USGS Chesapeake Science, 2020-2025 Work Plans:

Studies to assess land-use change and BMP effects on stream health, fish habitat, and aquatic conditions

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U.S. Department of the Interior
U.S. Geological Survey

Science to understand and predict the response of streams to management actions

What are the effects of watershed BMPs and land use change on downstream:

Stream health
Fish habitat
Aquatic conditions

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Theme 1: Provide an integrated understanding of the factors affecting stream health, fish habitat, and aquatic conditions

state of the science

Status and Trends

new metrics

data, new questions

new metrics

data, new questions

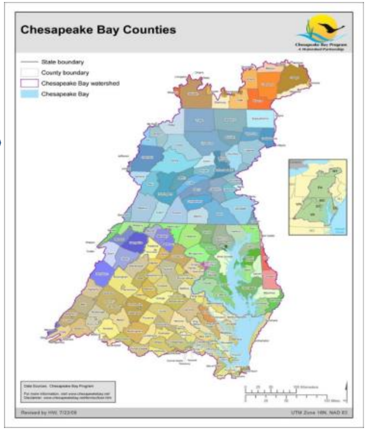
Regional Assessments

new questions

new processes

Focused studies

stakeholders



scientific continuum

Larger extent	Smaller extent
Correlative	Mechanistic/Process
Space	Time
Organismal endpoints	Multiple endpoints
Assess condition	R&D
Existing data	Some new data

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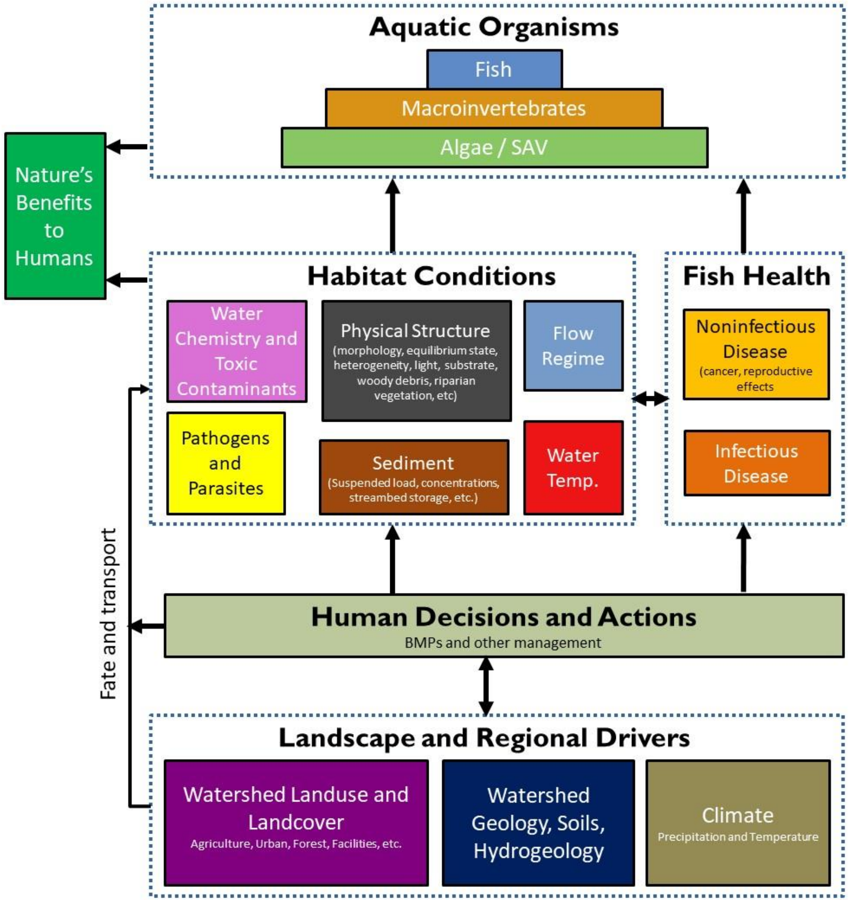
Conceptual model for explaining change of fish habitat, fish health, and aquatic conditions in relation to stressors and management activities



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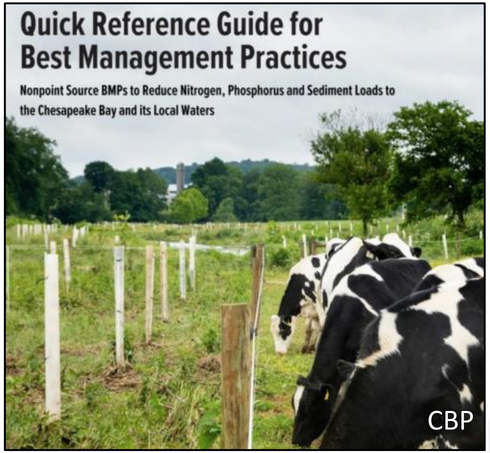
In other words…



CBP


Bay Journal


Soapboxie


Cary Institute


Gloucester Times, photo courtesy Steve Hurley

Focused studies of habitat settings

Integration Topic 1A: Explain factors and changes in stream health, fish habitats, and aquatic conditions

1. Summarize what is known about the stressors and drivers that are affecting stream health in the Chesapeake Bay Watershed.

2. Determine the effect of BMPs and other aquatic condition drivers on temporal and spatial water-quality responses in four showcase watersheds

3. Land-use change and BMPs effects on stream health and aquatic habitat response in select small watersheds with intensive BMP implementation
   a. Analyze relationships between management actions, drivers, stressors, aquatic habitat, and macroinvertebrates and fish
   b. Initiate studies on the effects of land-use change and BMPs on stream health, aquatic conditions (WQ), physical habitat, and aquatic organisms
   c. Planning of whole-system models of stream health, fish habitat and aquatic conditions response to management actions

4. Assessing the relation of toxic contaminants to stream health and BMPs to reduce impacts in urban areas

Focused studies of habitat settings

Integration Topic 1A: Factors affecting cold headwaters streams and implication for management decisions

1. Identify relationships between drivers, stressors, and macroinvertebrate and fish response in Shenandoah National Park, with a focus on climate change and changes in atmospheric acid deposition

2. Identify effects of non-native species removal on brook trout

3. Forecast thermal habitat suitability for brook trout at management relevant scale

4. Evaluate and coordinate science and monitoring needs to support Brook Trout Outcome

Focused studies of habitat settings

Integration Topic 1A: Factors affecting rivers and implication for management decisions

1. Complete synthesis and communication of the effects of contaminants on fish health in agricultural watersheds

2. Develop a bio-surveillance metric(s) as an indicator of declining fish health

3. Develop studies to examine BMP effects and stressors affecting habitat conditions and fish health

4. Fish health and water quality response to BMP implementation in agricultural watersheds
   a. Fish health response to BMP implementation
   b. Quantify effects of BMPs on load reduction of nutrients from agriculture to surface waters

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Focused studies of habitat settings

Integration Topic 1A: Factors affecting tidal freshwater estuary aquatic conditions and implication for management decisions

1. Complete synthesis of drivers and changes in estuary water quality

2. Relate watershed inputs to aquatic condition response

3. Conduct co-designed ‘test bed’ study with MD DNR on invasive blue catfish in the Patuxent River

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Integration Topic 1B: Quantitative Stream Condition, Fish Habitat and Fish Health Assessments

1. Assess relationships and identify stressors affecting stream health and freshwater fish habitats
   a. Improve predictive modeling of stream conditions using the Chessie BIBI

2. Plan and conduct assessment of fish habitats and fish health
   a. Improve predictive modeling of stream conditions using the Chessie BIBI
   b. Evaluate 1:100,000 data availability and application for watershed-wide assessment
   c. Evaluate technical approaches and refine assessment methodology in test areas
   d. Joint Planning with NOAA

3. Collaborate with partners and stakeholders to better understand science needs related to invasive and pre-listing species and species of listing concern.

Status and Trends

Integration Topic 1C: Data compilation, integrated monitoring networks and monitoring and computation of status and trends for relevant topics

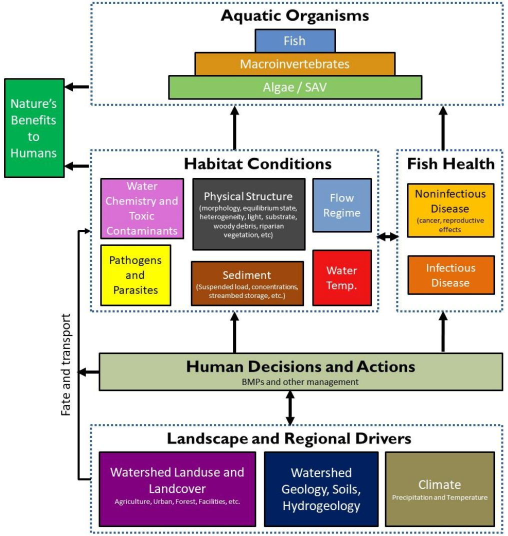
1. Conduct data inventories and compilation
   a. Aquatic Communities
   b. Flow and Water Temperature
   c. Water Quality: Nutrients and Suspended Sediment
   d. Toxic Contaminants
   e. Conductivity and associated ions

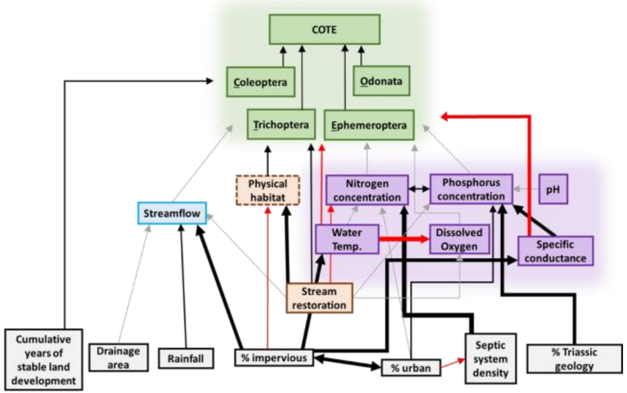
2. Conduct Status and Trends Analyses
   a. Conduct monitoring to support the CBP nontidal network
   b. Migration of the Chesapeake Bay nontidal network and total flow to the bay web pages to Drupal and subsequent content update
   c. Compute status and trends for key drivers and measures of fish habitat and health

3. Design and implement integrated monitoring network

Factors affecting streams and implications for management decisions

Conceptual model for explaining change of fish habitat, fish health, and aquatic conditions in relation to stressors and management activities





1. Land use and BMP characterization
2. Flow and Temp
3. Geomorph and riparian/floodplain condition
    a. Fine sediment storage and embeddedness and particle size distribution on stream bed
    b. Channel morphology, complexity, coarse wood distribution, slope
    c. Channel stability metrics
    d. Bank characteristics (roots, veg, shape) and erosion (short-term and long-term)
    e. Riparian vegetation (near bank) characteristics: shading, cover, basal area, coarse wood, invasives
    f. Active floodplain width and deposition (short-term and long-term)
4. WQ and contaminants
5. Organisms: community response, DELT, and targeted species for health
6. Whole system response using statistical approach

Chesapeake and Delaware Floodplain Network: network design

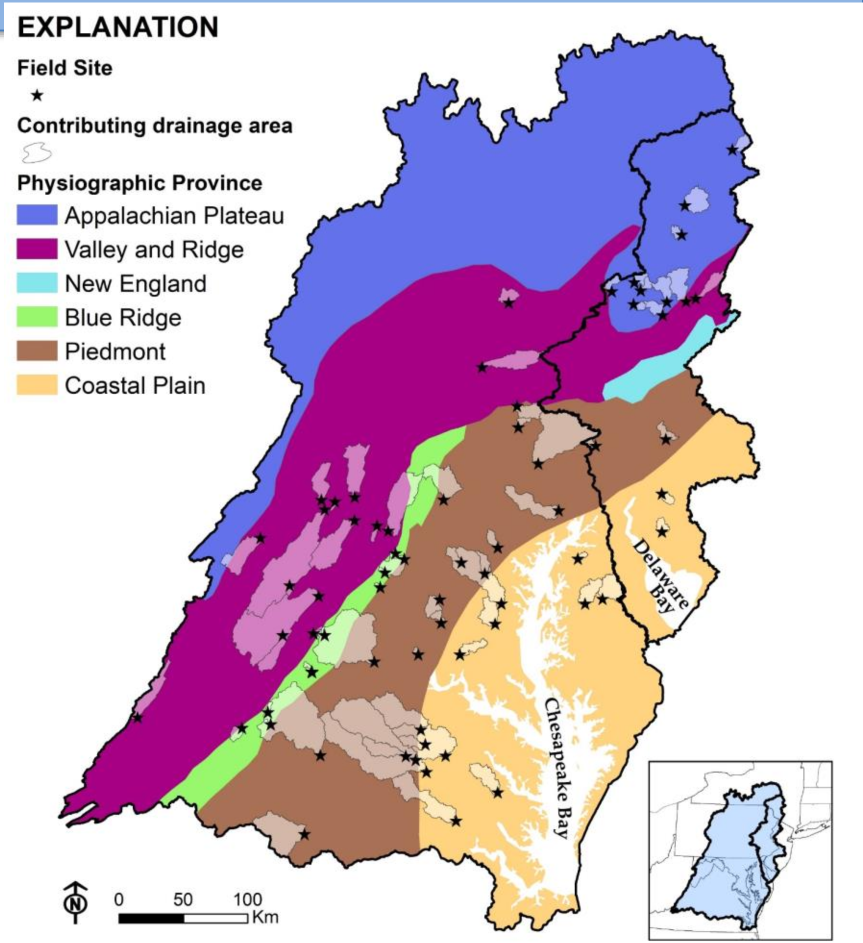
Bank and floodplain

sediment characteristics and fluxes

measured at 68 reaches

across mid-Atlantic,

representing variability in watershed drainage area, geology, and land use



<u>Site selection</u>:

- Chesapeake USGS NTN load gages, mix in Delaware, ungaged BR
- ‘Unmanaged’ floodplain land use (with woody vegetation)
- Unchannelized
- Landowner permission

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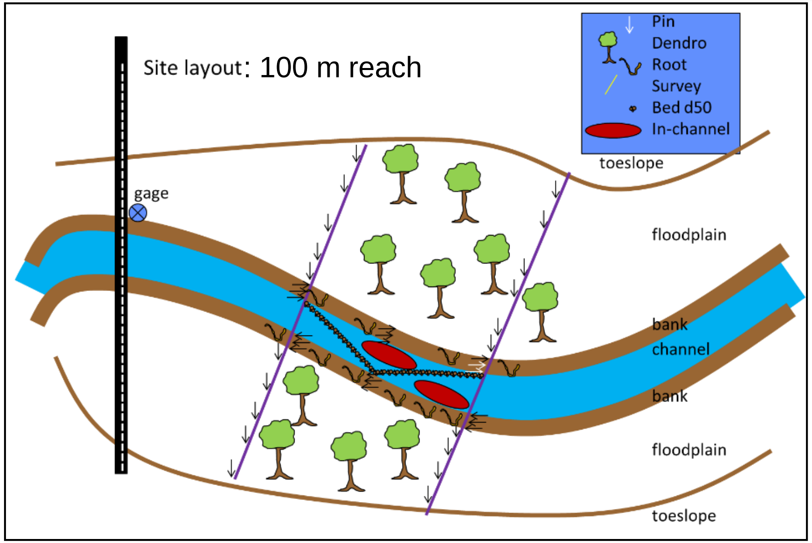
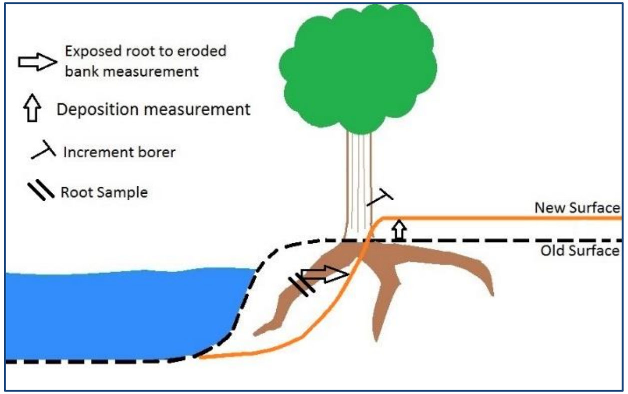
Chesapeake and Delaware Floodplain Network: measurements at 68 reaches



Dendrogeomorphic fluxes



Root analysis to determine years since exposure

Stream valley x-section surveying:
136 x-sections

Floodplain tree coring:
650 floodplain tree cores

Bank root:
492 bank root samples

Floodplain sed coring (5 cm deep):
296 floodplain samples

Bank sed coring (5 cm deep):
461 bank samples

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Geomorphic measurements:

Active floodplain width
Bank height
Channel width
Lateral and vertical change (cm/yr)
% eroding bank
Adjusted lateral erosion (cm/yr)

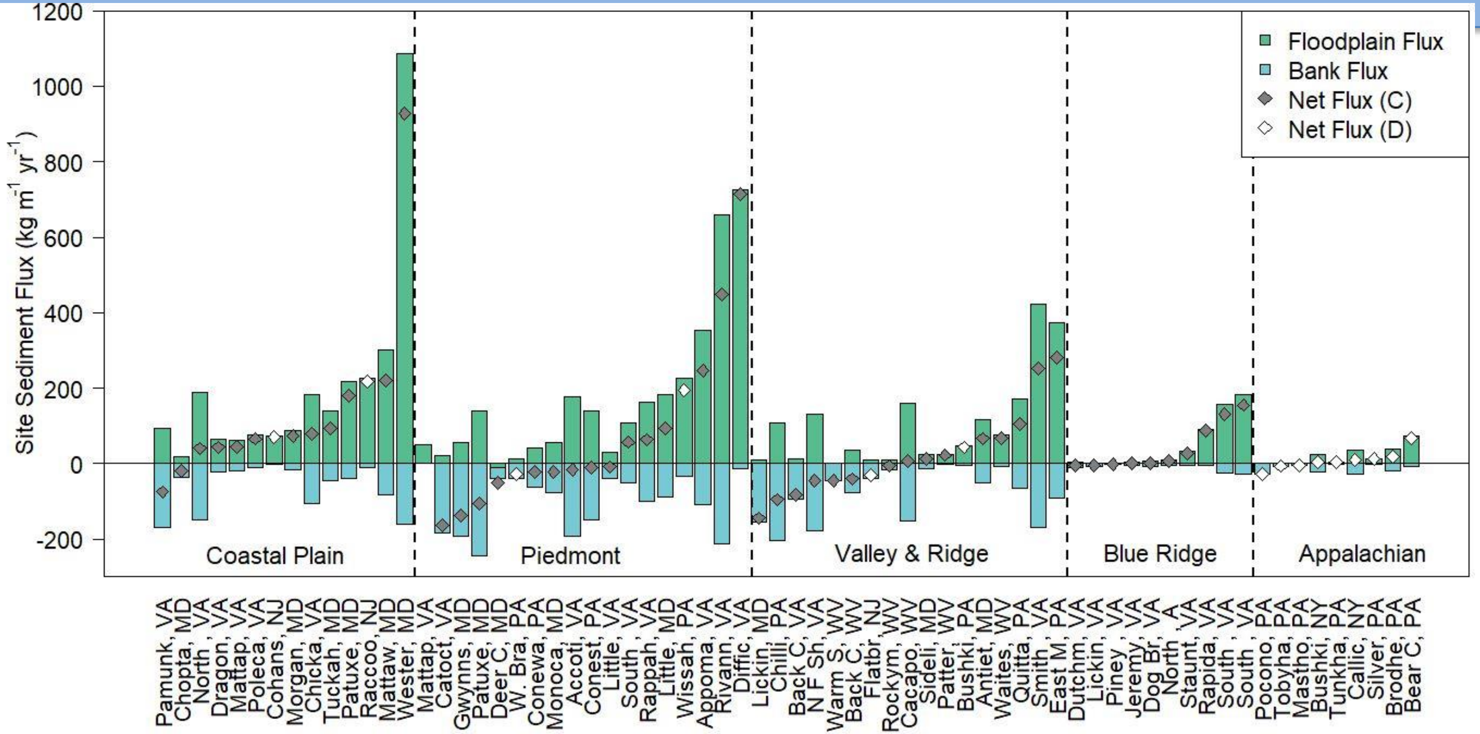
Sediment characteristics:

Bulk density (g/cm3)
Bulk density <2 mm (g/cm3)
Bulk density <1 mm (g/cm3)
% organic
% mineral
% carbonate
Total OC (%)
Total N (%)
Total P (%)
Total Ca (mg/g)
Total Na (mg/g)
Total Mg (mg/g)
Total K (mg/g)
Total Al (mg/g)
Total Fe (mg/g)
Total Ti (mg/g)
Particle size: mean (um)
Particle size: d50 (um)
Particle size: %<63 um

Chesapeake and Delaware Floodplain Network : long-term bank and floodplain flux

provisional results

<u>Mean ages of trees:</u>
floodplain = 51 yr,
bank = 17 yr exposed



<u>Bank flux =</u>
lateral change rate * bulk density * bank height * 2 * %eroding

<u>Floodplain flux =</u>
vertical change rate * bulk density * total floodplain width

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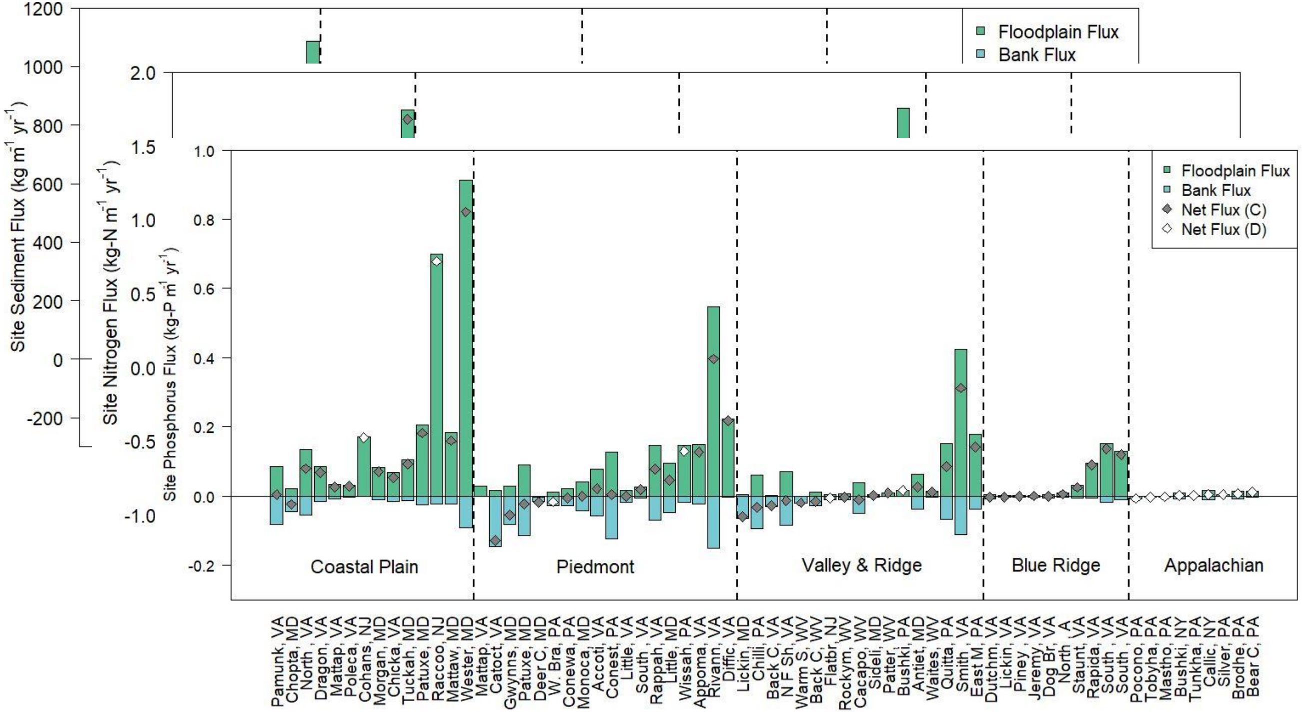
Chesapeake Floodplain Network: modeling of fluxes

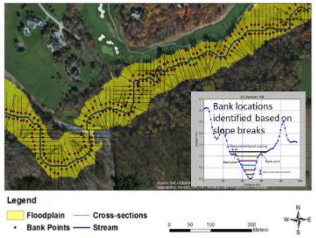
provisional results

Sediment, Sediment < 63 um, Sediment-N, Sediment-P, Sediment-C



GIS FACET toolkit

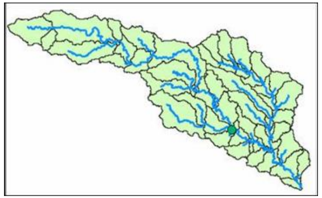
Floodplain width, bank height, channel width, …



Boosted Regression Trees

GIS Watershed Attributes

Land use, hydrology, soils, topography, upland erosion



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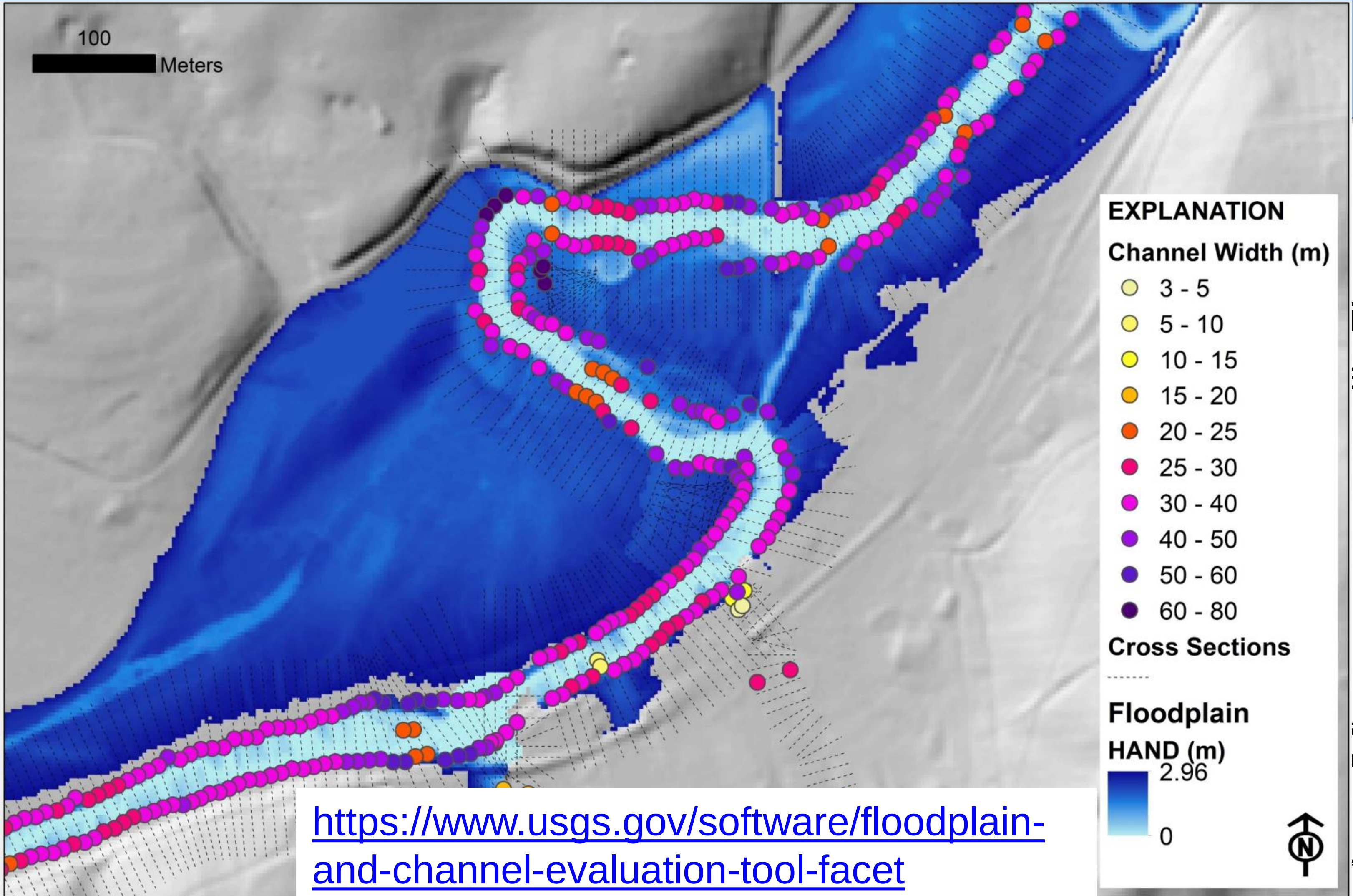

https://www.usgs.gov/software/floodplain-and-channel-evaluation-tool-facet

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Chesapeake Floodplain Network: floodplain characteristics

provisional results

combined Ches Del mean characteristics and fluxesv2 - Excel

Site name	Site physiographic province	Streambed particle size d50 (mm)	Streambed fine sediment (%)	Streambed fine+sand sediment (%)	Floodplain width (m)	Streambank height (m)	Channel width EOW (m)	Channel width TOB (m)	Channel W:D	Channel W*D	fp_width:bank_height	fp_width:ch_width	bank_height:fp_width	ch_width:fp_width	Floodplain vertical accretion rate sample size (n)	Floodplain vertical accretion rate mean (cm/yr)	Floodplain vertical accretion median (cm/yr)	Floodplain vertical accretion rates stdev (cm/yr)	Floodplain tree age mean (yr)	Floodplain sed bulk density sample size (n)	Floodplain sediment bulk density mean (g/cm3)	Floodplain sediment bulk density stdev (g/cm3)	Floodplain sediment bulk density <1mm mean (g/cm3)	Floodplain sediment mineral content mean (%)	Floodplain sediment organic content mean (%)	Floodplain sediment carbon content mean (%)	Floodplain sediment total organic C mean (%)
Antietam Creek near Sharpsburg, MD	V	45	3	3	34.8	1.40	25.7	29.5	21.1	41.3	24.9	1.18	0.040	0.85	10	0.47	0.19	0.90	51	4	0.72	0.50	0.46	83.3	11.6	5.1	4.95
Back Creek near Jones Springs, WV	V	32	3	6	13.2	1.71	22.0	29.2	17.1	49.9	7.7	0.45	0.130	2.21	5	0.38	0.40	0.27	40	4	1.01	0.05	1.01	93.2	5.4	1.4	1.83
Back Creek near Mountain Grove, VA	V	32	0	0	25.2	1.22	28.4	34.9	28.6	42.6	20.7	0.72	0.048	1.38	4	0.05	0.06	0.03	58	4	0.88	0.21	0.87	92.4	6.7	0.9	3.63
Bush Kill at Shoemakers, PA	V	45	0.75	4	33.2	0.45	31.3	33.1	73.8	14.8	74.1	1.00	0.013	1.00	14	0.17	0.16	0.04	50	8	0.83	0.25	0.68	90.3	9.3	0.4	3.70
Cacapon River near Great Cacapon, WV	V	90	0	13	42.7	2.28	45.2	45.2	19.8	103.1	18.7	0.94	0.053	1.06	10	0.47	0.19	0.90	48	6	0.99	0.16	0.99	93.1	6.6	0.4	2.59
Chillisquaque at Washingtonville, PA	V	22.5	0	0	58.5	2.07	13.4	24.2	11.7	50.1	28.3	2.42	0.035	0.41	13	0.20	0.18	0.21	46	4	0.87	0.11	0.87	88.3	11.6	0.1	3.51
East Mahantango Creek near Dalmatia, PA	V	45	0	2	79.6	1.82	26.3	33.8	18.6	61.5	43.7	2.36	0.023	0.42	8	0.58	0.53	0.23	36	4	1.06	0.12	1.05	90.3	8.7	1.0	2.44
Flatbrook Creek, NJ	V	32	0	21	4.8	1.41	19.8	22.8	16.1	32.2	3.4	0.21	0.296	4.78	8	0.29	0.26	0.16	78	8	0.65	0.16	0.65	86.8	12.7	0.5	5.39
Licking Creek near Pectonville, MD	V	32	3	3	19.5	1.79	18.5	30.4	17.0	54.4	10.9	0.64	0.092	1.56	5	0.09	0.22	0.56	34	4	0.87	0.13	0.87	91.6	7.3	1.1	3.13
N F Shenandoah River near Strasburg, VA	V	45	16	18	34.4	2.12	54.4	54.4	25.7	115.3	16.2	0.63	0.062	1.58	10	0.39	0.26	0.37	42	4	0.87	0.23	0.87	86.8	10.1	3.1	3.85
Patterson Creek, WV	V	362	1	3	24.8	1.13	16.4	24.0	21.2	27.1	21.9	1.03	0.046	0.97	16	0.09	0.15	0.20	56	4	1.01	0.05	0.97	90.2	9.5	0.4	3.70
Quittapahilla Ck near Bellegrove, PA	V	11.3	0	22	60.3	1.59	17.1	21.3	13.4	33.9	37.9	2.83	0.026	0.35	7	0.32	0.28	0.30	31	4	0.91	0.32	0.74	80.8	13.4	5.8	4.23
Rockymarsh Run at Scrabble, WV	V	1	39	55	6.6	1.59	5.3	11.7	7.4	18.6	4.2	0.56	0.241	1.77	3	0.25	0.27	0.23	46	5	0.51	0.12	0.49	58.1	17.6	24.4	7.62
Sideling Hill Creek near Bellegrove, MD	V	90	0	0	22.8	1.47	21.8	31.8	21.6	46.7	15.5	0.72	0.064	1.39	11	0.13	0.14	0.45	52	4	1.04	0.13	1.04	94.8	5.2	0.0	1.46
Smith Creek near New Market, VA	V	5.7	13	13	46.1	1.95	11.5	20.9	10.7	40.8	23.6	2.21	0.042	0.45	5	1.36	0.54	1.99	21	4	0.89	0.08	0.89	83.5	10.3	6.2	4.71
Waites Run near Wardensville, WV	V	60	0	2	31.1	1.10	10.3	17.0	15.5	18.7	28.3	1.83	0.035	0.55	4	0.33	0.33	0.32	77	4	0.87	0.18	0.63	92.3	6.8	0.9	2.28
Warm Springs Run near Berkeley Springs,	V	8	11	11	6.2	1.66	6.2	11.8	7.1	19.6	3.7	0.53	0.268	1.90	1	0.00	0.00	na	22	4	1.16	0.21	0.93	91.3	7.8	0.9	2.70
Accotink Creek near Annandale, VA	P	11.3	27	24	166.6	2.06	11.8	20.2	9.8	41.6	80.9	8.25	0.012	0.12	12	0.11	0.10	0.27	42	4	0.97	0.24	0.95	90.5	8.6	0.9	3.04
Appomattox River at Farmville, VA	P	8	1	33	99.7	3.23	17.3	28.8	8.9	93.0	30.9	3.46	0.032	0.29	13	0.35	0.18	0.38	36	4	1.00	0.11	1.00	89.9	9.4	0.7	3.50
Catoctin Creek at Taylorstown, VA	P	16	9	9	82.6	2.23	15.6	34.9	15.7	77.7	37.1	2.37	0.027	0.42	8	0.03	0.07	0.58	29	4	0.94	0.12	0.93	92.6	6.6	0.8	2.72
Conestoga River, PA	P	8	14	14	49.8	3.35	43.4	54.5	16.3	182.6	14.9	0.91	0.067	1.10	7	0.26	0.26	0.12	56	4	1.06	0.13	1.03	90.6	7.8	1.5	2.95
Conewago Creek near Bellaire, PA	P	5.7	2	2	28.9	1.41	10.8	12.7	9.0	17.9	20.5	2.28	0.049	0.44	3	0.12	0.18	0.11	59	4	1.14	0.04	1.14	90.6	9.0	0.4	2.70
Deer Creek near Darlington, MD	P	362	0	0	15.4	2.48	30.6	40.1	16.2	99.3	6.2	0.38	0.161	2.61	8	-0.07	0.03	0.32	74	4	0.92	0.19	0.92	92.7	6.4	0.9	3.13
Difficult Run near Great Falls, VA	P	11.3	6	15	187.7	2.04	19.3	24.3	11.9	49.6	91.9	7.72	0.011	0.13	14	0.42	0.35	0.39	44	4	0.98	0.04	0.97	93.4	5.8	0.8	1.92
Gwynns Falls at Villa Nova, MD	P	22.5	3	19	159.2	1.72	14.2	21.9	12.7	37.7	92.4	7.27	0.011	0.14	12	0.03	0.07	0.17	32	4	1.10	0.08	1.09	90.1	8.9	1.0	2.67
Little Patuxent River at Guilford, MD	P	1	26	26	81.9	1.99	14.3	19.1	9.6	37.9	41.3	4.29	0.024	0.23	10	0.22	0.17	0.25	35	4	1.03	0.07	0.98	90.3	8.9	0.8	2.65
Little River near Doswell, VA	P	16	23	23	47.0	2.01	20.5	25.6	12.7	51.5	23.4	1.83	0.043	0.55	5	0.07	0.06	0.05	50	4	0.88	0.13	0.88	86.2	13.0	0.8	4.68
Monocacy River at Bridgeport, MD	P	32	3	3	51.4	2.77	32.9	48.9	17.7	135.5	18.5	1.05	0.054	0.95	8	0.13	0.13	0.12	54	4	0.86	0.13	0.86	87.5	11.8	0.7	3.91
Patuxent River, MD	P	22.5	15	15	141.7	1.91	12.4	17.3	9.0	33.1	74.1	8.19	0.014	0.12	12	0.12	0.11	0.13	66	4	0.84	0.19	0.83	87.9	11.1	1.0	3.89
Rappahannock River at Remington, VA	P	32	3	3	75.1	3.72	37.4	50.2	13.5	186.7	20.2	1.50	0.050	0.67	10	0.27	0.22	0.21	36	4	0.80	0.12	0.80	88.0	11.2	0.8	3.34
Rivanna River, VA	P	4	14	14	122.0	3.75	31.1	31.1	8.3	116.6	32.5	3.92	0.031	0.25	11	0.59	0.44	0.47	21	4	0.91	0.16	0.91	89.9	9.2	0.9	2.72
South Fork Quantico Creek near Independe	P	16	3	3	75.3	1.03	4.3	10.5	10.2	10.8	73.1	7.17	0.014	0.14	12	0.18	0.15	0.18	51	4	0.79	0.14	0.79	90.5	8.9	0.5	3.83
West Branch Brandywine Creek near Honey	P	16	0	13	3.6	1.09	6.5	12.2	11.2	13.3	3.3	0.29	0.307	3.43	8	0.39	0.28	0.30	34	8	0.94	0.18	0.88	91.4	8.4	0.3	2.92
Wissahickon Creek at Fort Washington, PA	P	45	0	10	67.4	1.62	15.7	22.3	13.8	36.0	41.7	3.02	0.024	0.33	11	0.30	0.35	0.15	48	8	1.13	0.14	1.11	92.4	6.9	0.7	2.42
Chickahominy River, VA	C	1	6	77	199.9	1.90	14.6	20.5	10.8	39.0	105.2	9.75	0.010	0.10	18	0.10	0.06	0.09	81	6	0.95	0.17	0.95	91.5	8.2	0.3	3.01
Choptank River near Greensboro, MD	C	1	7	61	130.3	1.46	23.4	28.9	19.8	42.2	89.3	4.51	0.011	0.22	18	0.02	0.04	0.04	77	6	0.60	0.24	0.59	77.0	22.3	0.7	9.71
Cohansey River at Seeley, NJ	C	nd	nd	nd	204.4	0.55	8.2	8.2	14.9	4.5	372.3	24.93	0.003	0.04	10	0.10	0.10	0.04	105	8	0.35	0.11	0.35	72.0	27.0	1.0	8.27
Dragon Swamp near Mascot, VA	C	0.03	60	93	113.0	2.31	13.1	15.1	6.5	34.9	48.9	7.48	0.020	0.13	15	0.10	0.12	0.06	71	6	0.59	0.27	0.59	83.2	16.4	0.4	6.33
Mattaponi River near Beulahville, VA	C	1	0	58	100.6	2.90	20.3	25.3	8.7	73.4	34.7	3.98	0.029	0.25	13	0.09	0.07	0.07	70	6	0.69	0.17	0.69	87.0	12.5	0.5	5.44
Mattaponi River near Bowling Green, VA	C	nd	nd	nd	111.6	0.99	23.5	24.0	24.2	23.8	112.5	4.65	0.009	0.21	18	0.05	0.06	0.05	79	6	0.87	0.09	0.87	88.0	11.2	0.8	4.16
Mattawoman Creek near Pomonkey, MD	C	16	16	16	200.4	1.54	11.4	19.2	12.4	29.6	129.9	10.43	0.008	0.10	14	0.20	0.12	0.19	48	6	0.77	0.18	0.77	87.4	12.5	0.2	4.95
Morgan Creek near Kennedyville, MD	C	0.03	28	85	67.4	1.45	5.7	8.3	5.7	12.1	46.4	8.12	0.022	0.12	9	0.16	0.10	0.11	36	6	0.80	0.19	0.79	86.5	12.9	0.6	5.21
North Anna River near Doswell, VA	C	1	0	99	128.0	4.01	27.0	32.6	8.1	130.8	31.9	3.93	0.031	0.25	16	0.21	0.18	0.14	55	6	0.72	0.11	0.72	87.3	11.7	1.0	3.72
Pamunkey River near Hanover, VA	C	0.03	14	88	127.5	4.38	34.1	41.8	9.5	183.0	29.1	3.05	0.034	0.33	14	0.11	0.13	0.07	48	6	0.67	0.11	0.67	84.0	15.3	0.7	4.61

Sheet1

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Chesapeake Floodplain Network: modeling of fluxes

provisional results

CFDN watershed_attr fluxes and loads - Excel

COMID	Drainage area (km2)	Stream length (km)	Stream FTYPE	Tidal (1) / Nontidal (0)	Watershed	Floodplain sed flux (kg-sed/m/yr)	Floodplain fine sed flux (kg-finesed/m/yr)	Floodplain sedC flux (kg-C/m/yr)	Floodplain sedN flux (kg-N/m/yr)	Floodplain sedP flux (kg-P/m/yr)	Streambank sed flux (kg-sed/m/yr)	Streambank fine sed flux (kg-finesed/m/yr)	Streambank sedC flux (kg-C/m/yr)	Streambank sedN flux (kg-N/m/yr)	Streambank sedP flux (kg-P/m/yr)	Net sed flux (kg-sed/m/yr)	Net fine sed flux (kg-finesed/m/yr)	Net sedC flux (kg-C/m/yr)	Net sedN flux (kg-N/m/yr)	Net sedP flux (kg-P/m/yr)	StreamBed D50 (mm)	StreamBed fines (%)	StreamBed fines+sands (%)	SPARROW TN total (kg-N/yr)
8465829	323.69	13.738	StreamRiv	0	C	58.64883	20.21186	1.914083	0.14268	0.041481	-76.7073	-30.7657	-1.41708	-0.09955	-0.03442	-18.0584	-10.5539	0.497001	0.043127	-0.05601	34.09177	2.464608	10.88045	129000
4722107	115.25	13.73	StreamRiv	0	C	102.3955	33.1263	4.31653	0.335037	0.107508	-75.5626	-32.6494	-2.06863	-0.14767	-0.05162	26.83296	0.476921	2.247902	0.187372	-0.04724	12.81036	7.699529	19.41482	437000
8465851	34.72	8.521	StreamRiv	0	C	83.92298	27.34621	3.868451	0.218368	0.081479	-65.604	-30.6129	-1.38602	-0.10241	-0.04215	18.31899	-3.26665	2.482435	0.115955	-0.02527	7.276912	17.58634	29.30483	18800
11905734	18.92	14.53	StreamRiv	0	C	112.389	30.32386	3.633565	0.315806	0.119078	-75.8648	-29.5036	-1.38306	-0.10413	-0.03699	36.52412	0.820267	2.250501	0.211671	0.000689	7.249261	7.515052	28.71197	20900
4720209	57.8	8.959	StreamRiv	0	C	98.31894	31.58687	4.122697	0.325475	0.132699	-51.6789	-21.109	-1.21603	-0.07454	-0.02987	46.64	10.47785	2.906665	0.250932	0.044935	18.39143	6.204113	13.23572	152000
11687752	34.91	6.485	StreamRiv	0	C	148.3849	40.4442	4.570972	0.336722	0.142901	-87.3677	-24.6657	-1.67908	-0.09653	-0.04091	61.01717	15.77851	2.891887	0.240188	0.034779	14.91871	6.255375	19.50583	33000
4725793	16.81	10.203	StreamRiv	0	C	53.47622	14.25705	2.482309	0.224284	0.064168	-71.1986	-28.3518	-1.59967	-0.12312	-0.04404	-17.7224	-14.0947	0.882641	0.101161	-0.05968	30.42479	4.994288	13.40827	19700
8465813	26.42	7.773	StreamRiv	0	C	75.90317	24.92622	2.773719	0.174204	0.05743	-64.1509	-35.3256	-1.48241	-0.10625	-0.04017	11.75229	-10.3994	1.291307	0.067951	-0.04452	30.73104	5.187105	9.566393	16500
4725381	14.97	8.953	StreamRiv	0	C	41.92518	12.73491	1.993139	0.214565	0.054135	-40.9915	-17.7997	-1.40513	-0.08207	-0.02684	0.93364	-5.06481	0.588006	0.132491	-0.02859	19.37455	3.099319	19.67586	20200
4724669	13.02	7.88	StreamRiv	0	C	68.61112	21.00582	3.094499	0.246104	0.073825	-57.1865	-24.8883	-1.96621	-0.1228	-0.04031	11.42463	-3.88248	1.128289	0.123301	-0.06251	16.12507	5.967939	16.69486	59400
11687226	14.85	7.629	StreamRiv	0	C	45.70533	12.43828	1.885188	0.185048	0.05813	-62.7199	-25.9515	-1.39022	-0.1044	-0.04026	-17.0146	-13.5133	0.494964	0.080647	-0.05012	34.91098	4.378285	11.22319	20600
4722139	124.9	13.021	StreamRiv	0	C	123.8407	37.43174	5.225736	0.410795	0.132675	-92.8849	-34.1607	-2.24733	-0.18439	-0.06171	30.95575	3.271046	2.978403	0.22641	-0.04936	4.211952	8.921504	38.88053	533000
4763608	82.34	11.077	StreamRiv	0	C	91.52207	31.40052	3.716853	0.336234	0.096797	-73.1304	-27.4965	-2.00874	-0.12151	-0.04499	18.39164	3.904038	1.708114	0.214719	-0.0225	6.519208	7.090733	24.84625	236000
4763106	17.37	9.332	StreamRiv	0	C	58.57325	17.10364	2.332485	0.212352	0.066776	-68.6394	-24.9436	-1.89001	-0.12607	-0.04608	-10.0661	-7.83997	0.442472	0.086284	-0.07277	25.45851	5.808858	15.76479	25800
11688596	10.61	5.362	StreamRiv	0	C	108.2132	26.2026	3.576083	0.298338	0.117269	-100.31	-36.9006	-1.49809	-0.10819	-0.03551	7.903428	-10.698	2.077991	0.190148	-0.00536	26.59054	7.820976	18.45401	12500
4506772	23.7	5.709	StreamRiv	0	C	189.3905	60.18064	5.912008	0.364392	0.124146	-116.93	-40.3889	-1.85556	-0.11042	-0.04927	72.46023	19.7917	4.056448	0.253969	0.003776	12.99981	14.21251	18.92083	25900
11689684	67.28	4.937	StreamRiv	0	C	112.7472	37.3329	3.585867	0.287094	0.12158	-131.403	-40.9553	-2.35697	-0.16042	-0.05643	-18.6559	-3.62241	1.228893	0.126679	-0.05778	13.22393	4.934225	20.39658	80600
8468561	33.83	11.952	StreamRiv	0	C	76.79959	29.74982	3.477702	0.301371	0.06708	-86.5452	-37.7671	-2.03183	-0.13675	-0.05505	-9.74566	-8.01725	1.445868	0.164621	-0.06686	9.877033	7.76005	19.02881	31300
4726353	67596.37	3.961	ArtificialP	0	C	107.8304	31.84042	3.907012	0.336965	0.097324	-120.099	-32.6418	-1.87436	-0.14706	-0.0602	-12.2688	-0.80135	2.032657	0.189906	-0.05423	9.527385	2.867429	22.79532	60300000
4724709	13.64	7.001	StreamRiv	0	C	96.80059	27.15828	4.70203	0.406213	0.139026	-54.7455	-20.9599	-1.71179	-0.09853	-0.03288	42.05505	6.198398	2.990236	0.307683	0.036755	11.90086	8.105779	23.40795	19400
8468789	39.64	8.983	StreamRiv	0	C	92.09335	31.44731	4.389308	0.334553	0.092759	-96.8583	-37.4319	-2.38761	-0.16066	-0.06169	-4.76499	-5.98459	2.001695	0.173896	-0.0694	6.460105	9.211207	33.39612	37100
8465817	368.51	8.696	StreamRiv	0	C	64.47972	21.63067	2.119943	0.186142	0.046355	-78.2041	-27.1993	-1.41347	-0.09442	-0.02948	-13.7244	-5.56865	0.706475	0.091726	-0.05419	33.25067	2.243851	10.58538	138000
4725537	12.93	5.022	StreamRiv	0	C	93.73795	26.71398	4.012903	0.331853	0.123689	-55.3638	-20.4104	-1.64581	-0.10055	-0.03831	38.37411	6.303581	2.367097	0.231299	0.013659	11.78602	5.994077	25.21706	45500
11687124	15	9.885	StreamRiv	0	C	44.68276	11.63925	1.980084	0.188179	0.051797	-56.7602	-25.3827	-1.5144	-0.11299	-0.03536	-12.0775	-13.7434	0.465685	0.075191	-0.06459	40.68771	2.84634	10.05018	13000
4722113	812.92	5.294	StreamRiv	0	C	131.1307	45.57168	4.459821	0.326037	0.111558	-94.5664	-34.6888	-2.09877	-0.14459	-0.05725	36.56429	10.88289	2.36105	0.181451	-0.03232	8.441931	6.10505	18.69717	2730000

fluxes all | fluxes censored | loads censored | sum loads censored

Average: 22.11966676 Count: 99665 Numerical Count: 99664 Min: 0.837586667 Max: 81.33706667 Sum: 2204534.468

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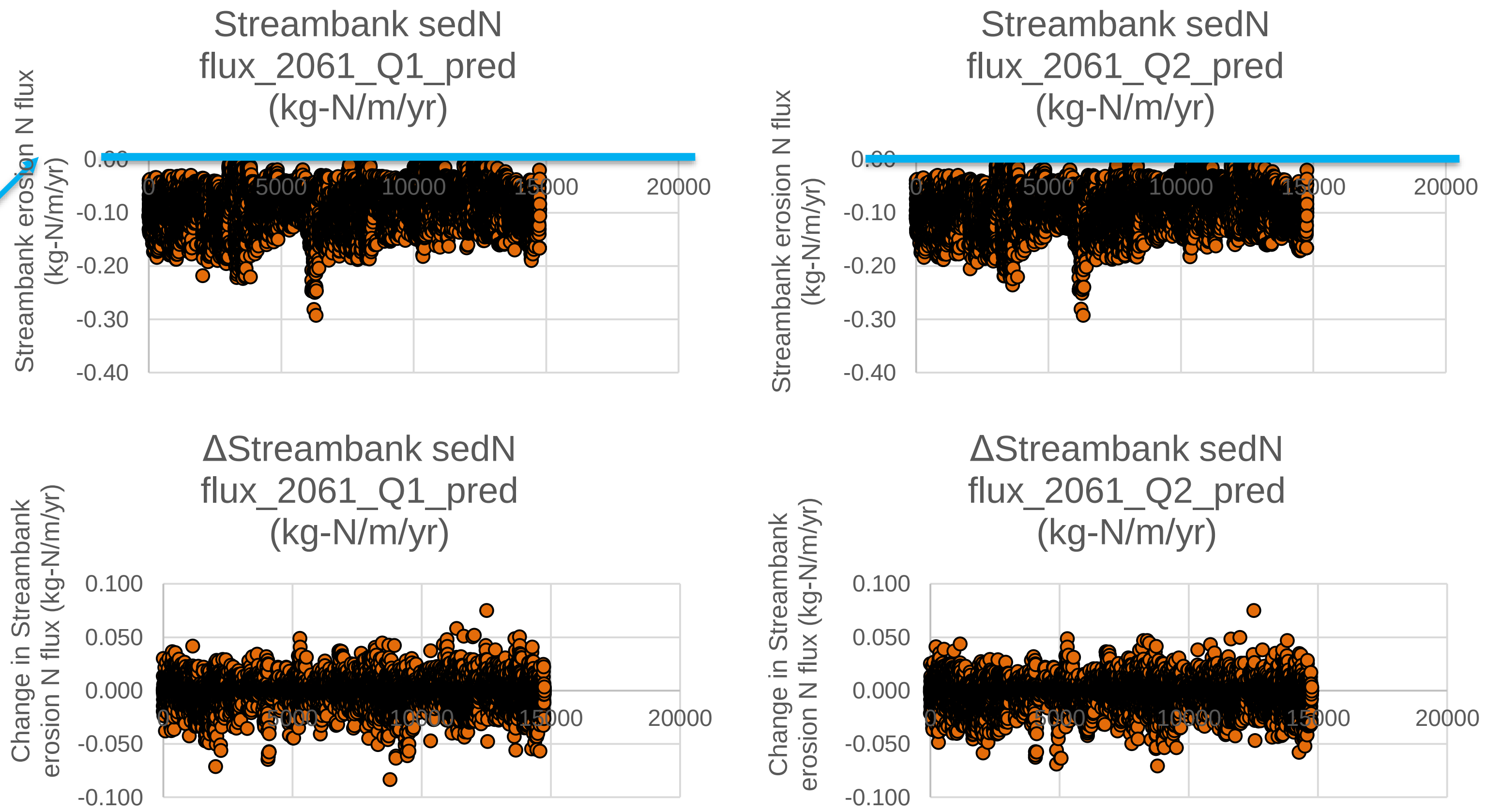
Land use change leads to hotspots of greater N pollution

Current average rate



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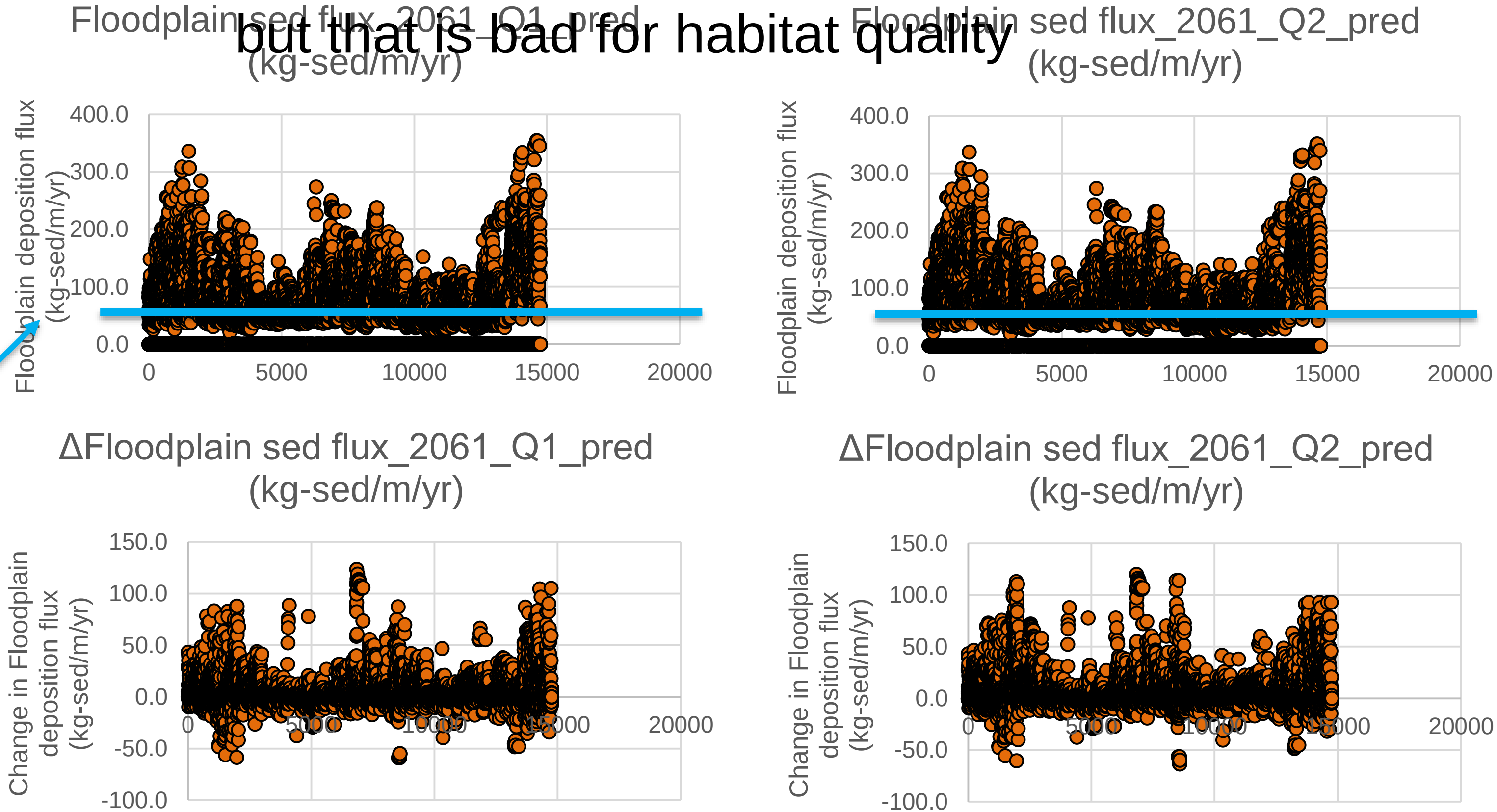
Floodplains respond by trapping more sediment,

but that is bad for habitat quality



Current average rate

USGS

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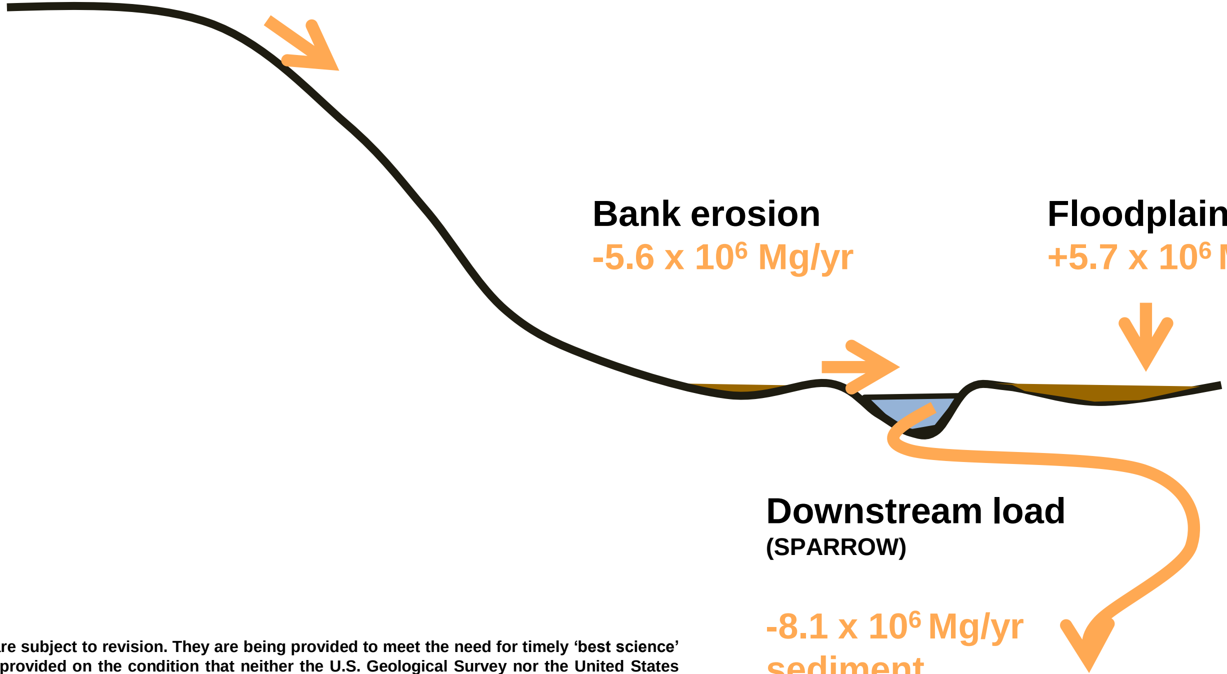
Fluxes extrapolated to 14,754 NHDPlusV2 digital stream reaches
Sum of whole Changing Landscapes Initiative watersheds

Sediment Budget (megagrams/yr)



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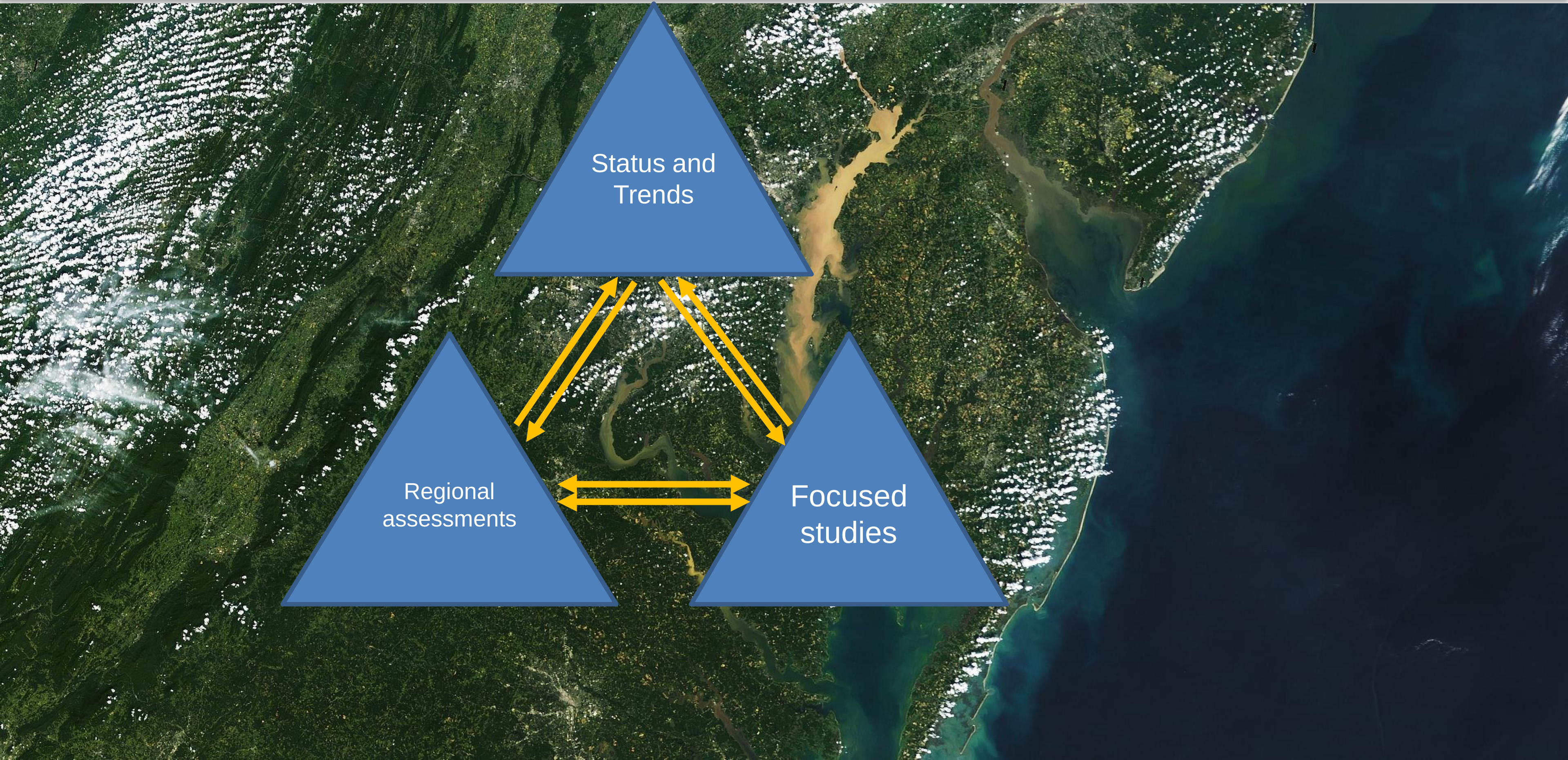
Holistic system science to address management needs



Factors affecting streams and implications for management decisions

Engage stakeholders

We will communicate, coordinate, and collaborate with CBP

to ensure we do relevant science and to ensure communicate new knowledge

Chesapeake Bay Program
Science. Restoration. Partnership.

USGS

How do watersheds and estuaries control TFW ecosystems? and their ecogeomorphic responses to SLR?

Watershed

Estuary

Nontidal

al

Fr

Oligohaline +

Floodpla

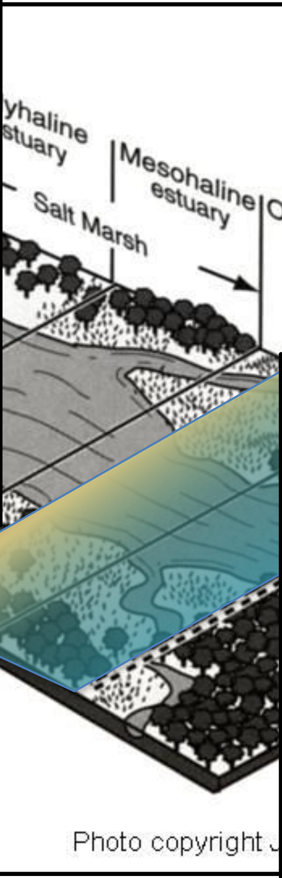
Channel

Tidal river

median length = 20 km among 127 rivers along U.S. Atlantic Coast (Ensign and Noe 2018)

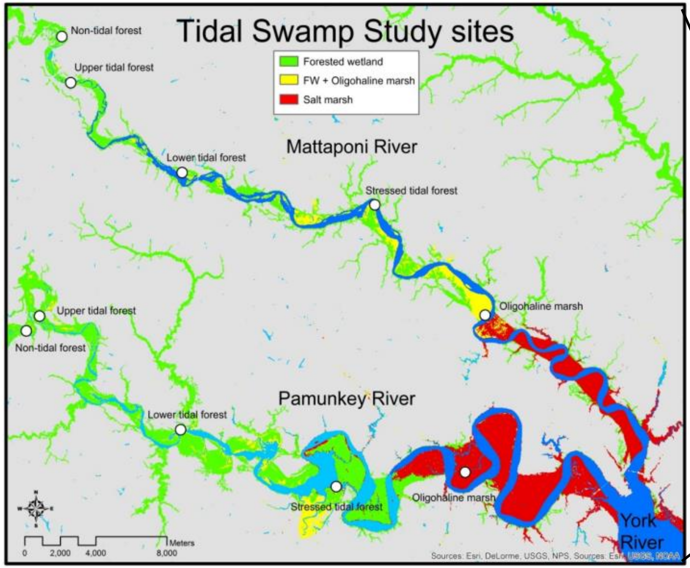
USGS

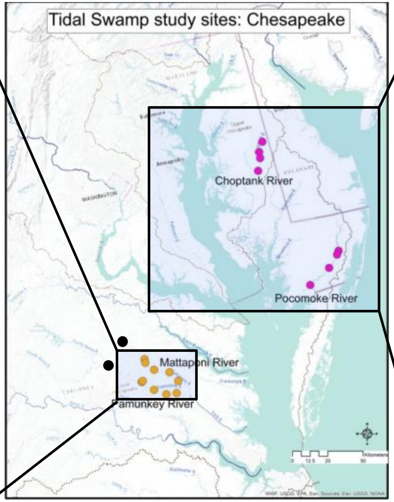
Dynamic salinity zones of upper estuary with SLR and drought

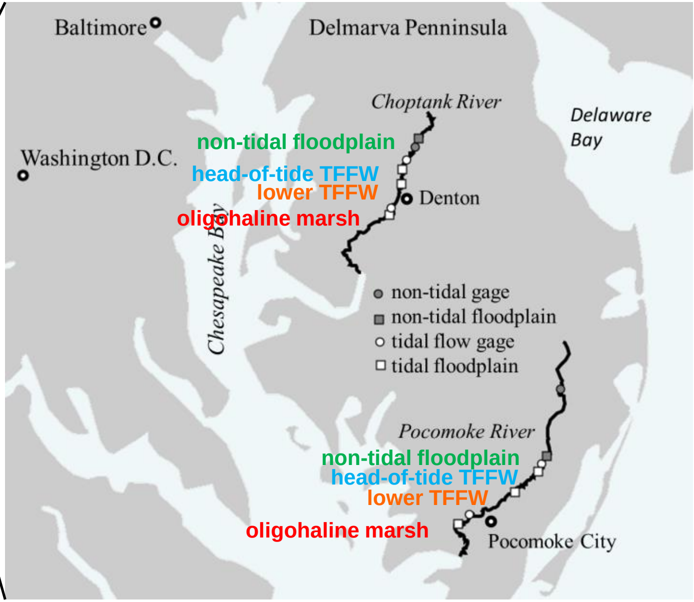


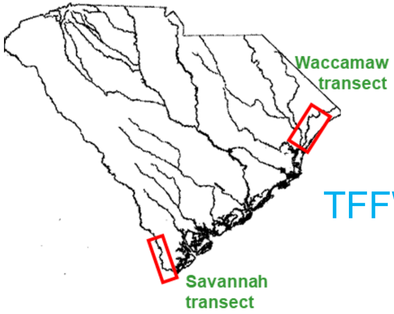
Mitsch and Gosselink 2000

Landscape gradients: nontidal → TFFW → oligohaline measuring ecosystem processes





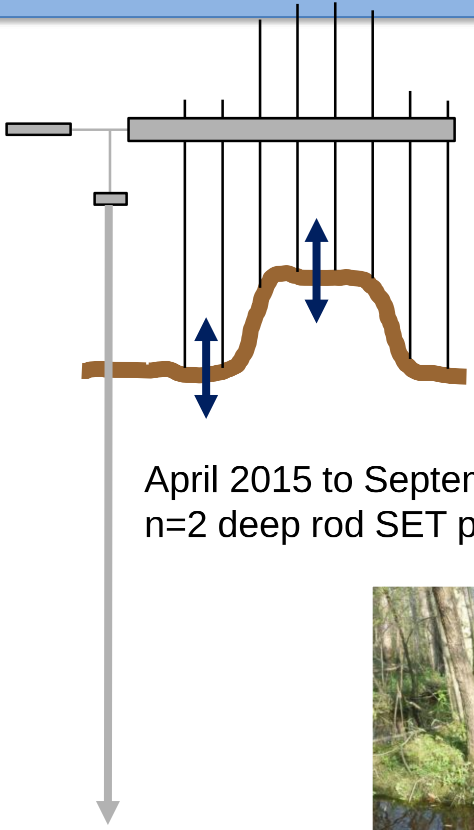




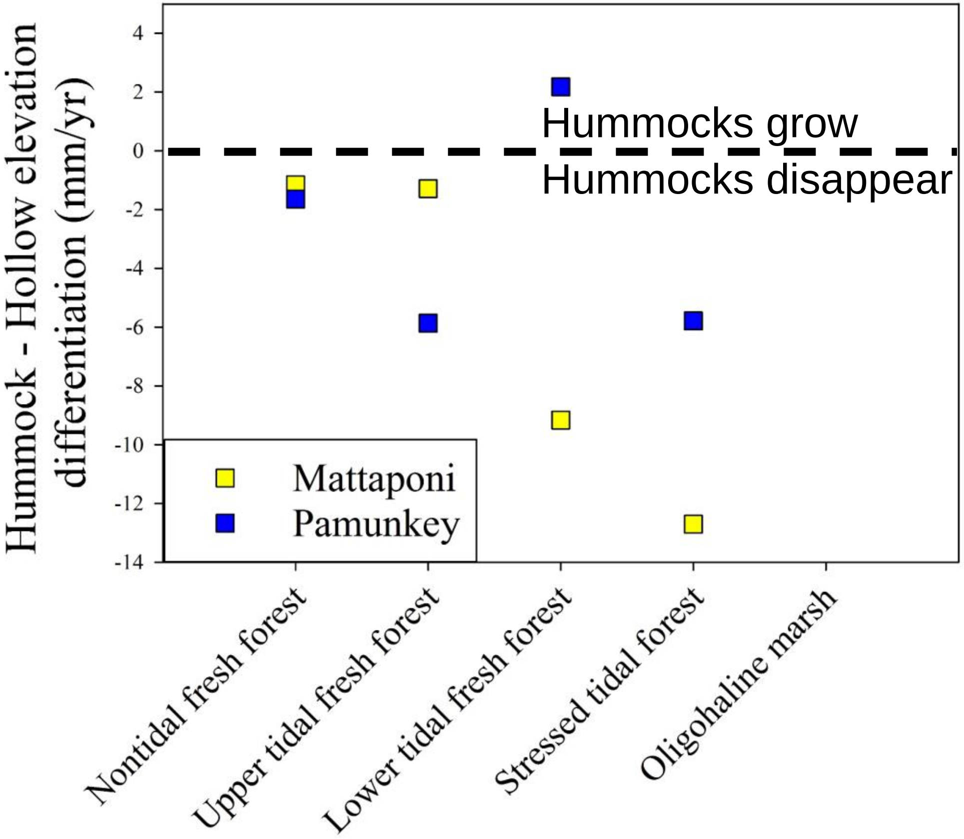
TFFW → oligohaline

USGS

Soil surface elevation change: hummocks are disappearing



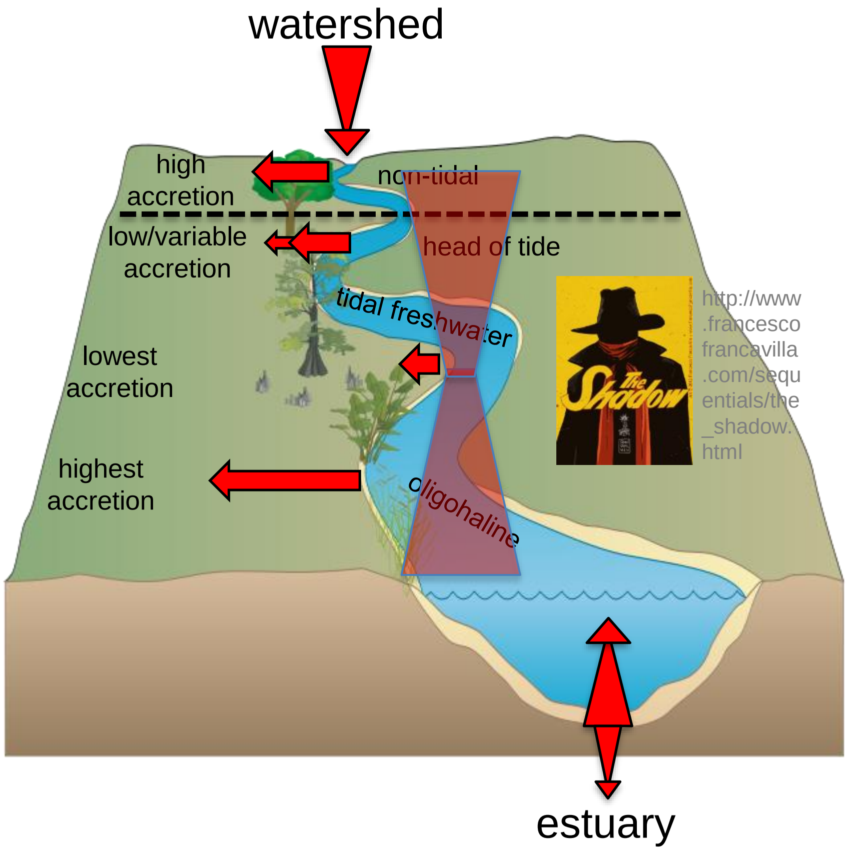
April 2015 to September 2017
n=2 deep rod SET per site



What is the Sediment Shadow?

Minimal sediment availability in lower tidal freshwater rivers and wetlands,

either in-channel suspended sediment concentration or tidal wetland sedimentation



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