Options for assessing dissolved oxygen criteria

Advancing Monitoring Approaches to Enhance Tidal Chesapeake Bay Habitat Assessment on Dissolved Oxygen Assessment

May 11, 2022

Virtual

Dong Liang, Jeremy Testa, Lora Harris, Walter Boynton

Outline and Motivation

(1) Chesapeake Bay has a large monitoring program that aids in the assessment of water quality criteria (including dissolved O_2)

(2) Given unavoidable limitations in the density of sampling stations in the program, do we sample enough to adequately assess criteria?

   3 possibilities: (a) current sampling adequately captures criteria failure
   (b) current sampling *underestimates* criterial failure (misses problem areas)
   (c) current sampling *overestimates* criteria failure (biased sampling)

(3) Can we optimize sampling technology and station density for effective criteria assessment?

(4) An approach will be presented that uses numerical model simulations as "data" that can be sampled using a variety of existing technologies within a range of potential effort
   - How many more stations are needed to capture criteria failure?
   - Can those stations include discrete sampling, or are continuous sensors needed?
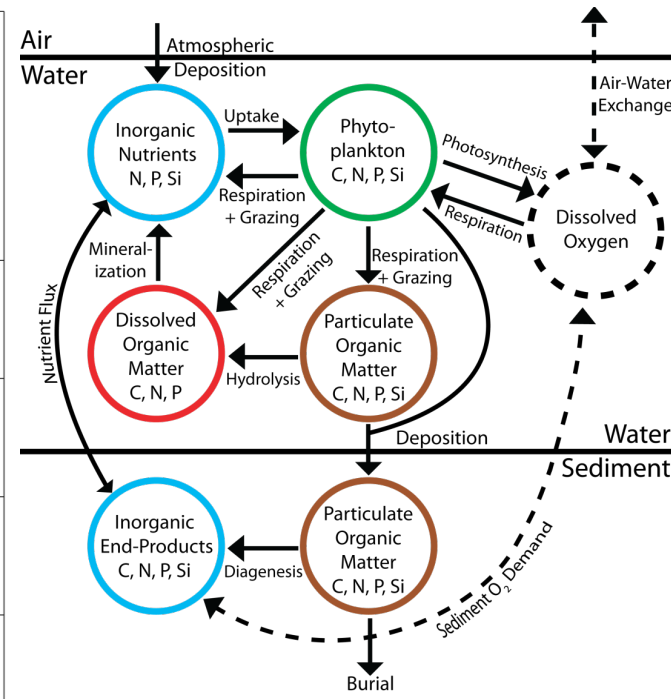
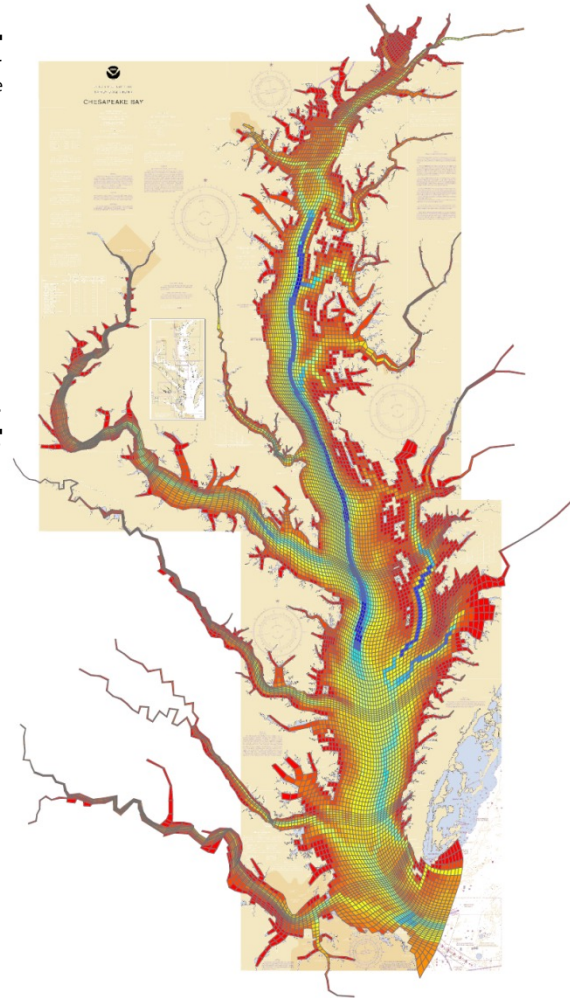# Models as Data to Fully Represent System in Time and Space

a) ROMS-RCA

(b)

EPA/ACOE Water Quality and Sediment Transport Model
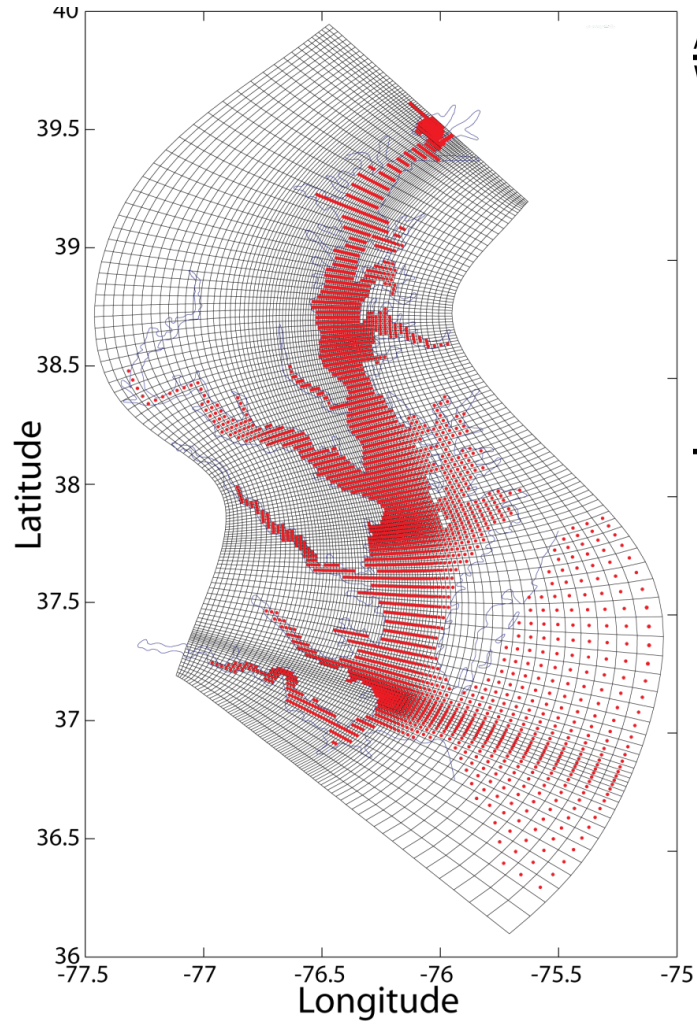
(Testa et al. 2014)

Similar Biogeochemistry in Both Models
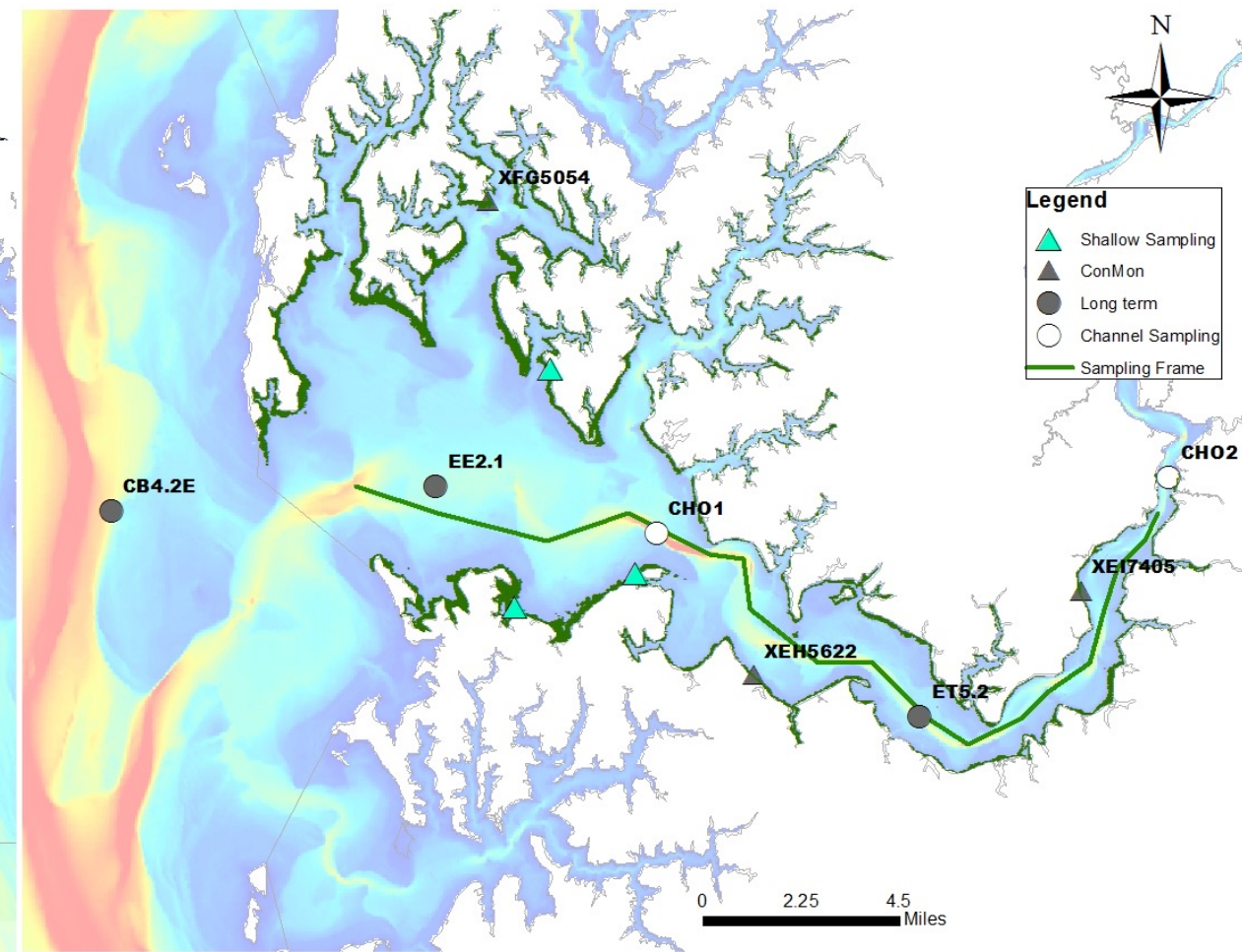

(Cerco and Noel 2010)

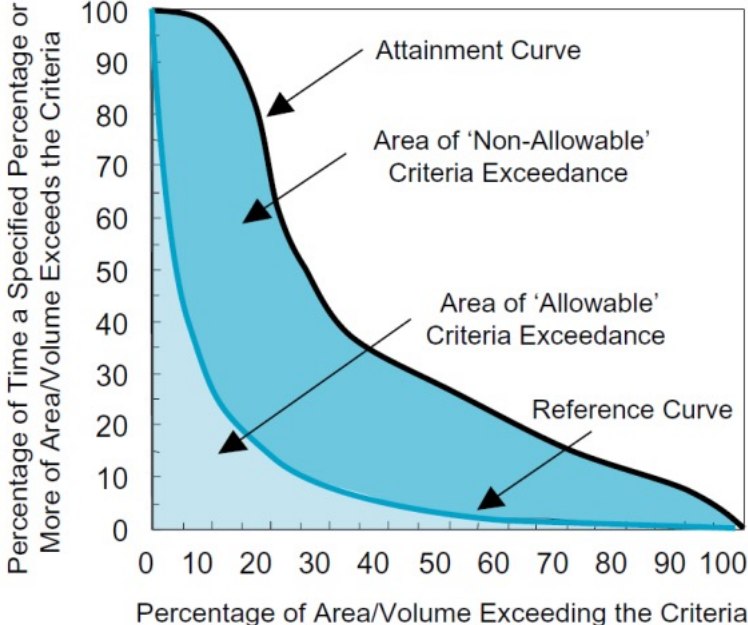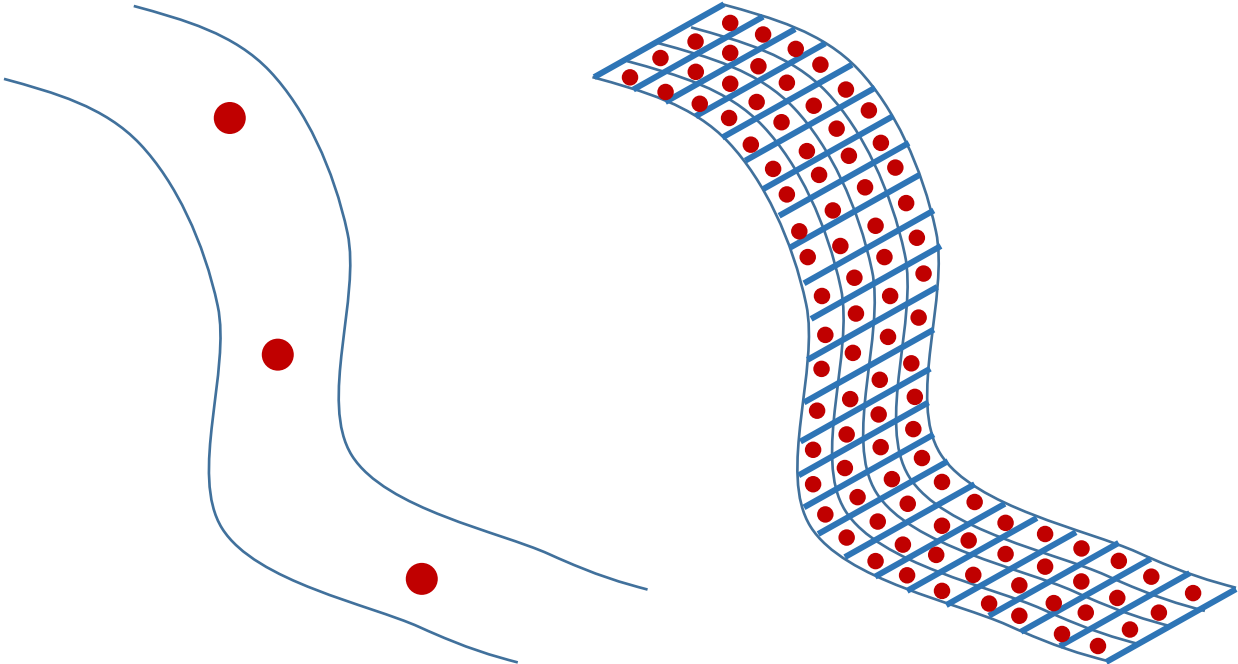# Sampling Designs

Mesohaline Potomac River
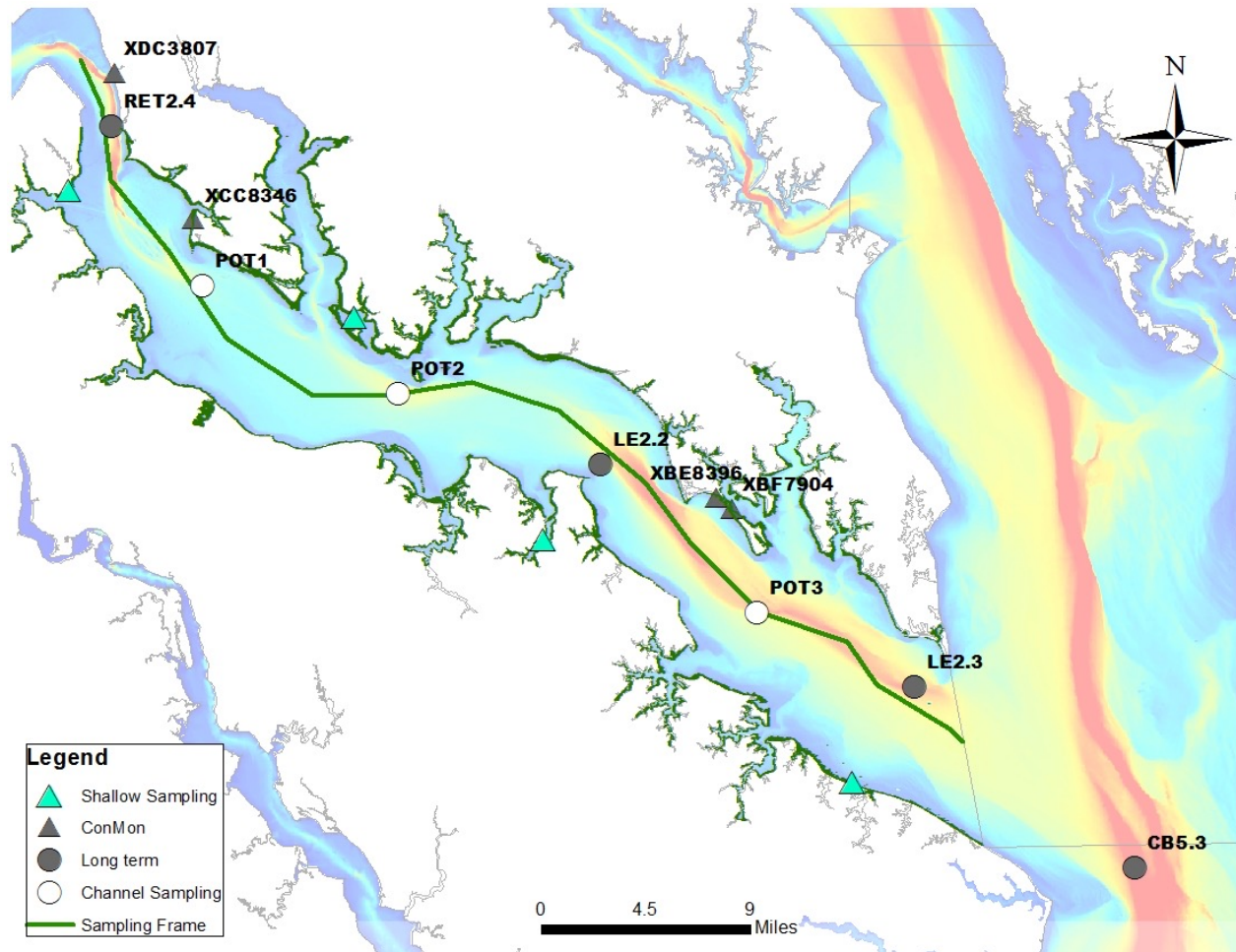
Mesohaline Choptank River

Approach to Computing Cumulative Frequency Diagram
from Interpolating Sub-sampled Model "Data"

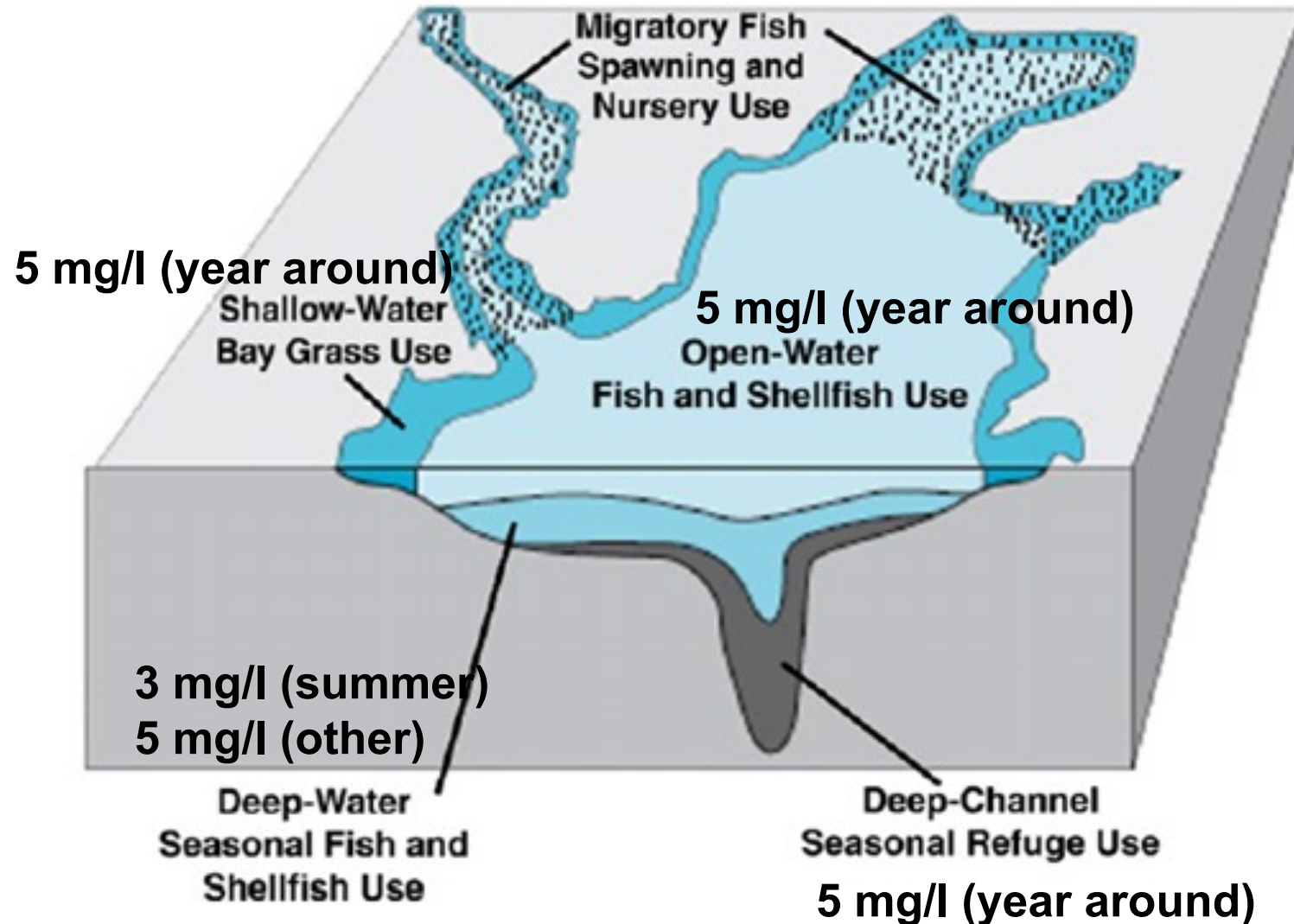## (25 Monthly Cruises: BAY524 – BAY566)

(1) Sample Water Body ➡ Interpolate to Grid ➡ Compute CFD (space, time)

Vol3DInterp

Approach to Computing Cumulative Frequency Diagram from Habitat Assessment for Dissolved Oxygen Criteria


**B.** Oblique View of the Chesapeake Bay and its Tidal Tributaries

Migratory Fish Spawning and Nursery Use

5 mg/l (year around)
Shallow-Water Bay Grass Use

5 mg/l (year around)
Open-Water Fish and Shellfish Use

3 mg/l (summer)
5 mg/l (other)
Deep-Water Seasonal Fish and Shellfish Use

Deep-Channel Seasonal Refuge Use
5 mg/l (year around)

(Batiuk et al. 2014)

Approach to Computing Cumulative Frequency Diagram from "True" attainment in Potomac Mesohaline Segment
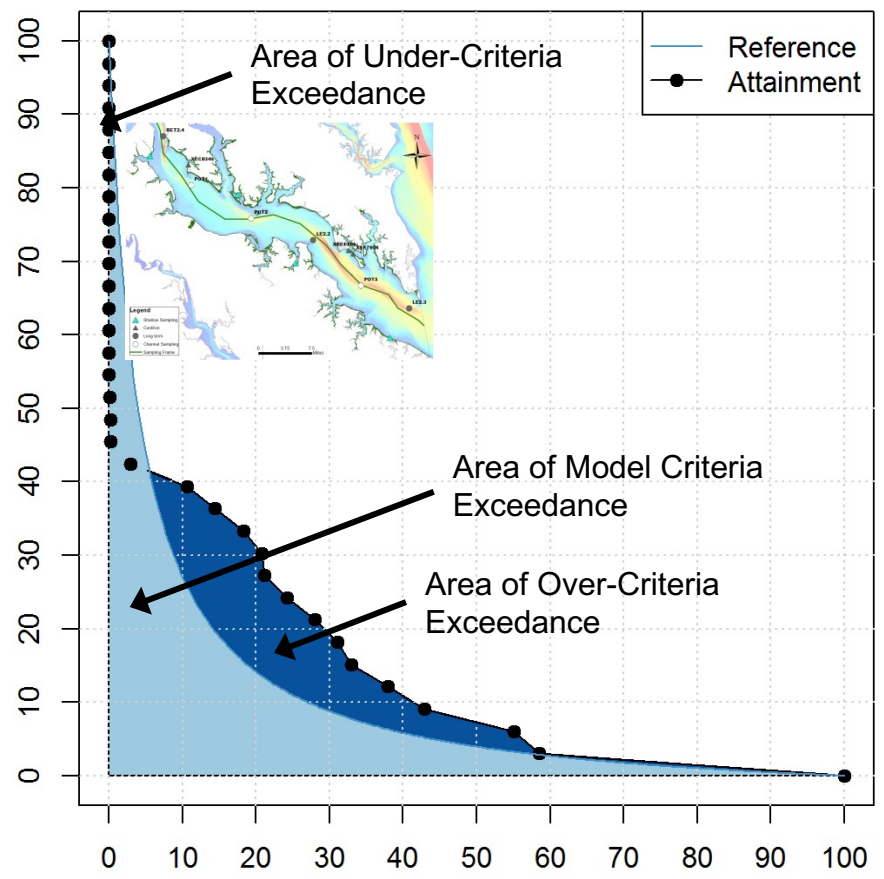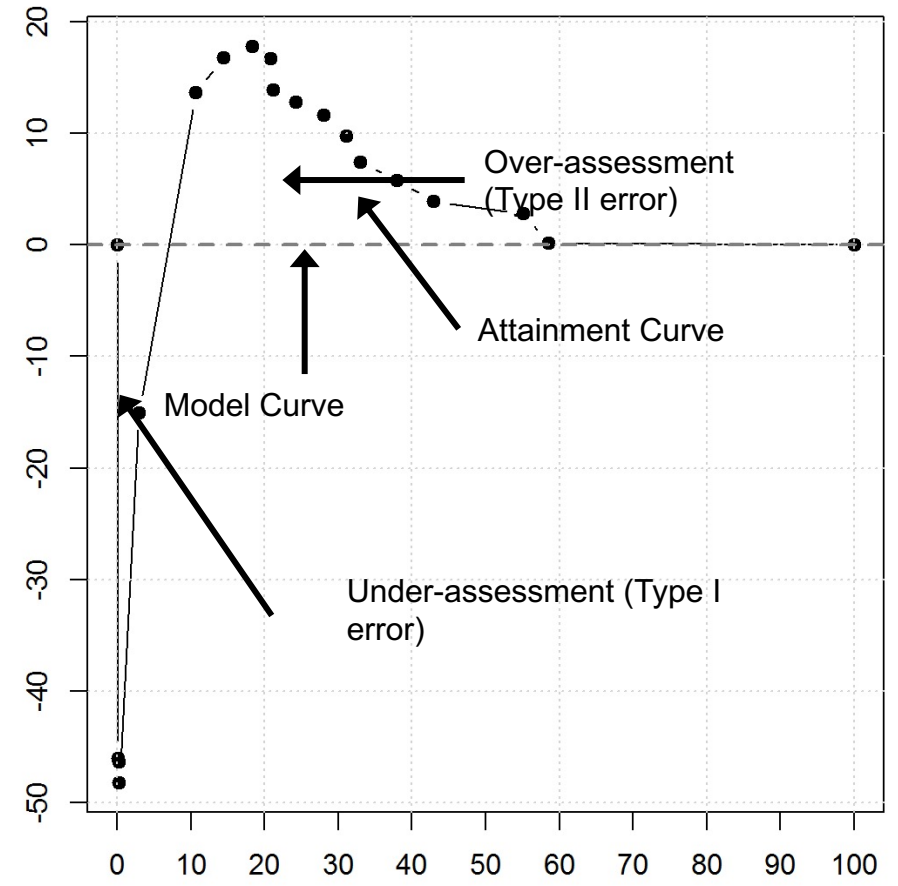
Comparing Sampling Effects on Criteria Exceedance (Potomac Mesohaline)
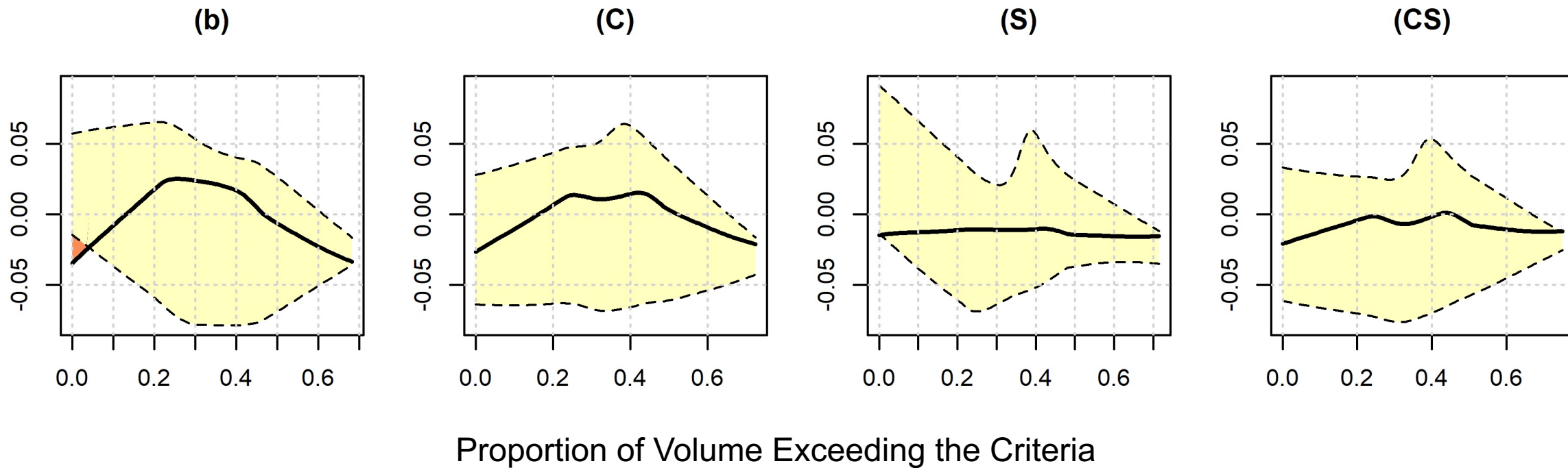
(b)=Baseline, (C)= More channel(n=3), (S)= More shallow(n=4), (CS)= C+S

Effects of Removing One Fixed Station on Criteria Exceedance (Potomac Mesohaline)
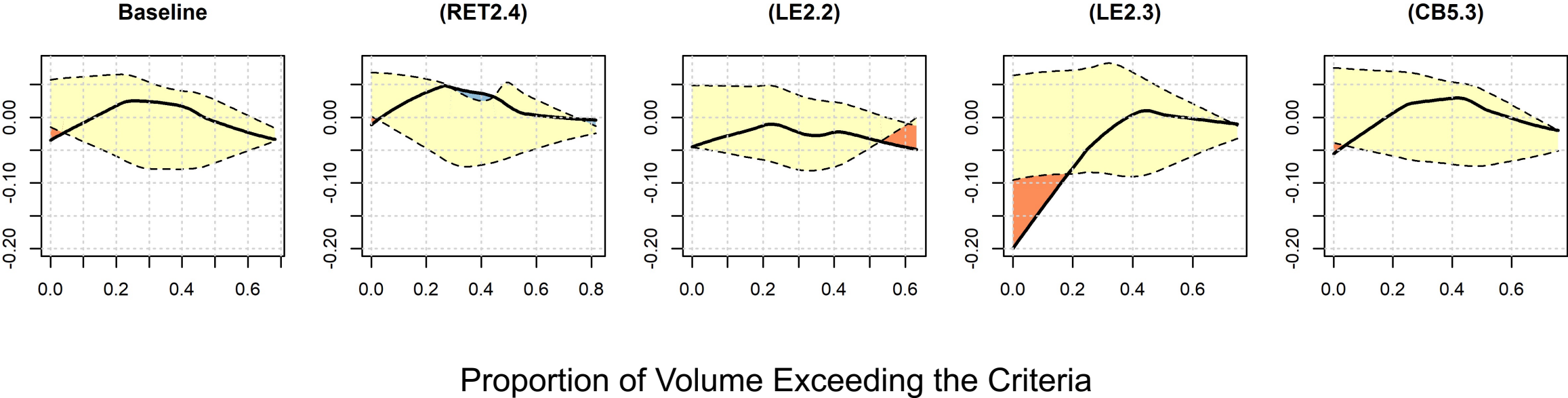
Comparing Sampling Effects on Criteria Exceedance (Choptank Mesohaline)
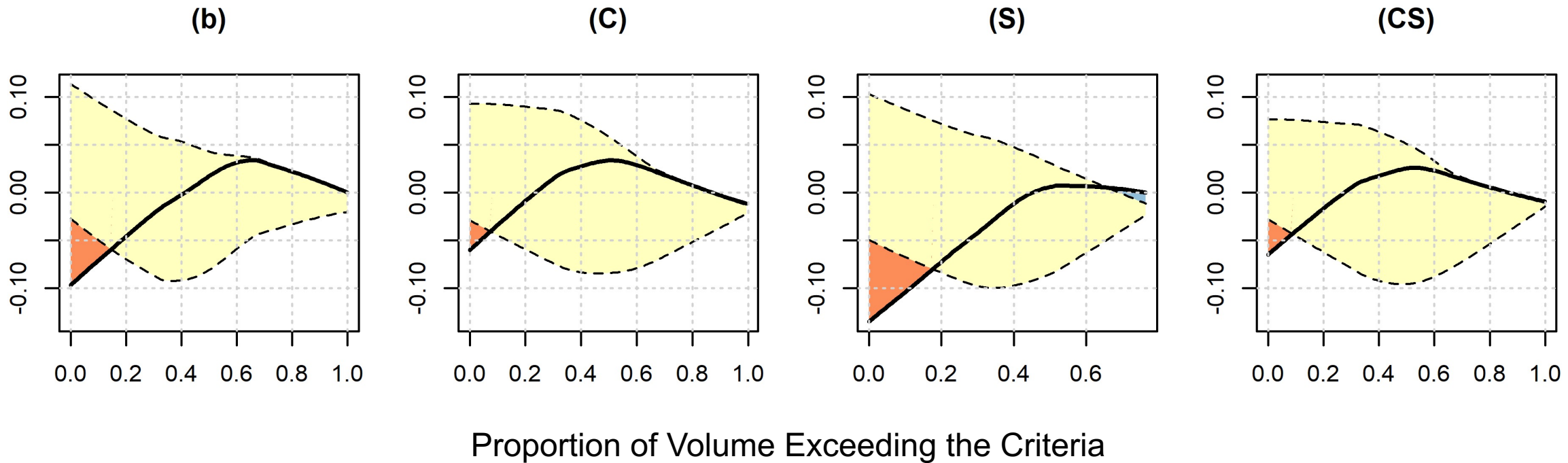
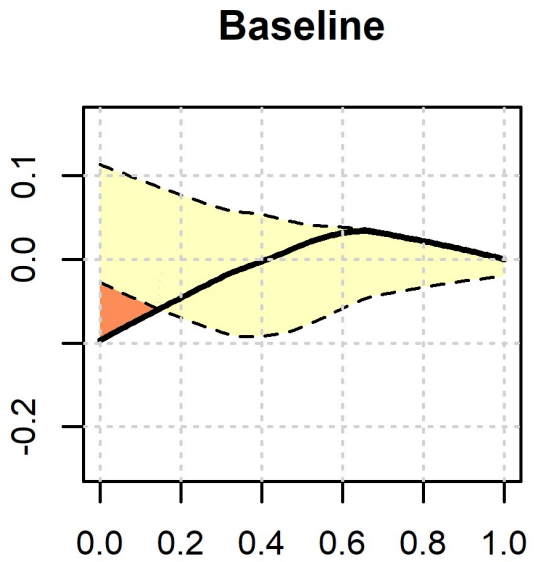(b)=Baseline, (C)= More channel (n=2), (S)= More shallow (n=3), (CS)= C+S

Effects of Removing One Fixed Station on Criteria Exceedance (Choptank Mesohaline)
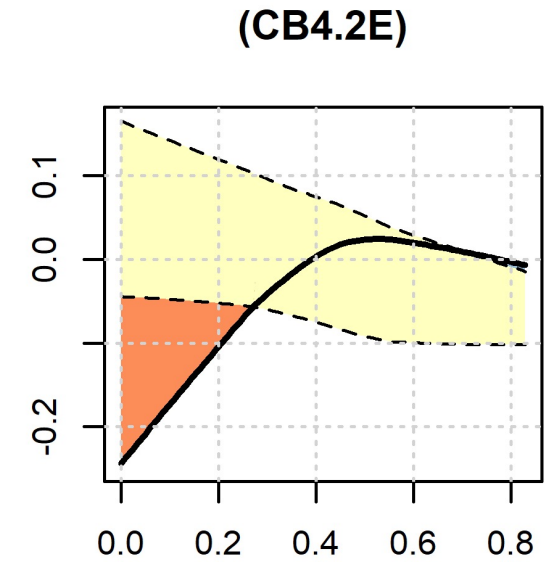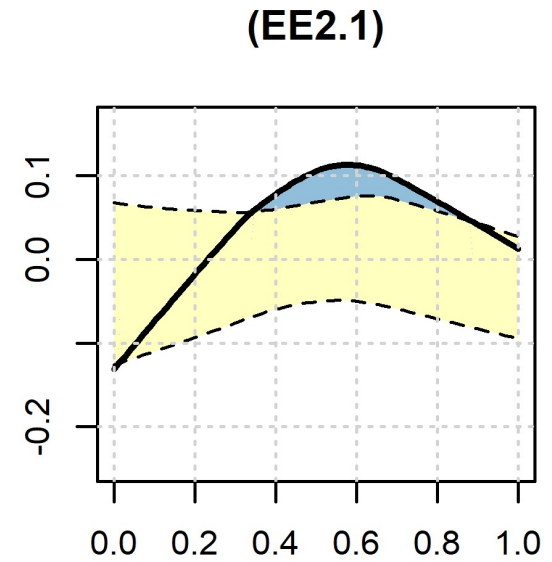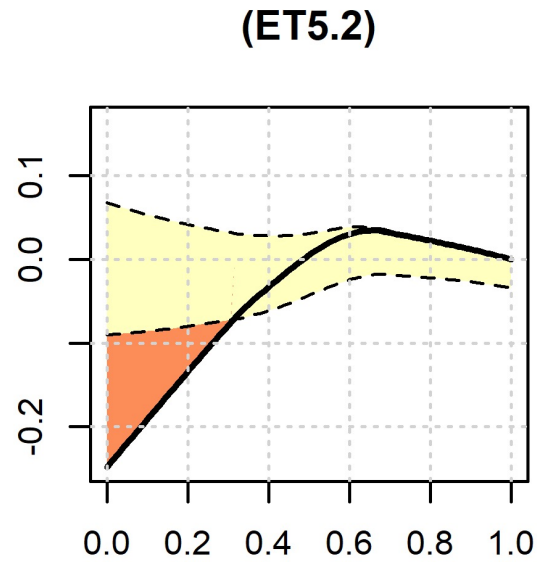
Summary and Recommendations

1) We sub-sampled numerical model to assess 30-day dissolved oxygen criteria in two river segments.

2) Current sampling can under-assess criteria failure in both river segments.

3) Sampling design is sensitive to placement of deep channel stations.
   a) Channel sampling addressed under-assessment, by increased sampling of hypoxic waters.
   b) We recommend maintaining sampling in the seaward portion of the estuary, which represents a large portion of the estuary areas.

4) Additional shallow sampling efforts contribute to assessment at larger spatial extents.
   a) Spatial configuration of shallow monitoring is not as important.
   b) We recommend continued deployment of short-term shallow monitoring efforts.
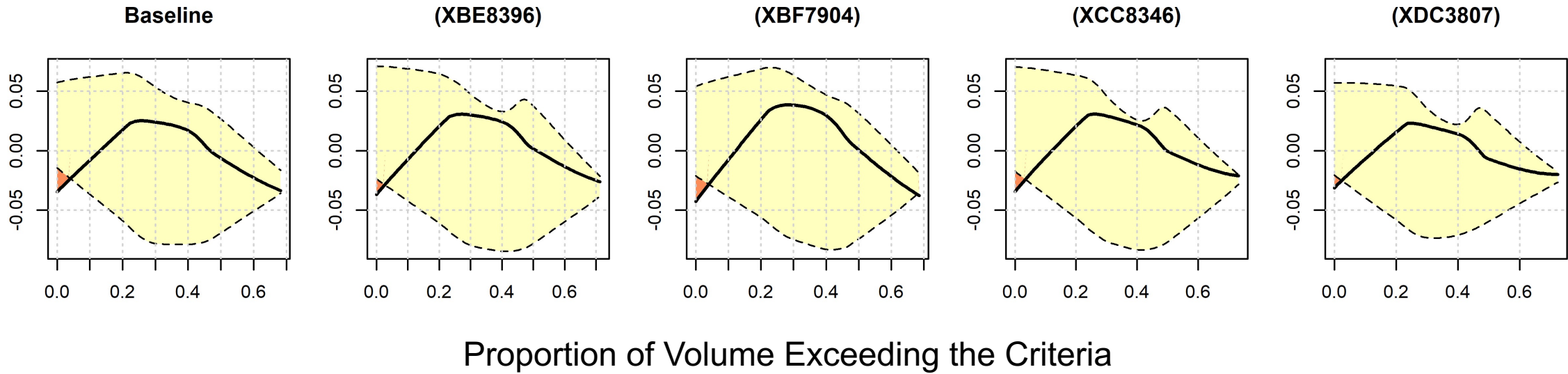
Future Work and Acknowledgement

1. Short term (7 day/instantaneous) assessment
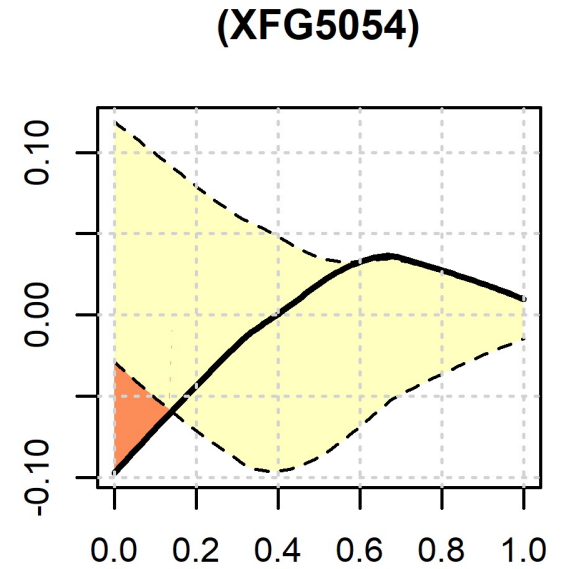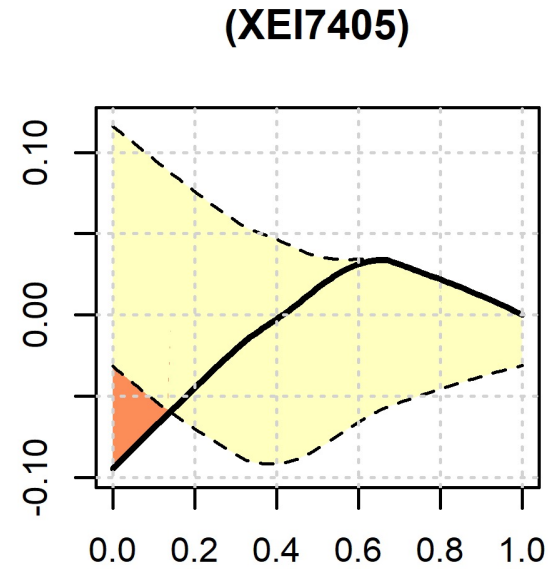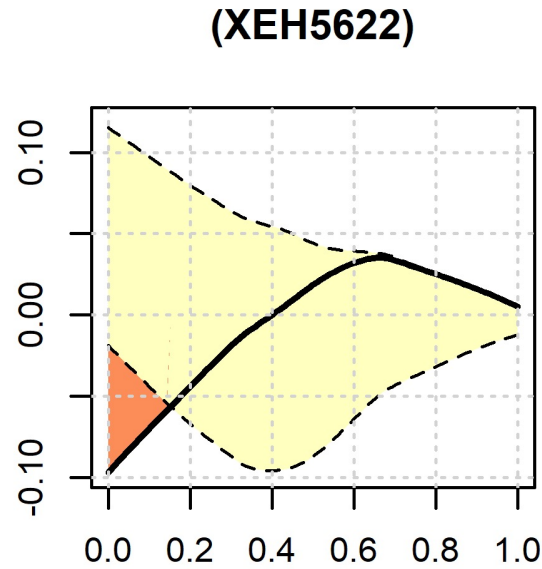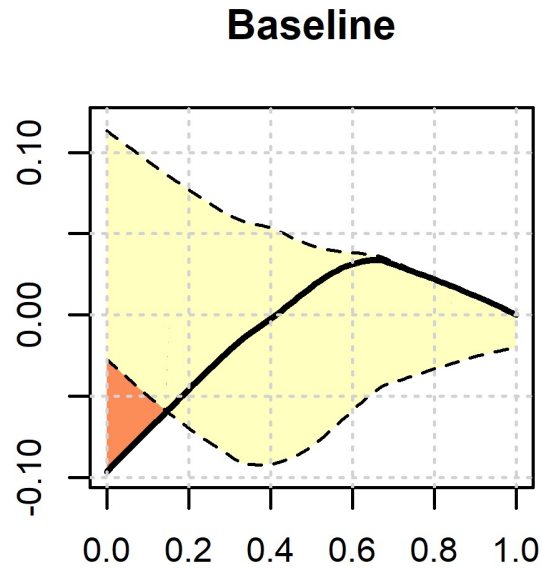2. Realistic sampling frames
3. Model uncertainty

Effects of Removing One ConMon Station on Criteria Exceedance (Potomac Mesohaline)

Effects of Removing One ConMon Station on Criteria Exceedance (Choptank Mesohaline)