CESR: **C**omprehensive **E**valuation of **S**ystem **R**esponse

Estuary Report:

Knowledge Gaps, Uncertainties, and Opportunities Regarding the Response of the Chesapeake Bay Estuary to Restoration Efforts

Jeremy Testa, William Dennison, William Ball,
Kathleen Boomer, Deidre Gibson, Lewis Linker,
Michael Runge, and Lawrence Sanford

Two Aspects the Estuarine CESR

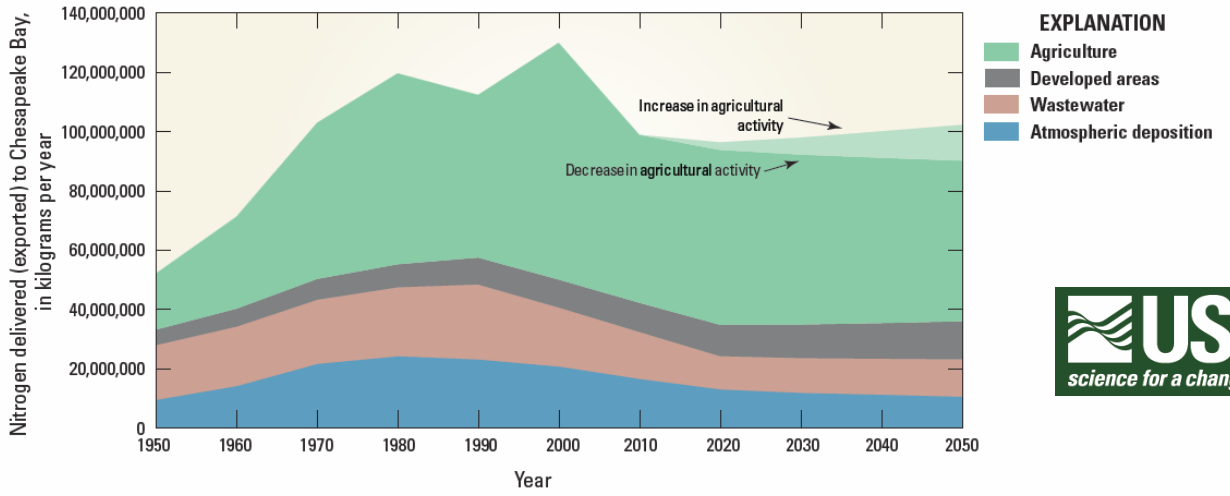
CESR = Executive Summary
+ Summary Report
+ Resource Documents (watershed (loads), estuary (WQ), living resources)

1: Summary Report: A targeted evaluation of why water quality standards may not be attained by 2025

2: Estuary Report: A more detailed reflection on the state of estuarine restoration goals and processes

1: A targeted evaluation of why water quality standards may not be attained by 2025

Perspective 1: ***There have been substantial WQ improvements in Bay where large, sustained load reductions have occurred***

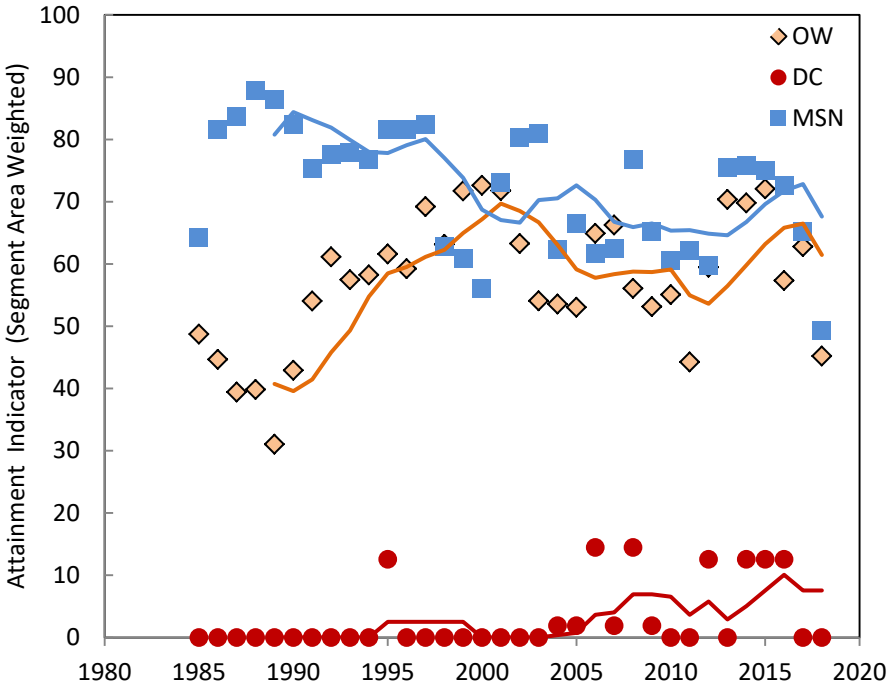


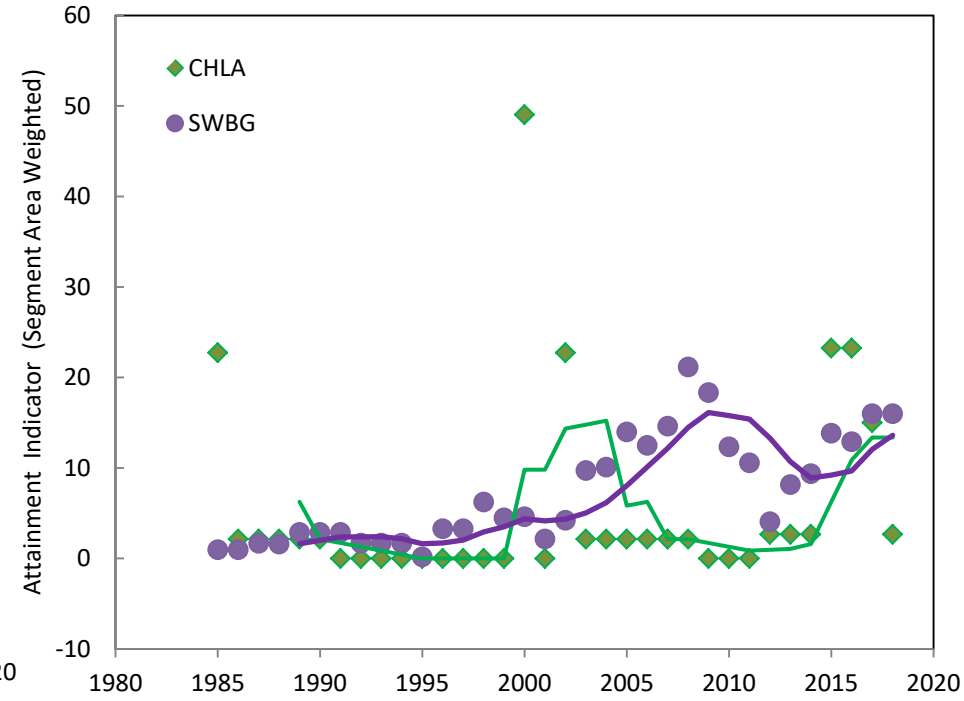
USGS science for a changing world

Examples: a. Widespread reductions in TN and TP in estuarine water Baywide
b. Low-salinity SAV recovery and subsequent resilience
c. WWTP reductions and WQ response in Back, Choptank, Patapsco, James, etc
d. Stability, even improvements in mainstem DO despite warming

1: A targeted evaluation of why water quality standards may not be attained by 2025

Perspective 2: ***We are still far short of reaching criteria, some criteria going in the wrong direction***





2: A more detailed reflection on the state of estuarine restoration goals and processes

Key Highlights

- ***Shift the management and science focus*** from one of slowing and preventing ecosystem degradation to one of ***accelerating ecosystem restoration and recovery***

- Promote ***collaborative research integration approaches***, thus improving capacity to forecast system responses to management actions and climate change and to identify fundamental uncertainties.

- Focus research efforts on spatial and temporal scales relevant to stakeholders and decision makers; for example, understanding the dynamics of ecosystems at the ***land-sea interface (triblets)*** in Bay restoration.

- Investigate the impact of ***tipping points (ecological thresholds)*** in estuarine restoration dynamics.

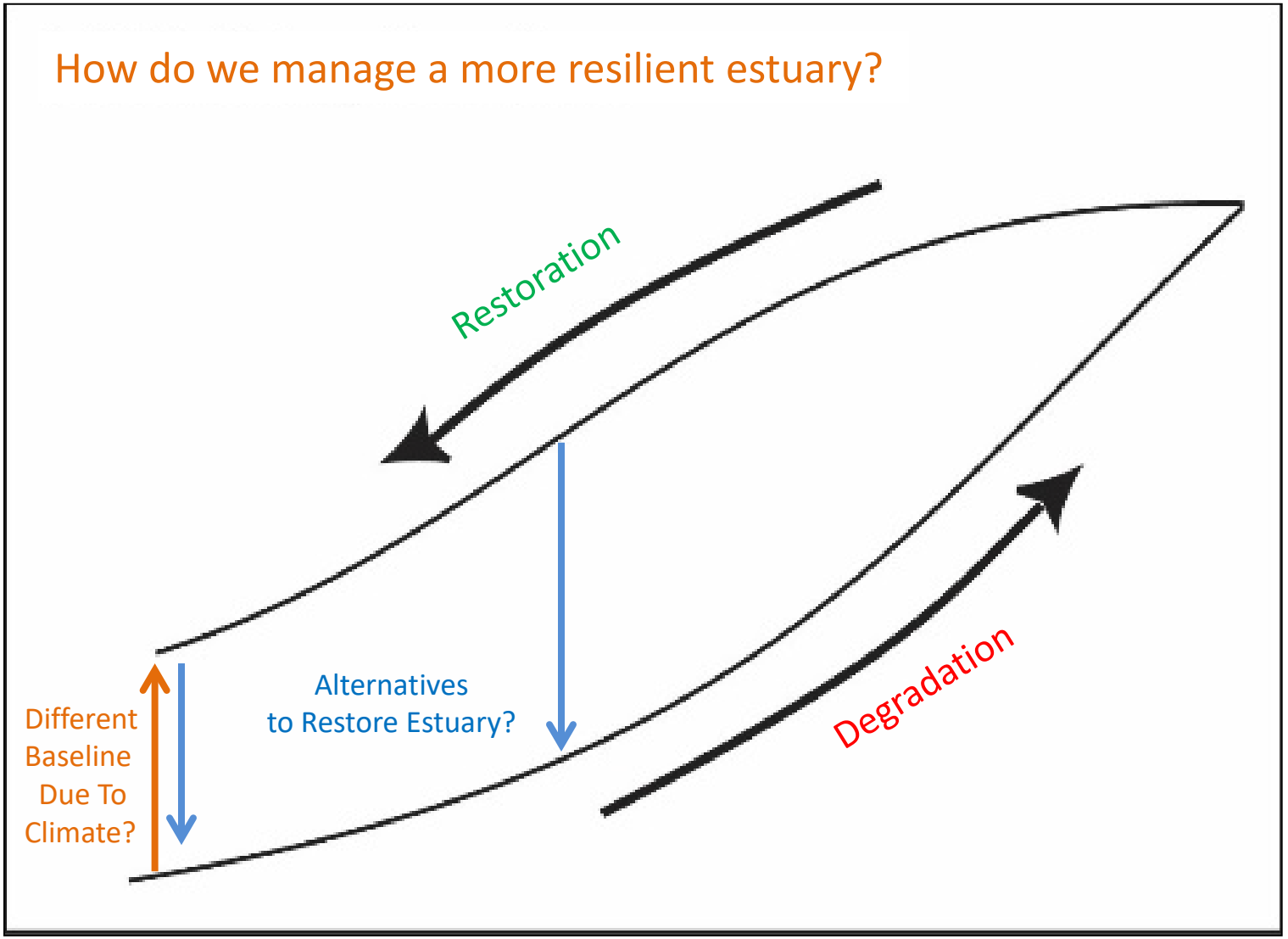
- Account for ***climate change*** in Bay restoration and expectations of recovery.

- Use ***shallow water habitats*** as a testbed for integrating the land-sea interface, tipping points, and climate change using monitoring, modeling, and research approaches.

- Develop a ***future vision*** of Chesapeake Bay management that better embraces and addresses decision making in the face of uncertainty by incorporating adaptive management, considers potential major interventions, and uses an outcomes-based framework.

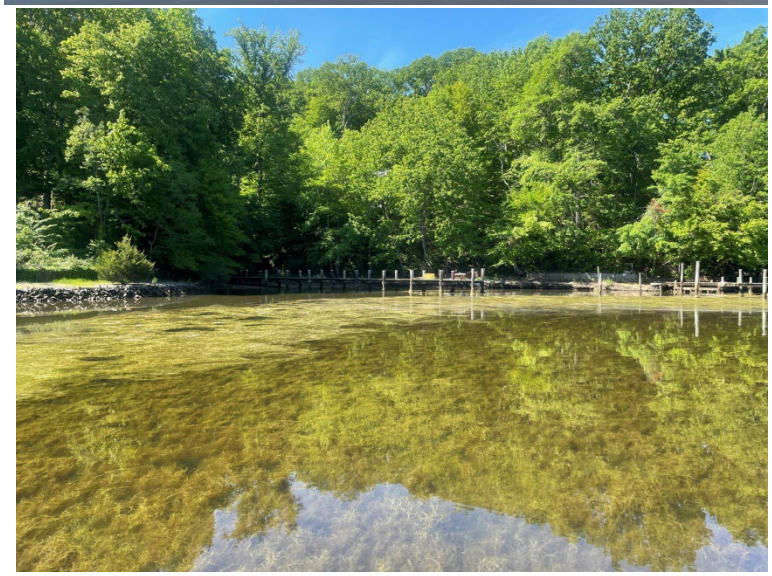
- Identify ***new tools, approaches, and personnel*** that could feature in Chesapeake Bay restoration science and analysis.

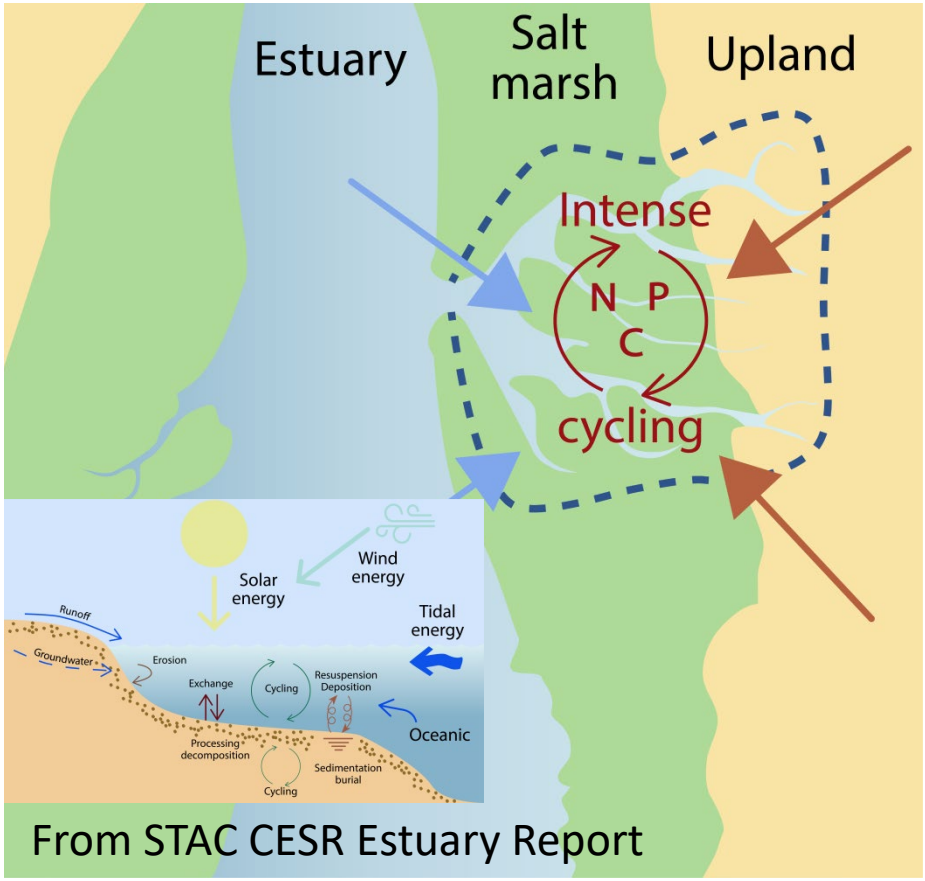
What do we expect in the future? *What do we Want*?

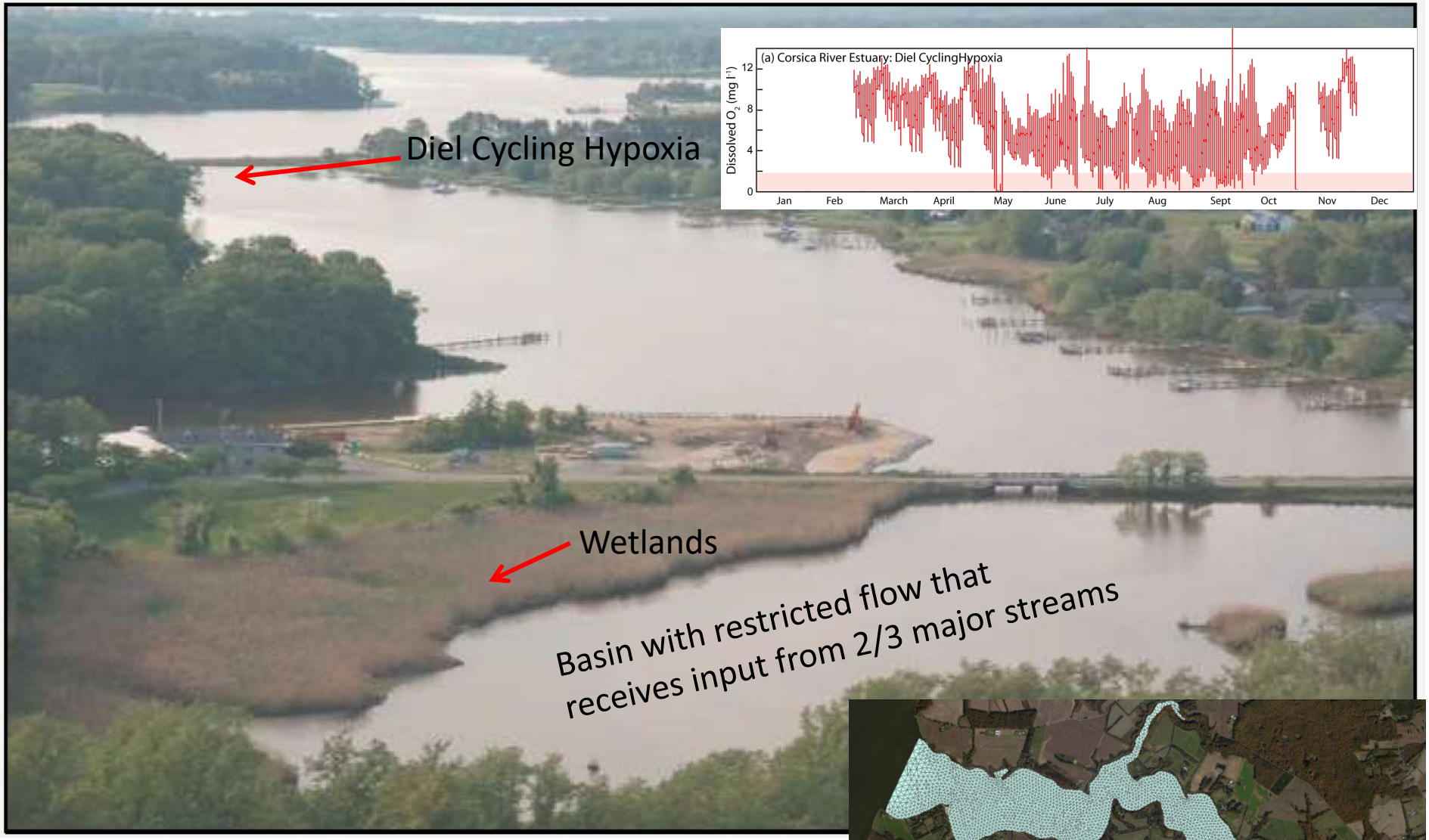


An Emphasis on “Shallow Water”: **Why?**

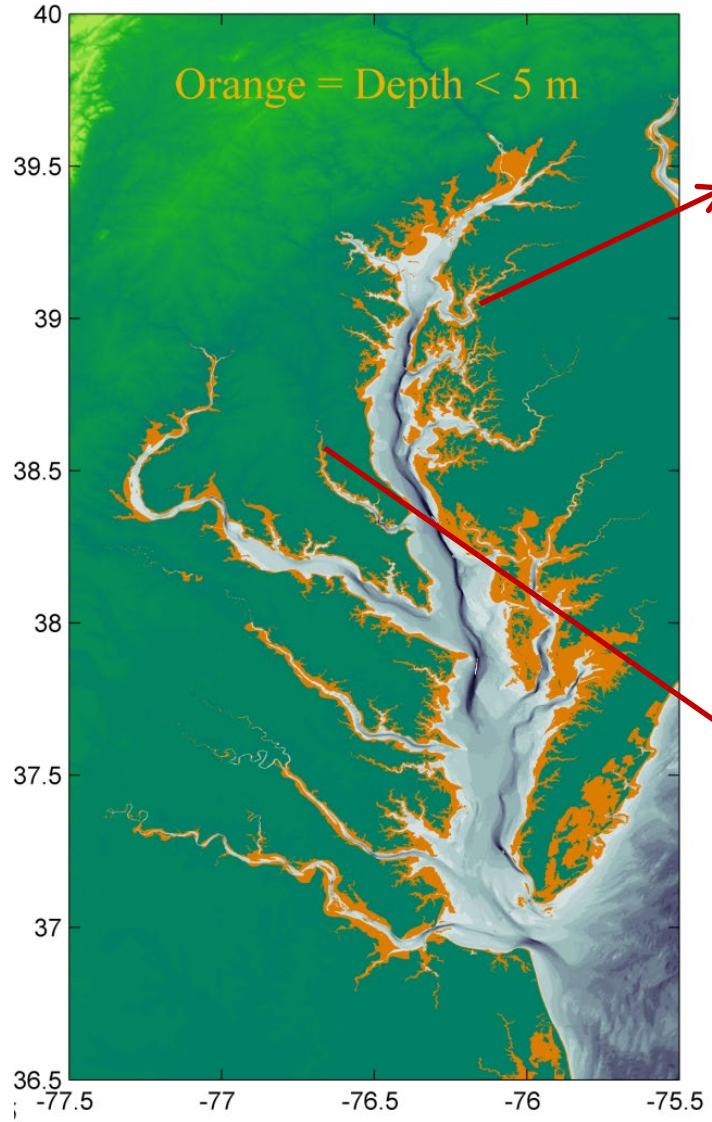
The ***Terrestrial-Estuarine Transition Zone (T-zone)*** and the important role of ***triblets*** in Bay restoration.





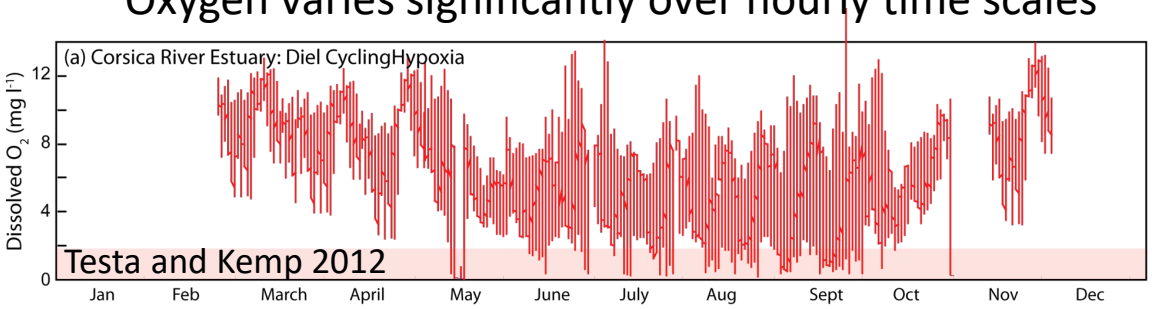

Diel Cycling Hypoxia
Wetlands
Basin with restricted flow that
receives input from 2/3 major streams
(a) Corsica River Estuary: Diel CyclingHypoxia
Dissolved O2 (mg l-1)
0
4
8
12
Jan
Feb
March
April
May
June
July
Aug
Sept
Oct
Nov
Dec

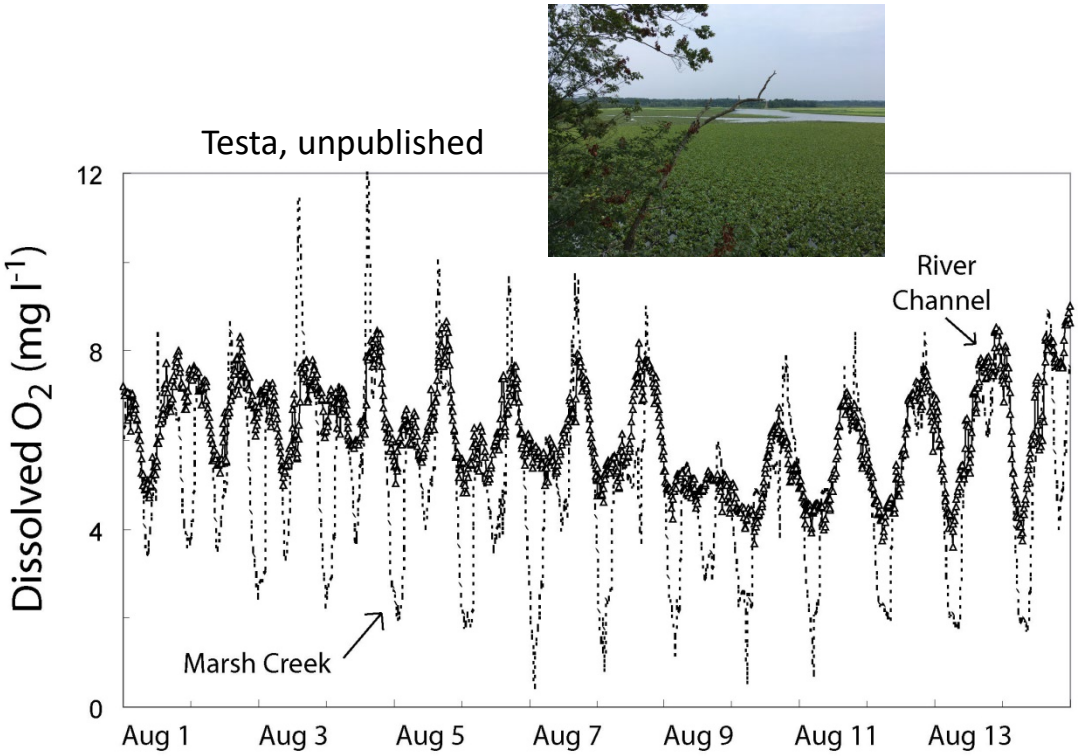
The Bay's Shallow, Nearshore Waters are Highly-Utilized, But Poorly Understood



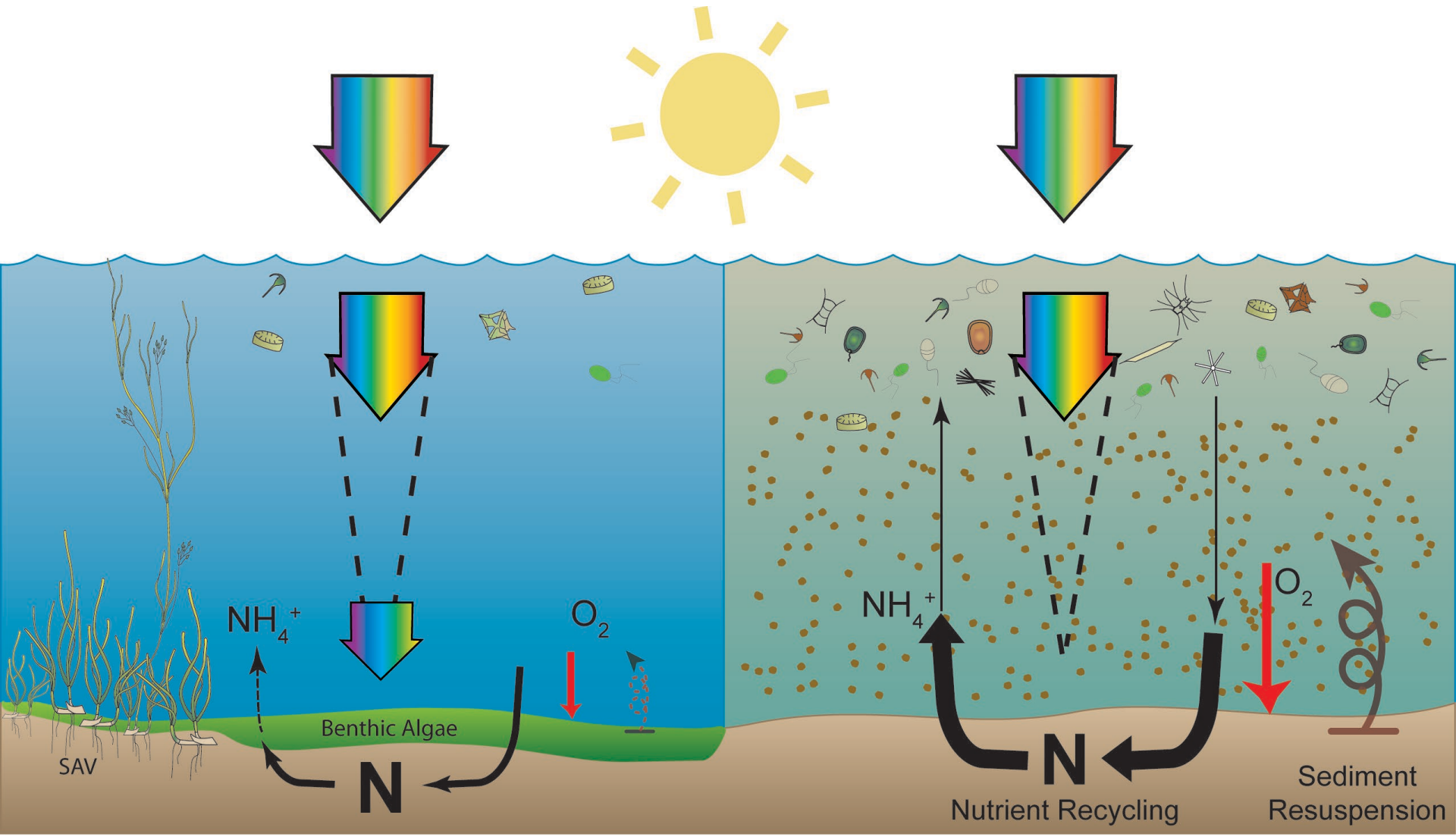
Shallow habitat ubiquitous

Oxygen varies significantly over hourly time scales



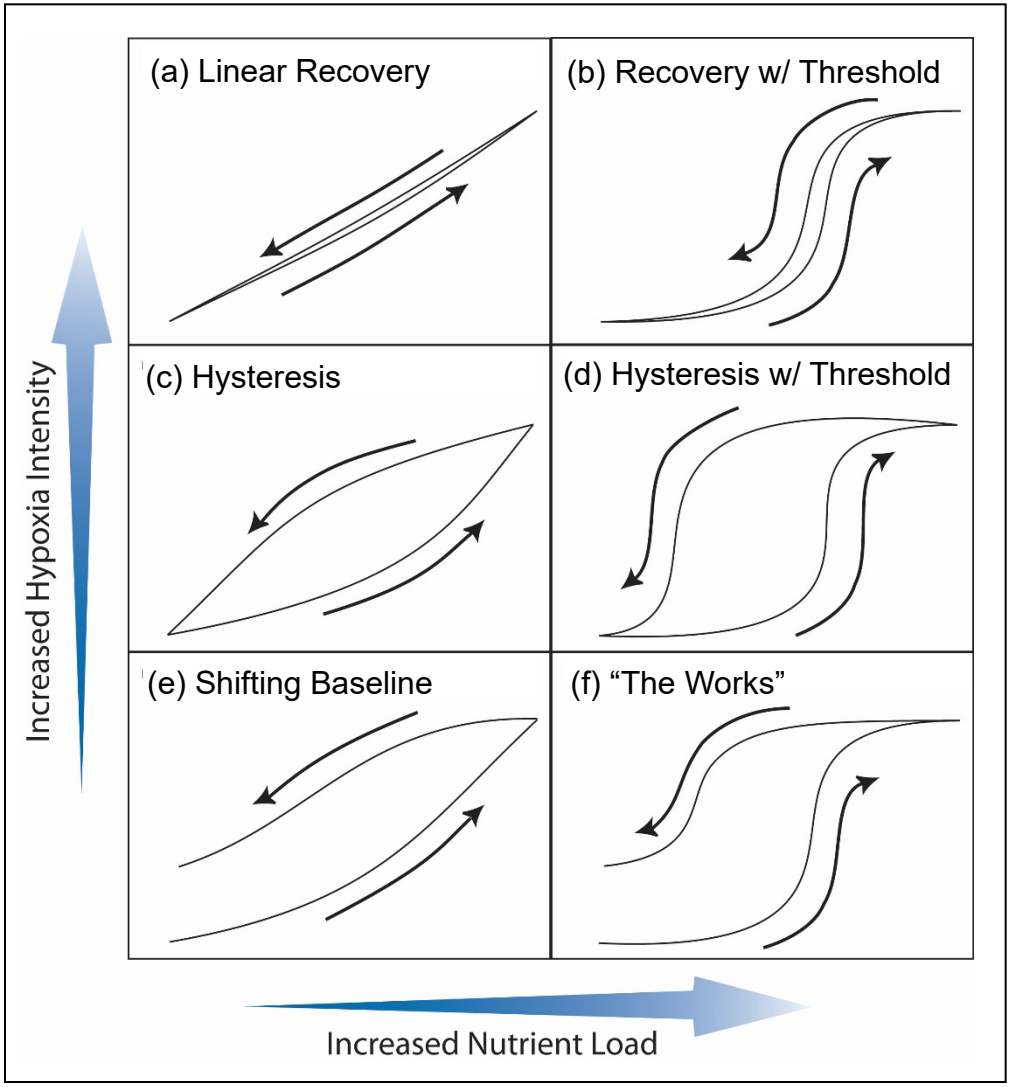


Tipping Points in Shallow Environments



Boynton et al. 2009

There are changes in the Bay that are not as fast as the load reduction is. This includes lags in when BMPs put into place and when that effect is felt in the load. There are also biological communities that take time to recover, and some of these communities can accelerate recovery (tipping points)



Kemp et al. 2009

So what are our recommendations and conclusions?

(a) Emphasize shallow waters:

- The shallow-water/T-Zone filter could supercharge restoration.
- Will help with shallow attainment, which is helpful, and will also limit flux of nutrients downstream.
- Tipping points could be jumpstarted with targeted reductions.

(a) Emphasize augmentation of the TMDL:

- Living Shorelines, Biological Communities,
- Biogeochemical Processes.
- This will help living resources directly.