Past Application of SWEM

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December 17, 2012

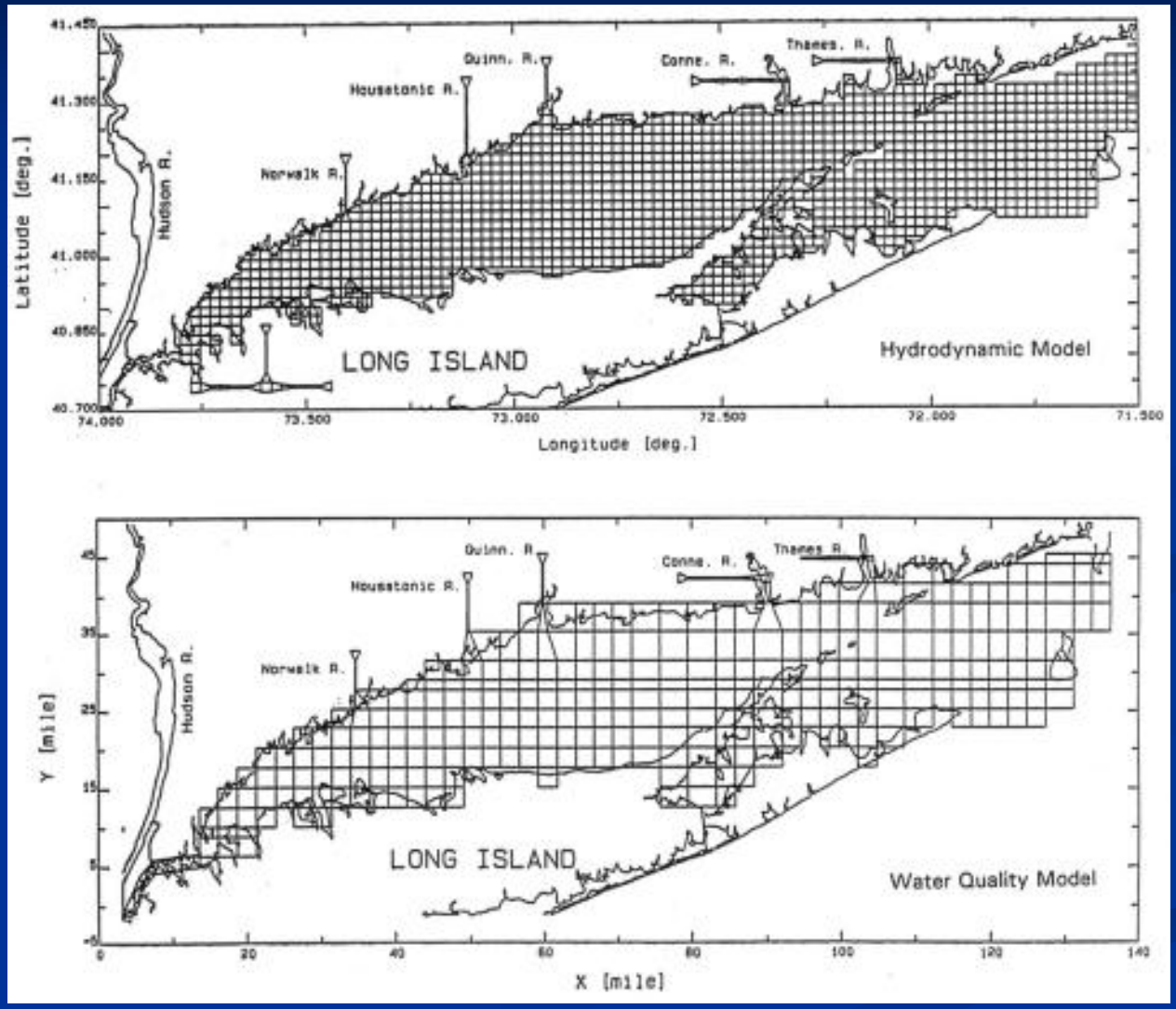
SWEM MEG

HDR | HydroQual

HISTORY

- Modeling work began in 1987
  - Water quality – HydroQual
  - Hydrodynamics – NOAA/HydroQual
- Four generations of water quality models
  - LIS 1.0 – 2-D/steady-state
  - LIS 2.0 – 2-D/time-varying
  - LIS 3.0 – 3-D/time-varying
  - SWEM – 3-D/time-varying/regional response
- Objective: effect of carbon and nitrogen inputs on dissolved oxygen balance

LIS 3.0 Grids

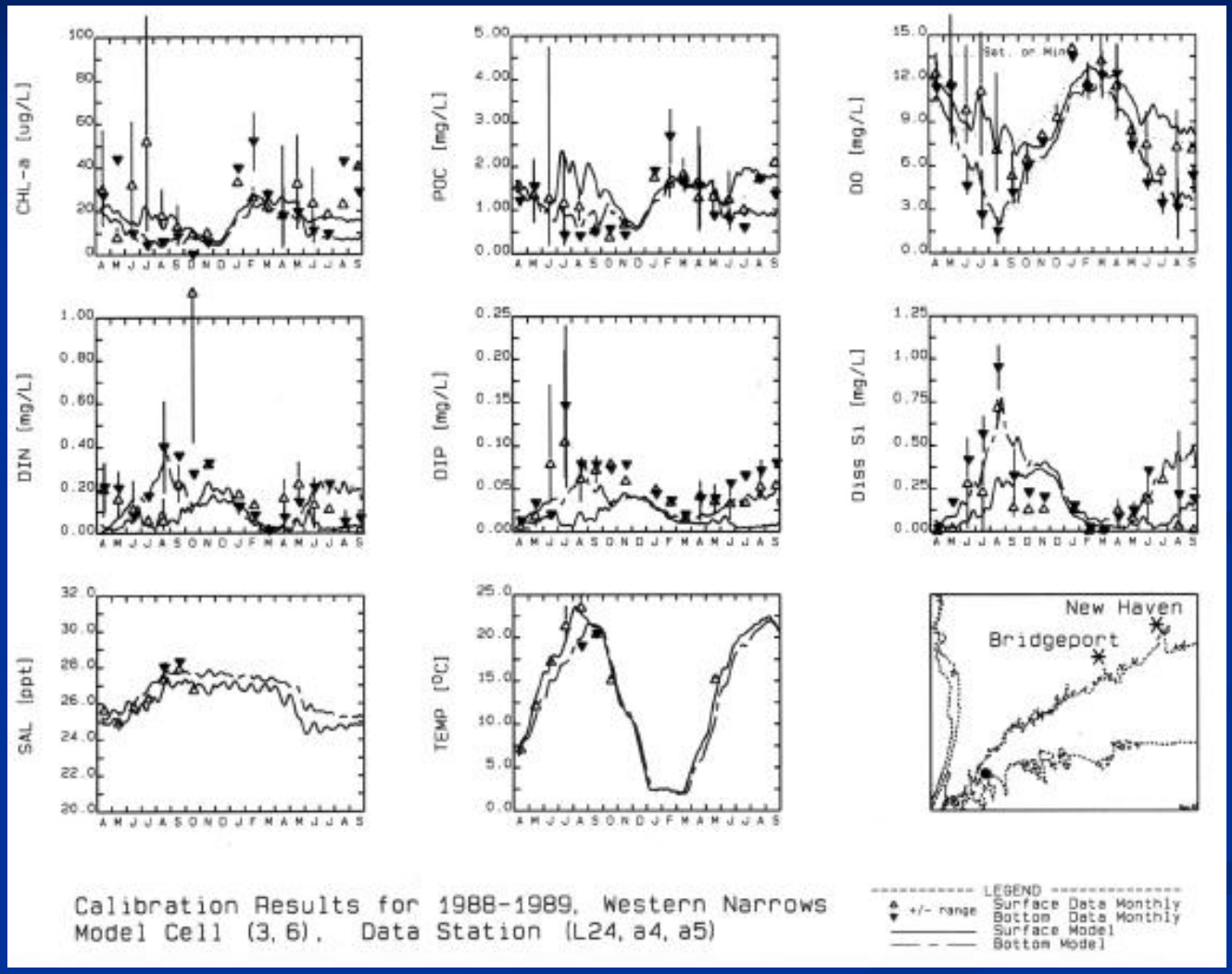

Latitude [deg.]
Longitude [deg.]
Hudson R.
Norwalk R.
Housatonic R.
Quinn. R.
Conne. R.
Thames. R.
LONG ISLAND
Hydrodynamic Model
Y [mile]
X [mile]
Water Quality Model

LIS 3.0 Model Application

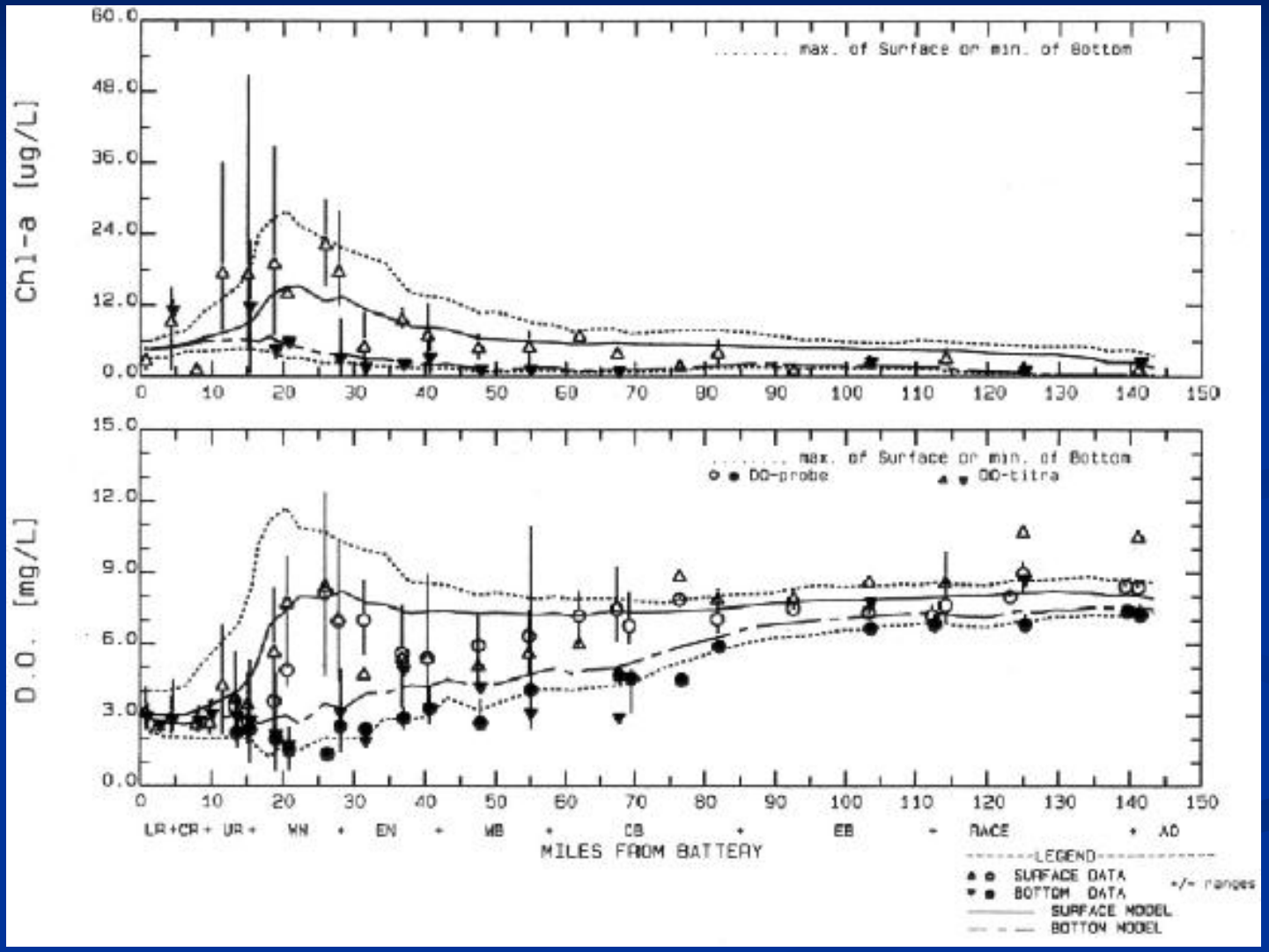
- Calibrated with comprehensive data set

  April 1988 – August 1989 field effort
- Peer reviewed
- Nitrogen determined as limiting nutrient
- Developed loading response matrix
- Analyzed 5 nutrient reduction scenarios
- Basis for the LIS N TMDL

LIS 3.0 Temporal Calibration Results



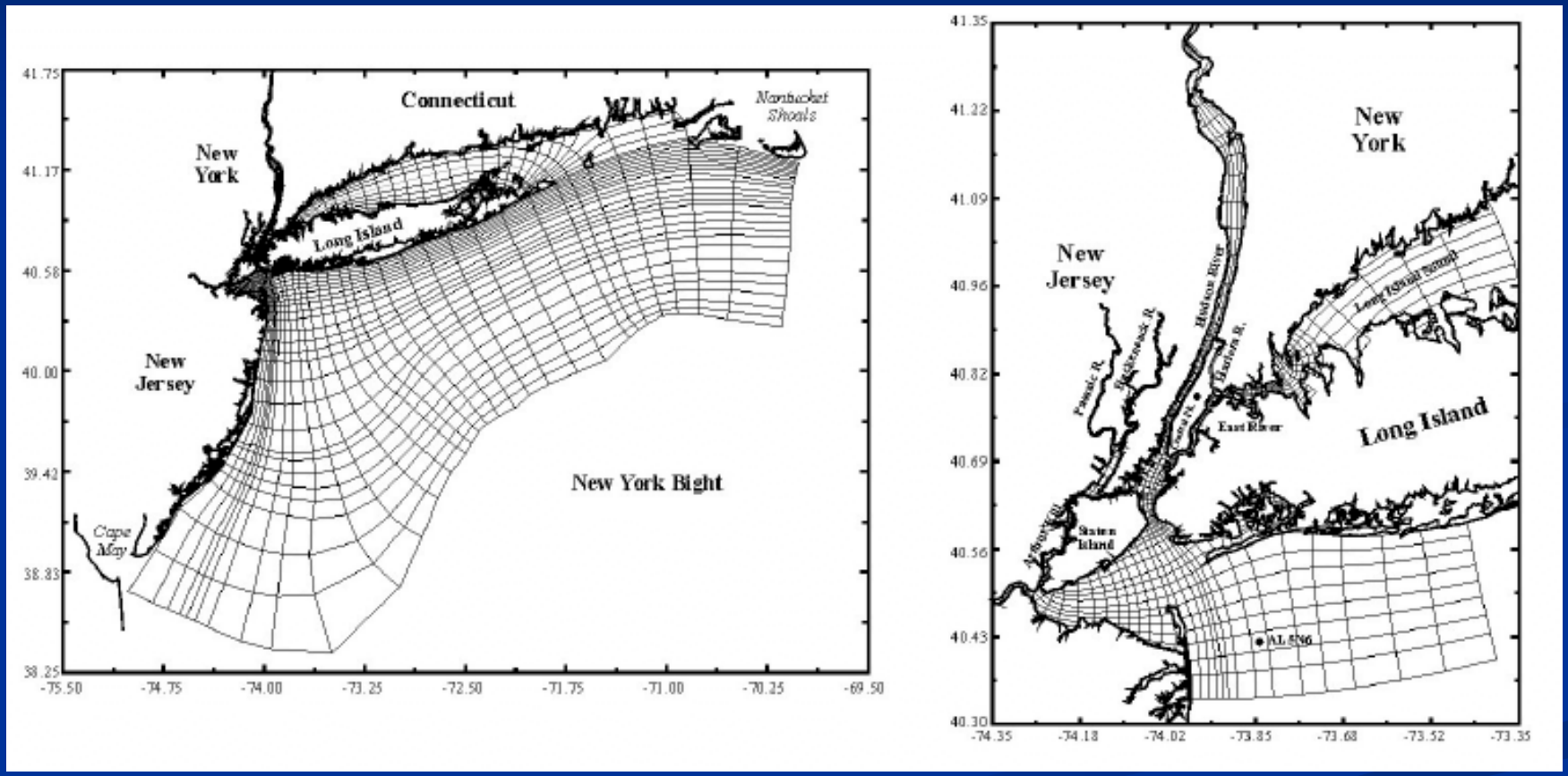
LIS 3.0 Spatial Calibration Results



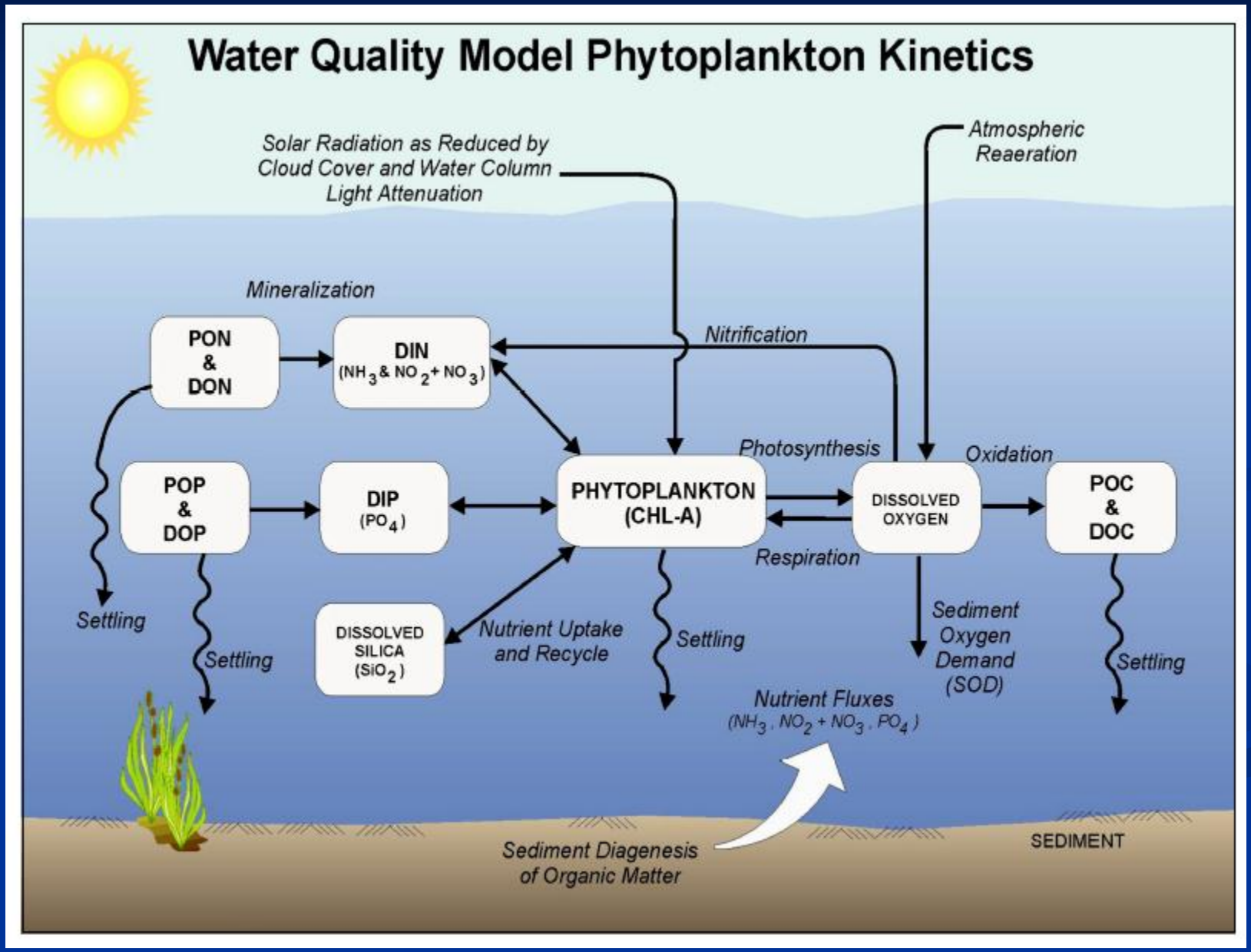
LIS 3.0 Model Limitations

- Model boundaries impacted by internal loads
  - Battery in Lower East River
  - Block Island Sound
- Somewhat coarse model grid
- Lack of explicit interactions of Long Island Sound with NY/NJ Harbor and Atlantic Ocean

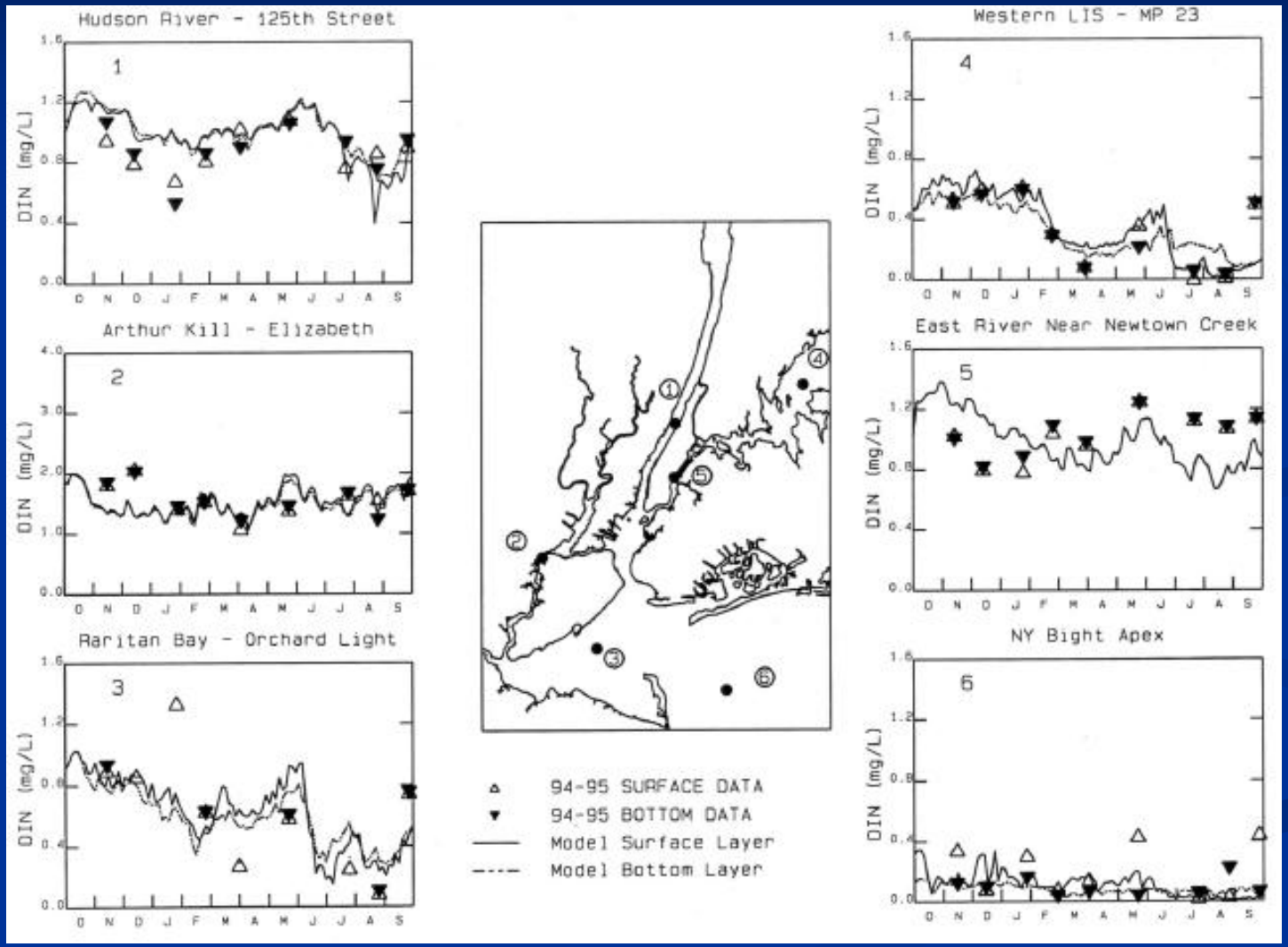
System-Wide Eutrophication Model (SWEM)



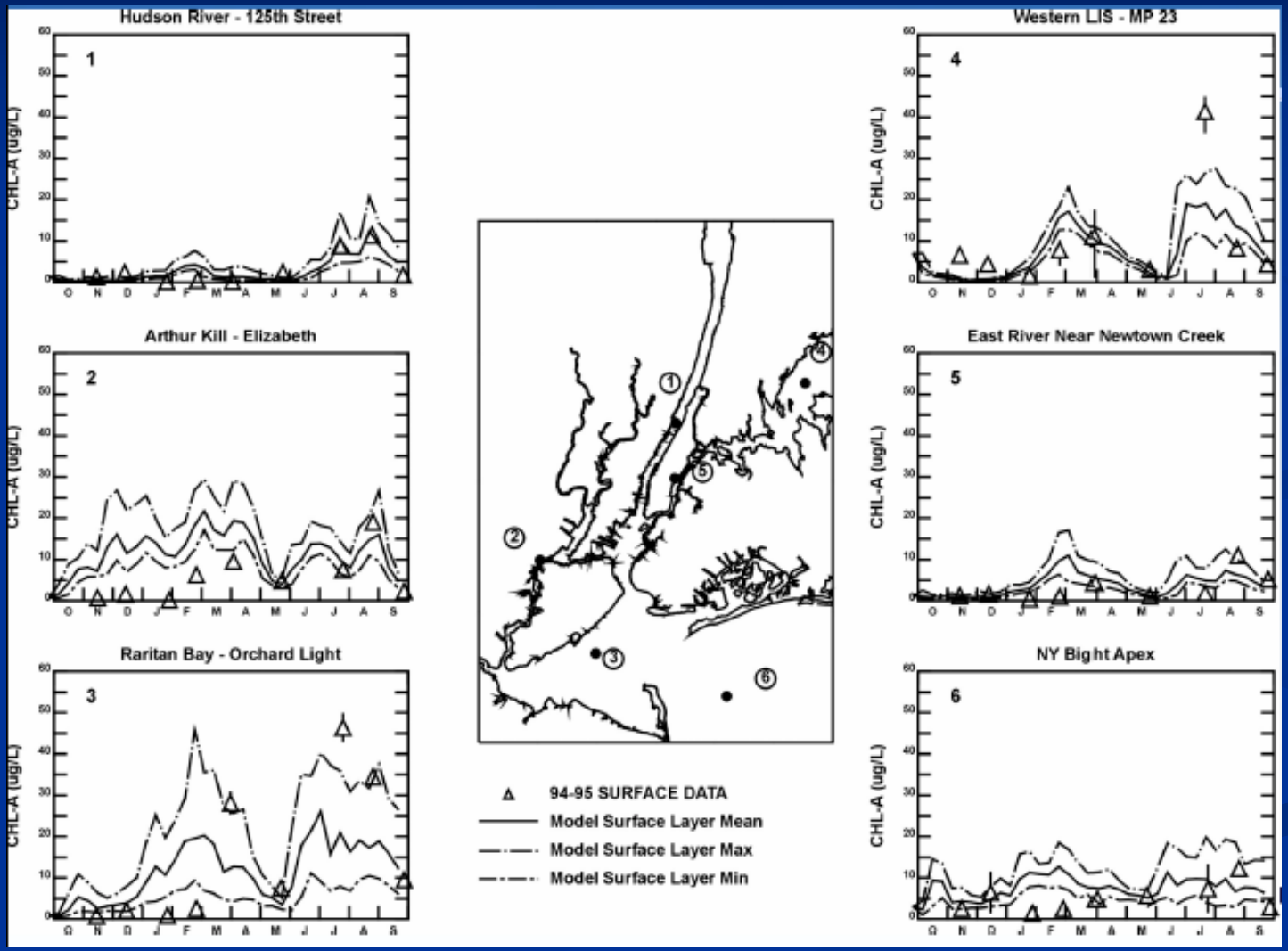
System-Wide Eutrophication Model (SWEM)



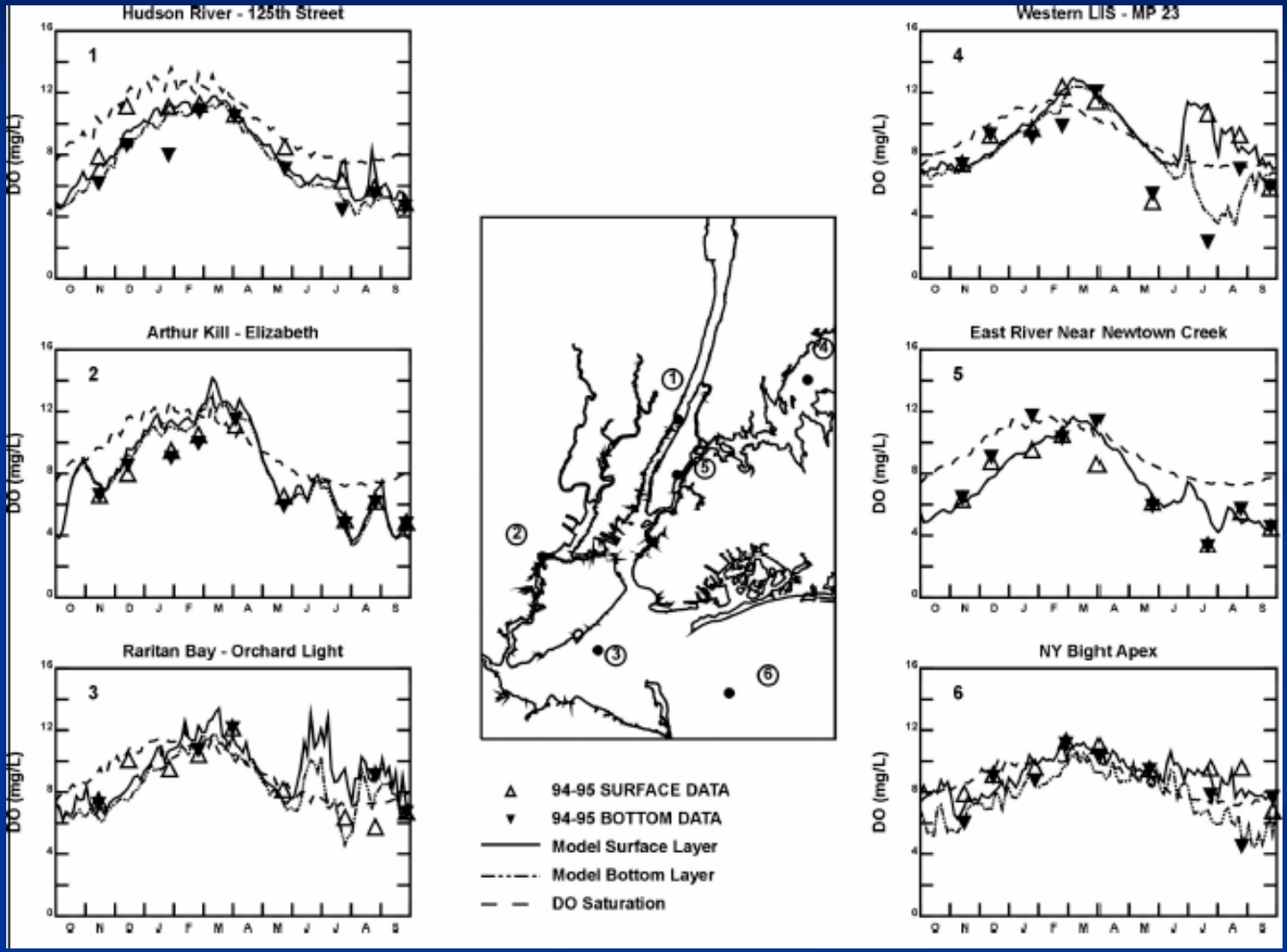
SWEM Temporal Calibration - DIN



SWEM Temporal Calibration – Chl-a



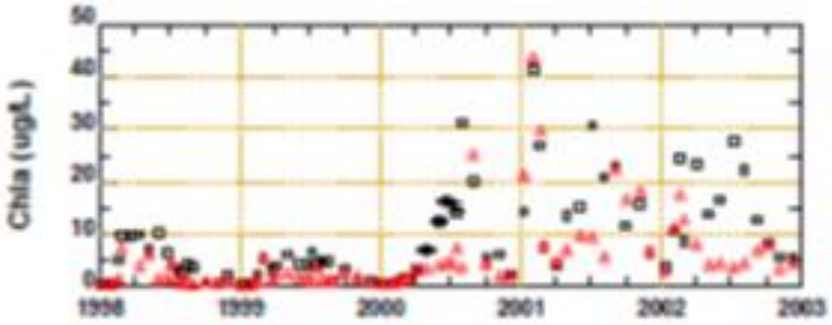
SWEM Temporal Calibration - DO



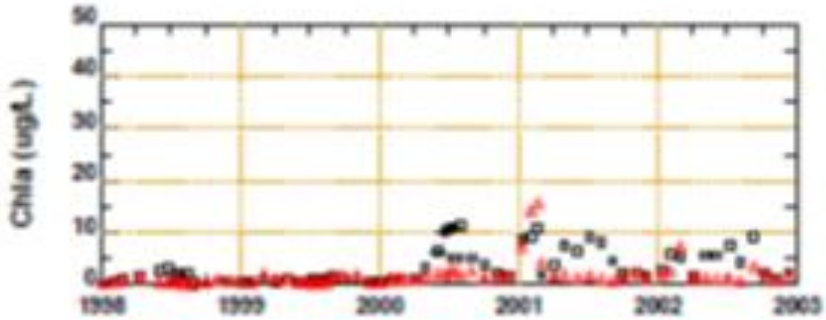
SWEM vs. LIS 3.0

- Expanded geographical domain
- Elimination of internal load effects on boundaries
- Enhanced grid resolution
- Additional calibration data
- Defines interactions between the Sound, the Harbor complex and the Atlantic Ocean

Questions

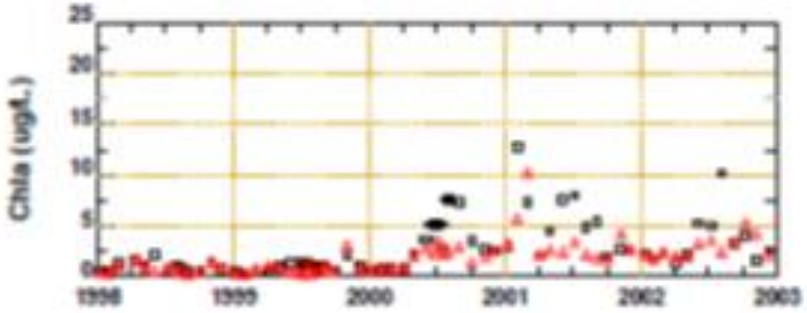

Chla (ug/L)
50
40
30
20
10
0
1998
1999
2000
2001
2002
2003

A4

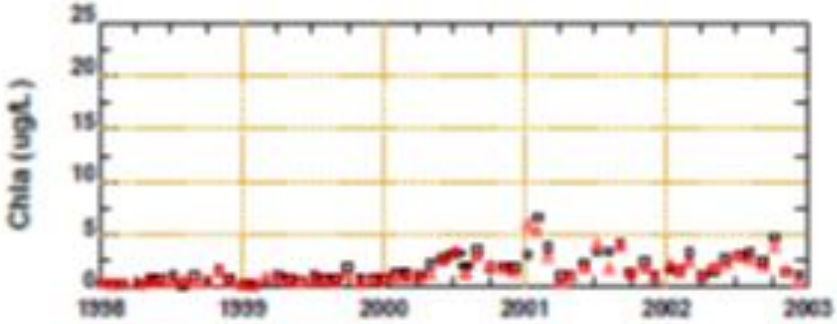

Chla (ug/L)
50
40
30
20
10
0
1998
1999
2000
2001
2002
2003

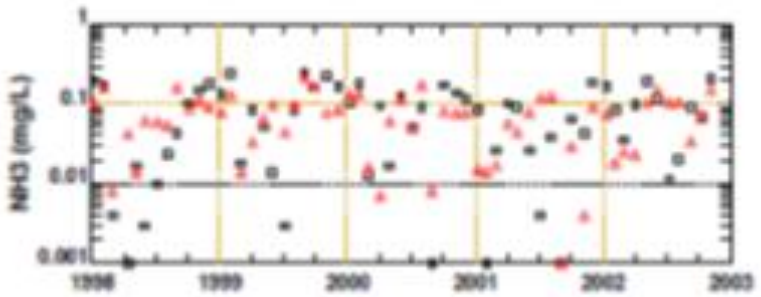
E1

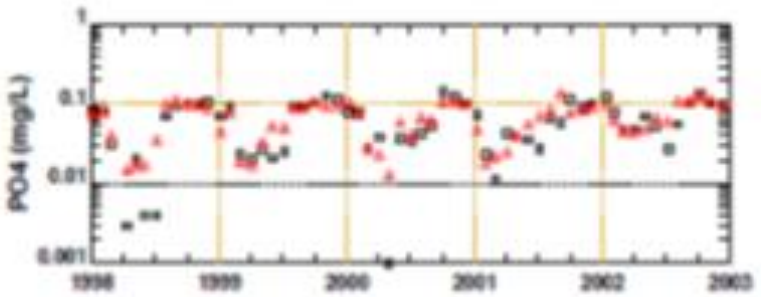
I2

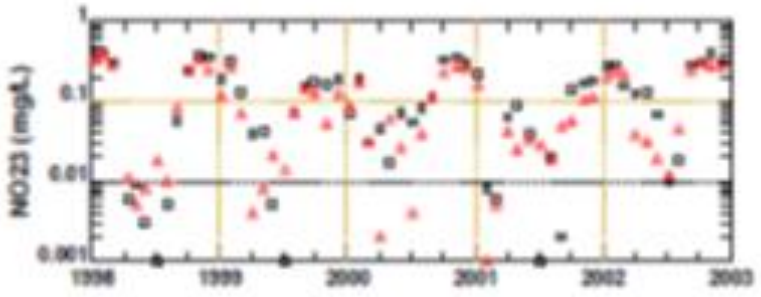

Chla (ug/L)
25
20
15
10
5
0
1998
1999
2000
2001
2002
2003

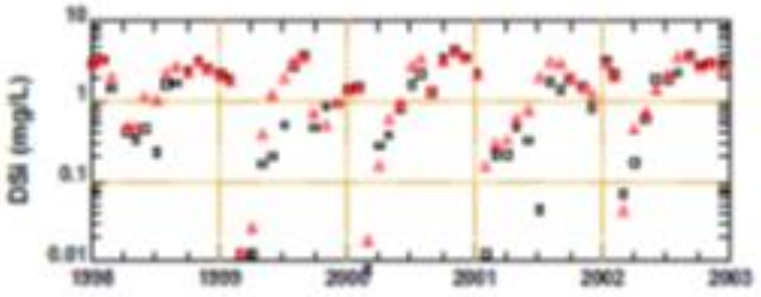
M3


Chla (ug/L)
25
20
15
10
5
0
1998
1999
2000
2001
2002
2003

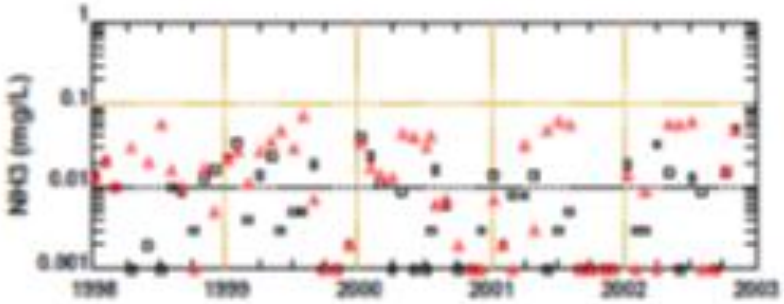

NH3 (mg/L)
1
0.1
0.01
0.001
1998
1999
2000
2001
2002
2003

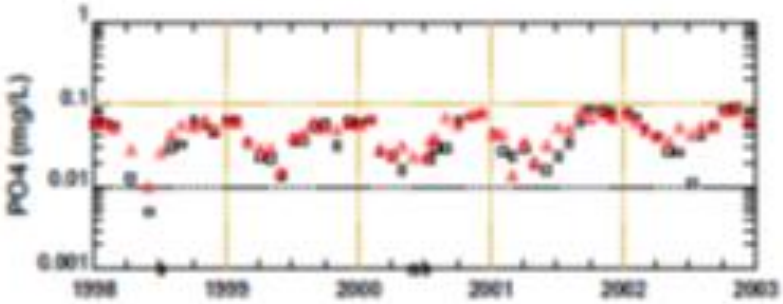

PO4 (mg/L)
1
0.1
0.01
0.001
1998
1999
2000
2001
2002
2003

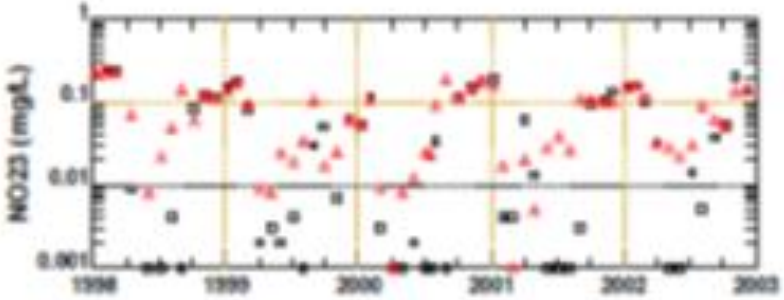

NO23 (mg/L)
1
0.1
0.01
0.001
1998
1999
2000
2001
2002
2003

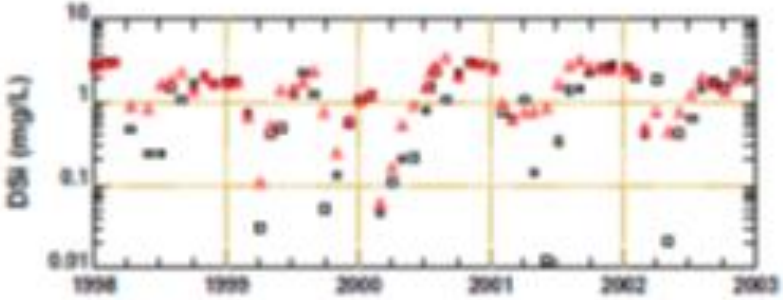

DSi (mg/L)
10
1
0.1
0.01
1998
1999
2000
2001
2002
2003

A4

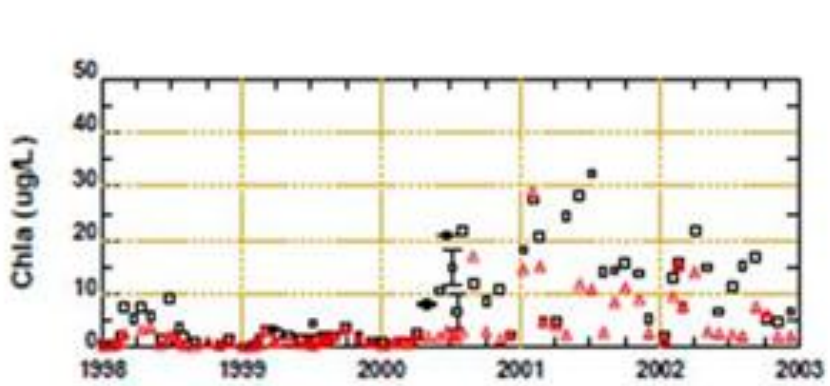

NH3 (mg/L)
1
0.1
0.01
0.001
1998
1999
2000
2001
2002
2003

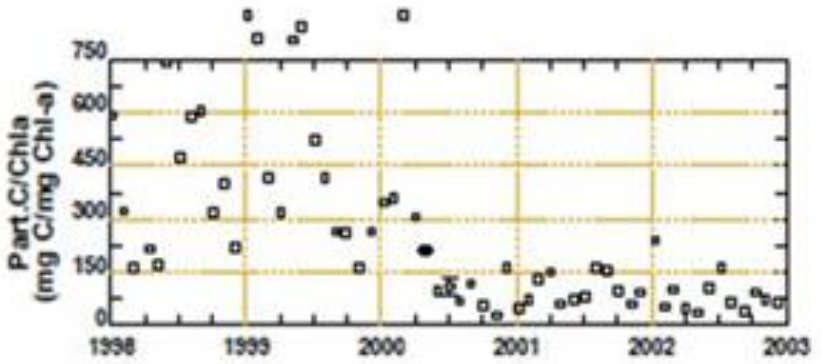

PO4 (mg/L)
1
0.1
0.01
0.001
1998
1999
2000
2001
2002
2003

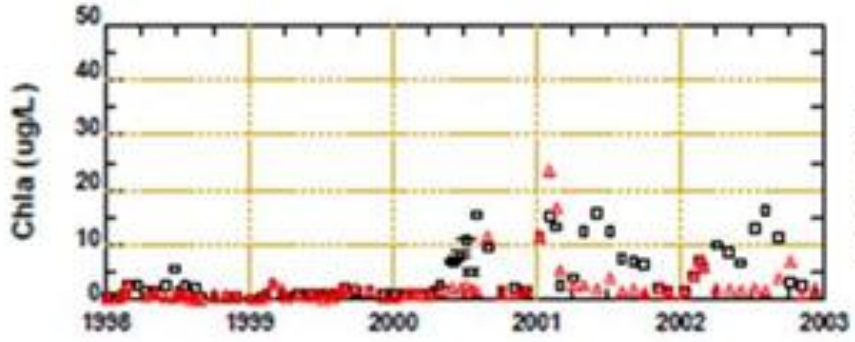

NO23 (mg/L)
1
0.1
0.01
0.001
1998
1999
2000
2001
2002
2003

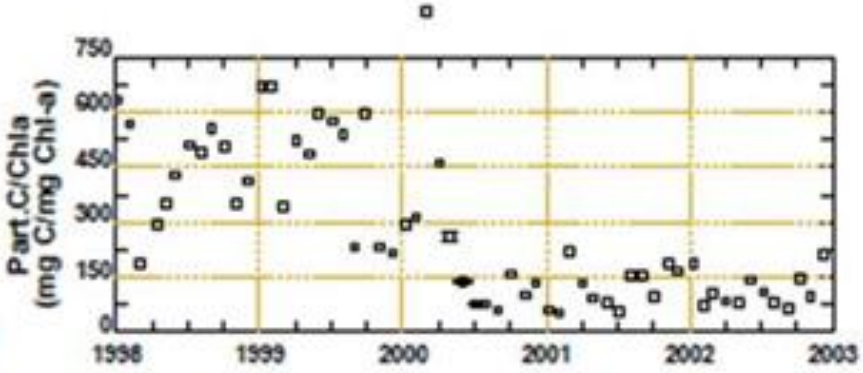

DSi (mg/L)
10
1
0.1
0.01
1998
1999
2000
2001
2002
2003

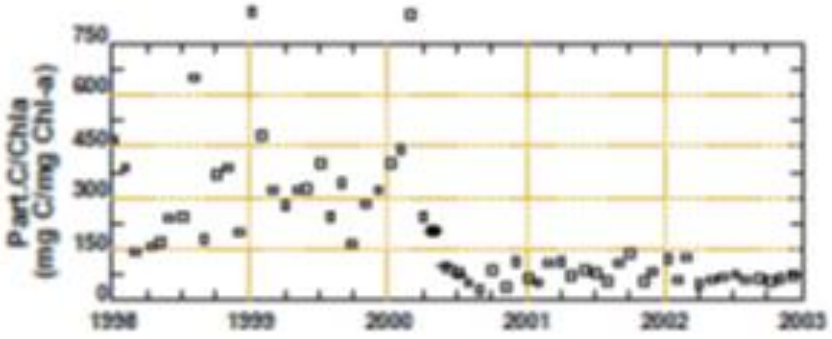
E1


Chla (ug/L)
50
40
30
20
10
0
1998
1999
2000
2001
2002
2003

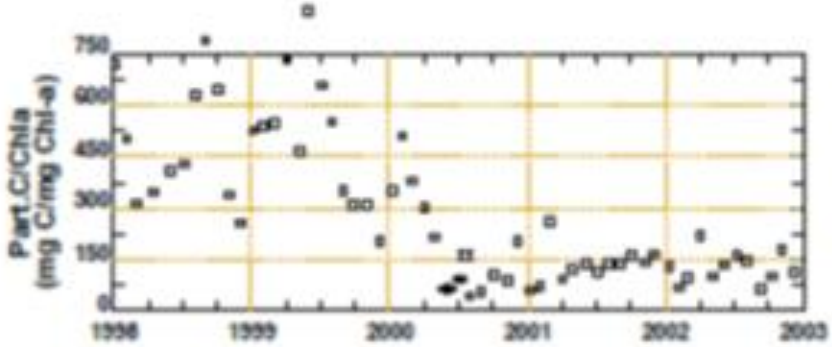

Part.C/Chla
(mg C/mg Chl-a)
750
600
450
300
150
0
1998
1999
2000
2001
2002
2003


Chla (ug/L)
50
40
30
20
10
0
1998
1999
2000
2001
2002
2003


Part.C/Chla
(mg C/mg Chl-a)
750
600
450
300
150
0
1998
1999
2000
2001
2002
2003

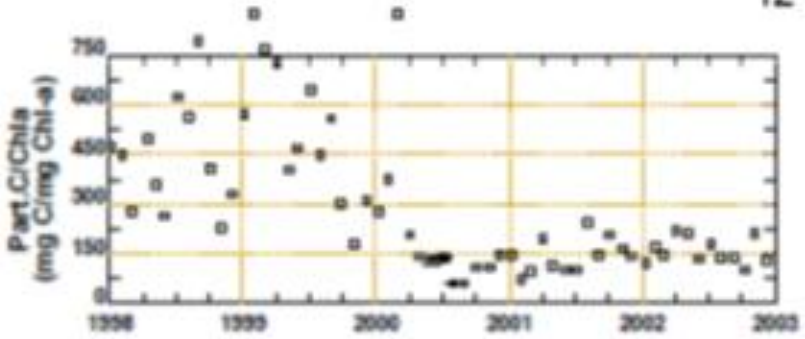

Part.C/Chla
(mg C/mg Chl-a)
750
600
450
300
150
0
1998
1999
2000
2001
2002
2003

A4

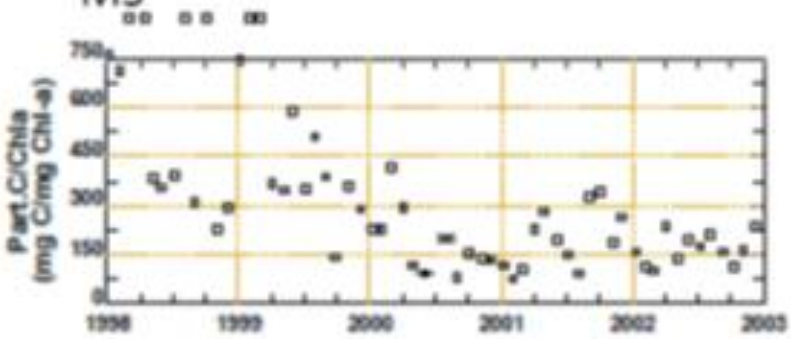

Part.C/Chla
(mg C/mg Chl-a)
750
600
450
300
150
0
1998
1999
2000
2001
2002
2003

E1

I2

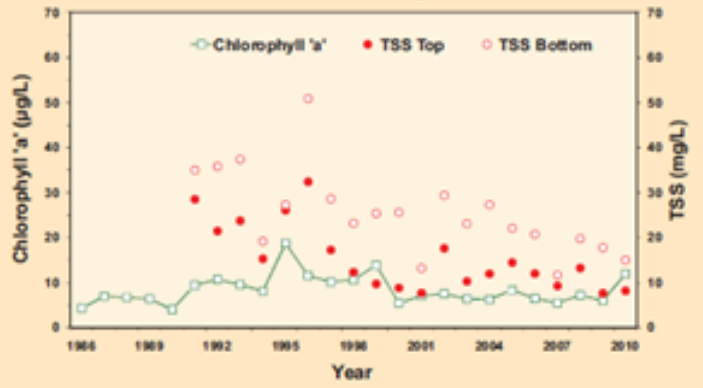

Part.C/Chla
(mg C/mg Chl-a)
750
600
450
300
150
0
1998
1999
2000
2001
2002
2003

M3


Part.C/Chla
(mg C/mg Chl-a)
750
600
450
300
150
0
1998
1999
2000
2001
2002
2003

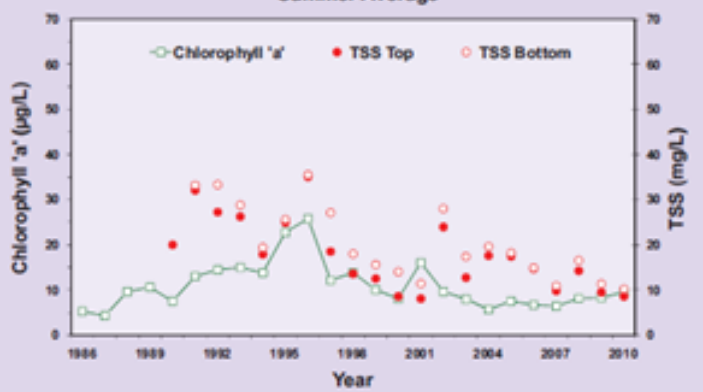
Chlorophyll 'a' and Total Suspended Solids

Inner Harbor Area
Summer Average



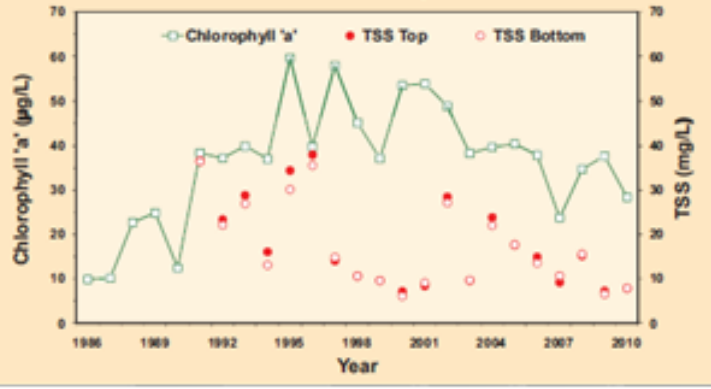
Chlorophyll 'a' and Total Suspended Solids

Upper East River–Western Long Island Sound
Summer Average



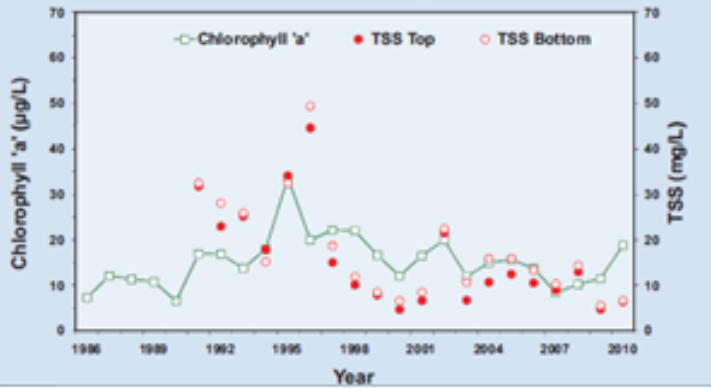
Chlorophyll 'a' and Total Suspended Solids

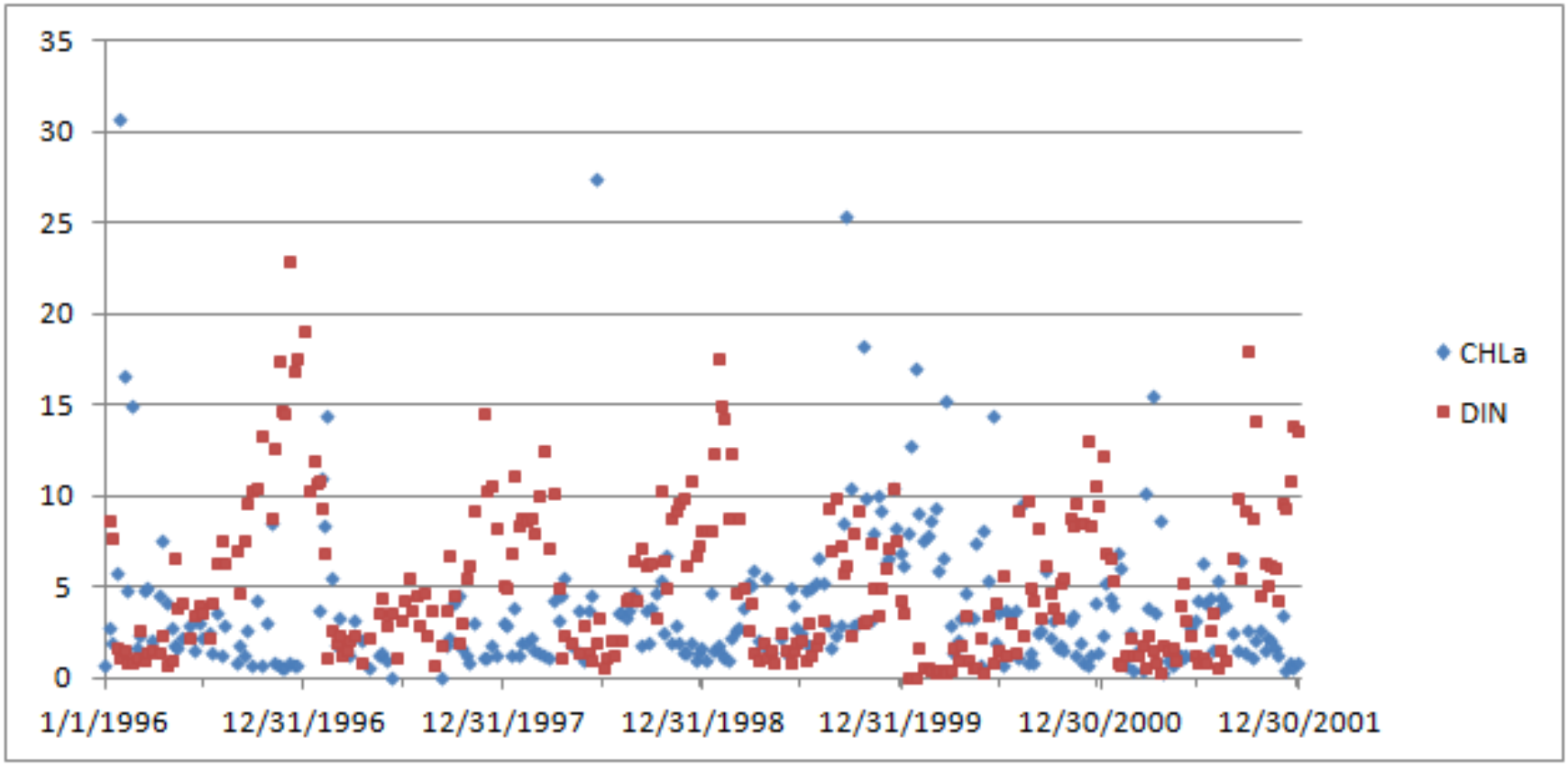
Jamaica Bay
Summer Average

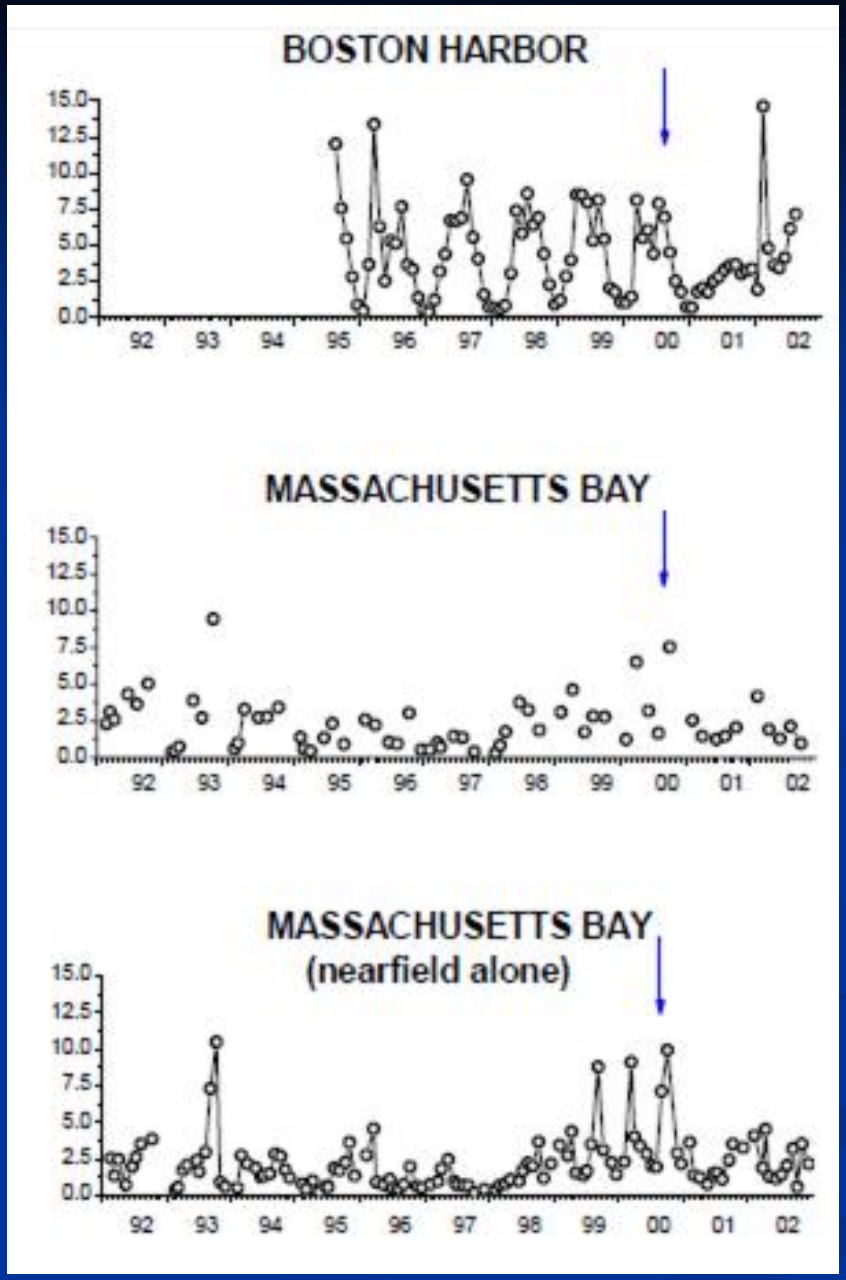


Chlorophyll 'a' and Total Suspended Solids

Lower New York Bay–Raritan Bay
Summer Average

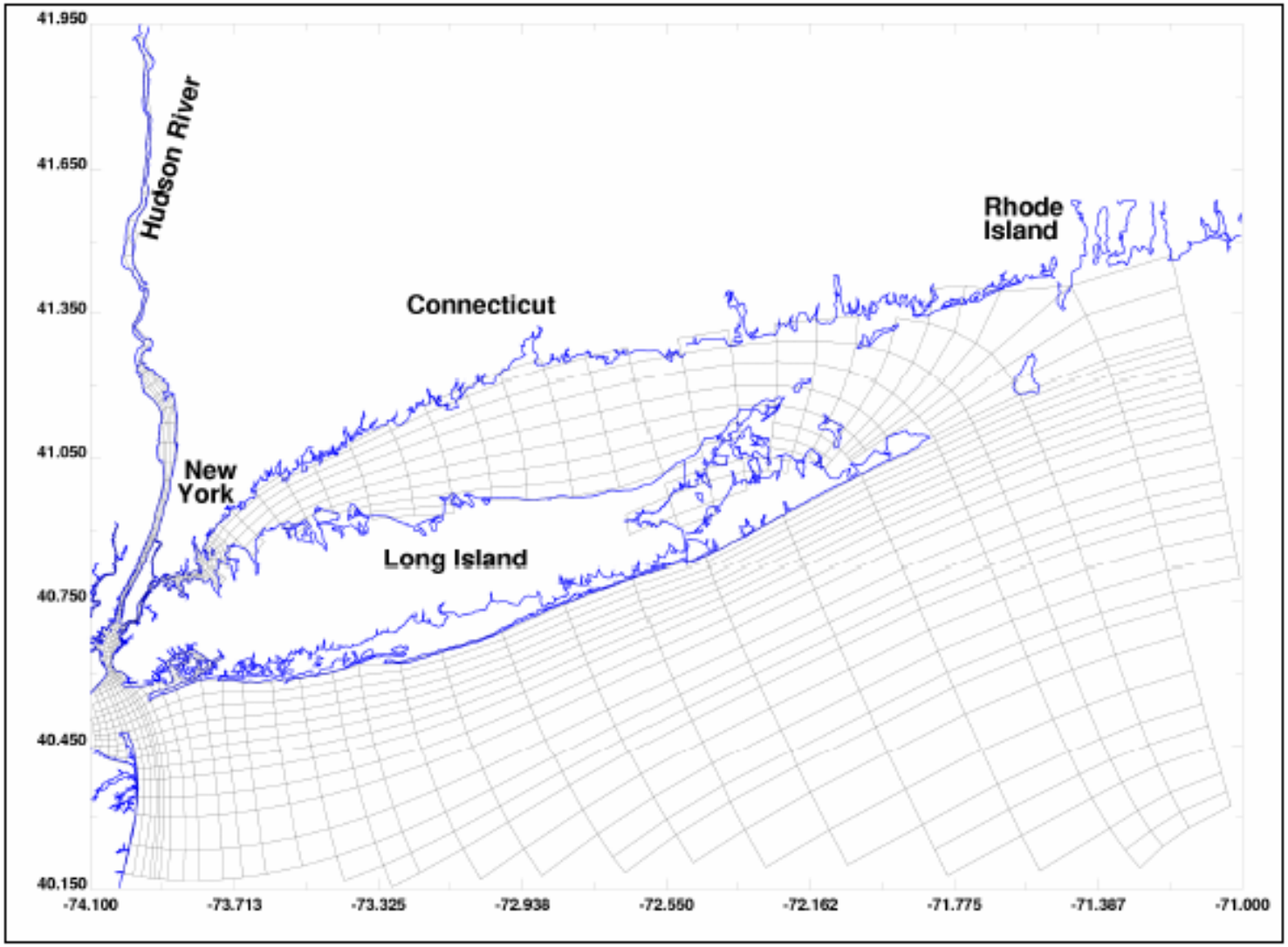



35
30
25
20
15
10
5
0
1/1/1996
12/31/1996
12/31/1997
12/31/1998
12/31/1999
12/30/2000
12/30/2001
CHLa
DIN


BOSTON HARBOR
15.0
12.5
10.0
7.5
5.0
2.5
0.0
92 93 94 95 96 97 98 99 00 01 02
MASSACHUSETTS BAY
15.0
12.5
10.0
7.5
5.0
2.5
0.0
92 93 94 95 96 97 98 99 00 01 02
MASSACHUSETTS BAY
(nearfield alone)
15.0
12.5
10.0
7.5
5.0
2.5
0.0
92 93 94 95 96 97 98 99 00 01 02

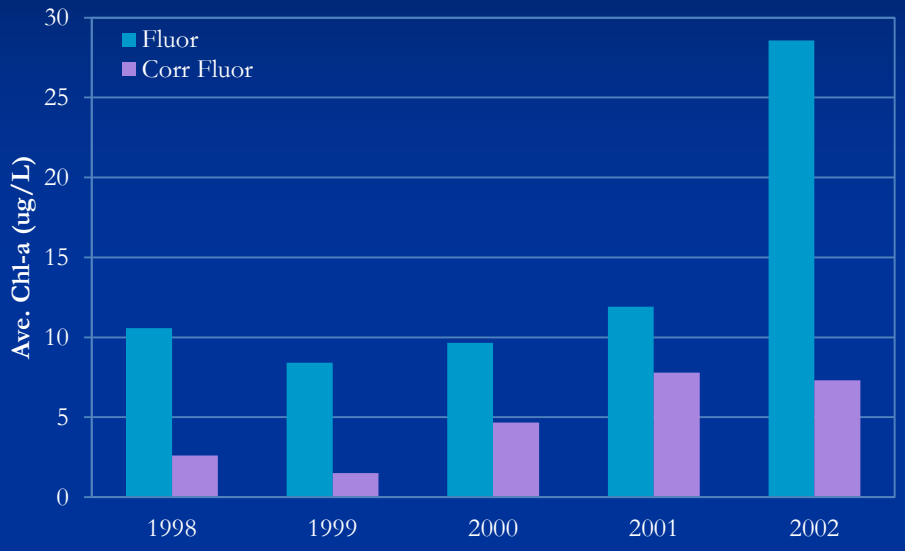
Year	Winter/ Spring	Summer	Fall	Annual
1992	60	60	84	67
1993	39	60	136	77
1994	71	55	90	71
1995	36	27	85	50
1996	90	28	46	53
1997	49	38	41	43
1998	25	52	70	52
1999	149	62	170	126
2000	193	87	**212**	156
2001	**70**	**45**	**87**	**67**
2002	**112**	**50**	**96**	**80**
2003	**178**	**45**	**87**	**99**
2004	**101**	**61**	**44**	**69**
2005	**133**	**61**	**43**	**79**
2006	**129**	**89**	**94**	**104**
2007	**128**	**55**	**65**	**83**
Caution Threshold	238	93	212	118
Baseline Mean*	82	51	90	67
Post-diversion Mean*	**122**	**58**	**91**	**83**

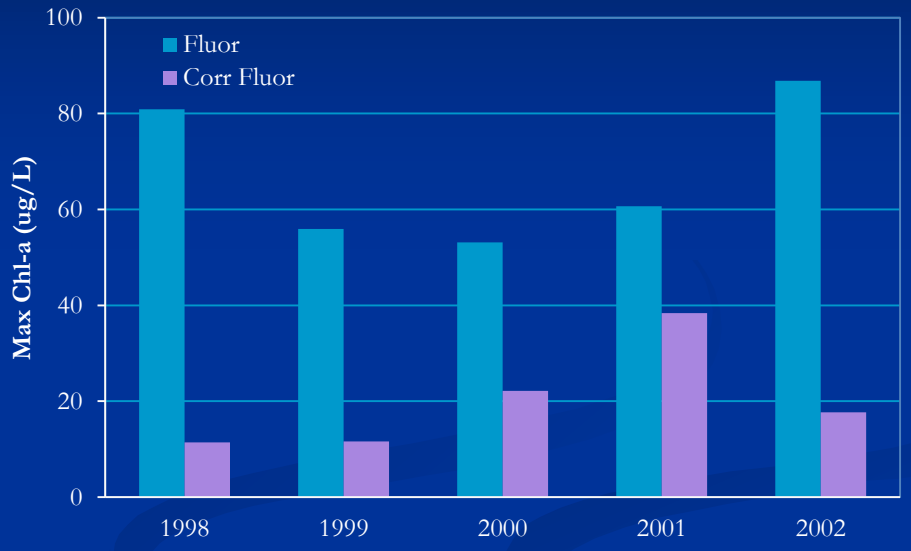
*Bay Outfall began discharging September 6, 2000. Post-diversion data are in bold and shaded. Data from 2000 are included in baseline for winter/spring and summer means, in post-diversion fall mean, and not used in annual mean comparison.

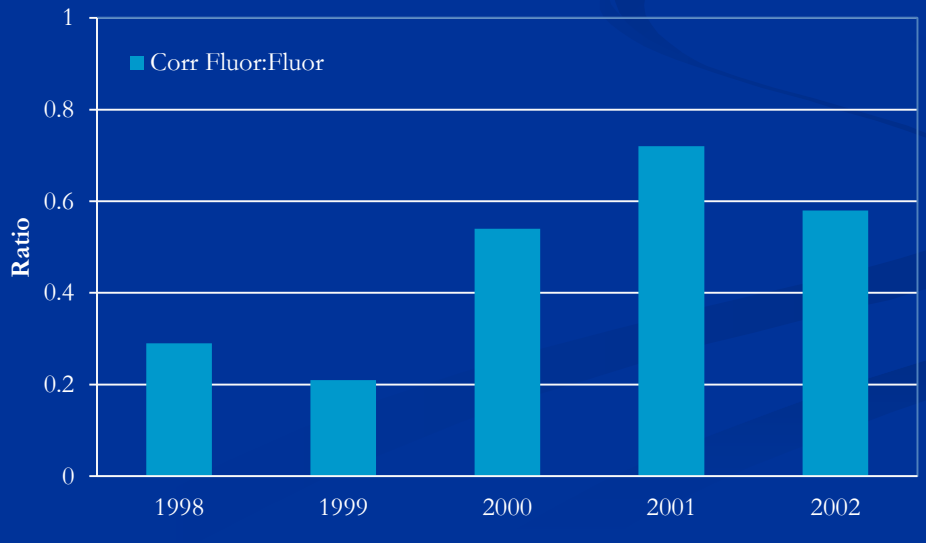

41.950
41.650
41.350
41.050
40.750
40.450
40.150
-74.100
-73.713
-73.325
-72.938
-72.550
-72.162
-71.775
-71.387
-71.000
Hudson River
Rhode Island
Connecticut
New York
Long Island

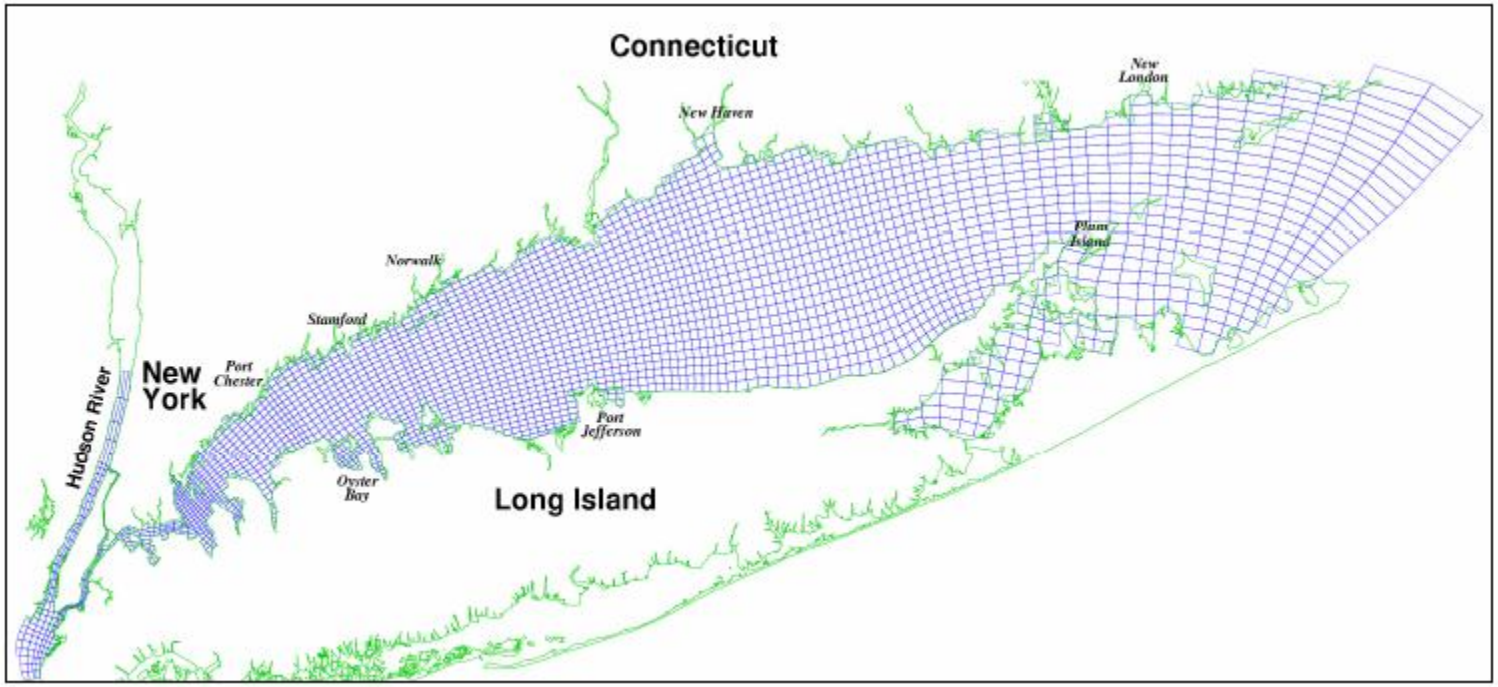
(b)

Fluorometric vs. Corrected Fluorometric Chlorophyll Data








Connecticut
New London
New Haven
Plum Island
Norwalk
Stamford
New York
Port Chester
Hudson River
Port Jefferson
Oyster Bay
Long Island