e-Estuary: Developing a decision-support system for coastal management in the conterminous United States

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Coastal GeoTools

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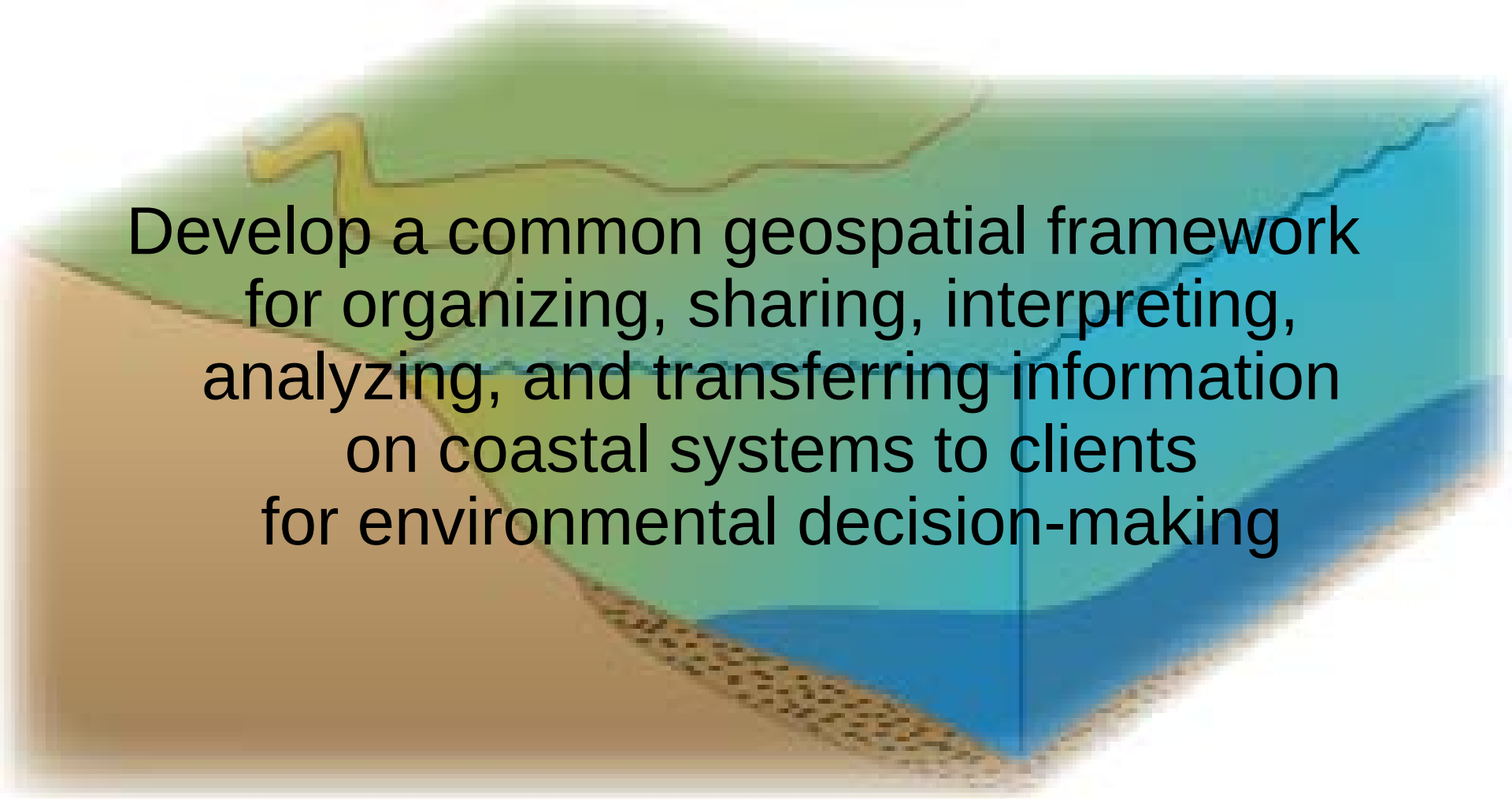
From a scientific perspective, we need a comprehensive, dynamic data system that is geo-referenced and crosses all sectors of human activity, so that it is possible to readily access data on marine ecosystem attributes and human activities. We need a consistent and powerful biophysical modeling framework that allows management scenarios to be considered at high spatial and temporal resolution, and we need the ability to analyze trade-offs between ecosystem services under different management options, be they zoning or within-sector efforts.

Andrew Rosenberg, "Is a new mandate needed for marine ecosystem-based management?", Frontiers in Ecology

e-Estuary Objective



Develop a common geospatial framework for organizing, sharing, interpreting, analyzing, and transferring information on coastal systems to clients for environmental decision-making

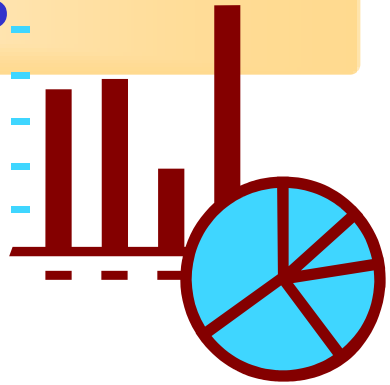
e-Estuary components

Metadata

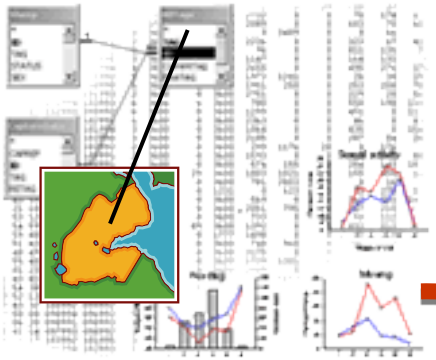
Bibliography

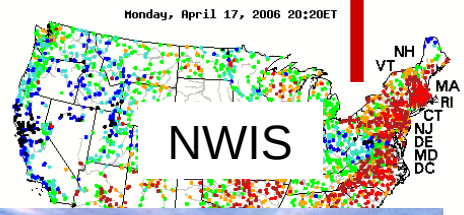
Link to experts

Georeferenced relational database



Analytical tools



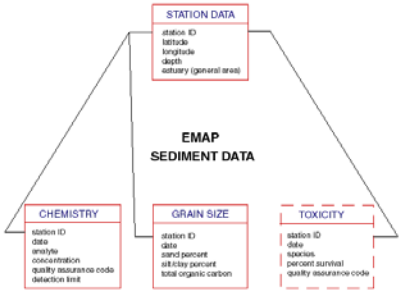


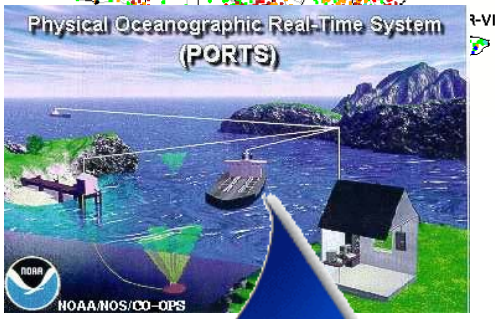
Links to geospatial data

Extract

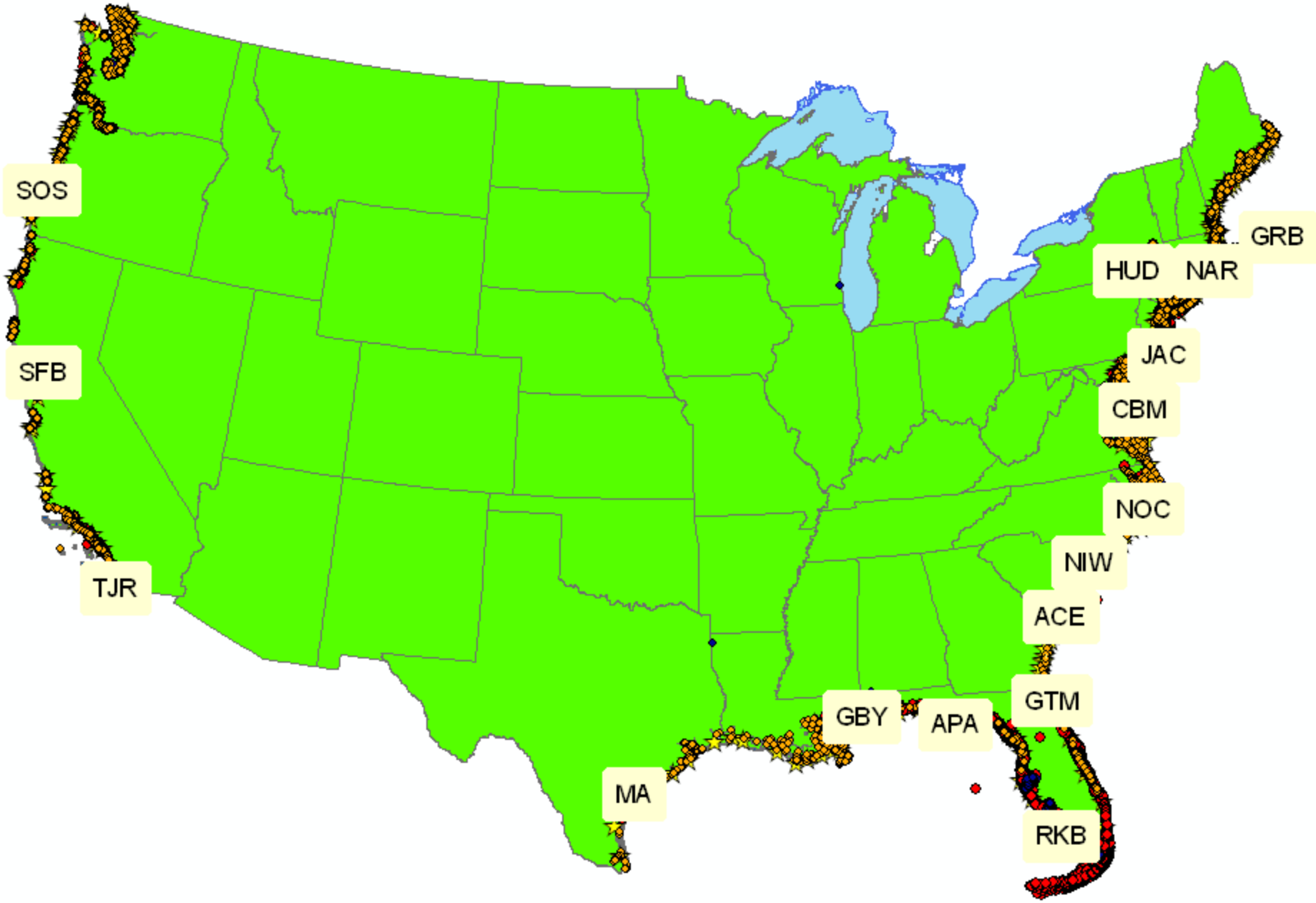
Interpolate

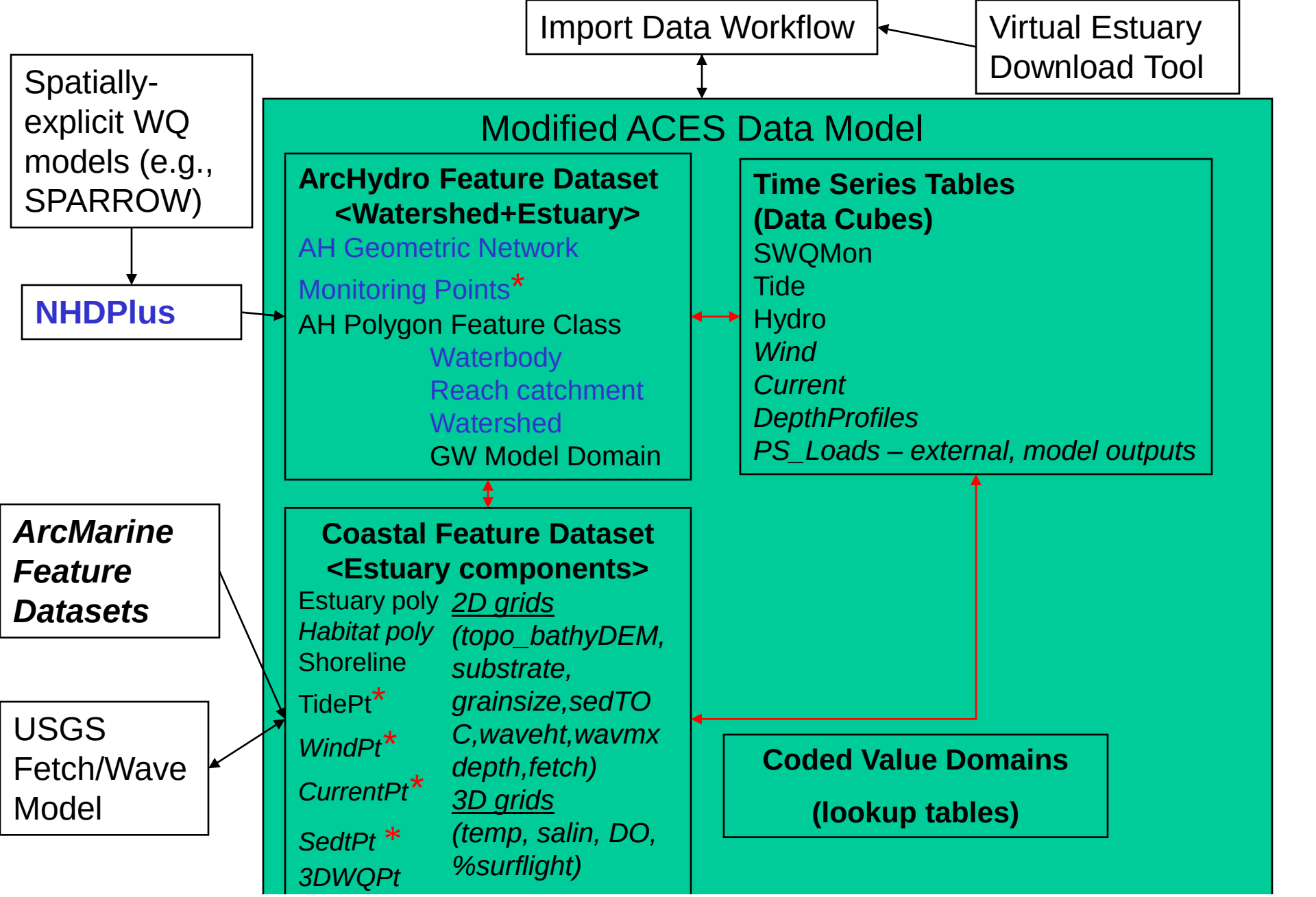
Extrapolate





Historic WQ sampling stations





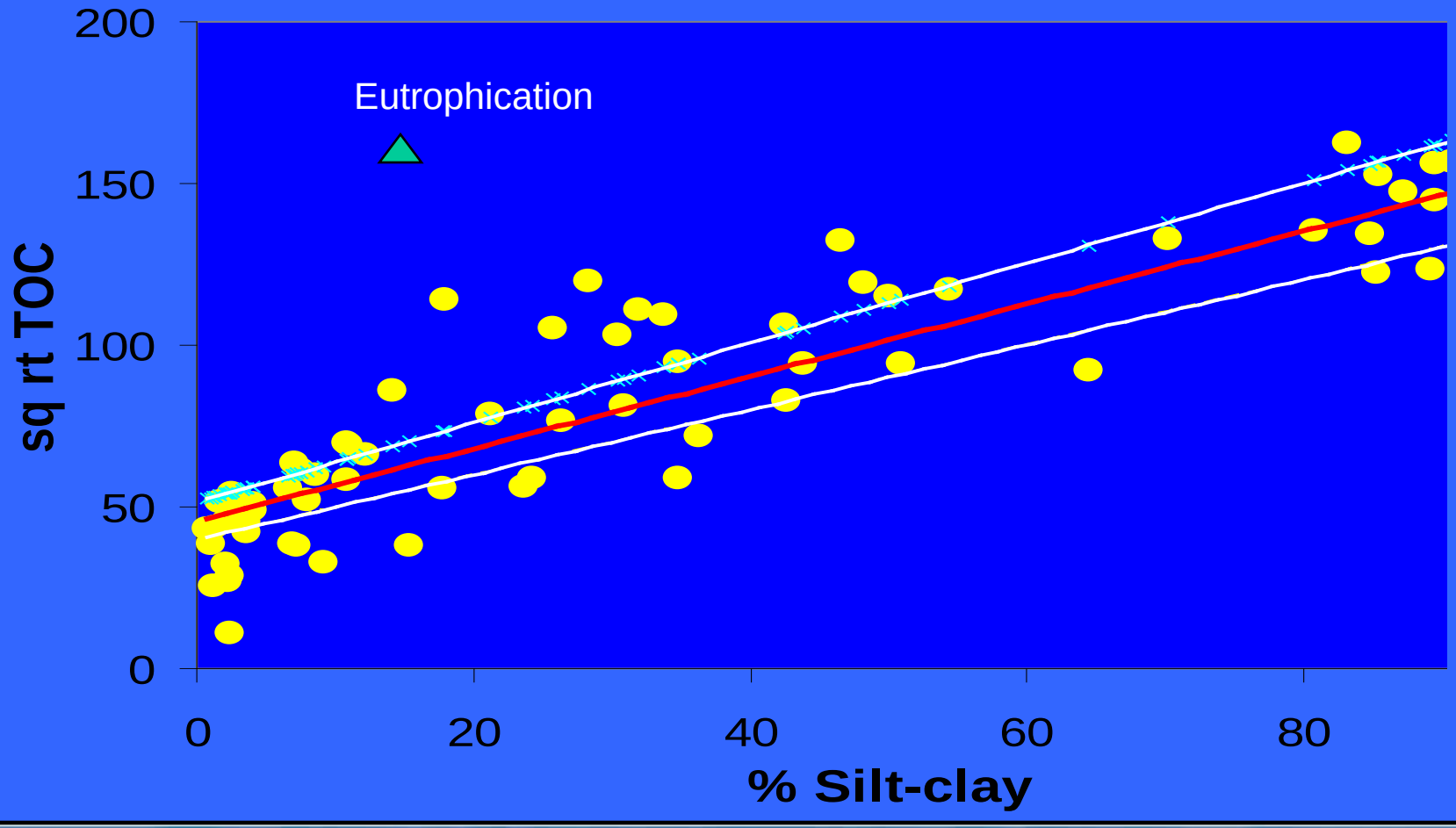
*** Dynamic link w external databases – NWIS, STORET, USEPA NCA, NOWCoast…**

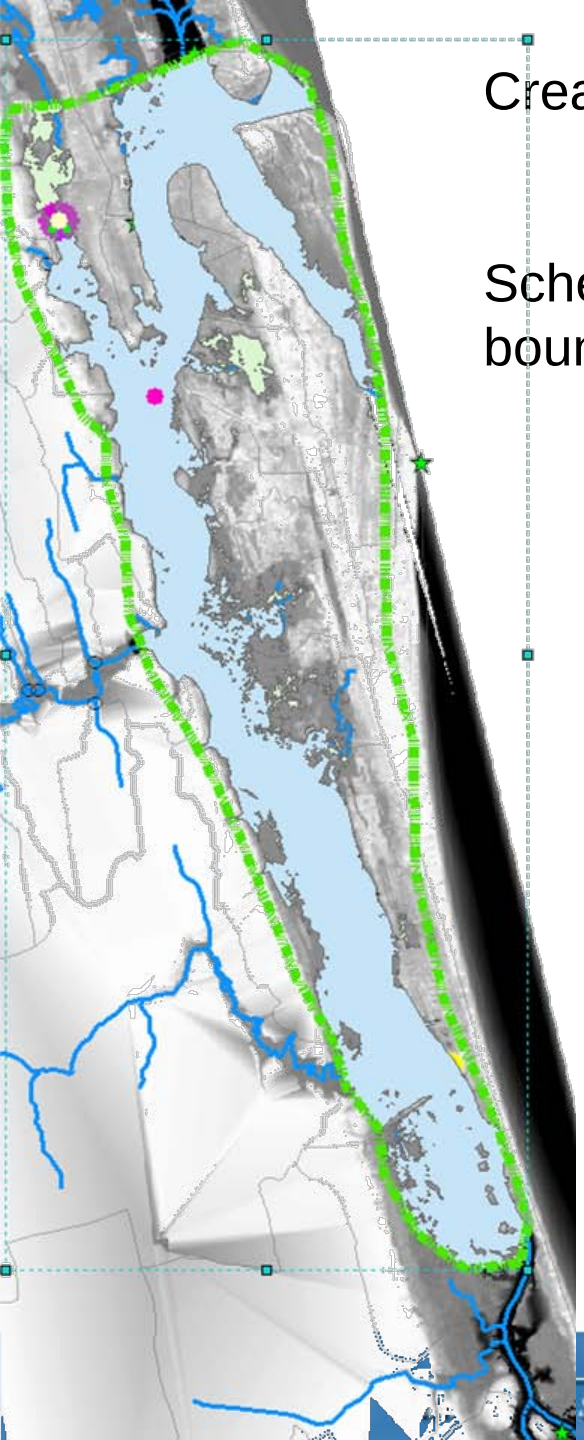
↔ Relationship classes

Regional Eutrophication Assessment

Grain Size Normalized Total Organic Carbon (TOC)

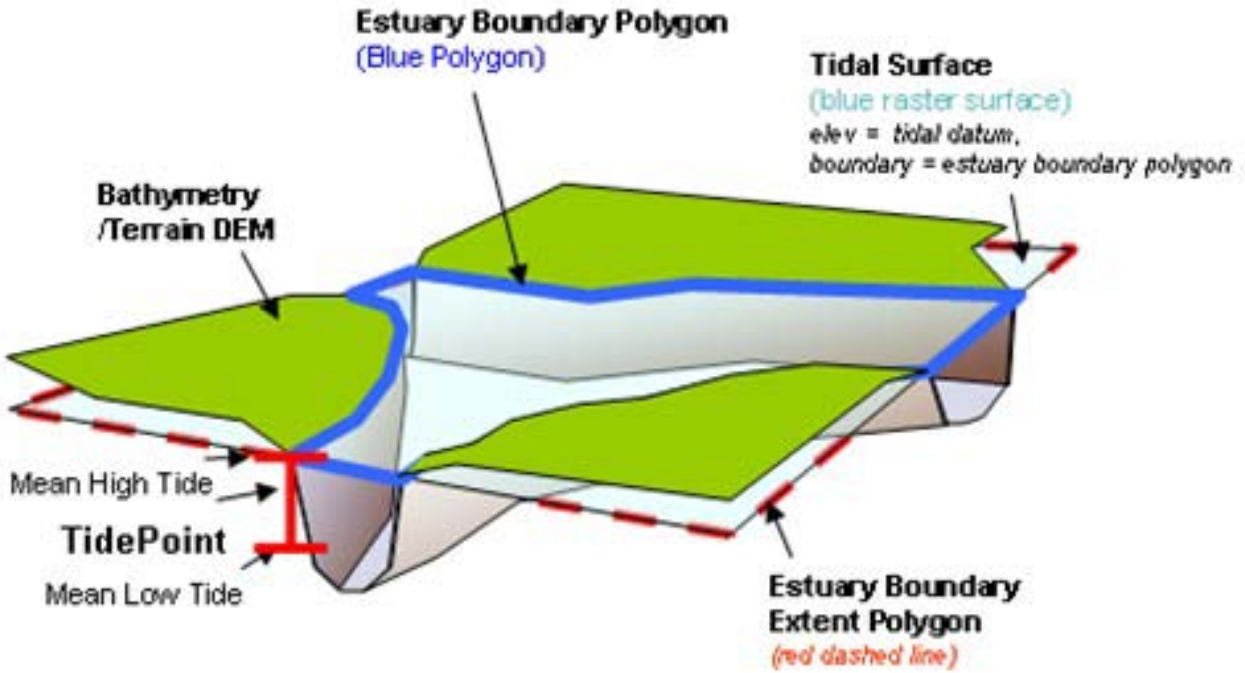
(U.S. EPA EMAP Virginian Province Reference Data (1990-1993))



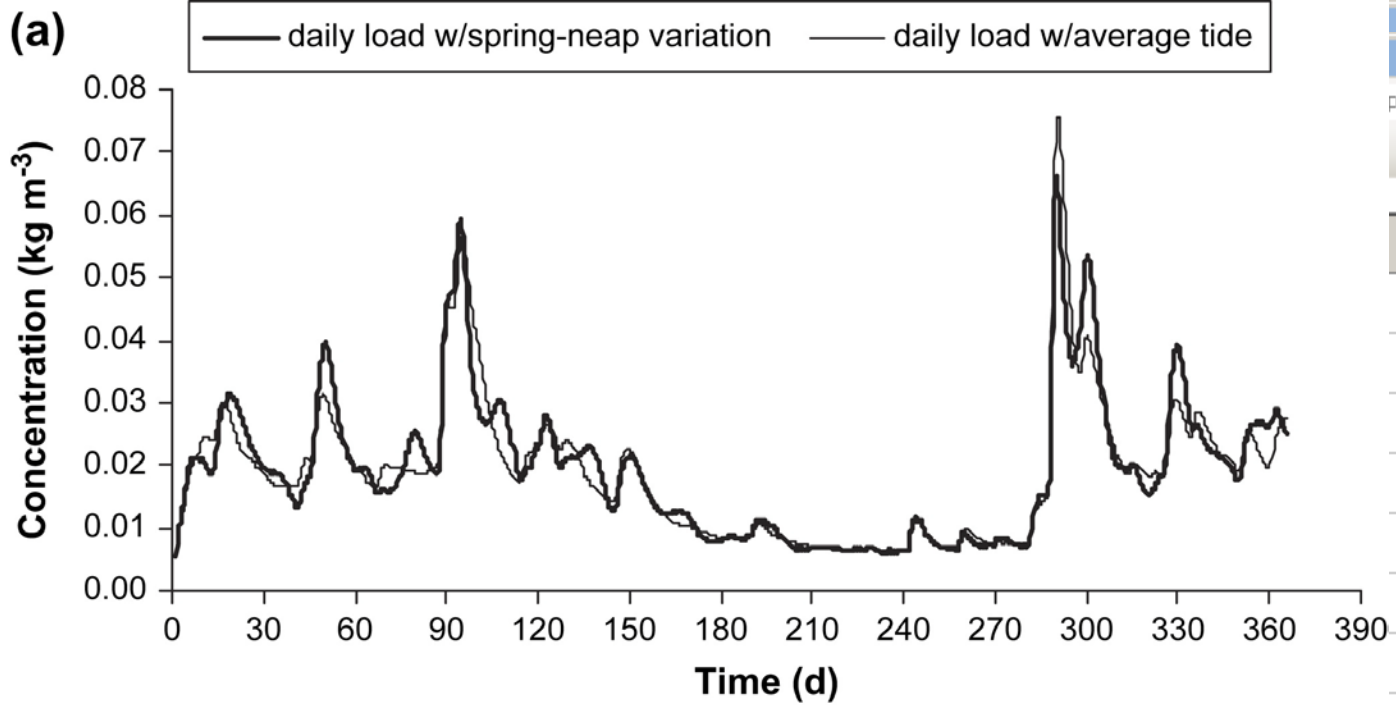


Creating the Estuary boundary or boundaries

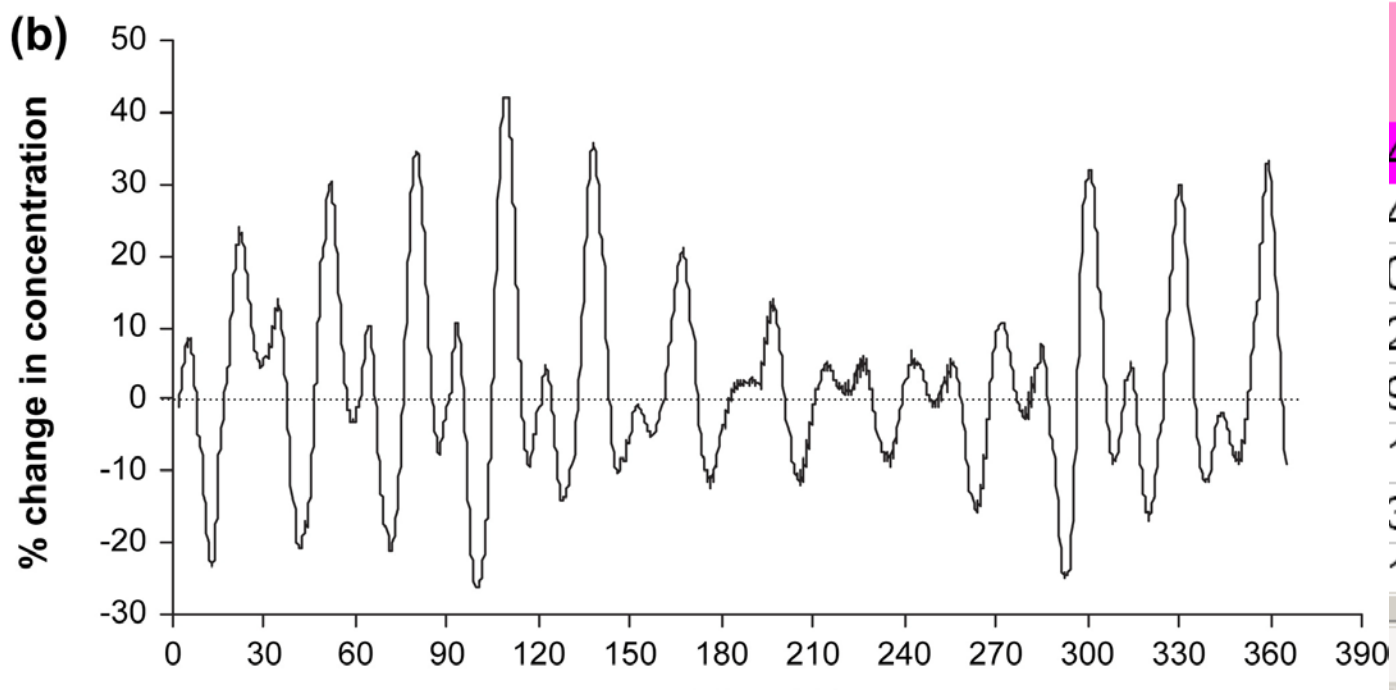
Schematic of the process for creating the Estuary boundary polygon



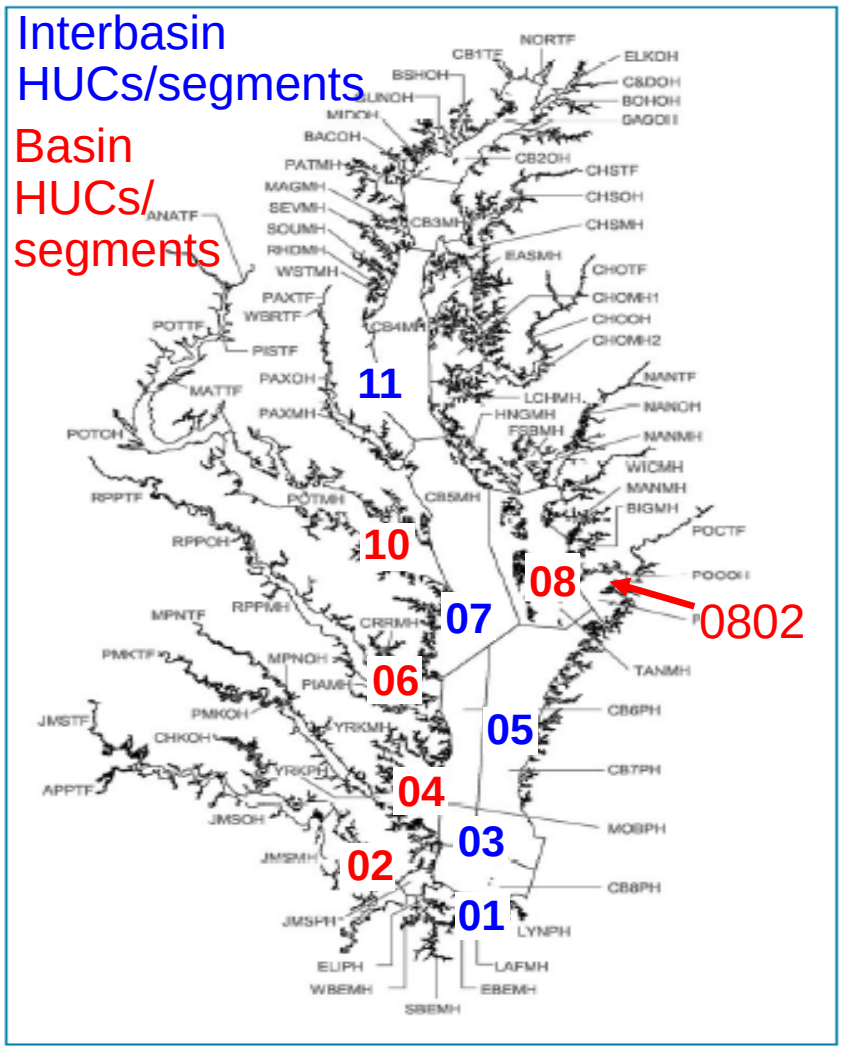
From Fox and Bourne 2008



Abdelrhman, M.A. 2007. Estuarine, Coastal and Shelf Sci74:742-55.



Determining scales for assessment & listing



2003 Chesapeake Bay Segmentation Scheme

Source: Chesapeake Bay Program.

- **Issue**
  - No common protocol for determining 303(d) listing segments
- **e-Estuary will provide**:
  - Segmentation by local residence time
  - Hierarchical coding scheme
    - Estuary “address”
    - Flexible aggregation
    - Link to appropriate watershed scale

Local residence time for identifying homogeneous response units

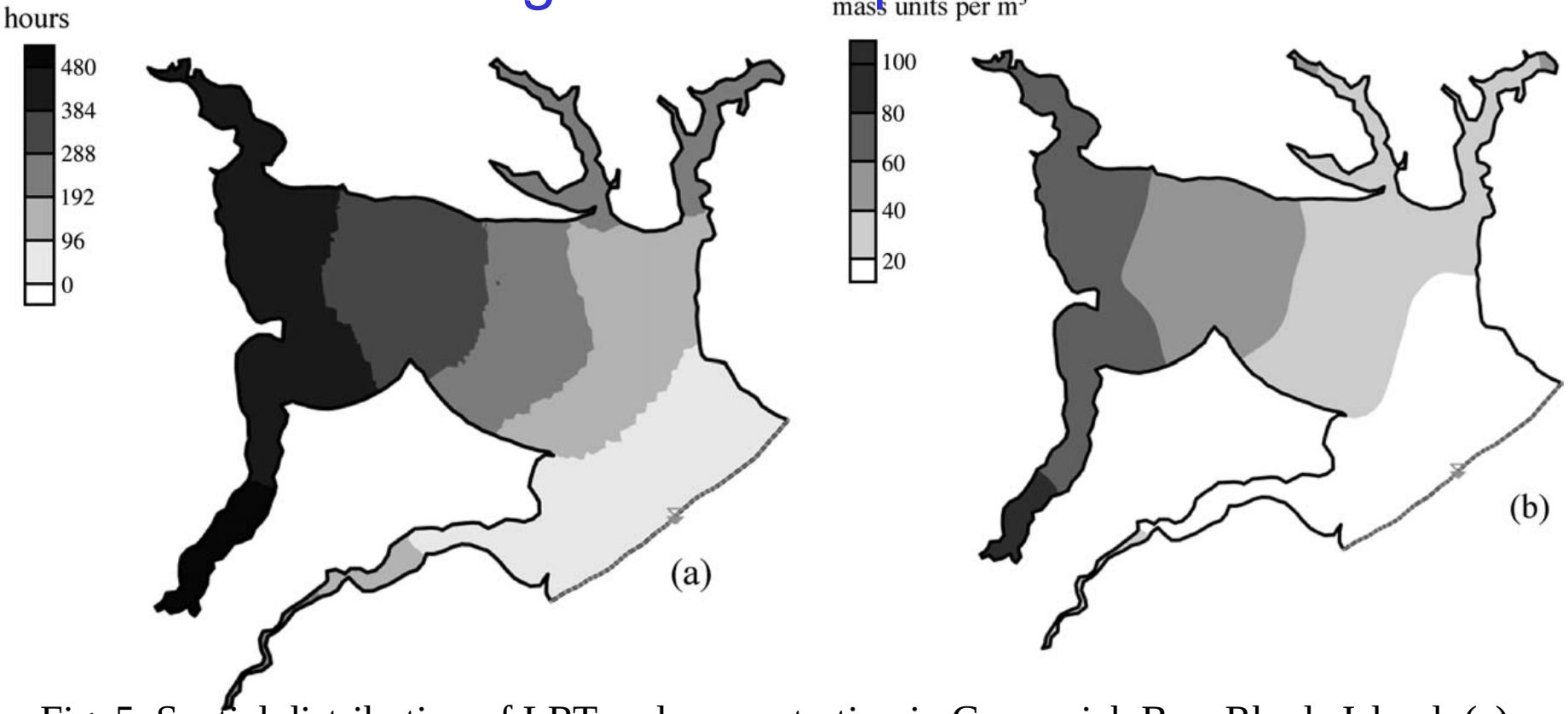
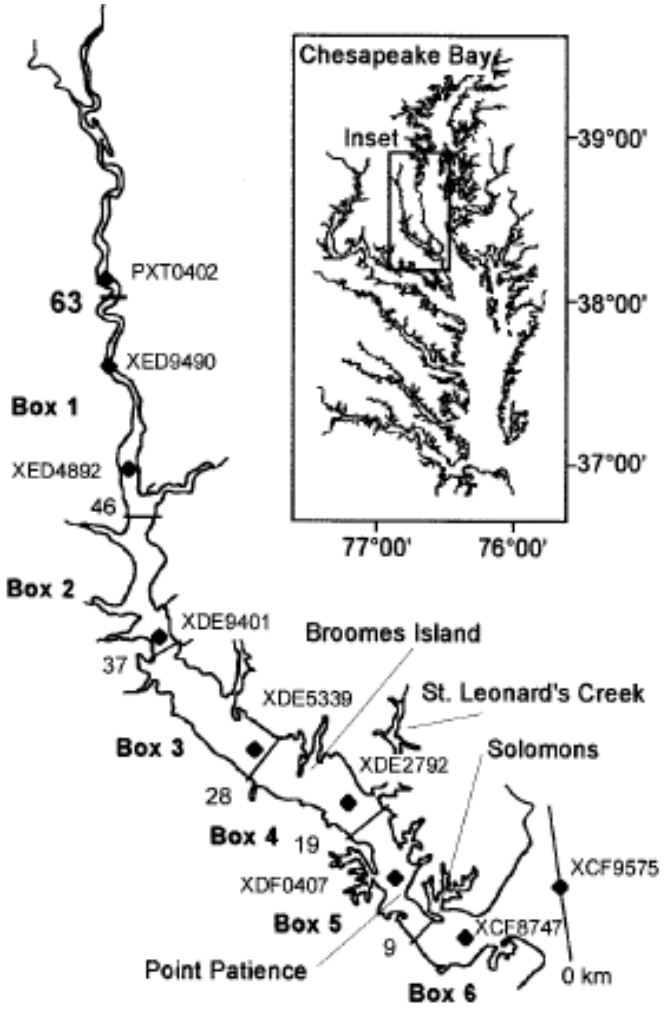
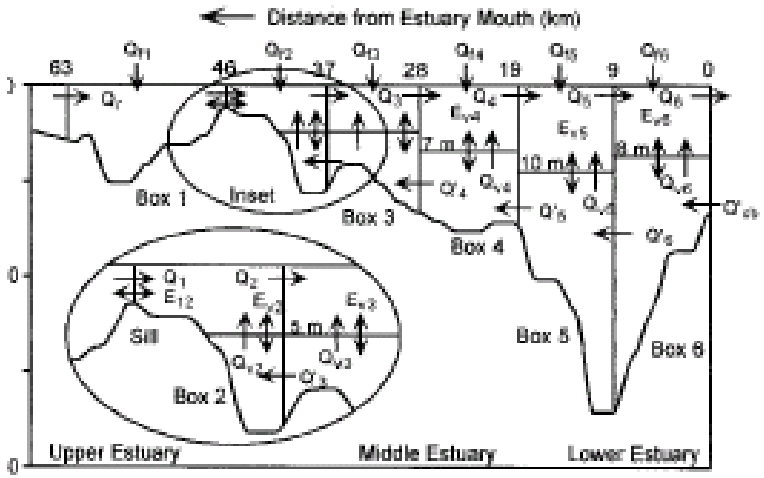
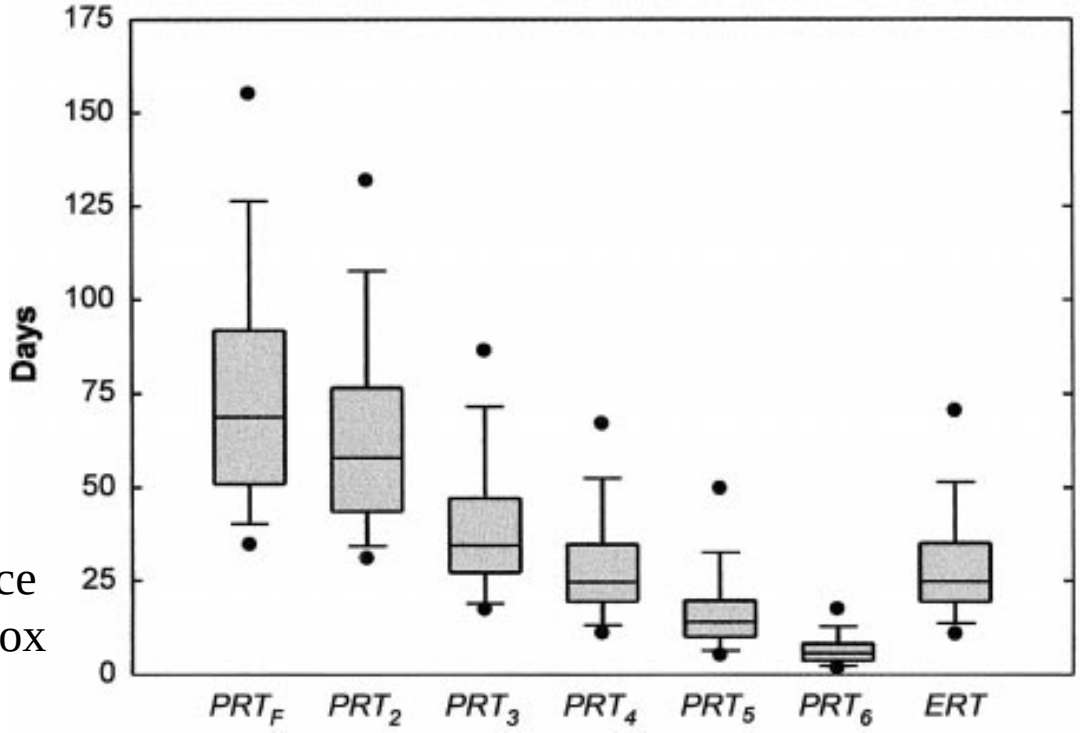


Fig. 5. Spatial distribution of LRT and concentration in Greenwich Bay, Rhode Island: (a) distribution of LRT (h), and (b) distribution of constituent concentration at the calculated flushing time (9.2 d). concentration (mass units m3). From Abdelrhman, M.A. 2005. Simplified modeling of flushing and residence times in 42 embayments in New England, USA, with special attention to Greenwich Bay, Rhode Island. Estuarine, Coastal and Shelf Science 62 (2005) 339–351.

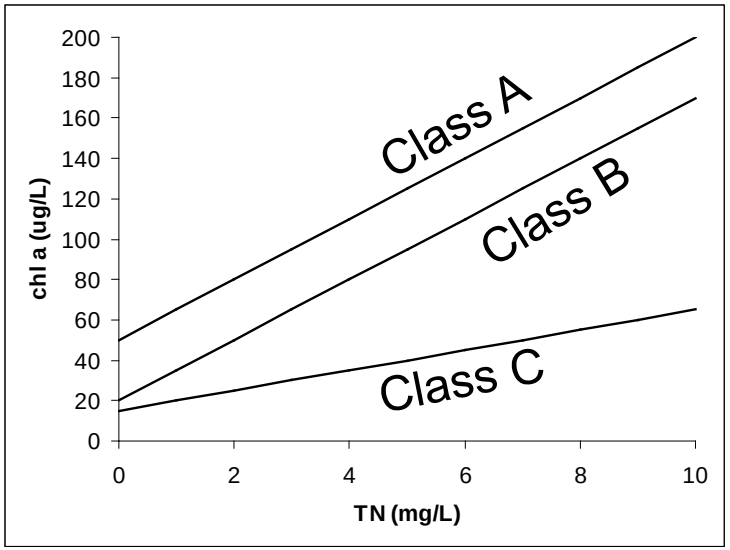






From Hagy et al. 2000. Estimation of Net Physical Transport and Hydraulic Residence Times for a Coastal Plain Estuary Using Box Models. Estuaries 23(3):328-40.

Nationwide Classification Tools



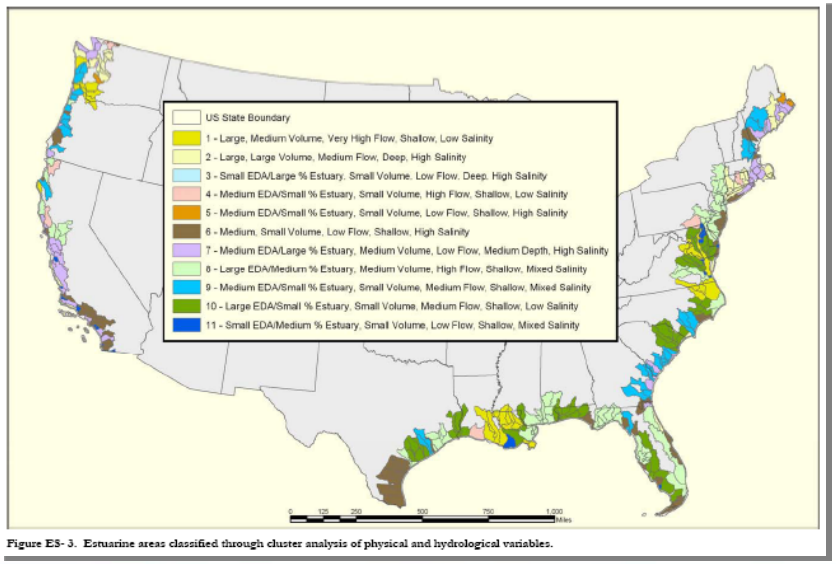


Figure ES- 3. Estuarine areas classified through cluster analysis of physical and hydrological variables.

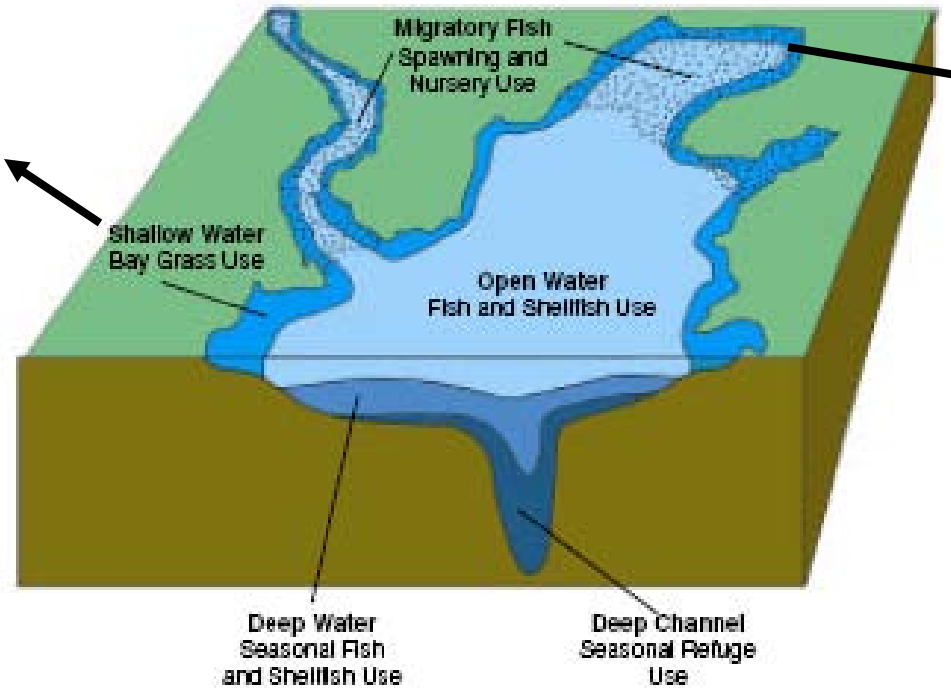
- **Issue**
  - Stressor-response relationships from nationwide data sets are too noisy to support criteria development
- **e-Estuary is providing**:
  - Identification of reference watersheds/estuaries within a class
  - Strata for applying criteria
  - Stratified stressor-response relationships as a basis for criteria

Factoring habitat quality constraints into WQ standards

1

Mapping potential zones by seagrass habitat requirements

Oblique View of the Chesapeake Bay and Its Tidal Tributaries

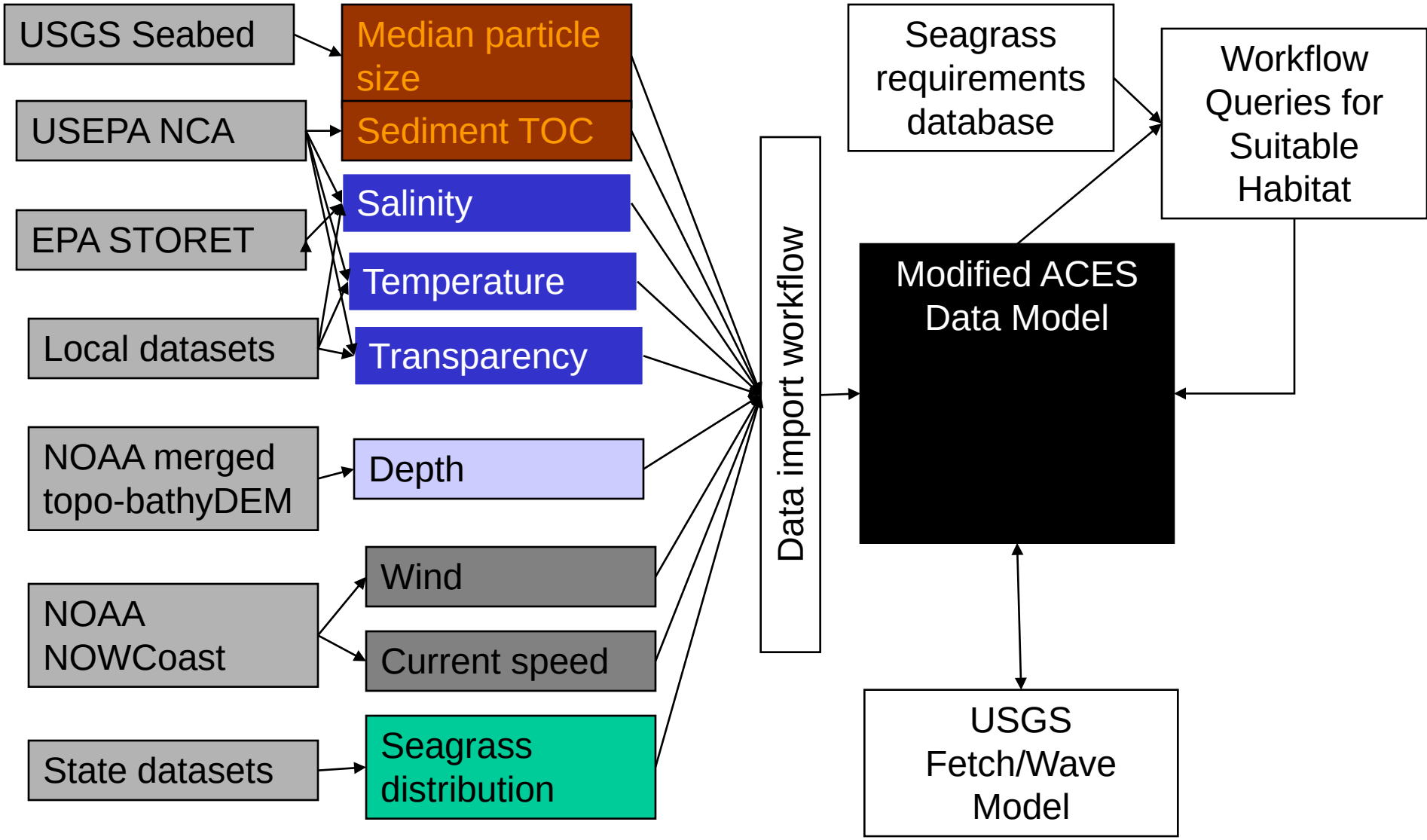


2

NOAA Environmental Sensitivity Index maps of spawning site distributions + application of methods for saltwater DO criteria development to support larval survival

How might we adapt or modify this model to apply to other estuarine classes and regions?

Potential Seagrass Habitat: Model Workflow



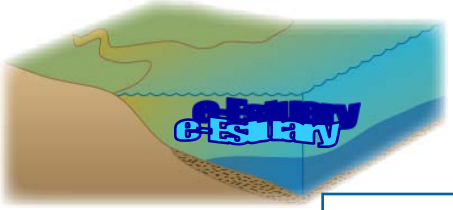
Benthic Database

TSN	Species	Common name	Life history	Salinity	Sediment
155554	*Amathia vidovici*	bryozoan			
93423	*Ampithoe longimana*	ampithoid amphipod		18-32 ppt	sand & mud
159682	*Branchiostoma caribaeum*	lancelet		18-32 ppt	sand

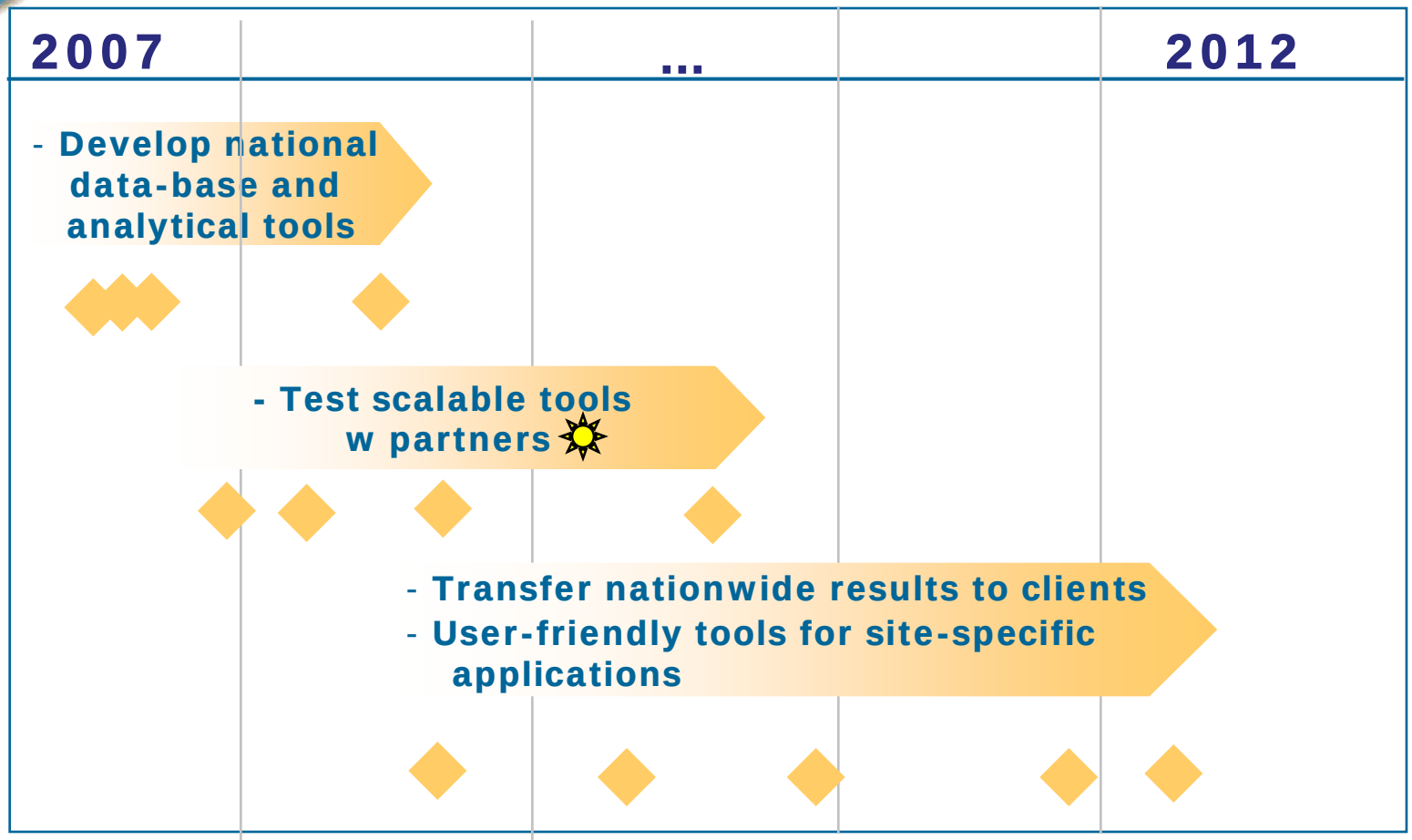
TSN	Species	Habitat	Feeding Type	Indicator	ref
155554	*Amathia vidovici*	epifauna	suspension		4,5
93423	*Ampithoe longimana*	epifauna	interface		a,b
159682	*Branchiostoma caribaeum*	infauna	suspension		4,5
66106	*Glycera americana*	infauna	carnivore-omnivore	pollution sensitive	
158429	*Leptosynapta*	infauna	deposit feeder		4,5
68639	*Limnodrilus hoffmeisteri*	infauna	deep deposit feeder	pollution tolerant	4,5
79452	*Mytilus*	epifauna	suspension		5
79195	*Nuculana acuta*	infauna	deposit feeder		5,18
158626	*Saccoglossus kowalevskii*	infauna	deposit feeder		4,5
68687	*Tubificoides*	infauna	deep deposit feeder	pollution tolerant	4,5
159338	*Styela plicata*	epifauna	suspension		4,5

Staged tool development

- Stand-alone tools or tools with minimal software requirements
  - e.g.,ArcExplorer, Google Earth visualization interfaces
  - Excel
  - Virtual Estuary – standalone download tool
- Modular features in ArcMap
  - Data model at estuarine scale
  - Model Builder workflows
- Web service (linked to other web services to distribute maintenance costs)
- ArcGIS server interface – interactive tool applications at local to regional scales



Timeline



- If your organization has an interest in helping to test/demonstrate decision-support tools, please contact us (detenbeck.naomi@epa.gov)