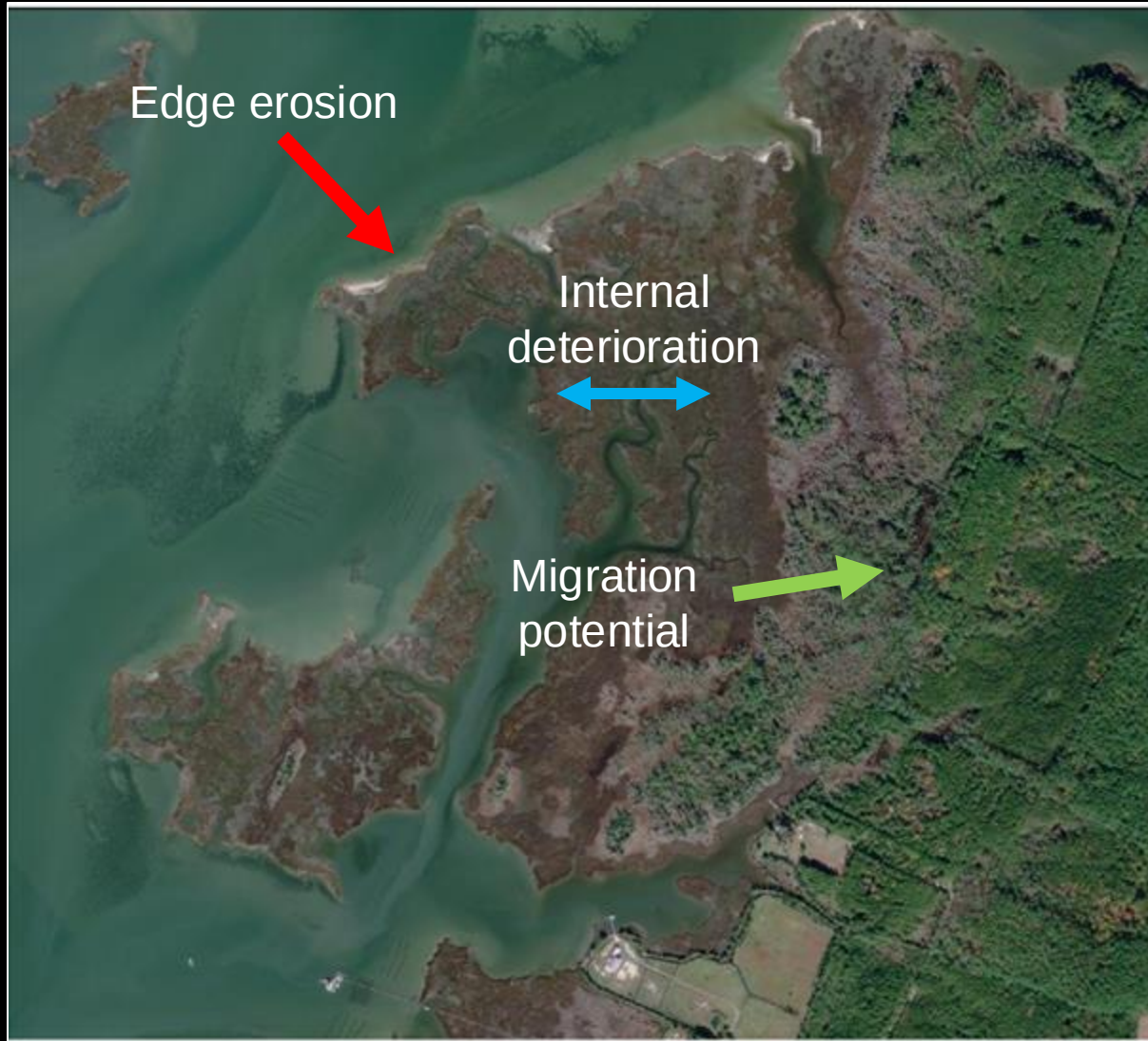


Geospatial analysis to support salt marsh management and restoration: applications in the Gulf of Maine and Beyond

Neil Ganju, Kate Ackerman, and Zafer Defne
U.S. Geological Survey, Woods Hole Coastal and Marine Science Center



Where are salt marshes headed?



Edge erosion controlled by waves, marsh height, estuary configuration

Internal deterioration controlled by multiple factors (SLR, herbivory, sediment deficits) but reveals itself through open water conversion and elevation loss

Migration potential controlled by slope, sea level, tidal and storm inundation, salinity, land use, canopy cover, groundwater...

Internal deterioration: the UVVR (UnVegetated-Vegetated Ratio)

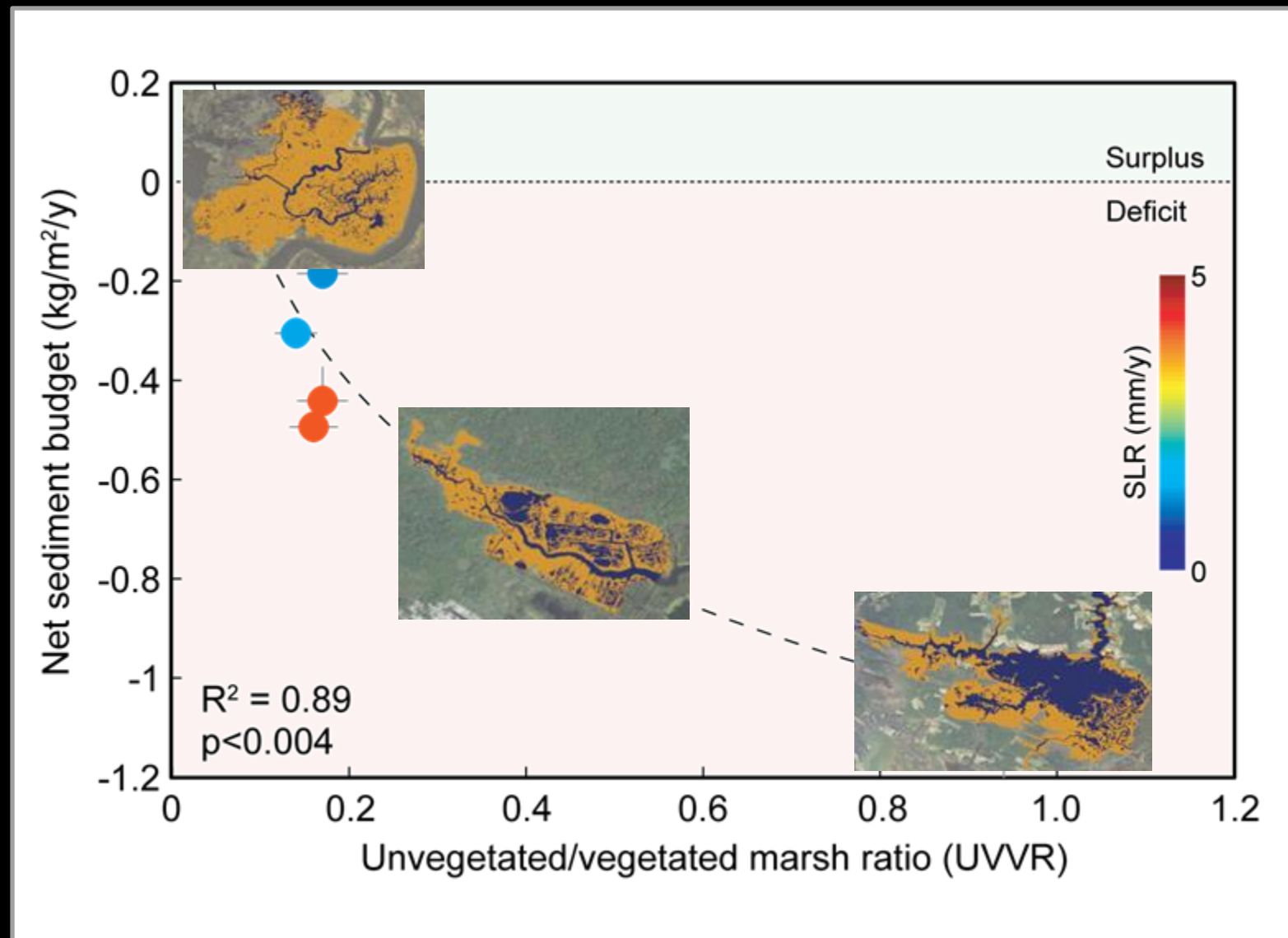
UVVR tracks disintegration of wetland complex

Loss of vegetation decreases trapping, increases sediment liberation

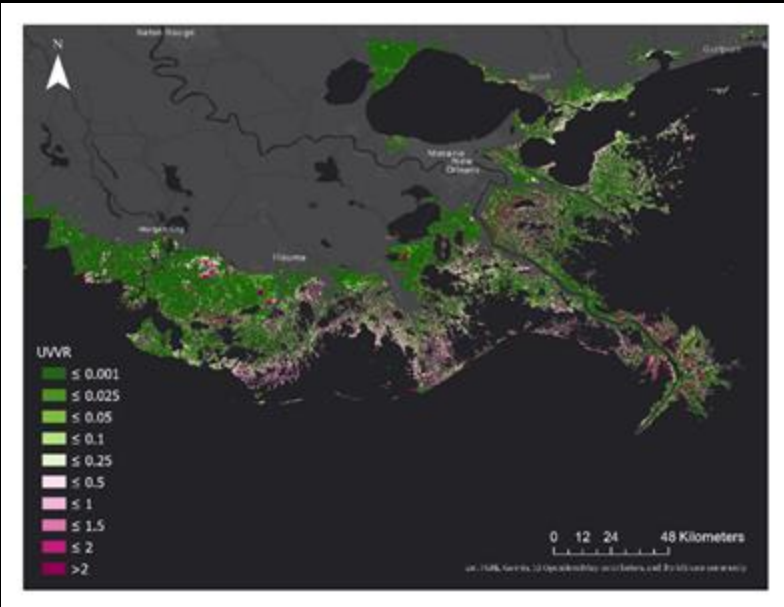
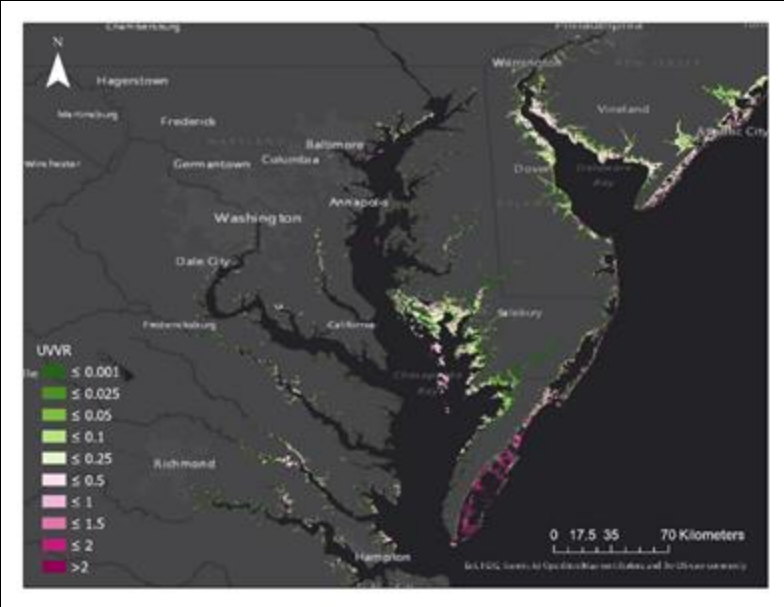
Healthy marsh plain should have minimal ponding from root collapse

Relationship ties SLR, sediment budget, and marsh processes together

Stability value $\sim 0.10 - 0.15$



UVVR: Landsat, CONUS-wide



UVVR: NAIP, Northeast USA



Couvillion et al., 2022;
Ackerman and Defne, various

Results from Landsat-based UVVR 1985-2022 change

Barnstable Marsh, MA
Largely stable, minimal changes in vegetated area

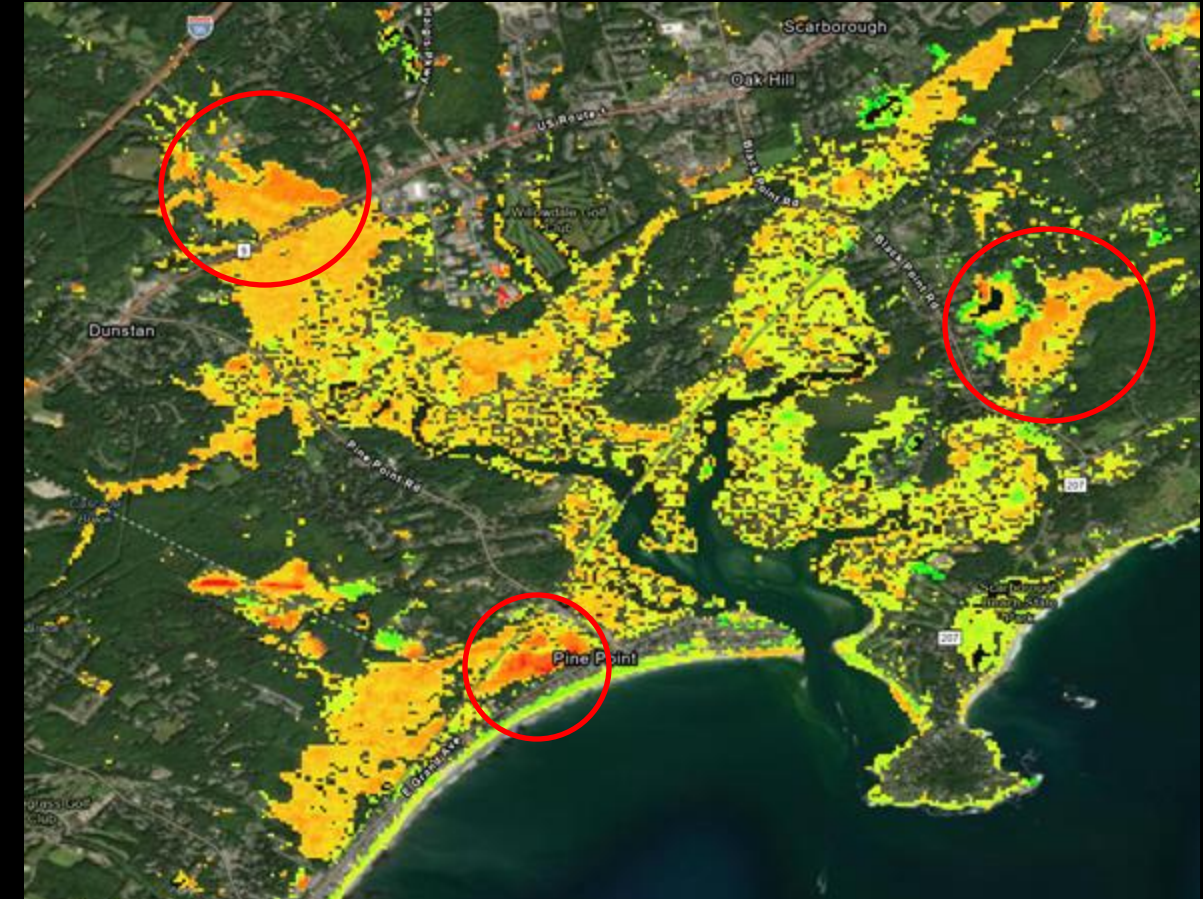
Scarborough Marsh, ME
Largest losses behind tidal restrictions



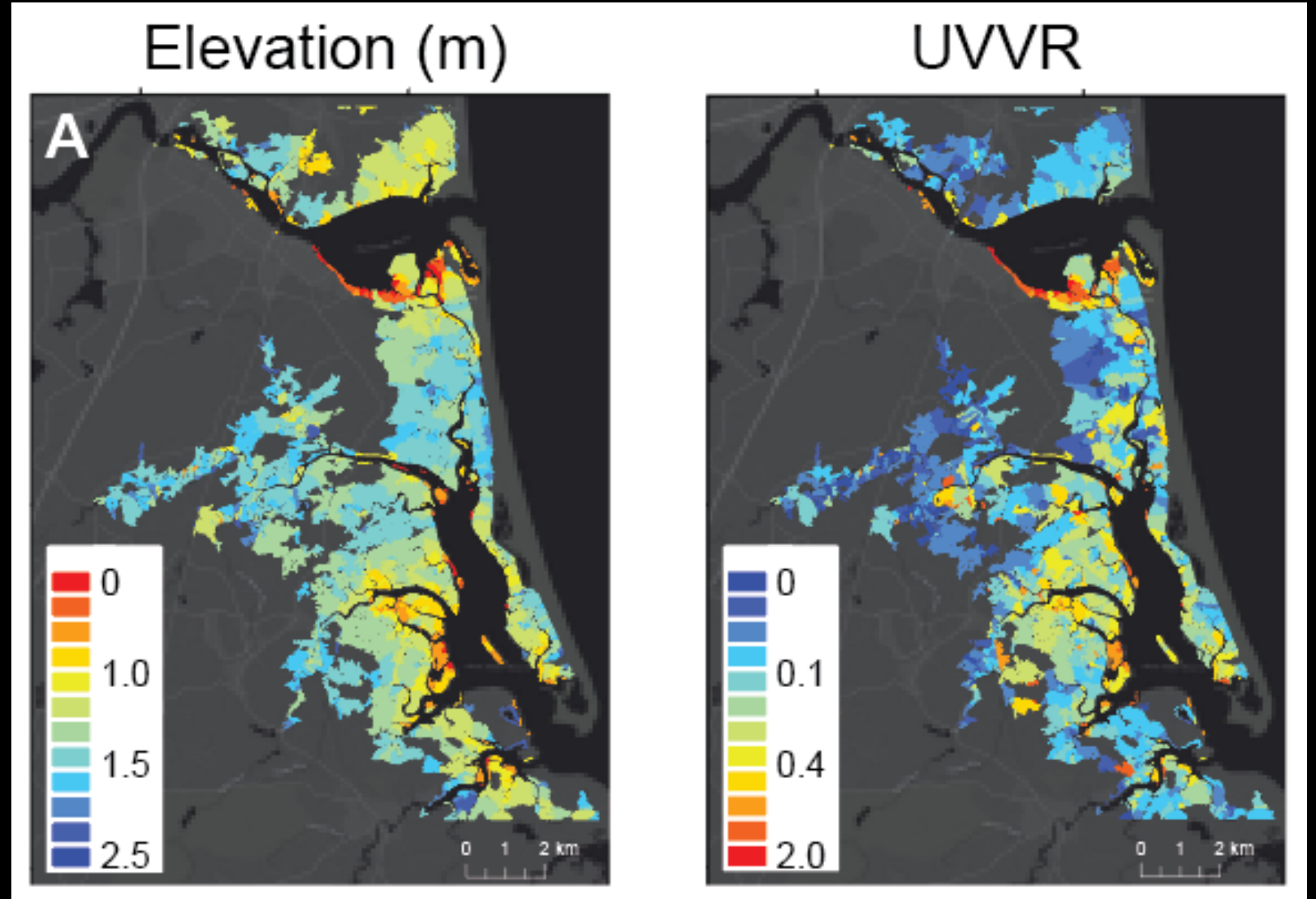
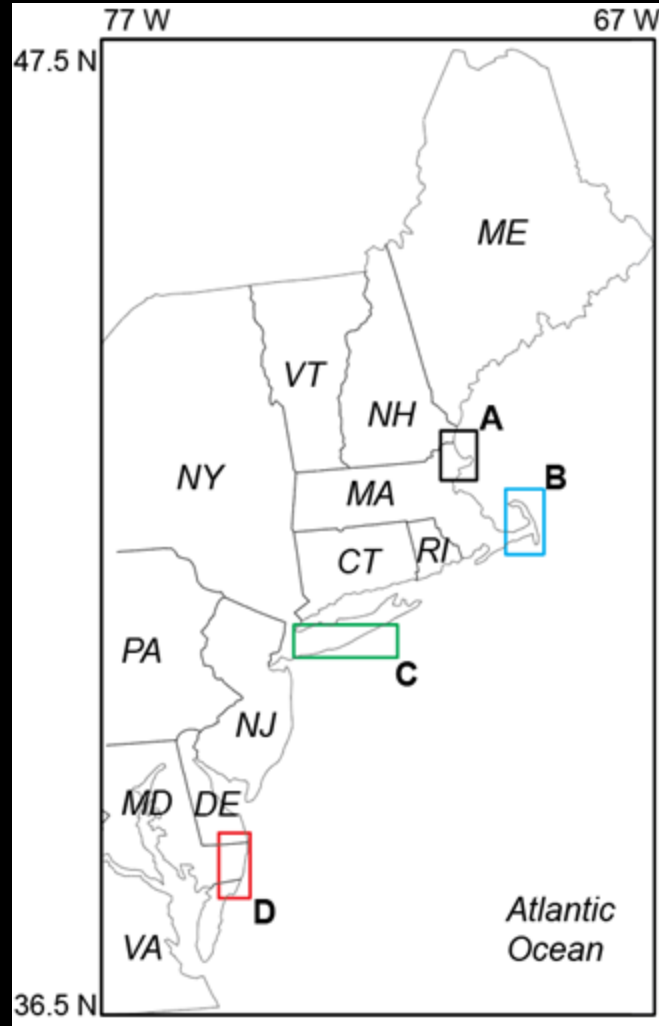
Couvillion et al., 2024

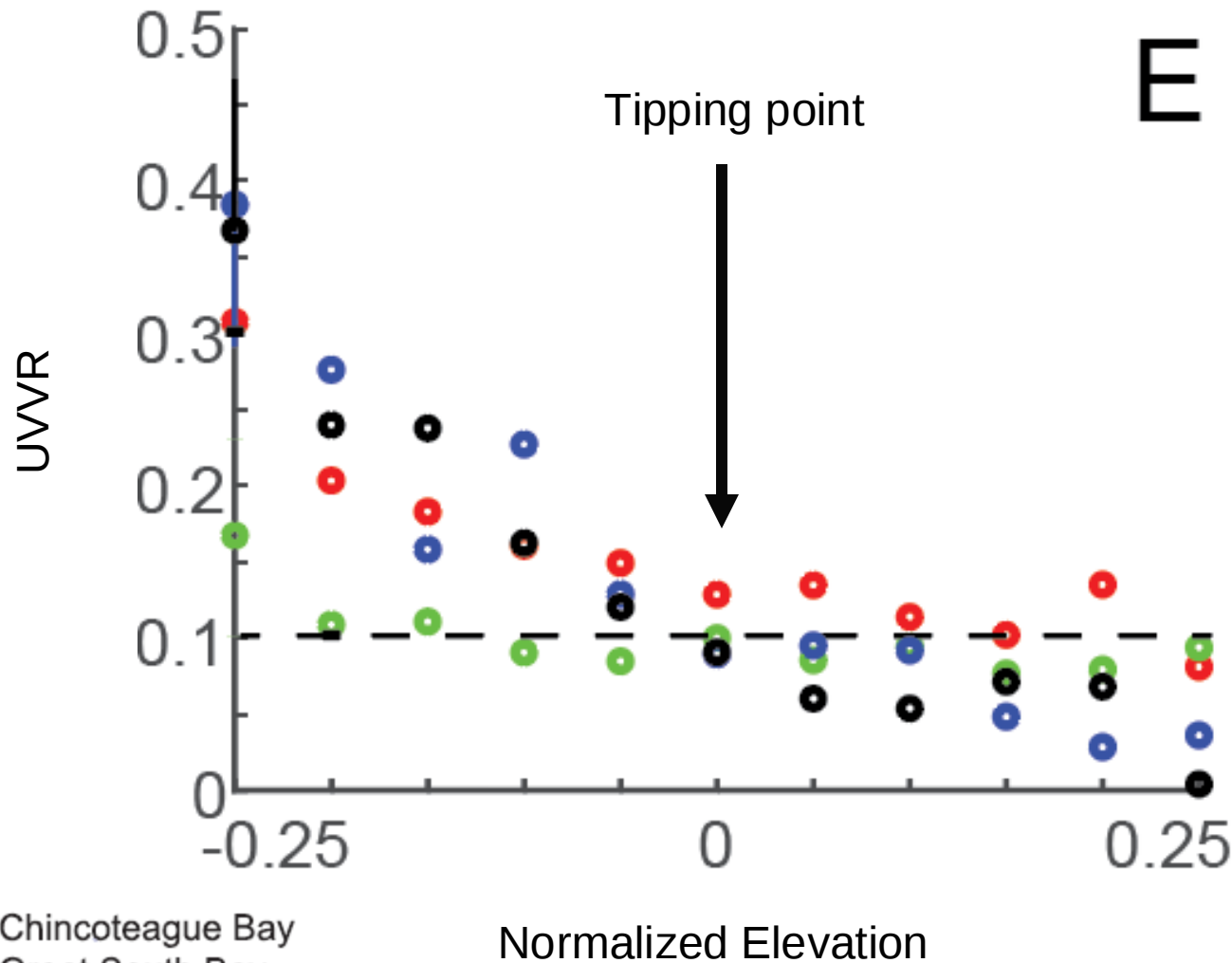
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Results from NAIP-based UVVR and marsh units





- Chincoteague Bay
- Great South Bay
- Cape Cod
- Plum Island Estuary

Relationship across estuaries collapses when elevation is normalized

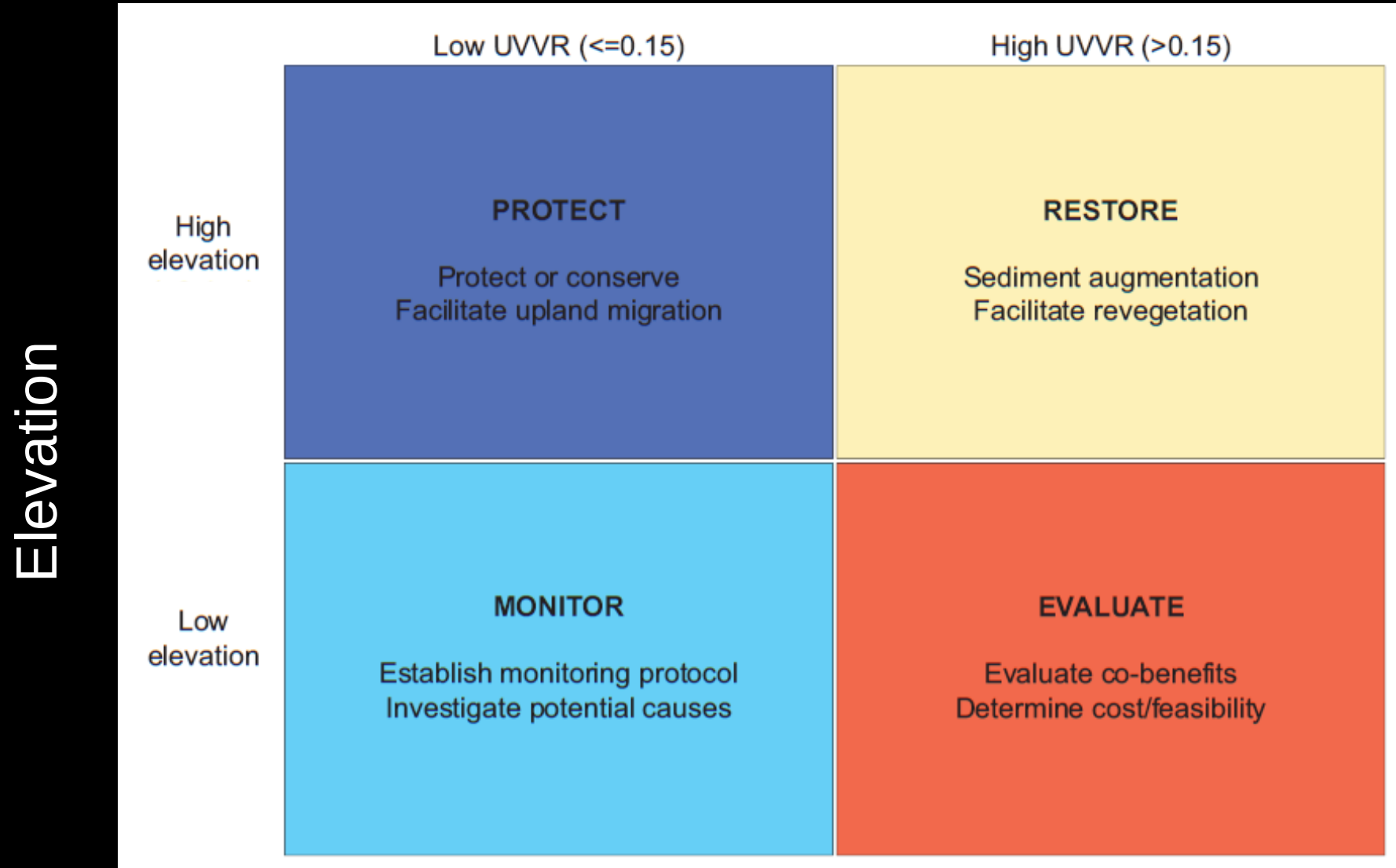
At UVVR ~ 0.1 and normalized elevation of zero, curves intersect, i.e. areas below mean elevation are laterally unstable

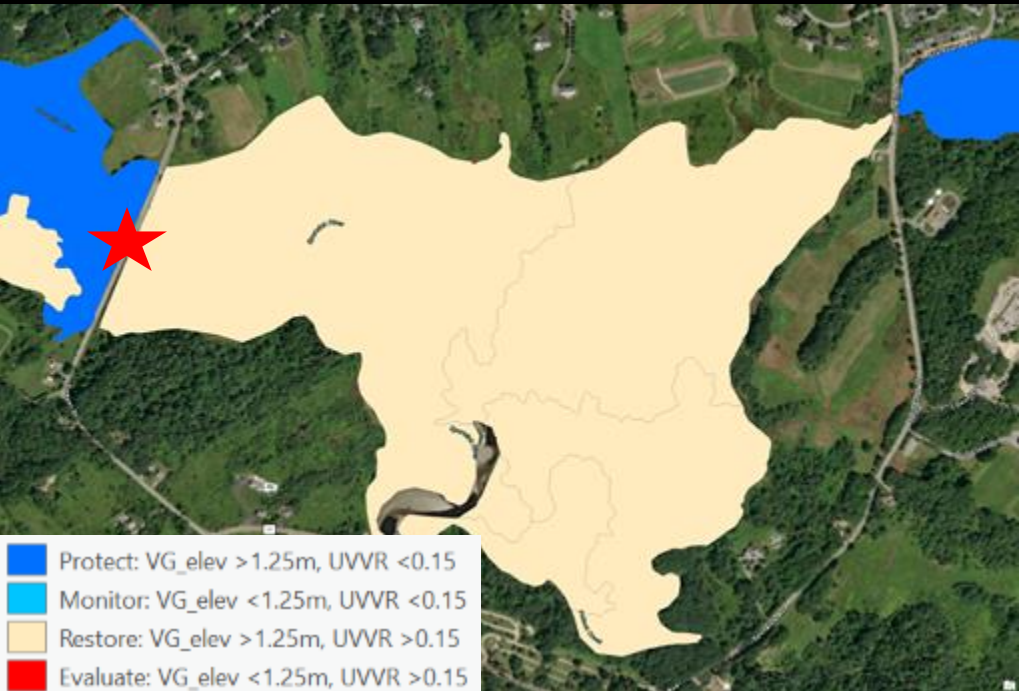
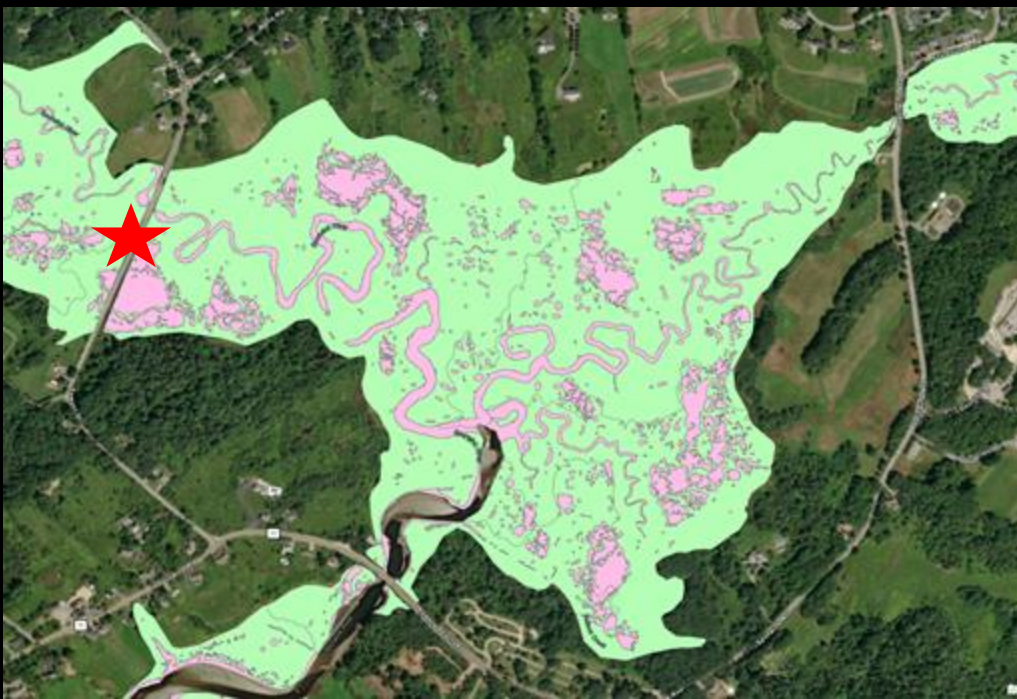
More simply, every marsh complex has a similar threshold for vertical and lateral instability, regardless of elevation and tide range

How can we use these relationships to inform management and restoration?

Determining strategies: restoration decision matrix

UnVegetated-Vegetated Ratio (UVVR)





Spurwink Marsh, ME: Multiple marsh units experiencing restriction and coastal squeeze

High elevation, high UVVR, significant ponding and internal deterioration

Currently planned for restoration by improvement of Sawyer Road culvert (★)

Collaborative work in the Gulf of Maine

Marshes for Maine's Future: Collaborative Science to Support Marsh Conservation and Management Decisions in Maine – A Model for Transferring Geospatial Science in the NERRS

- Led by Chris Feurt, Wells National Estuarine Research Reserve
- Participated in user-focused workshops with USGS data

USGS-NPS Natural Resources Partnership Program: Using Consistent Science and Structured Decision Making to Inform Marsh Conservation and Management Decisions in Coastal Parks

- Northeast Region-wide effort to use geospatial data at 8 coastal parks
- SDM process and geospatial mapping complete
- Cape Cod National Seashore using results in planning marsh restoration



Thank you!

