

Lake Erie Center, University of Toledo  
Land-Lake Loadings Workshop  
March 18, 2008

# Linking Watershed Atrazine and PCB Loads to Lake Michigan

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P.J. Horvatin<sup>3</sup>, D.A. Griesmer<sup>4</sup>, W. Melendez<sup>4</sup>, X. Xia<sup>4</sup>

<sup>1</sup> U.S. EPA/ORD/NHEERL/MED – Grosse Ile, Michigan

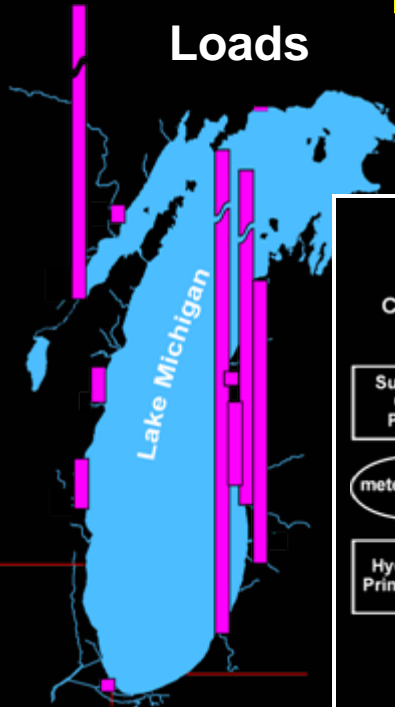
<sup>2</sup> Z-Tech Corporation, LLC. – Grosse Ile, Michigan

<sup>3</sup> U.S. EPA Great Lakes National Program Office – Chicago, Illinois

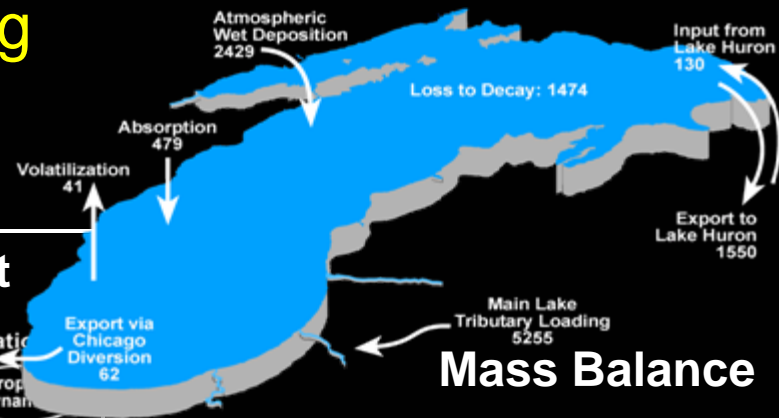
<sup>4</sup> Computer Sciences Corporation – Grosse Ile, Michigan

# Modeling and Forecasting

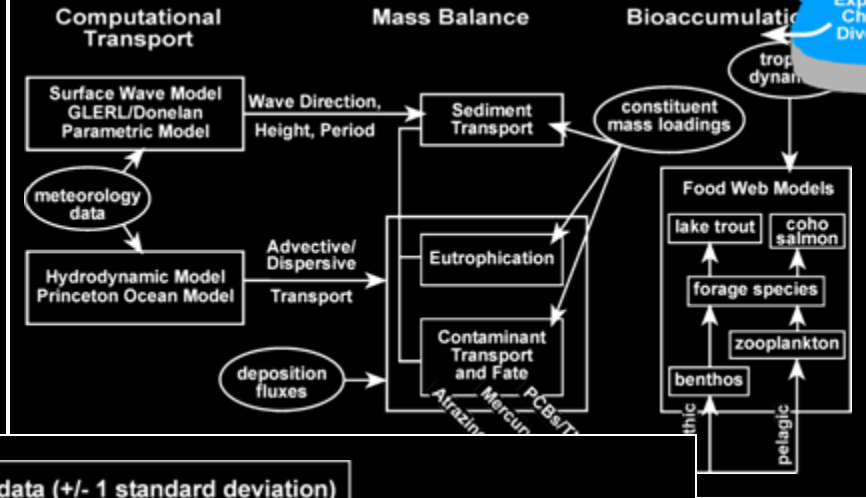
## Loads



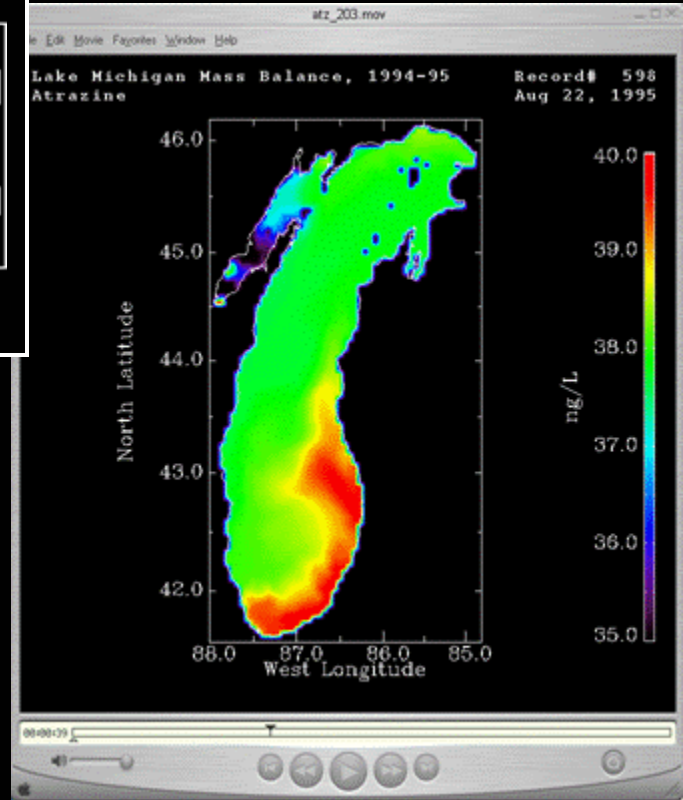
## Mass Balance



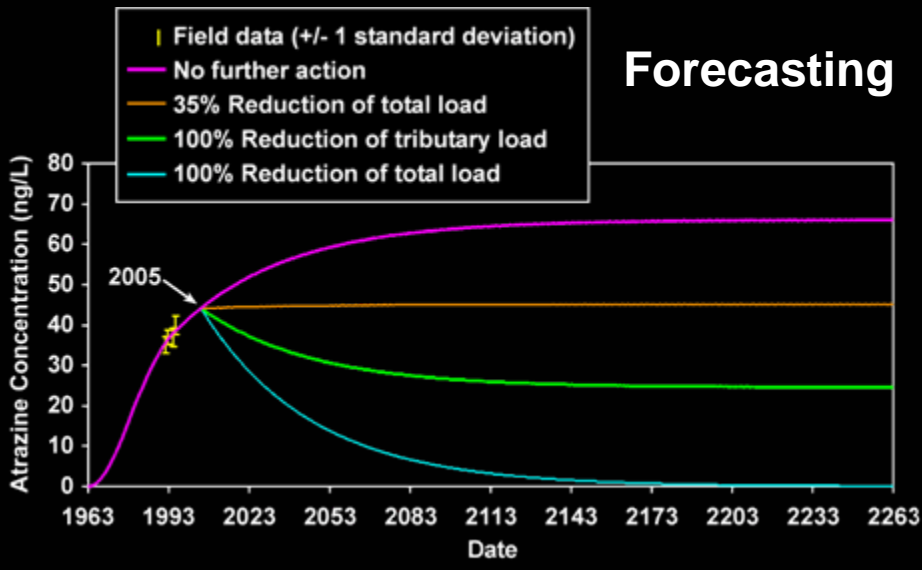
## Integrated Modeling Construct



## Mass Balance

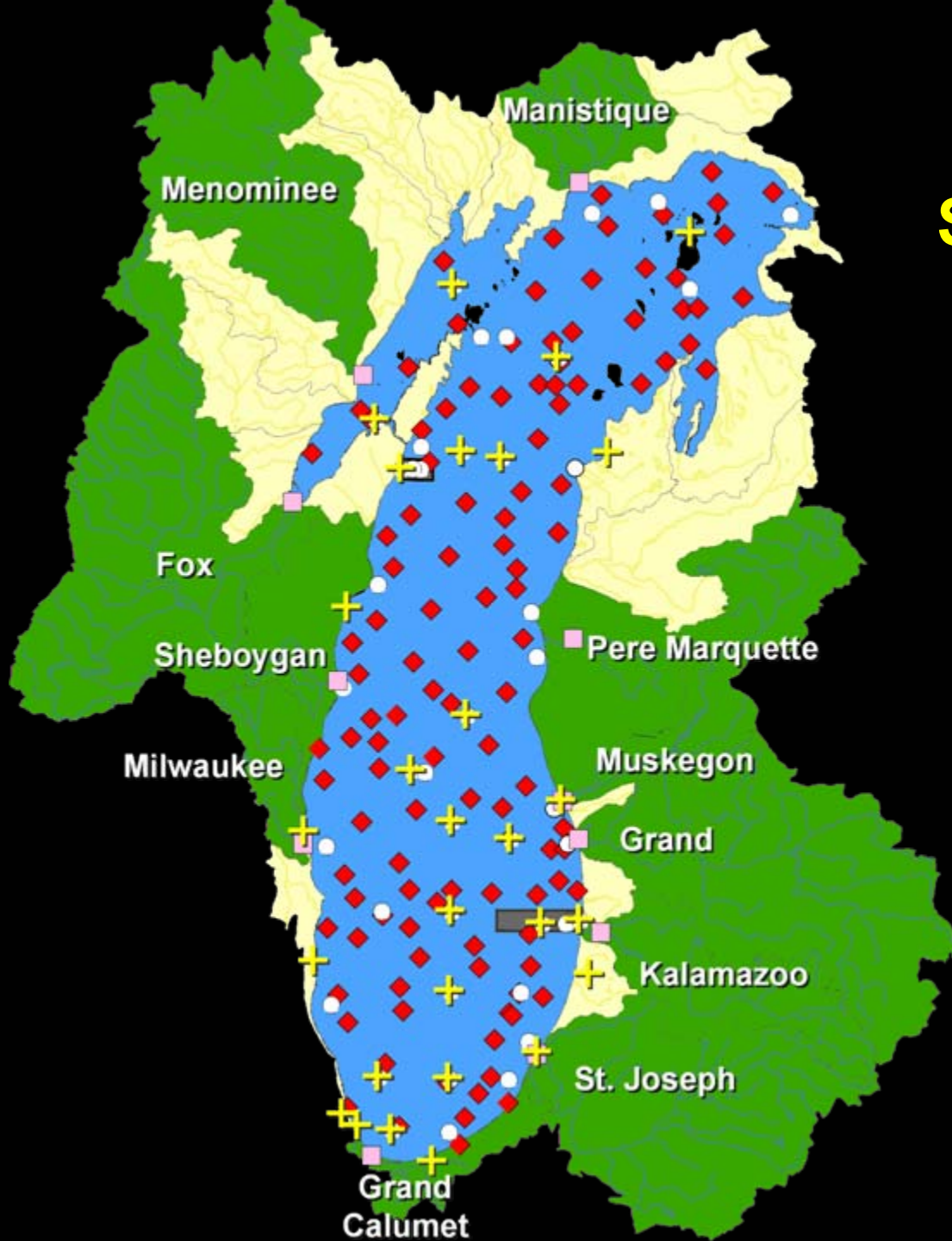


## Forecasting



## High Resolution Forecasting

# Lake Michigan Sampling Design



- + atmospheric monitoring stations
- ◆ sediment samples
- water survey stations
- tributary monitoring stations
- unmonitored tributary basins
- monitored tributary basins
- biota survey boxes

# Lake Michigan Mass Balance Project

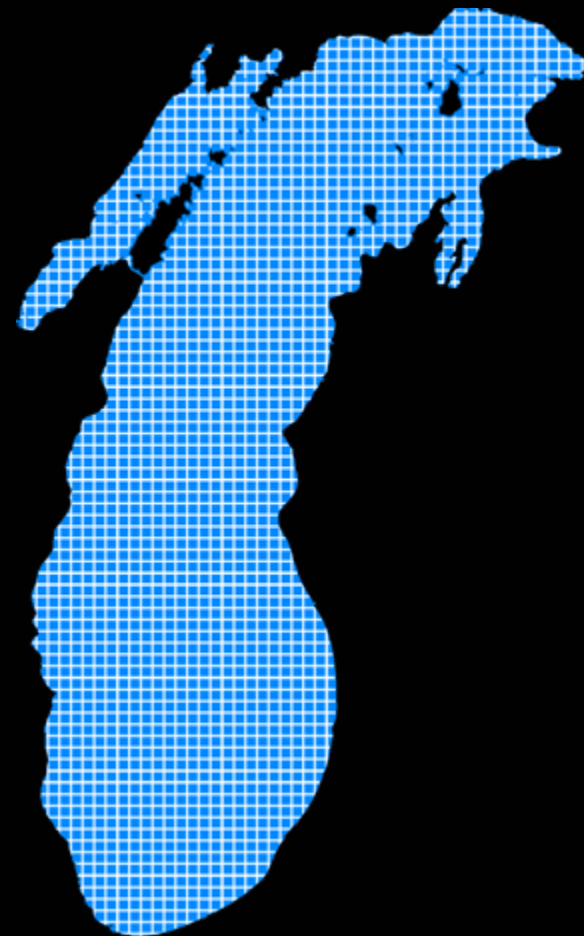
## Water Spatial Resolution/Segmentation Scheme



**LEVEL 1**  
Whole Lake



**LEVEL 2 - LM-2**  
10 Surface Segments  
41 Water Segments

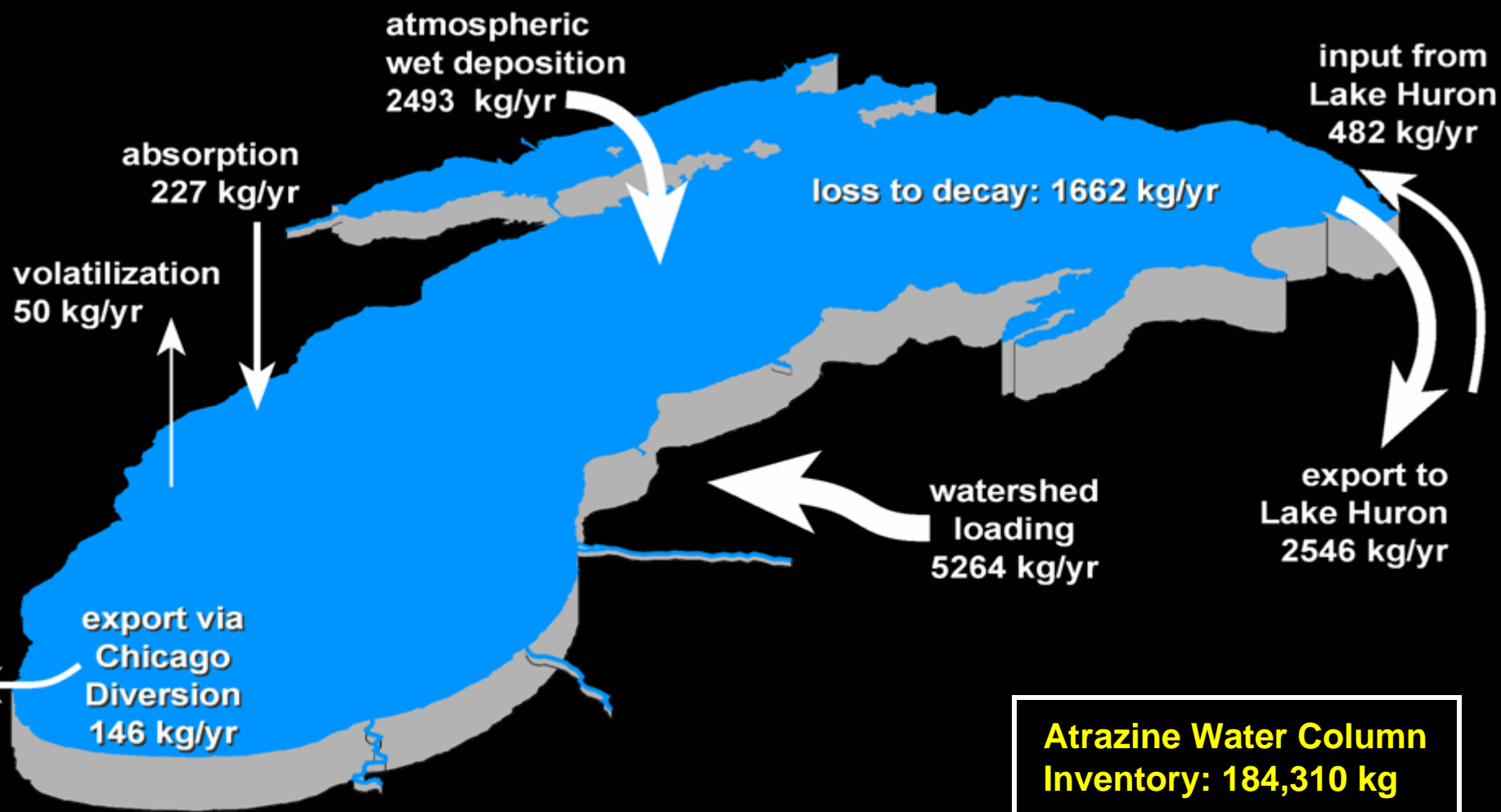


**LEVEL 3 - LM-3**  
(High Resolution 5 x 5 km Grid)  
2,318 Surface Segments  
44,042 Water Segments  
19 "Sigma" Levels

# Lake Michigan Mass Balance Contaminants

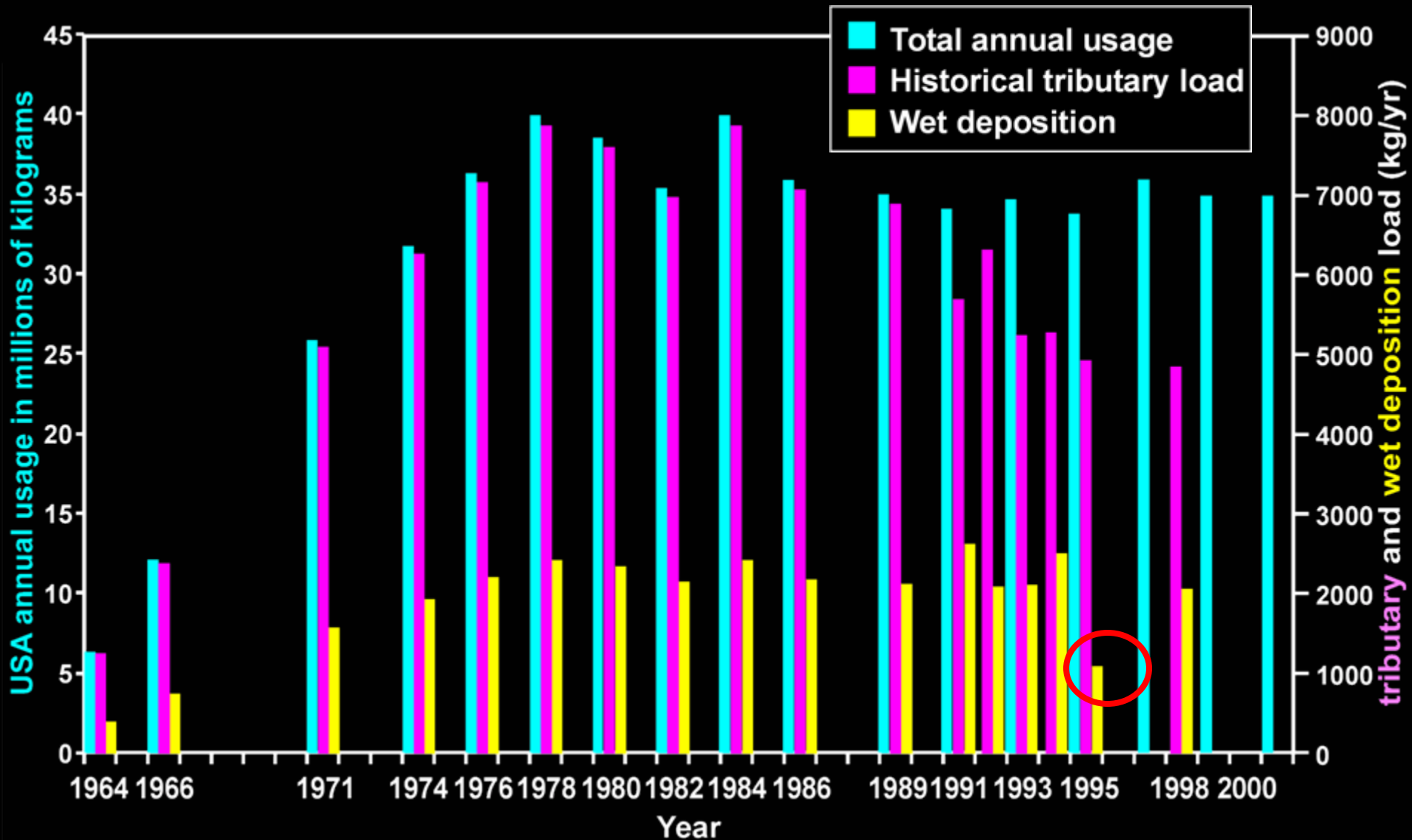
- **Nutrients:** concern for over-production of algae, and other symptoms controlled by nutrients
- **Atrazine:** potential concern for human and ecological effects; current use – herbicide
- **PCB Congeners:** concern for fish consumption and ecological effects; manufacturing banned
- **Total Mercury:** concern for fish consumption and ecological effects; multiple sources and uses

# Lake Michigan Atrazine Mass Balance (including Green Bay) 1994

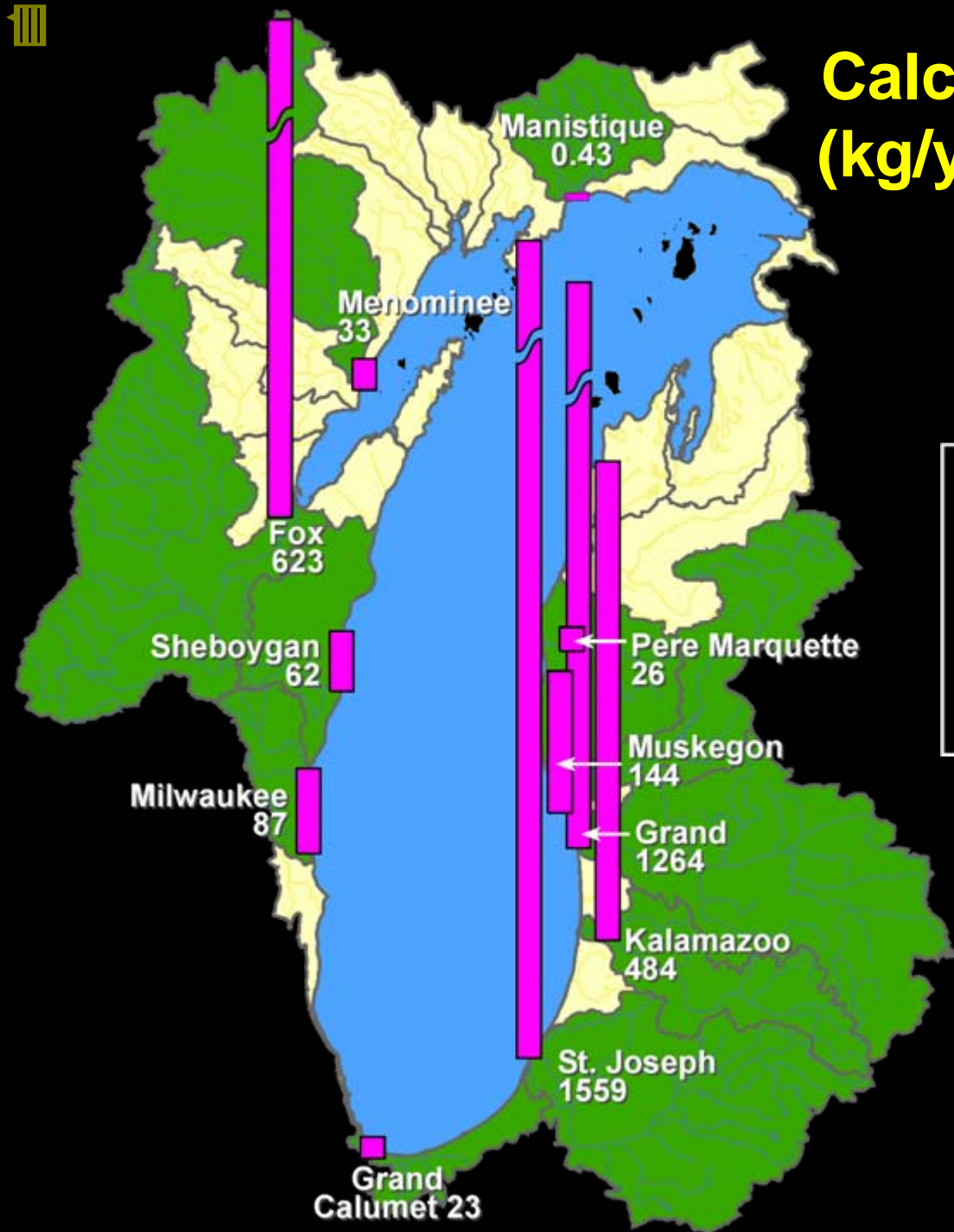


Dry deposition, settling, sediment resuspension and net burial are negligible

# Calculating the Historical Atrazine Loading to Lake Michigan



# Calculated Atrazine Loads (kg/year) to Lake Michigan from Tributaries, 1994



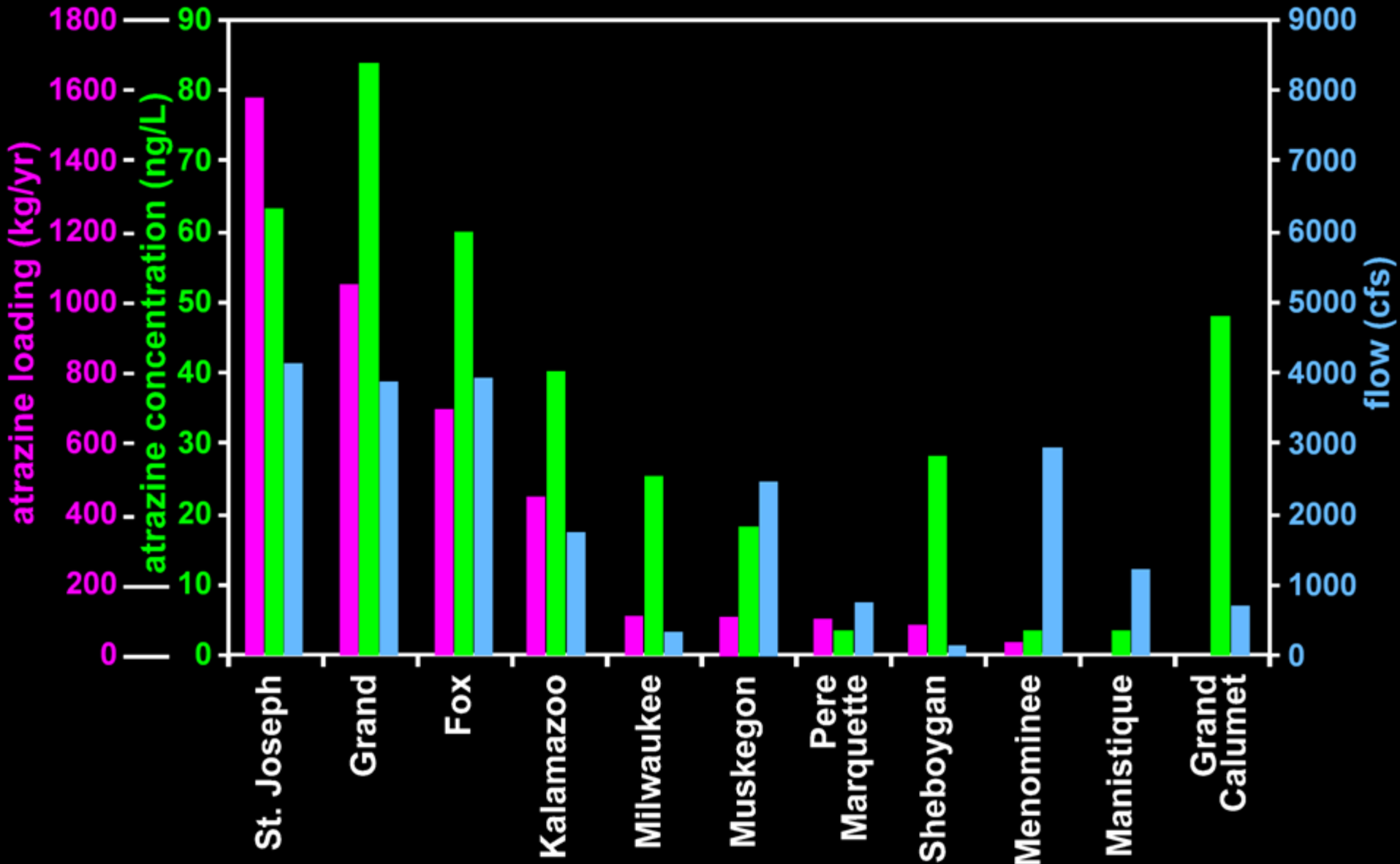
■ calculated atrazine loads (kg/year)

■ monitored tributary loads: 4305

■ unmonitored tributary loads: 959



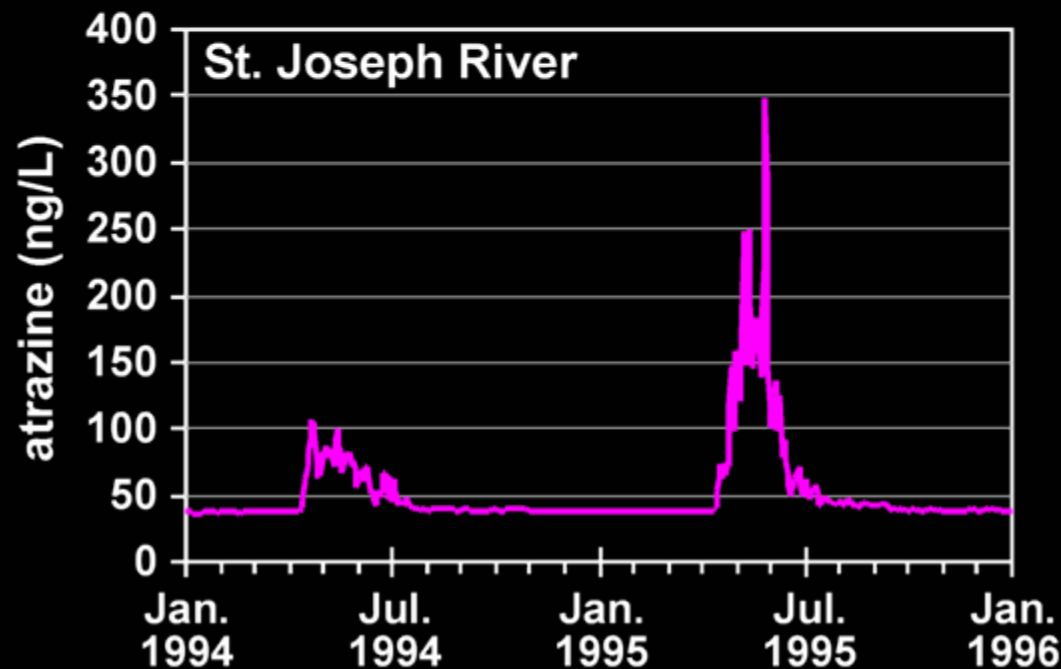
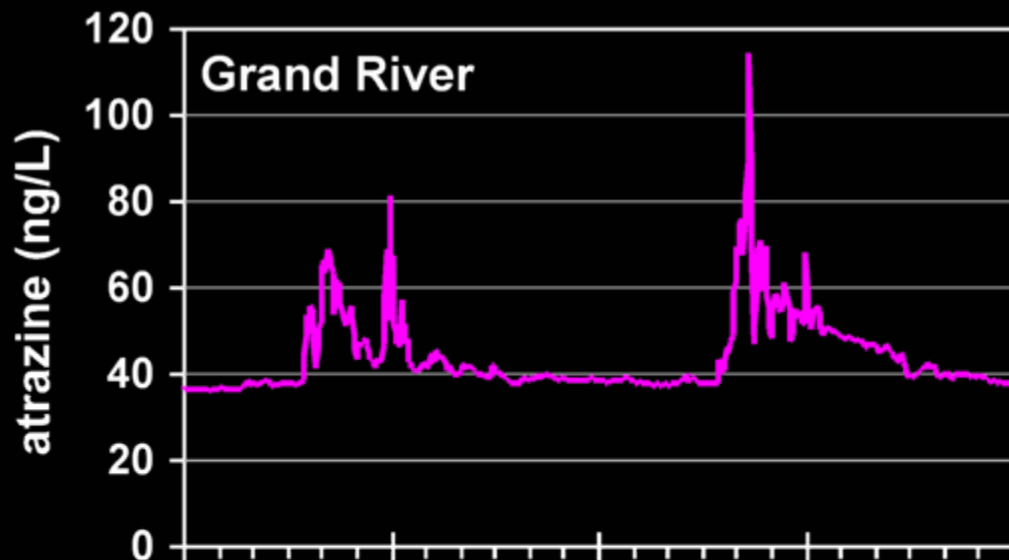
# Median Atrazine Loading and Concentration Relative to Flow in Lake Michigan Monitored Tributaries 1995





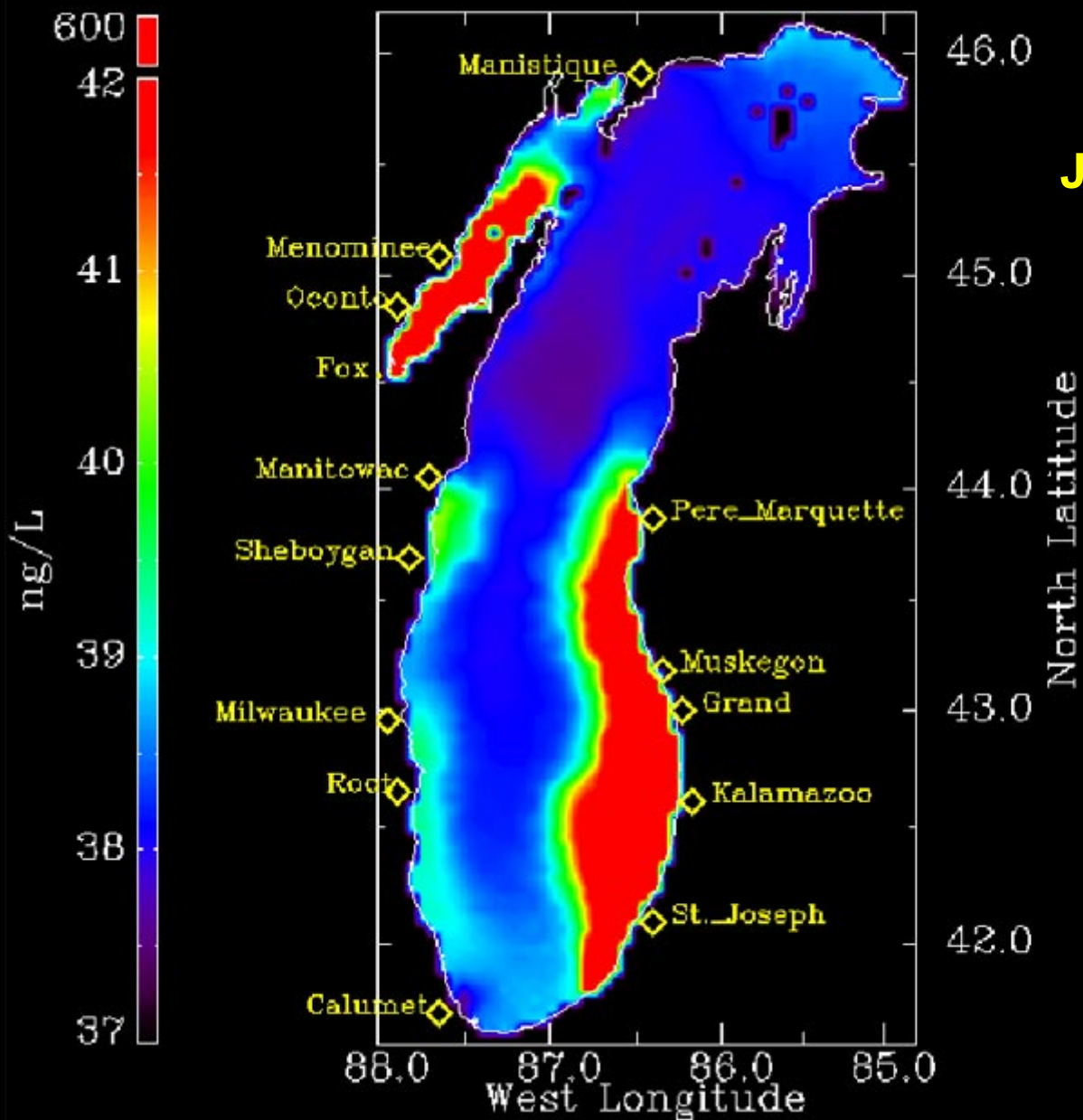
# LM3 Model Results – 1994-1995

## Nearshore Segments by Selected Rivers



# Lake Michigan Mass Balance: 1994-95

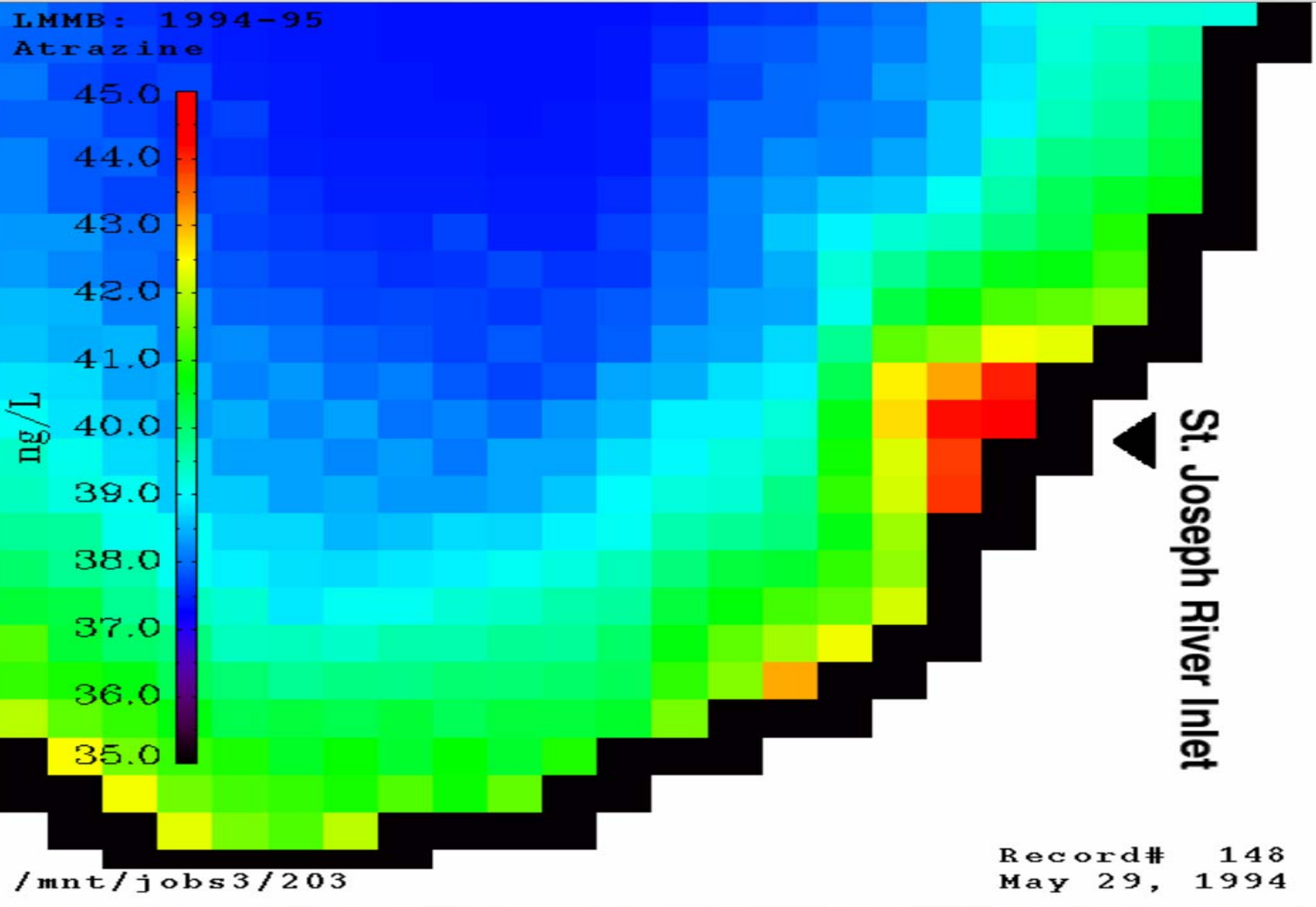
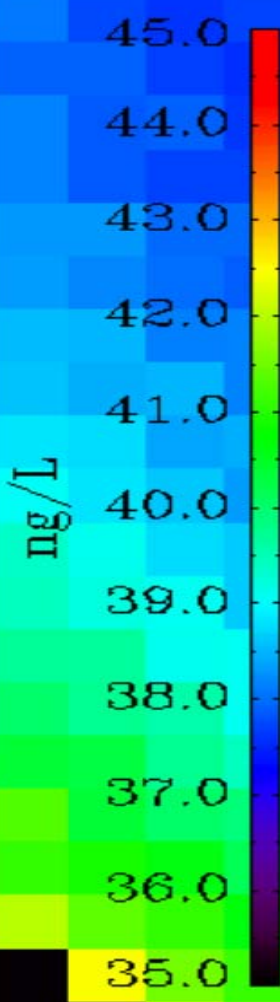
Atrazine



**June 28, 1995**

LMMB: 1994-95

Atrazine



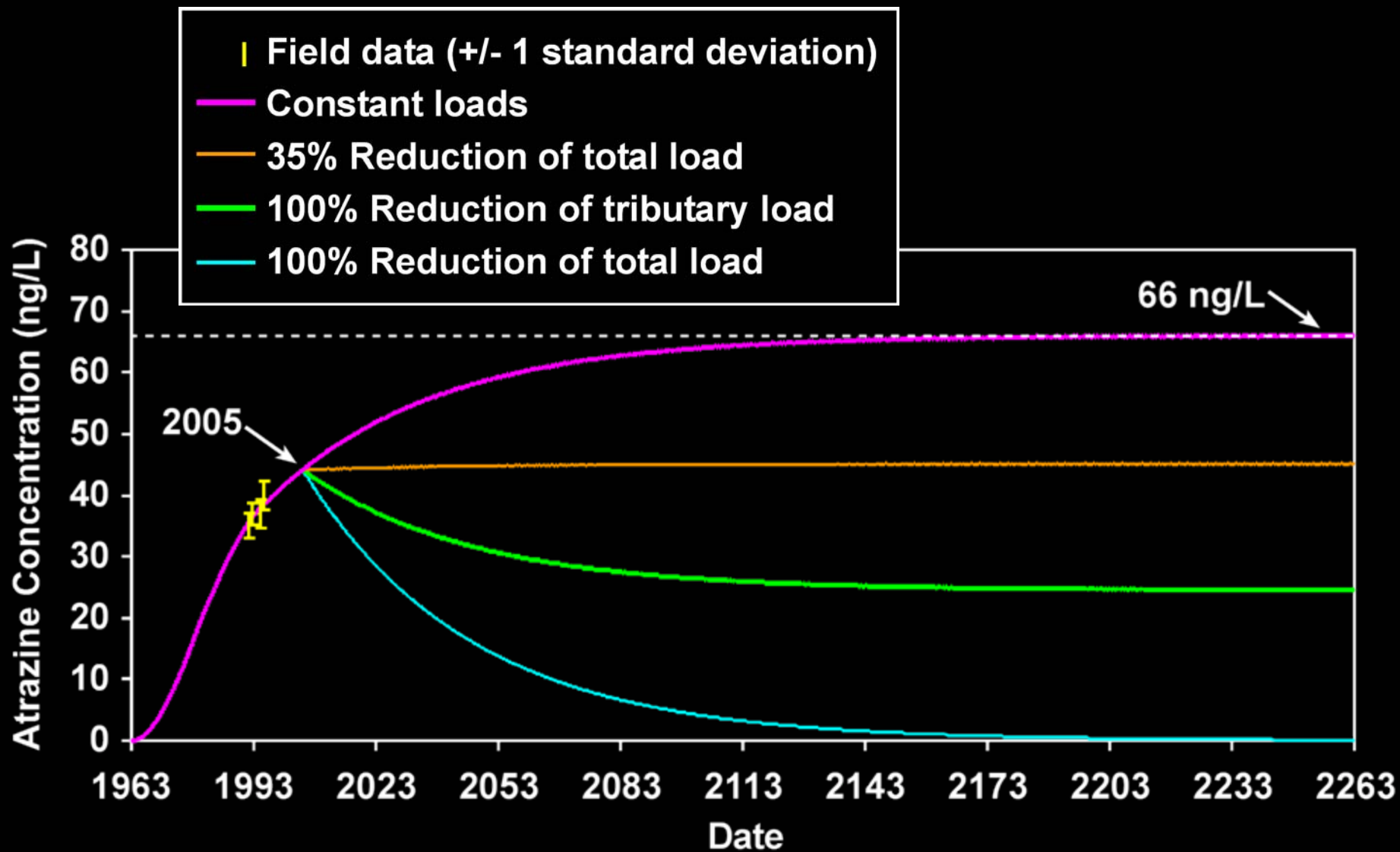
St. Joseph River Inlet

/mnt/jobs3/203

Record# 148  
May 29, 1994

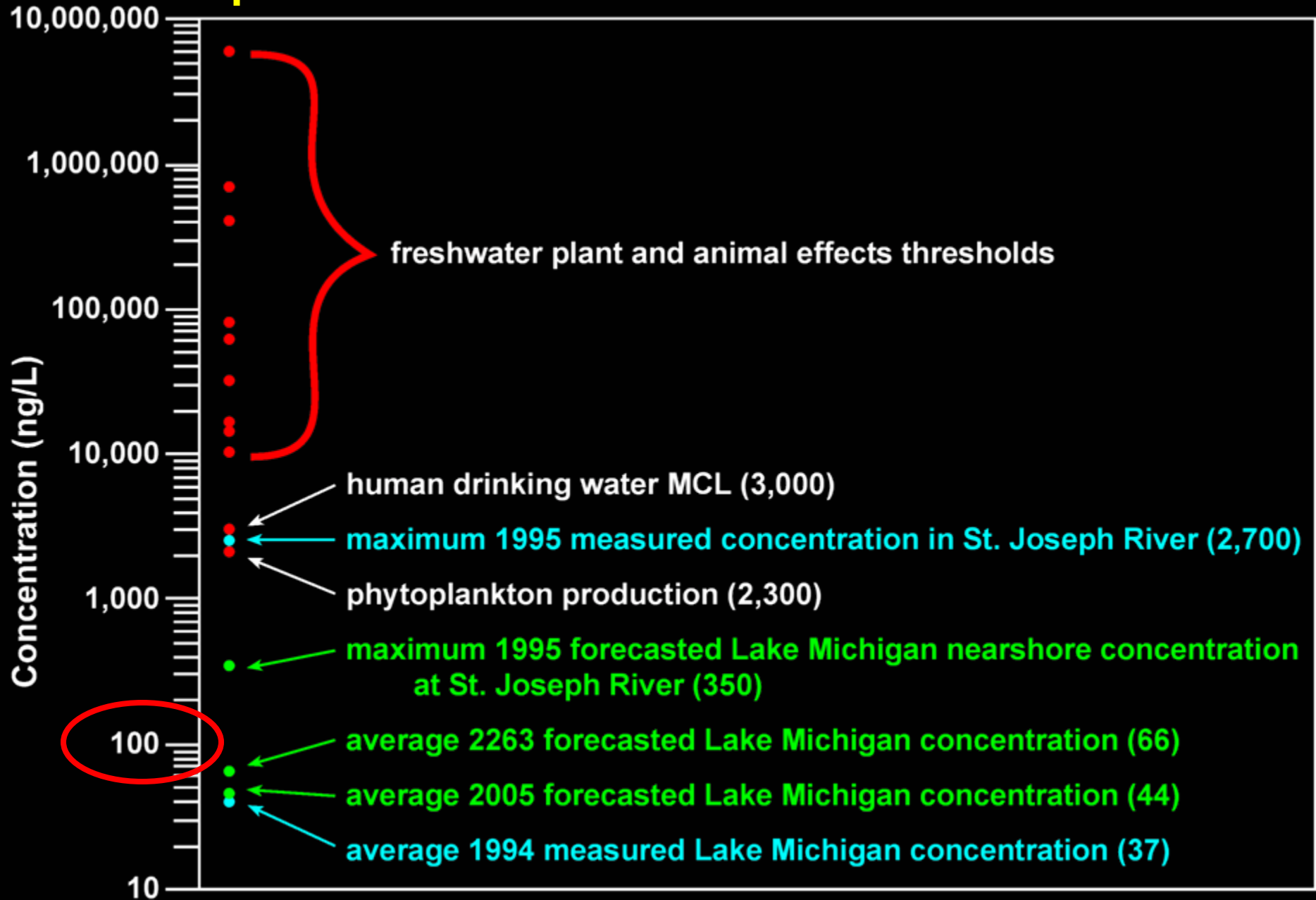


# Lake Michigan Atrazine Forecasts (LM2-Toxic Model)

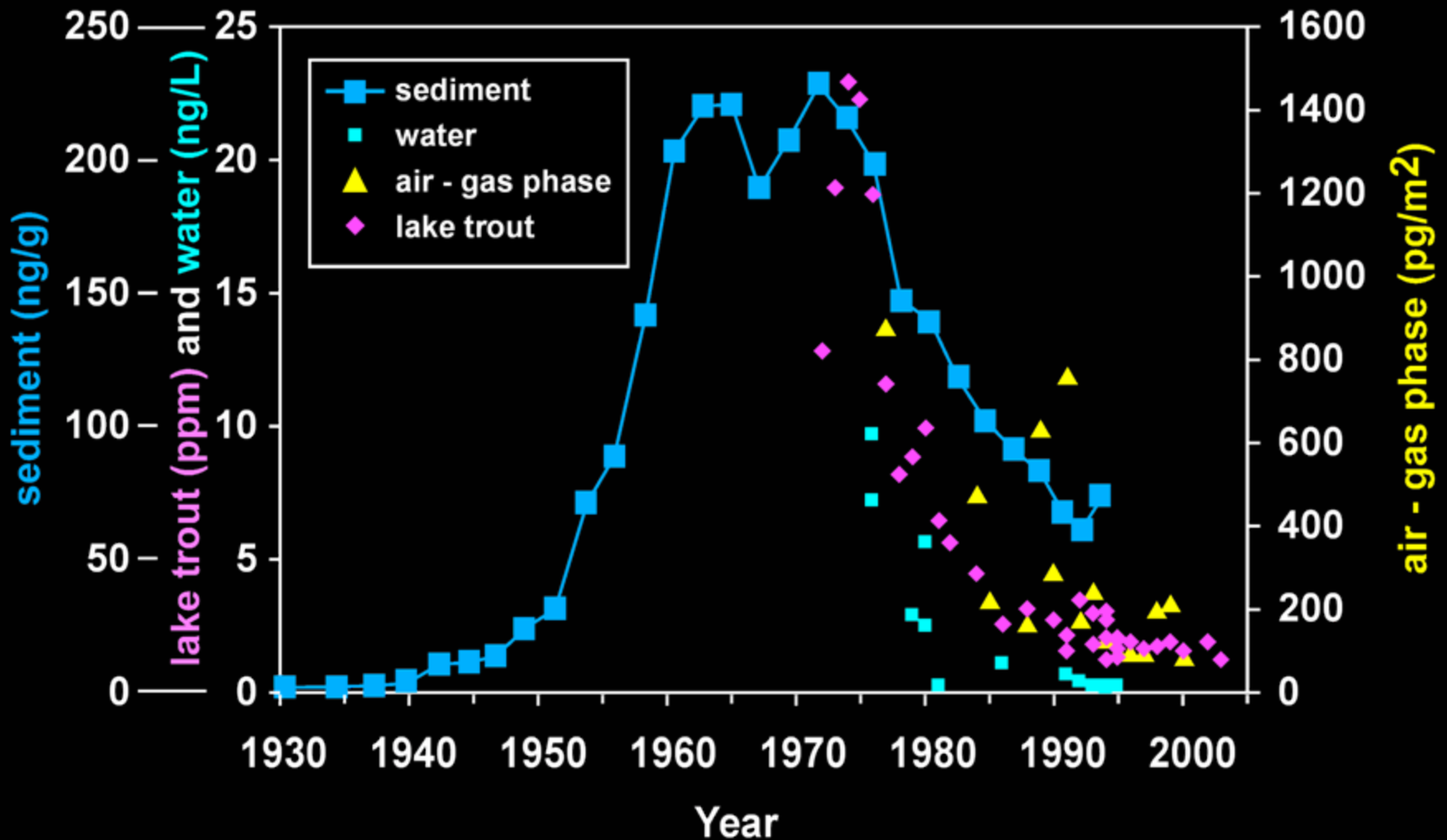


# Atrazine Effects Thresholds

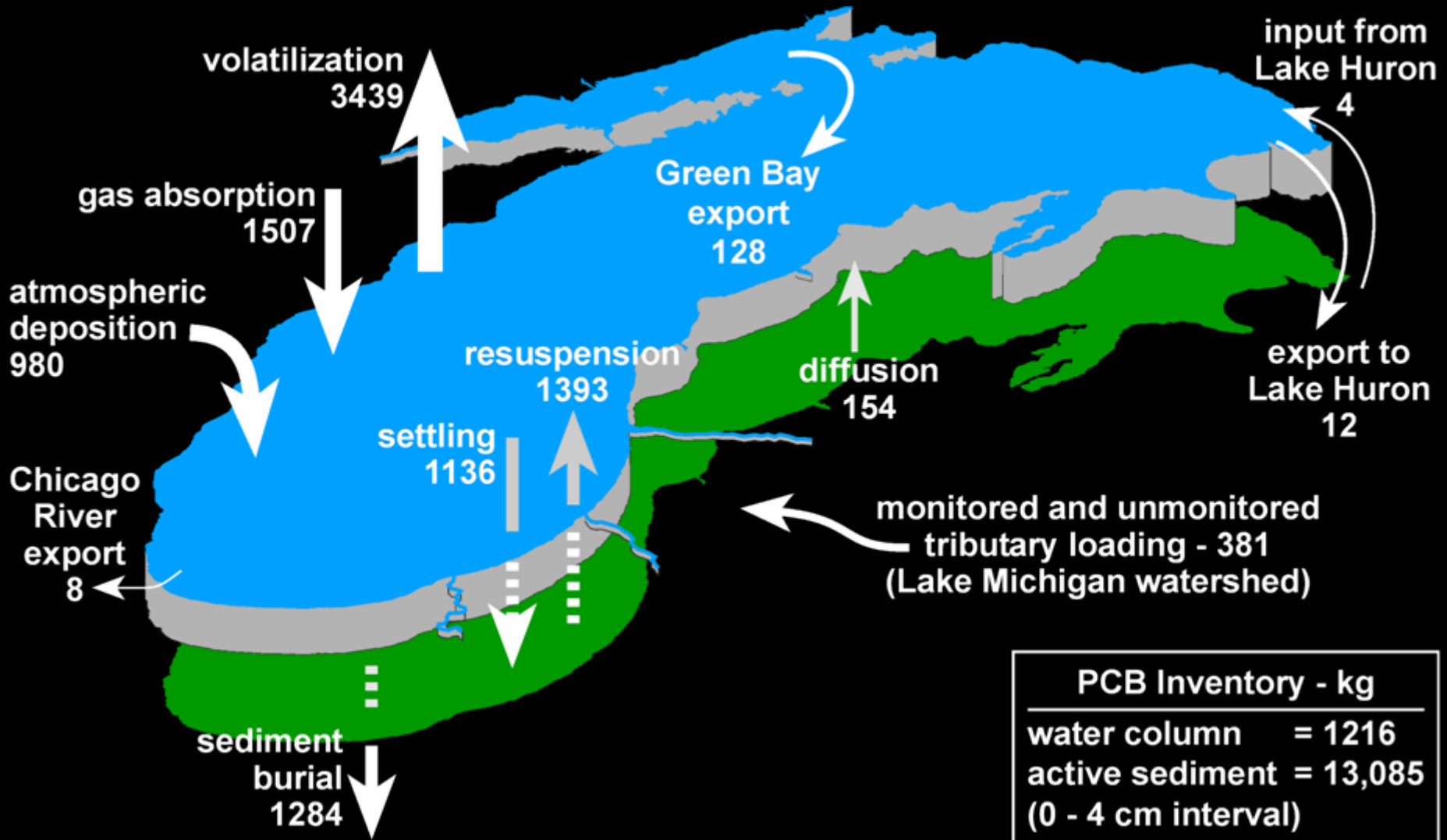
## Compared to Observations and Model Predictions



# Total PCB trends in Lake Michigan Media

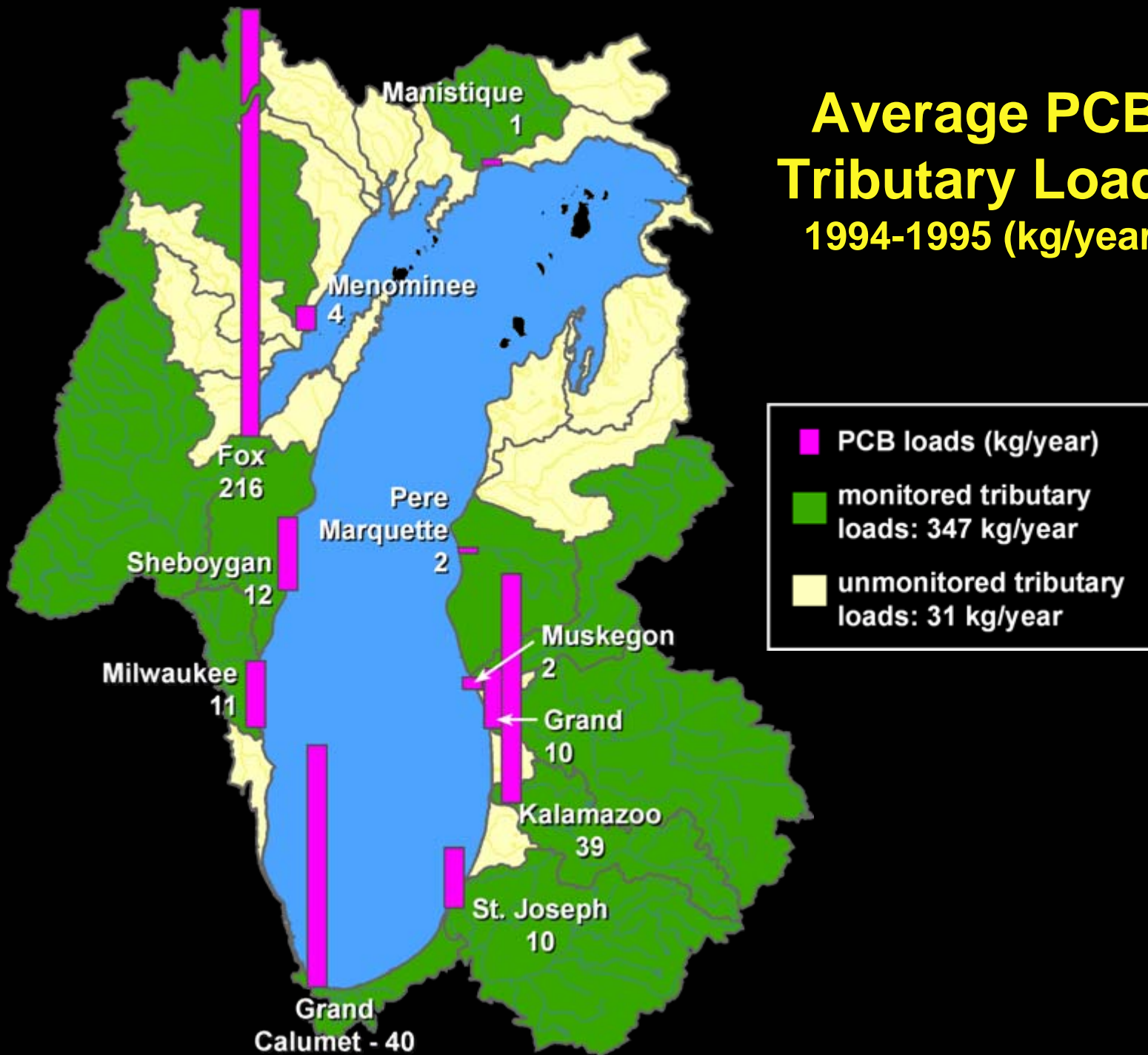


# PCB Mass Balance (kg/yr) for 1994-1995

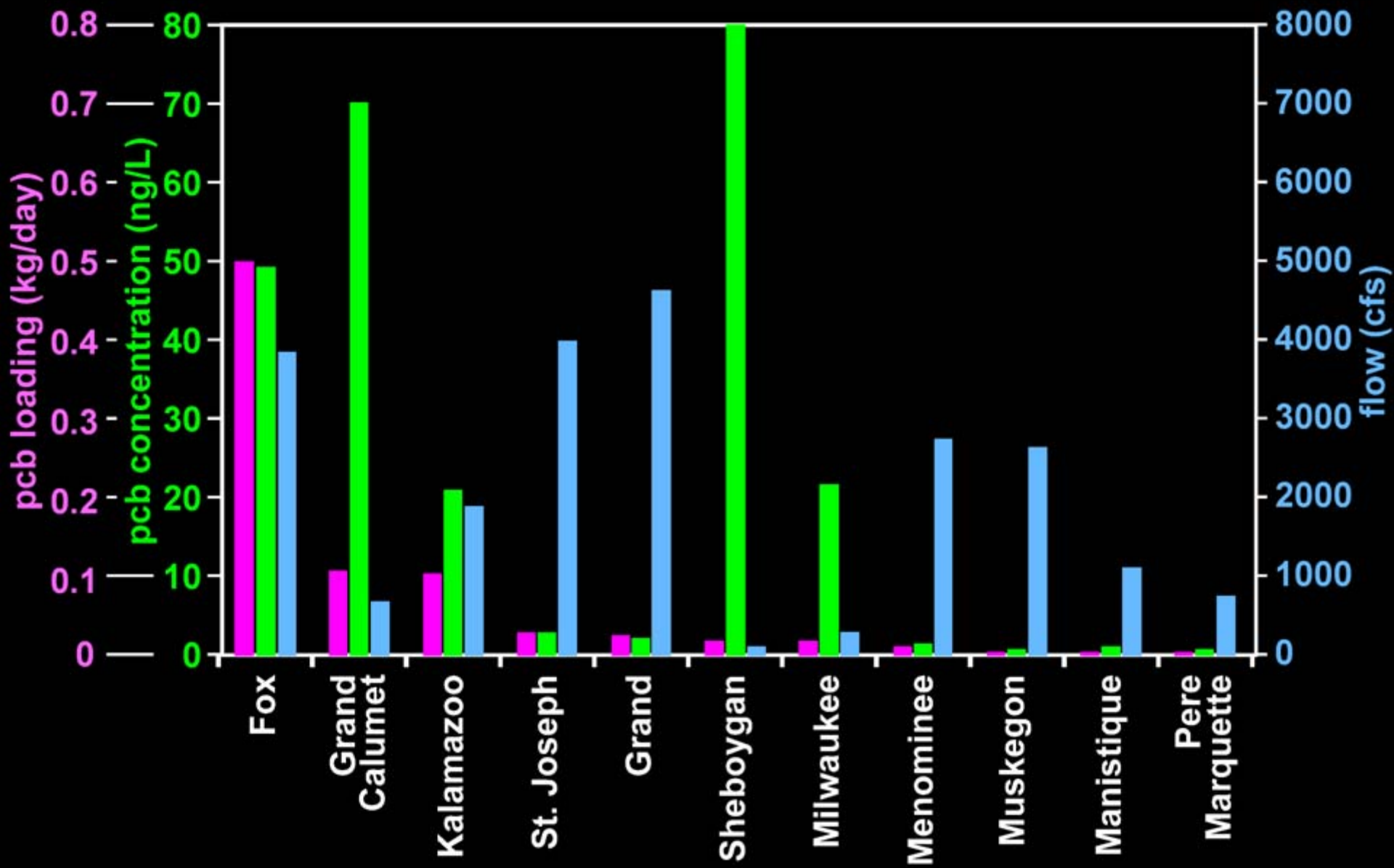


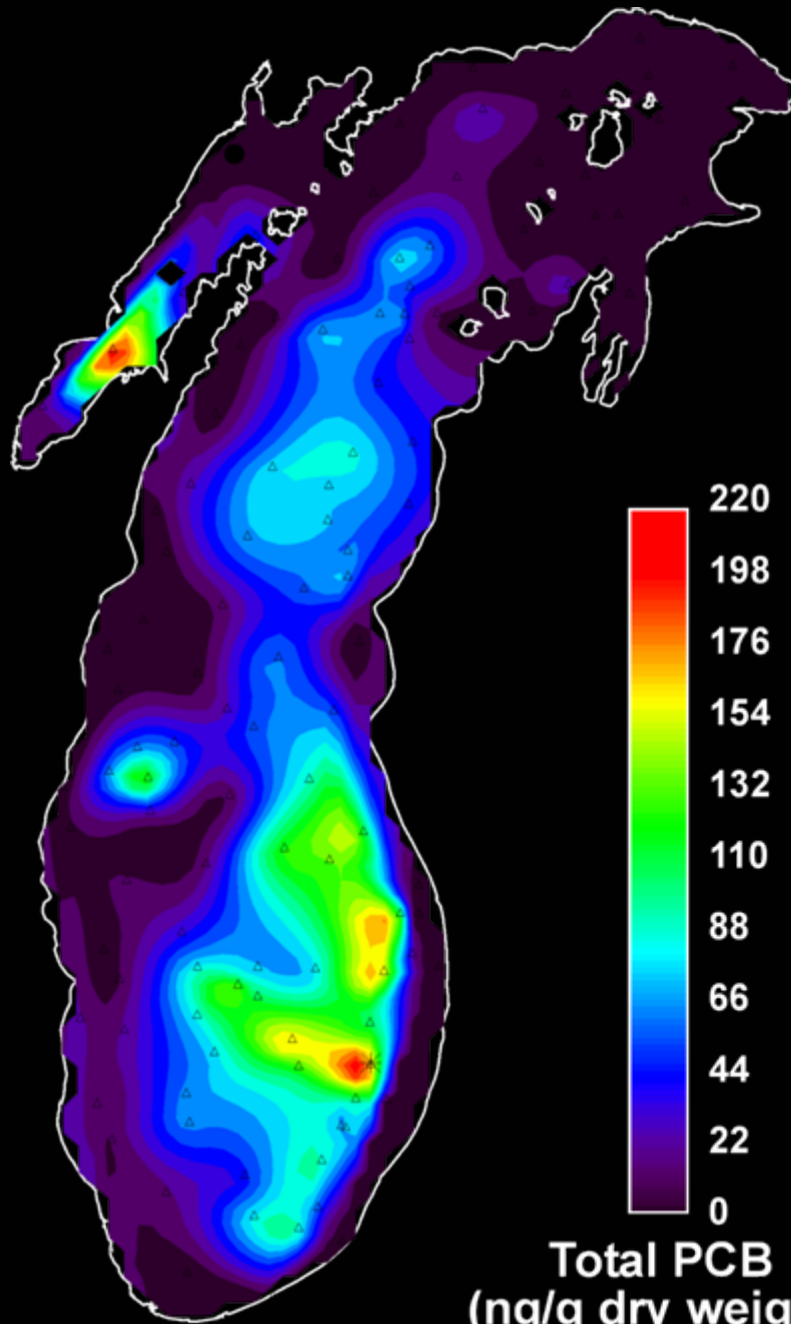


# Average PCB Tributary Loads 1994-1995 (kg/year)

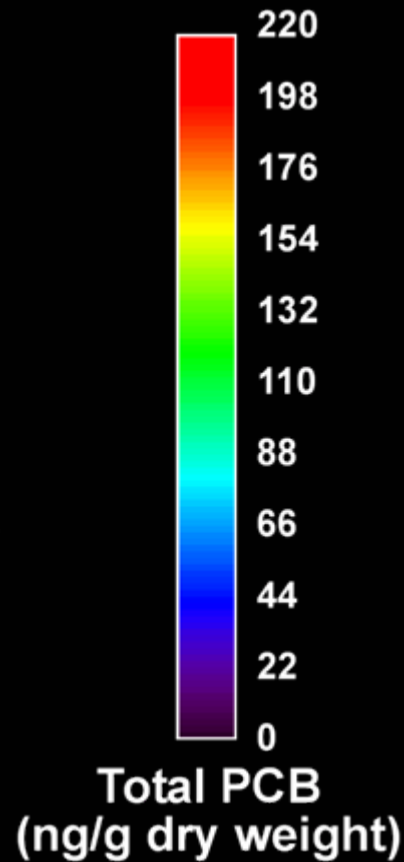


# Median PCB Loading and Concentration Relative to Flow at Lake Michigan Monitored Tributaries 1994-1995



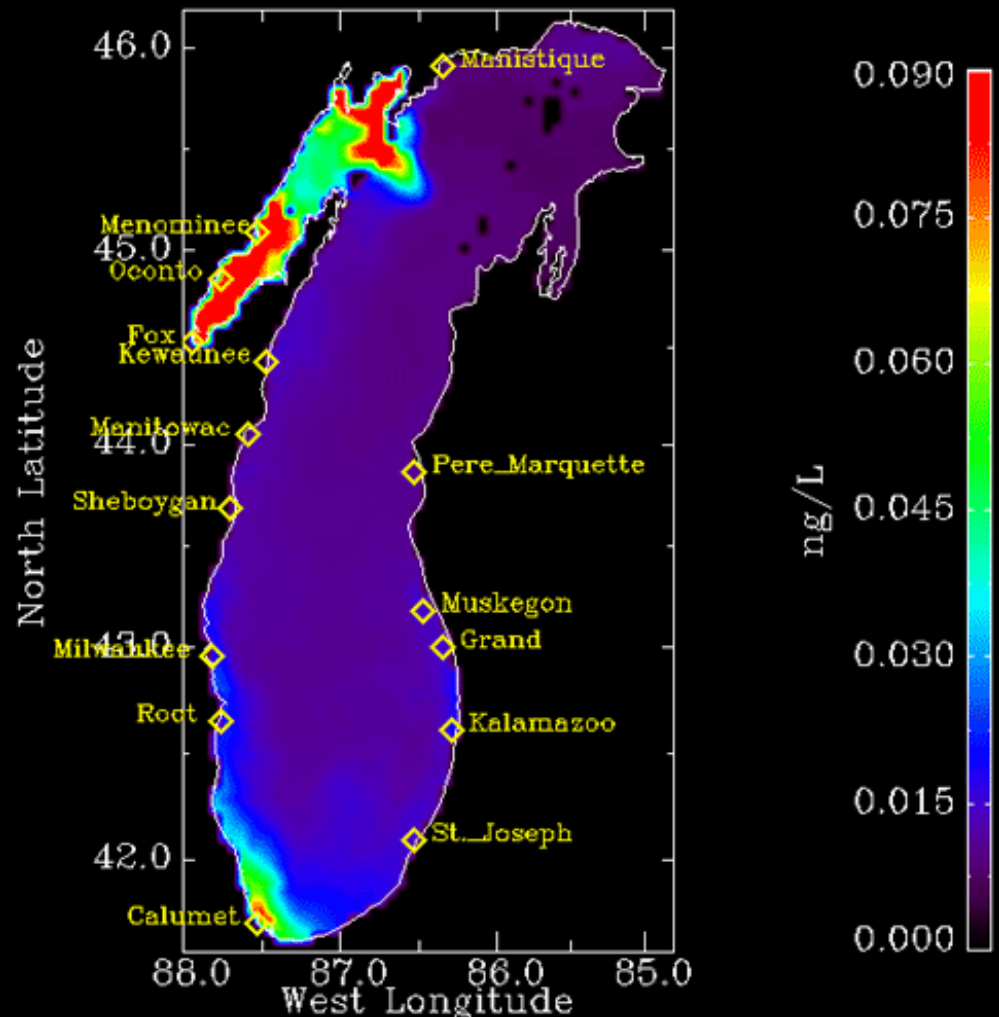


## PCB Concentrations Surface Sediments (1994-1995)



Lake Michigan Mass Balance: 1994-95  
PCB Congener 28+31

Record# 303  
Oct 31, 1994



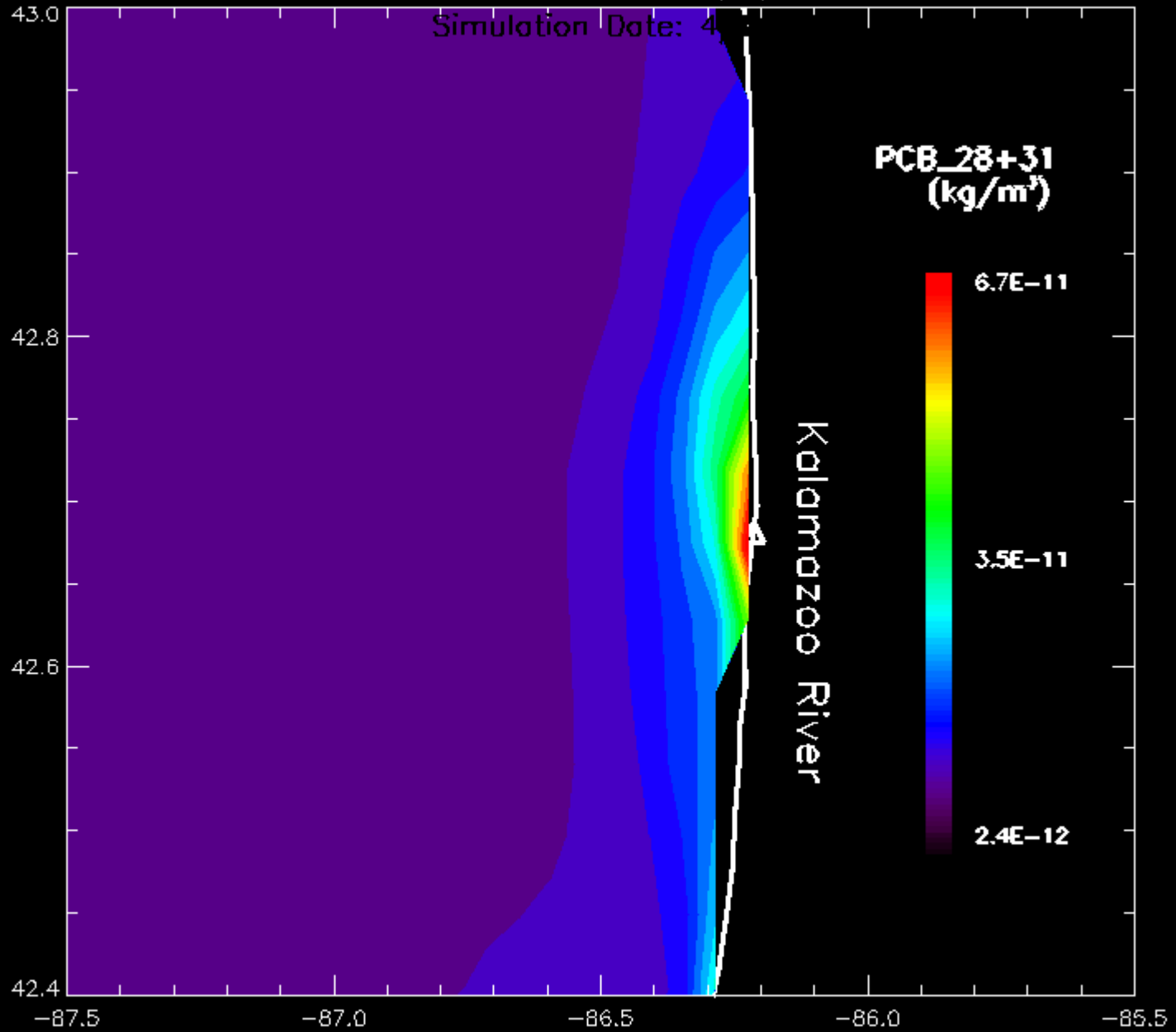
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00:00:20

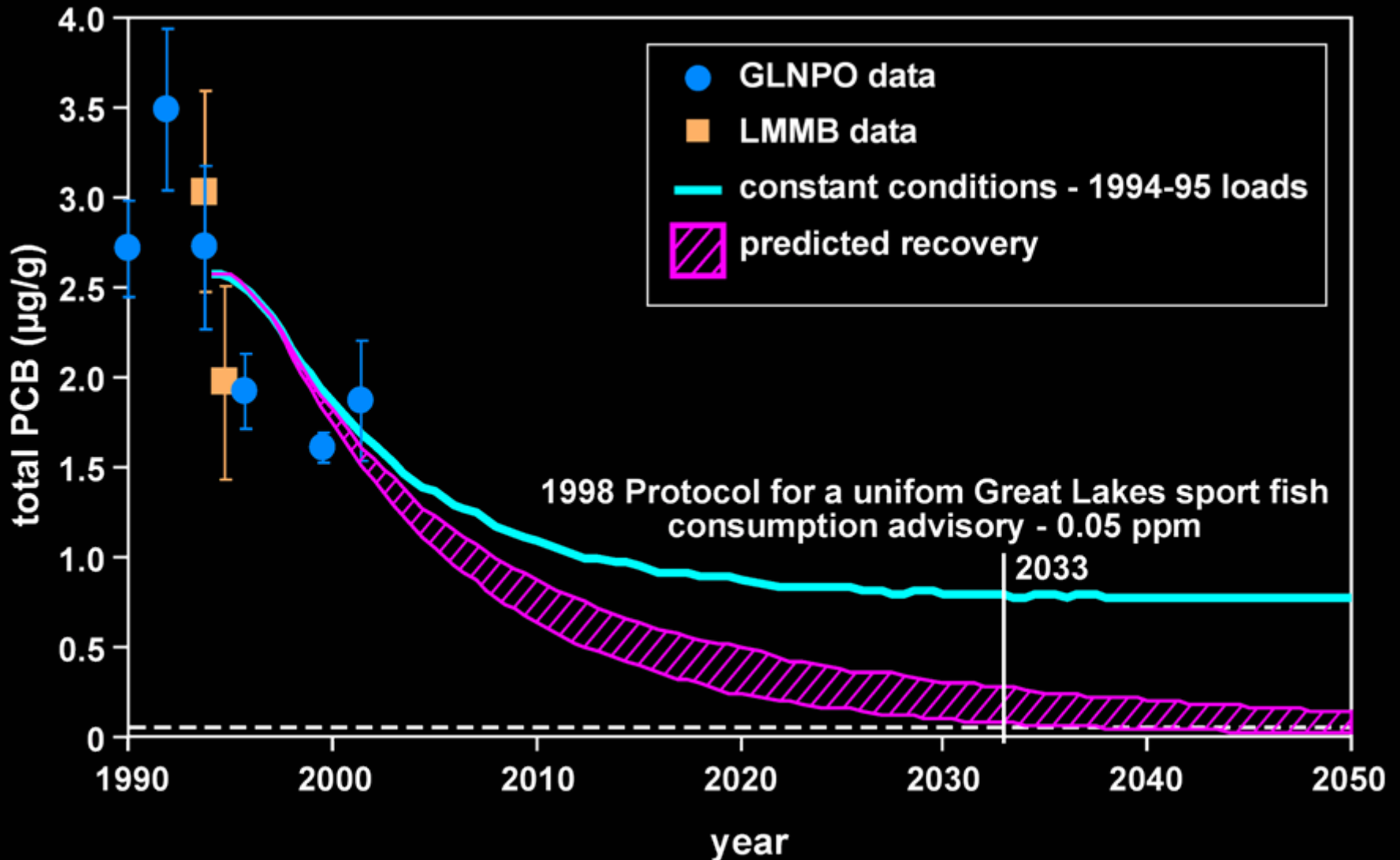


Simulation Date: 4/6/1994

Simulation Date: 4/6/1994



# Predicted PCB Concentrations in Age 5.5 Lake Michigan Lake Trout at Saugatuck



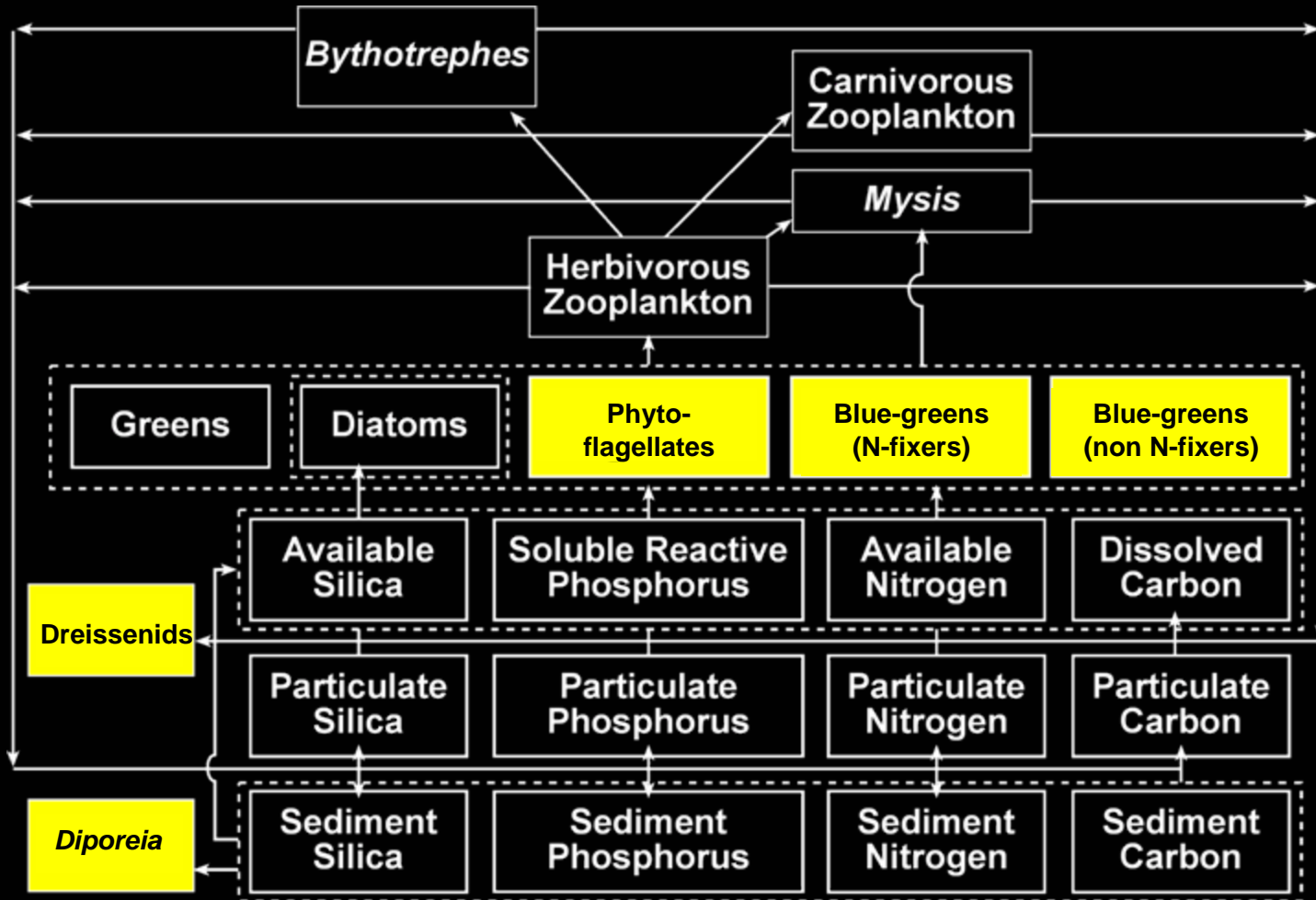
# Lake Michigan



900302 165420 STS36 78 09\*

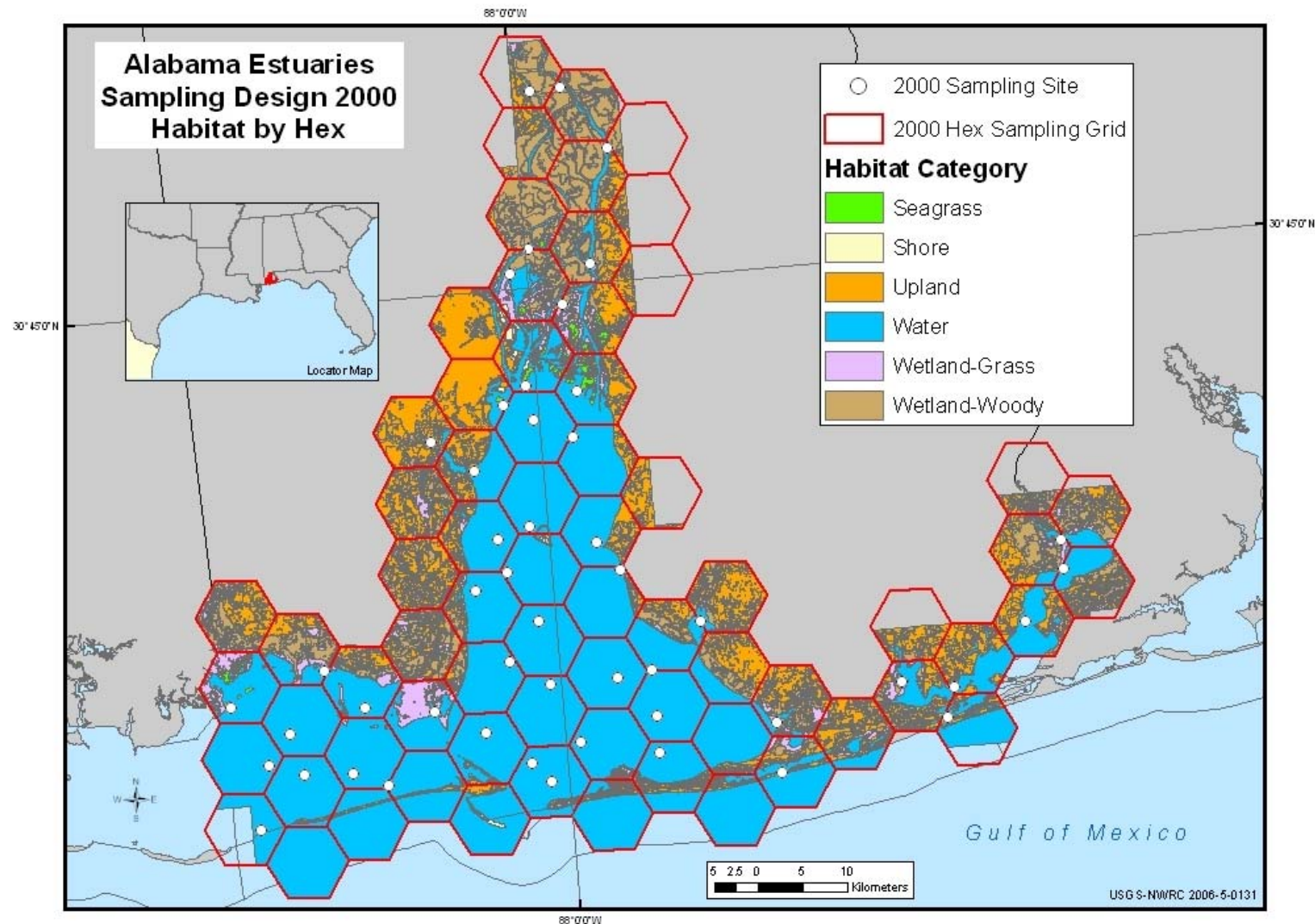
# Future Directions

## Lake Michigan Ecosystem Model, Phase II Development





# Modeling and mapping at multiple scales



(source: M. McDonald)