CALCULATING MERCURY LOADING TO THE TIDAL HUDSON RIVER, NEW YORK, USING RATING CURVE AND SURROGATE METHODOLOGIES

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Abstract. Total mercury (THg) load in rivers is often calculated from a site-specific "rating-curve" based on the relation between THg concentration and river discharge along with a continuous record of river discharge. However, there is no physical explanation as to why river discharge should consistently predict THg or any other suspended analyte. THg loads calculated by the rating-curve method were compared with those calculated by a "continuous surrogate concentration" (CSC) method in which a relation between THg concentration and suspended-sediment concentration (SSC) is constructed; THg loads then can be calculated from the continuous record of SSC and river discharge.

The rating-curve and CSC methods, respectively, indicated annual THg loads of 46.4 and 75.1 kg for the Mohawk River, and 52.9 and 33.1 kg for the upper Hudson River. Differences between the results of the two methods are attributed to the inability of the rating-curve method to adequately characterize atypical high flows such as an ice-dam release, or to account for hysteresis, which typically degrades the strength of the relation between stream discharge and concentration of material in suspension.

Keywords: Hudson River, load, mercury, Mohawk River, rating curve, surrogate, suspended-sediment concentration, yield

1. Introduction

The Hudson River is the largest source of freshwater to New York Harbor, which requires frequent dredging to maintain navigation. Much of the dredged material contains mercury and other contaminants; thus, proper disposal of dredge spoils can be costly. A first step toward developing a management plan to decrease the rate of mercury deposition within the harbor is to identify its main sources. In 1999, the U.S. Geological Survey (USGS), in cooperation with the New York State Department of Environmental Conservation, began an 18-month study to assess the loading of suspended sediment and dissolved and suspended contaminants, including unfiltered total mercury (THg), dissolved mercury (DHg) and dissolved methylmercury (MeHg), from the upper Hudson River and its largest tributary – the Mohawk River (Figure 1) to the tidal Hudson River, which extends from the Green Island Dam at Troy to New York City.

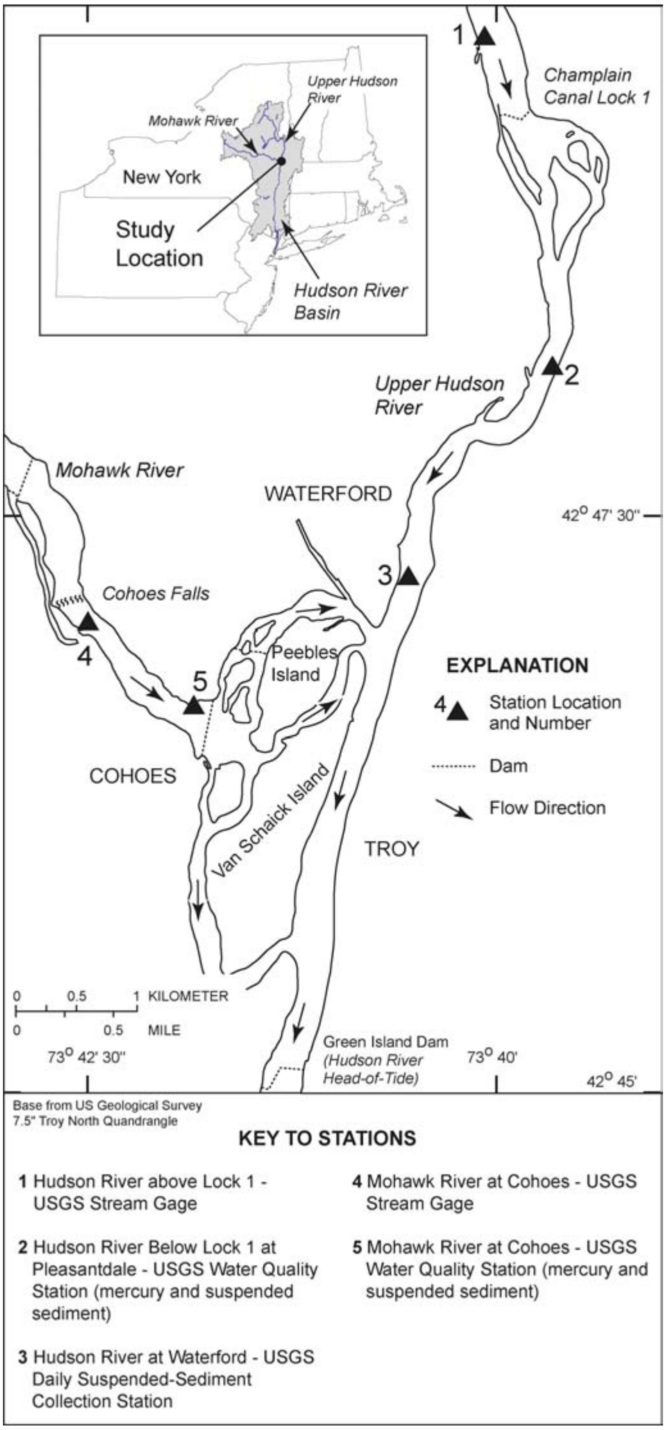

Figure 1. Pertinent geographic features of study area near Waterford, N.Y.

The most accurate way to define loading of a particular analyte from a river is to collect analyte data at a high enough frequency to construct a continuous concentration curve. The product of this concentration curve and river discharge results in a loading curve over time which can be integrated to compute load for a period of interest. For a study of significant duration, the amount of sampling required to produce a continuous concentration curve can be cost prohibitive. A simpler, alternative method of load estimation, commonly referred to as a rating-curve method (Ferguson, 1986; Helsel and Hirch, 1992; Cohn, 1995), constructs a site-specific relation between concentration and river discharge. This method uses discharge as a surrogate for analyte concentration, but as Cohn *et al.* (1992) point out, the assumption that the concentration of a given suspended analyte is related to river discharge has no basis and is generally not a reliable predictor. This weakness in predictive ability is due to a variety of factors, including dams and the distribution of precipitation and sediment sources in a watershed, which may introduce hysteresis to the relation (Williams, 1989).

Presented here is an alternative to the rating-curve method called the "continuous surrogate concentration" (CSC) method which makes use of a continuous and economical surrogate with a better relation to the analyte of interest than discharge. THg has been reported in association with various types of suspended material – particulate organic carbon (Shanley *et al.*, 2002; Kolka *et al.*, 2001), suspended sediment (Balogh *et al.*, 1997, 1998), the total organic fraction of suspended sediment (Scherbatskoy *et al.*, 1998; Mason and Sullivan, 1998), suspended solids (Grosheva, 1993), suspended particulate matter (Lawson *et al.*, 2001; Mason *et al.*, 1999; Hurley *et al.*, 1998), and humic matter (Mierle and Ingram, 1991). Except for humic matter, all of the above are components of suspended sediment. Therefore, in environments where THg is dominated by suspended Hg, suspended-sediment concentration (SSC) provides a reasonable surrogate. THg loads and yields obtained by this method are compared with those calculated by the conventional rating-curve method for an 18-month period from March 1999 through August 2000.

2. Methods

2.1. Sampling location

Samples were collected at three sites on the Hudson River (Sites 1–3) and two sites on the Mohawk River (Sites 4 and 5). Site 1, Hudson River above Lock 1 near Waterford (Figure 1), recorded discharge continuously. Site 2, Hudson River Below Lock 1 at Pleasantdale, is 1.4 miles downstream from site 1 and was used to collect paired mercury and suspended-sediment samples at a range of river flows and suspended-sediment samples during high flows. Site 3, Hudson River at Waterford, is 1.4 miles downstream from Site 2 and was used to collect suspended-sediment samples daily. No large tributaries enter the Hudson River mainstem between any

TABLE I

Mean daily discharge for 18-month study period (March 1999–August 2000) and historic mean daily discharge and standard deviation for the 22 previous 18-month March–August periods, at Mohawk River and Hudson River sampling sites (Locations are shown in Figure 1)

	Mean daily discharge, in cubic meters per second	
Period	Mohawk River at Cohoes (Site 4)	Hudson River above Lock 1 (Site 1)
March 1999–August 2000 (this study)	190	250
22 previous 18-month periods (March–August)	170 ± 30	240 ± 40

of the sites, and the difference in drainage areas represented by the upstream and downstream sites differ by less than 0.4%. Site 4, the Mohawk River at Cohoes (Figure 1), recorded discharge continuously, and Site 5 (0.4 mile downstream from Site 4) was used for collection of suspended-sediment and mercury samples.

Most of the land in both basins is forested. Agricultural land accounts for 34% of the Mohawk River Basin and 15% of the upper Hudson River Basin (Phillips and Hanchar, 1996). Industrial land is mostly along the mainstem of both rivers and accounts for only a small percentage of each basin. The Mohawk and upper Hudson River Basins together represent 61% of the entire Hudson River Basin and >99% of the drainage area above the Hudson River head-of-tide at Green Island (Figure 1).

Mean discharge from both rivers during the study period (March 1999–August 2000) exceeded the mean for the 22 previous 18-month (March–August) periods (Table I). The mean discharge of the Mohawk River during the study period was exceeded by 4 of the 22 previous 18-month mean discharges, and the mean for the Hudson River during the study period was exceeded by 8 of the 22 previous 18-month mean discharges.

2.2. Sampling and Analysis

Samples were collected for THg, DHg, MeHg, and SSC analysis at a wide range of discharges and suspended sediment concentrations during the 18-month study. Suspended-sediment samples were collected at a frequency that allowed the construction of a continuous SSC curve from March 1999 to August 2000.

Twelve paired suspended-sediment and mercury samples were collected from the Mohawk River (Site 5), and nine pairs were collected from the Hudson River at Pleasantdale (Site 2). Both samples of each pair were collected by a peristaltic pump connected to a fixed, Teflon[1]-lined length of polyethylene tubing between the pump and the river. The Cohoes sample intake was attached to a bridge abutment at the edge of flow (channel width here is 675 feet), 8.5 feet above the bottom and 475 feet upstream from a hydroelectric dam. The Pleasantdale intake was 40 feet from the bank (channel width here is 530 feet wide) and 6 inches above the bottom. The sample-intake line was rinsed for 3–5 minutes before collection of mercury samples. A 0.45 μm in-line capsule filter was attached to the discharge end of the peristaltic pump-head tubing just before collection of DHg and MeHg samples and was removed for collection of the THg sample. Mercury samples were collected in clean Teflon bottles provided by Frontier Geoscience Inc. (FGS) and shipped overnight with cold packs to FGS in Seattle Washington. Pumps were run in reverse after sample collection to purge the line of water and thereby decrease the possibility of algal growth, dilution, and carryover of Hg in subsequent samples.

Mercury analyses were performed at FGS using cold vapor atomic florescence spectrometry (CVAFS) (Bloom and Fitzgerald, 1988). THg and DHg samples were digested with BrCl, reduced with $SnCl_2$, and concentrated on gold traps for CVAFS analysis. (FGS personal communication, 2000). MeHg samples were distilled, ethylated, purged onto a Carbotrap column, separated by isothermal gas chromatography and analyzed by CVAFS (FGS personal communication, 2000).

Suspended-sediment samples from both sites were collected manually in clean plastic bottles when paired with mercury samples, and automatically with a pumping sampler at other times. The manual and automatic procedures used the same peristaltic pump and sample-intake line. Generally, a few to several samples were collected during every stormflow or snowmelt event with the collection frequency dictated by changes in river stage and supplemented with fixed-frequency sampling when stage changed little over a broad stormflow peak lasting several hours. Fixed-frequency sampling also was used during baseflow and low-flow periods to provide at least one sample per week. Samples were shipped to the USGS Sediment Laboratory in Louisville KY, for SSC analysis through methods described in Guy (1969).

Daily suspended-sediment samples were collected from the Hudson River at Waterford (Site 3) by a depth-integrating D-74 sampler mounted to a fixed bridge location. These samples were the primary source of data for construction of the continuous SSC curve for the 18-month period, although point samples from the Pleasantdale site (Site 2) occasionally were used to help define the trace of the curve during periods of rapidly changing discharge and/or SSC. Point samples collected from the Mohawk River by an automatic sampler were the primary source of suspended-sediment data for construction of the SSC curve for that site. Depth-integrated equal-width-increment (EWI) samples were collected at Sites 5 and 3 under a variety of discharge conditions to quantify the degree to which samples from the point intakes (Sites 5 and 2) or a single, depth-integrated profile (Site 3) were representative of the mean cross-section concentration. Corrections to non-EWI SSC data were applied, as needed, before construction of the continuous concentration curve. The percentage of fines (<62 μm) in paired intake and EWI samples on both rivers indicate that the grain-size distribution does not vary between the cross section and the intake point; therefore, the relation between SSC and THg concentration was assumed to pertain equally to the point intakes and full cross section.

2.3. Quality assurance

One field blank for Hg was collected at each site using clean tubing and blank water provided by FGS. One end of the FGS tubing was attached to the intake side of the peristaltic pump tubing (the outside diameter of the FGS tubing matched the inside diameter of the pump-head tubing) and the other placed in the blank water. Blank water was rinsed briefly through the tubing to simulate rinsing of tubing that occurs during normal sampling procedures and then collected in a standard FGS sample bottle. Blank concentrations were low or non-detectable (Table II) and did not warrant blank-correction of environmental sample concentrations.

On two occasions at the Mohawk River (Site 5), open-bottle grab samples for THg analysis were collected within a few feet of the peristaltic-pump-tubing intake for comparison with samples collected at the same time with the peristaltic pump. The similarity between grab-sample concentrations of 11.5 and 35.9 ng/L and peristaltic-pump sample concentrations of 10.3 and 35.2 ng/L indicated that the sample tubing was not a source of Hg contamination or loss.

Laboratory quality-assurance procedures for mercury and sediment analysis followed the guidelines given in Gauthier (2000) and Scholar and Shreve (1998), respectively.

2.4. Data computation

2.4.1. *Rating-Curve Method*

A regression equation relating the log of instantaneous river discharge and log of THg concentration (Figures 2A and B) was developed for both rivers. A “smearing” bias-correction factor (Helsel and Hirch, 1992) was applied to the retransformed regression equation to remove bias introduced by the retransformation of log units into original concentration units. One sample, collected from the Mohawk River on February 28, 2000, was not used in the Figure 2A regression because it was collected during a release from the breakup of an upstream ice dam and, therefore, was not considered to represent the normal range of hydrologic conditions encompassed by the remaining samples. The computation was adjusted for two conditions – days in which discharge changed appreciably (see Potterfield, 1972, for details) and hourly data were available, and days in which discharge did not change appreciably, or hourly data were not available. For days in which discharge changed appreciably, and hourly data were available, the regression equation was used to estimate an hourly THg concentration, and hourly loads were computed and summed to obtain a daily load. For days in which discharge did not change appreciably, or hourly

TABLE II

Discharge and concentration of suspended sediment and mercury at Hudson River at Pleasantdale (Site 2) and Mohawk River at Cohoes (Site 5) sites, March 1999 through August 2000 (Site locations are shown in Figure 1)

			Concentration[1]			
				Mercury		
Date (m/d/y)	Sample type	River discharge (m^3/s)	Suspended sediment (mg/L)	THg (ng/L)	DHg (ng/L)	MeHg (ng/L)
Hudson River at Pleasantdale						
3/12/99	Pumped	210	3	2.2	1.45	0.03
3/23/99	Pumped	550	88	14.3	3.17	0.046
4/5/99	Pumped	660	27	5.87	2.36	0.084
11/2/99	Pumped	170	5	2.12	0.92	<0.005
1/5/00	Pumped	480	51	8	2.44	0.029
2/28/00	Pumped	950	269	37.4	1.9	<0.024
3/29/00	Pumped	760	29	6.36	1	0.045
4/5/00	Pumped	870	180	18.8	1.58	0.075
6/7/00	Pumped	170	196	25.1	1.78	<0.054
4/5/99	Blank	NA	NA	NA	<0.13	0.014
Mohawk River at Cohoes						
3/11/99	Pumped	160	6	2.87	1.64	0.032
3/22/99	Pumped	640	34	7.11	1.51	0.041
4/5/99	Pumped	520	18	4.21	1.85	0.065
5/3/99	Pumped	40	4	3.36	1.52	0.045
11/2/99	Pumped	60	4	2.6	1.05	0.025
11/29/99	Pumped	250	15	3.76	1.41	0.033
1/5/00	Pumped	830	176	23.1	3.07	<0.063
2/28/00	Pumped	1,350	525	80*	1.49	<0.024
3/29/00	Pumped	1,060	225	22.6	1.72	0.026
6/7/00	Pumped	1,690	269	56.7	3.26	0.065
4/8/01	Pumped	1,280	113	10.3	2.77	0.035
4/8/01	Grab	1,280	NA	11.5	NA	NA
4/9/01	Pumped	1,780	429	35.2	1.84	0.032
4/9/01	Grab	1,780	NA	35.9	NA	NA
1/5/00	Blank	NA	NA	NA	0.77	<0.028

[1]THg total mercury, DHg – dissolved mercury, MeHg – methyl mercury.
NA sample not analyzed for this analyte.
< concentration was below analytical detection limit.
*anomalous discharge; data not used in rating-curve regression.

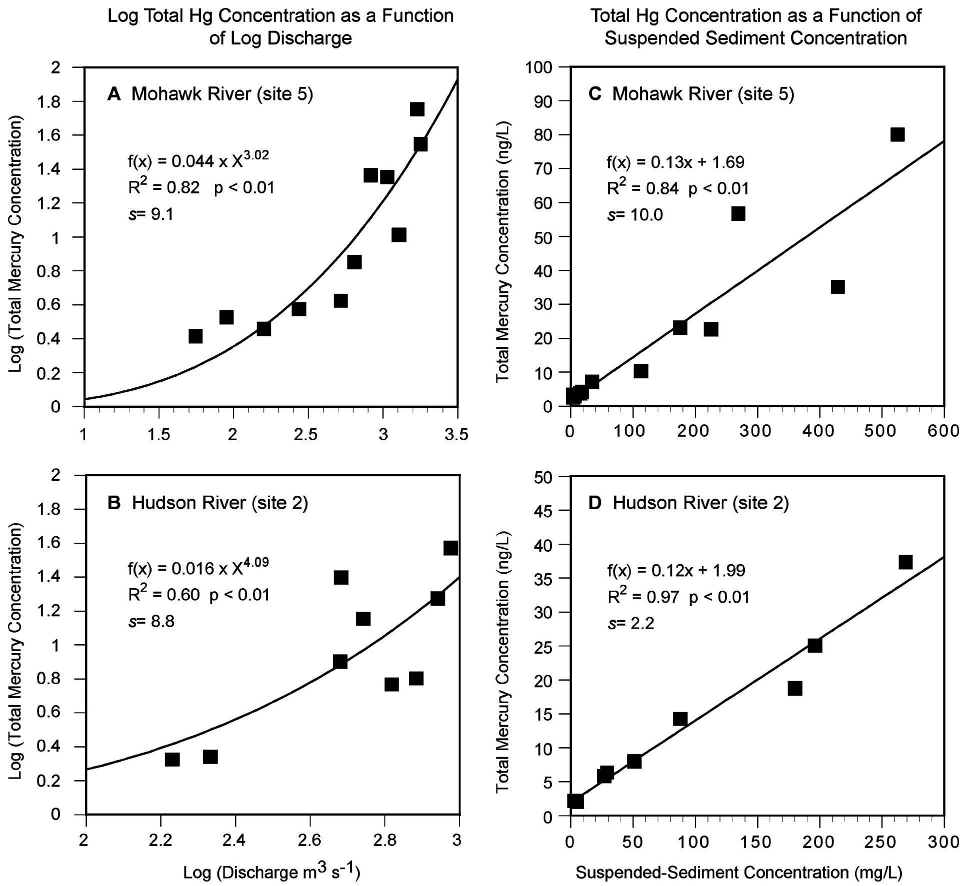

Figure 2. Regression equations and summary statistics for the Mohawk and Hudson River sites: (A, B) rating-curve method. (C, D) Continuous surrogate-concentration (CSC) method. (Site locations are shown in Figure 1.) R^2 denotes the variability explained by the independent variable, p denotes the significance of the regression line, and s denotes the standard deviation of the regression residuals in ng/L.

data were not available, daily mean discharge was used in the regression equation, and the derived THg concentration was multiplied by the daily mean discharge to obtain the daily load. Average annual yield was computed for each of the two sites as the average of the total loads for the first and last 12-month-periods within the 18-month study, divided by the respective basin area.

2.4.2. *Continuous Surrogate Concentration (CSC) Method*

The CSC method requires a relation between a surrogate (SSC in this case) and the analyte for which a load is being estimated (THg), along with a continuous record of the surrogate and river discharge. A continuous SSC curve was constructed, and daily suspended-sediment concentrations were calculated for the 18-month period by the method of Potterfield (1972). For periods of rapidly changing concentration, the sampling frequency was sufficient for construction of a continuous concentration curve without the aid of concentration-discharge relations or other methods of estimation. For days in which the SSC and/or the discharge changed appreciably, an hourly suspended-sediment concentration value was estimated, and the mid-interval method of Potterfield (1972) used to obtain a flow-weighted mean concentration for the day.

SSC values derived from the continuous-SSC curve were applied to the equation developed for each site from the THg-SSC regression (Figures 2C, 2D). As with the rating-curve method, the computation of THg load was adjusted for two conditions – days in which SSC and/or river discharge changed appreciably and hourly discharge data were available, and days in which neither SSC nor river discharge changed appreciably. For days in which SSC and/or river discharge changed appreciably, hourly values of SSC were used in the regression equations to provide hourly THg concentrations; these values were, in turn, multiplied by the corresponding hourly river discharge to provide an hourly load and the mid-interval method of Potterfield (1972) again was used to sum the hourly loads and produce a daily load. For days in which neither SSC nor river discharge changed appreciably, the daily mean SSC values were applied to the regression equation to obtain a daily mean concentration; the daily mean THg concentration was, in turn, multiplied by the daily mean river discharge to produce a daily load. An average annual yield was calculated for each of the two sites the same as in the rating-curve method.

Extension of the relation between SSC and THg at the Mohawk site (Site 5) was required on three occasions during the 18-month study – by a maximum of 26% beyond the maximum sampled SSC (500 mg/L) for 8 hours on September 1, 1999, and 12 hours on June 7–8, 2000, and by a maximum of 460% for 32 hours on February 28–29, 2000. The Hudson (Site 2) relation was extended a maximum of 23% beyond the maximum sampled SSC (300 mg/L) for 8 consecutive hours on February 28–29, 2000.

3. Results

SSC and percent fines ($<62\ \mu$m) data from the Mohawk River (Site 5) and Hudson River at Pleasantdale (Site 2) are available in Butch *et al.* (2001). SSC data from Hudson River at Waterford are unpublished but available from the USGS office in Troy, N.Y. Daily suspended-sediment loads for Hudson River at Waterford are given in Butch *et al.* (2000 and 2001) and for the Mohawk River at Cohoes in Butch *et al.* (2001). Hg and SSC data for samples collected at Pleasantdale and Cohoes are given in Table II.

DHg plus MeHg concentrations in 7 of 9 samples from the upper Hudson River (Site 2) and 11 of 12 samples from the Mohawk River (Site 5) exceeded the Water Quality Guidance for the Great Lakes System for protection of wildlife (1.3 ng/L),

TABLE III

Total mercury loads and yields calculated by continuous suspended-sediment concentration (CSC) method and rating-curve method for Mohawk and Hudson River sites, March 1999 through August 2000

Site and statistic	Method: Continuous surrogate concentration (CSC)	Method: Rating curve
Mohawk River (Site 5)		
Load (kg yr^{-1})	75.1	46.4
Yield (g $km^{-2}yr^{-1}$)	8.4	5.2
Hudson River (Site 3)		
Load (kg yr^{-1})	33.1	52.9
Yield (g $km^{-2}yr^{-1}$)	2.8	4.4

and the concentrations in 5 samples from each of these sites exceeded the guidance for protection of human health (1.8 ng/L). None of the samples from either site contained DHg concentrations exceeding the USEPA criterion for freshwater chronic exposure (777 ng/L), or the maximum contaminant level for DHg established under the Safe Drinking Water Act (200 ng/L).

Average annual THg loads and yields for the 18-month study period computed by both methods for both rivers are given in Table III. These yields are within the range reported by Larson *et al.* (2001) for various tributaries to Chesapeake Bay. The daily, monthly, and cumulative THg loads calculated with both methods for both sites are shown in Figure 3. No clear correlation was observed between MeHg concentration and that of any other measured variable. Detectable concentrations of MeHg ranged from 0.01 to 0.09 ng/L in the upper Hudson River and from 0.02 to 0.07 ng/L in the Mohawk River. MeHg concentrations represented less than 1.5% of the THg detected in individual samples.

4. Discussion

Although results from the Mohawk site indicate both methods are comparable in their ability to estimate THg concentration, knowing the proper discharge to associate with that concentration is critical in the load computation. Implicit with the use of a rating curve is the assumption that the hydrologic and concentration peaks during a storm event are coincident. With discharge typically ranging over an order of magnitude for both sites during an event, the error introduced to the load computation in the prediction of concentration can be insignificant relative to that introduced by using the incorrect discharge. The CSC method avoids the need for this assumption by tracking a surrogate which better reflects the movement of THg over time than discharge.

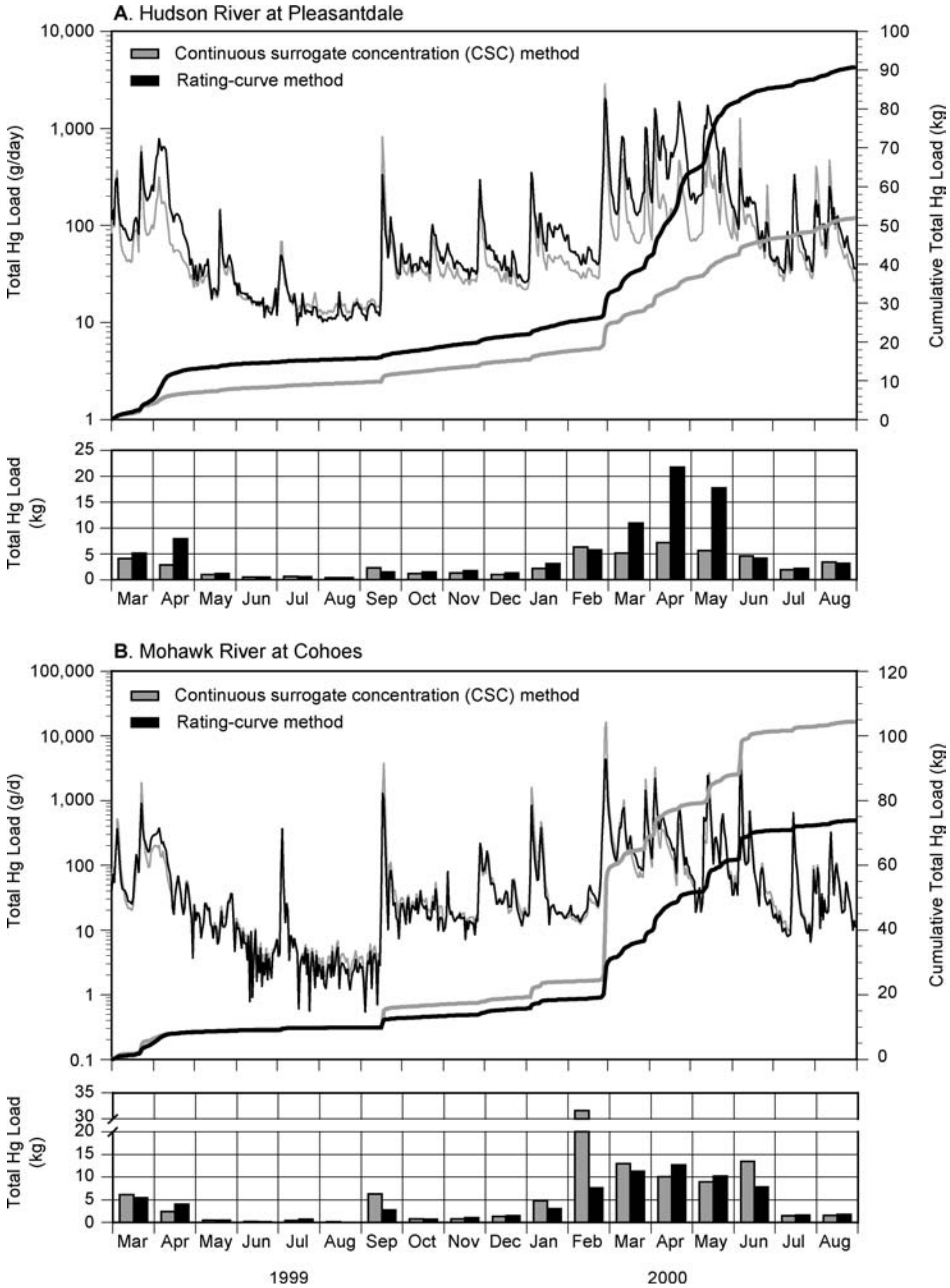

Figure 3. Daily, monthly, and cumulative total mercury load calculated by continuous-surrogate-concentration (CSC) method and rating-curve method for 18-month study period, March 1999 through August 2000, at the two sampling sites: (A) Hudson River at Pleasantdale (Site 2). (B) Mohawk River at Cohoes (Site 5). (Site locations are shown in Figure 1.)

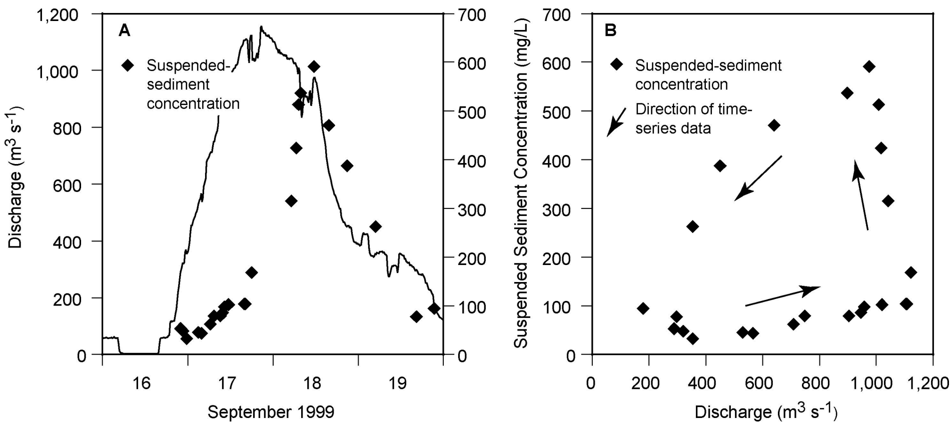

Figure 4. (A) Typical time series of suspended-sediment concentration in relation to Mohawk River discharge (Sites 4 and 5) showing offset in arrival times of discharge and sediment-concentration peaks. (B) Resulting hysterisis loop in suspended-sediment-concentration-to discharge relation that compromises usefulness of discharge as a predictor of the concentration of suspended sediment and associated contaminants. (Site location is shown in Figure 1.)

Streamflow impediments, such as dams for navigation and hydropower, large contributions of sediment from tributaries, and the location and intensity of a storm in the watershed can all act to shift the SSC peak away from the peak discharge on both rivers. Because the SSC peak often precedes or lags behind the peak flow, and rarely coincides with it, the rating-curve method can indicate the peak daily THg load occurred a day early or a day late. Figure 4a illustrates this offset in a single storm event and Figure 4b illustrates the resulting variability in the SSC-discharge relation. The fact that there appears to be a relation between THg and SSC (Figure 2C) indicates there is likely hysteresis in the THg-discharge relation as well, but it may be masked by the small sample size. The data scatter in the relation between SSC and discharge (Figure 5) from the Hudson site results from multiple hysteresis events which act to further degrade the relation between these parameters and by extension the relation between THg and discharge.

Most of the 30-kg difference between Mohawk River load estimates obtained by the two methods for the 18-month study can be attributed to the difference in daily loads calculated for 12 days during for the six largest stormflows of the study (2 days per stormflow); the differences totaled 31 kg. These 12 days represented 12% of the total discharge for the 18-month period and 53% of the THg load calculated by the CSC method for that period. The hysteresis of SSC data from the Mohawk site suggests the difference in THg loads for these events is because of a failure of the Mohawk rating curve to accurately predict the timing and magnitude of THg concentrations for stormflows of this magnitude. In addition, much of the difference for these 12 days is related to the 460% extension of the SSC-THg relation because of an ice dam release in February 2000; this amount of extension clearly

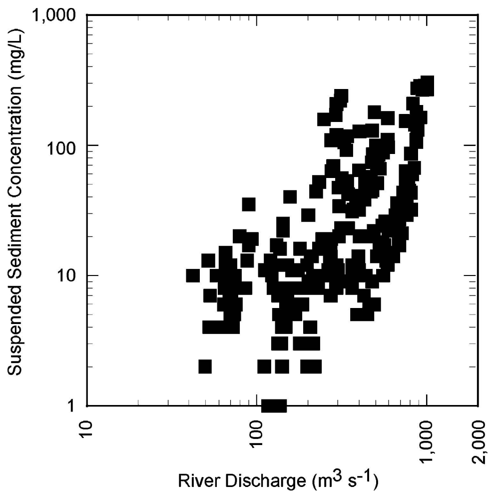

Figure 5. Suspended-sediment concentration as a function of discharge at Hudson River Site 2, March 1999 through August 2000. The poor relation ($R^2 = 0.35$) between these parameters illustrates the weakness of the rating-curve method for this site. (Site location is shown in Figure 1.)

illustrates the questionable accuracy of the CSC method on those days. However, the rating-curve method also failed by completely missing an extremely large slug of suspended sediment associated with this release which caused a temporary shift in the relation between SSC (and by extension THg concentration) and discharge. This shift, which was unnoticeable if not for frequent sampling during the event, highlights the importance of sampling during high flows and the usefulness of the CSC method to produce a realistic concentration time-series.

Differences between loads calculated by the two methods for the upper Hudson River (Site 2) are likely tied to the weak relation between log THg concentration and log discharge, which stems from the similarly weak relation between SSC and discharge (Figure 5). This poor relation is because of the inconsistent timing of sediment contributions from major upstream tributaries relative to peaks in SSC and discharge in the Hudson mainstem. Unlike the Mohawk rating curve, which consistently underestimated the peak daily THg loads relative to the CSC method for some of the highest stormflows, the upper Hudson rating curve consistently overestimated THg loads during periods of elevated base flow in the spring of 2000; this overestimation accounts for much of the difference between the 18-month load estimates calculated by the two methods. The weakness of the Hudson rating-curve in its ability to predict THg concentration reflects the method's inability to account for, or reliably predict, sediment transport for this site.

Based on data in Butch *et al.* (2001) the size and organic content of suspended material is similar between rivers which suggests the similar slope and intercept in Figures 2C and 2D indicates the affinity of Hg to suspended sediment is similar in both watersheds. That the rating-curve method produced an annual THg load from the upper Hudson greater than that of the Mohawk is, therefore, counterintuitive because the export of suspended sediment was appreciably greater from the Mohawk than the Upper Hudson. The similarity of slope and intercept for the two basins also might indicate a similar source of Hg in both basins – the geographic proximity of the basins indicates that both basins receive similar rates of atmospheric Hg deposition. This evidence is not conclusive but is consistent with a hypothesis that atmospheric Hg deposition is the dominant source of Hg in both rivers.

5. Conclusions

Collection of inexpensive surrogate data, such as SSC, for construction of a continuous concentration curve for sites at which the relation between discharge and the concentration of a given analyte is poor, is more cost effective than collecting numerous samples for the analyte of interest and may provide a more accurate method for calculating analyte loads than a standard rating curve. Surrogate data that better reflects the movement of an analyte of interest than discharge provides a better estimate of analyte concentration along with an analyte time series independent of discharge. Discharge independence eliminates the assumption implicit with a rating curve that peaks in analyte concentration are coincident with peaks in discharge and the resulting errors associated with using the wrong discharge in the load computation.

The rating-curve method indicated THg loads for the upper Hudson River exceeded the CSC-based 18-month values by 75% and monthly values by as much as 300%. The rating-curve method was unable to account for a temporary shift in the Mohawk River rating caused by an upstream ice dam release in February 2000; this anomalous flow may have accounted for as much as 30% of the 18-month THg load and most of the difference in load computed by the two methods at this site. Similarities in the relation between SSC and THg in both rivers suggest the rating curve method overestimated THg load from the upper Hudson and/or underestimated the load from the Mohawk.

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Note

1. Use of trade, product, or firm names in this publication is for descriptive purposes only and does not imply endorsement by the U.S. Government.

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