Using river distance and existing hydrography data can improve the geostatistical estimation of fish tissue mercury at unsampled locations

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Supporting Information

Pages: 6; Figures: 6; Tables: 3; Movies: 1

Figure S1 depicts the study area and shows data locations for fish tissue mercury, water column mercury, and pH. Tables S1 and S3 summarize the data used in the study. Table S2 describes the estimation scenarios. Figures S2 and S3 show scatterplots of the regression between pH and fish mercury and surface water mercury and fish mercury, respectively, along with plots of the residuals. Figure S4 shows the model residuals as a function of river distance, and Figure S5 shows the distribution of fish species in the study. Figure S6 shows a map of the estimation variance. Movie S1 depicts the spatiotemporal trends in fish tissue at 180-day intervals.

Study Area and Data Locations

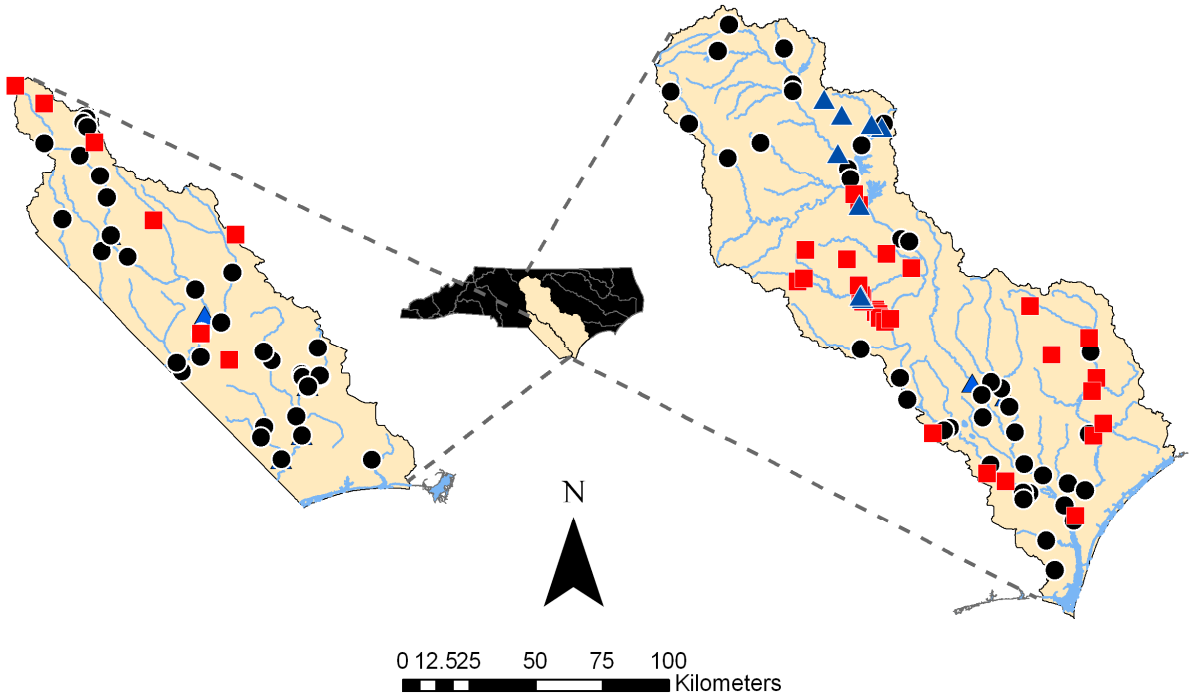


Figure S1: Lumber (Left) and Cape Fear (Right) Basins in North Carolina, with locations for *Fish*Hg (circles), pH (squares), and *WC*Hg (triangles).

Table S1: Data summary for mercury and pH in the Cape Fear and Lumber Basins, 1990-2004

Data Type	# of Locations	# of Independent Samples	# of Samples collocated with Fish Hg Samples
Fish Hg	75	1663	-
pH	33	356	143
Surface Water Hg*	7	80	35

*starts in 1995

Estimation Scenarios

Table S2: Cross-validation scenarios for *Fish*Hg estimations using river-BME and Euclidean-BME

Scenario	Metric Used	Hard Data Used	Soft Data Used
I	Euclidean	Measured log-*Fish*Hg	-
II	River	Measured log-*Fish*Hg	-
III	River	Measured log-*Fish*Hg	Gaussian from log-pH
IV	River	Measured log-*Fish*Hg	Gaussian from log-*WC*Hg

Regression Analysis

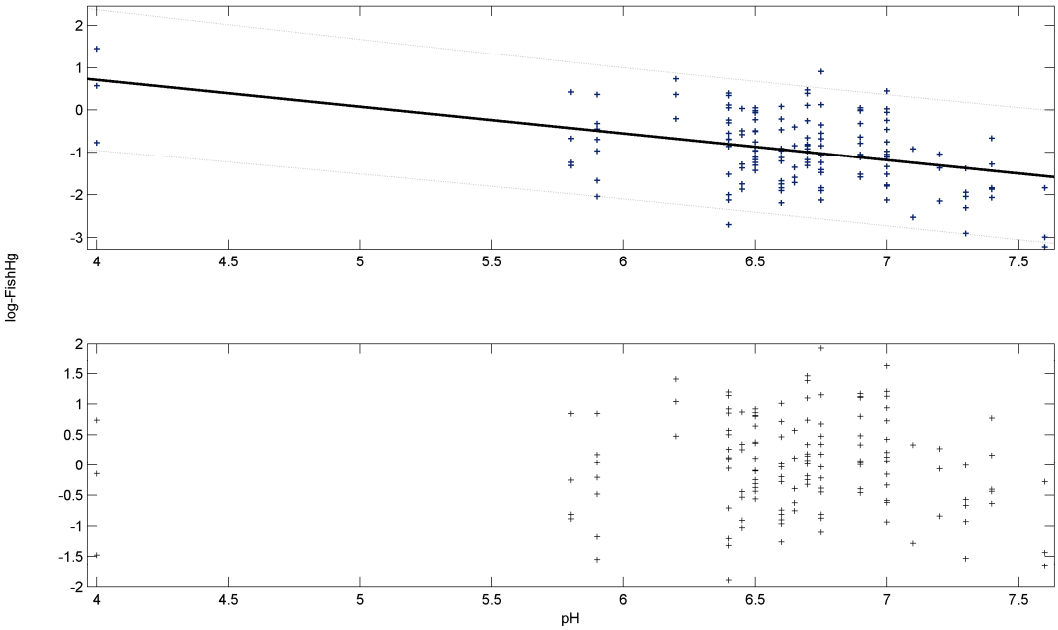


Figure S2: (top) Regression scatter plot of pH vs. log-*Fish*Hg used to derive *Fish*Hg soft data. Dashed lines represent the 95% prediction bounds for new observations; (bottom) scatter plot of the residuals; p-values for the model coefficients were < 0.001.

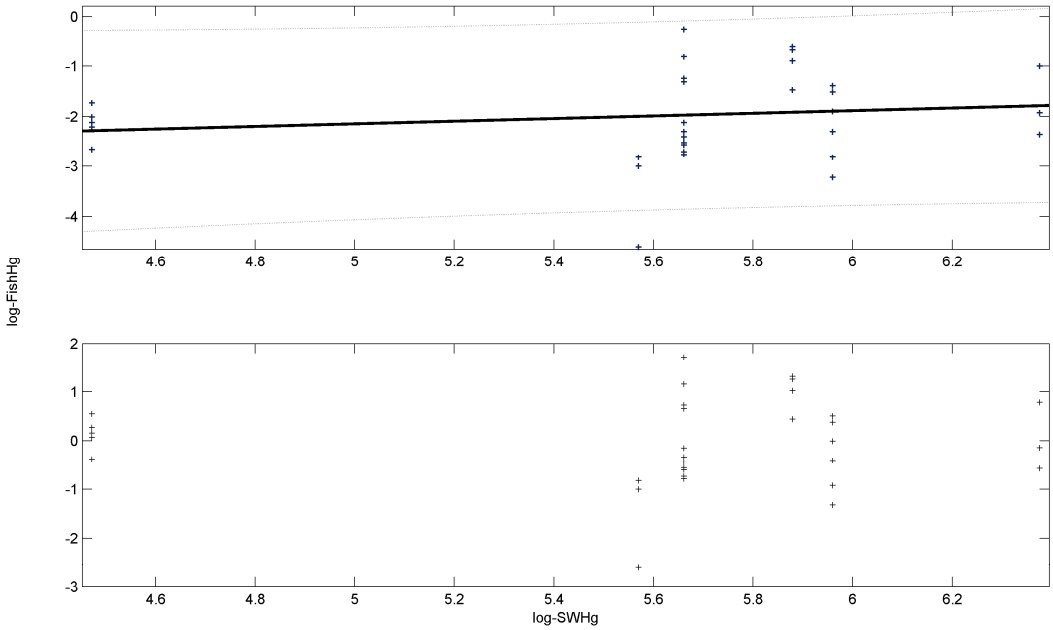


Figure S3: (top) Regression scatter plot of log-SWHg vs. log-FishHg used to generate FishHg soft data; Dashed lines represent the 95% prediction bounds for new observations; (bottom) scatter plot of the residuals; intercept p-value: 0.035; variable coefficient p-value: 0.37.

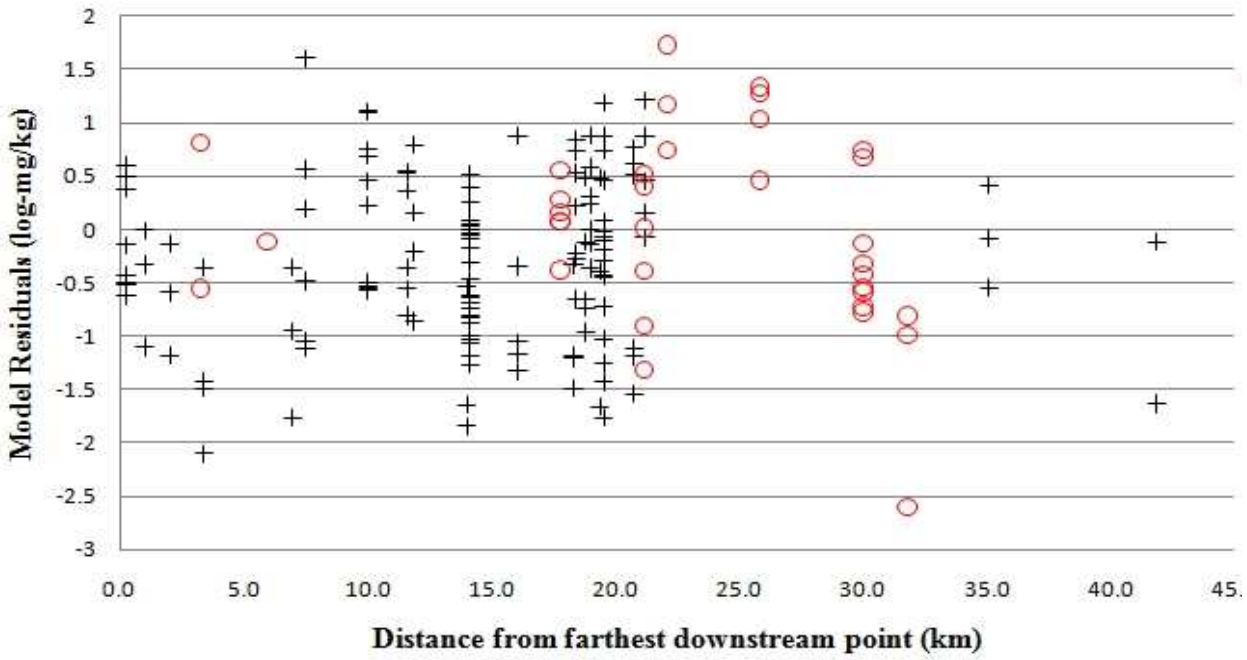
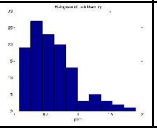
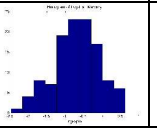
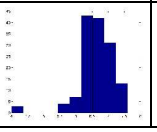
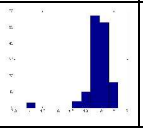
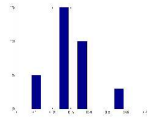
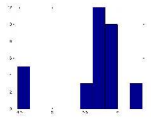


Figure S4: Scatter plot of model residuals for collocated data as a function of river distance from the farthest downstream point of the combined river network. The '+' represents the residuals from the pH model (Equation 1), while the 'o' represents the residuals from the *WC*Hg model (Equation 2).

Table S3: Summary statistics for fish tissue mercury, pH, and surface water mercury used in the study.

Parameter / Statistics	***Fish*Hg (ppm)**	**log-*Fish*Hg**	**pH**	**log-pH**	***SW*Hg (ppm)**	**log-*SW*Hg**
Mean	0.62	-0.69	6.62	1.88	0.31	5.62
Standard Deviation	0.57	0.64	0.54	0.69	0.13	0.54
Skewness	2.30	-0.31	-2.25	-3.19	0.20	-1.21
Kurtosis	11.5	2.79	12.5	18.1	3.48	3.72
Distribution						

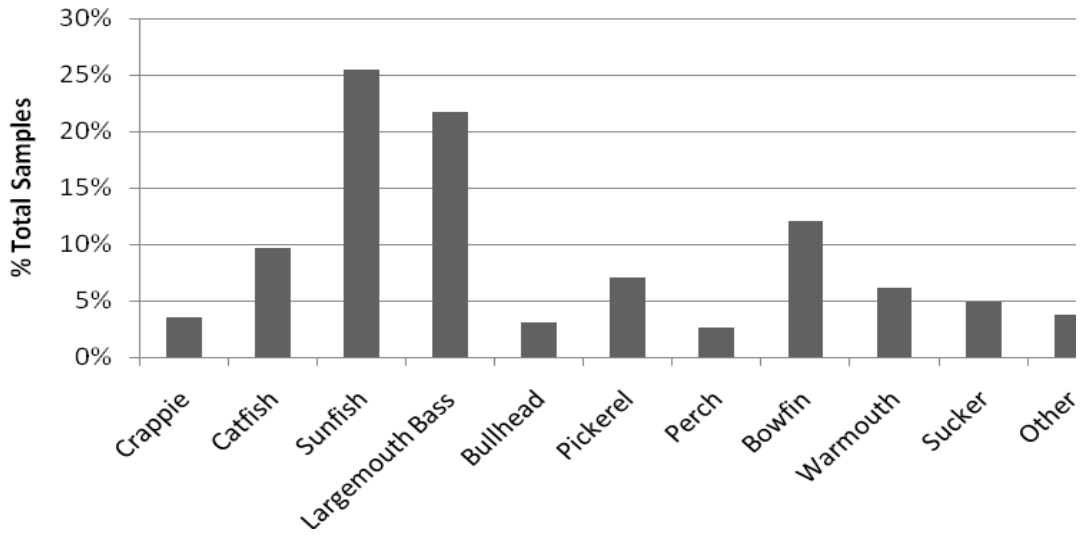
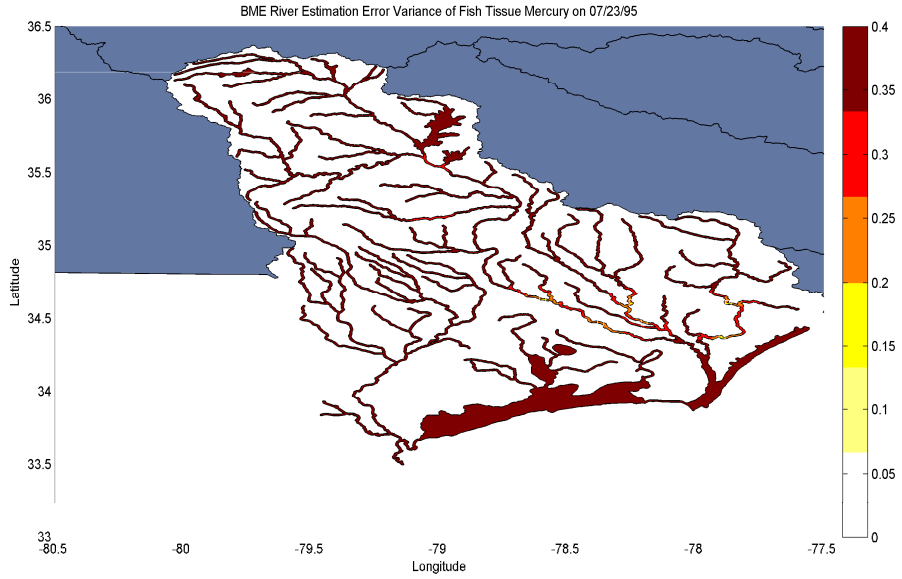


Figure S5: Distribution of fish species with measurements of fish tissue mercury between 1990-2004 in the Cape Fear and Lumber River Basins, NC.

Estimation Variance



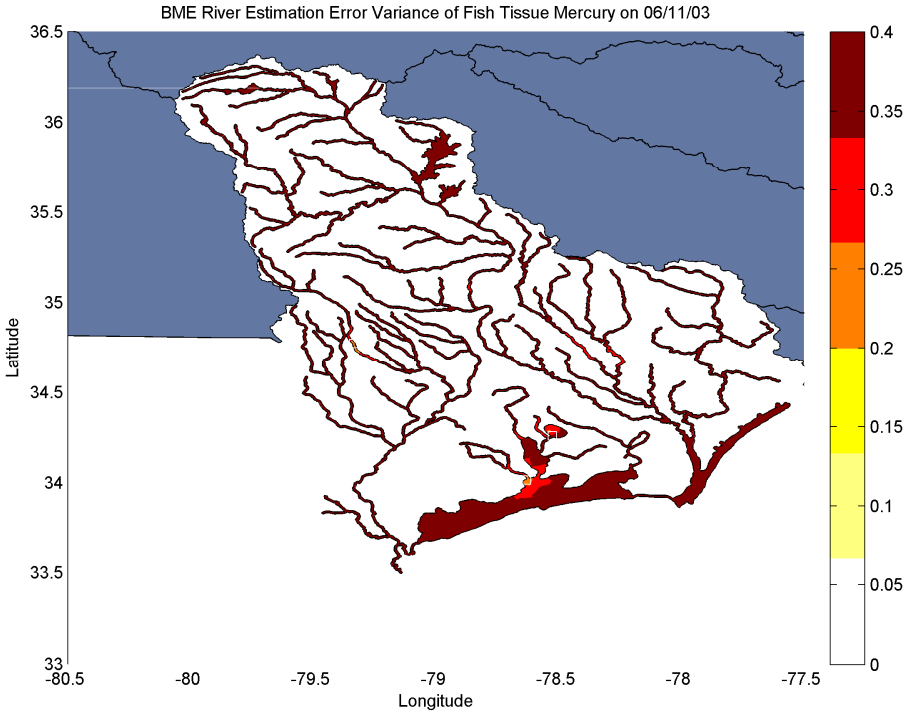


Figure S6: river-BME estimation variance (ppm^2) in the Cape Fear and Lumber Basins on July 23, 1995 (Top); and June 11, 2003 (Bottom).

Movie of Spatiotemporal Trend

Movie S1 can be viewed as an animated GIF at the following online location:

http://www.unc.edu/depts/case/BMElab/studies/HgFish_NC/CapefearLumber_HgFish_1991_2004.GIF

Movie S1: Space/time distribution of *Fish*Hg in the Cape Fear and Lumber Basins, every 180 days, between 1991-2004.