Mass Balance Assessment for Mercury in Lake Champlain

I G GA ,*, . GAB IE A A A ,
A E B. HA E , EI C. A A ,
E IC . I E ,⊥ GE A D . EE E ,#
I H CHE BA ,

TABLE 1. Physical Dimensions (*25*) and MB Modeling Results for Each of the 13 Lake Segments[a]

segment (sampling location)	surface area (km²)	vol (km³)	length (km)	trib input (g Hg/ year)	WWTFs input (g Hg/year)	wet dep input (g Hg/year)	dry dep input (g Hg/year)	volatile loss (g Hg/year)	sedim ent loss (g Hg/year)	sampled [Hg] (ng Hg/L)	modeled [Hg] (ng Hg/L)
Isle LaMotte (at Point Au Fer)	185.59	1.892	40. 3	2417	0	1455	1581	3613	5194	0.27	0.18
Cumberland Bay	10.75	0.063	3.4	2241	80	84	115	694	309	0.38	0.49
Main Lake	414.14	16.787	47	8216	13	3255	3077	1856 7	7399	0.33	0.35
Port Henry (at C Ba)	75.55	1.463	20. 1	188	3	605	278	2233	1387	0.32	0.25
Missisquoi Bay	89.94	0.205	16. 8	2340	3	738	699	1842	1525	0.38	0.18
St. Albans Bay	7.21	0.023	3.4	71	9	57	50	16	158	0.30	0.06
Northeast Arm (at Inland Sea)	248.25	3.38	33. 5	243	0	1959	1884	414	4670	0.24	0.05
Malletts Bay	55.06	0.722	6.7	3165	0	433	426	1181	2655	0.28	0.19
Burlington Bay (at Burlington Harbor)	5.51	0.063	2	52	38	44	39	179	251	0.27	0.27
Shelburne Bay	9.62	0.14	3.4	213	3	77	69	374	181	0.26	0.31
Otter Creek (at Diamond Island)	28.49	0.955	10. 1	3690	2	229	101	1286	542	0.32	0.36
South Lake A (at Crown Point)	43.27	0.125	33. 5	1424	2524	353	160	3482	766	0.52	0.60
South Lake B (at Benson's Landing)	5.79	0.0078	20. 1	2203	2	47	21	984	179	0.98	1.23
Total	1179.1 7	25.826	N/A	2646 3	2677	9336	8479	3486 5	25216	a 0.37	a 0.35

[a] h m n f m h MB m n h ɩ ɩa n ɩ n n 2001 an h a mpɩ n h aɩ [DGM = 20%[H .

, , , C . . I / . II H . F C , , H , (*17*), (*18–20*), (*21*). C - (, ,) (*22, 23*) (. .,). - . (*3, 24*). A G , 2000 2003 . H ( ) , 14 , 14 (2001), H . H C (*13*) . (*25*). A I H . II , 2005, H - . H C (I), H (II).

2. Development of a Mass Balance Model for Hg in Lake Champlain

C , , , (*26–28*). C 250 , . . I 20.2 122 (*26*). C / 18 1 (*26*). , H

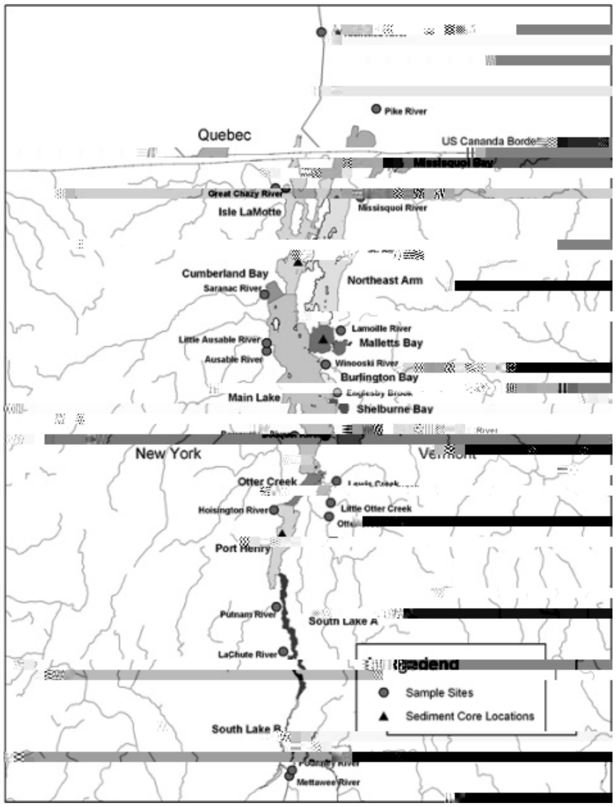

FIGURE 1. Thirteen segments of Lake Champlain and sampling sites.

. B , , 13 (*29*). 1 13 , F 1 (*29*). F , H . H , , , ,

.
, ,
. -
.

. H (H),
.

$C(t)_i, C(t)_j,$ $C(t)_k$
H (/) , i;
j; k. L
H (/) ; $Q_{j,i}$
$Q_{i,k}$ (^{3}/)
j i, i k,
. DF$_{ik}$ (^{3}/)
i k (
); V_i
(^{3}).
($C(t)_i/$ $t = 0$),
- H
.

2.1. Influx Variables. *Tributaries.* F 2000 2003,
30−50
C (F
1) H .

I .
F H 2001
2003 (1
30)
14 67%
, ( ). B
H -
( ) (*15*),
H H
. H 15-
( )
– ,
H H – ,
H .
15- H
H . B H -
,

H .
F , H

. F
,

3.56 8.52 μ / ^{2}

9

.

Sedimentation Flux. ,

H

C

H . ,

C B H -

, (17, 2003), B , (31,

2002), ,

(A 5, 2003) (F 1).

C ,

.

, H , .

I .

^{210}

0.5 C ^{3} $^{-1}$ (*42*).

E H (μ / ^{2}) ,

,

2. A H ,

, . E

. E , H

C

. H , -

C ,

, H C

,302( ) 6 , -302 42( ) 6 6415( )-6-328( )-38 5.C 66(302( )-249(2

. H

H B

.

F H

.

F , H C

10.4 / 6.68 / A , 1.58 / ,

0.81 / 2003, H A

2001 3.11 / .

H ,

,

.

H

H .
E I
— H ,
H . F , H
C 0.4−16%
H , 0.5−5.9%
. H
4−6% H C ,
, (*48*), -
90
H (*44*). B
(H 6.1),
C , H
5% H (*49*).
, (H 8.2)
C B ,
H , 2−3%
(*1*). H -
0.3−0.6% H -
.
I
'
II . , (1)
H
; (2)
H ; (3)
H ; (4)
H F ;
(5) H H ,
DG
; (6) H , . .
, -
H ; (7)
, ,
H , H , , D C -
H .

Acknowledgments

C
C - .
C
I E
A17 1225 . CA4/II-08
G E (G E),
A A (AA),
. . D C ,
AA A . . .
.
D C , . .
D . D E
(^{210}) , D .
C
,
. A C G ,
.
D E C ,
H
. , C ,
D F
. C

.

Supporting Information Available

H , -
, H ,
, .
I ://
. . .

Literature Cited

(1) D , C. .; , C.; , C. . A . *Environ. Sci. Technol.* **1994**, *28* (3), 136A−143A.
(2) , . .; , . A. . *Environ. Sci. Technol.* **1997**, *31*, 942−947.
(3) , A. F.; . .; , G. . D B (, 1994− , 1995). *Environ. Sci. Technol.* **2002**, *36* (21), 4525−32.
(4) , . .; , H. E.; C , . B. D . *Environ. Sci. Technol.* **2003**, *37* (5), 865−72.
(5) , .- .; , . H.; , . A. D E F B . *Environ. Sci. Technol.* **2000**, *34* (19), 4058−63.
(6) , B.; C , D.; , B. . . *Environ. Sci. Technol.* **1999**, *33* (6), 840−9.
(7) , H.; , . .; B , . . , . *Environ. Sci. Technol.* **2002**, *36* (7), 1383−8.
(8) I , A., E . *Lake Champlain sediment toxics assessment program: an assessment of sediment associated contaminants in Lake Champlain, Phase I*; C B . 5; C B : G I , , 1994.
(9) B , .; H , .; , G.; , . C B . *Water, Air, Soil Pollut.* **1995**, *80*, 353−362.
(10) , .; B , . .; , A. .; , G. . A C B . I *Atmospheric Deposition of Contaminants to the Great Lakes and Coastal Waters*; B , . E., E .; E AC ; E AC : , F , 1997; 245−257.
(11) , .; , . .; A , . . C A A I C B . I *Lake Champlain in Transition: From Research Toward Restoration*; , . ., . ., E .; A ; A G : , DC, 1999; . 1, 1−23.
(12) , . B.; D , A. F.; , .; , G. C B . *Lake Champlain in Transition: From Research Toward Restoration*; , . ., , . ., E .; A ; A G : , DC, 1999; . 1, 277−299.
(13) , .; , . B.; , G. . F . *Water, Air, Soil Pollut.* **1998**, *105*, 427−438.
(14) C , H. B.; , .; B , . .; , .; , . *Results of the Lake Michigan Mass Balance Study: Mercury Data Report*; E A 905 -01-012; . . E A : , DC, 2004.
(15) , . B.; , . F.; , . .; , D.A.; , H. E.; A , G. . . *EOS, Trans. Am. Geophys. Union* **2002**, *83*, 5, 45−48.
(16) C , . A.; C , . F. *Geochemical data on concentrations of inorganic constituents and polychlorinated biphenyl congeners in streambed sediments in tributaries to Lake Champlain in New York, Vermont, and Québec, 1992*; . . G - F 94−472; . . G : , DC, 1994; 1−65.
(17) , .; , C. A.; , . . . F : . *Limnol. Oceanogr.* **2001**, *46* (3), 623−31.

(18) , .; , .B.
. *Environ. Sci. Technol.* **1997**, *31*, 1716−22.

(19) H , . .; , . C.; G , . . H
-
: ?
Limnol. Oceanogr. **1998**,