

## A Geostatistical Framework for Estimating Mercury Along NC Rivers

**Eric Money**  
Dept. Of Environmental Sciences & Engineering, UNC-Chapel Hill

Water Resources Research Institute Annual Conference, October 8<sup>th</sup>, 2008

## Agenda

- What is Geostatistics?
- Techniques for Water Quality
  - Bayesian Maximum Entropy
  - River Based Functionality
- A Framework for Mercury in NC
  - Multiple source integration
- Study: Fish Tissue Mercury in the Cape Fear & Lumber Basins

## What is Geostatistics?

- Based on the concept that data points that are close together tend to be related to each other (autocorrelation)
- We can use this relationship to estimate variables in areas where no data exists

## Techniques for Water Quality

- Kriging, Cokriging, Bayesian Maximum Entropy
- Bayesian Maximum Entropy (BME)
  - More General Case
  - Space/Time correlation
  - Linear/Non-linear estimator
  - Incorporate Secondary Variables

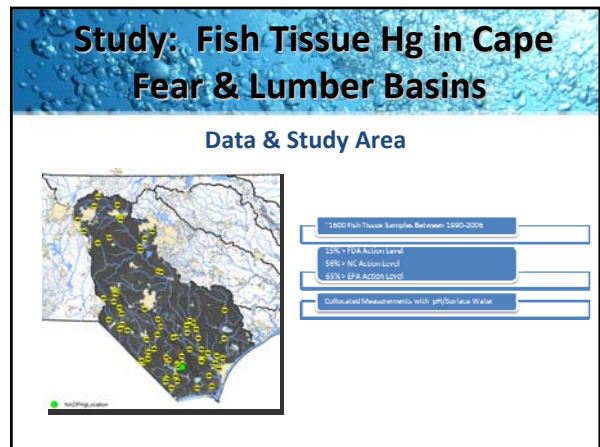
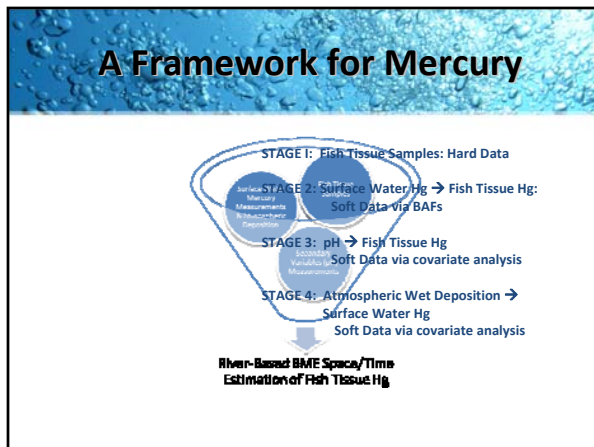
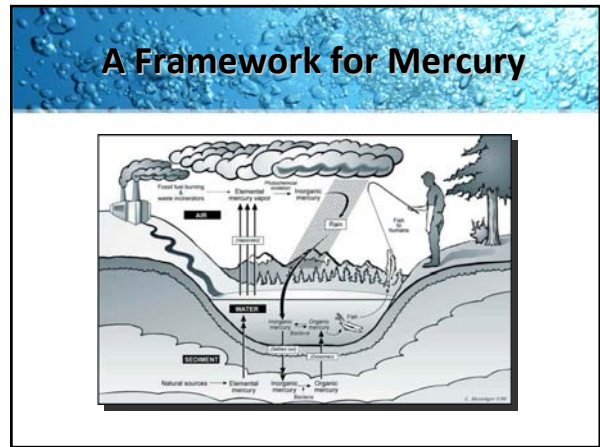
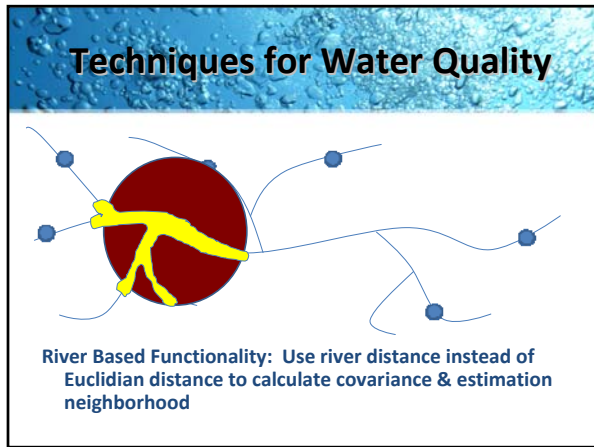
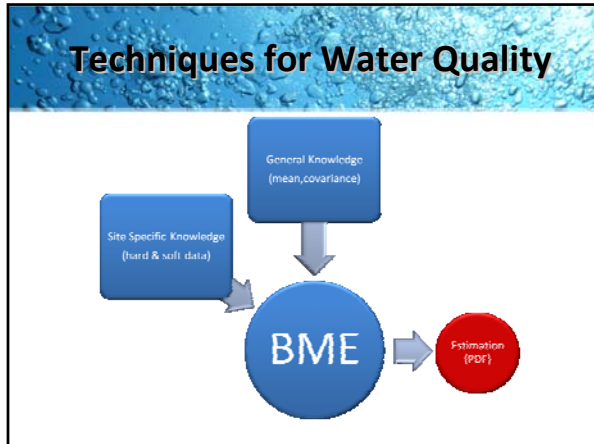
## Techniques for Water Quality

Points that are further apart are less correlated (i.e. covariance approaches zero) – First we model this relationship with a Covariance Model

## Techniques for Water Quality

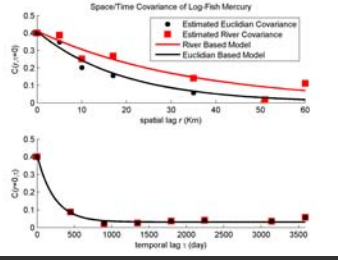
- = Hard Data (measured values) or Soft Data (predicted values from secondary relationships)
- = Estimated Value (Posterior PDF describing concentration at that location)

**Then we integrate the site specific knowledge**  
 Any given monitoring data) or data from secondary variables (i.e using pH to predict Mercury)



## Study: Fish Tissue Hg in Cape Fear & Lumber Basins

### STAGE 1: Basin-wide Fish Tissue Analysis



## Study: Fish Tissue Hg in Cape Fear & Lumber Basins

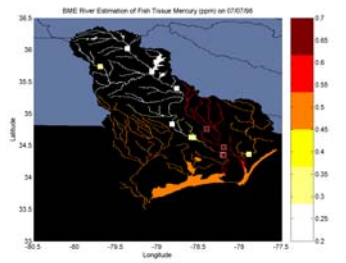
### STAGE 1: Basin-wide Fish Tissue Analysis

Cross-Validation Scenario	Mean Square Error
Euclidian Distance	0.31
River Distance	0.25
16% Reduction in Estimation Error Using River Distance	

Based on the Cross-validation results, a river-based model will be used in the subsequent basin-wide Estimation of Fish Tissue Hg

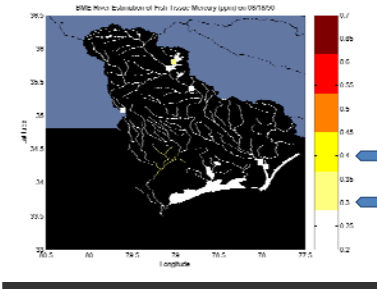
## Study: Fish Tissue Hg in Cape Fear & Lumber Basins

### STAGE 1: Basin-wide Fish Tissue Analysis



## Study: Fish Tissue Hg in Cape Fear & Lumber Basins

### STAGE 1: Basin-wide Fish Tissue Analysis



## Study: Fish Tissue Hg in Cape Fear & Lumber Basins

### STAGE 1: Conclusions

- Accounting for river connections, we increase Fish Hg mapping accuracy by 16%
- Framework has been established to add other data sources (Surface Water, Atmospheric, Secondary WQ variables) which we hypothesize will further improve estimation accuracy

## Study: Fish Tissue Hg in Cape Fear & Lumber Basins

### How Can We Use This Information?

- Calculate Number of River Miles Impaired
- Highlight sub-basins with high concentrations & limited Data
- Use in a GIS Framework to:
  - Examine relationship with fish consumption patterns
  - susceptible population data
  - Point/Nonpoint source locations
- Refine RAT calculations
- Refine regression analysis for secondary water quality variables

## Acknowledgements

- BMElab at UNC-Chapel Hill
  - Advisor: Dr. Marc Serre
- Dr. Derek Aday & Dana Sackett @ NC State
- WRRRI

## Questions?

