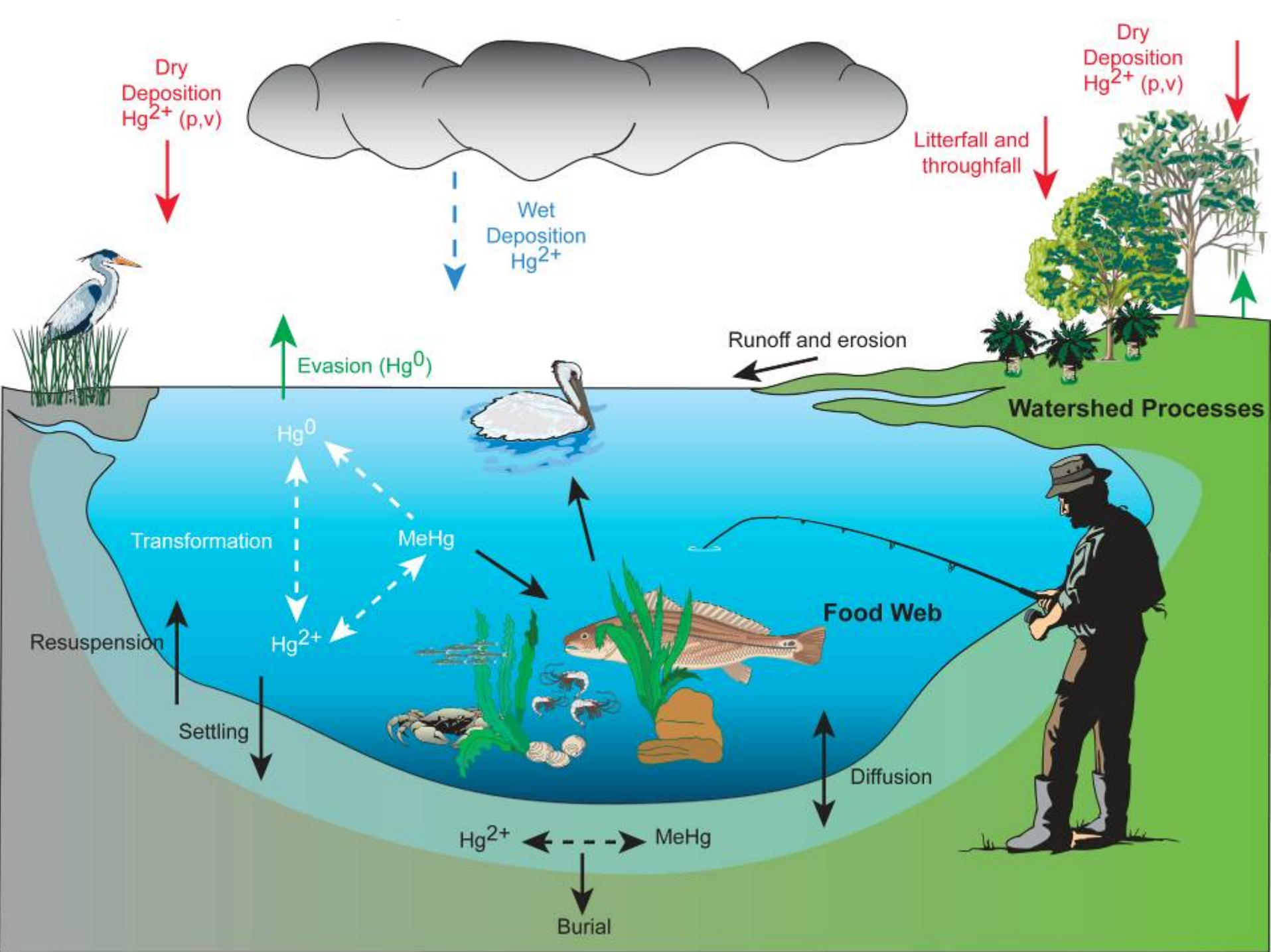


Relationship between Monitoring and Modeling

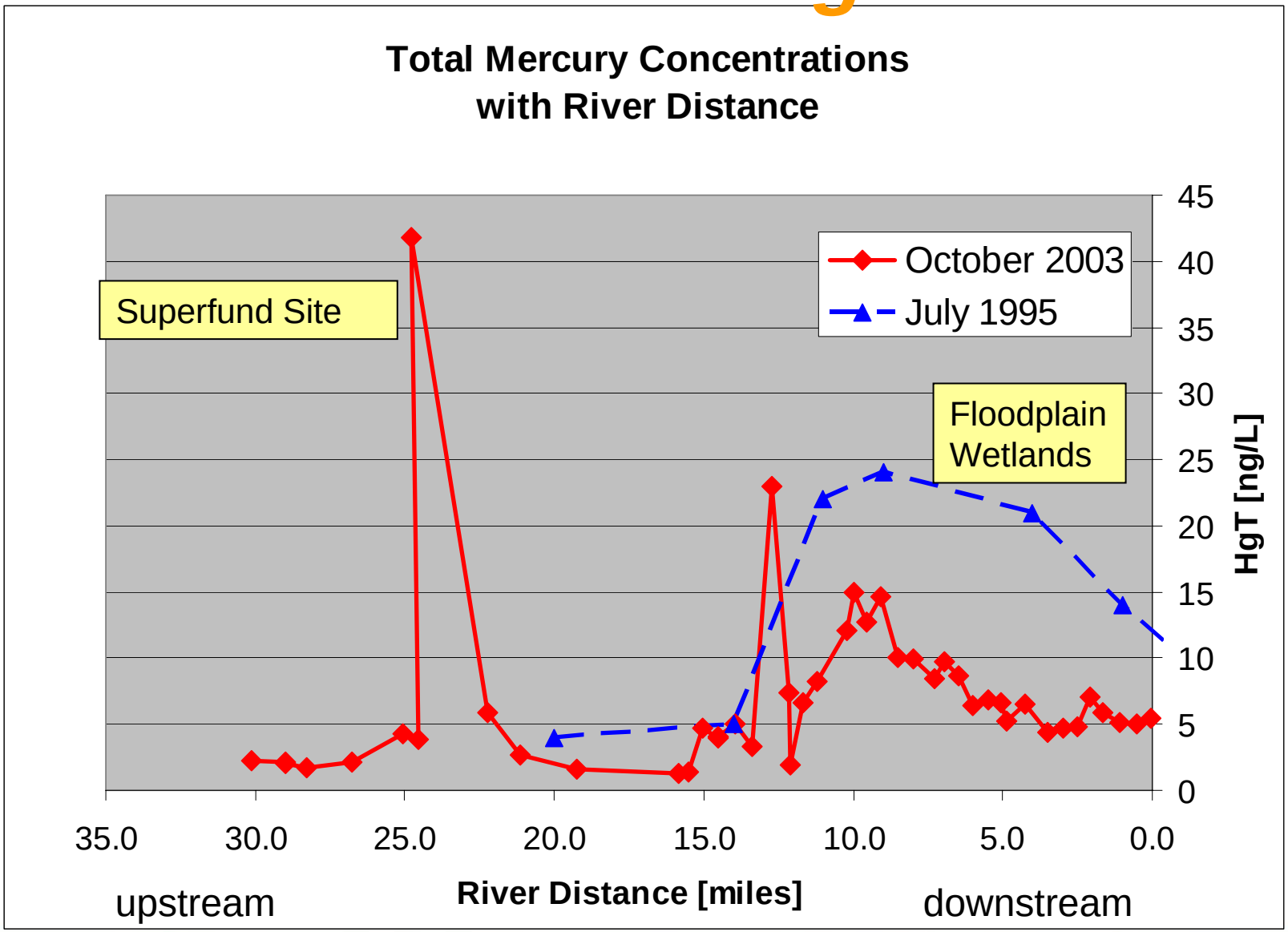


Mercury in the Environment

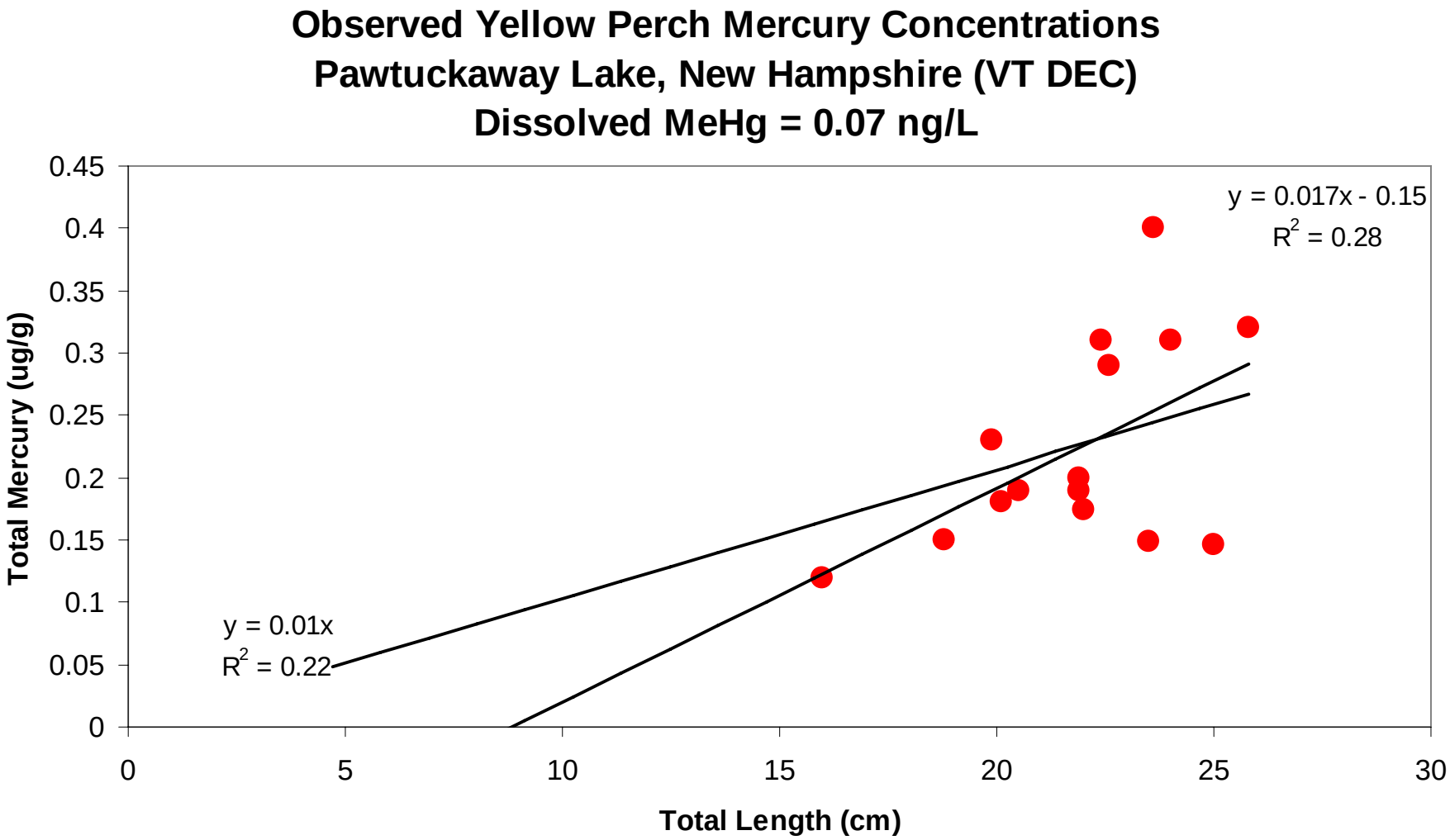

Dry Deposition Hg^{2+} (p,v)
Wet Deposition Hg^{2+}
Dry Deposition Hg^{2+} (p,v)
Litterfall and throughfall
Evasion (Hg^0)
Runoff and erosion
Watershed Processes
Hg^0
Transformation
MeHg
Hg^{2+}
Food Web
Resuspension
Settling
Diffusion
Hg^{2+}
MeHg
Burial

Monitoring

Monitoring


Total Mercury Concentrations
with River Distance
Superfund Site
October 2003
July 1995
Floodplain
Wetlands
45
40
35
30
25
20
15
10
5
0
HgT [ng/L]
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
upstream
River Distance [miles]
downstream

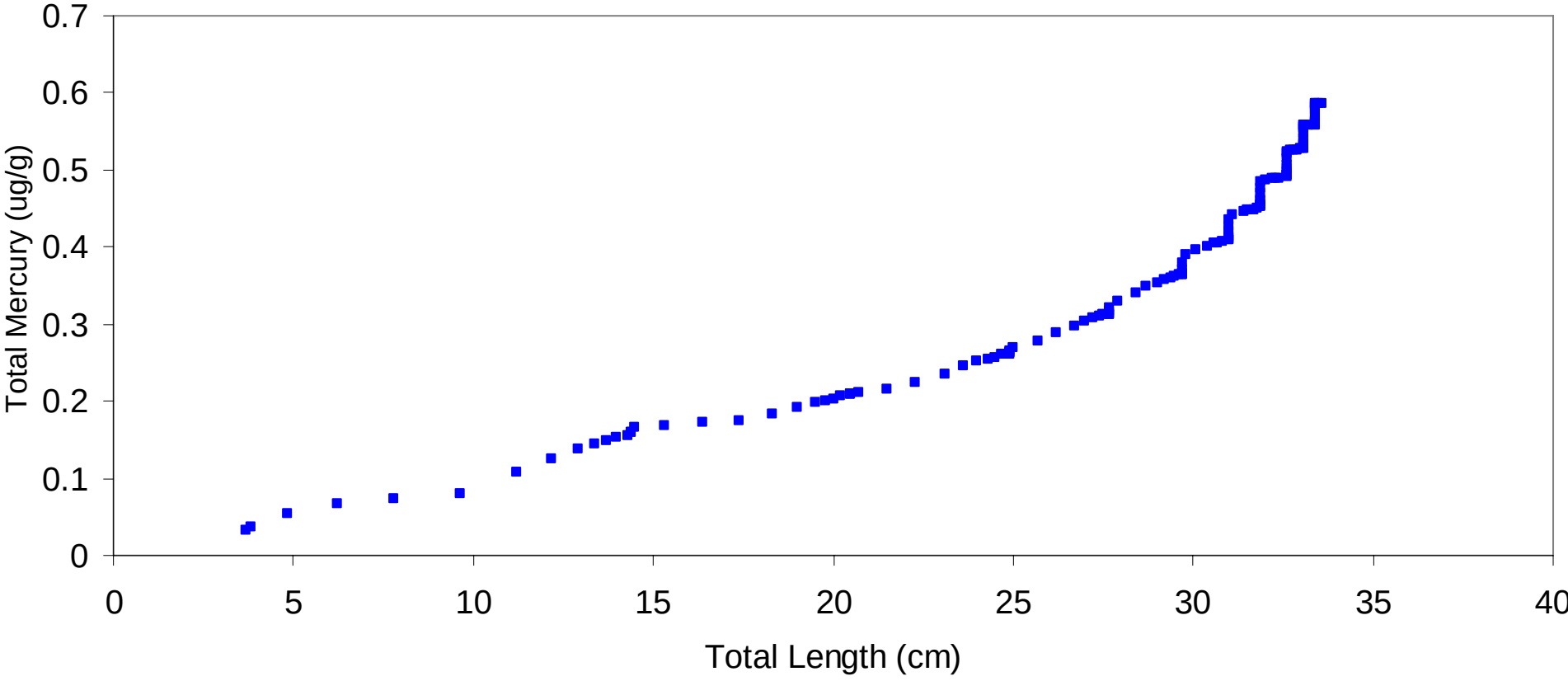
Monitoring


Observed Yellow Perch Mercury Concentrations
Pawtuckaway Lake, New Hampshire (VT DEC)
Dissolved MeHg = 0.07 ng/L
Total Mercury (ug/g)
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
0
5
10
15
20
25
30
Total Length (cm)
y = 0.017x - 0.15
R2 = 0.28
y = 0.01x
R2 = 0.22

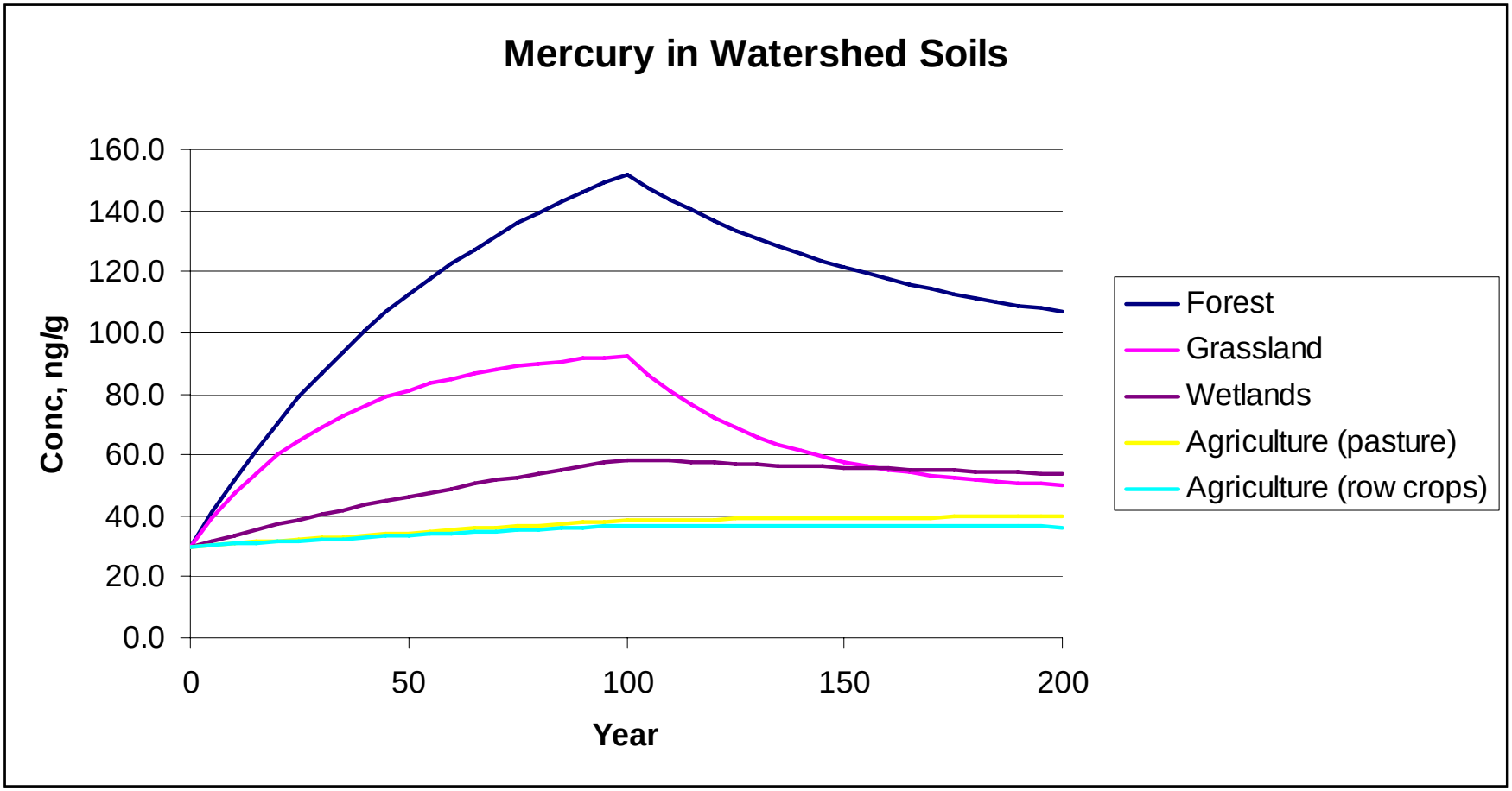
Modeling

Modeling

BASS Model Results for Yellow Perch
exposed to MeHg = 0.07 ng/L
Pawtuckaway Lake, New Hampshire



Modeling

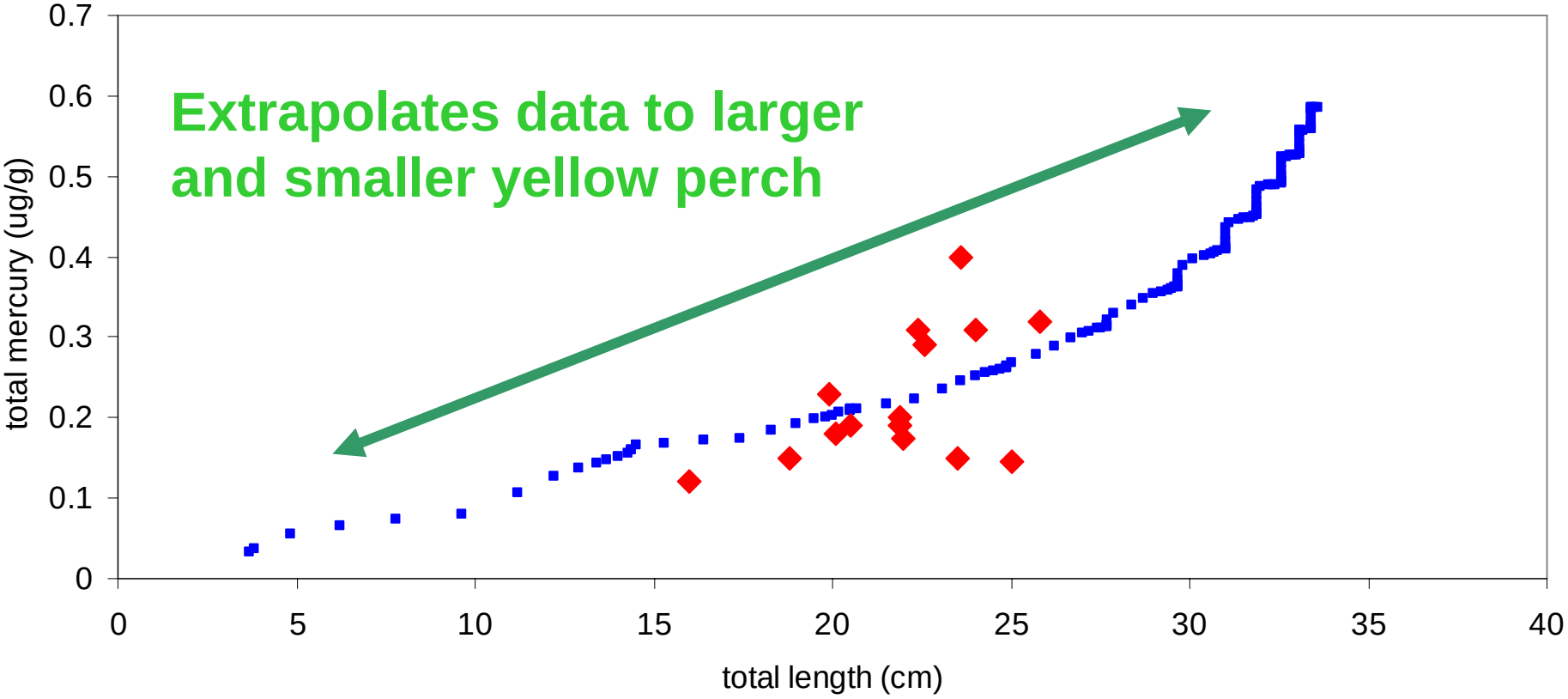


SERAFM-NPS: Hg Watershed Modeling

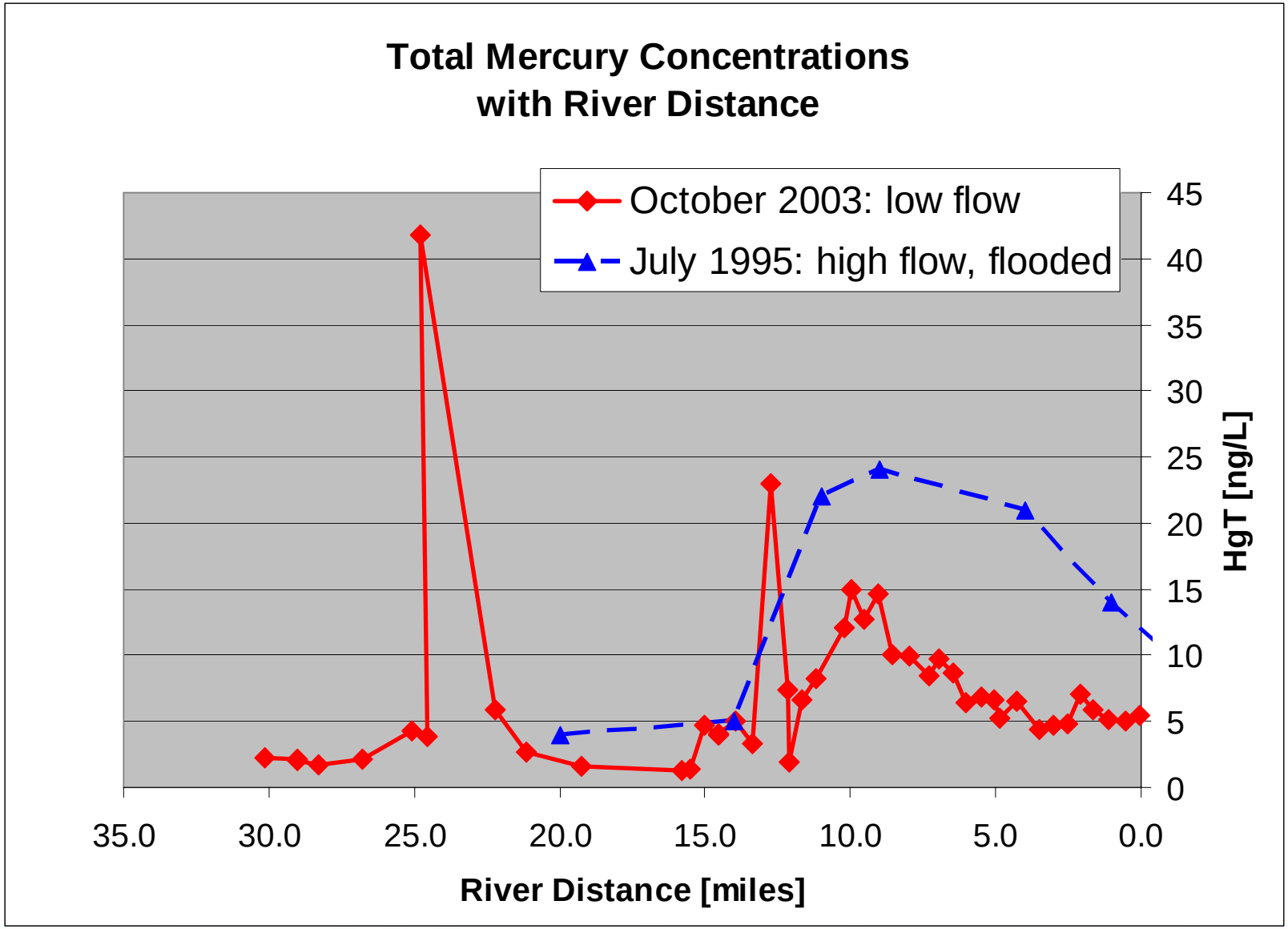
Comparison of Monitoring and Modeling

Monitoring and Modeling

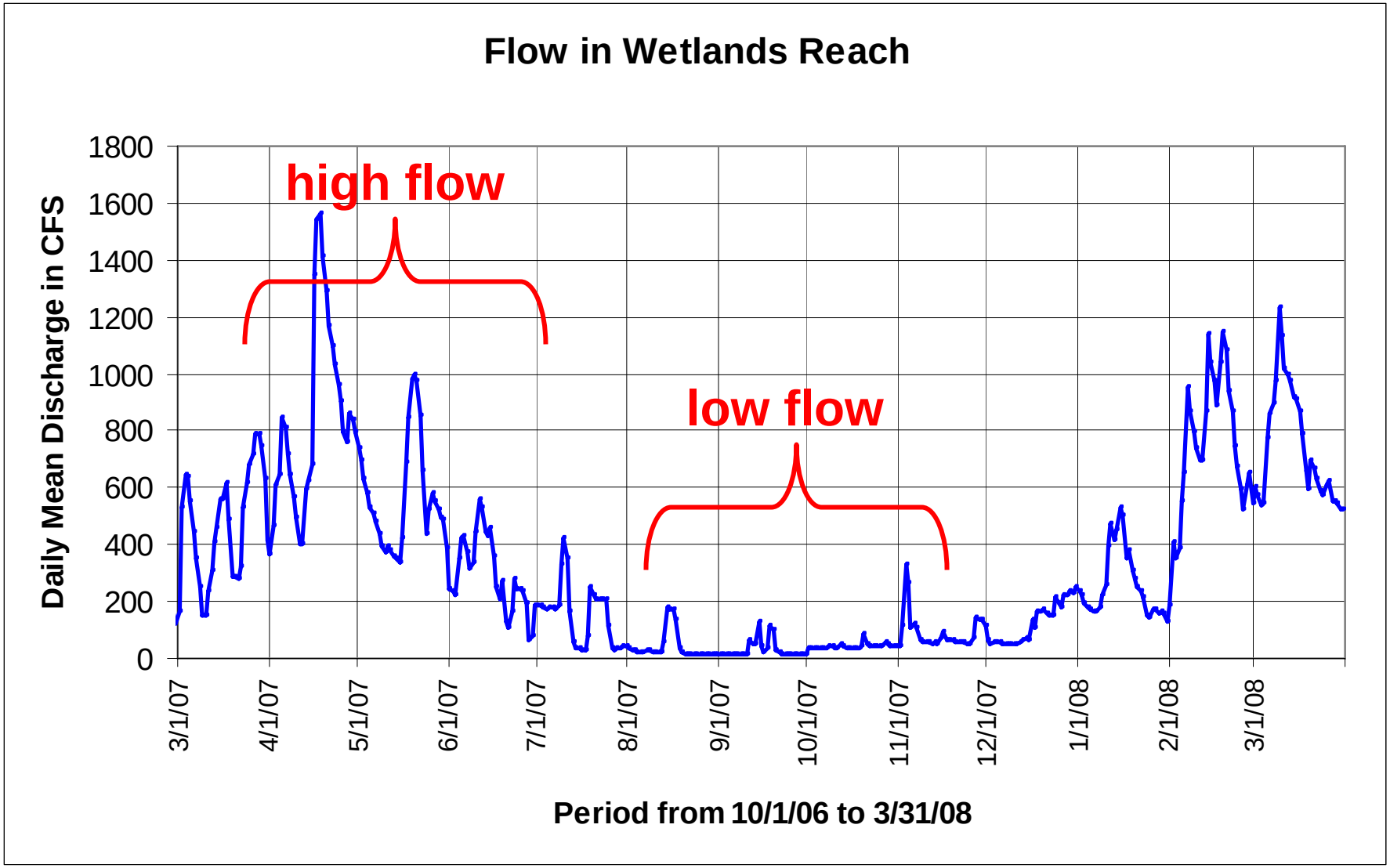
Yellow Perch Pawtuckaway Lake
Model and Monitoring



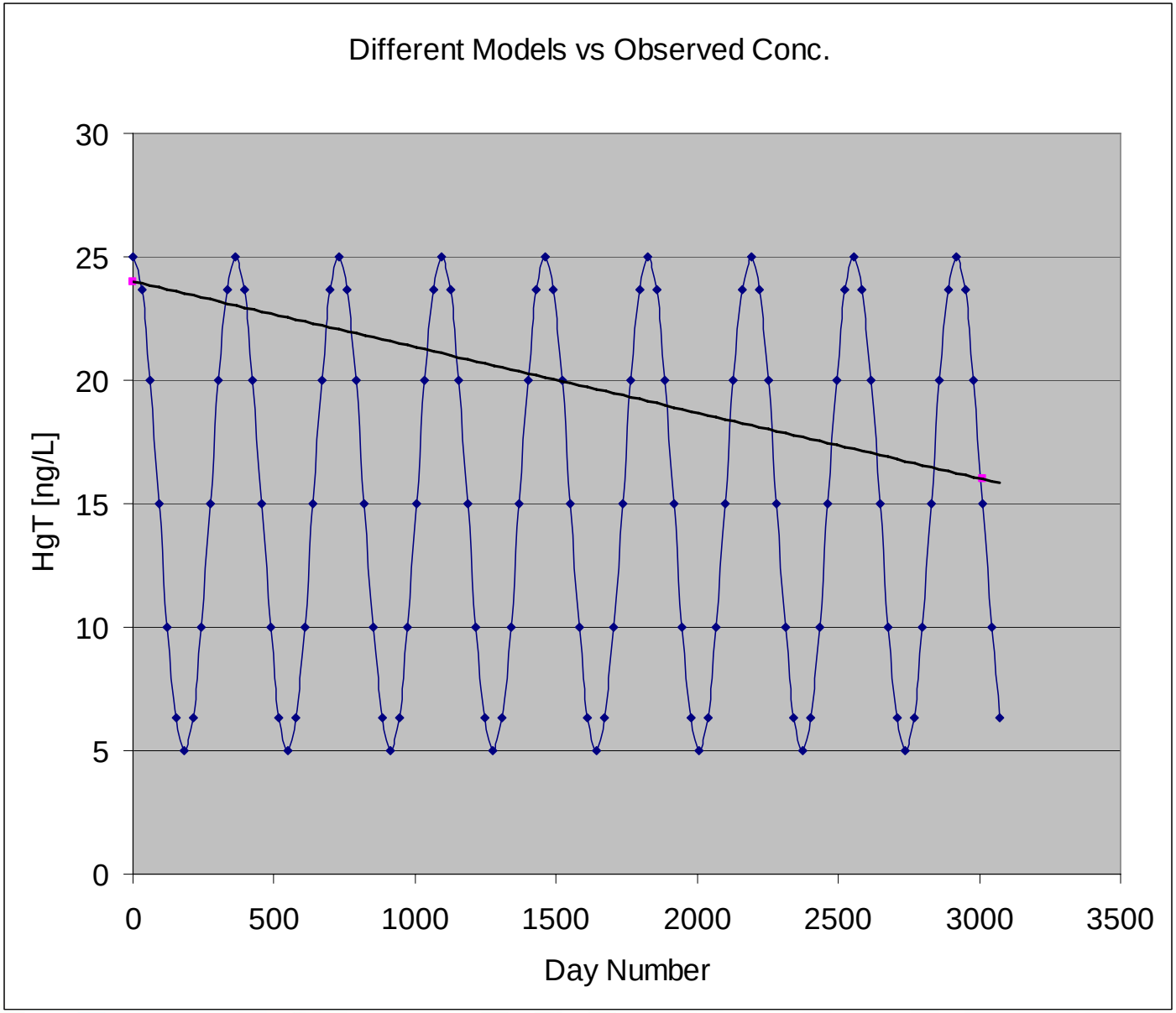
Monitoring and Modeling



Monitoring and Modeling



Two Possible Patterns:



Combining Modeling with Observations may improve interpretation and understanding

Monitoring versus Modeling

Strengths:

- Temporal and spatial representation of existing conditions
- Observed data often viewed to be real

Weaknesses:

- Data provides snapshot in specific location and at specific times
- Limited utility in understanding past, predicting future/futures

Strengths:

- Temporal and spatial across the entire space and system
- Predicts past, present, and future
- Can be used to predict different futures under different conditions

Weaknesses:

- Mercury model's not *a priori* predictive
- Missing processes may not be represented
- Predictions may not be viewed as real

Monitoring concurrent with Modeling

- Combines strengths and counters weaknesses of each separately
- Permits investigation of hypotheses and evaluation of system processes
- Puts monitoring into context
- Ground-truths modeling

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