
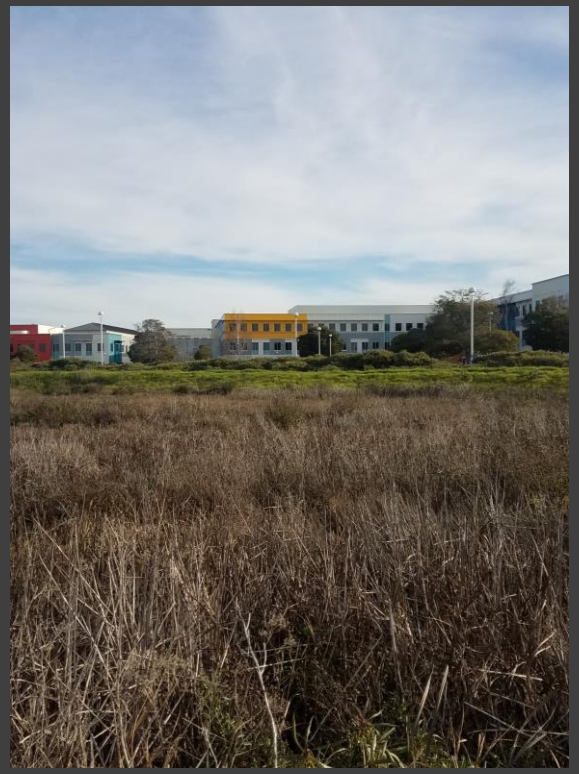

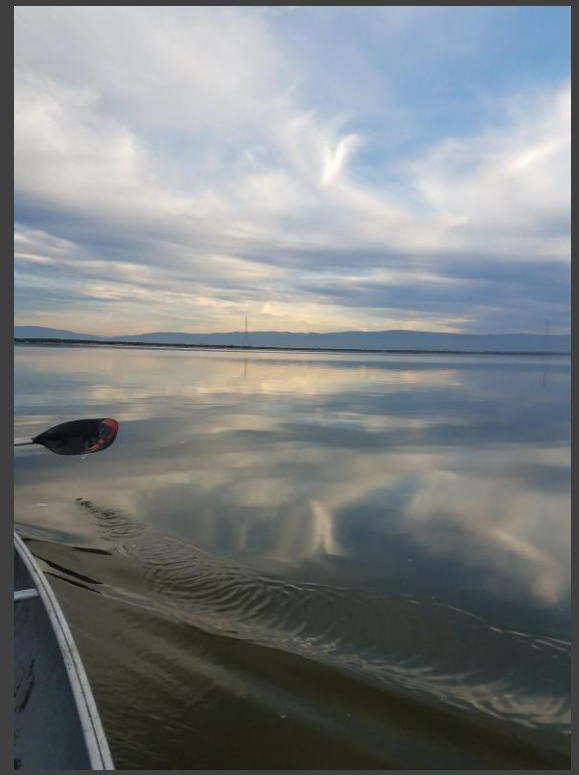

Understanding Marsh Characteristics to Inform Sea-Level Rise Vulnerability in South San Francisco Bay

Karen Thorne, PhD
U.S. Geological Survey, Western Ecological Research Center,

South Bay Salt Pond Restoration Project
Science Symposium 2022

Goal – to understanding the sea-level rise vulnerability of tidal marshes in south San Francisco Bay

Questions:

- How vulnerable are the existing marshes to sea-level rise?
- Does sea-level rise vulnerability vary across south SFB?
- What does this mean for restoration projects?

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Project Outline

Objectives:

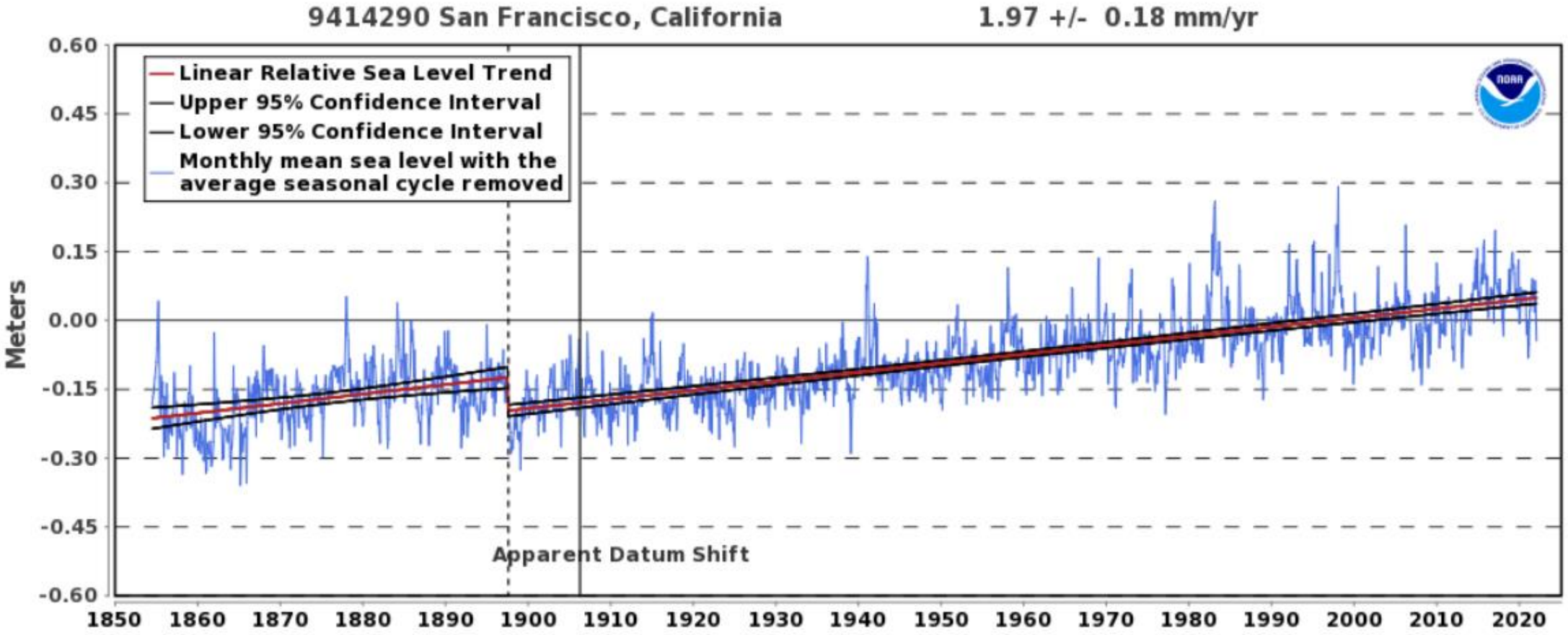
1. Measure marsh baseline conditions to inform modeling - completed
2. Collect cores to measure accretion rates - funded
3. Model future habitats under sea-level rise scenarios using WARMER-2 - funded

Timeline – Coring late summer/fall. Modeling will be done in 2023. Project updates will be provided.

Products – Report, manuscripts, and data release at sciencebase.gov

Funding – California State Coastal Conservancy

Current rate of sea-level rise



Tide gauge at Presidio: 1854

0.65 ft in 100 years

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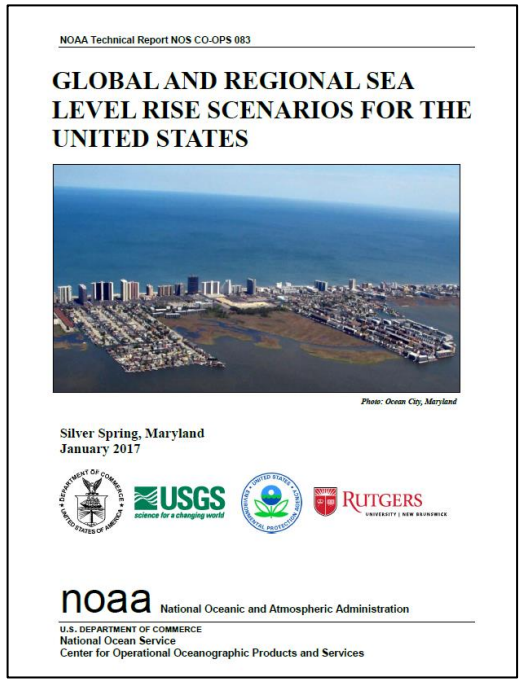
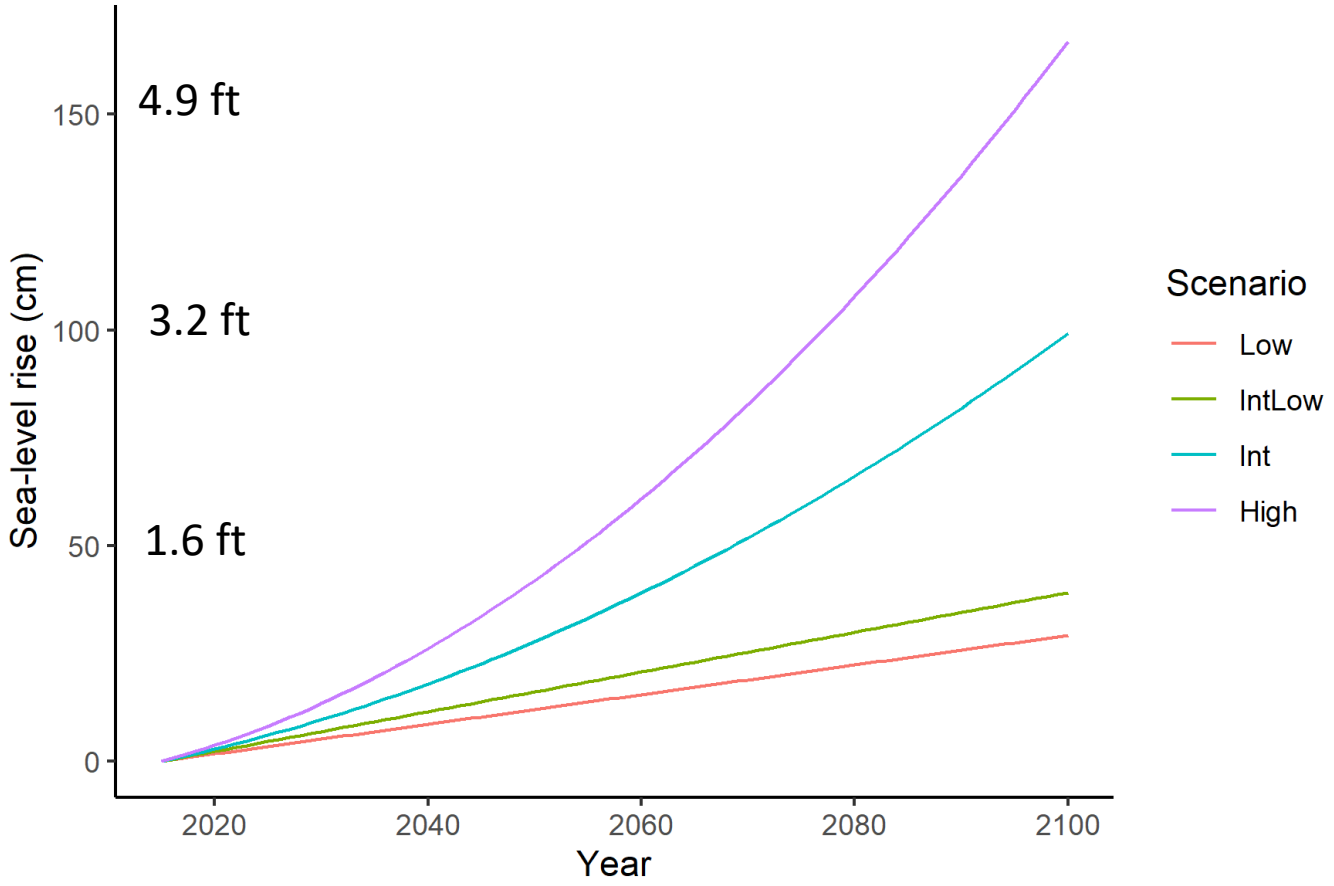
Sea-level threatens low lying areas

San Francisco Bay - sea-level rise projections





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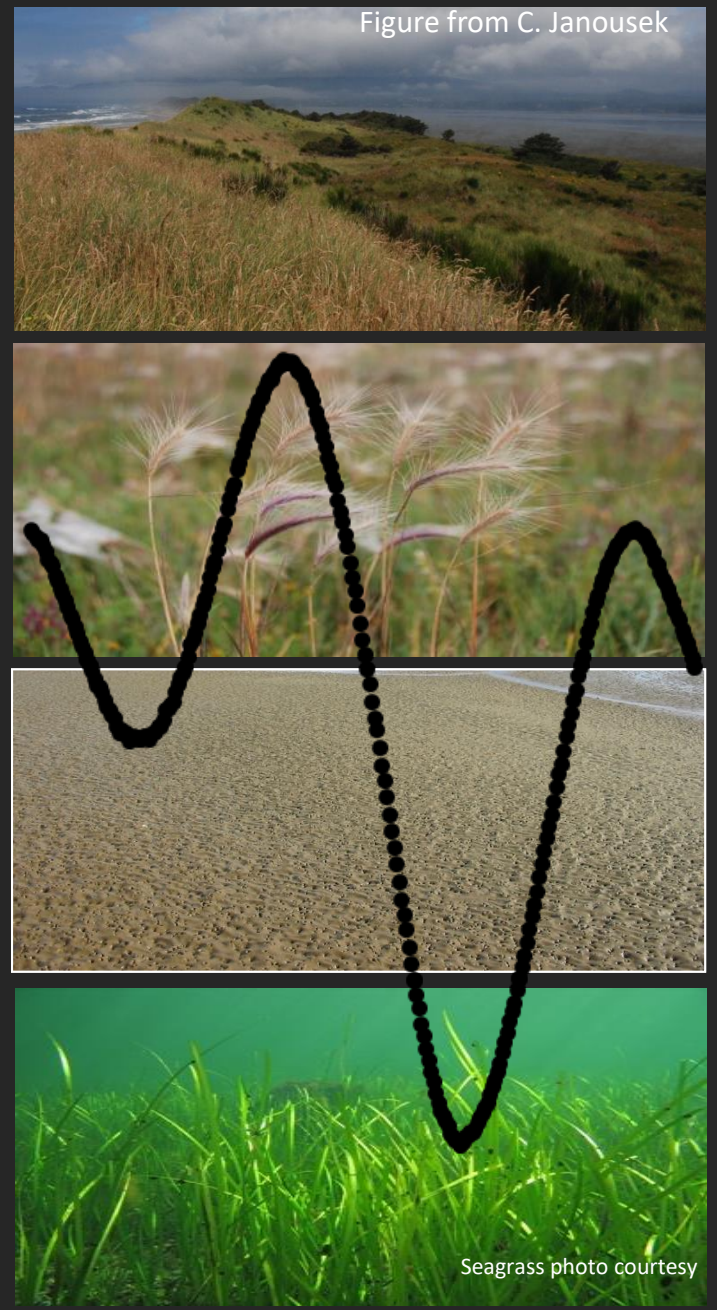
Sweet et al. 2018

Wetlands can respond to sea-level rise

- Tidal wetland vegetation typically occurs MHW to above MHHW – the upper half of the intertidal zone.
- Tidal wetlands can ‘keep pace’ with sea-level rise through elevation building processes called accretion
- Accretion can include mineral and organic accumulation
- Tidal wetlands can also migrate upslope



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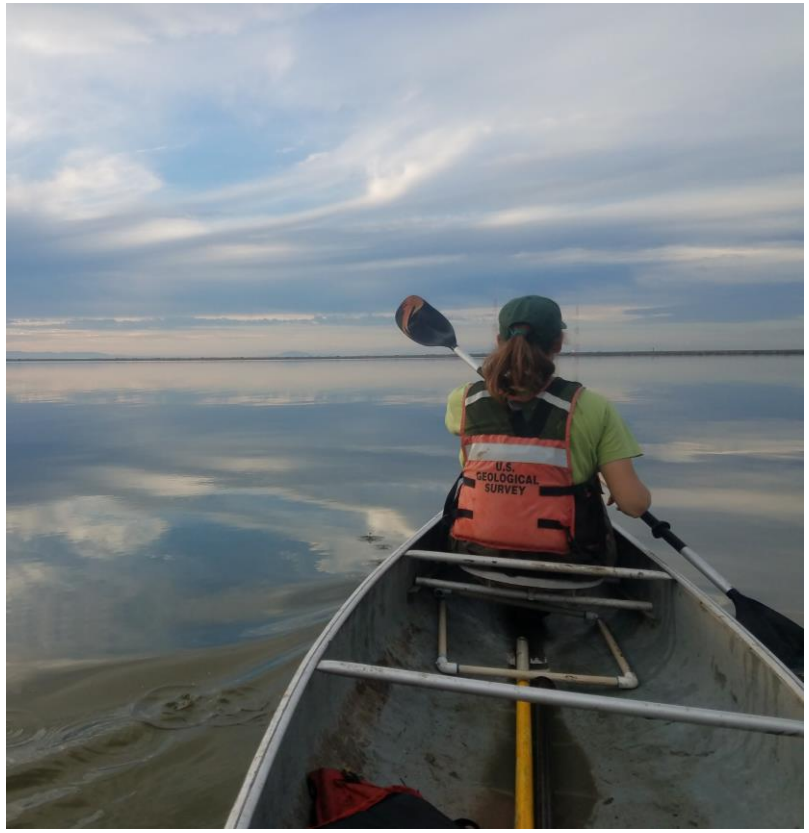


Modeling can be used to inform management considering future uncertainty

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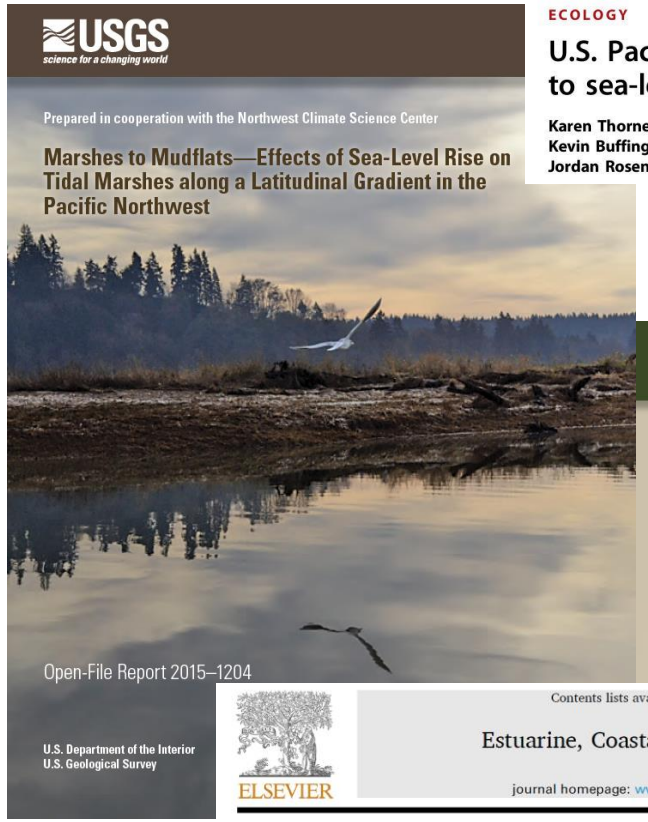

ECOLOGY

U.S. Pacific coastal wetland resilience and vulnerability to sea-level rise

Karen Thorne,[1]* Glen MacDonald,[2] Glenn Guntenspergen,[3] Richard Ambrose,[4] Kevin Buffington,[1,5] Bruce Dugger,[5] Chase Freeman,[1] Christopher Janousek,[1,5] Lauren Brown,[2] Jordan Rosencranz,[2†] James Holmquist,[6] John Smol,[7] Kathryn Hargan,[7‡] John Takekawa[1§]

Contents lists available at ScienceDirect
Estuarine, Coastal and Shelf Science
journal homepage: www.elsevier.com/locate/ecss
ELSEVIER

Wetlands in intermittently closed estuaries can build elevations to keep pace with sea-level rise

Karen M. Thorne[a,*], Kevin J. Buffington[a], Scott F. Jones[a], John L. Largier[b]

PLOS ONE

RESEARCH ARTICLE

Incorporation of uncertainty to improve projections of tidal wetland elevation and carbon accumulation with sea-level rise

Kevin J. Buffington[1☯*], Christopher N. Janousek[2☯], Bruce D. Dugger[2‡], John C. Callaway[3‡], Lisa M. Schile-Beers[4‡], Evyan Borgnis Sloane[5‡], Karen M. Thorne[1☯]

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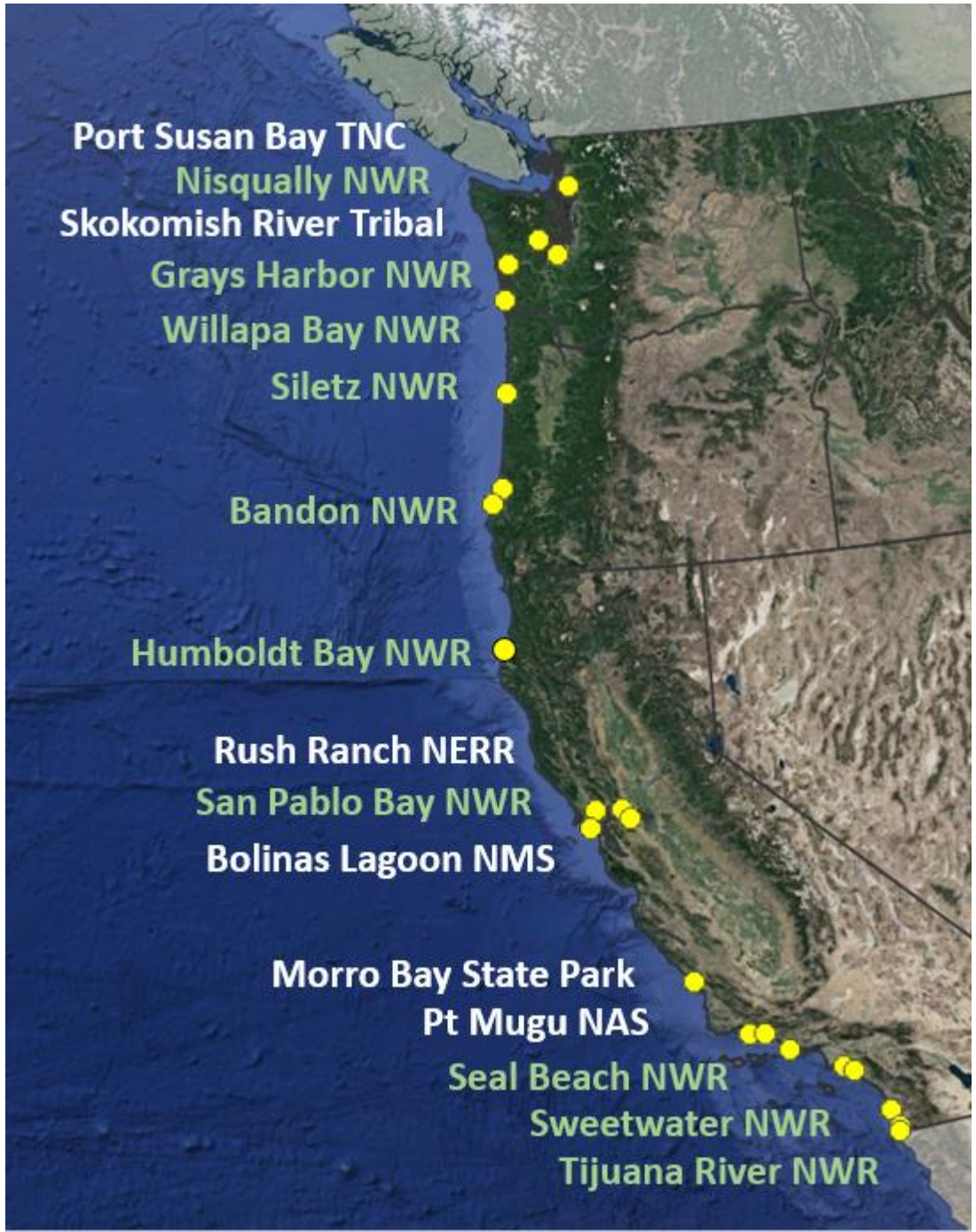
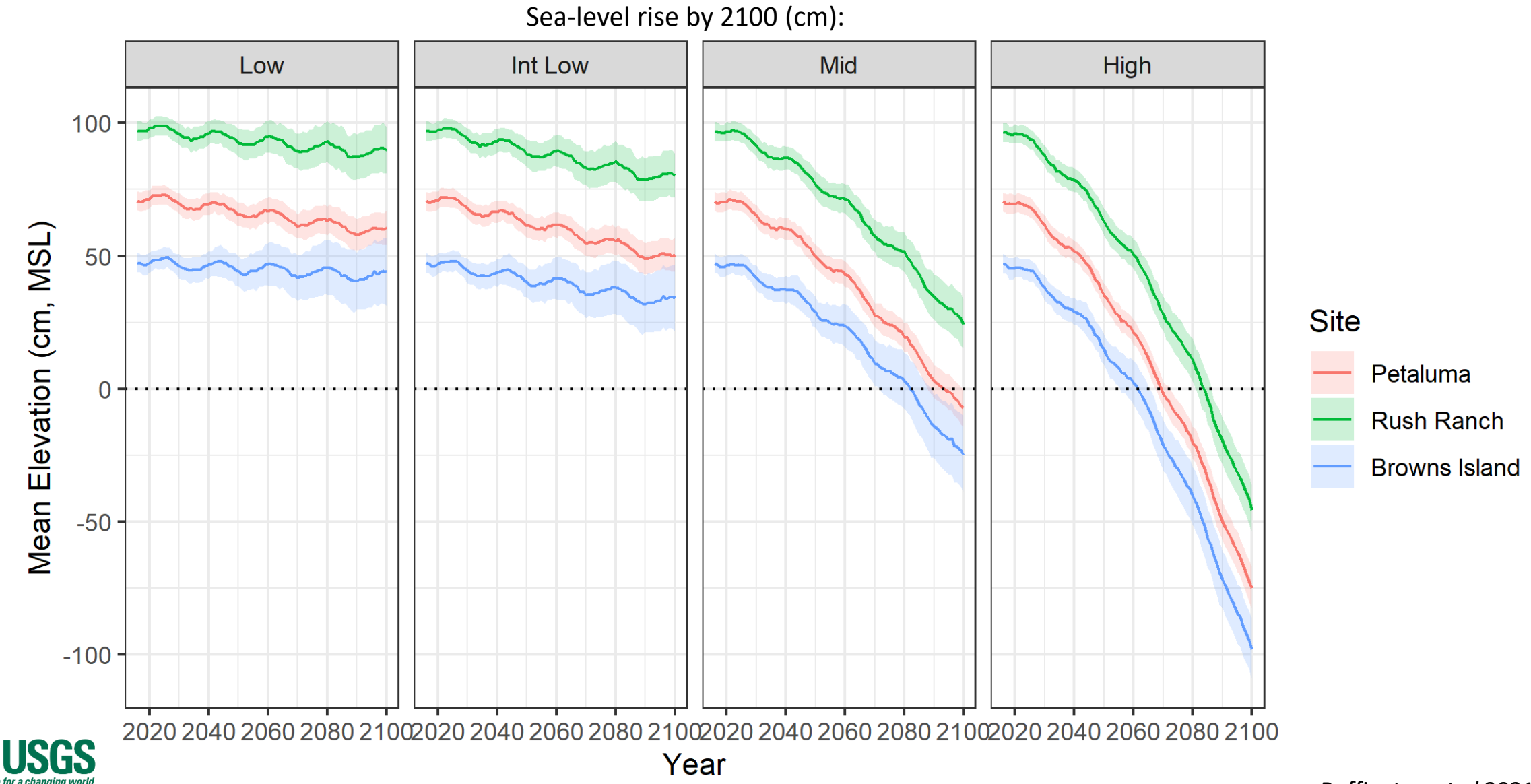


Examples from north San Francisco Bay - Elevation Projections



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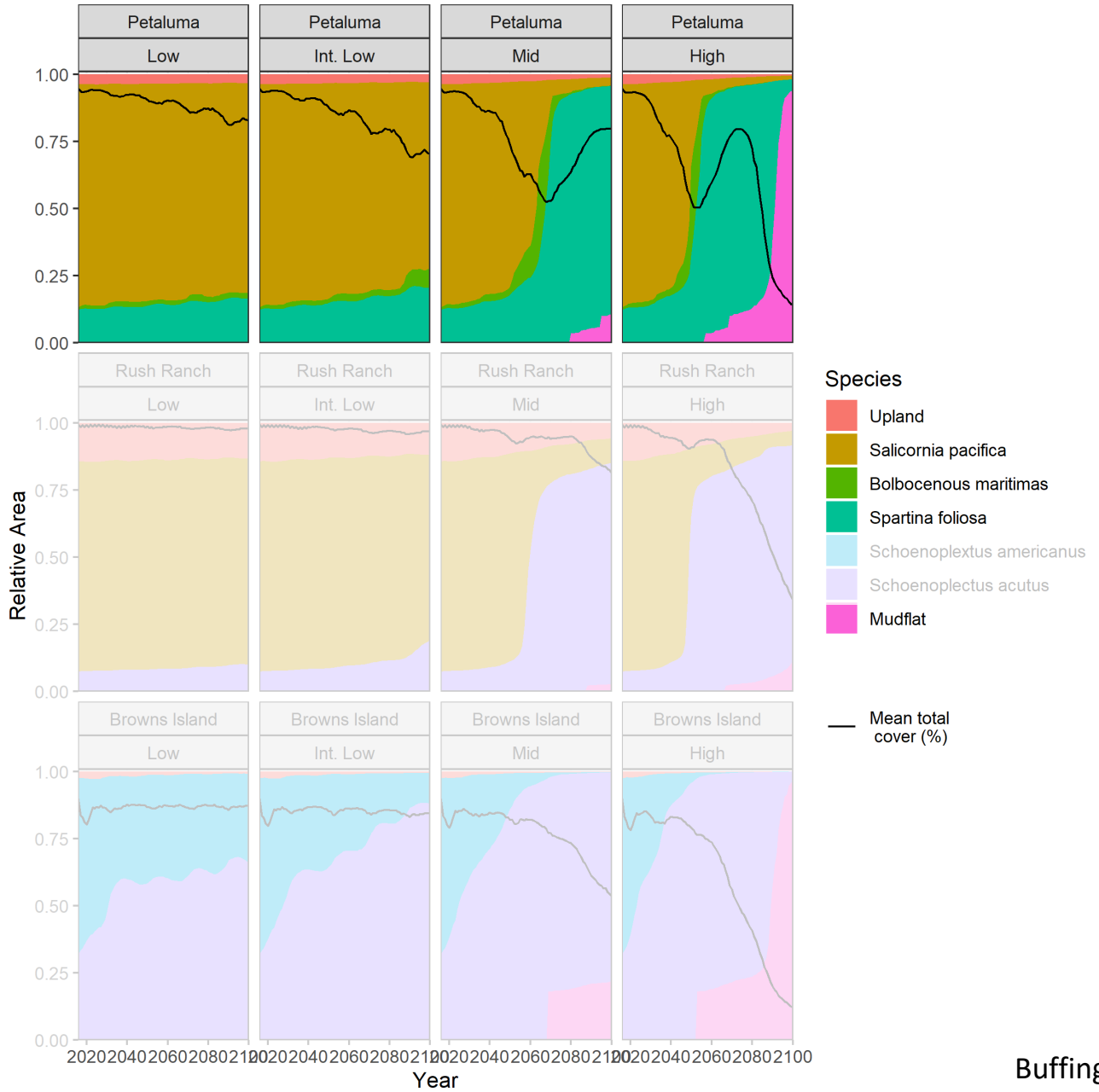
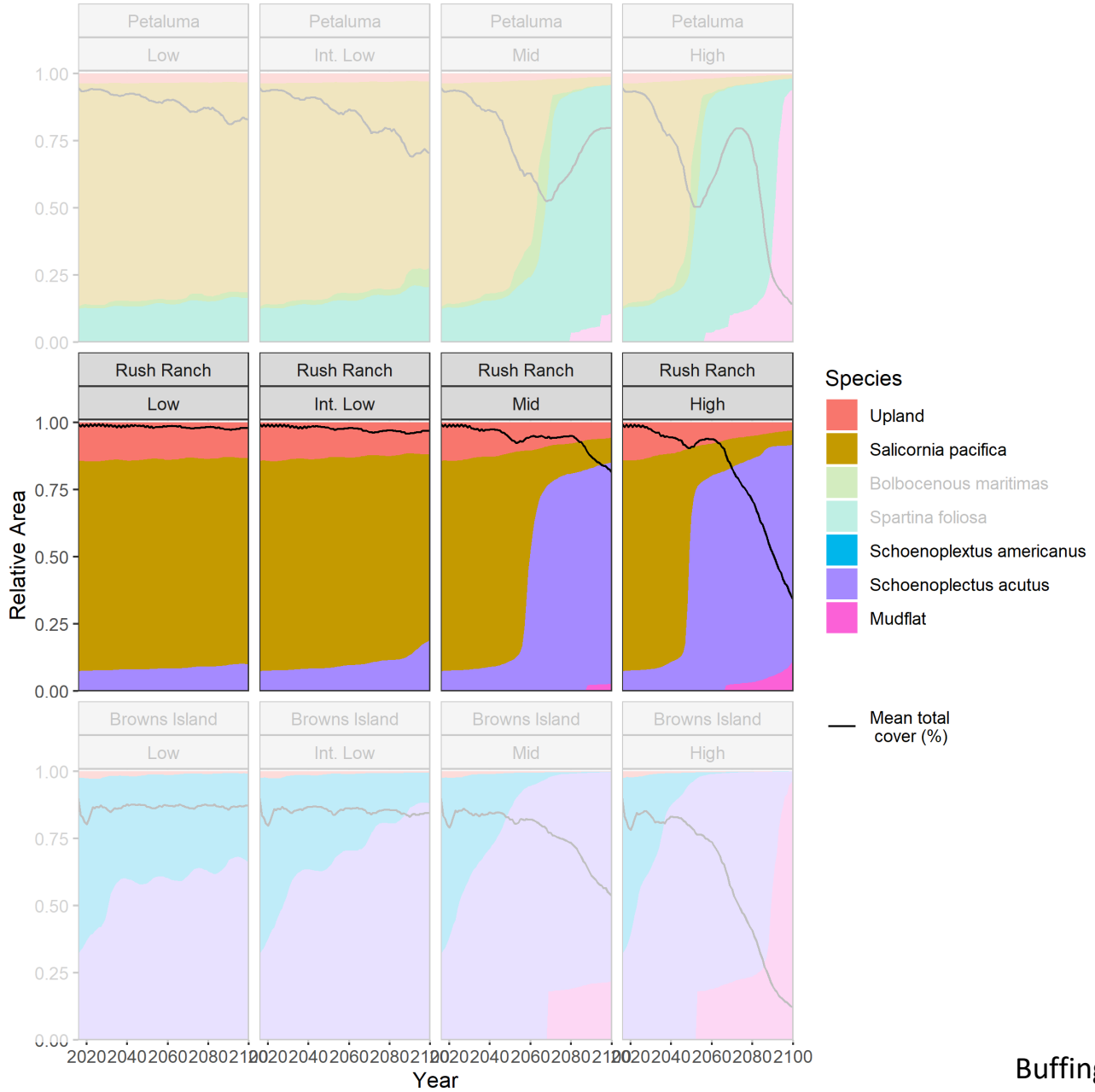
Buffington *et al* 2021 PLoS One

Examples from north San Francisco Bay – Plant Species Projections



Buffington *et al* 2021 PLoS One

Examples from north San Francisco Bay – Plant Species Projections



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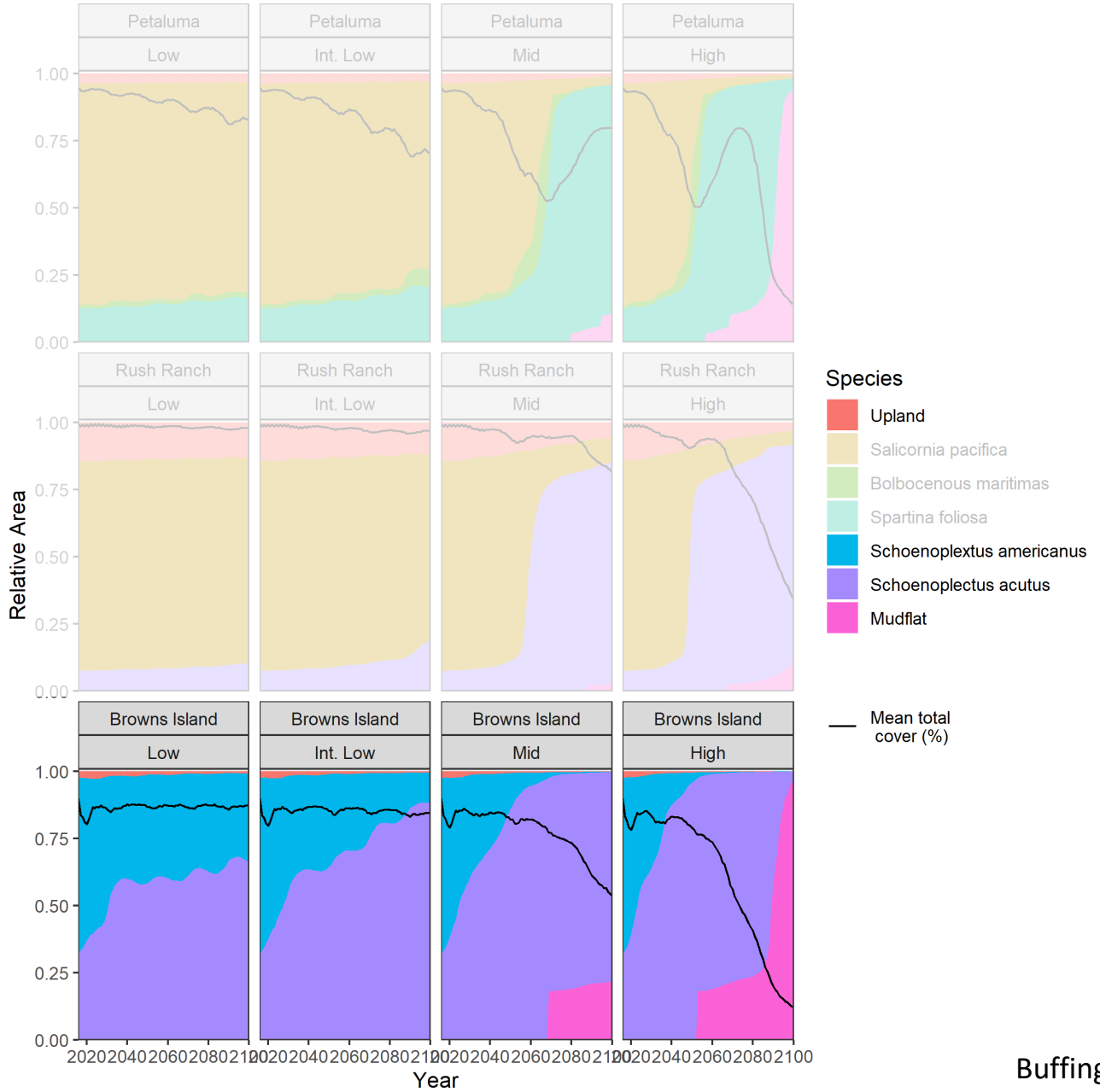
Examples from north San Francisco Bay – Plant Species Projections



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Buffington *et al* 2021 PLoS One

PLOS ONE

RESEARCH ARTICLE

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Elevation | Modeling Sea-level Rise | WARMER Results | Carbon Sequestration | Team →

Objectives

This collaborative project, funded by NOAA, aims to better understand ecosystem processes in Bay-Delta wetlands and model their vulnerability to sea level rise. Our research had three main objectives:

1. Identify how salinity and inundation drive wetland

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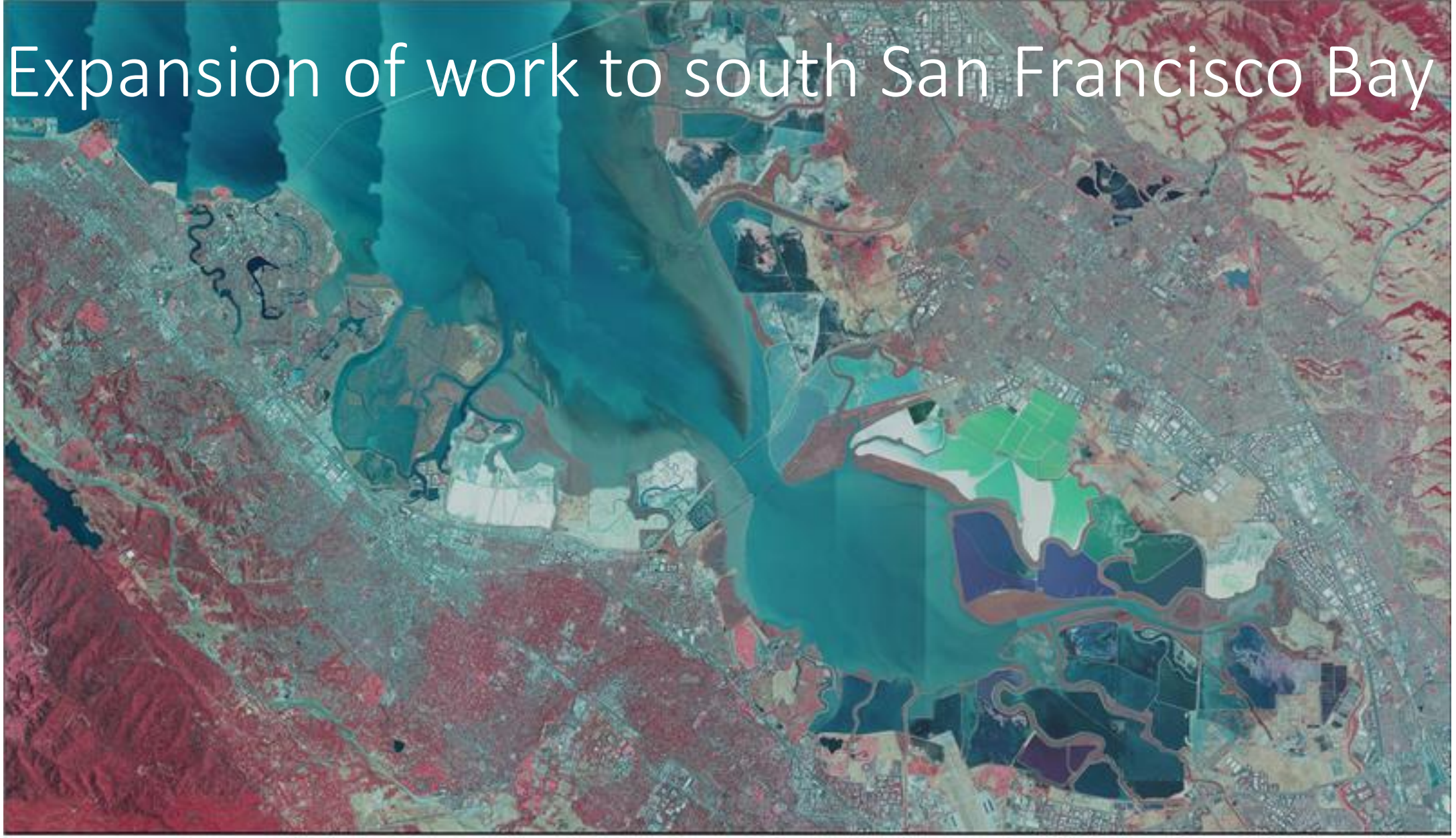
Online story map - https://storymaps.arcgis.com/stories/768622e923024ef19a211b5073af0e2b

Expansion of work to south San Francisco Bay



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N

0 2.5 5 10 15 20 Kilometers

Phase 1 - Measure marsh baseline conditions to inform modeling

- Develop digital elevation models (DEM) using a combination of RTK GPS ground data and remote sensing.
- Develop marsh elevation-vegetation relationship by conducting marsh vegetation surveys.
- Summarize elevation, vegetation, and tidal inundation relationships.
- Completed

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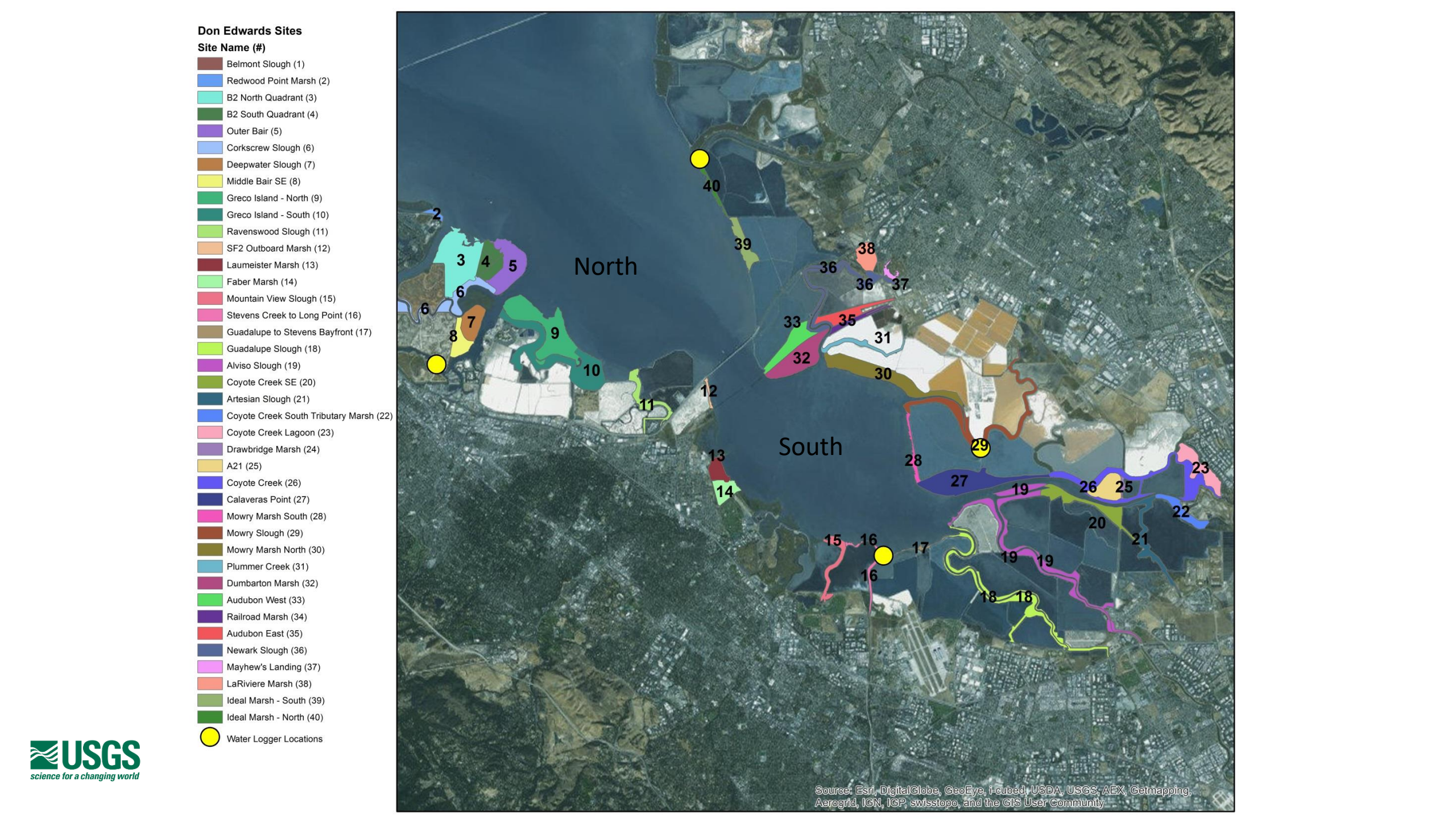

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Develop Elevation Models

- Leica Real Time Kinematics GPS Network (RTK GPS) determines x,y,z position. ~2 cm elevation accuracy

- Current wetland elevation was one of the biggest predictors of vulnerability from sea-level rise

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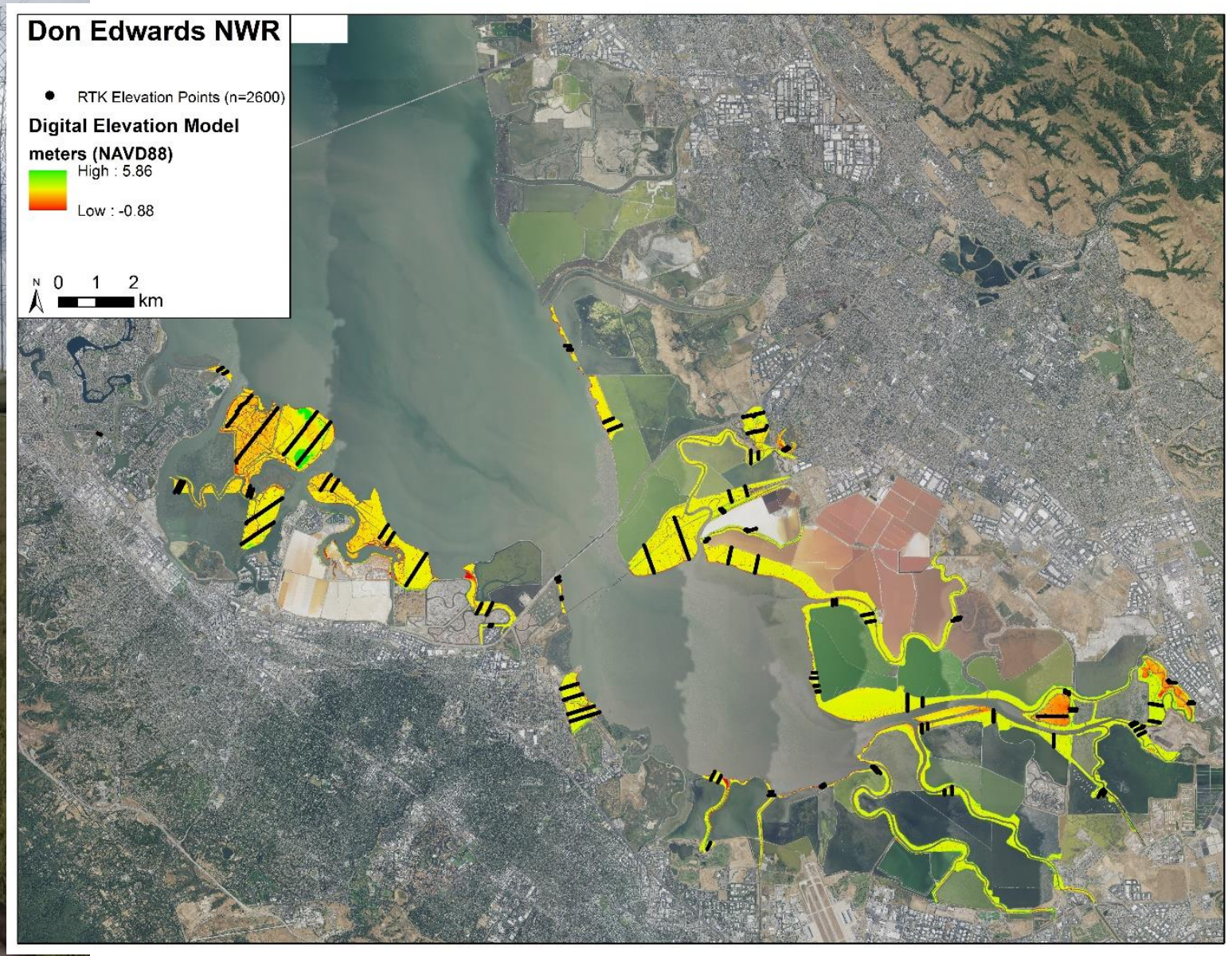
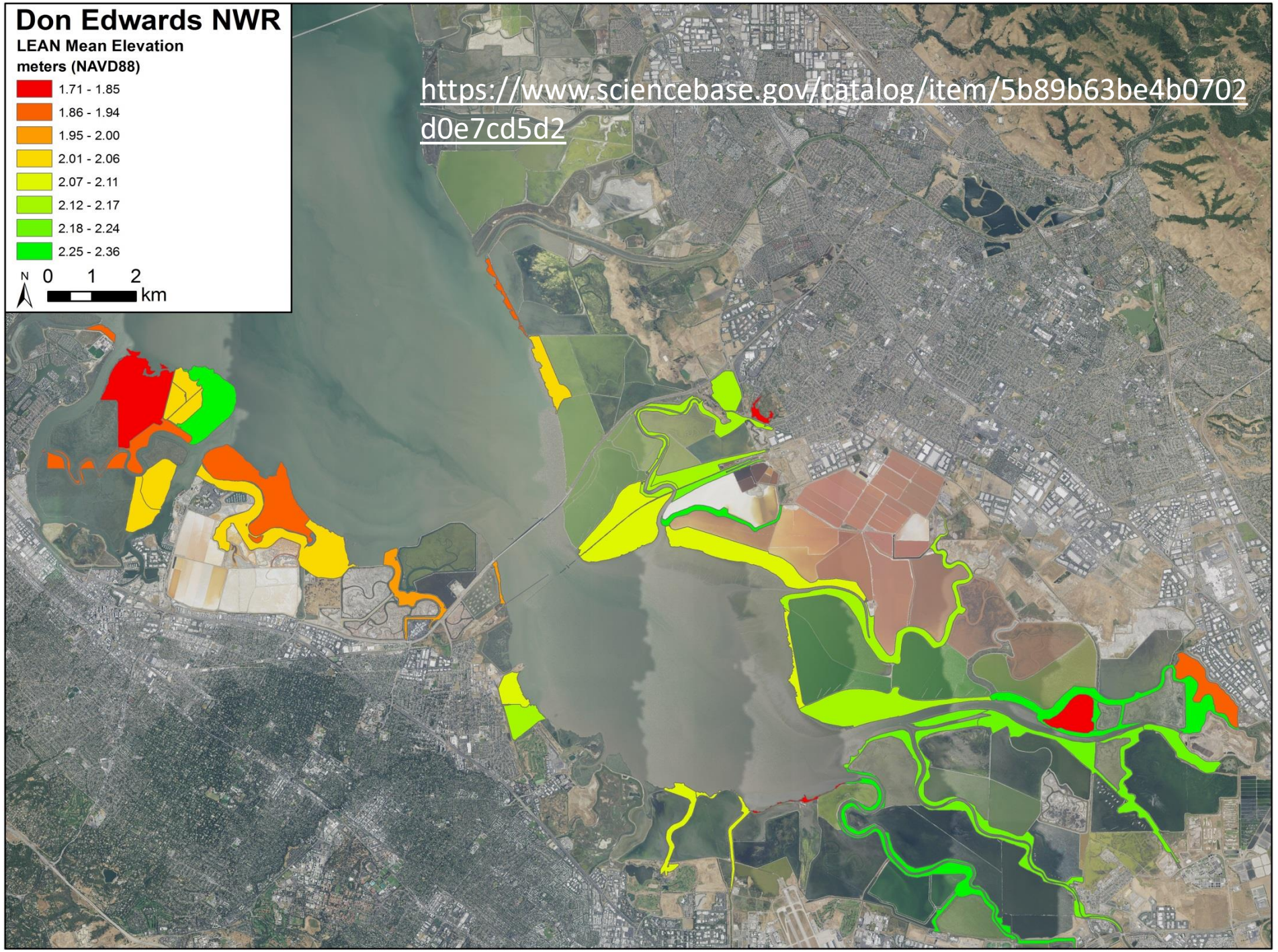

Don Edwards NWR
RTK Elevation Points (n=2600)
Digital Elevation Model
meters (NAVD88)
High : 5.86
Low : -0.88
N
0 1 2
km



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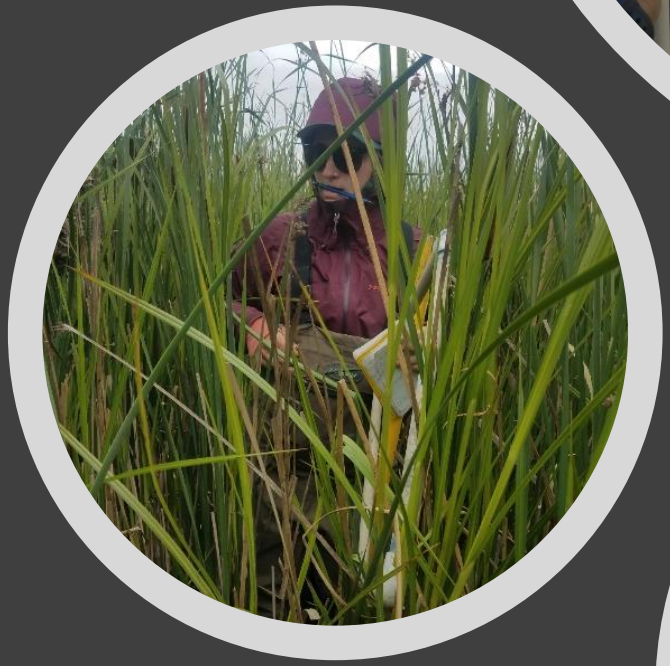
Plant community surveys

- 0.25 m^2 quadrat used, locations were surveyed along transects
- Data taken at 30% of the elevation points
- Data: species, elevation, percent cover, max and average heights
- Related to elevation and tidal datum



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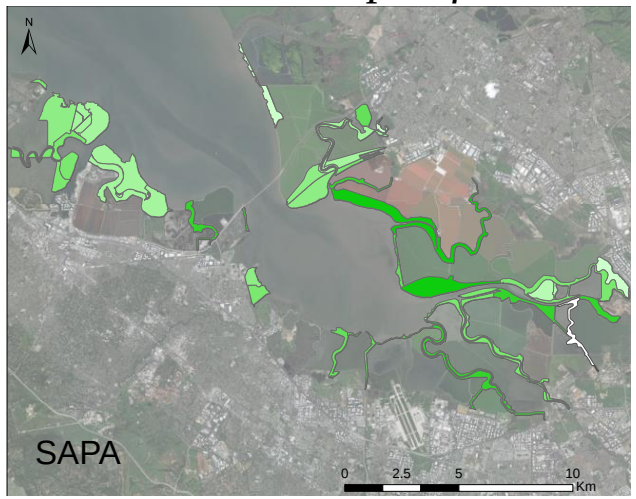
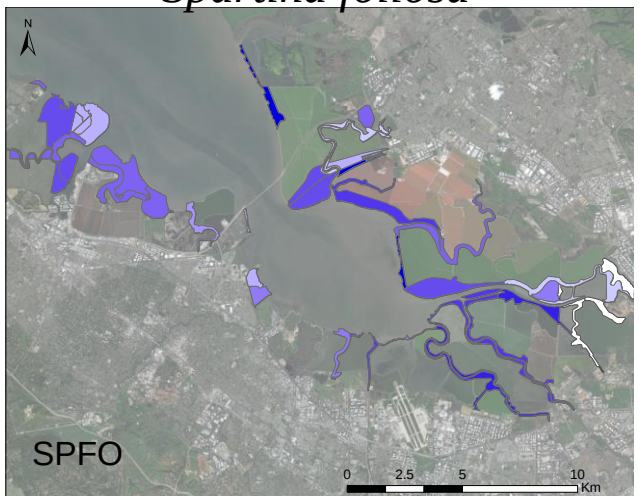
Species Presence

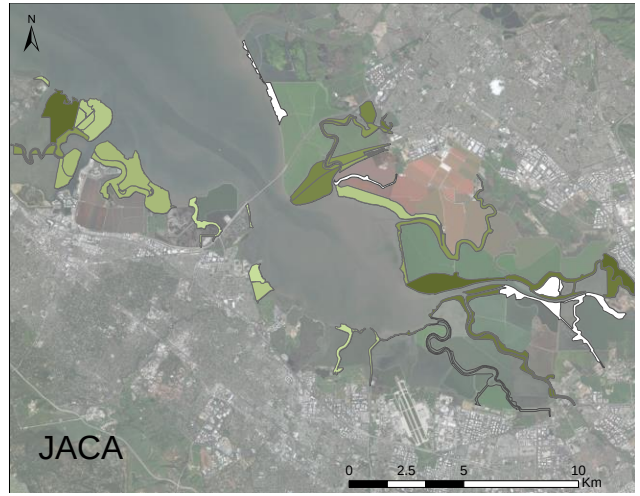
Salicornia pacifica

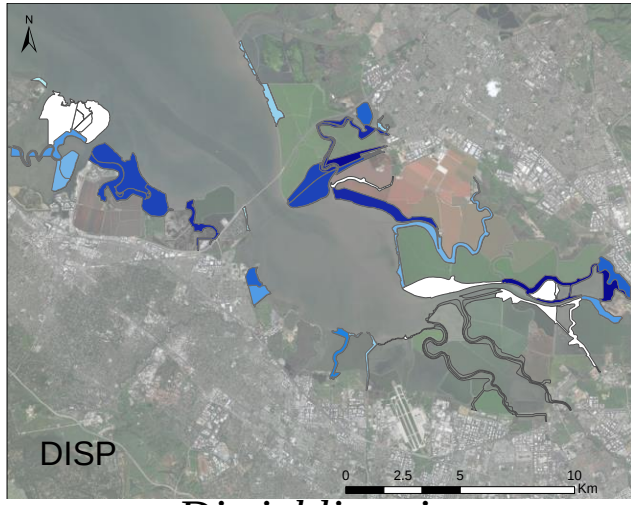


Spartina foliosa

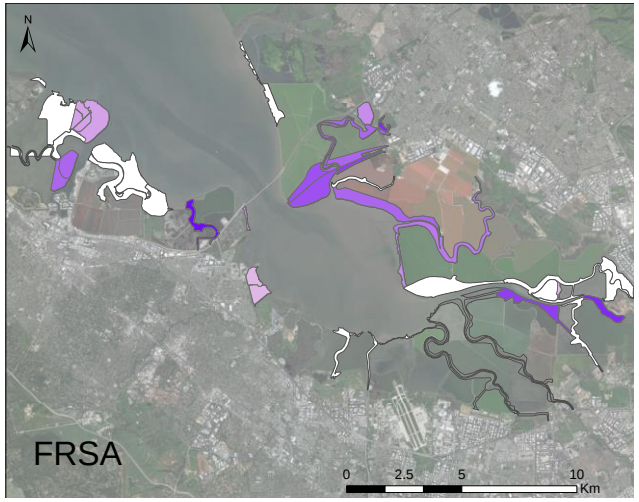


Jaumea carnosa

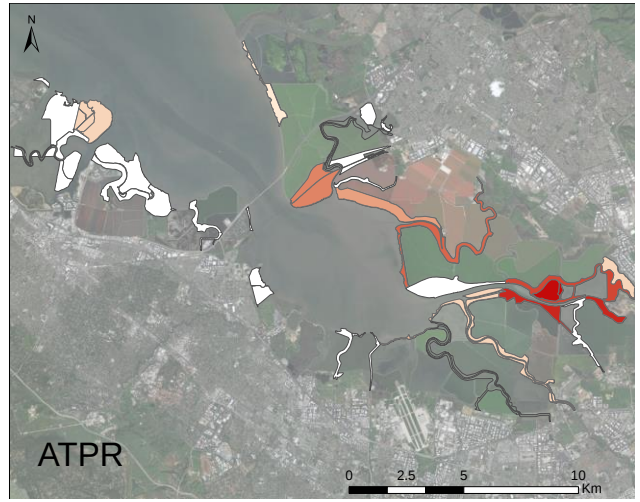




Distichlis spicata



Frankenia salina



Atriplex prostrata

Species presence by individual site is indicated by color in the polygon. Higher percent presence is indicated by darker colors.

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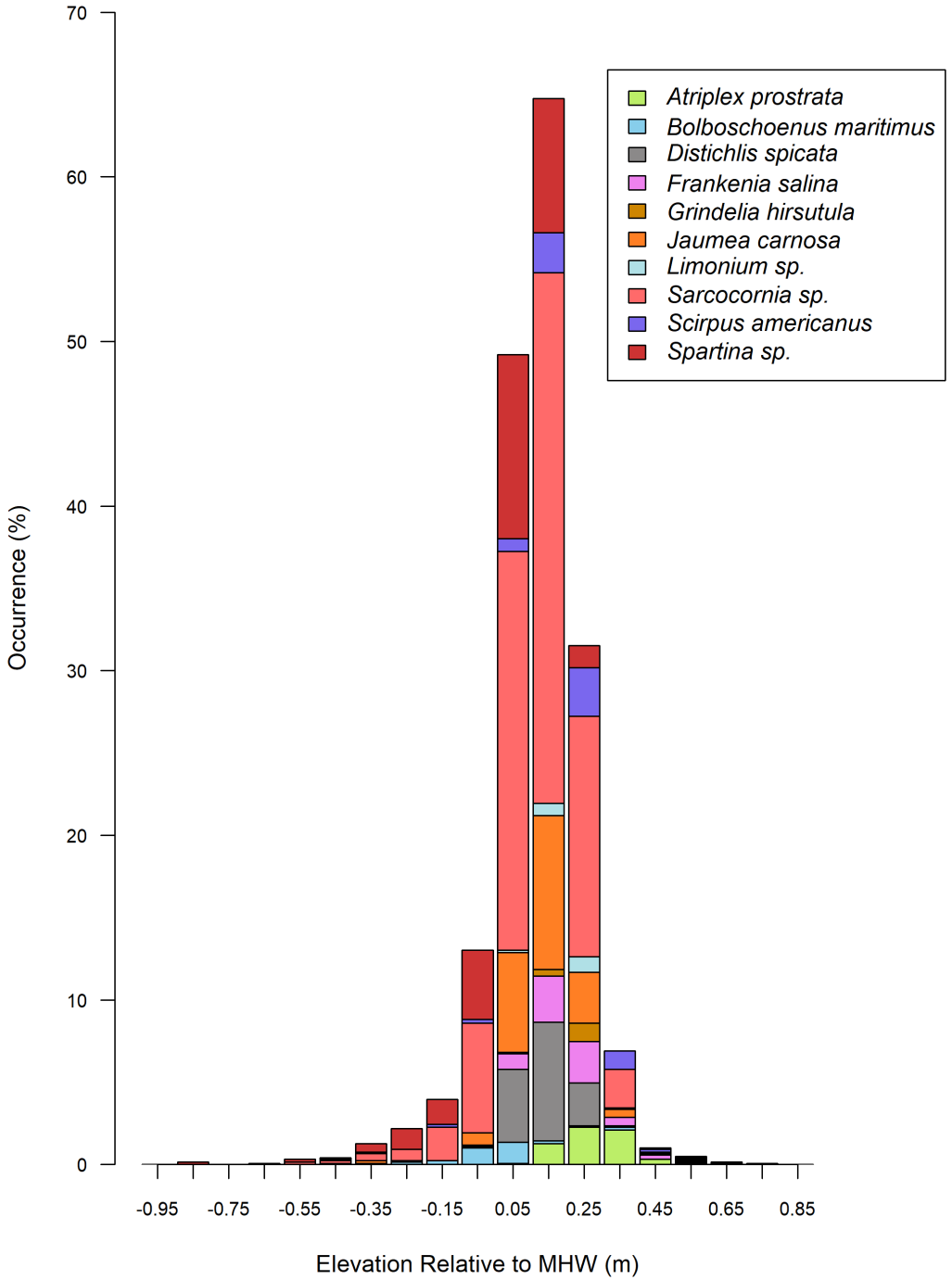

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Phase 2 –Measure accretion rates

Coring methods

- Sample 24 cores across the study region
- 8 marshes selected
- 3 cores per transect
- Coring location requirements: Cesium from 1950’s and Lead 100 years (or something similar)
- Calculate accretion rates and soil properties (radioisotope dating: ^{137}Cs, ^{210}Pb; organic matter, bulk density analysis)

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North Greco Island
Dumbarton Point/Mowry
Laumeister marsh
Coyote Creek
Warm Springs Marsh
Triangle marsh
Guadalupe Slough
N
0 1.25 2.5 5 7.5 10
Kilometers
Core Locations
Don Edwards NWR
Marsh Parcels
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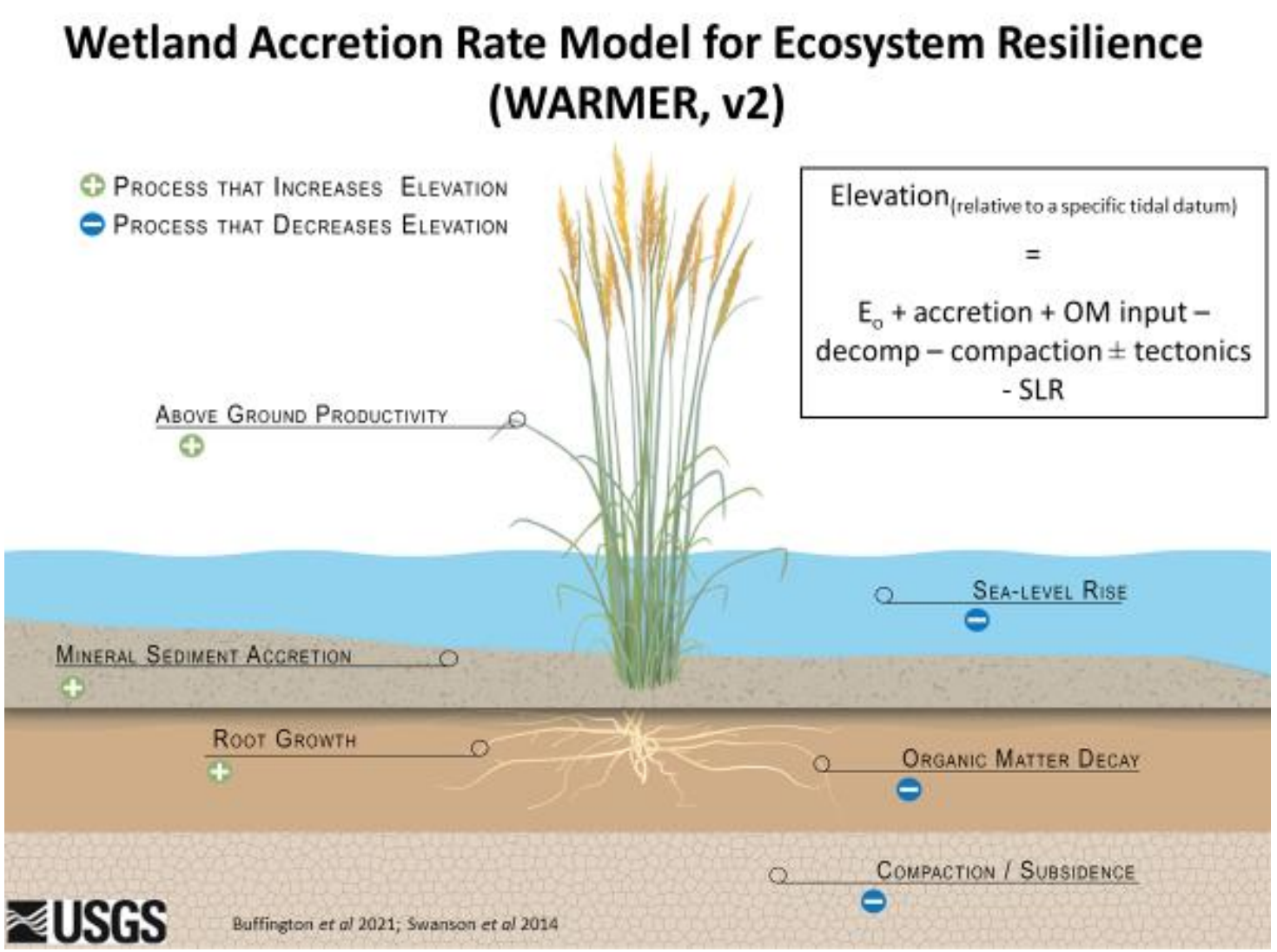
Phase 3 – Model wetland sea-level rise vulnerability

- Use WARMER2
- Mechanistic model to project marsh elevations under sea-level rise scenarios
- Multiple sea-level rise scenarios
- Select representative marshes
- Results will be relevant to overall vulnerability in south bay



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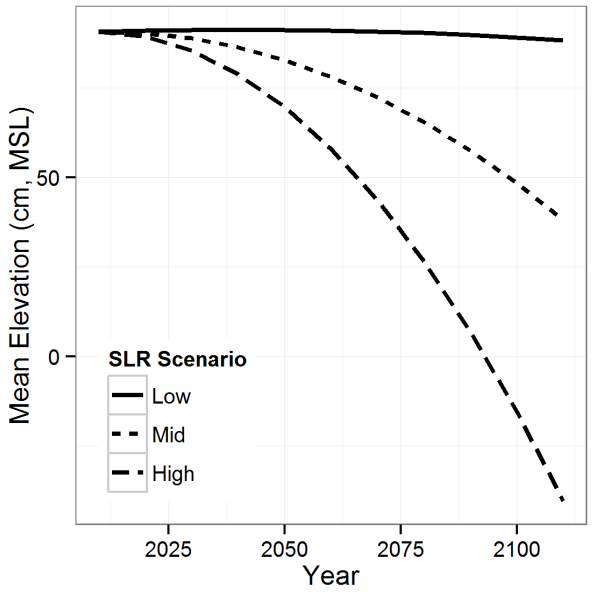
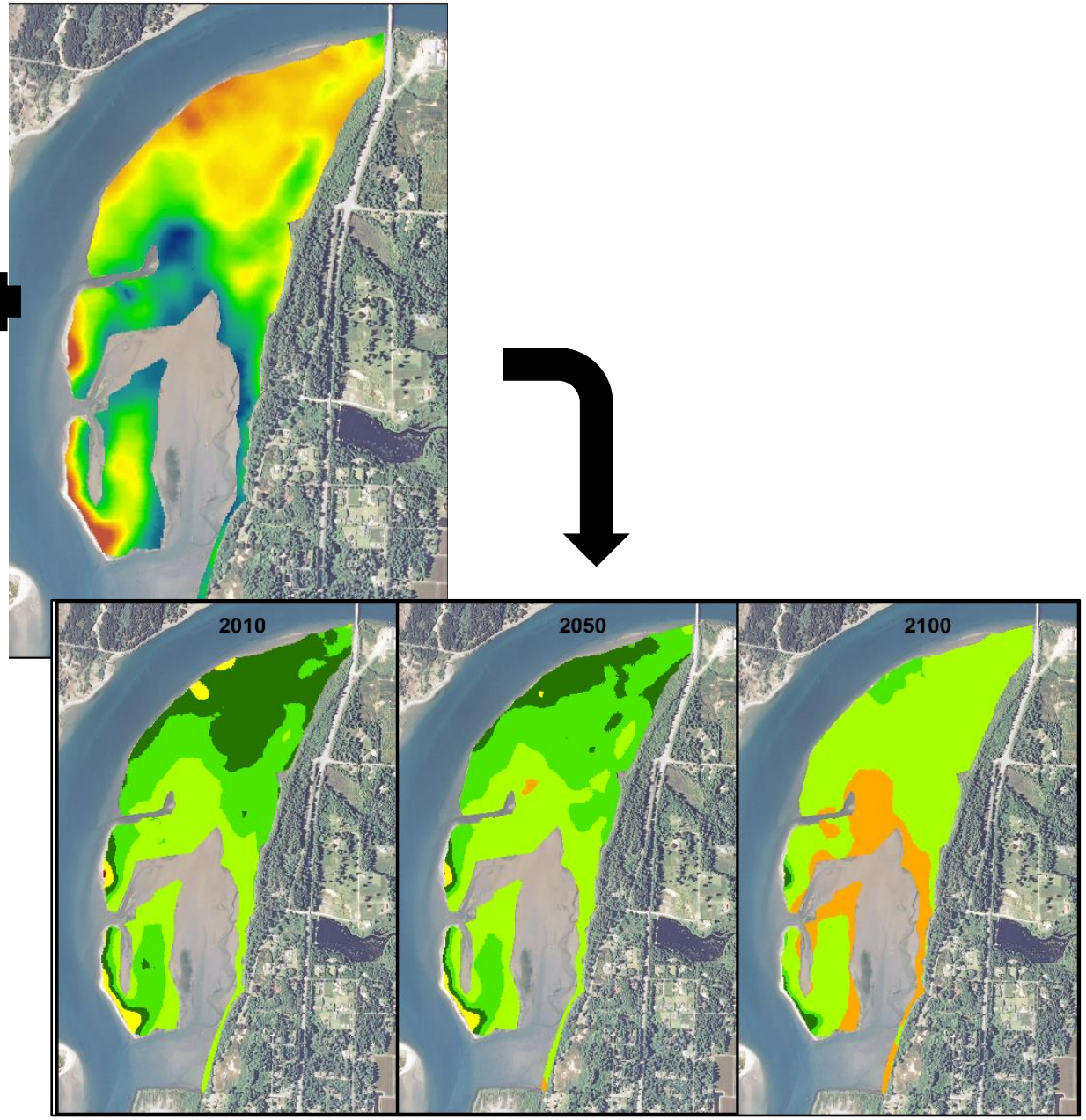
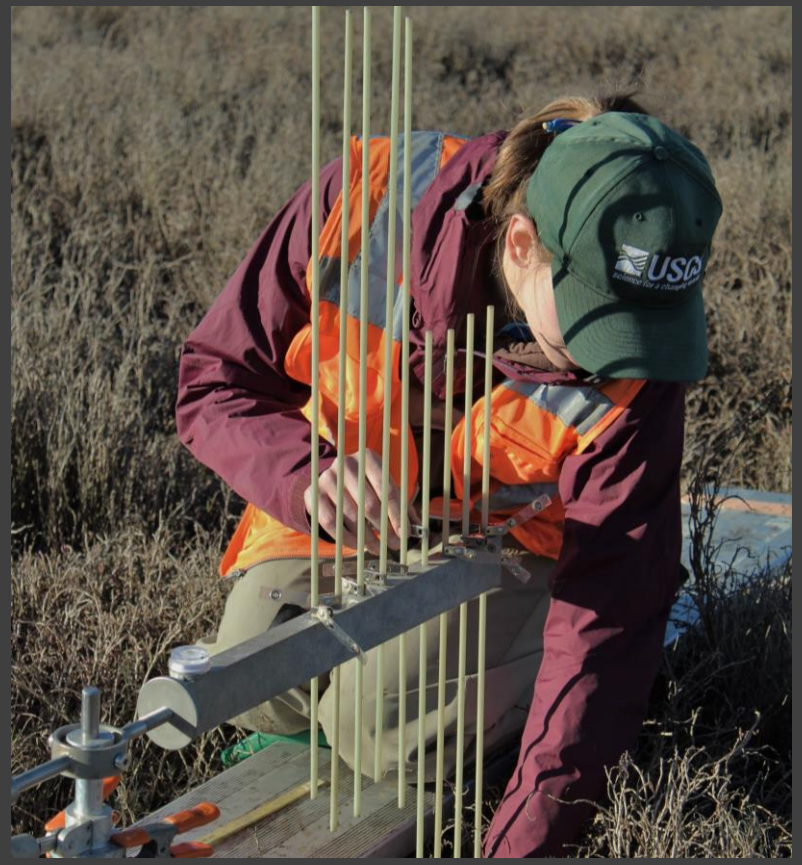
WARMER Results



Initial DEM



Swanson et al., 2013; Thorne et al. 2018, Buffington et al. 2021



Thinking 20, 50, and 100 years ahead

- Sea-level rise and changes in precipitation and snowpack are uncertain and dependent on greenhouse gas emissions
- Future sediment availability is also uncertain
- Modeling can help reduce uncertainty and inform decision making
- Monitoring accretion will help validate modeling results into the future (WRMP)

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Thank you

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