SOURCES, SINKS, AND BUDGET OF FINE-GRAINED SEDIMENT IN THE DELAWARE ESTUARY

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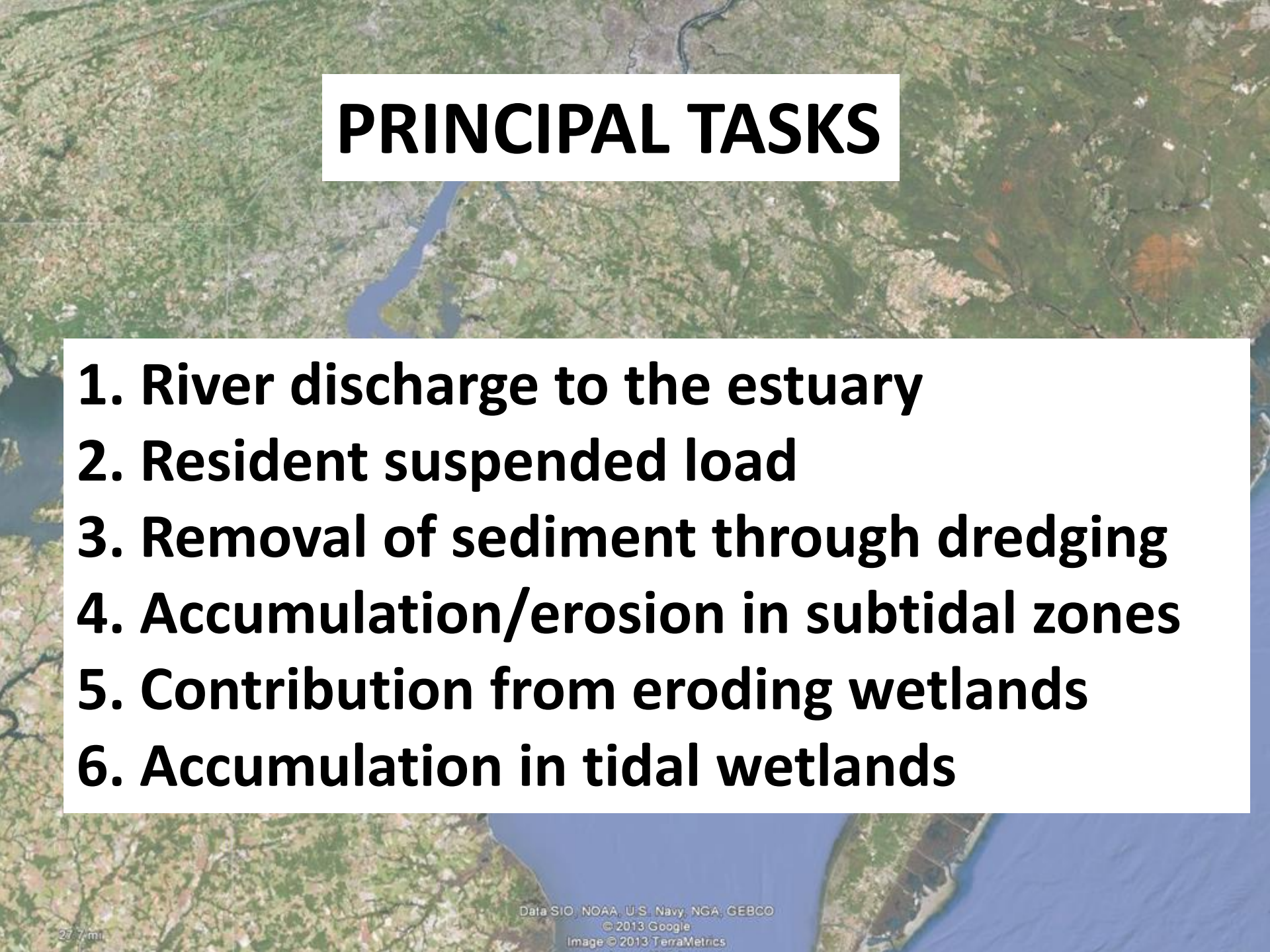
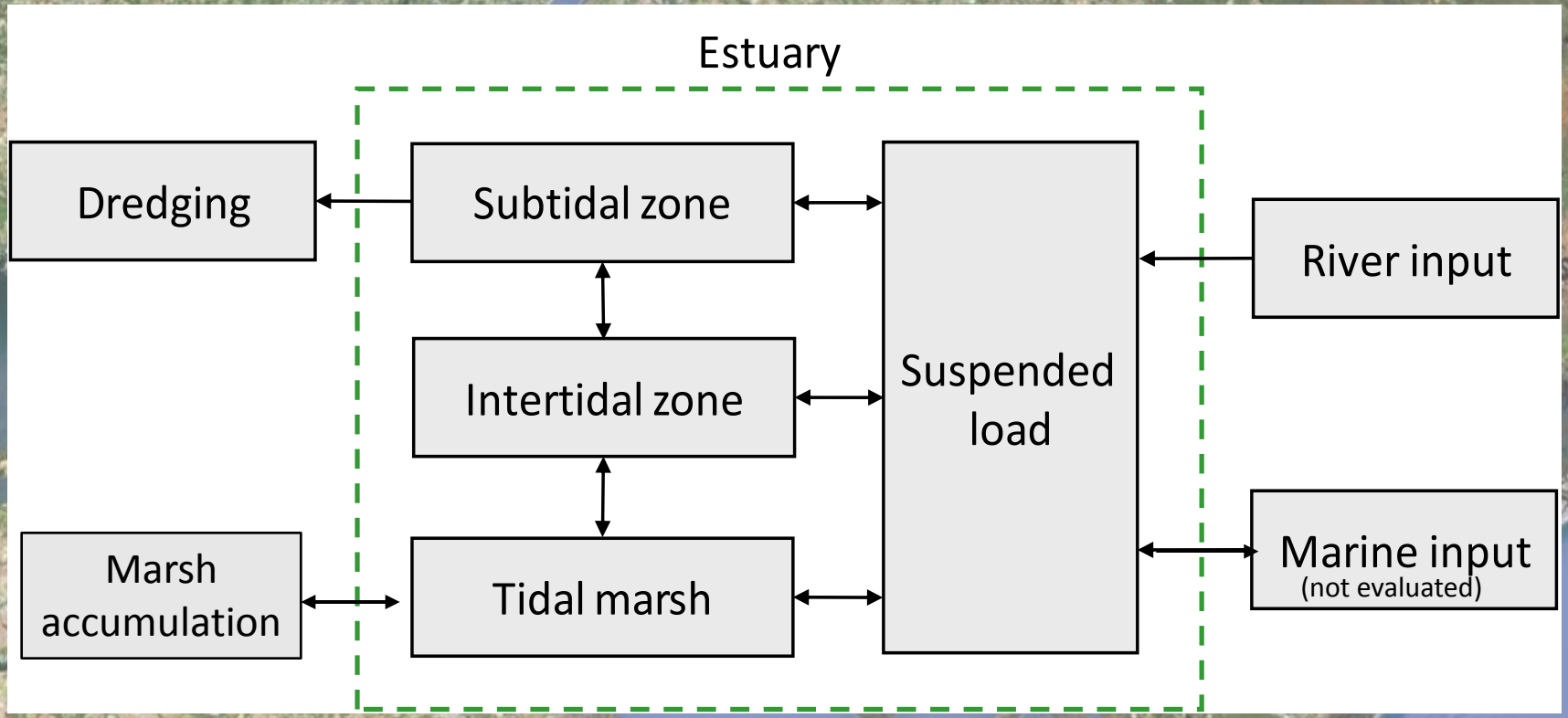
PRINCIPAL TASKS

1. River discharge to the estuary
2. Resident suspended load
3. Removal of sediment through dredging
4. Accumulation/erosion in subtidal zones
5. Contribution from eroding wetlands
6. Accumulation in tidal wetlands



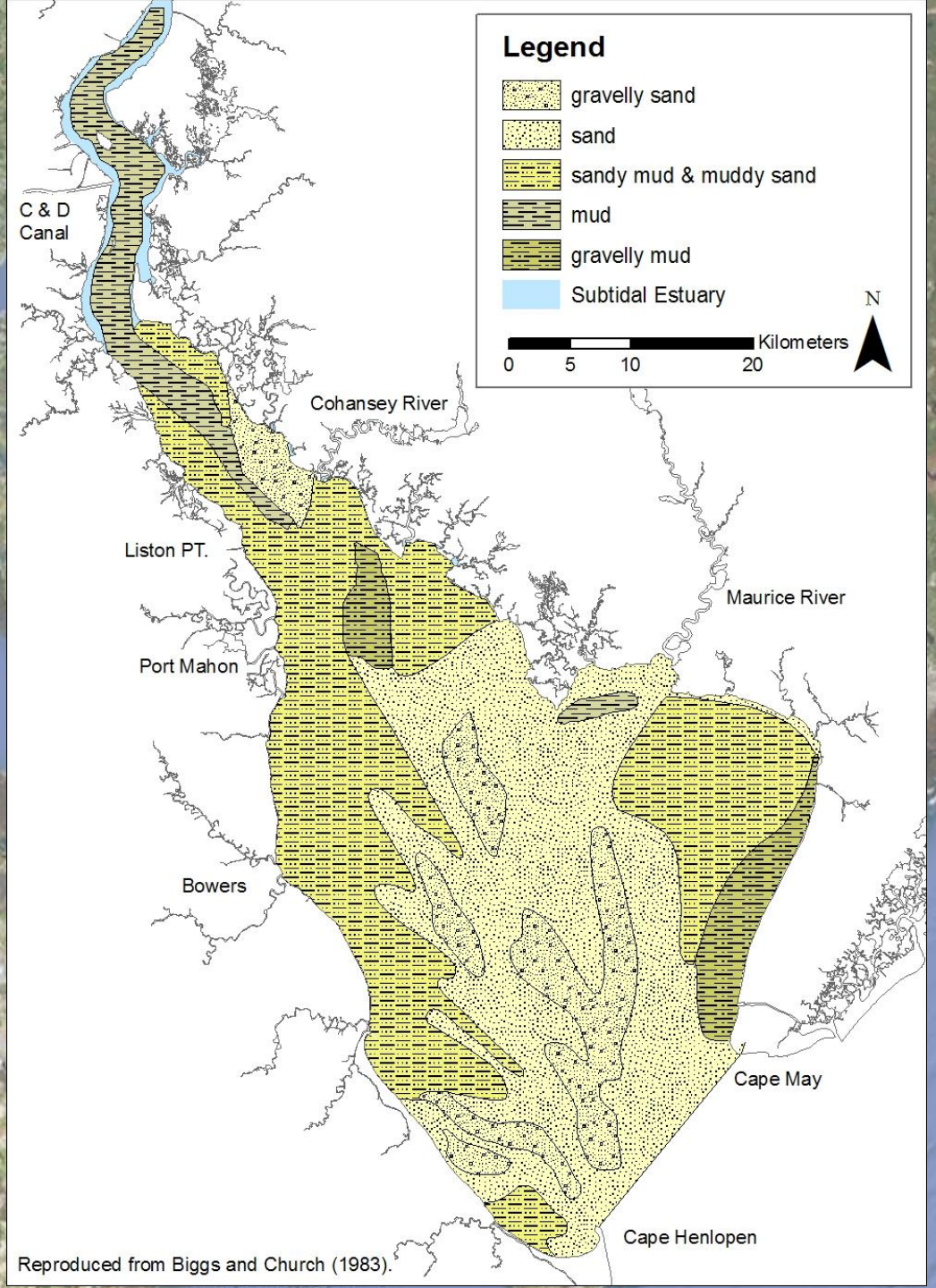
Sediment sources, sinks, and transport pathways in the Delaware Estuary



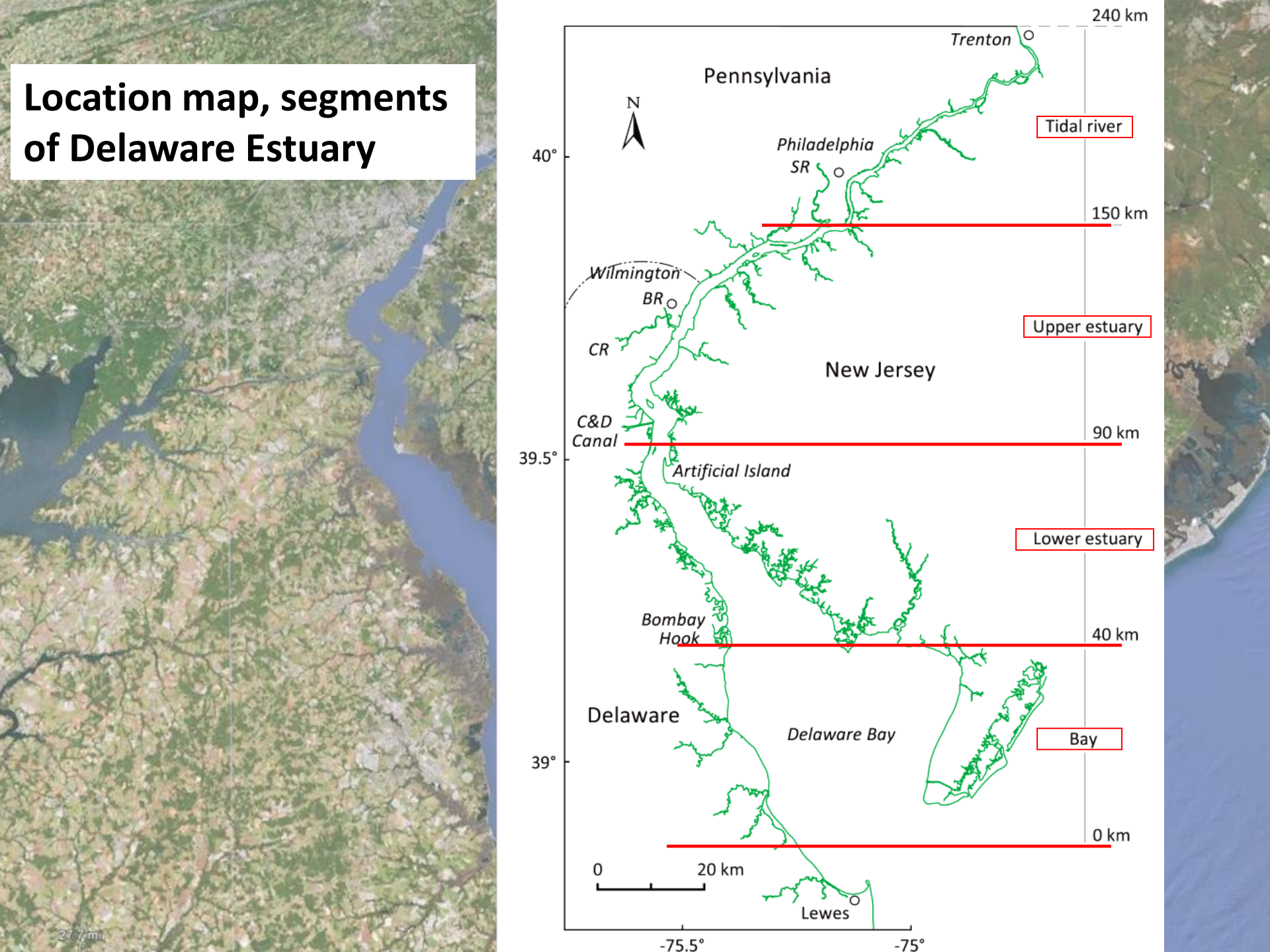
Rivers are chief external source of minerogenic sediment
Maintenance dredging is an external sink
Subtidal and intertidal zones serve as both sediment sources and sinks
Tidal marsh is a permanent sink for sediment; marsh fringe erosion is a source
Estuary water column is transient sink (resident suspended sediment load)

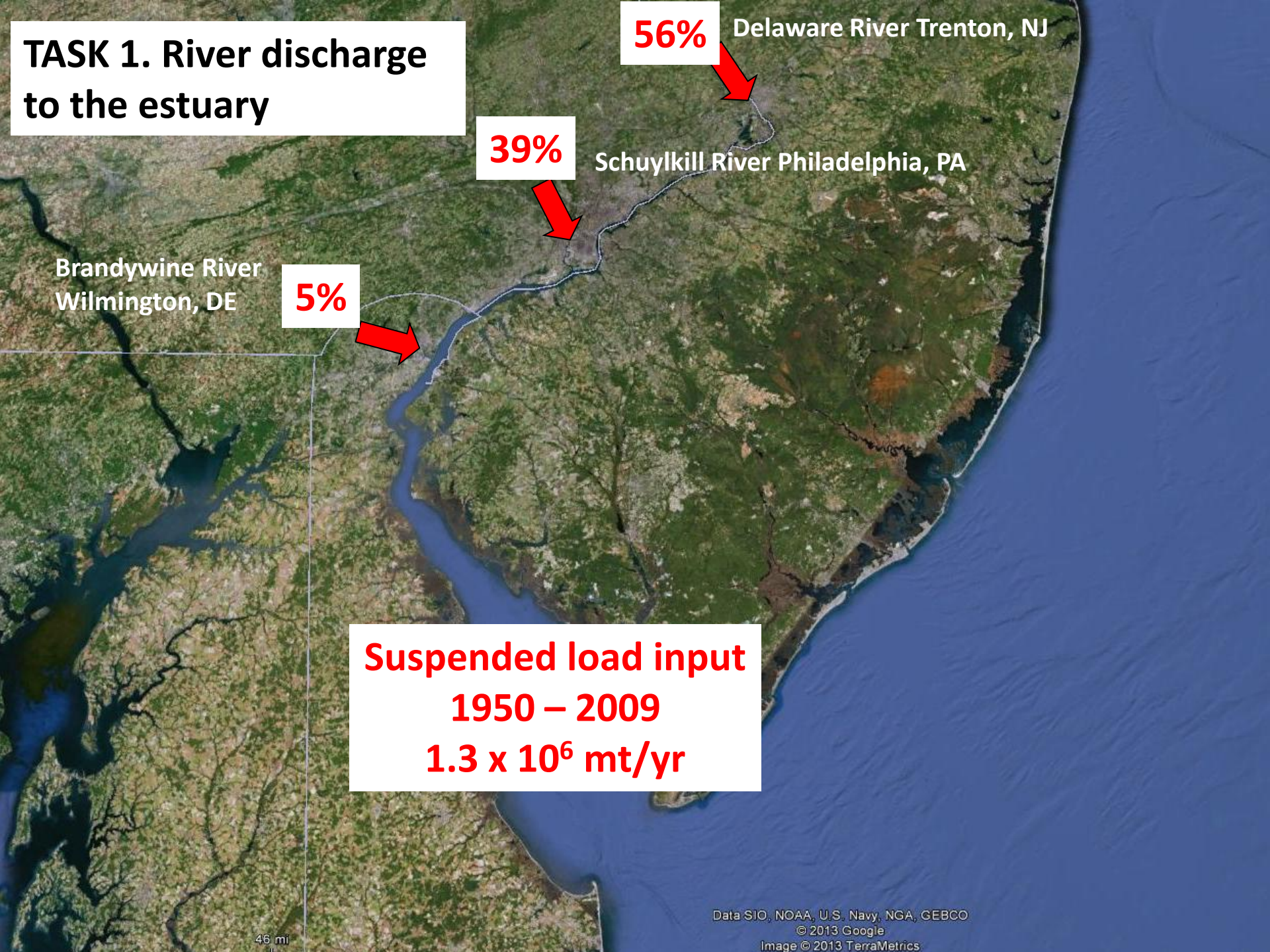
Bottom sediment classification

(Biggs & Church, 1983)



Location map, segments of Delaware Estuary




TASK 1. River discharge to the estuary
56%
Delaware River Trenton, NJ
39%
Schuylkill River Philadelphia, PA
Brandywine River Wilmington, DE
5%
Suspended load input
1950 – 2009
1.3 x 10^6 mt/yr
46 mi
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
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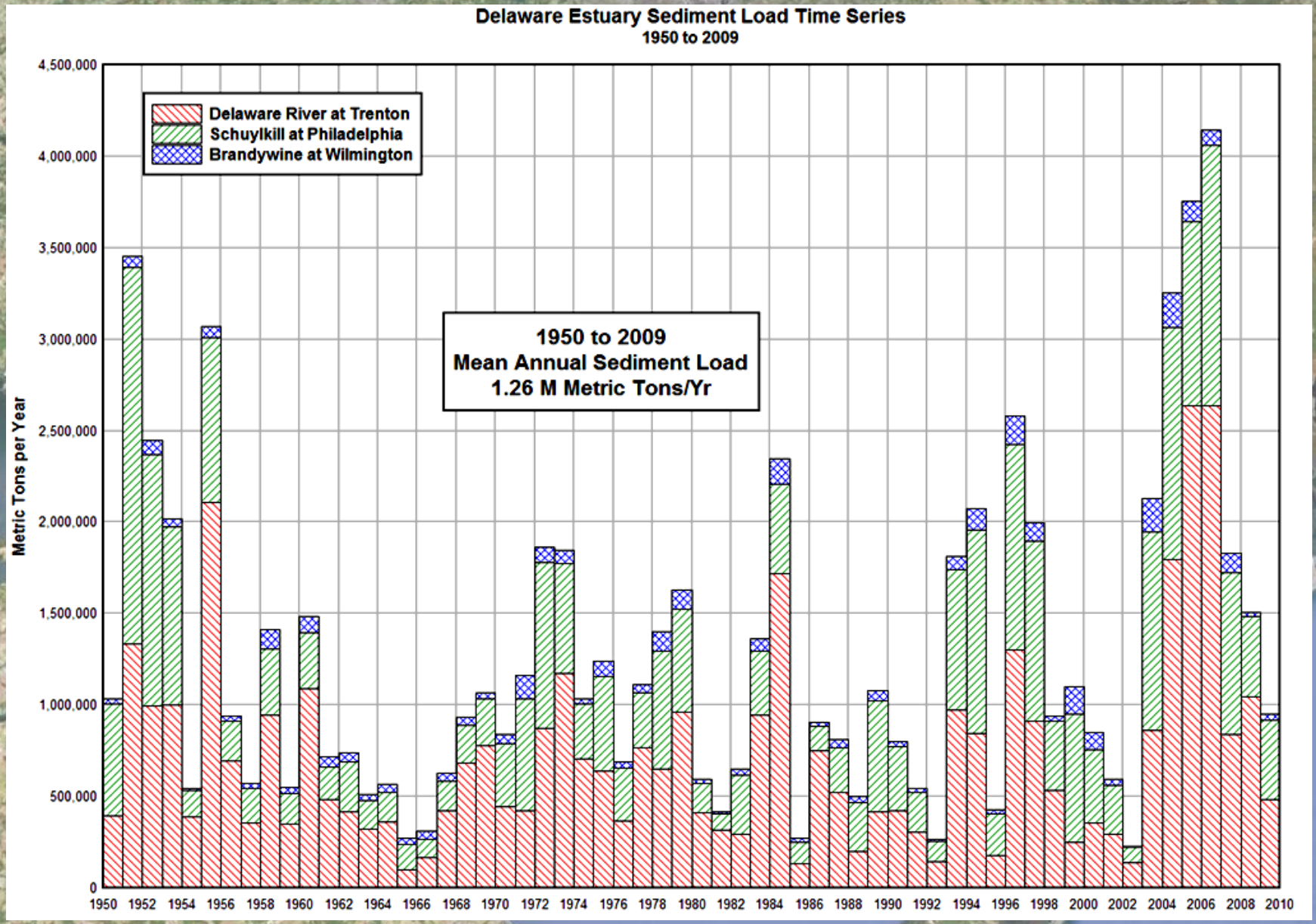
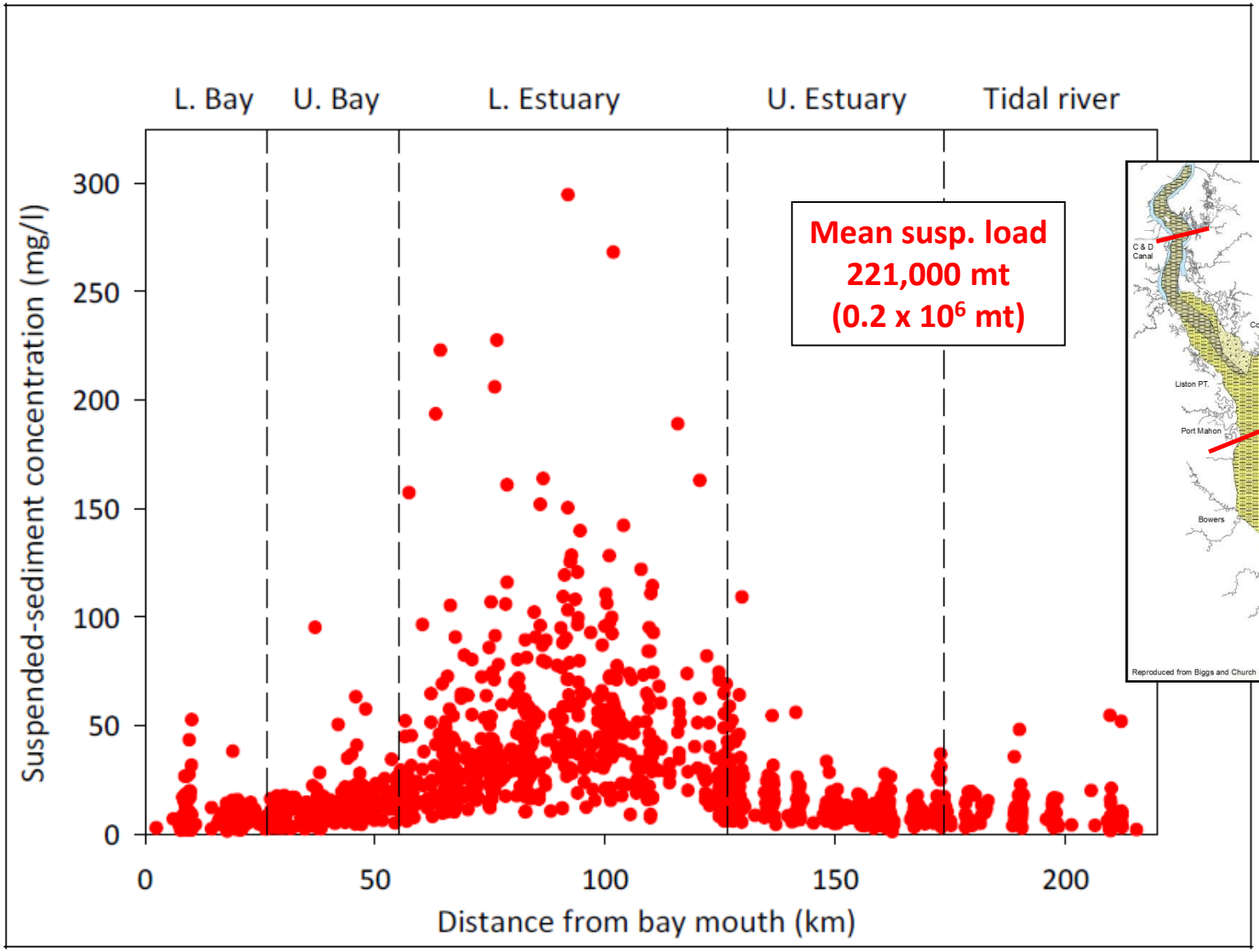


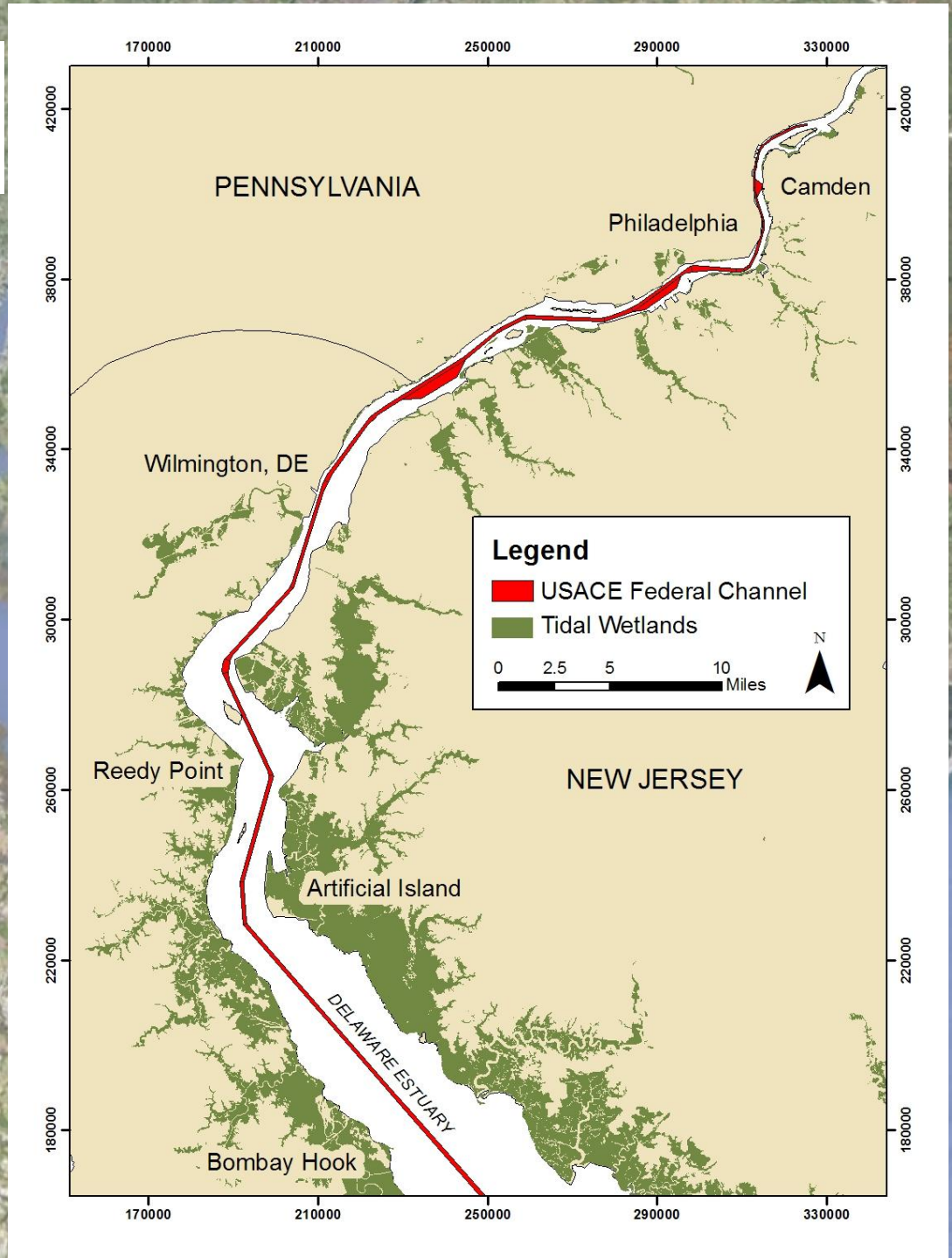
Suspended sediment load annual series, 1950 – 2009

TASK 2. Resident suspended load

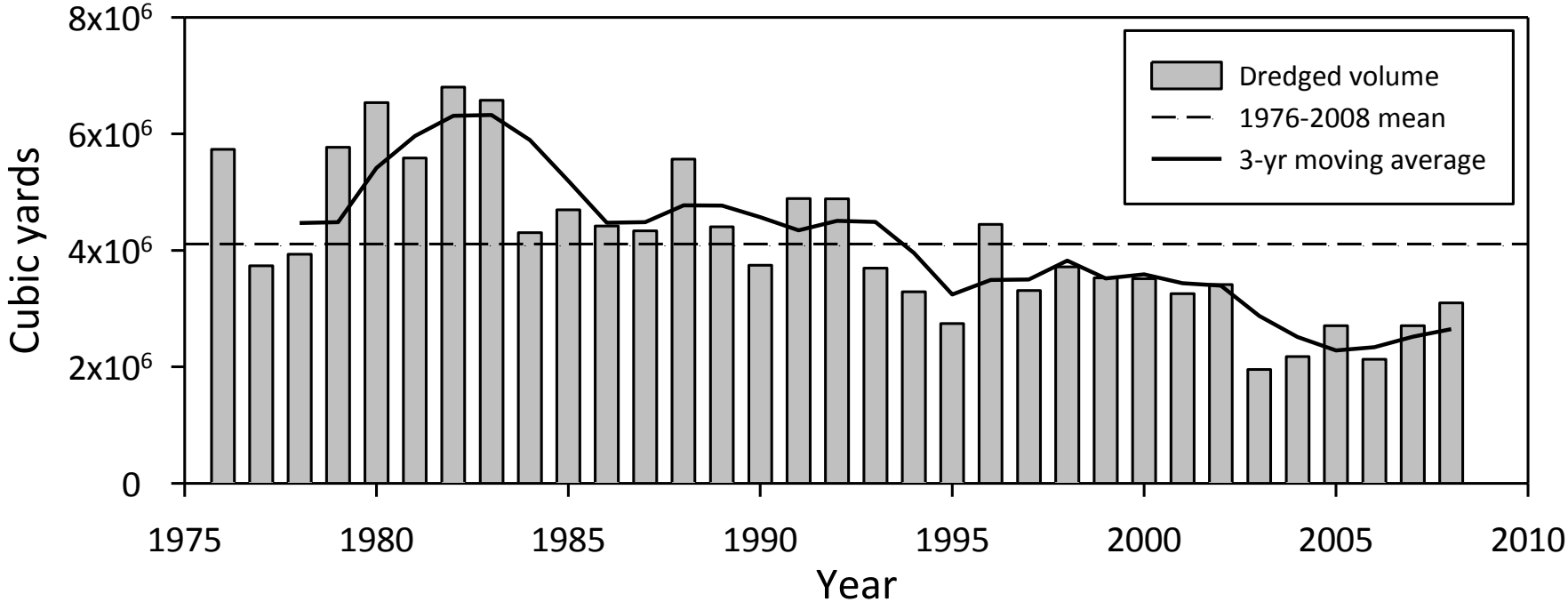


Suspended-sediment concentration along the axis of the estuary (n >1600)

TASK 3. Removal of sediment by dredging

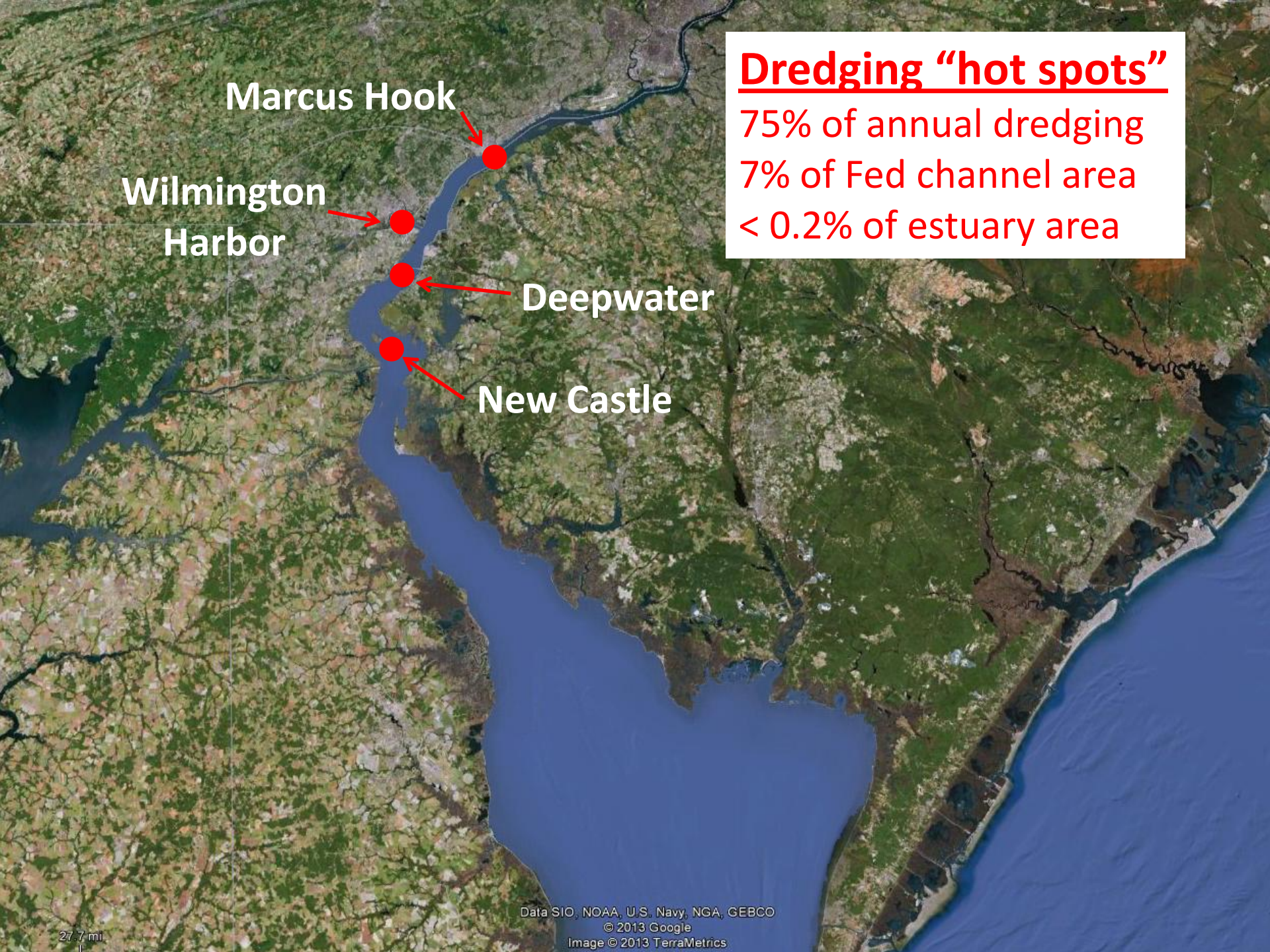


Maintenance dredging time series

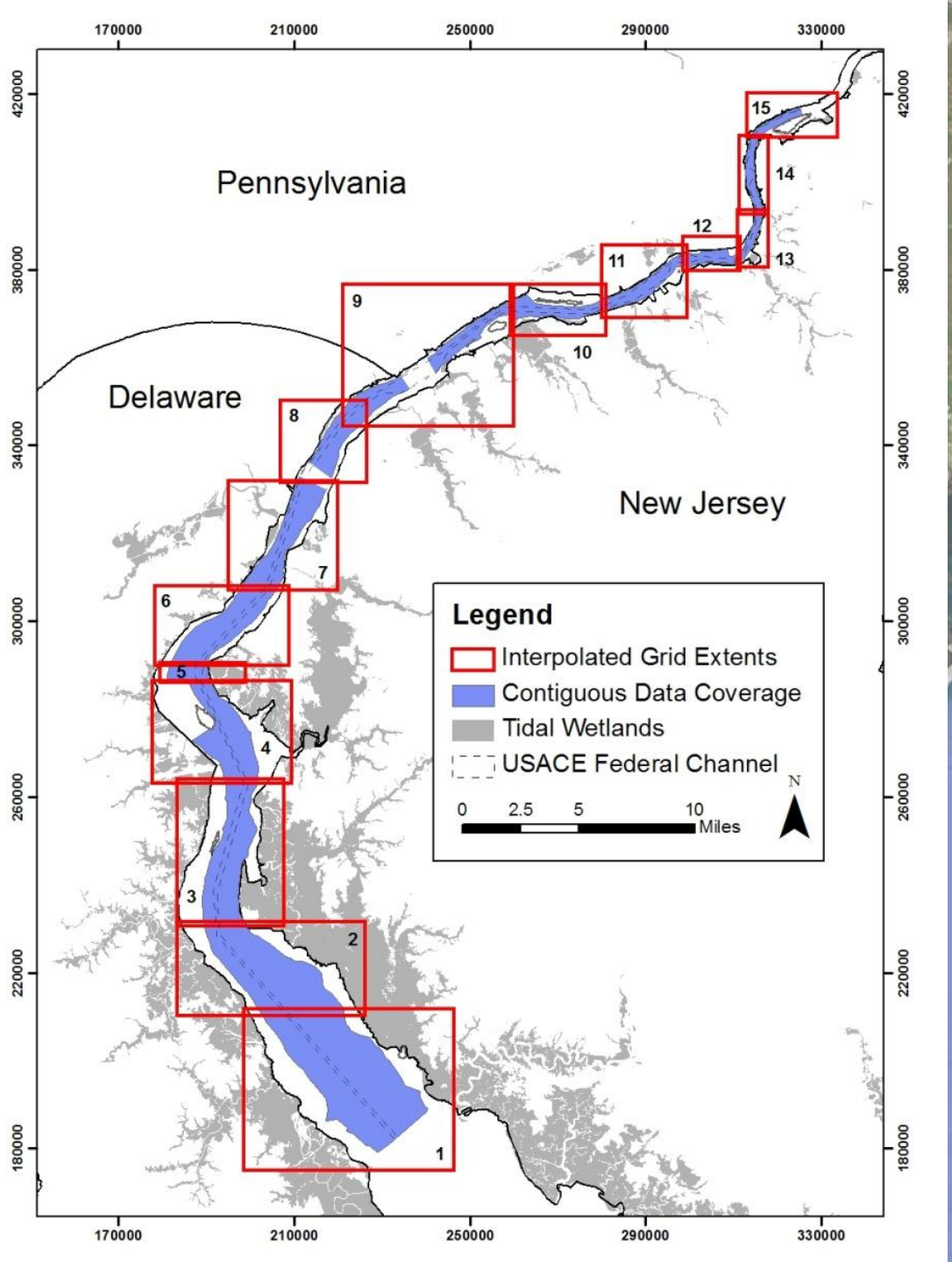


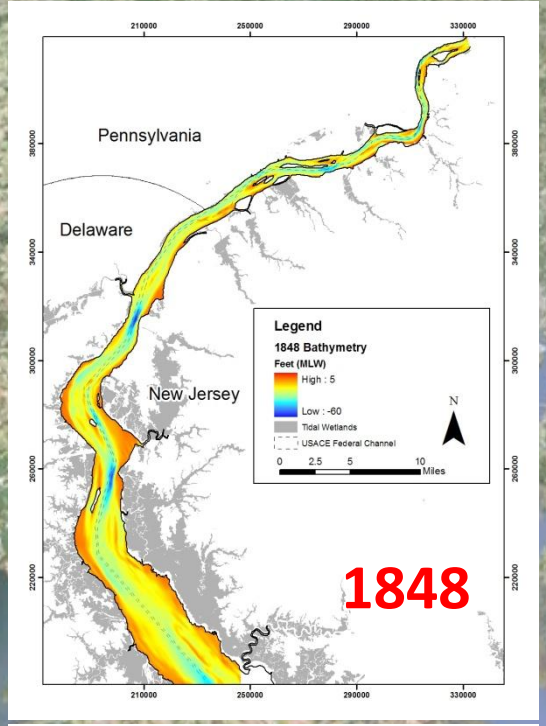
Average annual volume, 1976 – 2001: 3.4 x 10^6 m^3/yr

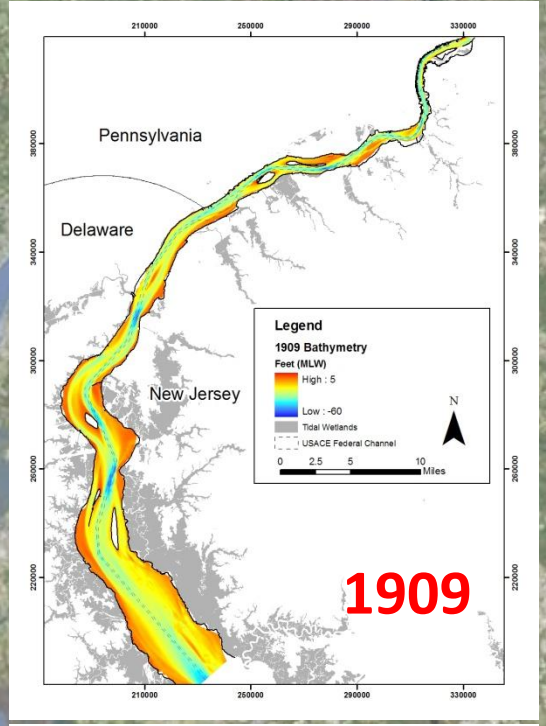
Average annual sediment mass: 1.8 x 10^6 mt/yr

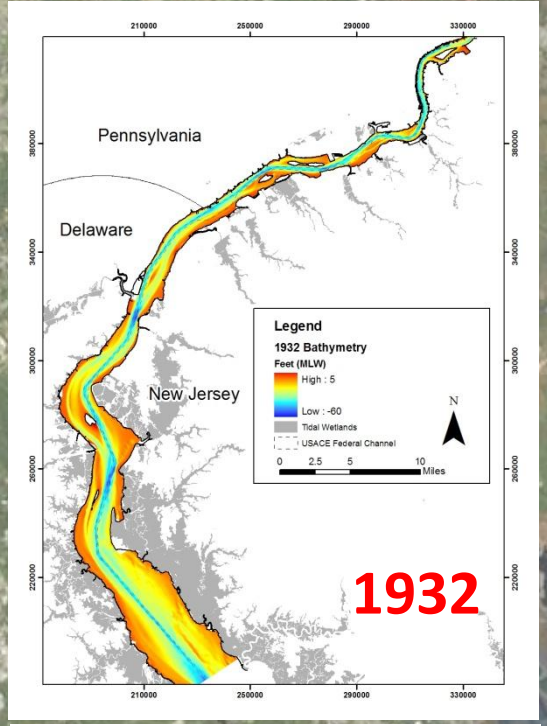

Marcus Hook
Wilmington Harbor
Deepwater
New Castle
Dredging "hot spots"
75% of annual dredging
7% of Fed channel area
< 0.2% of estuary area
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
© 2013 Google
Image © 2013 TerraMetrics
27.7 mi

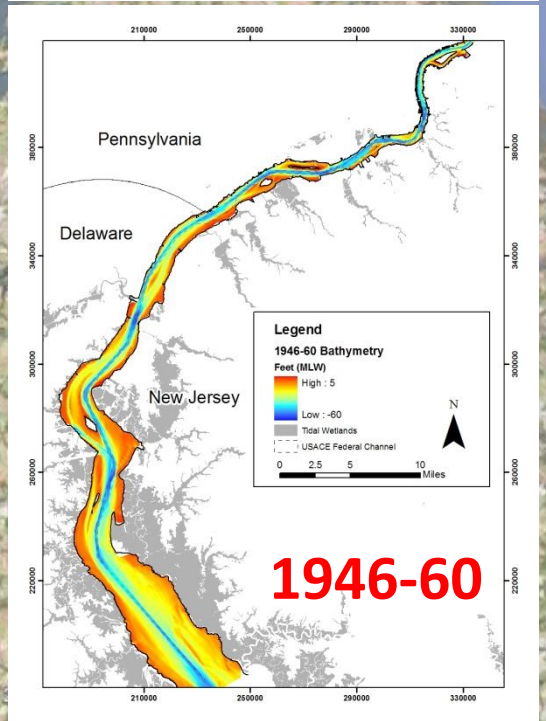
TASK 4. Accumulation/ erosion in subtidal zones

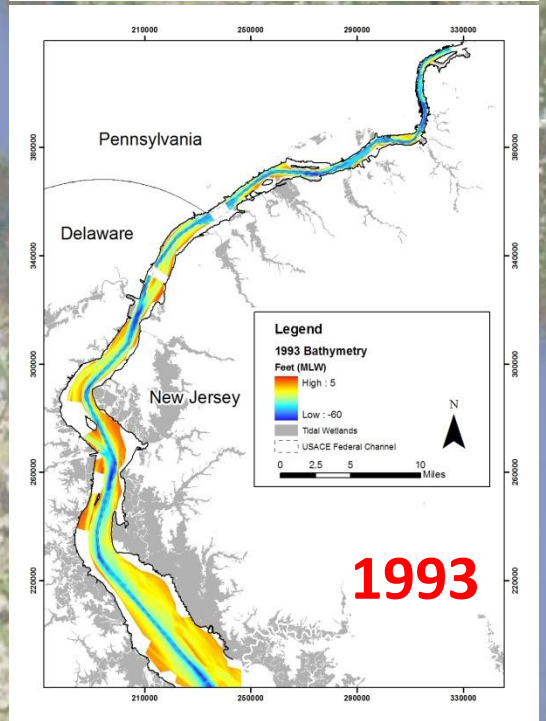


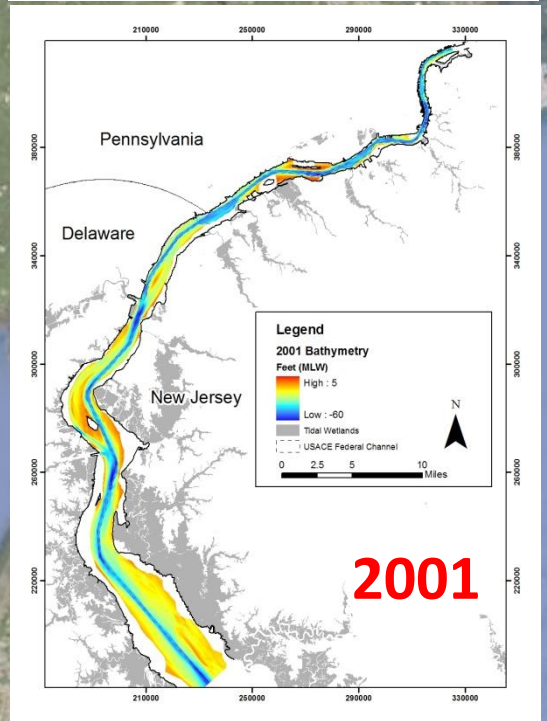

Pennsylvania
Delaware
New Jersey
Legend
1848 Bathymetry
Feet (MLW)
High : 5
Low : -60
Tidal Wetlands
USACE Federal Channel
0 2.5 5 10
Miles
N
1848


Pennsylvania
Delaware
New Jersey
Legend
1909 Bathymetry
Feet (MLW)
High : 5
Low : -60
Tidal Wetlands
USACE Federal Channel
0 2.5 5 10
Miles
N
1909

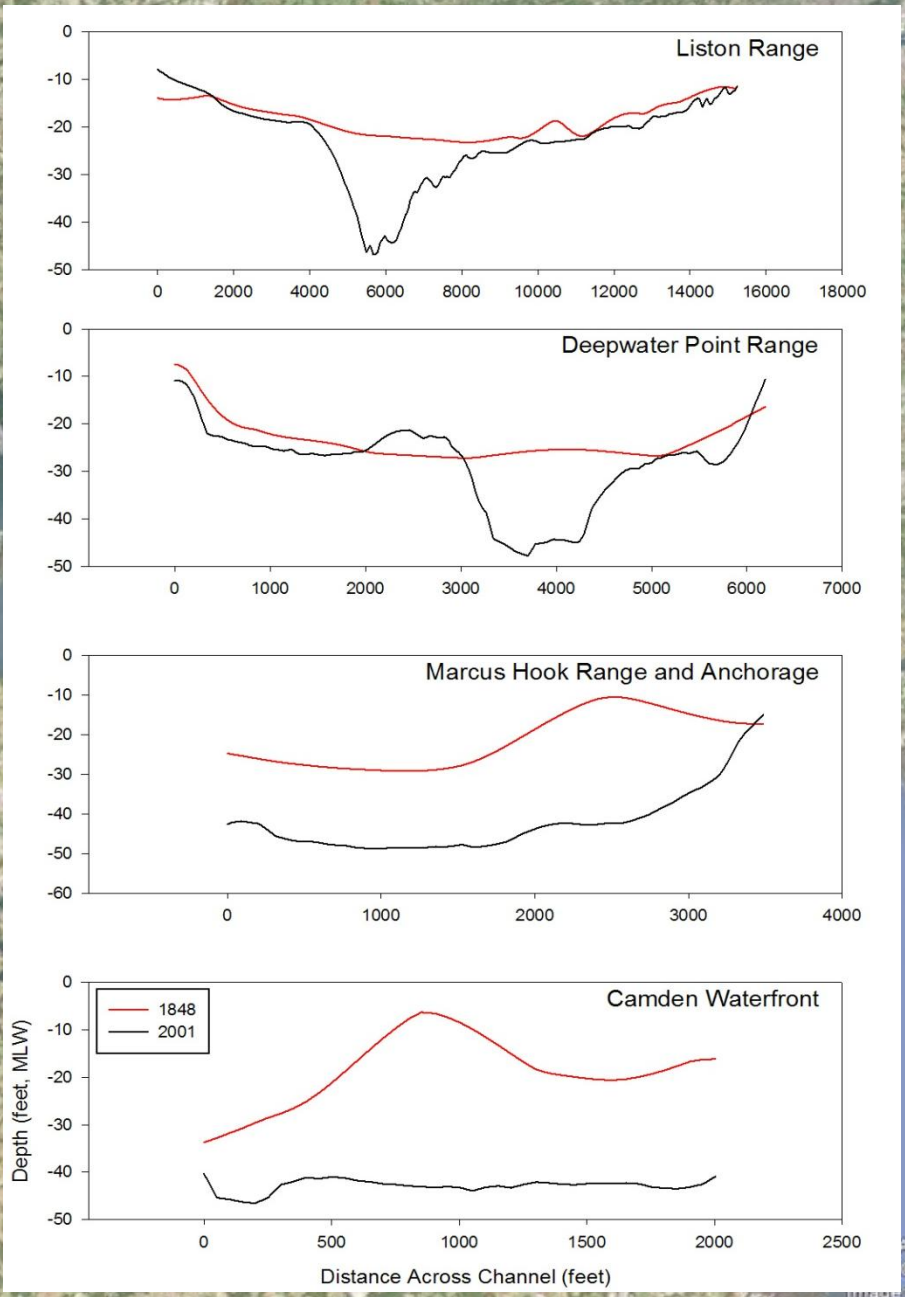

Pennsylvania
Delaware
New Jersey
Legend
1932 Bathymetry
Feet (MLW)
High : 5
Low : -60
Tidal Wetlands
USACE Federal Channel
0 2.5 5 10
Miles
N
1932


Pennsylvania
Delaware
New Jersey
Legend
1946-60 Bathymetry
Feet (MLW)
High : 5
Low : -60
Tidal Wetlands
USACE Federal Channel
0 2.5 5 10
Miles
N
1946-60

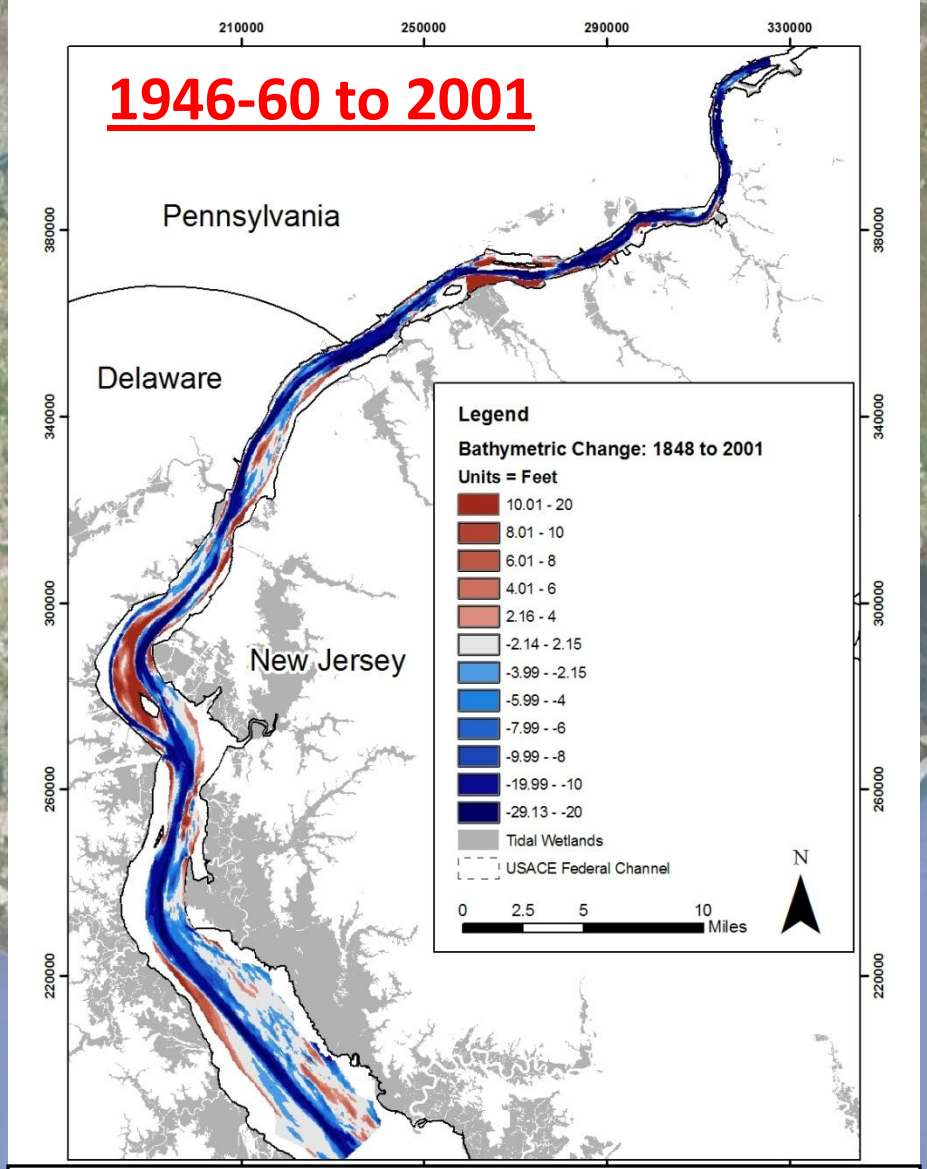

Pennsylvania
Delaware
New Jersey
Legend
1993 Bathymetry
Feet (MLW)
High : 5
Low : -60
Tidal Wetlands
USACE Federal Channel
0 2.5 5 10
Miles
N
1993


Pennsylvania
Delaware
New Jersey
Legend
2001 Bathymetry
Feet (MLW)
High : 5
Low : -60
Tidal Wetlands
USACE Federal Channel
0 2.5 5 10
Miles
N
2001

1848 to 2001



1946-60 to 2001



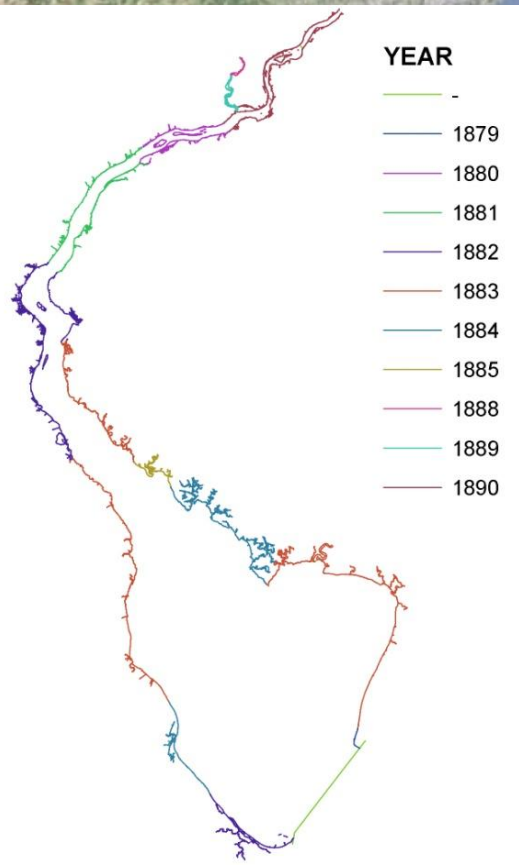
Subtidal losses: -2.4×10^6 mt/yr

Subtidal gains: $+0.4 \times 10^6$ mt/yr

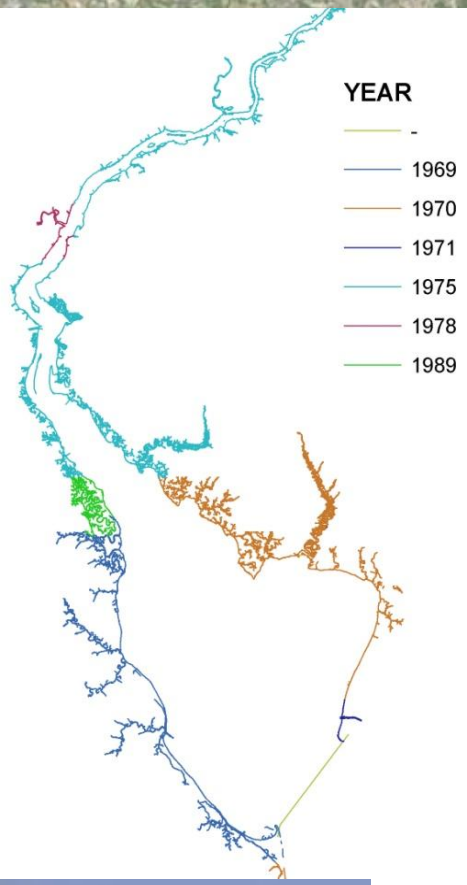
Net change: -2.0×10^6 mt/yr

TASK 5. Contribution from eroding wetlands

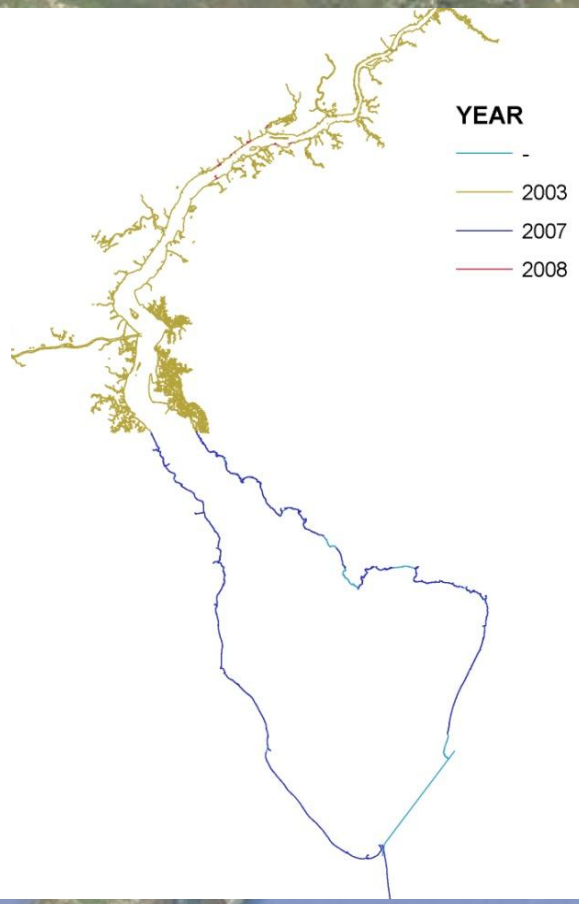
1879–1890



1969–1989

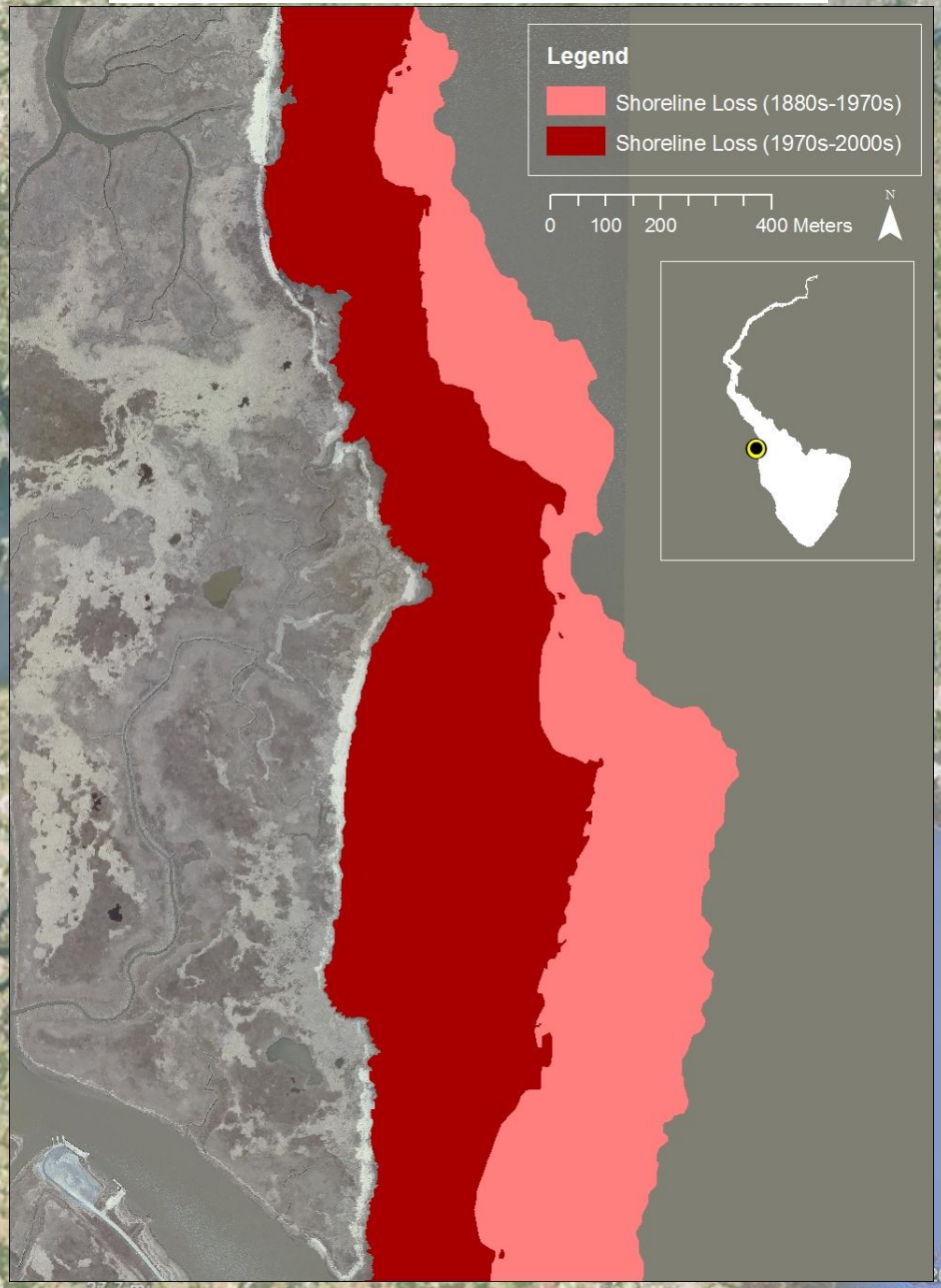


2003–2008

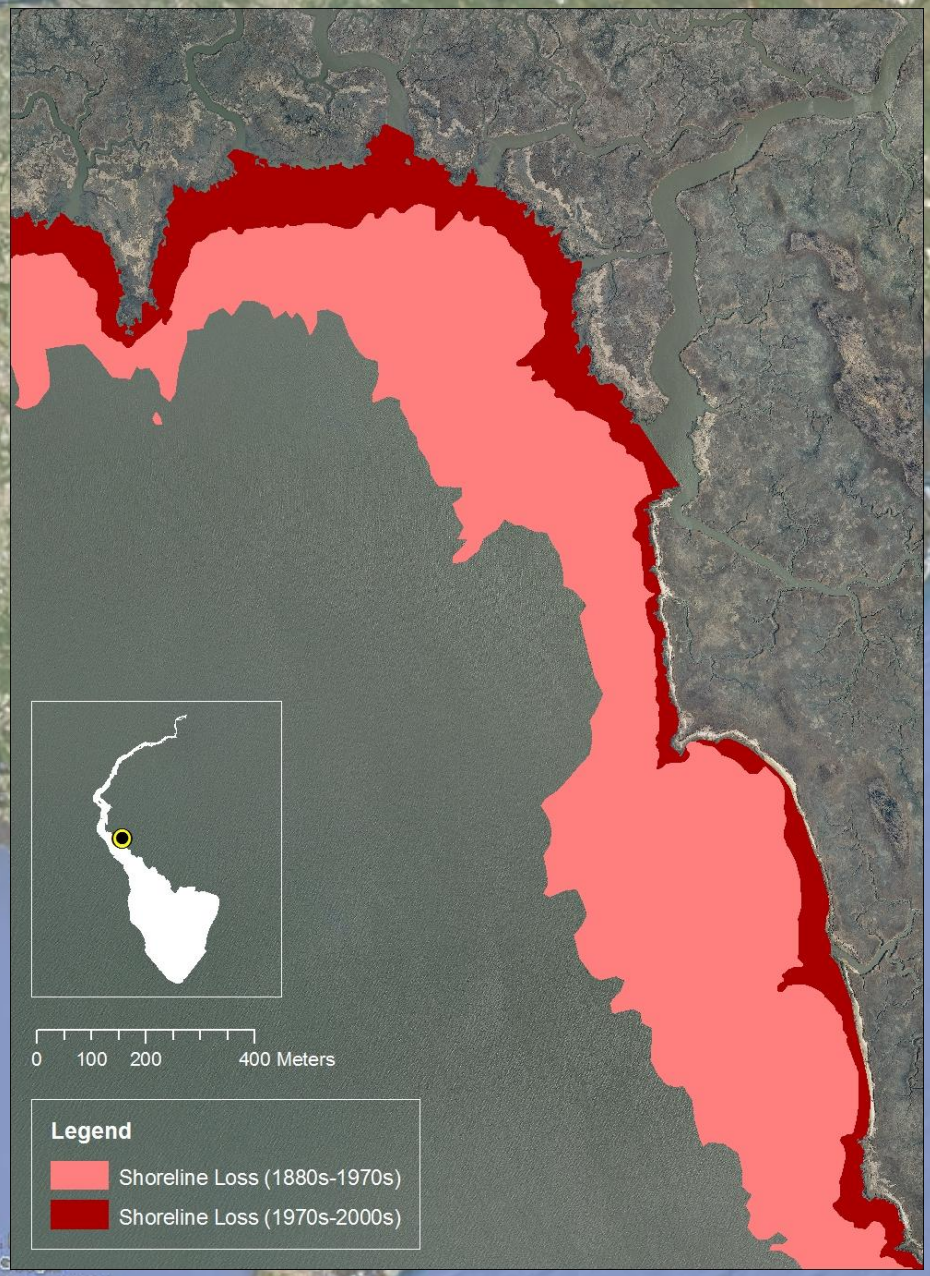


0.1 x 10^6 mt/yr

Port Mahon, DE vicinity



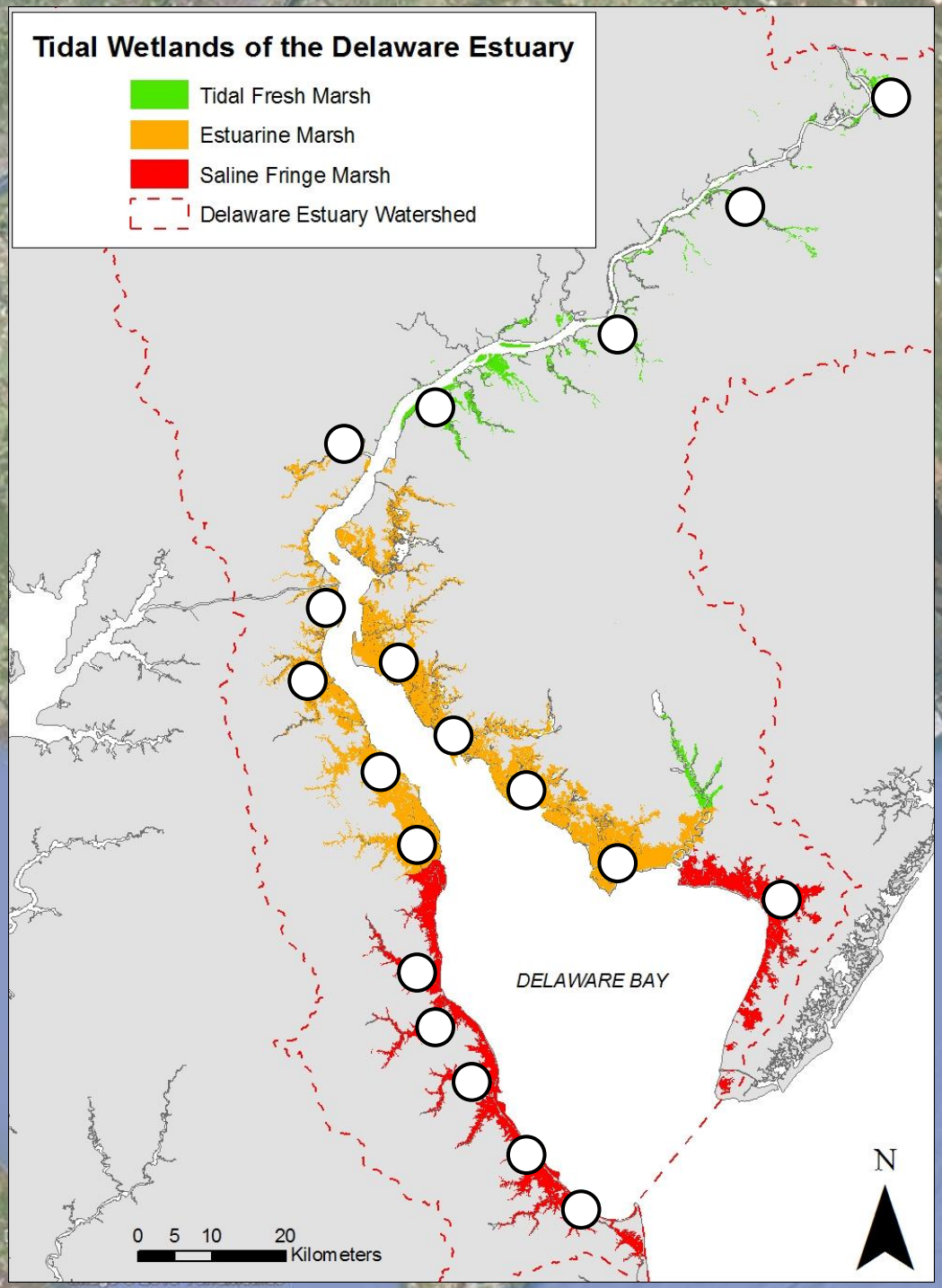
Alder Cove, NJ vicinity



TASK 6. Accumulation in tidal marshlands

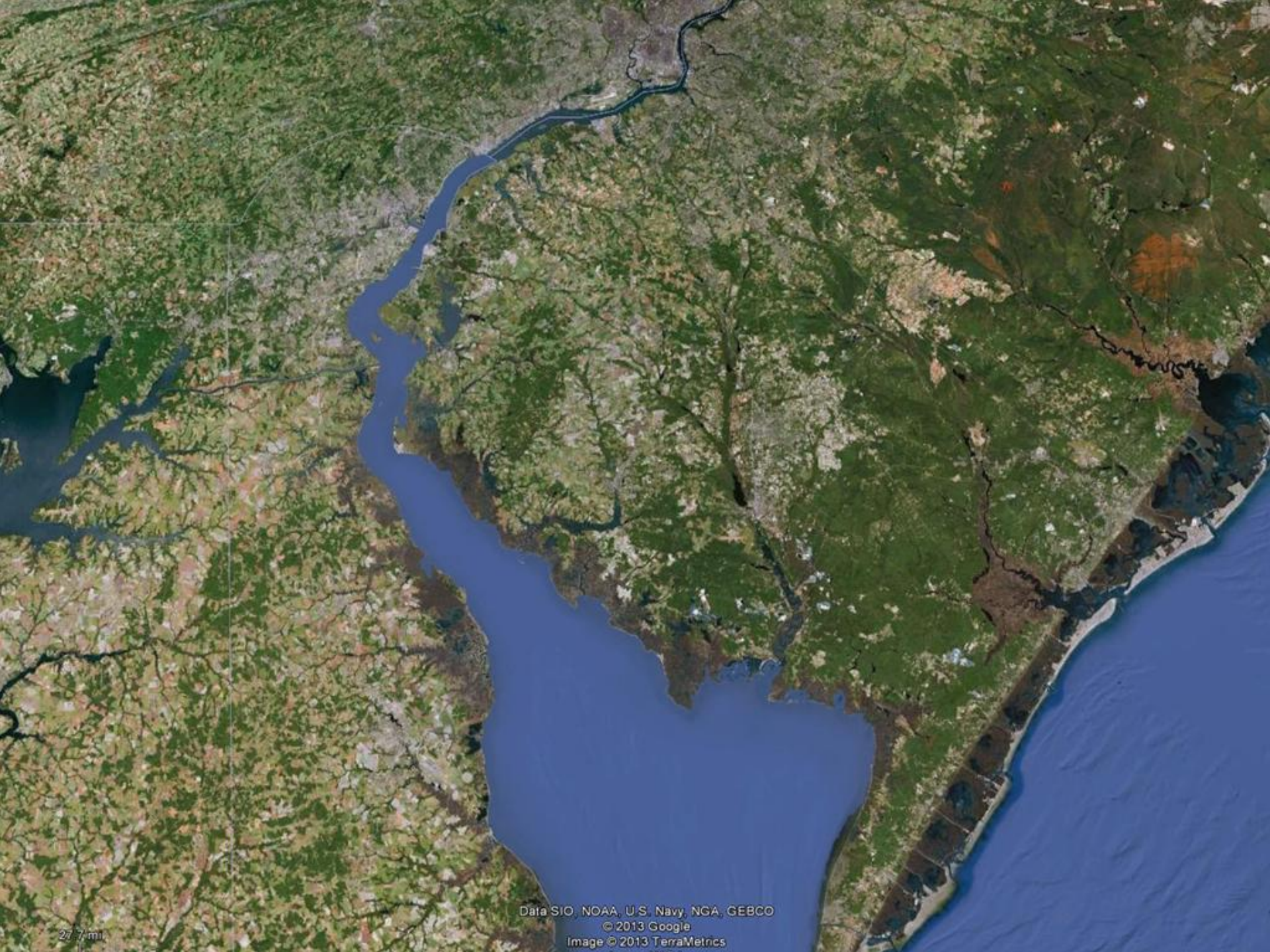
^{210}Pb and ^{137}Cs

1.1×10^6 mt/yr



Sediment mass balance for the Delaware Estuary averaged over 1953–2001

Sources	Input rate ($x10^6$ mt/yr)	%	***Sinks***	Rate of loss ($x10^6$ mt/yr)	%
Subtidal erosion	2.4±0.4	64	Maintenance dredging	1.8±0.5	55
River discharge	1.3±0.9	35	Marsh accumulation	1.1±0.2	33
Shore erosion	0.1±0.02	<1	Subtidal accumulation	0.4±0.2	12
Totals	**3.8±0.9**	**100**		**3.3±0.6**	**100**


Data SIO, NOAA, U.S. Navy, NGA, GEBCO
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27.7 mi

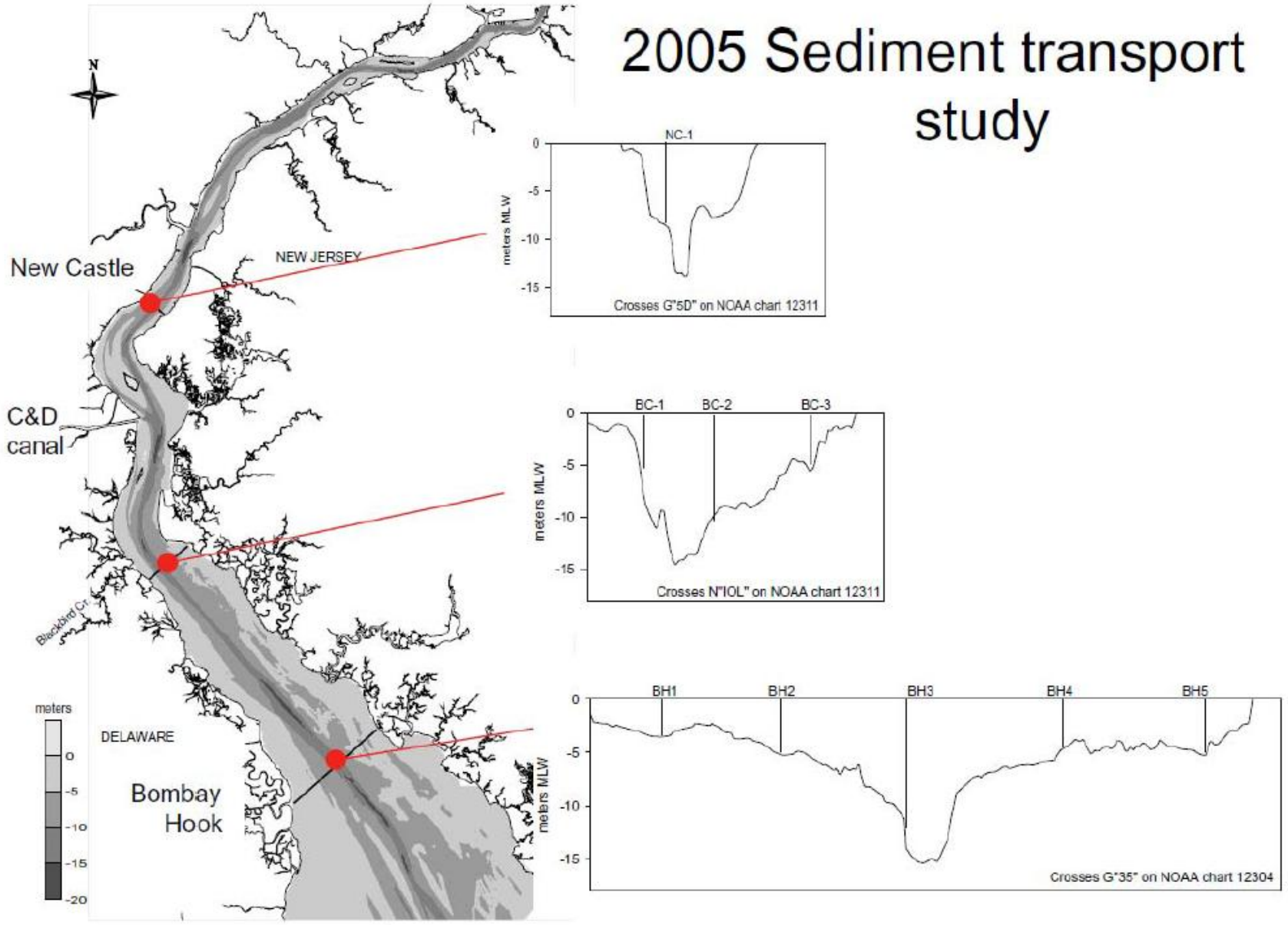
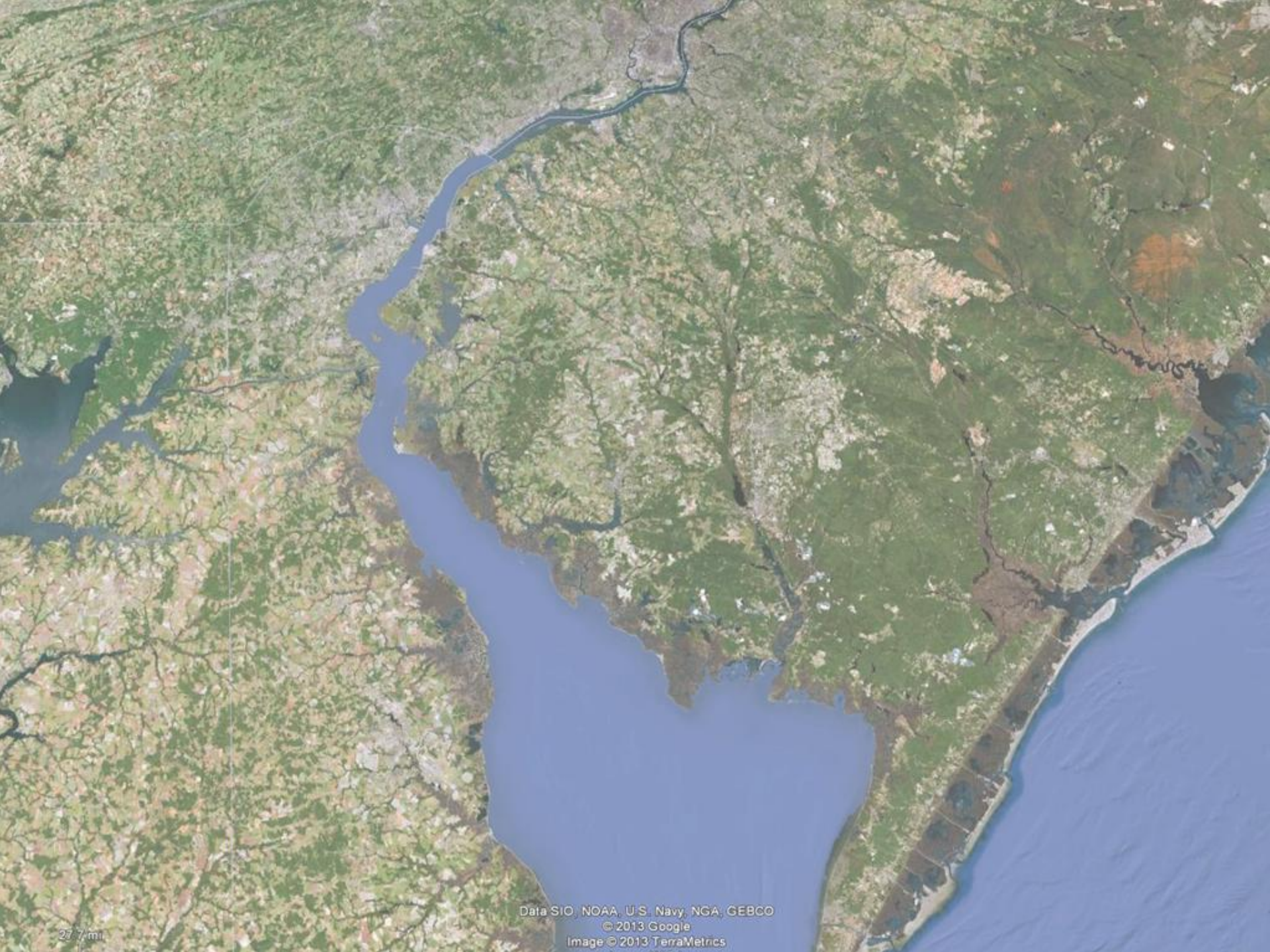


Figure 5: Location Map for UD 2005 Observations (Sommerfield, "Understanding Turbidity in the Delaware Estuary", 2007 Delaware Estuary Science Conference)


Data SIO, NOAA, U.S. Navy, NGA, GEBCO
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27.7 mi