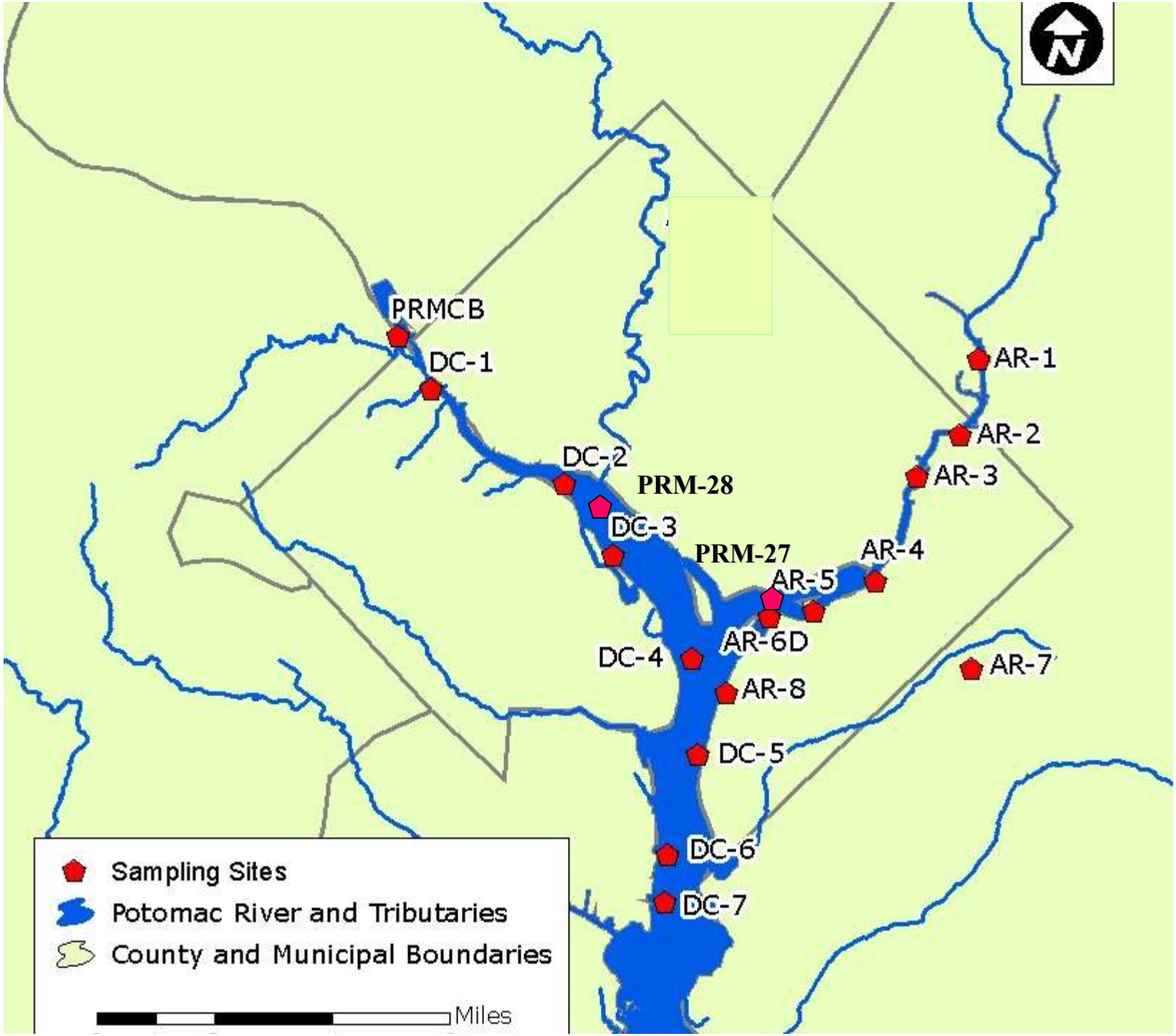
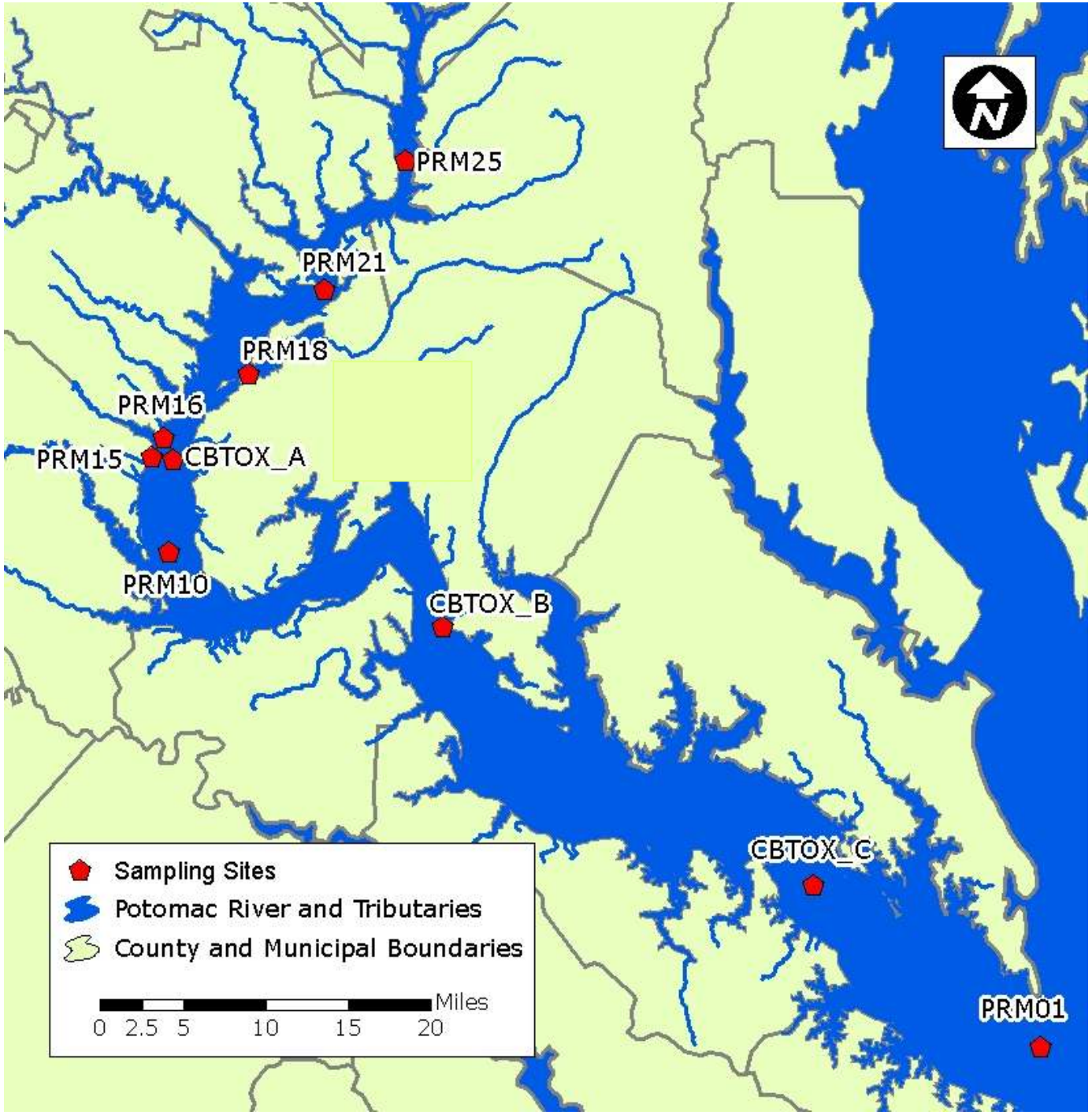
PCBs in the Potomac River Water Column


PRMCB
DC-1
DC-2
PRM-28
DC-3
PRM-27
AR-1
AR-2
AR-3
AR-4
AR-5
AR-6D
DC-4
AR-7
AR-8
DC-5
DC-6
DC-7
Sampling Sites
Potomac River and Tributaries
County and Municipal Boundaries
Miles


PRM25
PRM21
PRM18
PRM16
PRM15
CBTOX_A
PRM10
CBTOX_B
CBTOX_C
PRM01
Sampling Sites
Potomac River and Tributaries
County and Municipal Boundaries
Miles
0 2.5 5 10 15 20

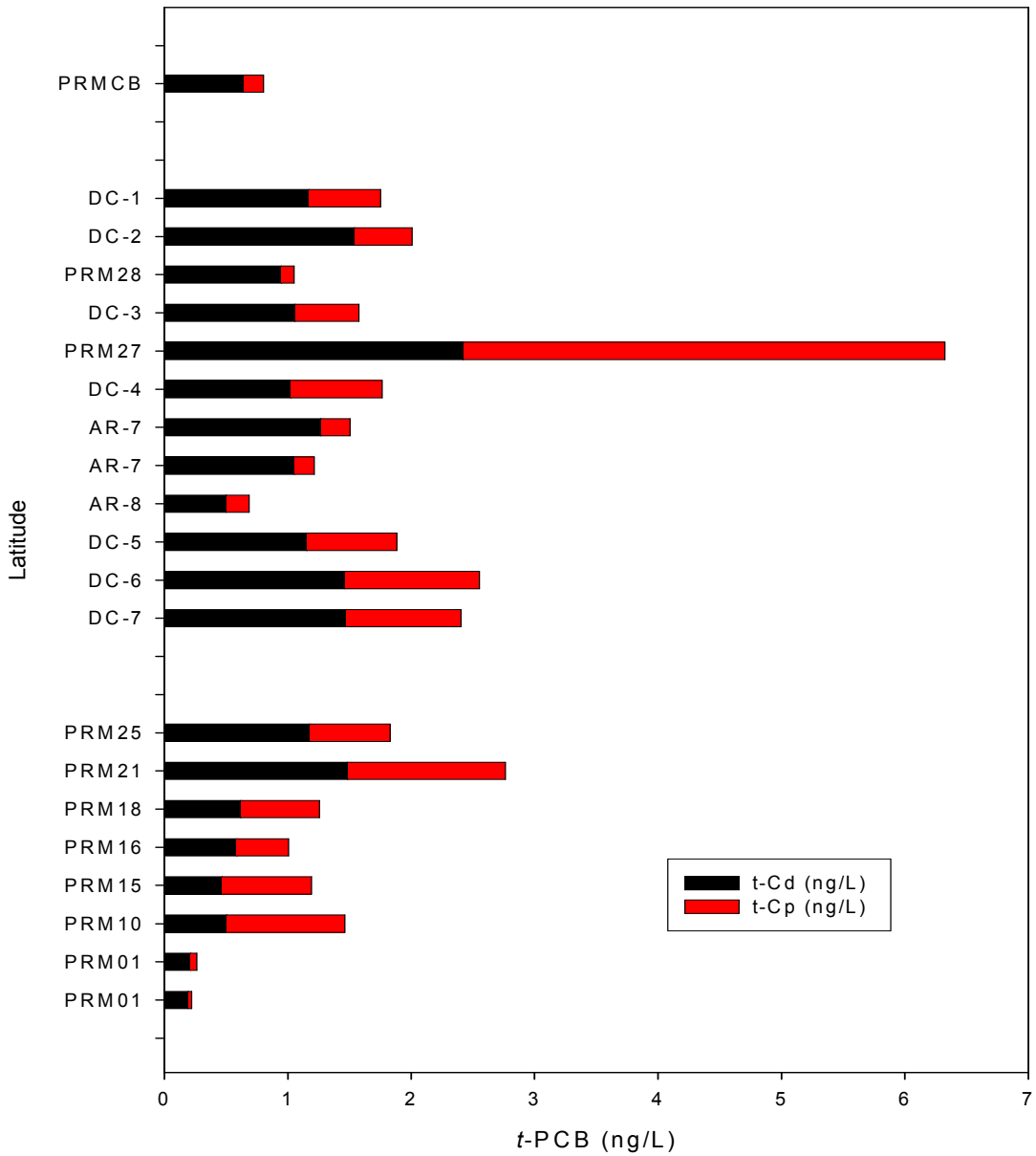
Particulate and dissolved PCBs isolated by filtration through GFF and XAD-2 resin

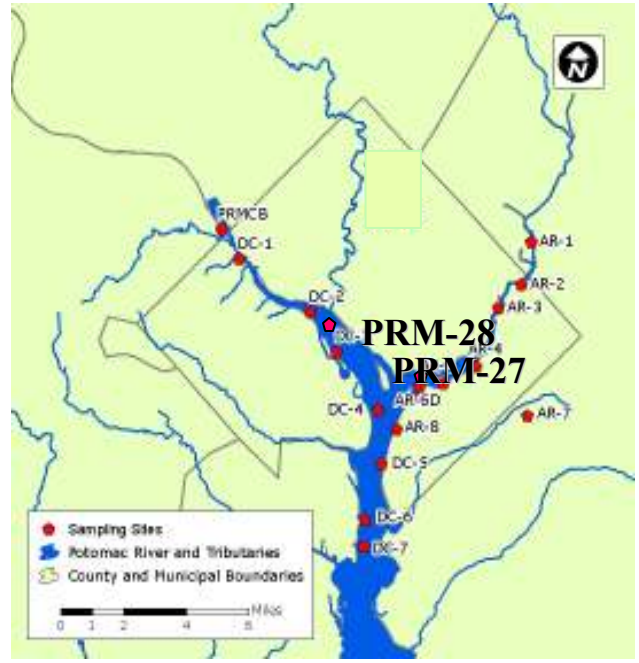
40-90 L sampled at 200 mL/min (ca. 4 hours/sample)

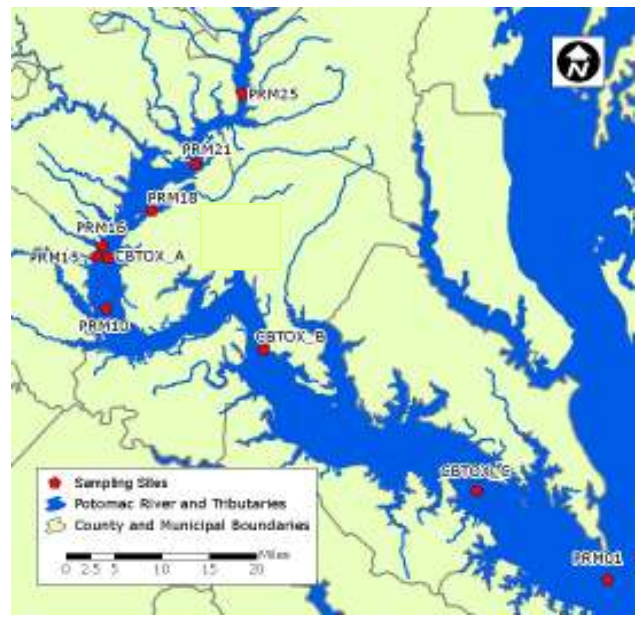
All sample processing done in Class 100 clean room

Analysis by capillary gas chromatography with electron capture detection; 60 m DB-5 column. 85 PCB peaks.

$$\text{MDL} = \frac{3\text{x mass in field blank}}{\text{sample volume}}$$



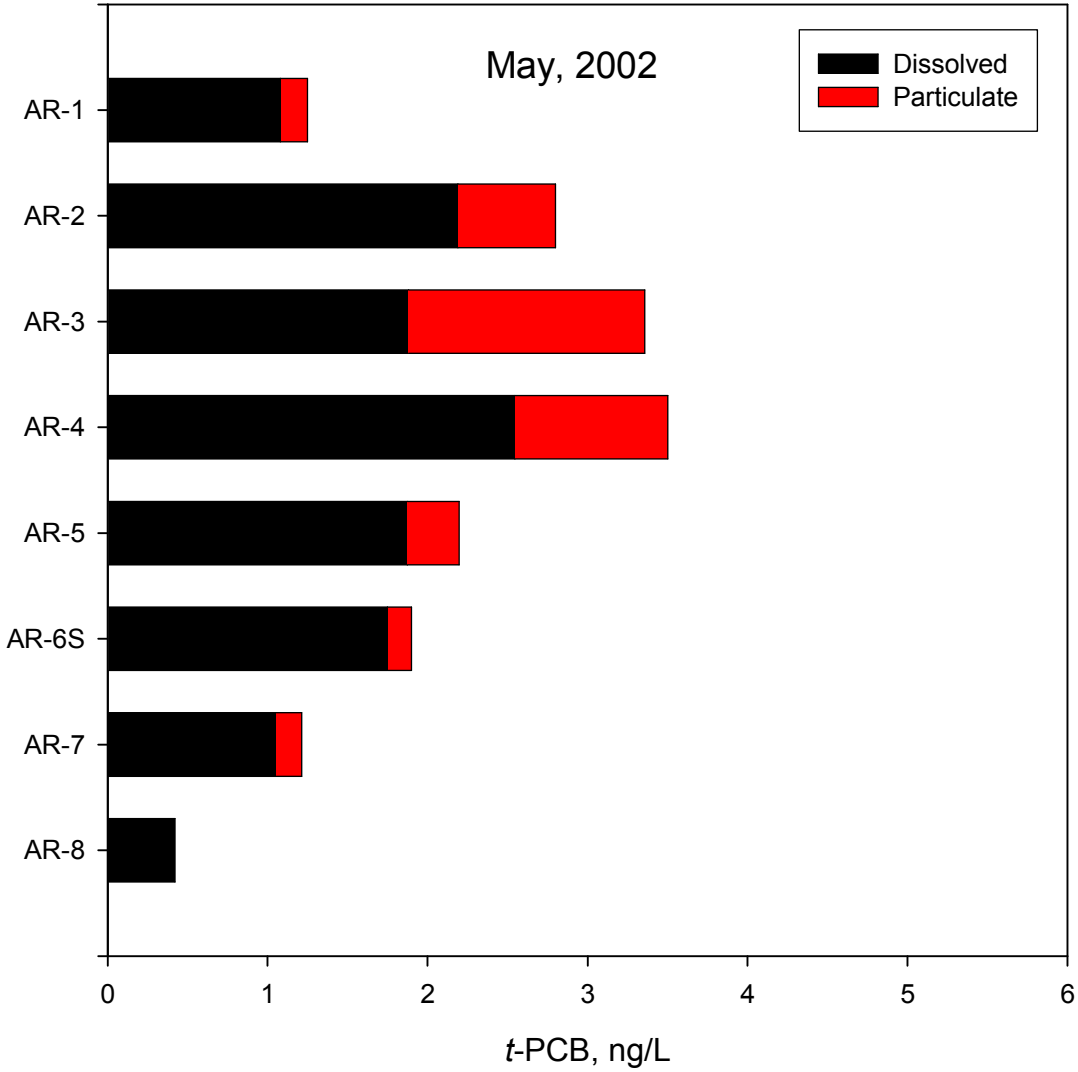


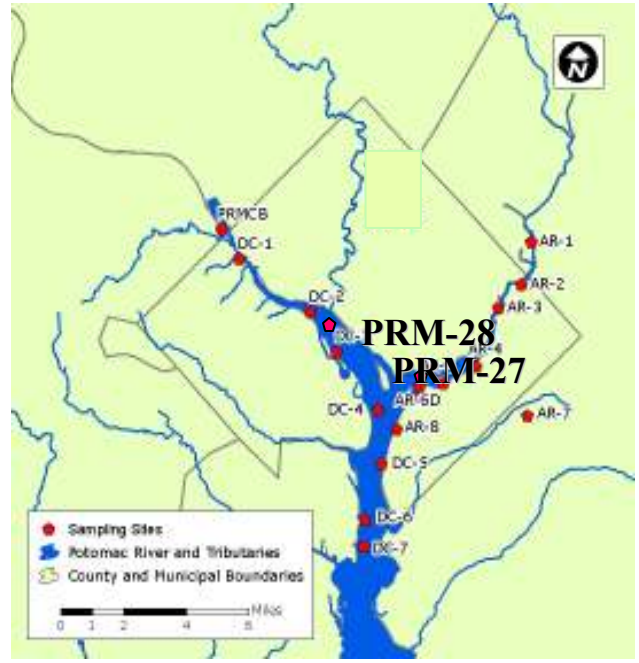


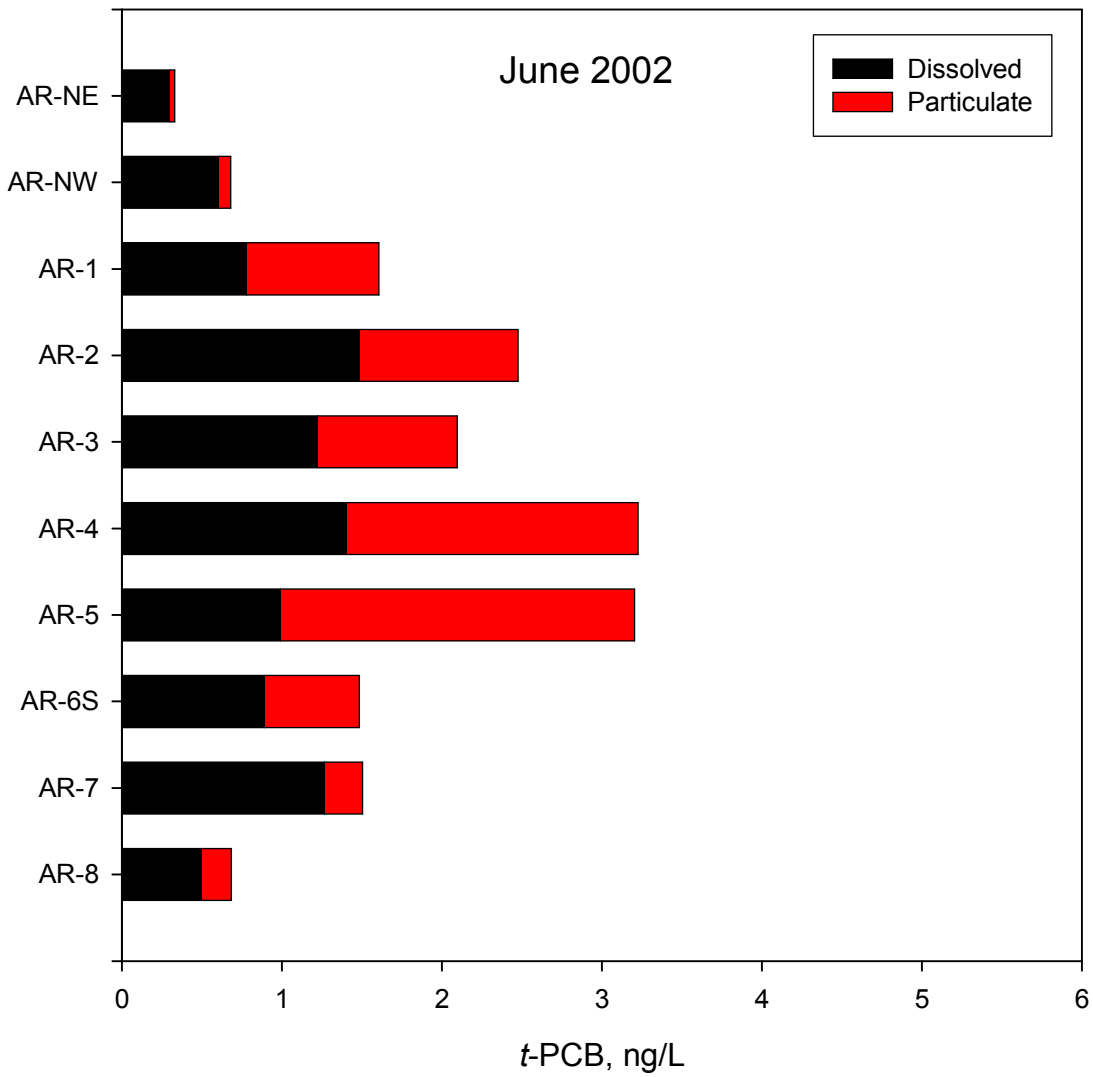
PRM: University of Maryland, 2005
DC: PERC/ANS, 2005
AR: GMU, 2002

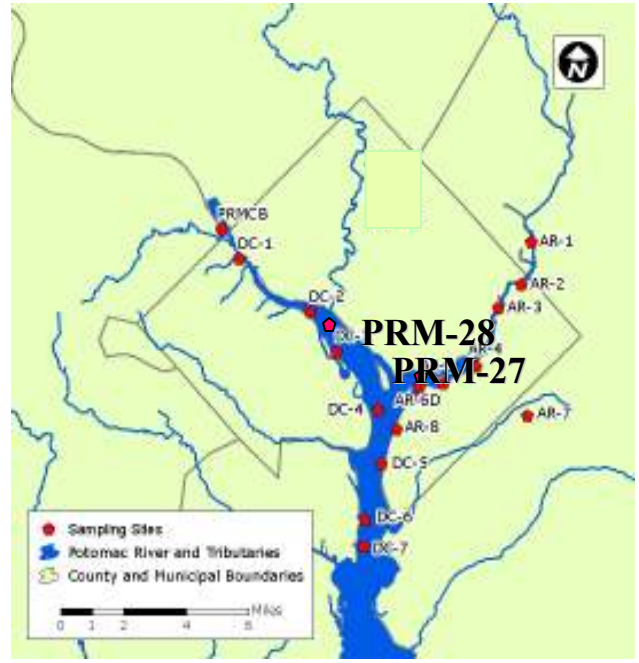
Anacostia River Stormwater Study 2002

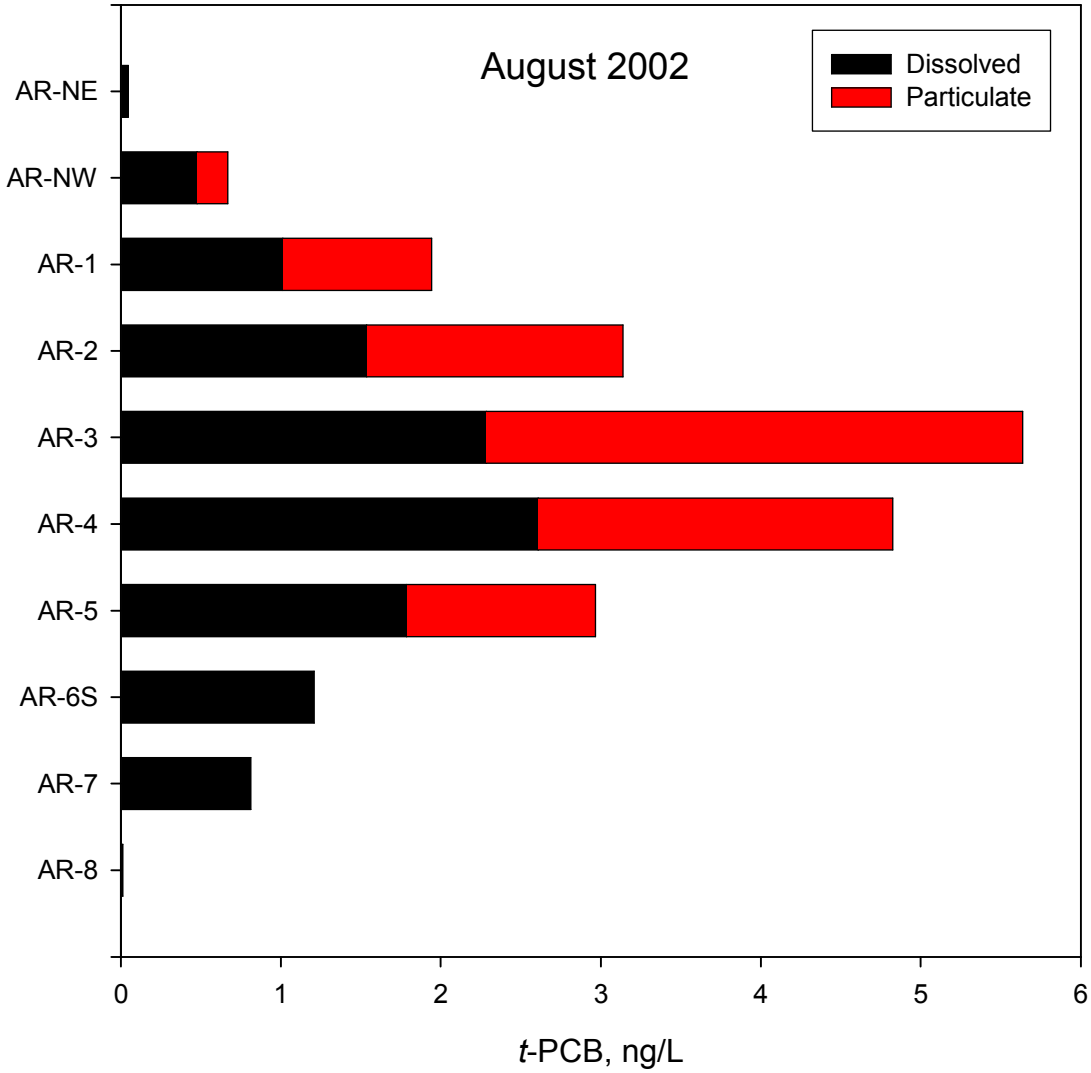
G. Foster
D. Velinsky
J. Ashley
G. Reidel

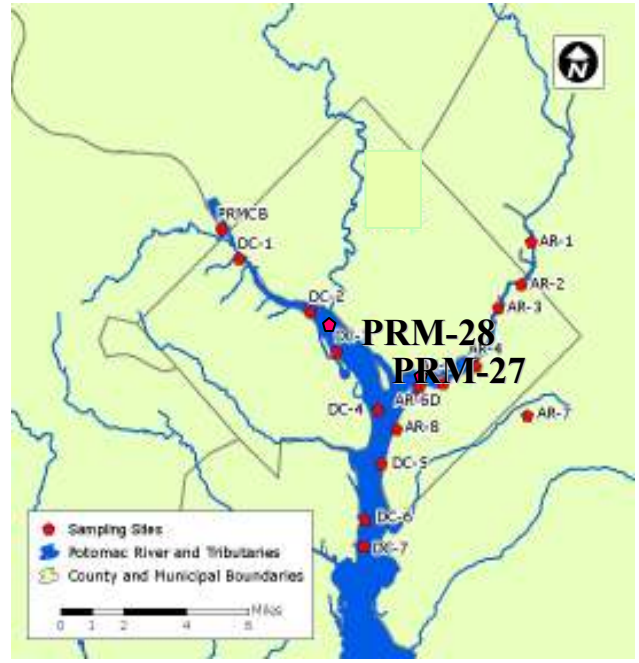

May, 2002
Dissolved
Particulate
AR-1
AR-2
AR-3
AR-4
AR-5
AR-6S
AR-7
AR-8
0
1
2
3
4
5
6
t-PCB, ng/L

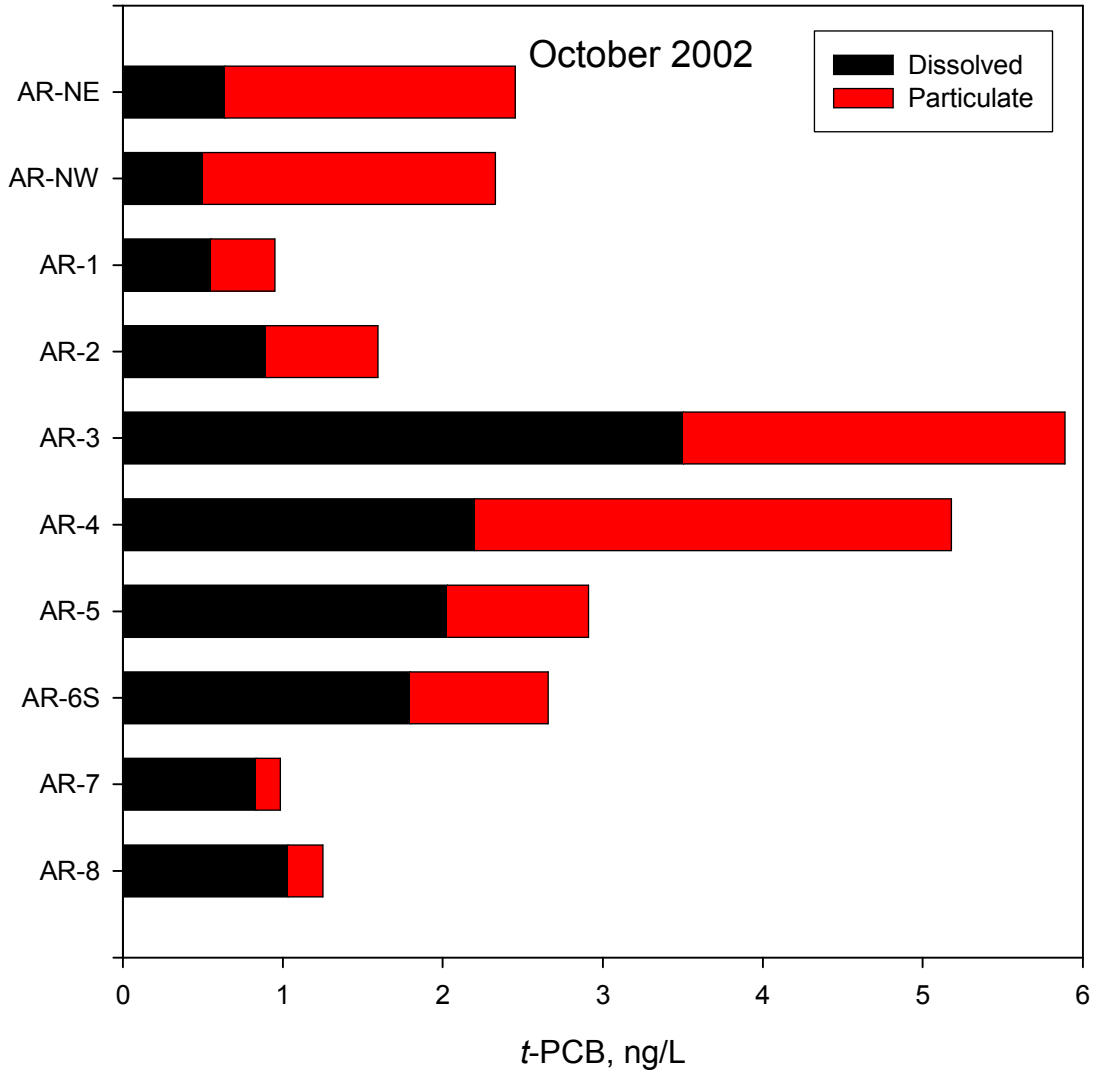

PRM-28
PRM-27
PRMCB
DC-1
DC-2
DC-4
DC-5
DC-6
DC-7
AR-1
AR-2
AR-3
AR-4
AR-6D
AR-8
AR-7
Sampling Sites
Potomac River and Tributaries
County and Municipal Boundaries

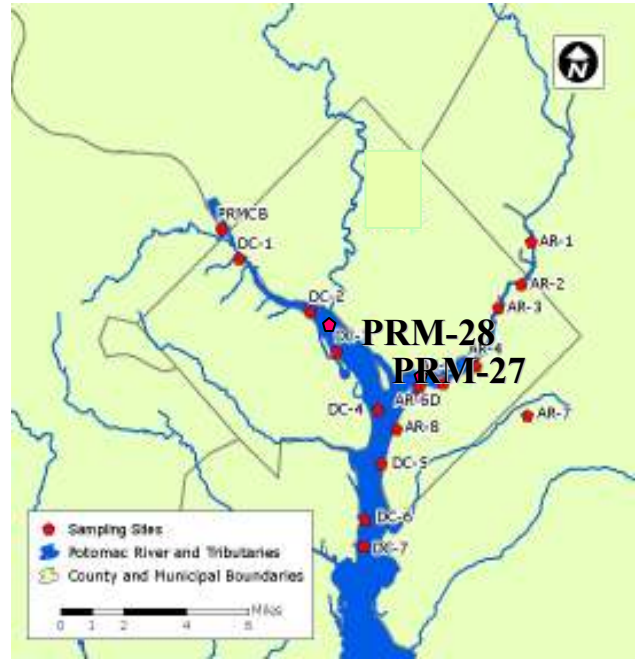

June 2002
Dissolved
Particulate
AR-NE
AR-NW
AR-1
AR-2
AR-3
AR-4
AR-5
AR-6S
AR-7
AR-8
0
1
2
3
4
5
6
t-PCB, ng/L


PRM-28
PRM-27
PRMCB
DC-1
DC-2
DC-4
DC-5
DC-6
DC-7
AR-1
AR-2
AR-3
AR-4
AR-6D
AR-7
AR-8
Sampling Sites
Potomac River and Tributaries
County and Municipal Boundaries


August 2002
Dissolved
Particulate
AR-NE
AR-NW
AR-1
AR-2
AR-3
AR-4
AR-5
AR-6S
AR-7
AR-8
0
1
2
3
4
5
6
t-PCB, ng/L

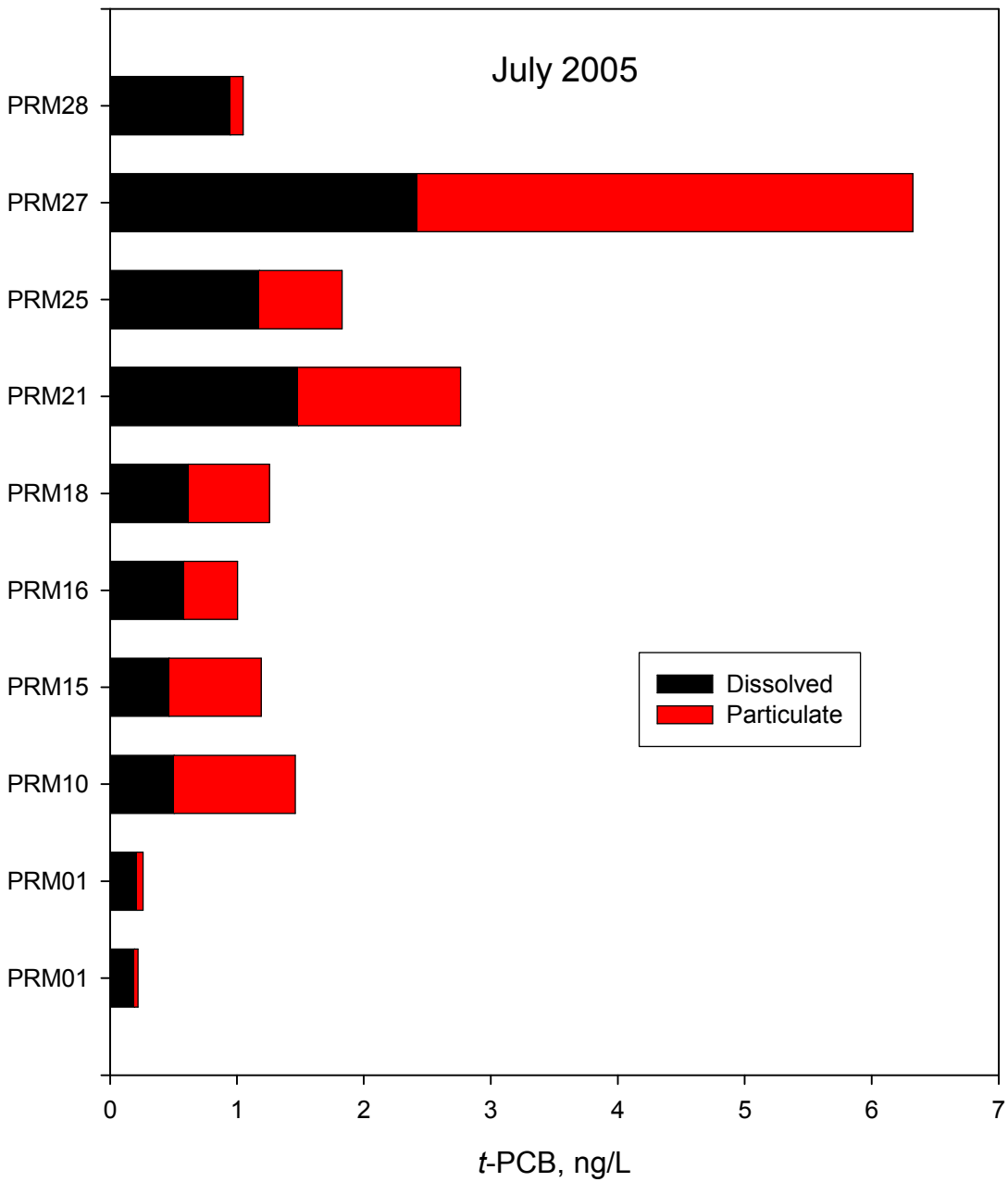

PRM-28
PRM-27
PRMCB
DC-1
DC-2
DC-4
DC-5
DC-6
DC-7
AR-1
AR-2
AR-3
AR-4
AR-6D
AR-7
AR-8
Sampling Sites
Potomac River and Tributaries
County and Municipal Boundaries
Miles
0 1 2 4 6

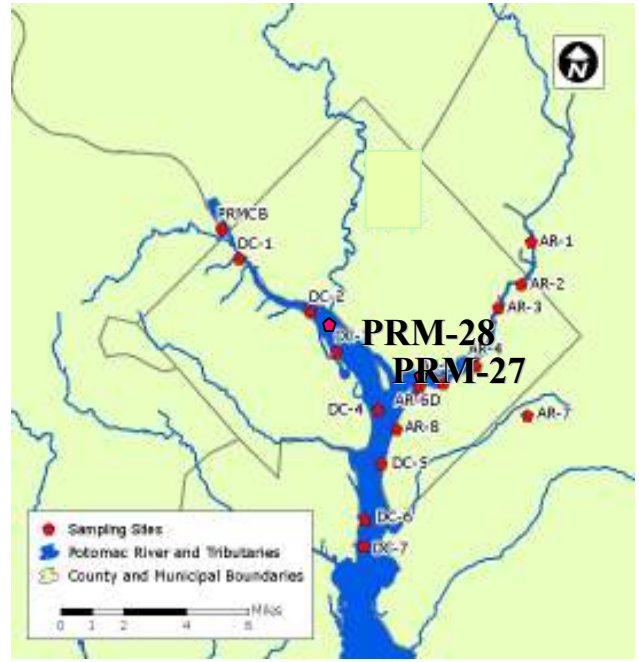

October 2002
Dissolved
Particulate
AR-NE
AR-NW
AR-1
AR-2
AR-3
AR-4
AR-5
AR-6S
AR-7
AR-8
0
1
2
3
4
5
6
t-PCB, ng/L

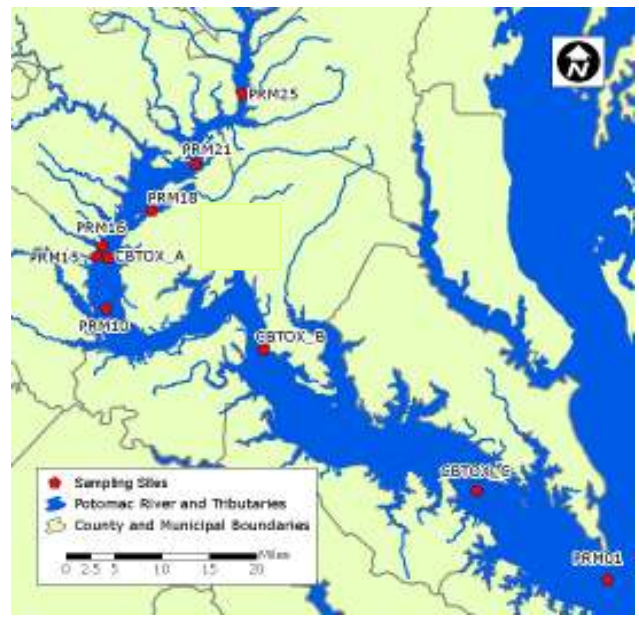

PRM-28
PRM-27
PRMCB
DC-1
DC-2
DC-4
DC-5
DC-6
DC-7
AR-1
AR-2
AR-3
AR-4
AR-6D
AR-7
AR-8
Sampling Sites
Potomac River and Tributaries
County and Municipal Boundaries
Miles
0 1 2 4 6

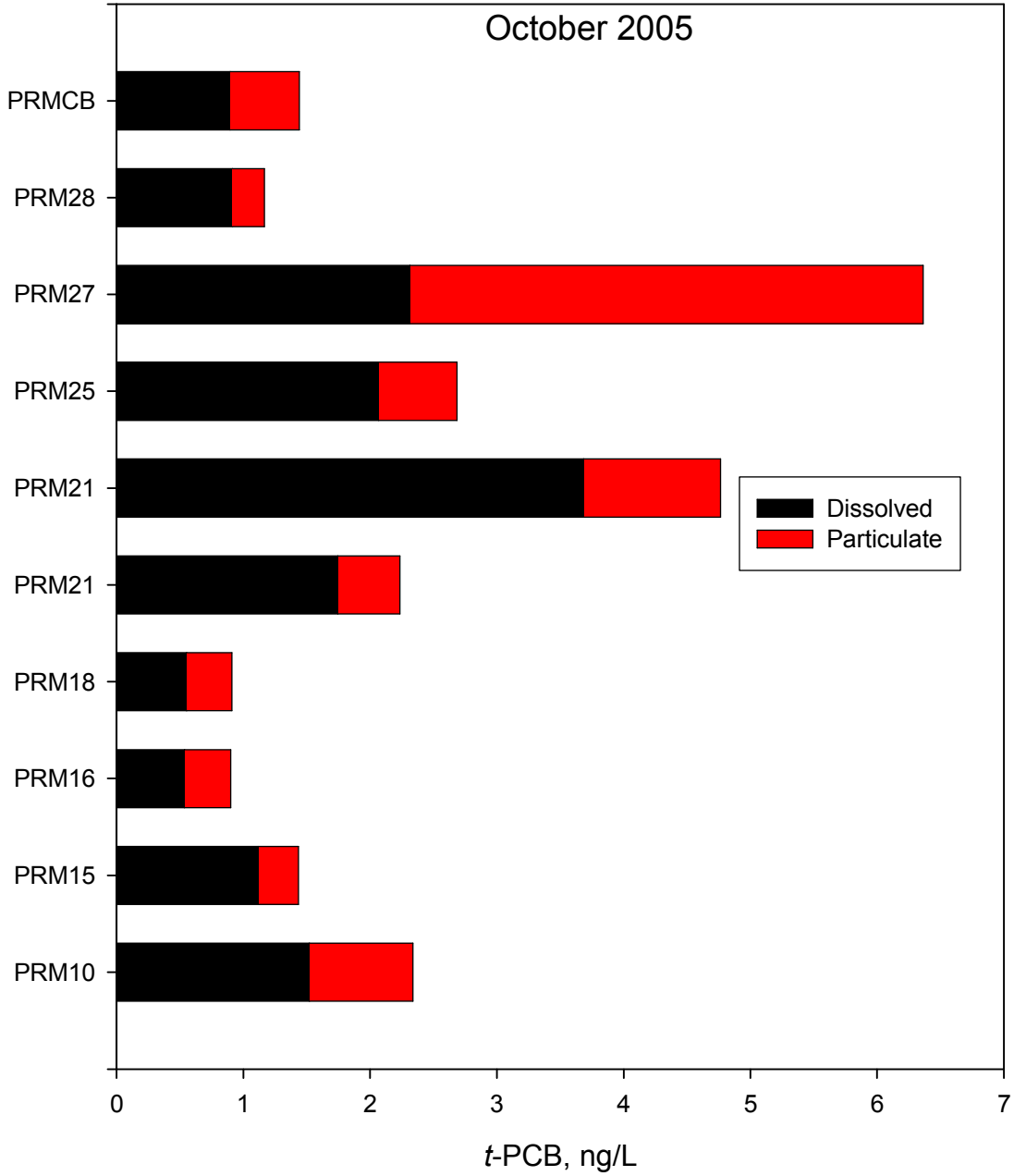
Potomac River Toxics Study 2005

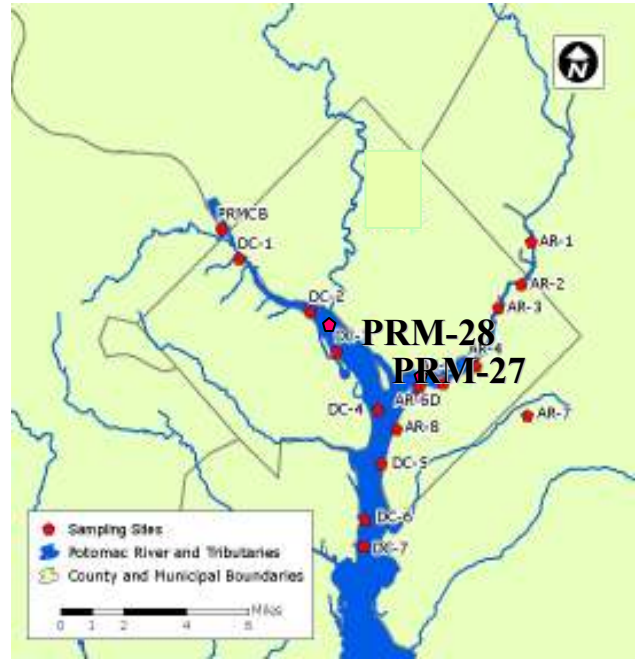
M. Fang
J. Baker

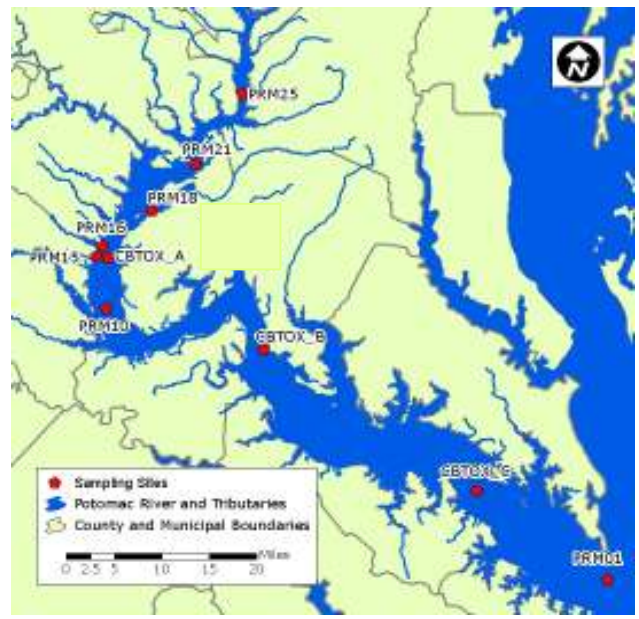

July 2005
PRM28
PRM27
PRM25
PRM21
PRM18
PRM16
PRM15
PRM10
PRM01
PRM01
Dissolved
Particulate
0
1
2
3
4
5
6
7
t-PCB, ng/L


PRM-28
PRM-27
PRMCB
DC-1
DC-2
DC-4
DC-5
DC-6
DC-7
AR-1
AR-2
AR-3
AR-4
AR-5D
AR-6
AR-7
AR-8
Sampling Sites
Potomac River and Tributaries
County and Municipal Boundaries

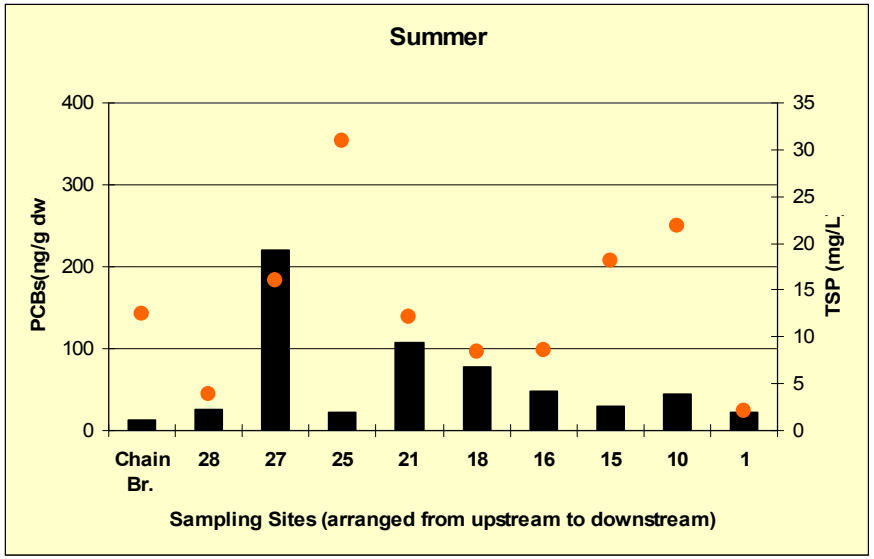

PRM25
PRM21
PRM18
PRM16
PRM15
CBTOX_A
PRM10
CBTOX_B
CBTOX_C
PRM01
Sampling Sites
Potomac River and Tributaries
County and Municipal Boundaries

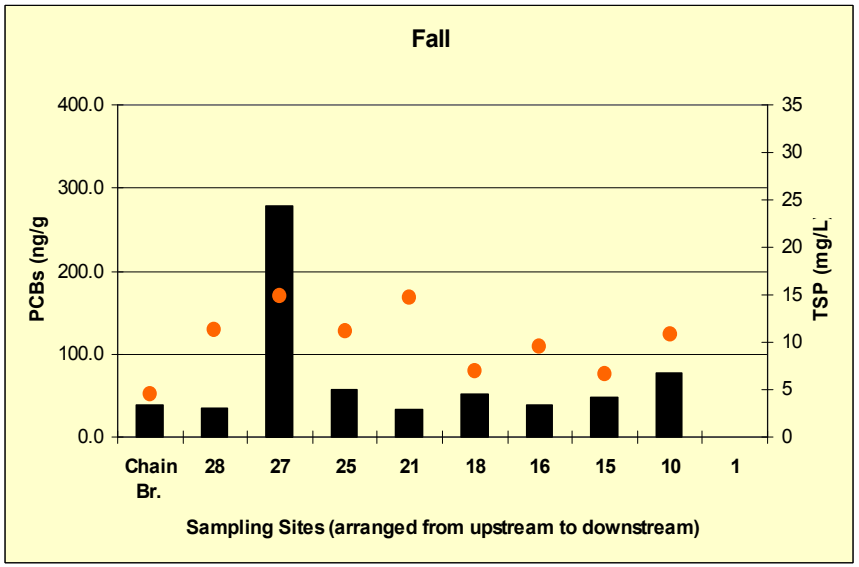

October 2005
PRMCB
PRM28
PRM27
PRM25
PRM21
PRM21
PRM18
PRM16
PRM15
PRM10
Dissolved
Particulate
0
1
2
3
4
5
6
7
t-PCB, ng/L

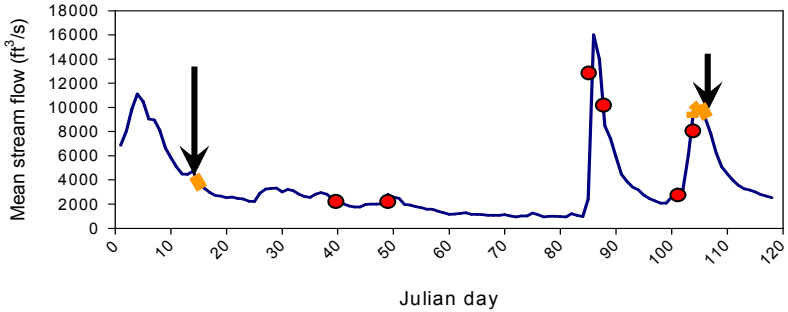

PRMCB
DC-1
DC-2
DC-4
DC-5
DC-6
DC-7
AR-1
AR-2
AR-3
AR-4
AR-5D
AR-6
AR-7
PRM-28
PRM-27
Sampling Sites
Potomac River and Tributaries
County and Municipal Boundaries


PRM25
PRM21
PRM18
PRM16
PRM15
CBTOX_A
PRM10
CBTOX_B
CBTOX_C
PRM01
Sampling Sites
Potomac River and Tributaries
County and Municipal Boundaries

Particulate PCB concentrations based on “g dry weight”

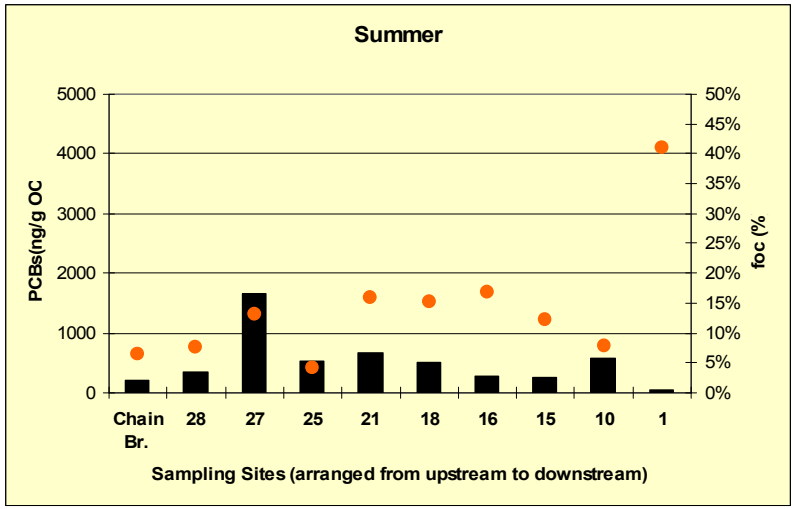


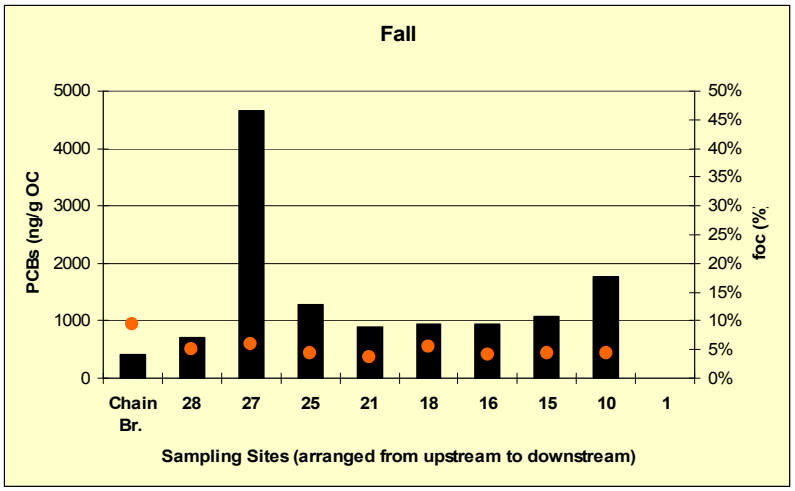




- TSP concentrations were highly variable during Summer
- Summer: “clean” particle dilution
- Fall: consistent PCB concentrations along river

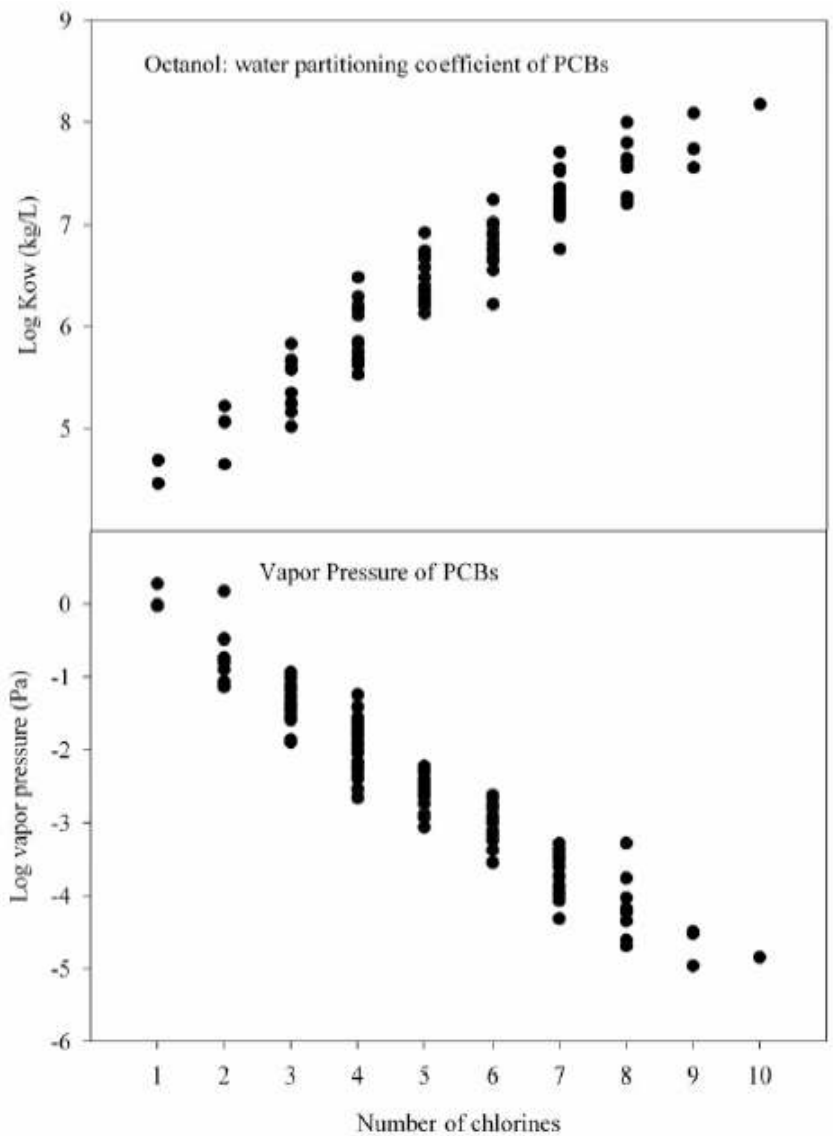
Carbon normalized particulate PCB concentrations





- foc were higher during Summer
- Summer: particulate PCB diluted by high-foc "clean" particles
- Fall: PCB concentrations were consistent

PCB Congener Partitioning

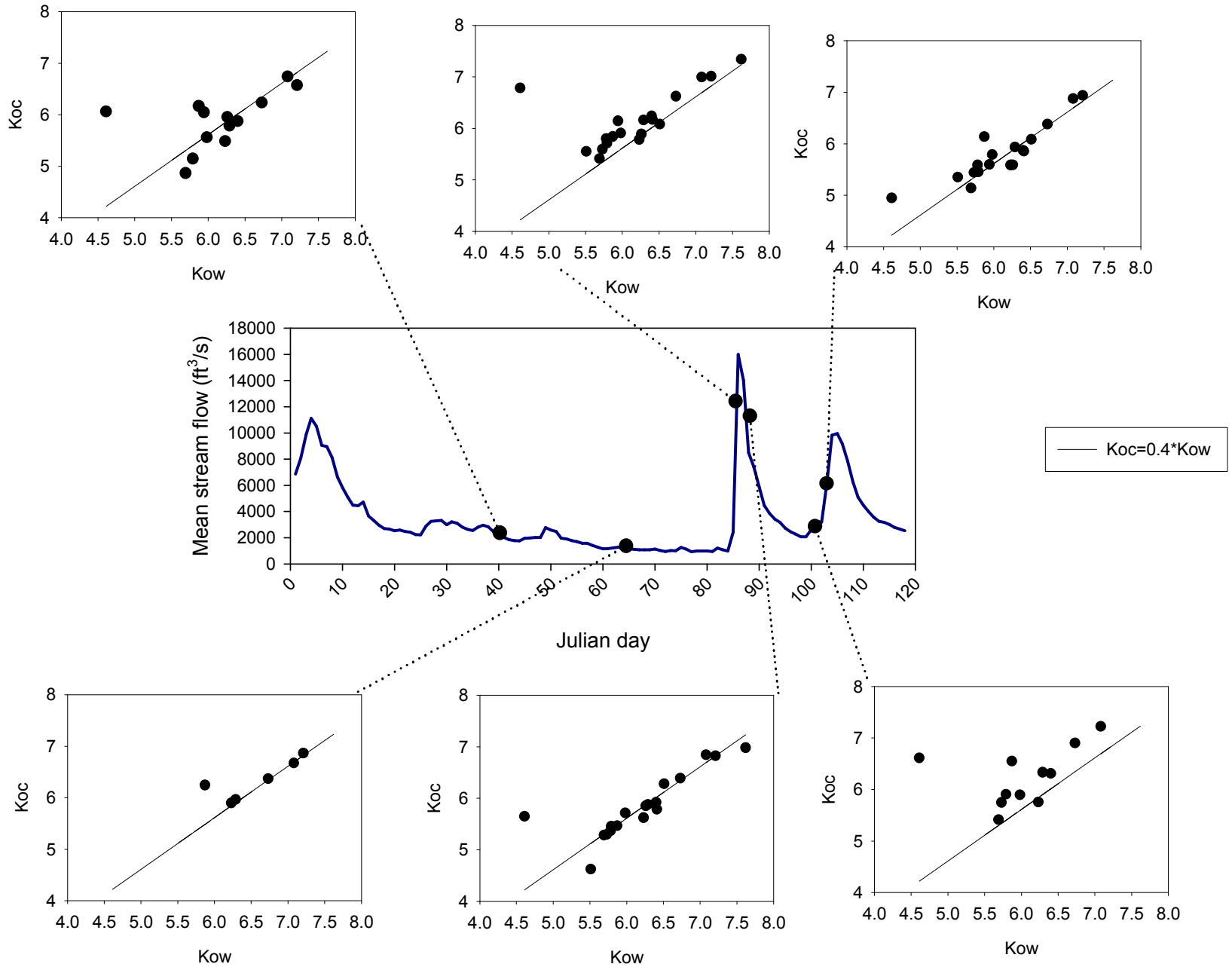


$$K_d = \frac{C_{particulate}}{C_{dissolved}} \quad (L/Kg)$$

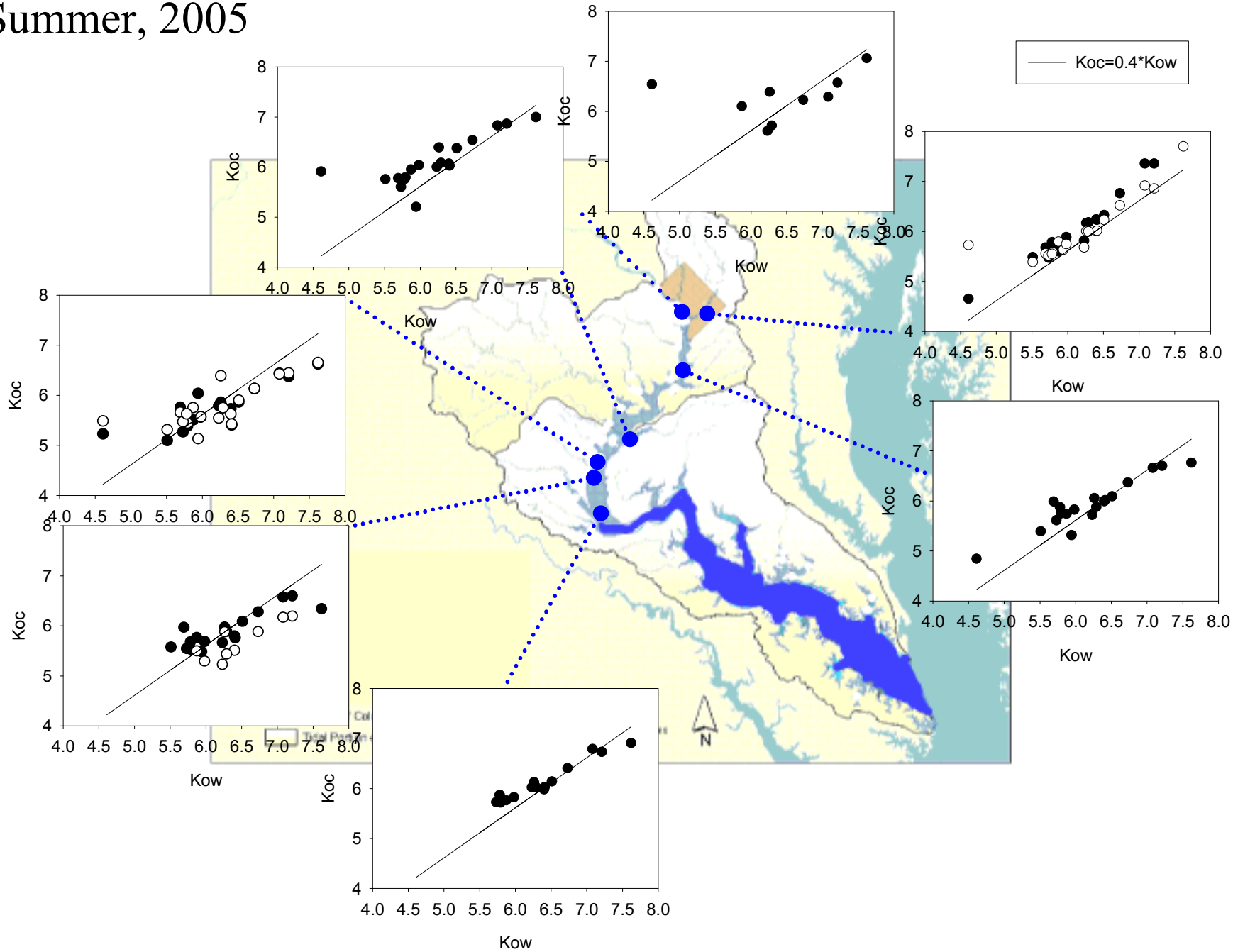
$$K_{OC} = K_d / foc$$

$$\text{Log } K_{OC} = a \text{ Log } K_{OW} + b$$

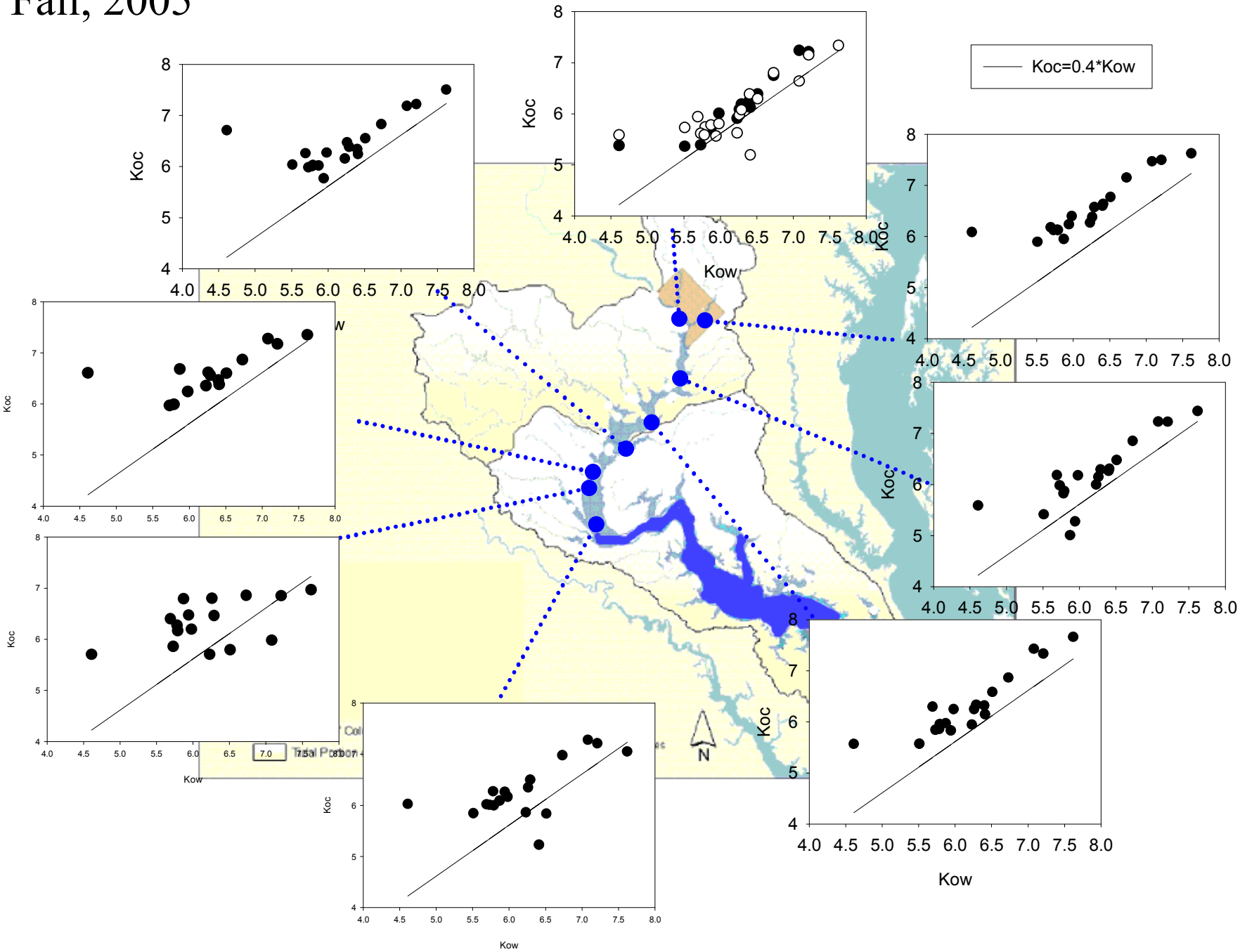
Chain Bridge



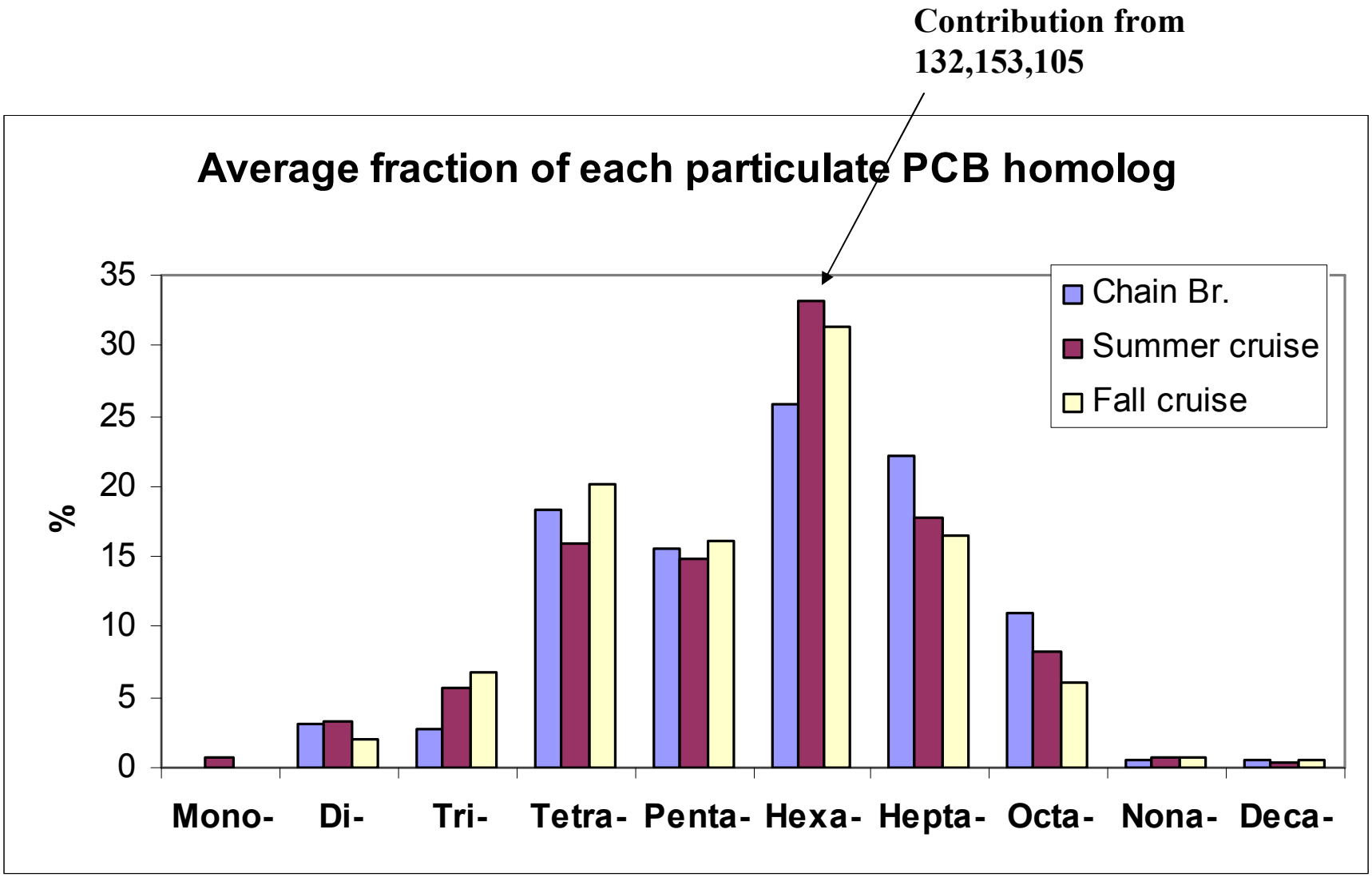
Summer, 2005

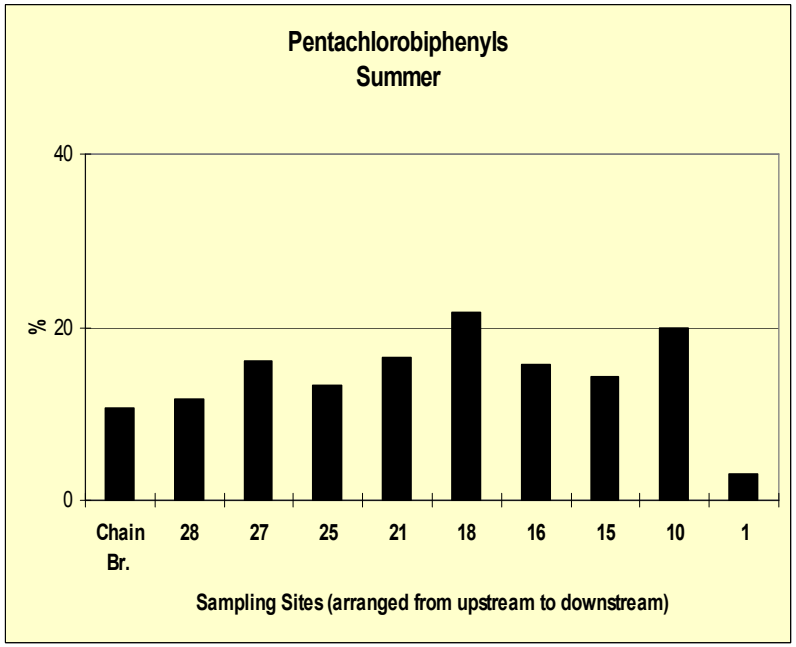


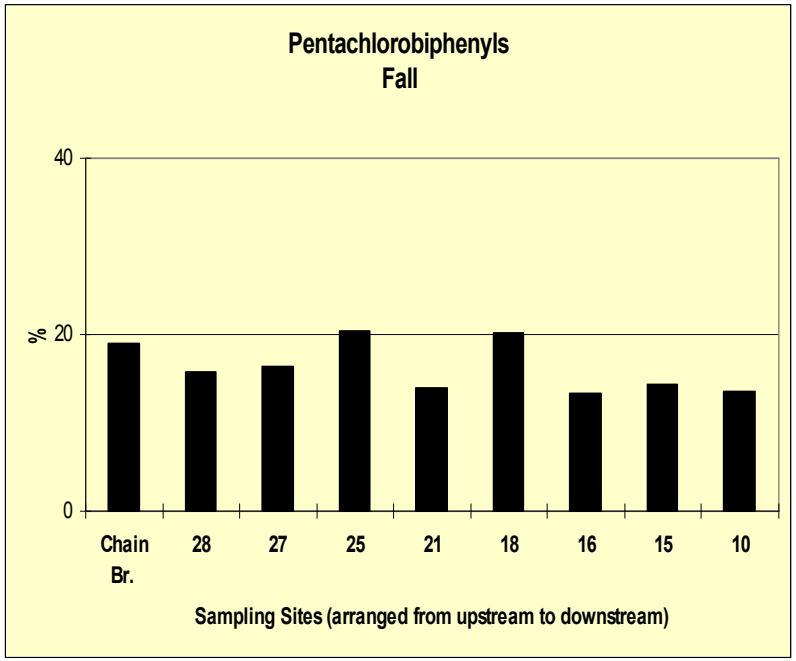
Fall, 2005

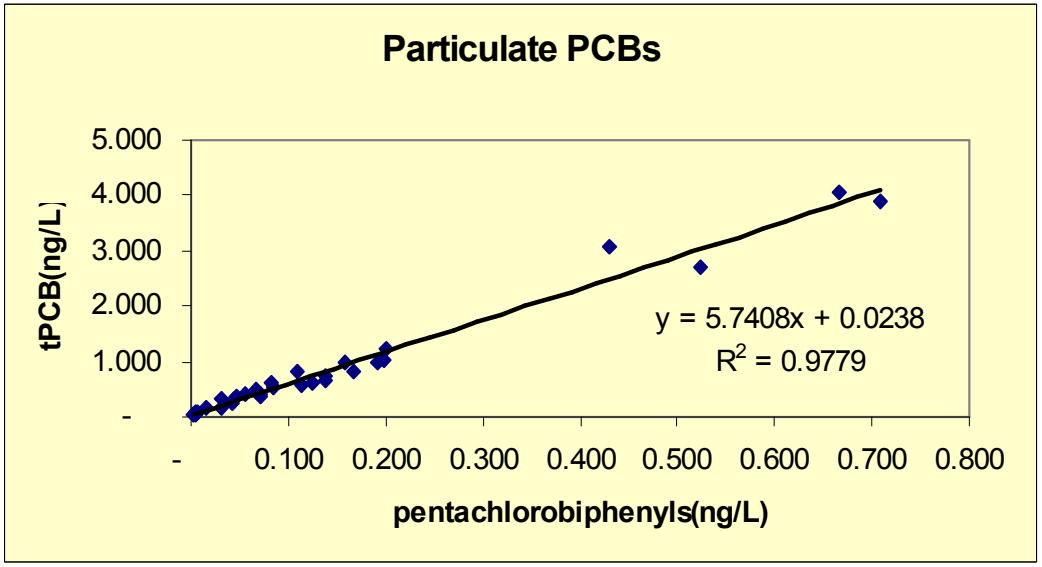


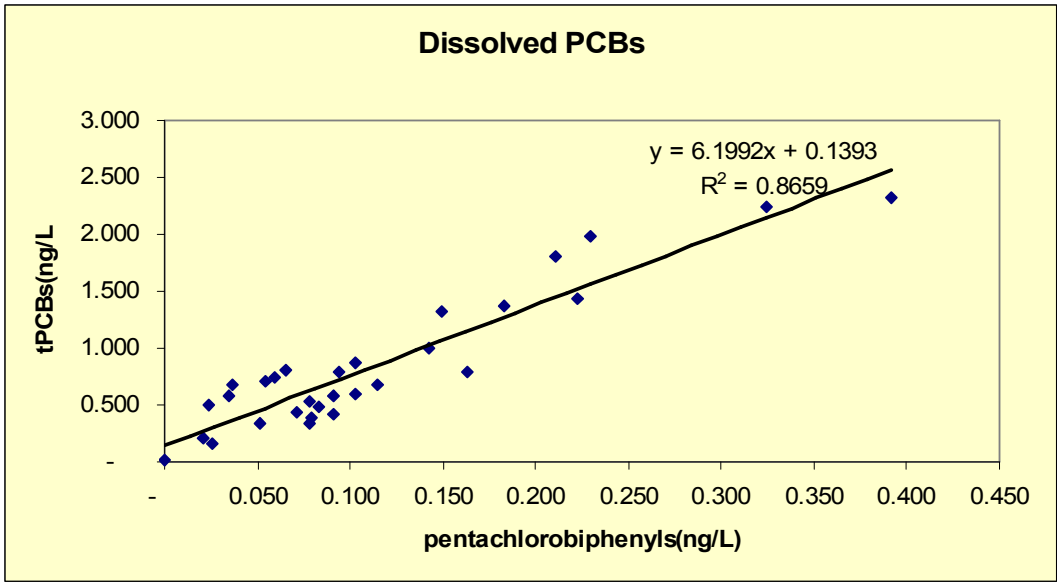
PCB Homologs




Pentachlorobiphenyls
Summer
40
20
0
%
Chain Br.
28
27
25
21
18
16
15
10
1
Sampling Sites (arranged from upstream to downstream)


Pentachlorobiphenyls
Fall
40
20
0
%
Chain Br.
28
27
25
21
18
16
15
10
Sampling Sites (arranged from upstream to downstream)


Particulate PCBs
5.000
4.000
3.000
2.000
1.000
-
tPCB(ng/L)
y = 5.7408x + 0.0238
R2 = 0.9779
-
0.100
0.200
0.300
0.400
0.500
0.600
0.700
0.800
pentachlorobiphenyls(ng/L)


Dissolved PCBs
3.000
2.500
2.000
1.500
1.000
0.500
-
tPCBs(ng/L
y = 6.1992x + 0.1393
R2 = 0.8659
-
0.050
0.100
0.150
0.200
0.250
0.300
0.350
0.400
0.450
pentachlorobiphenyls(ng/L)

Source Trackdown

- Multivariate analysis of congener data
  - specific sources
  - reductive dehalogenation products from highly contaminated sediments
- Positive matrix factorization
  - used by USEPA to determine sources of aerosols based upon their chemical composition
- Cluster analysis

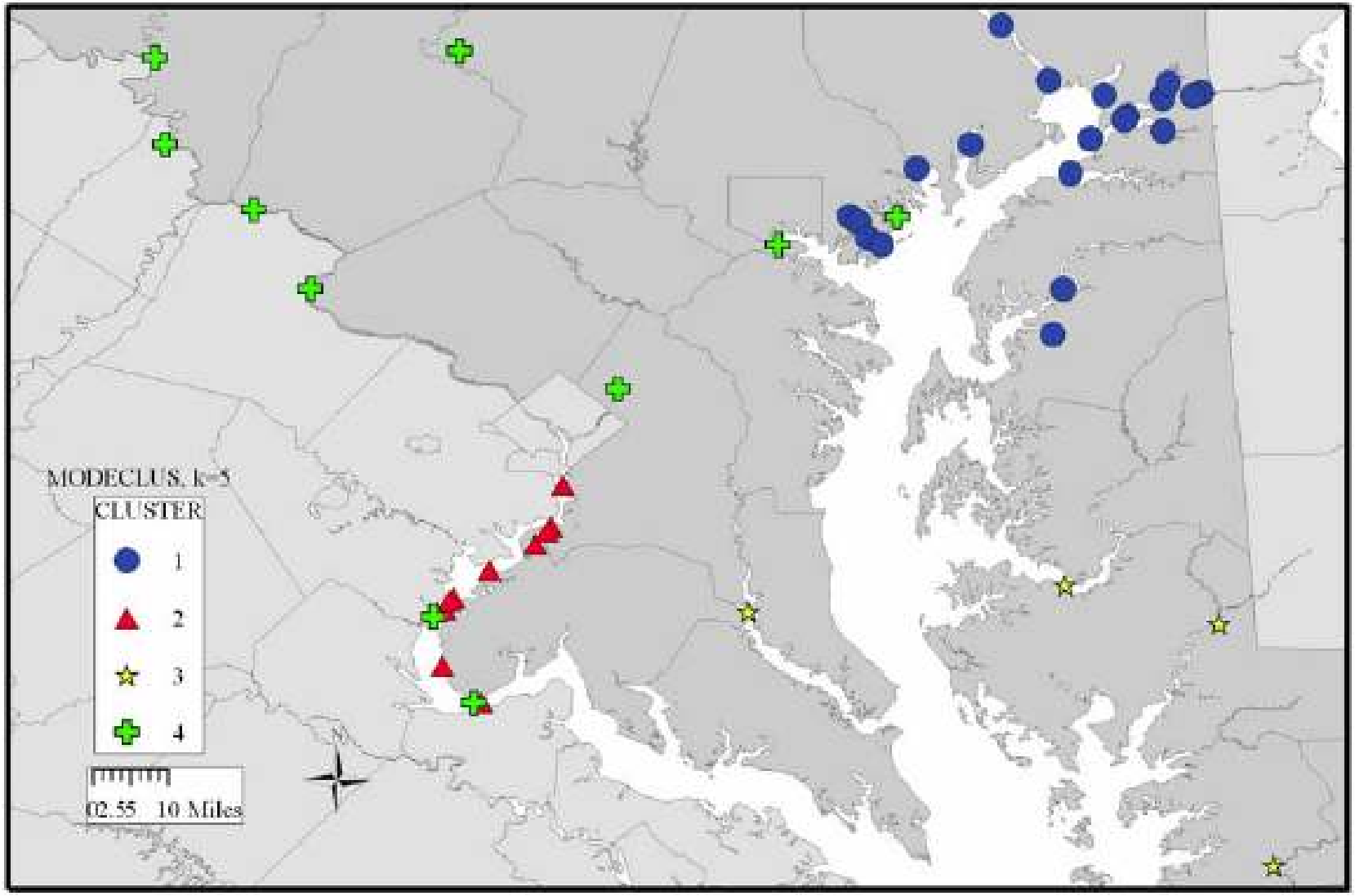


Figure 19. Clusters of PCB congener patterns observed in Maryland channel catfish.

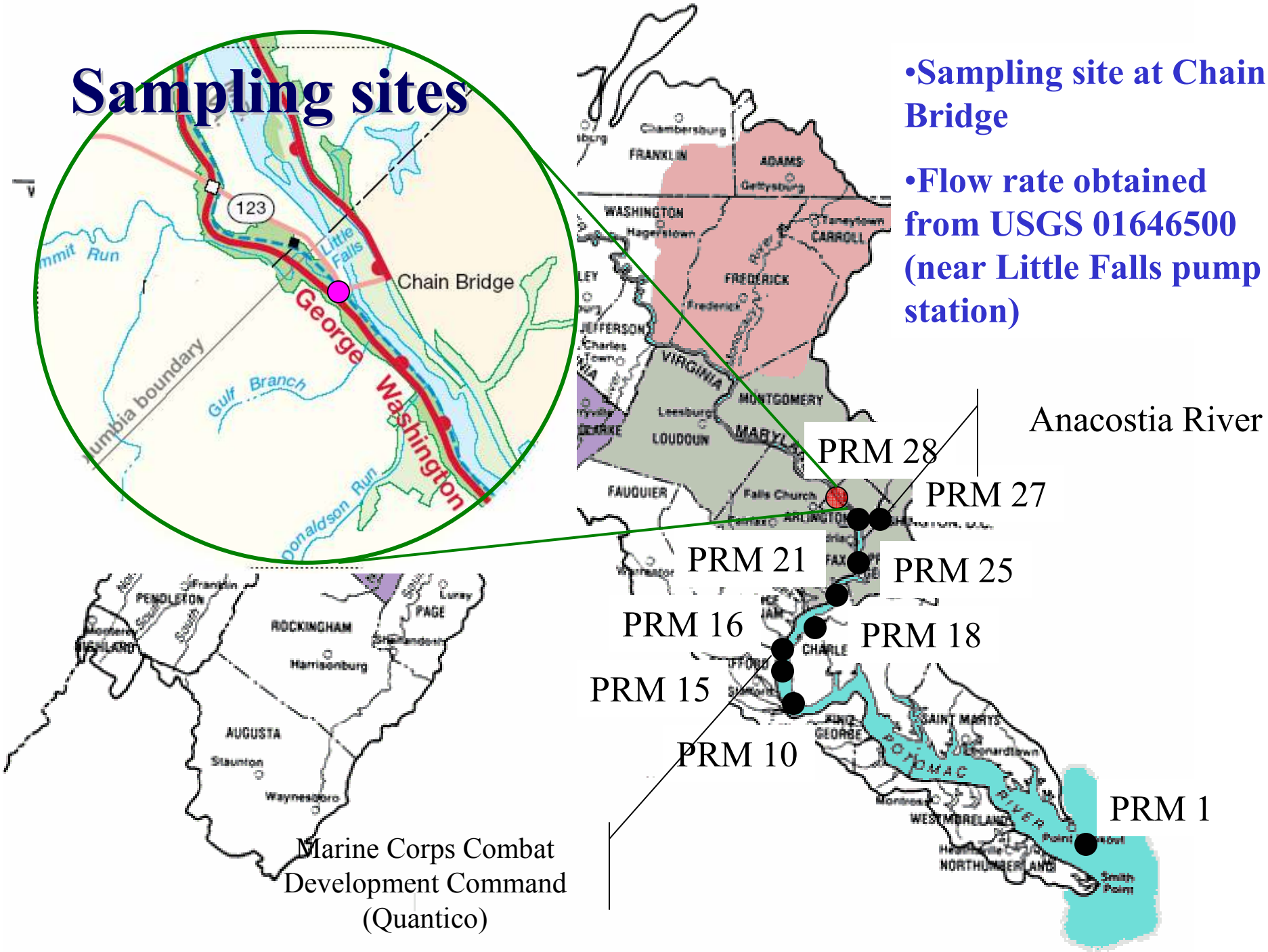
Liebert, 2006

Summary: PCB concentrations in Potomac River water

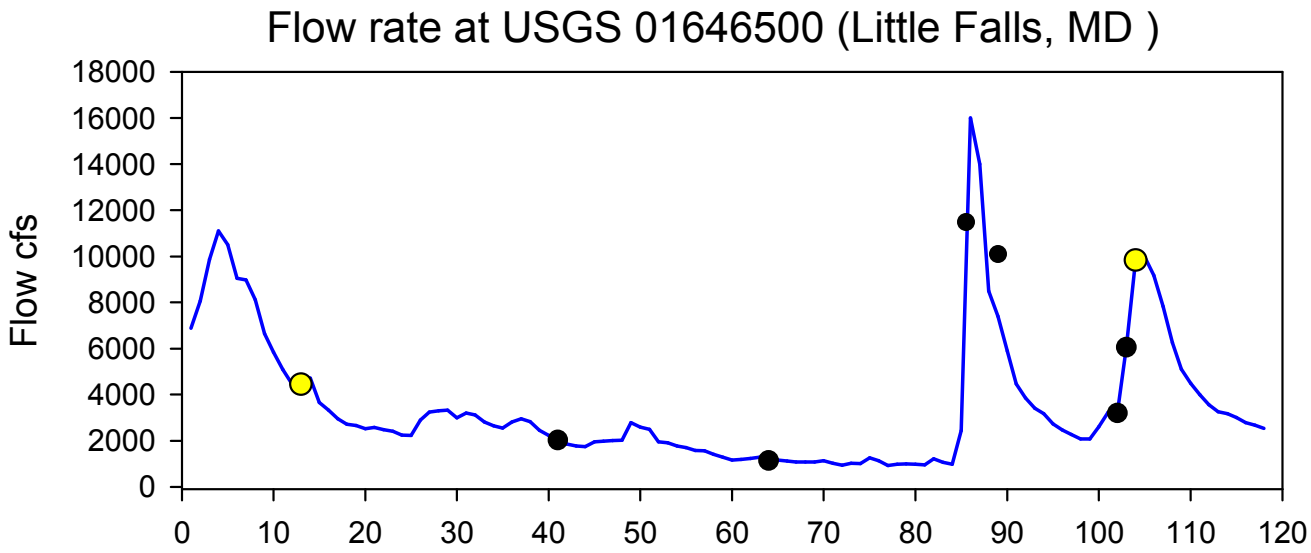
	t-PCB (ng/L)
Chain Bridge	0.8-3.9
Anacostia River	5.6-6.4
Anacostia River (Foster, 2000)	2.0-28.9
Potomac River mainstem	0.1-4.8
Potomac River (Foster, 1996)	0.5-3.6
DC DOH:	0.045
MDE:	0.64
VADEQ:	1.70

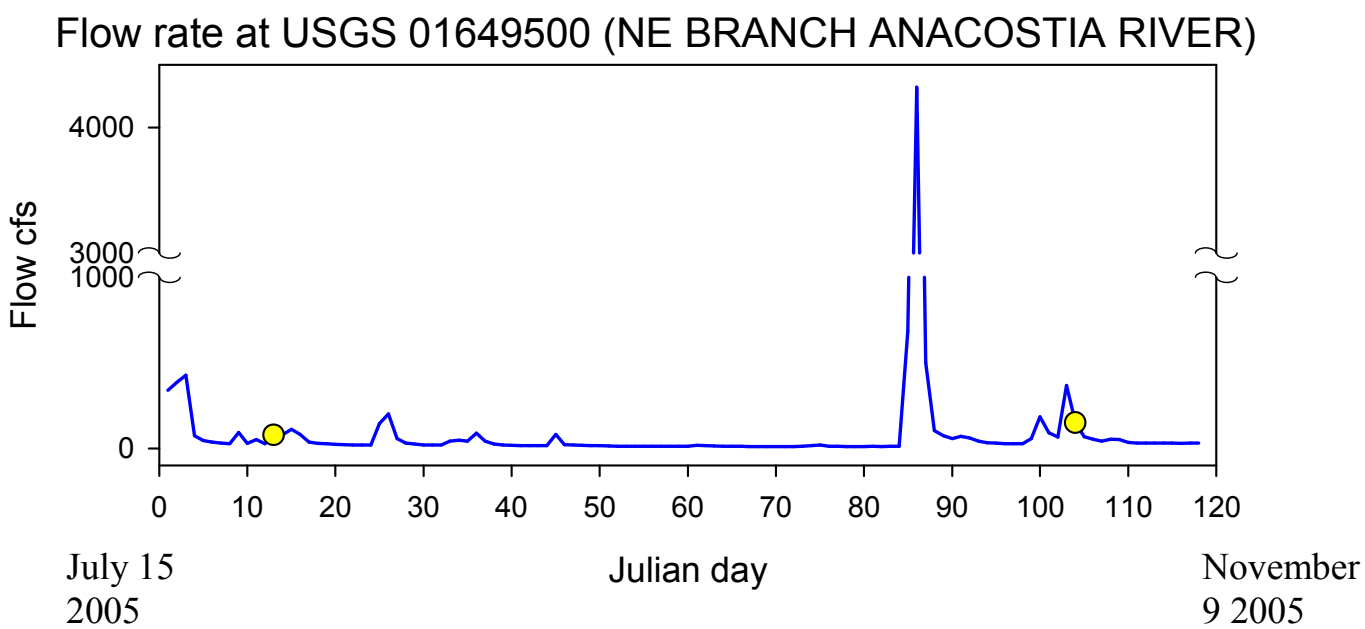
baker@cbl.umces.edu

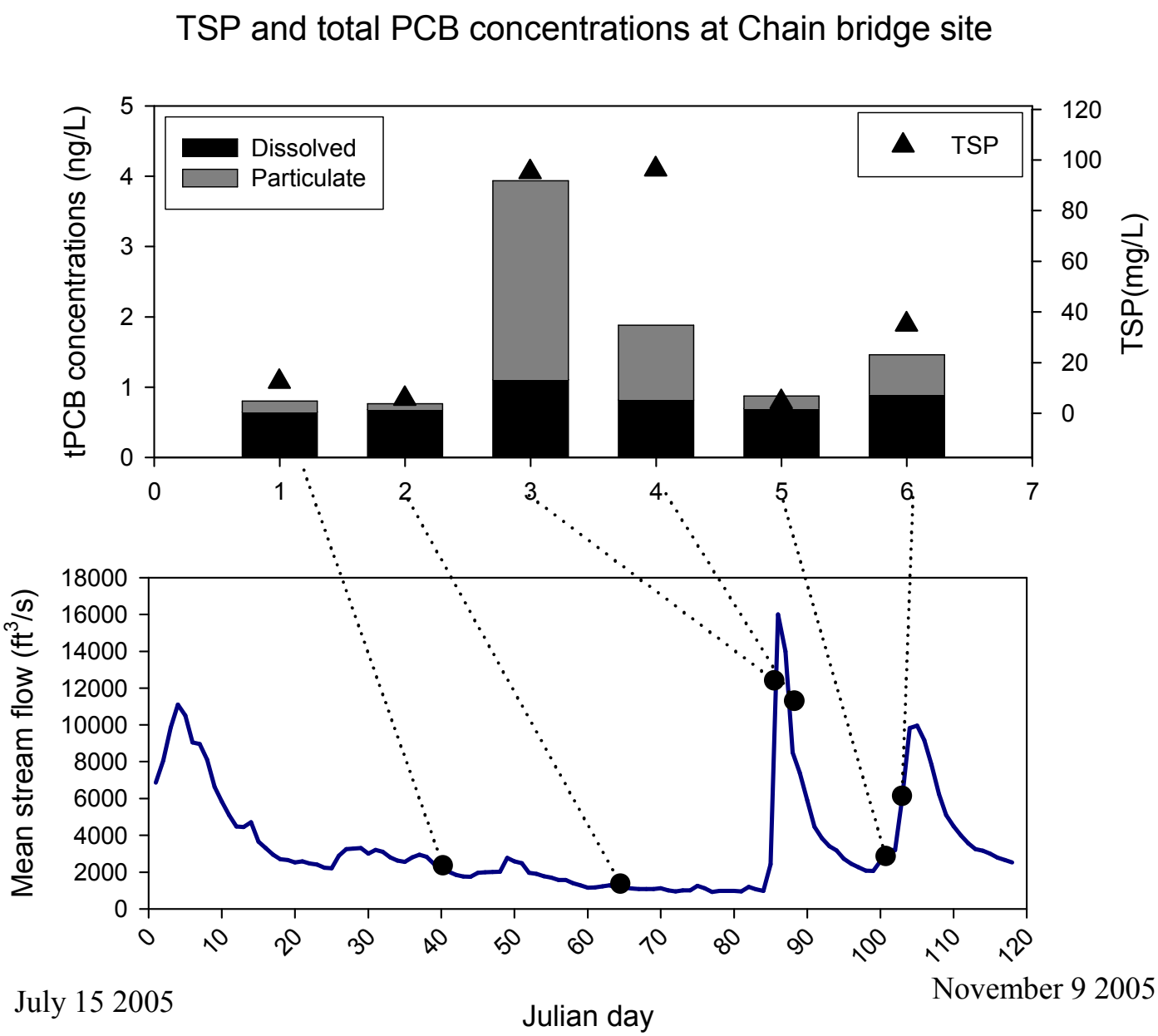
Sampling sites

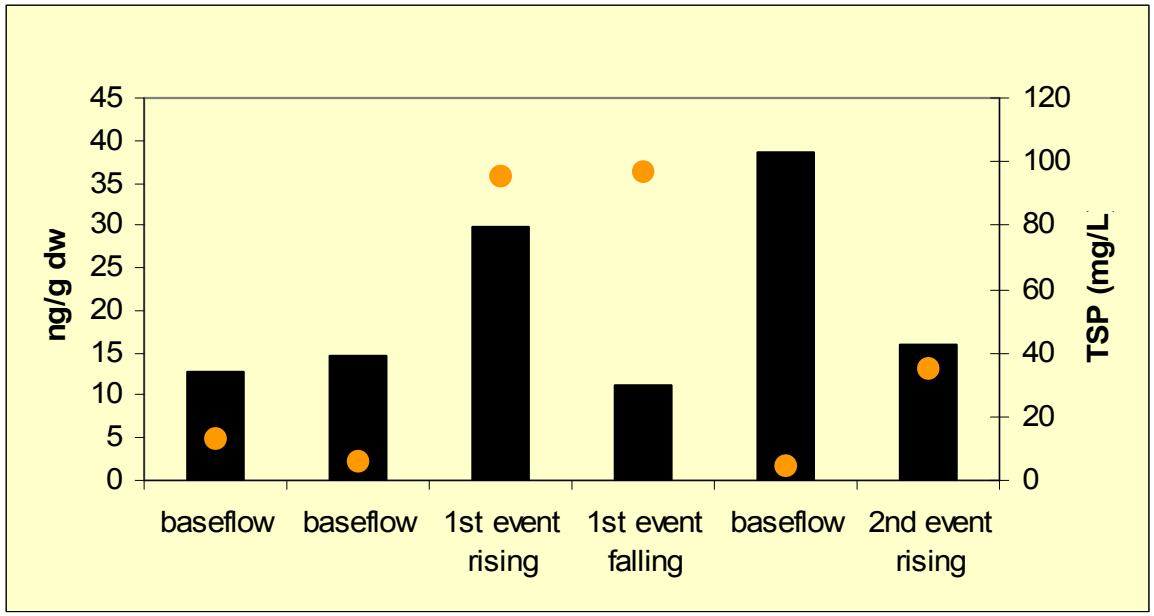


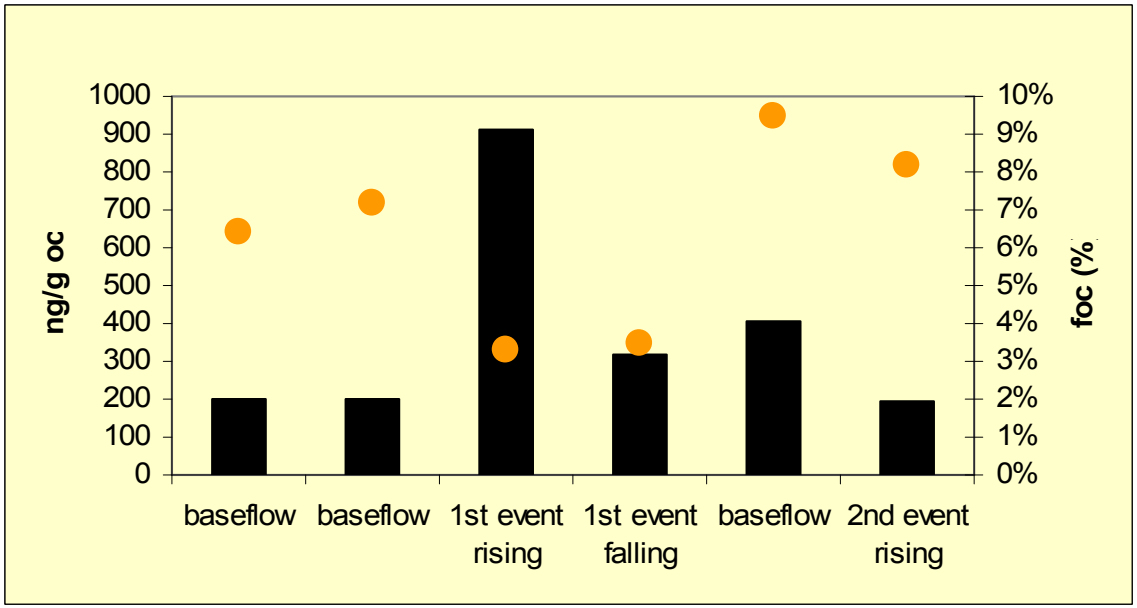
- Sampling site at Chain Bridge
- Flow rate obtained from USGS 01646500 (near Little Falls pump station)


Flow rate at USGS 01646500 (Little Falls, MD)
Flow cfs
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
0
10
20
30
40
50
60
70
80
90
100
110
120


Flow rate at USGS 01649500 (NE BRANCH ANACOSTIA RIVER)
Flow cfs
4000
3000
1000
0
0
10
20
30
40
50
60
70
80
90
100
110
120
July 15 2005
Julian day
November 9 2005

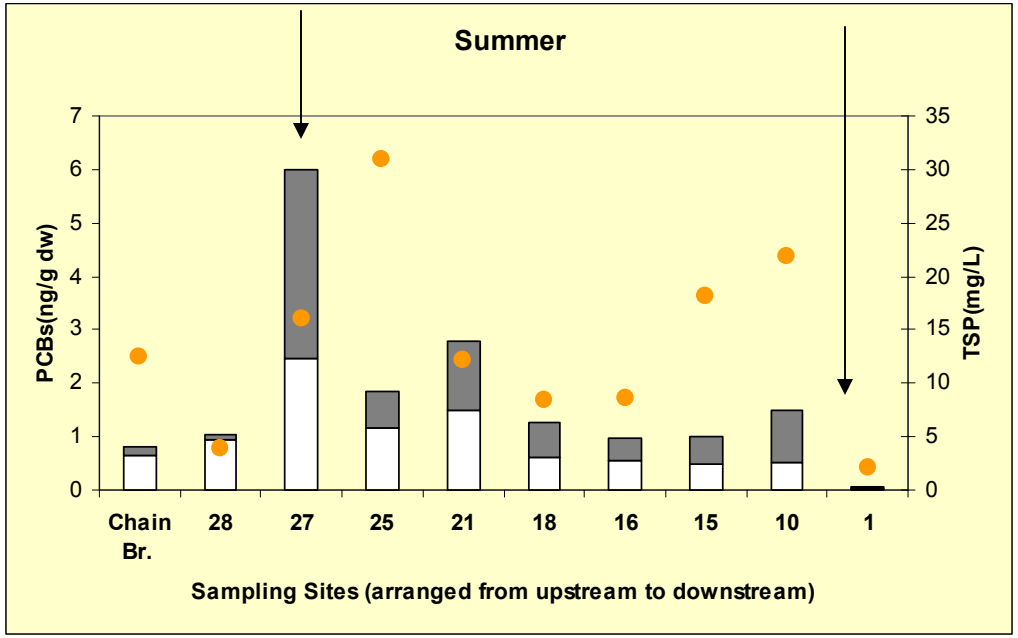

TSP and total PCB concentrations at Chain bridge site
tPCB concentrations (ng/L)
TSP(mg/L)
Dissolved
Particulate
TSP
Mean stream flow (ft3/s)
July 15 2005
November 9 2005
Julian day

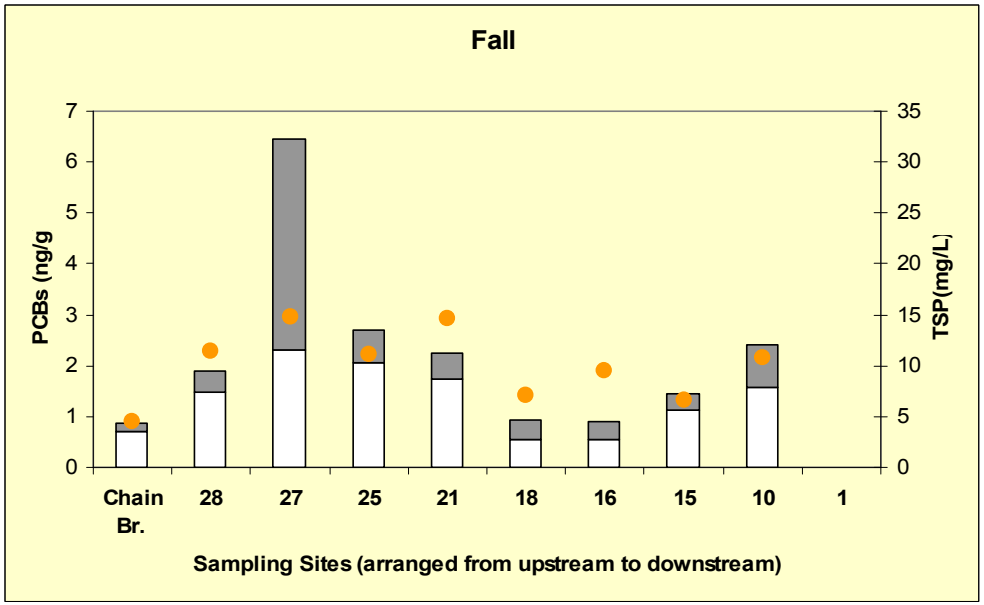




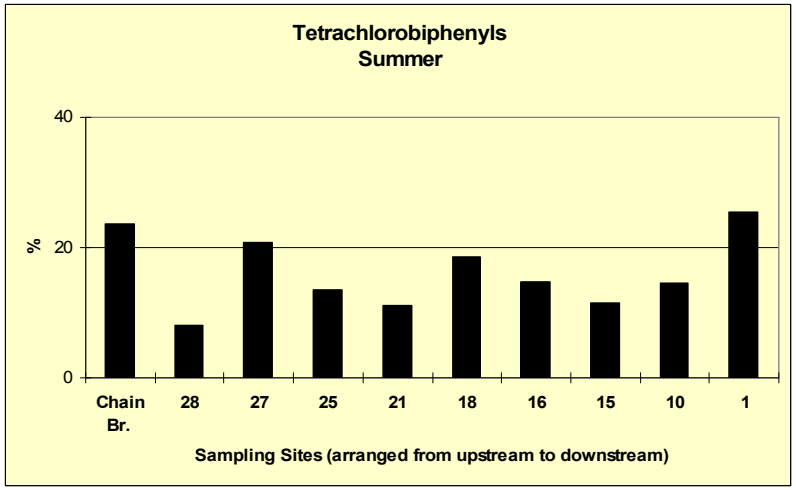
•Particle normalized PCBs varied much more than carbon normalized concentrations except the first storm event rising limb

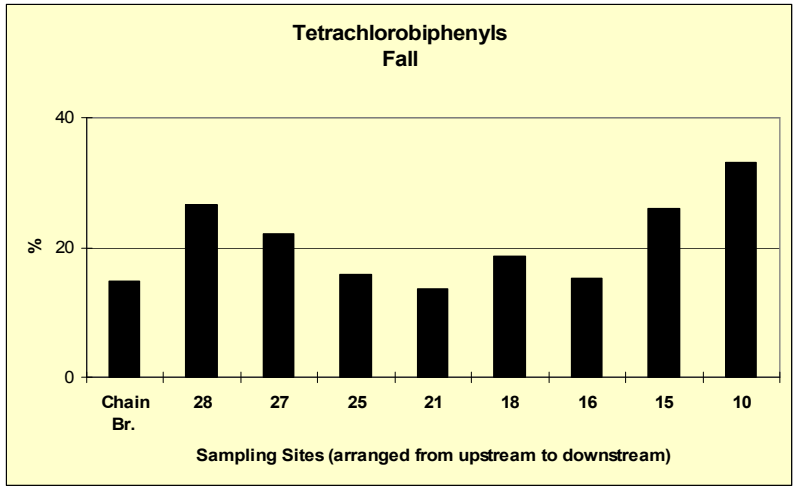
Anacostia River Point lookout

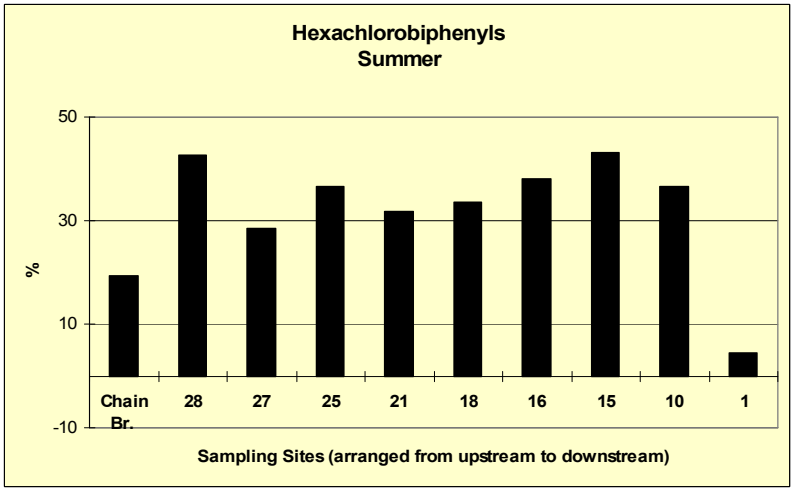


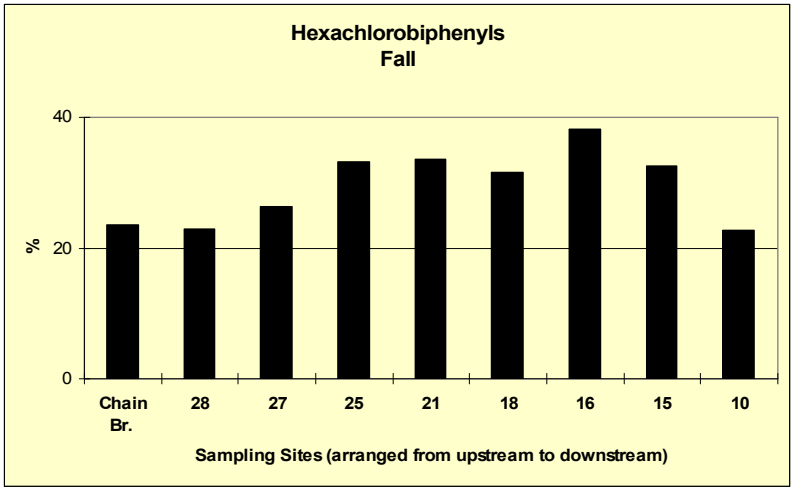


- Highest PCB concentration was at Anacostia River in both cruises
- Total PCBs correlated to TSP in Fall but not in Summer


Tetrachlorobiphenyls
Summer
40
20
0
%
Chain Br.
28
27
25
21
18
16
15
10
1
Sampling Sites (arranged from upstream to downstream)


Tetrachlorobiphenyls
Fall
40
20
0
%
Chain Br.
28
27
25
21
18
16
15
10
Sampling Sites (arranged from upstream to downstream)


Hexachlorobiphenyls
Summer
50
30
10
-10
%
Chain Br.
28
27
25
21
18
16
15
10
1
Sampling Sites (arranged from upstream to downstream)


Hexachlorobiphenyls
Fall
40
20
0
%
Chain Br.
28
27
25
21
18
16
15
10
Sampling Sites (arranged from upstream to downstream)