Presentation on the Corpus Christi Bay, Nueces Bay, and ship channel Far Field Study with Modeler, Spheros Environmental Group with Far Field Committee member comments on study results

Nicholas J. Winkelmann, P.E., Chief Operating Officer
Corpus Christi Water

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Spheros Environmental Group

June 2, 2026

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CORPUS CHRISTI WATER

History of Far Field Assessment

Far Field Assessment #1

SUNTANS Model (2019)

Commissioned by the Port of Corpus Christi

- Stanford Model (originally created for oil spill response and adapted for seawater discharges)

Included:

- 50 MGD POCCA Harbor Island (95 MGD discharge)
- 30 MGD POCCA La Quinta (40 MGD discharge)

Results:

- Less than 1ppt increase, no long-term accumulation

Far Field Assessment #2

EFDC+ Model (2023)

Commissioned by the Port of Corpus Christi

- VA Institute of Marine Science/William and Mary

Included:

- 30MGD POCCA La Quinta (40MGD discharge)
- 50MGD POCCA Harbor Island (95MGD discharge)
- CC Polymers (38.6MGD discharge)
- 30MGD Corpus Christi Inner Harbor (51.5MGD discharge)

Results:

- Less than 0.6ppt increase for 30MGD POCCA La Quinta + 50MGD POCCA Harbor Island

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History of Far Field Assessment (cont.)

Far Field Assessment #3

FNI Mass Balance Evaluation (2024)
Commissioned by the City of Corpus Christi

Included:

- 30 MGD CoCC Inner Harbor (51.5MGD discharge)
- 40 MGD CoCC La Quinta (68.6MGD discharge)

Results:

- 0.3 to 0.6ppt increase

Far Field Assessment #4

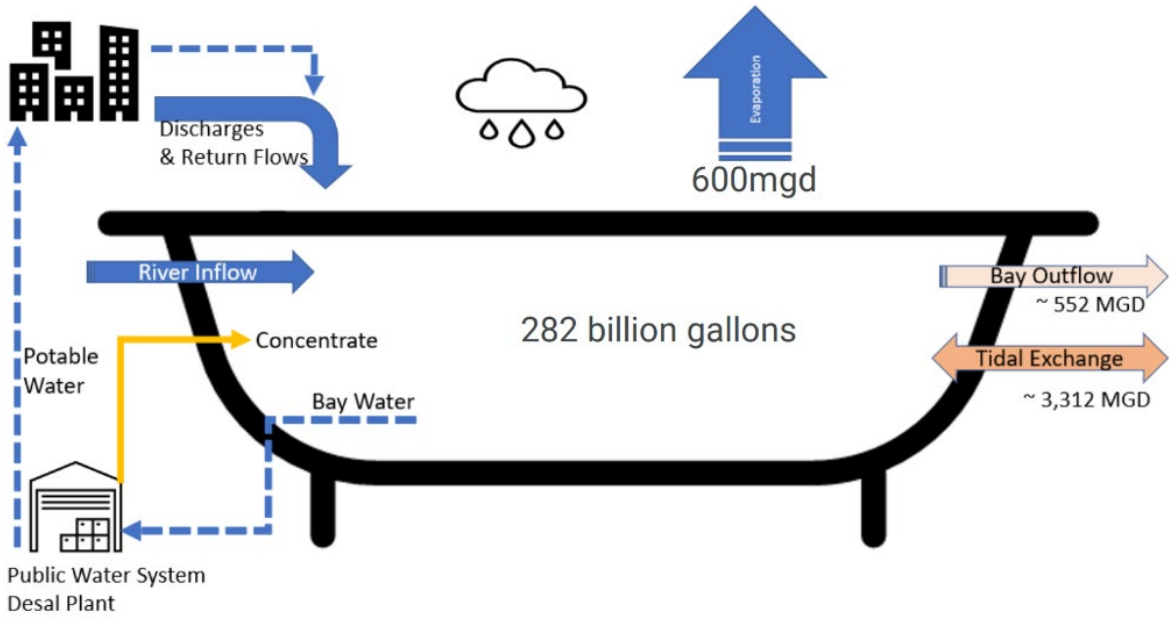
Kiewit/GHD (2025)
Commissioned by the City of Corpus Christi

Included:

- Near Field
  - Optimization of diffuser design to be compliant with TCEQ discharge permit requirements
- Far Field
  - Prediction of intake characteristics for IHWTC process design

Results:

- Contract terminated before completion



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Current Far Field Assessment

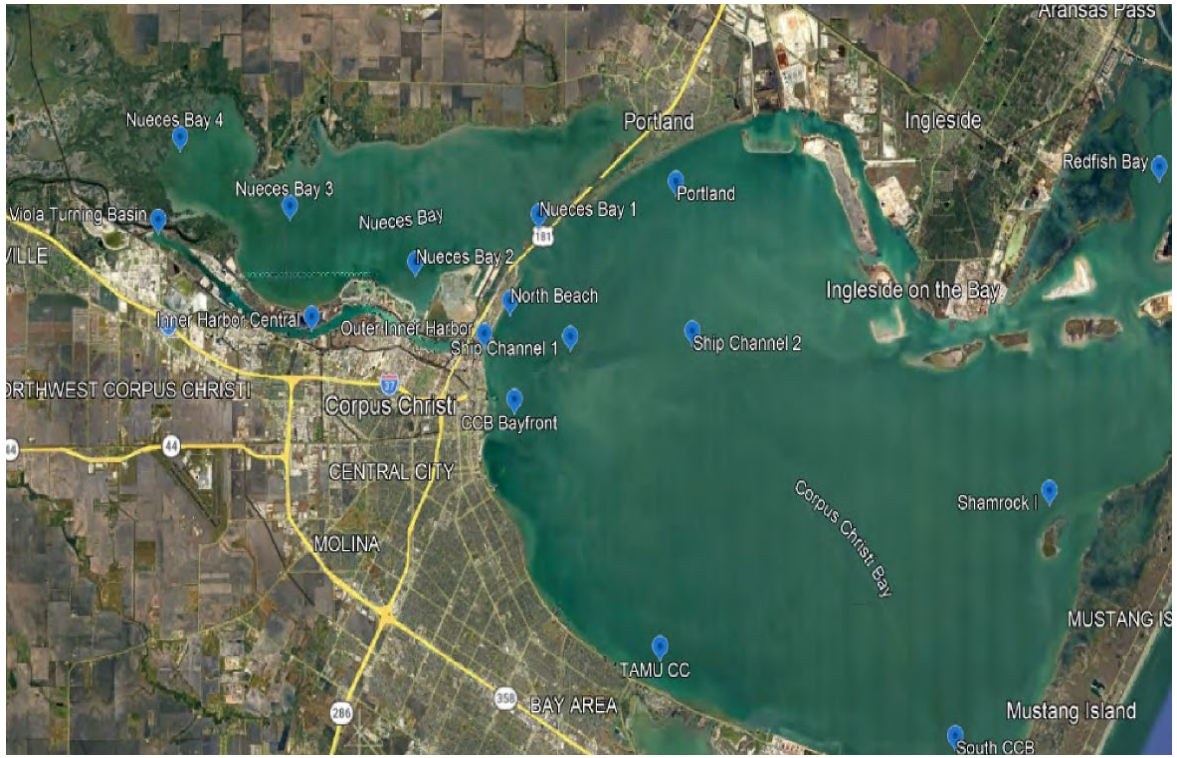
Far Field Assessment #5

EFDC+ Model (2026) – Spheros Environmental

Commissioned by the City of Corpus Christi

Included discharge scenarios with:

- 30MGD Corpus Christi Inner Harbor
- 30MGD POCCA La Quinta
- 50MGD POCCA Harbor Island
- CC Polymers
- Barney Davis
- Flint Hills
- Citgo
- GCGV
- Nueces Bay Power Station
- Valero
- US Dept of the Navy
- Cheniere



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CITY OF CORPUS CHRISTI
CORPUS CHRISTI WATER

City of Corpus Christi Desalination Project - Far Field Modeling Summary

June 2, 2026

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DSI LLC

Hazen

genda

Study Objectives

Modeling Team

Estuarine Hydrodynamics

Far Field Model Development

Far Field Model Application

Summary of findings

udy Objectives

Develop a hydrodynamic model of Corpus Christi Bay to reasonably represent observations of

- Water levels
- Salinity
- Temperature

Apply the model to evaluate potential changes to salinity within nner Harbor, Corpus Christi Bay, and Nueces Bay that could esult from brine discharges from the proposed desalination lant

pecific Modeling Tasks in the cope of Work

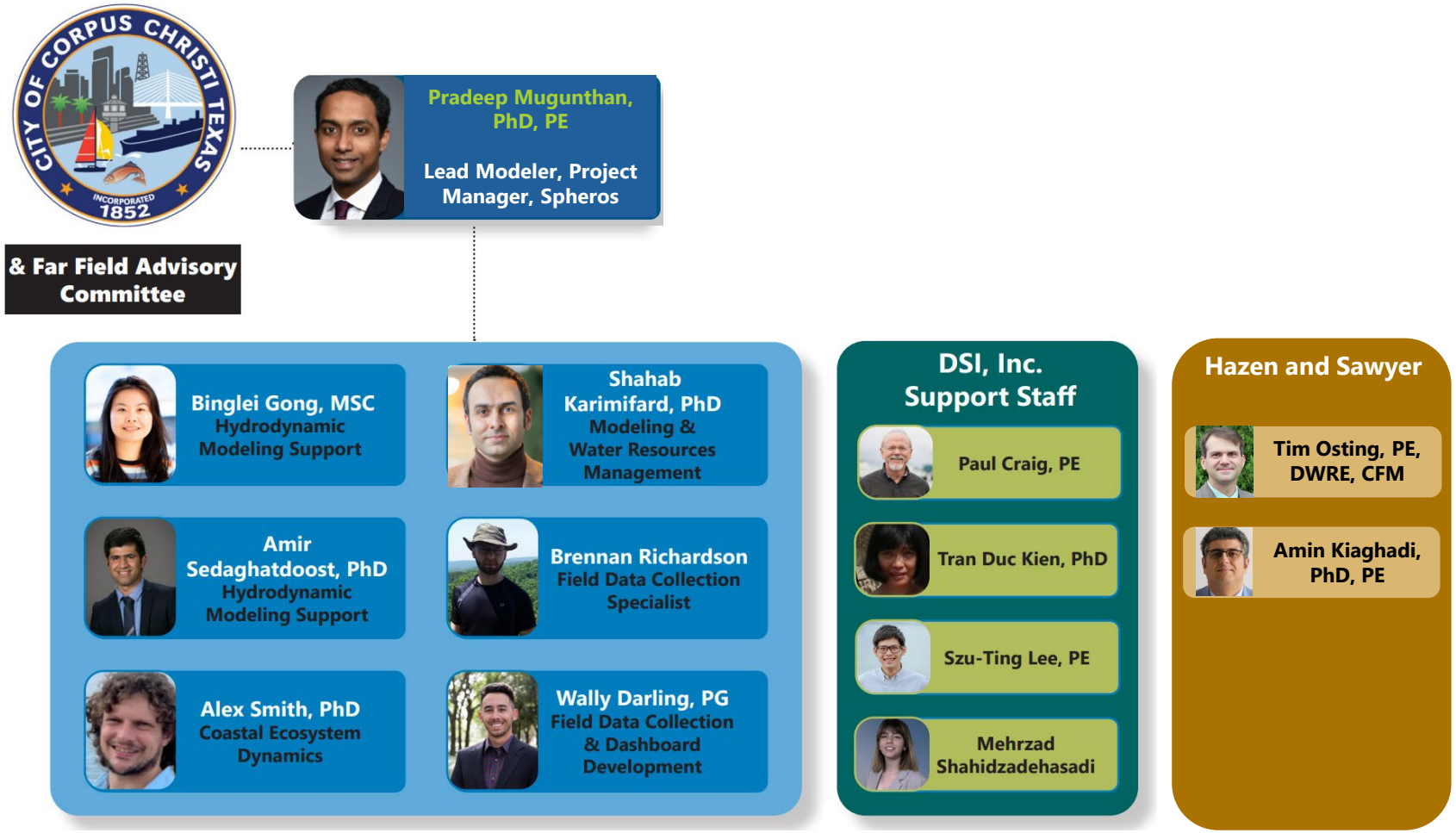
Develop a baseline simulation

- Incorporate recent bathymetry and improve model resolution in the Inner Harbor (Mod #1)
- Extend model inputs to recent years (Mod #4)

Process enhancements

- Dynamic mixing of desalination plant intake and return to assess recirculation effects in the Inner Harbor (Mod #2)
- Ship traffic – simulate effects of large ship traffic on brine mixing (Mod #3)

odeling Team



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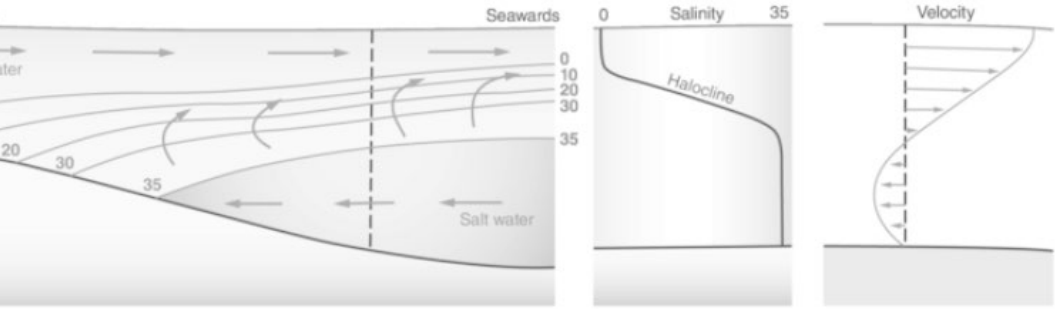
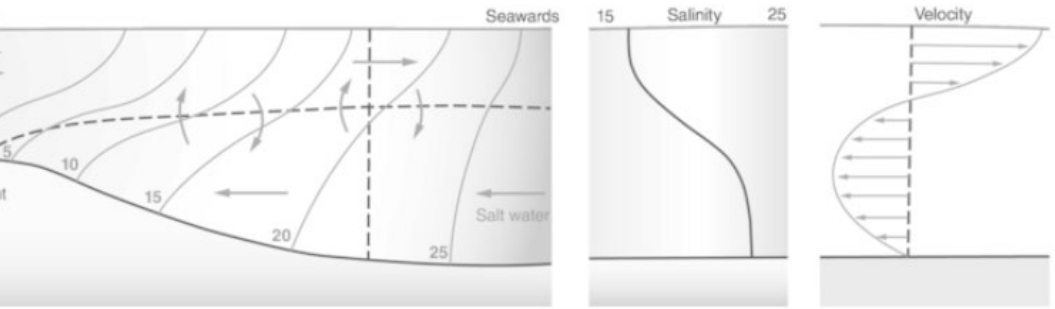
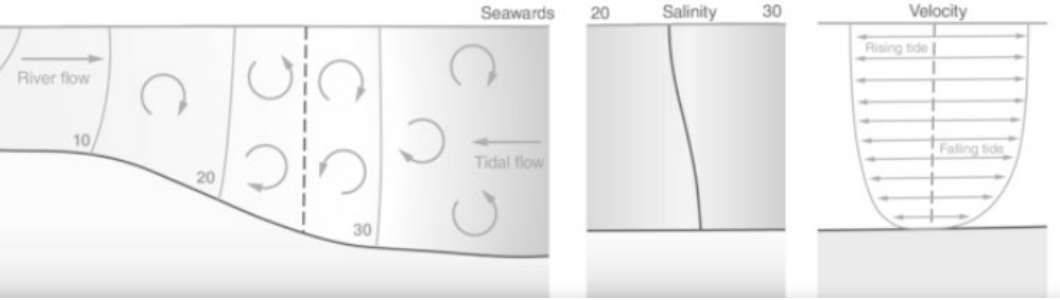
tuarine and Coastal Hydrodynamics



Salt-wedge – strongly stratified – typically bottom to surface salinity differences > 30 ppt, or bottom to surface density differences > 20 kg/m^3



Partially mixed – moderately stratified - typically bottom to surface salinity differences 3 – 30 ppt, or density differences are between 2 – 20 kg/m^3



Well mixed – weakly stratified - typically bottom to surface salinity differences < 3 ppt, or density differences < 2 kg/m^3

Source: The Urban Ocean by Blumberg and Bruno (2018)

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hat Does a Hydrodynamic Model Do?

pplies fundamental scientific principles of energy, momentum and mass onservation to predict

- Water movement and water levels
- Transport of heat and salinity

Models provide a prediction of reality at discrete points in space and time

- It cannot replicate nature exactly

Models are constrained by field measurements

- A good model will reproduce field measurements reasonably well

Model is a tool, when constrained and applied correctly can provide insights n effects of perturbations to a system (in this case the effect of desalination lant operation in Corpus Christi Inner Harbor)

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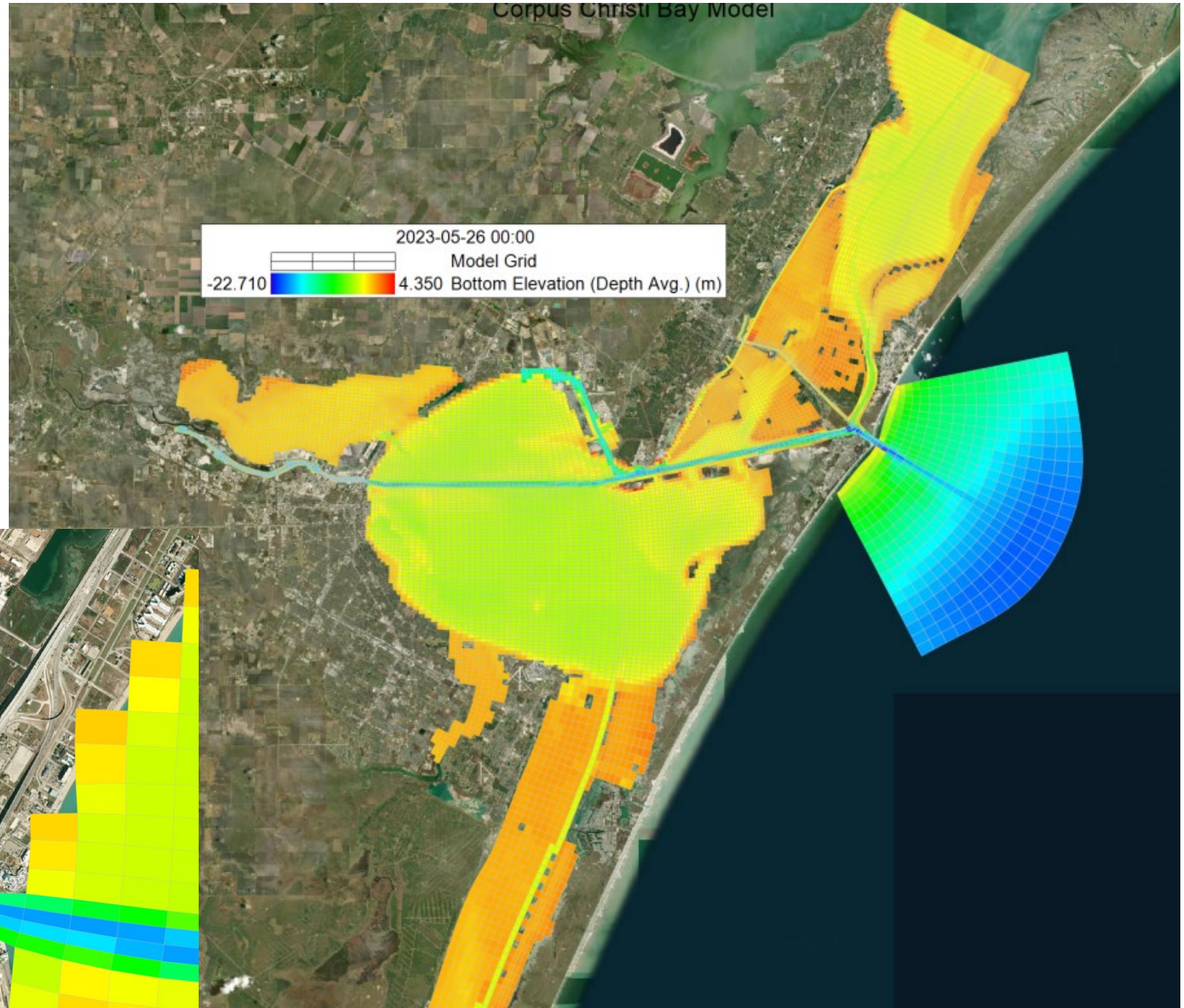
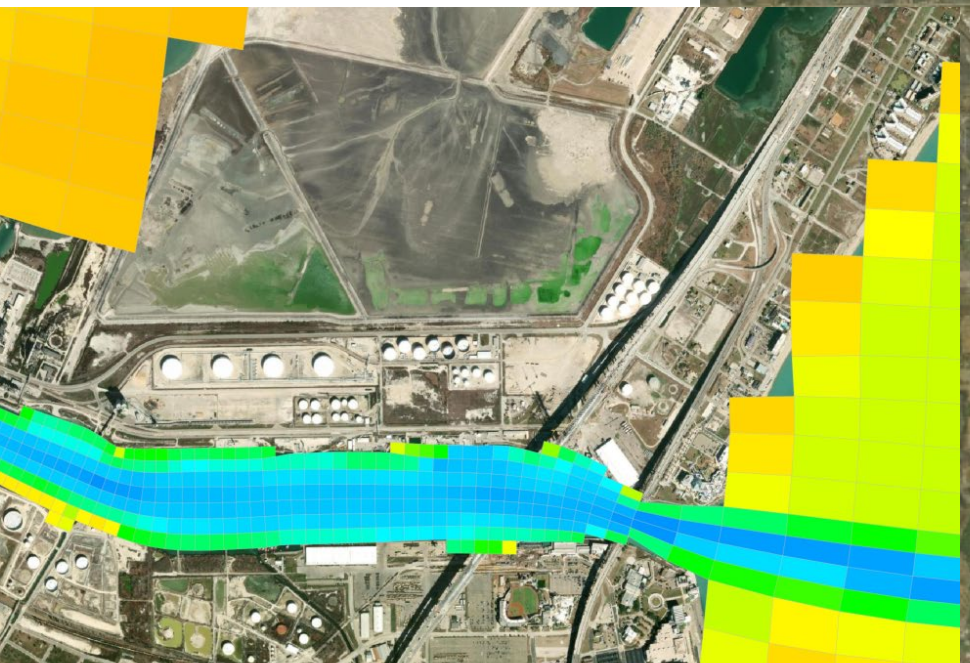
s Christi Bay Model

300 horizontal cells, with a
ution ~50m x 50m in the Inner
or near the desal intake and
arge
o 10 layers, with nominal cell
t of 2.3 m
400 active cells





verall Modeling Approach

Develop and validate model for 2023-2024 conditions

Apply model with desalination intake and discharge

- Existing conditions without ship traffic
- Hypothetical future conditions
- Assess potential mixing from ship traffic

formation Sources for Model Development

athymetry - NOAA BlueTopo (compiles atest bathymetry data from various ources)

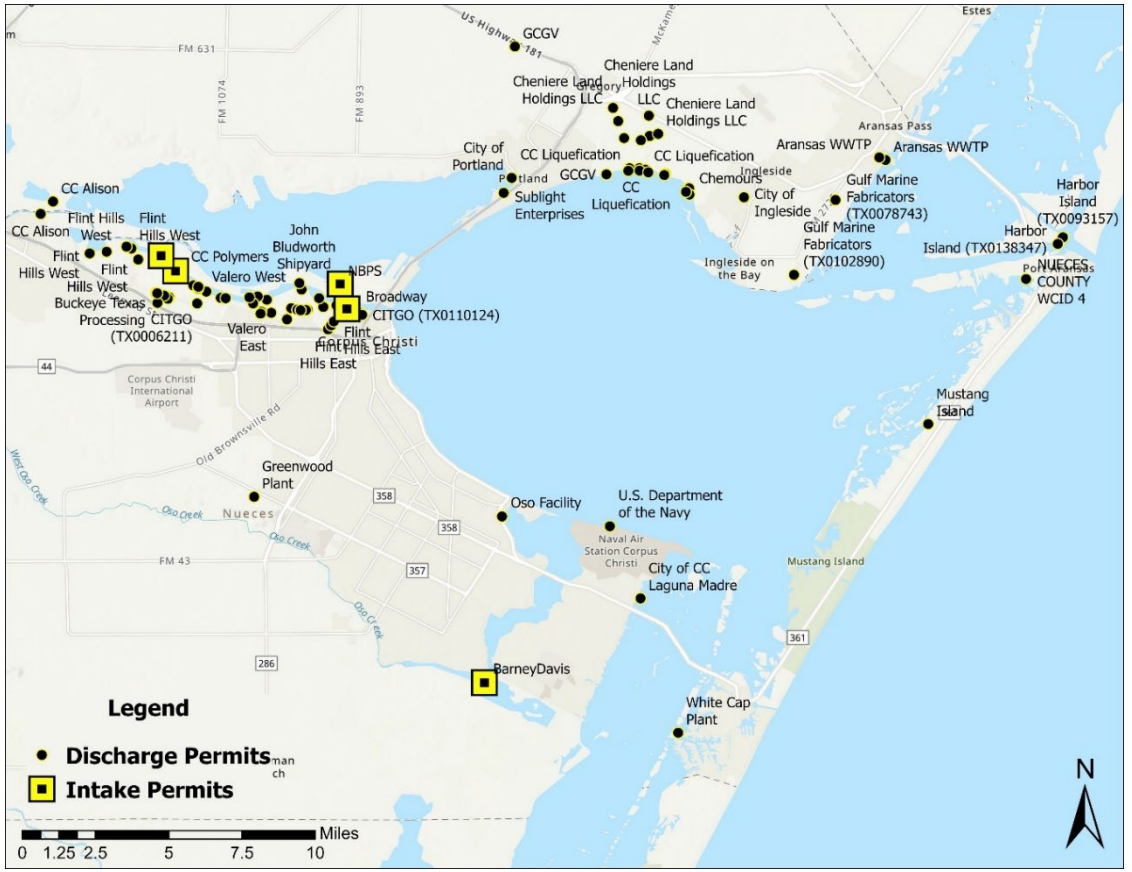
Water levels – NOAA, CBI

alinity – USGS, CBI, TWDB, TCEQ

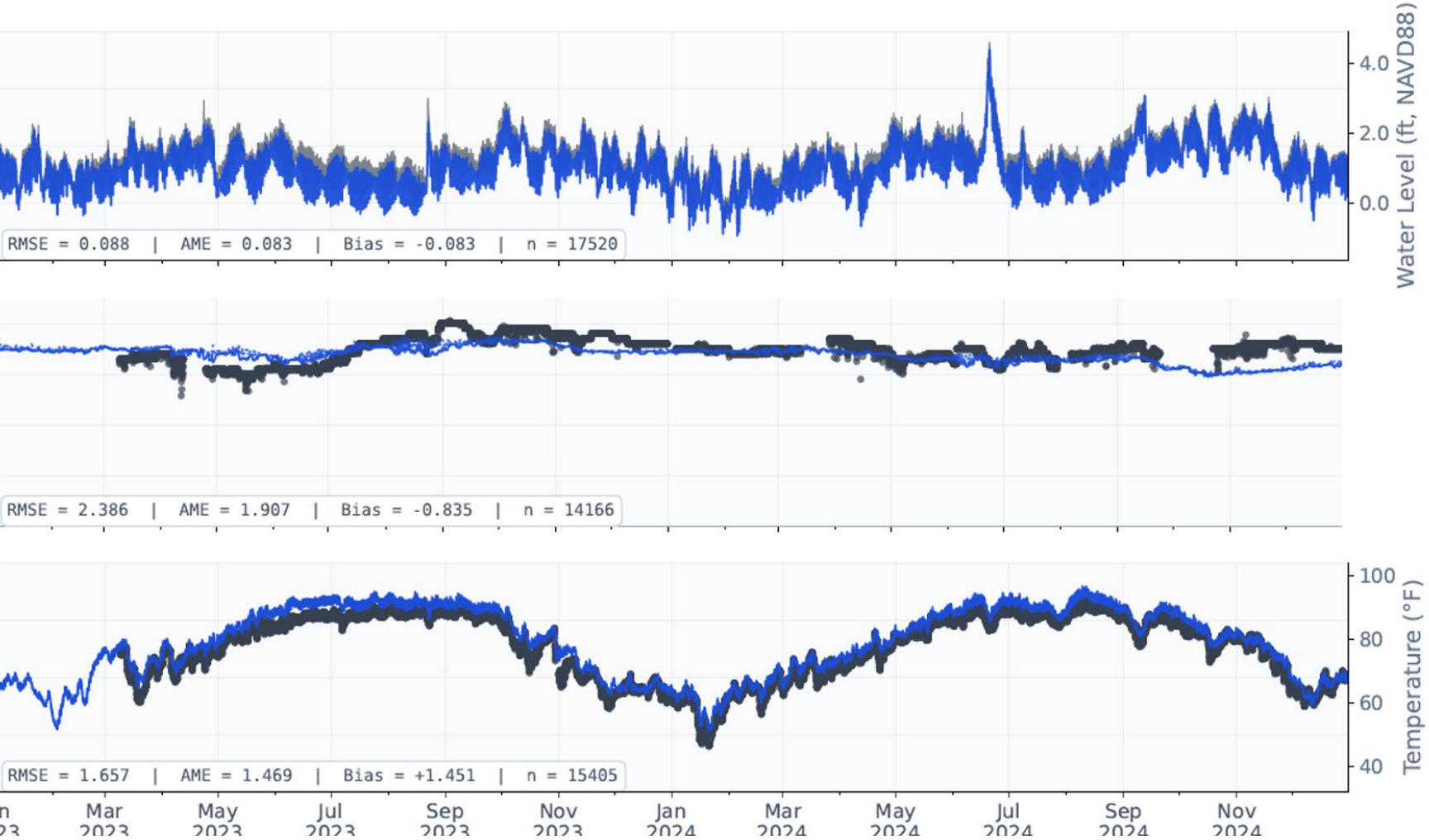
emperature – NOAA, CBI, USGS

oint sources/withdrawals

- TCEQ discharge permits and DMRs
- Water rights permits

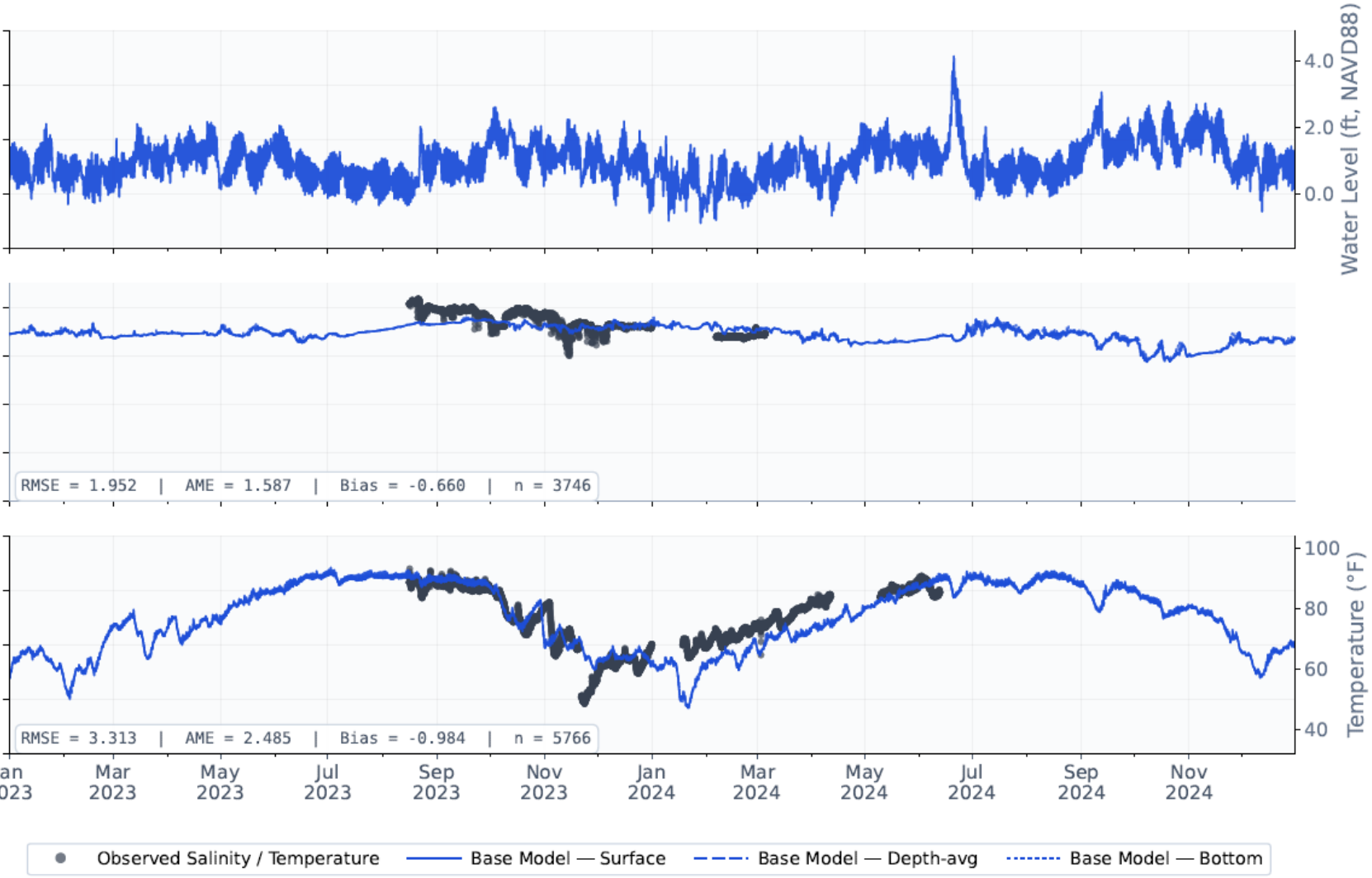


odel Performance at the Inner Harbor Mouth



er levels and temperature at NOAA USS Lexington Station. Salinity is at USGS CC Bay Station. Model predicted salinity is in parts per thousand salinity measurements are in practical salinity units (PSU). Differences between these two units are negligible for normal ocean salinity ranges umed to be equivalent for model-data comparisons.

odel Performance in Corpus Christi Bay



del predicted salinity is in parts per thousand (PPT), while salinity measurements are in practical salinity units (PSU). Differences between these e negligible for normal ocean salinity ranges and are assumed to be equivalent for model-data comparisons.

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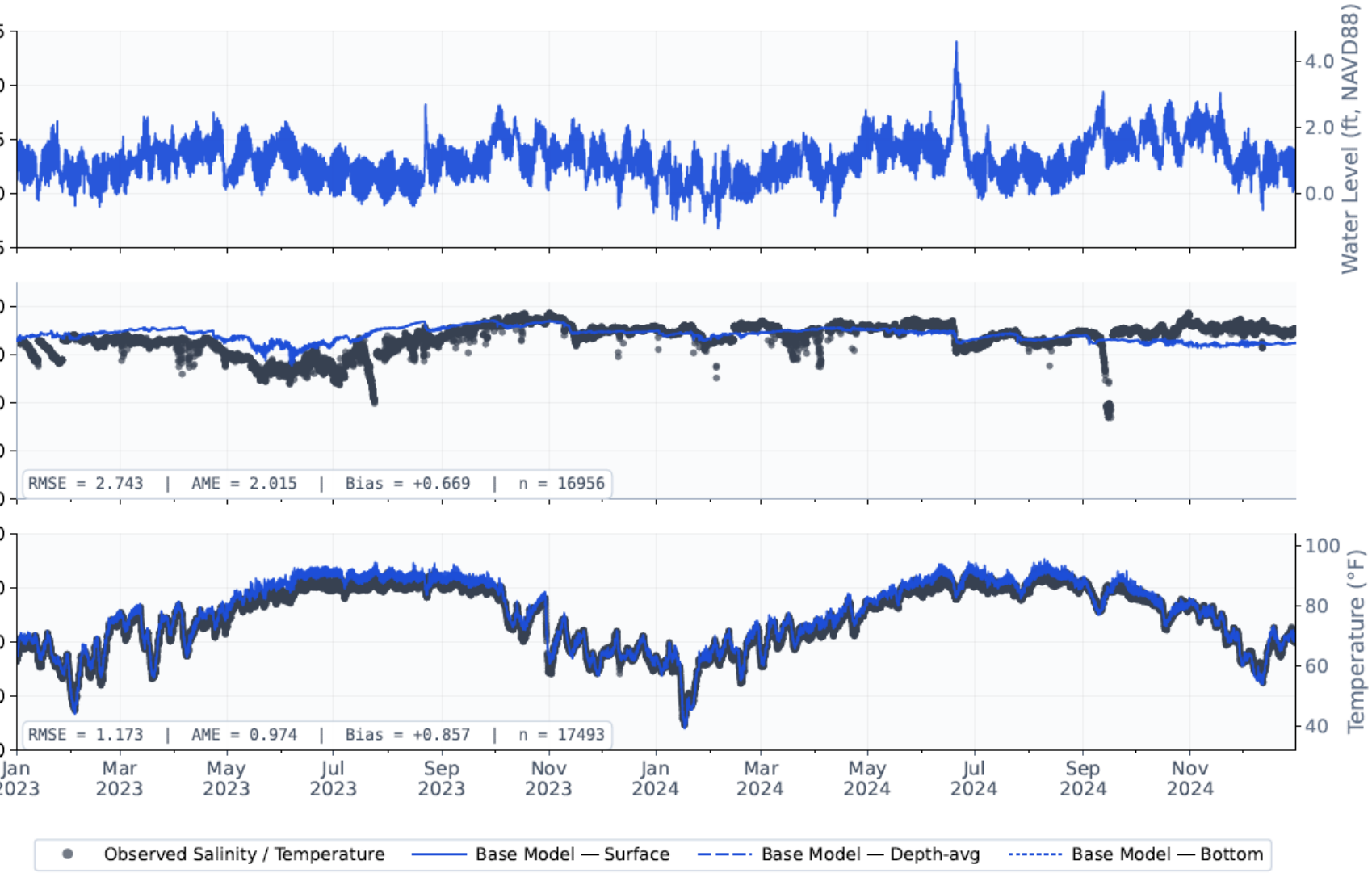
odel Performance within Nueces Bay



del predicted salinity is in parts per thousand (PPT), while salinity measurements are in practical salinity units (PSU). Differences between these

ensitivity to Vertical Resolution

Tested a 20-layer model to assess sensitivity to vertical resolution

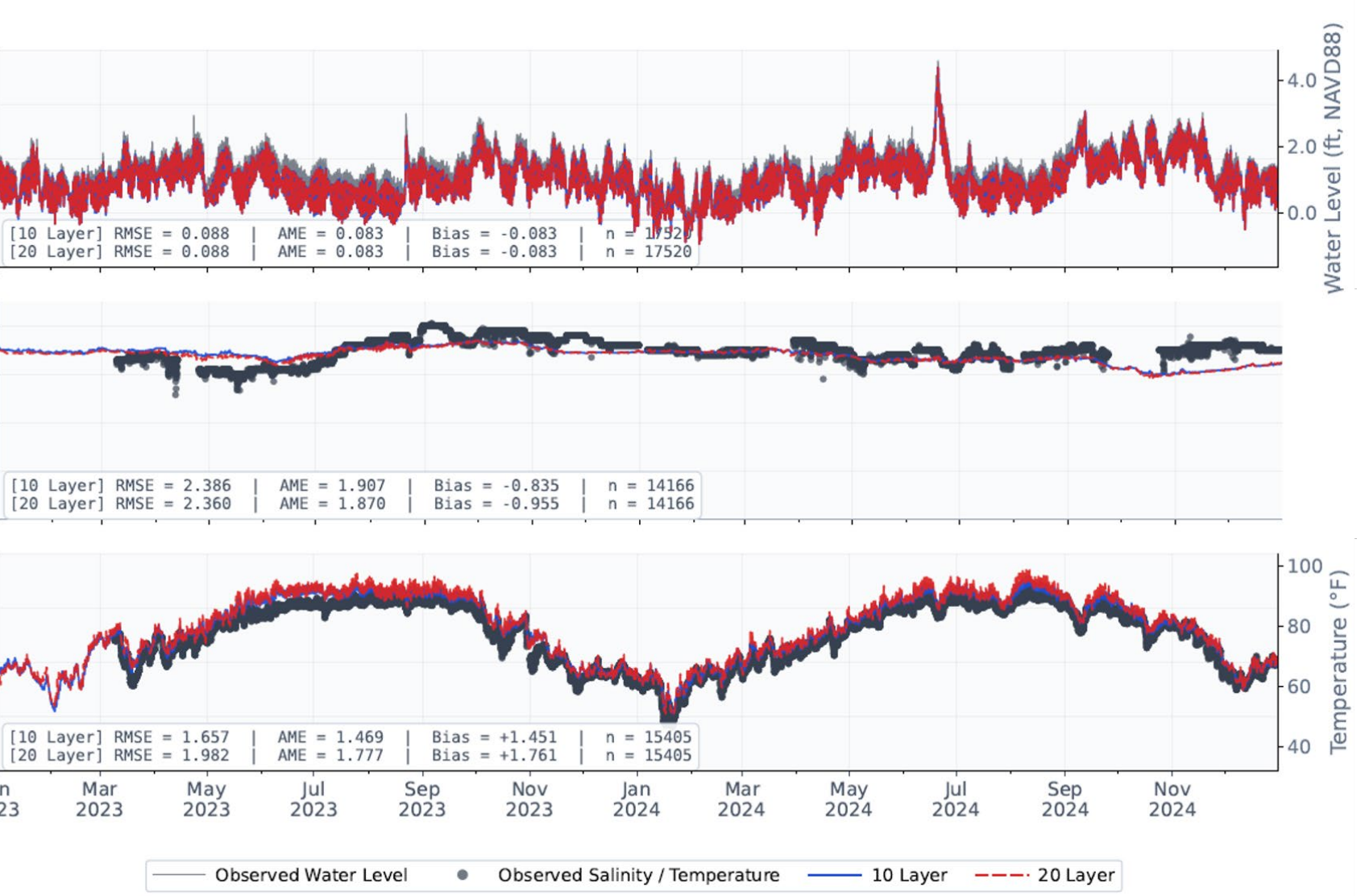
Up to 20 sigma-zed layers vs up to 10 layers in base model

1.1 m nominal vertical resolution in 20 L model vs. 2.3 m nominal vertical resolution in base model

Total number of active cells ~ 61,400 (base model has ~34,400 active cells)

The performance of the 20-layer model was compared relative to the 10-layer model both for existing conditions as well as in simulating the effects of brine discharge

rformance near Inner Harbor: NOAA USS/USGS



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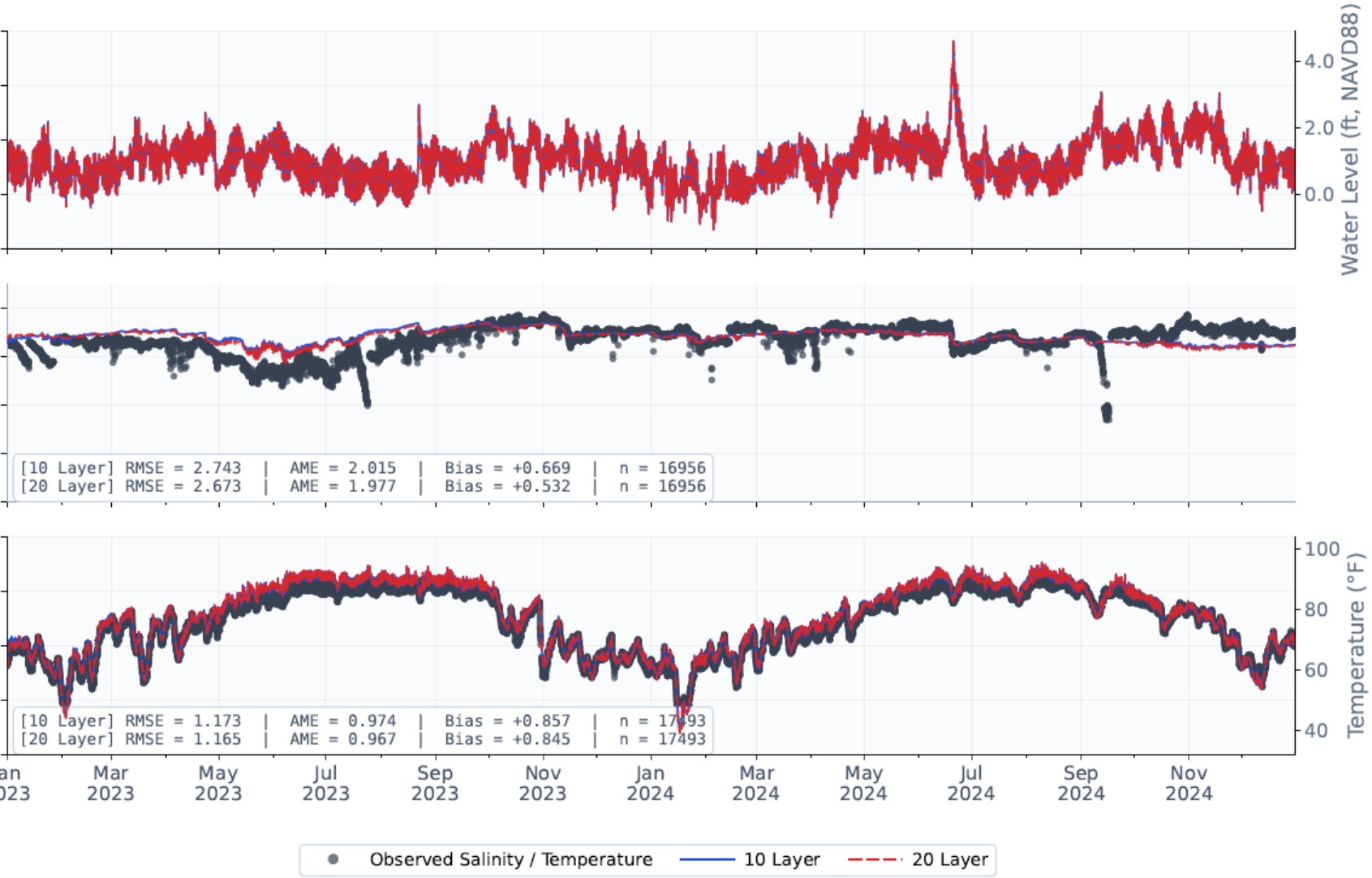

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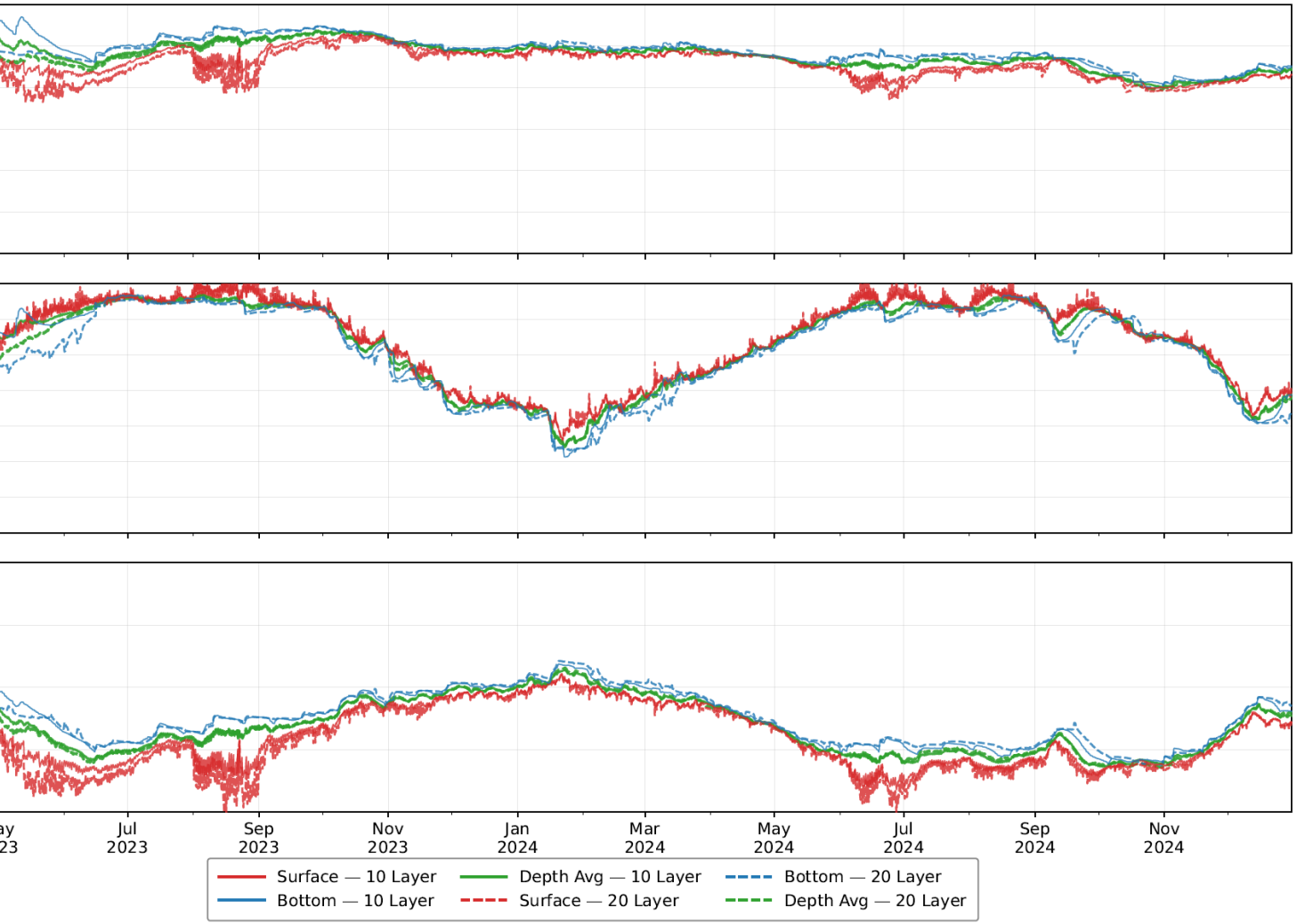
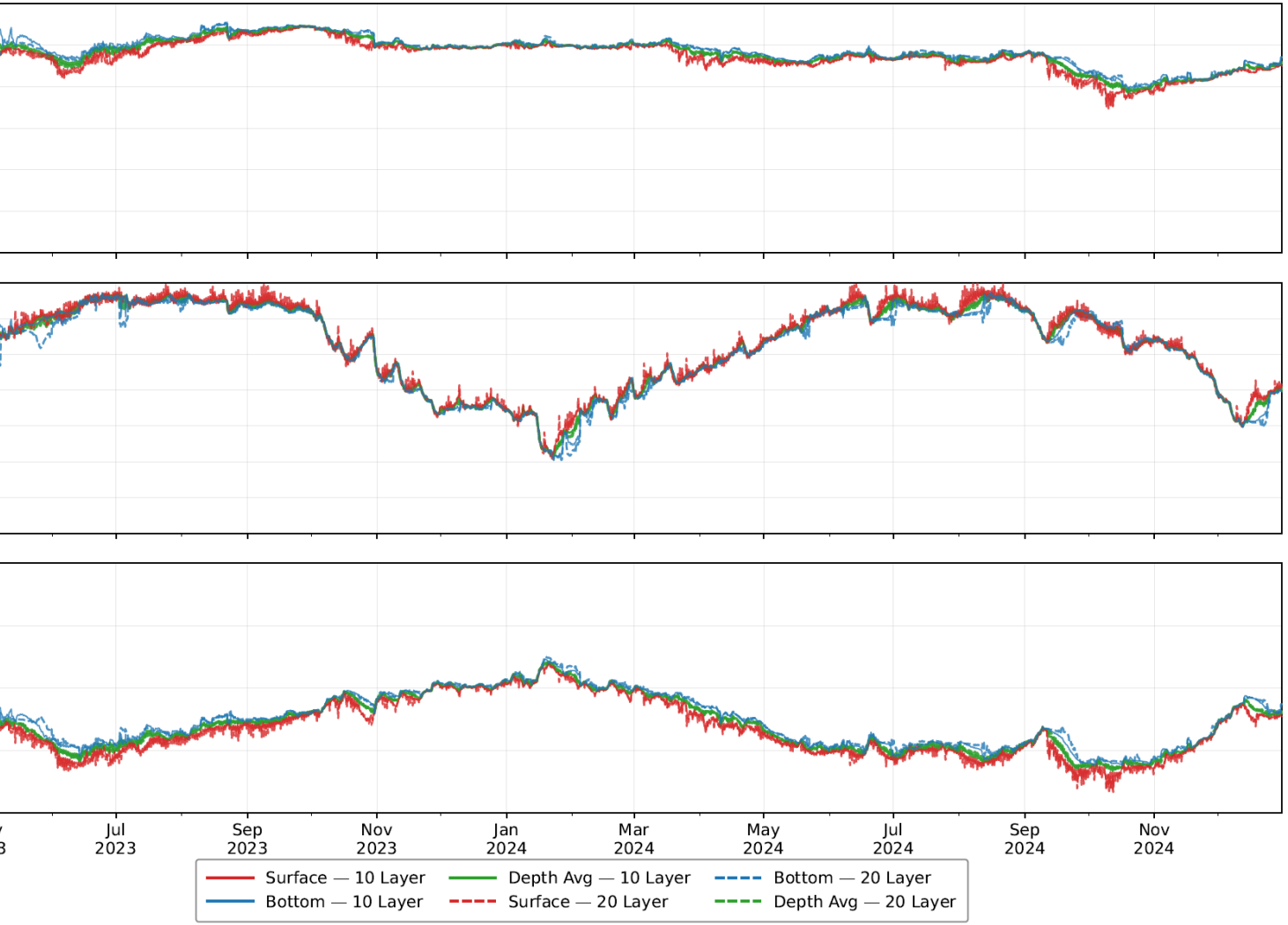
-layer vs 10-layer - Predicted Surface and Bottom linities, Temperature and Density: Inner Harbor



-layer vs 10-layer - Predicted Differences in inities: Ship Channel



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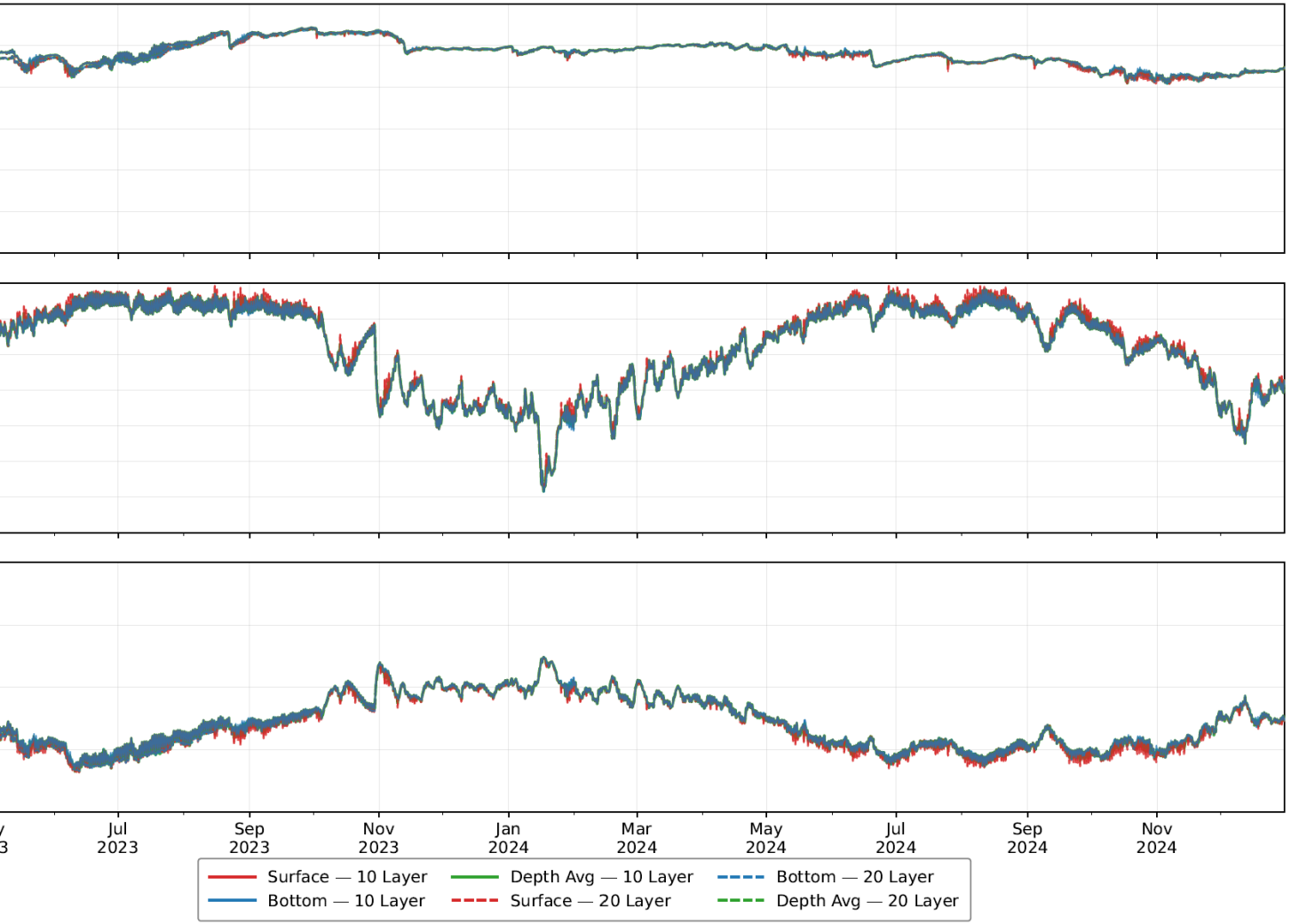
-layer vs 10-layer - Predicted Differences in inities: Nueces Bay



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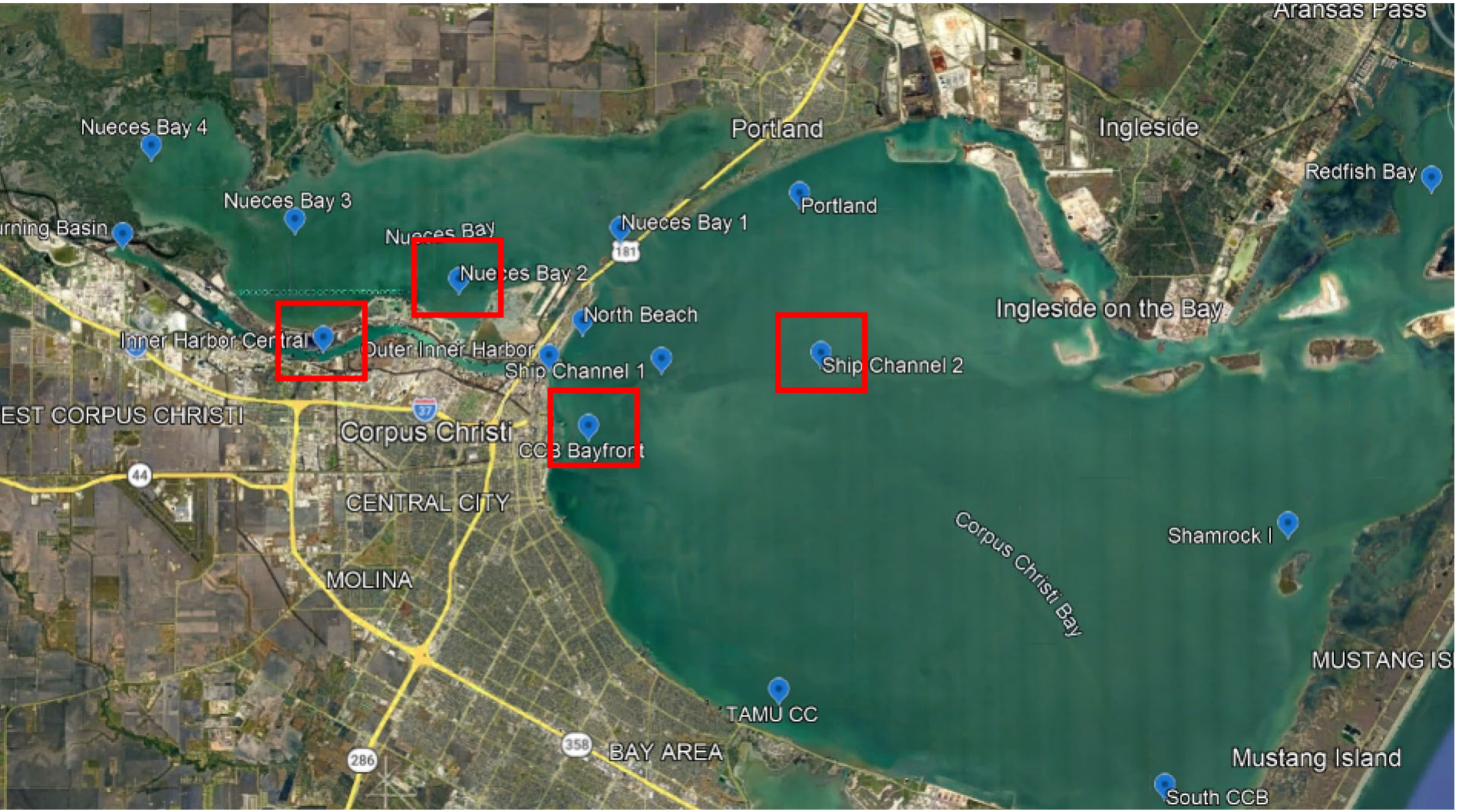
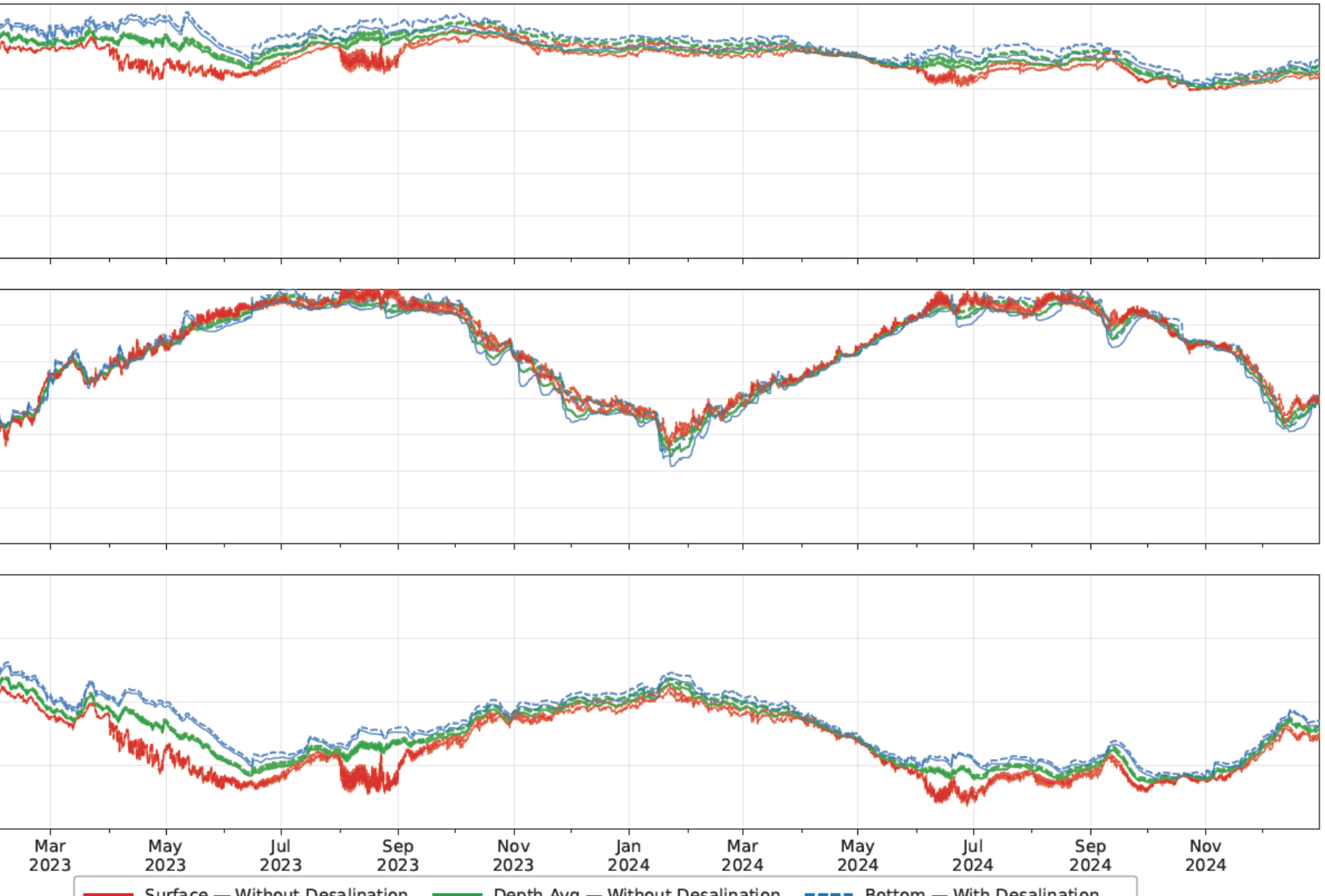
ocation Map for Scenarios



nulation of Brine Discharge under Existing nditions: Predicted Changes in Inner Harbor



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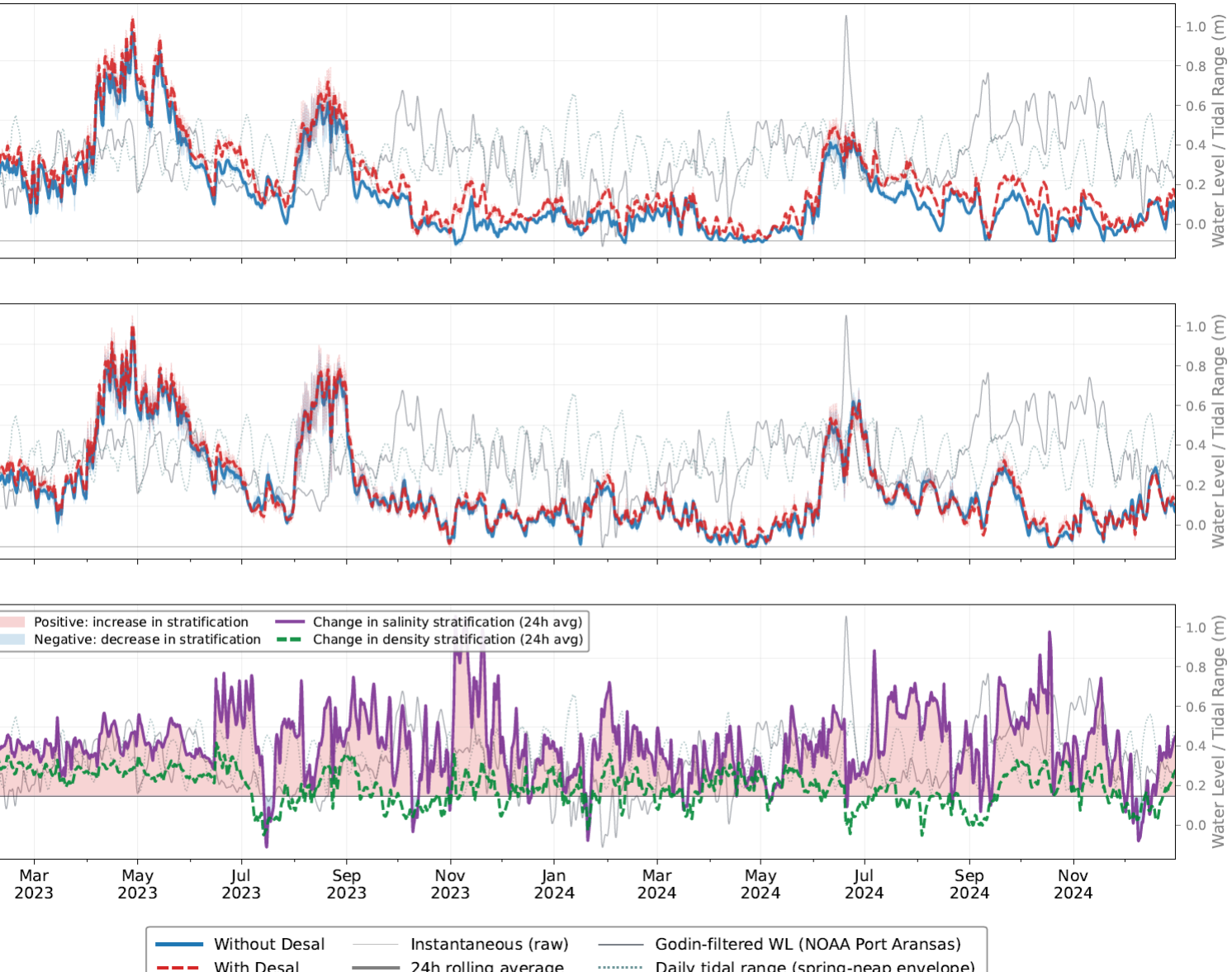
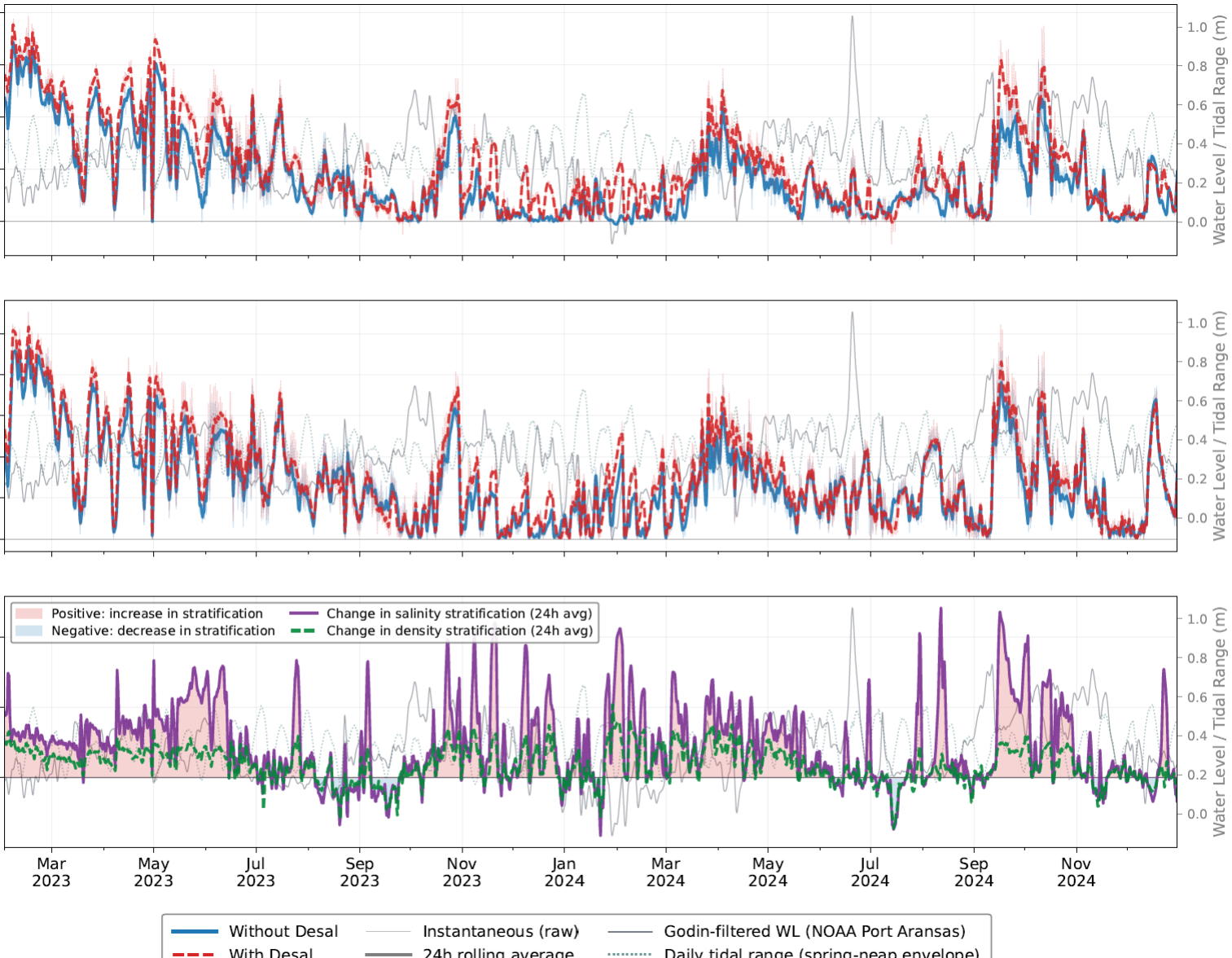
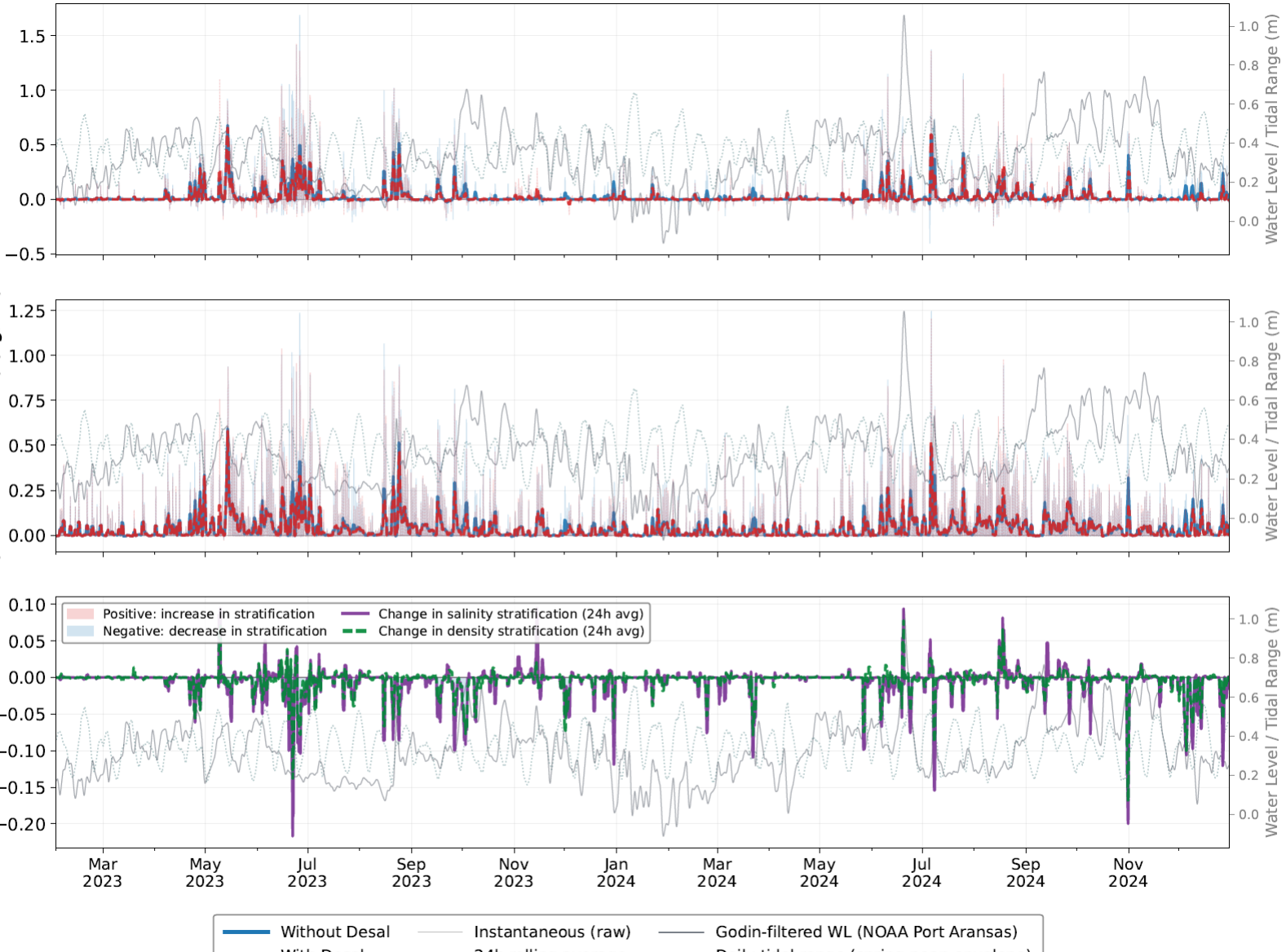


nulation of Brine Discharge under Existing Conditions: edicted Changes in Corpus Christi Ship Channel



SPHEROS

mulation of Brine Discharge: Predicted Changes
: Corpus Christi Bayfront



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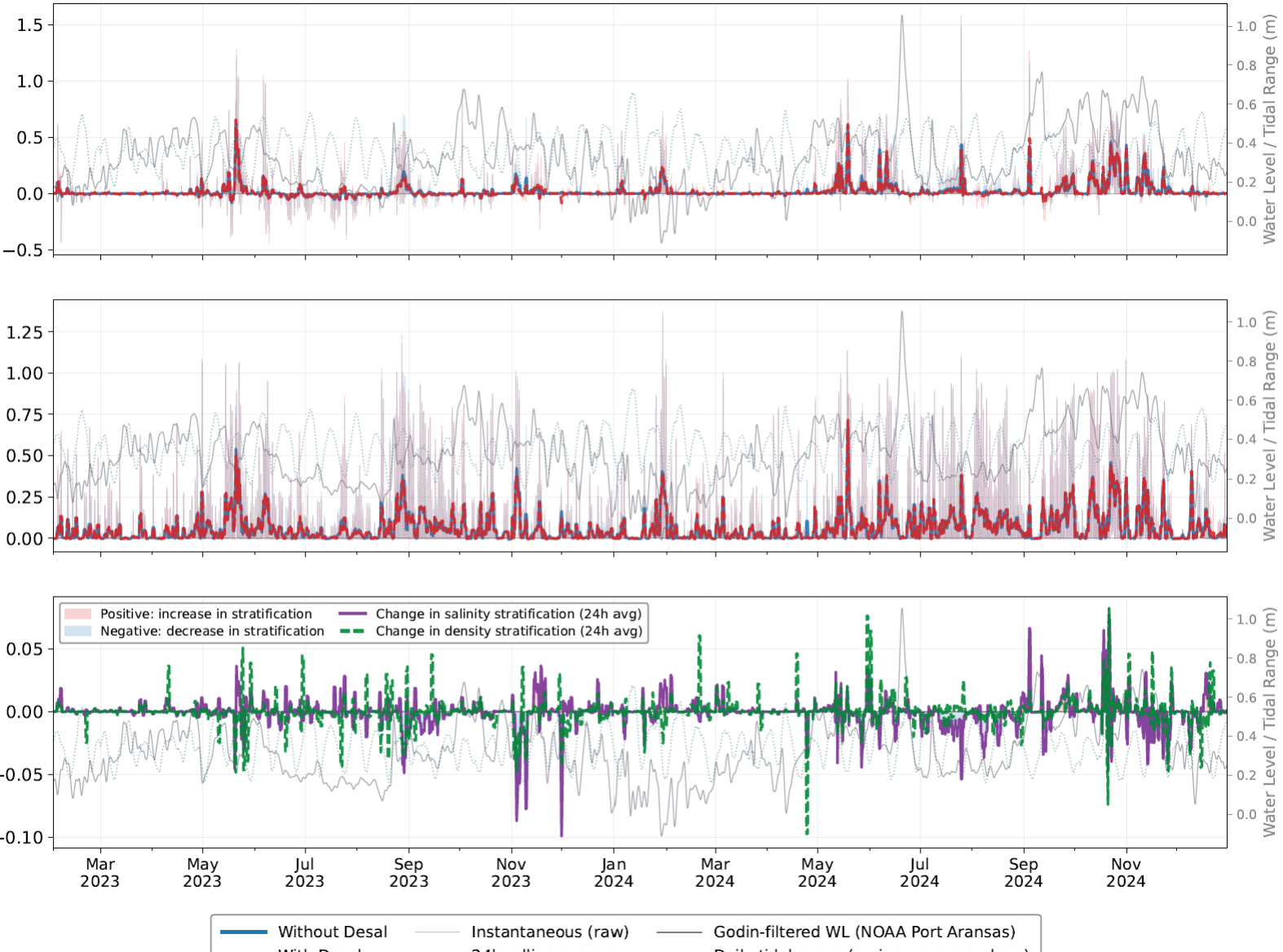
mulation of Brine Discharge: Predicted Changes ithin Nueces Bay



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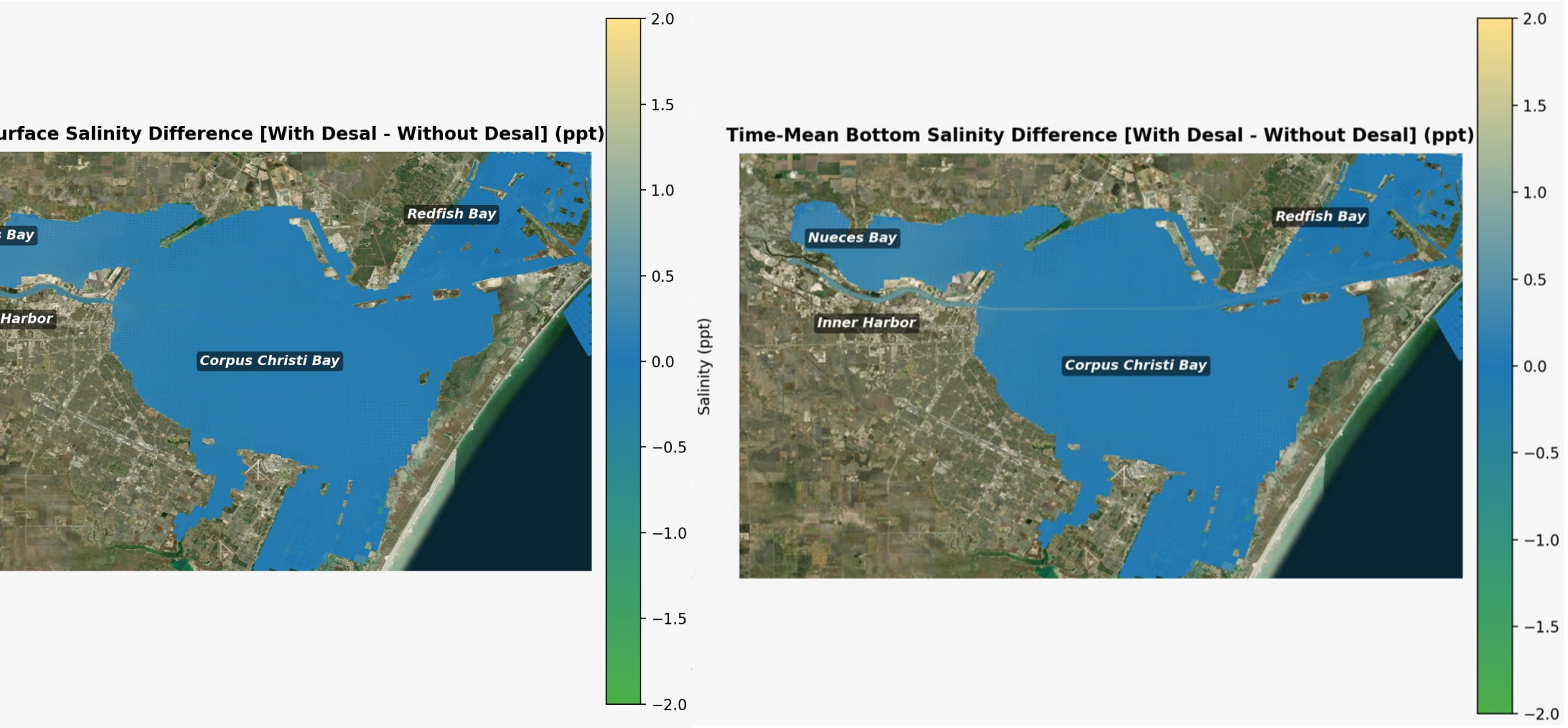
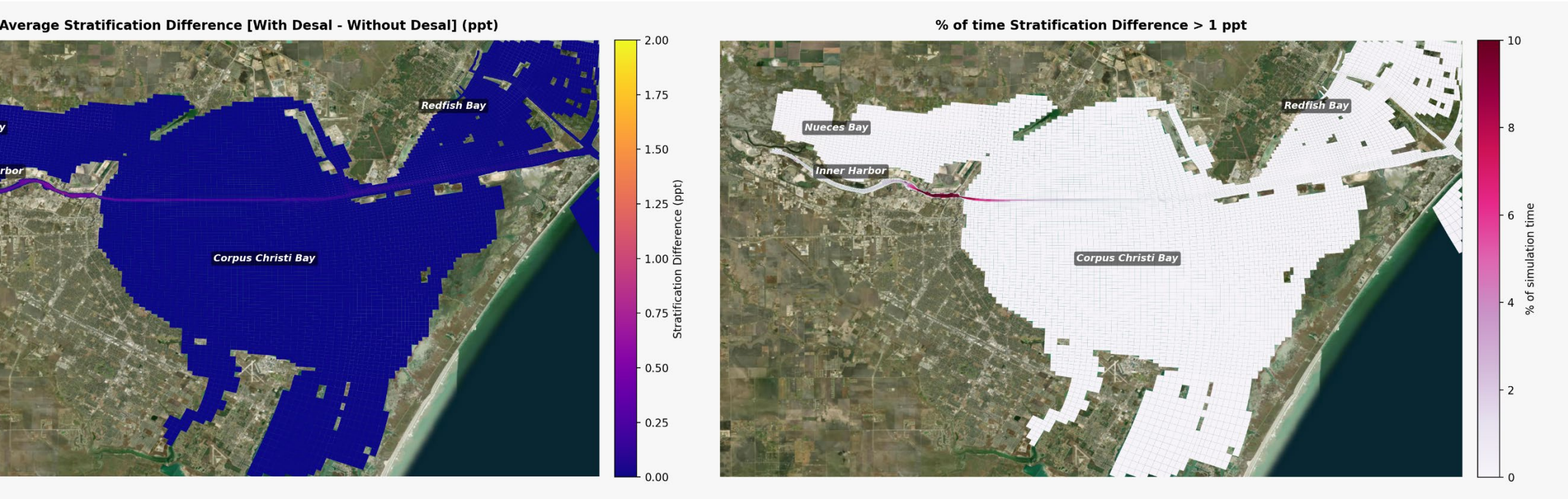
sting Conditions Simulations: Overall Changes to linity

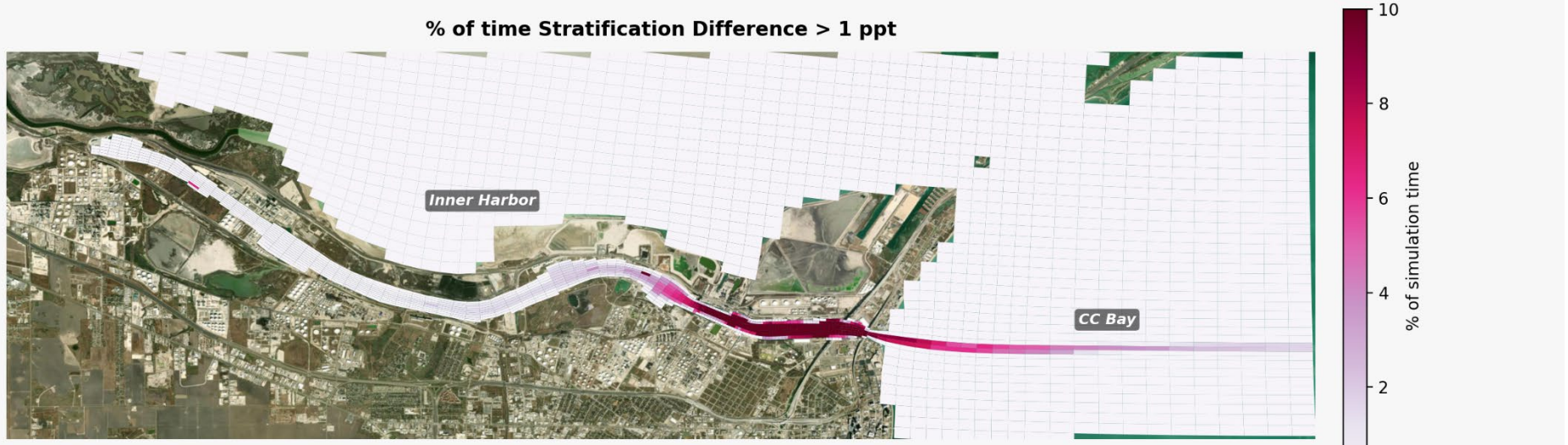


verall Changes to Salinity - Within Inner Harbor

atification Changes: Areal Extent and Duration

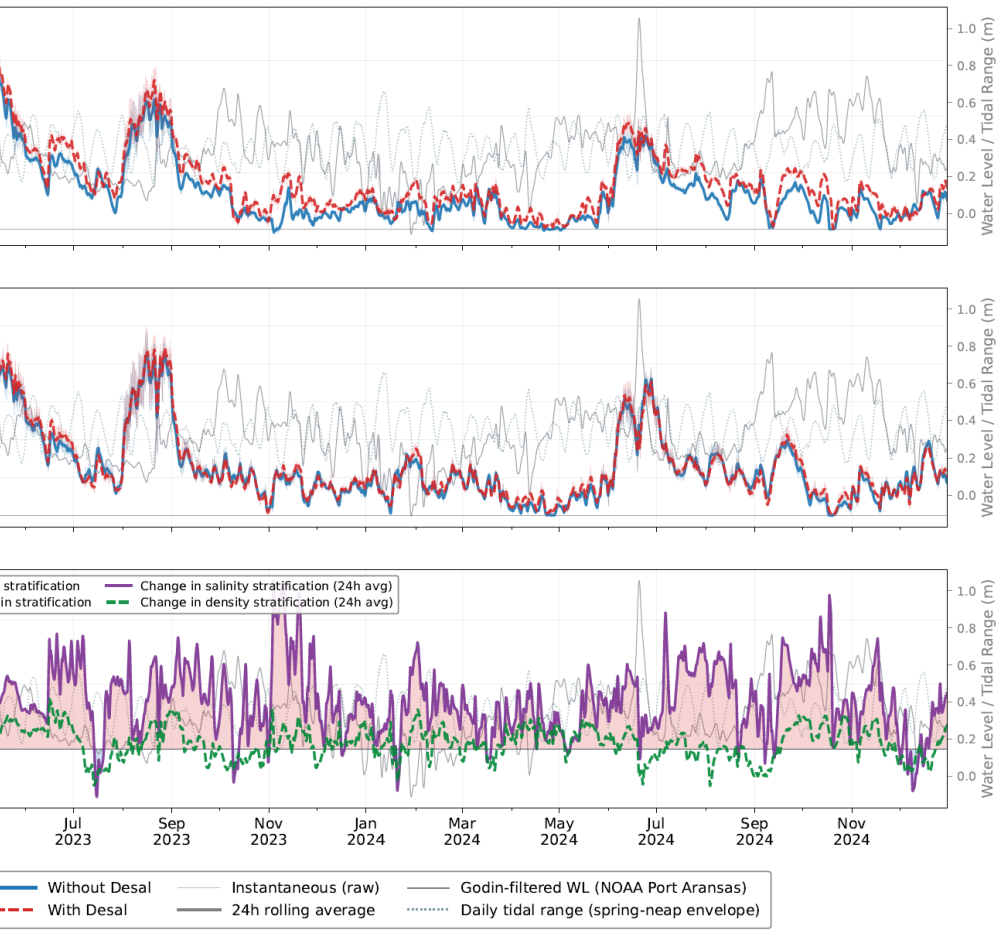


ratification Changes: Areal Extent and Duration
nner Harbor

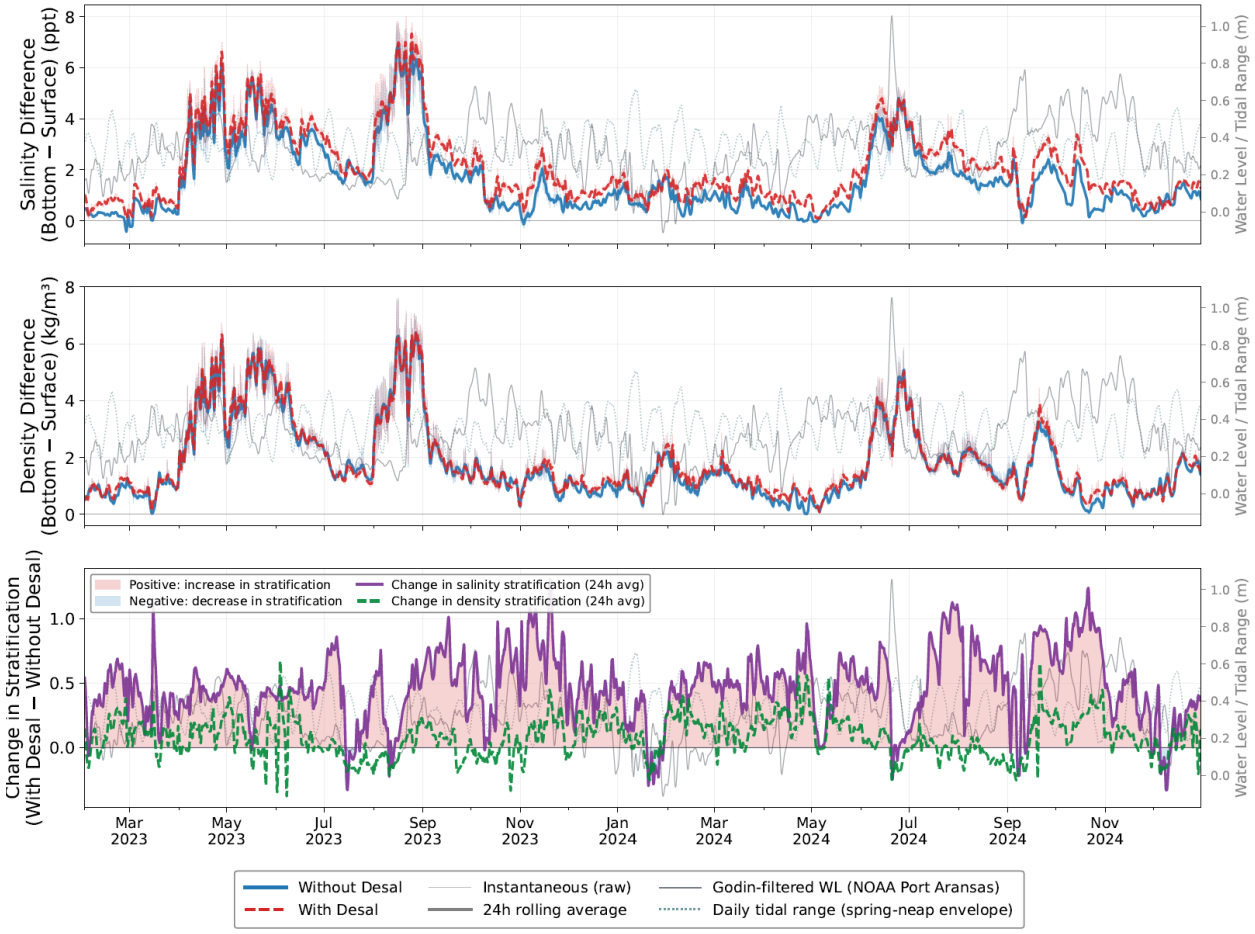


mulation of Brine Discharge – 10 L vs 20L: edicted Changes within Inner Harbor

10 Layer Model



20 Layer Model



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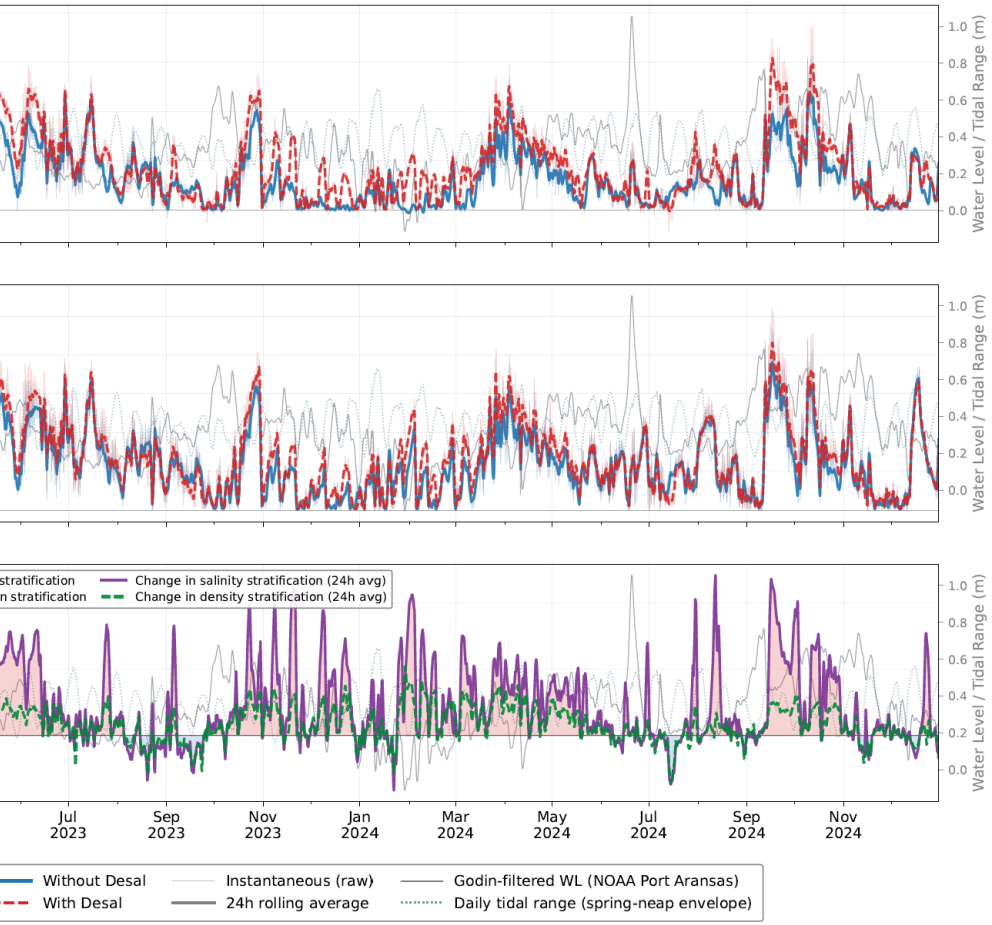
nulation of Brine Discharge – 10 L vs 20L: edicted Changes within Ship Channel

10 Layer Model



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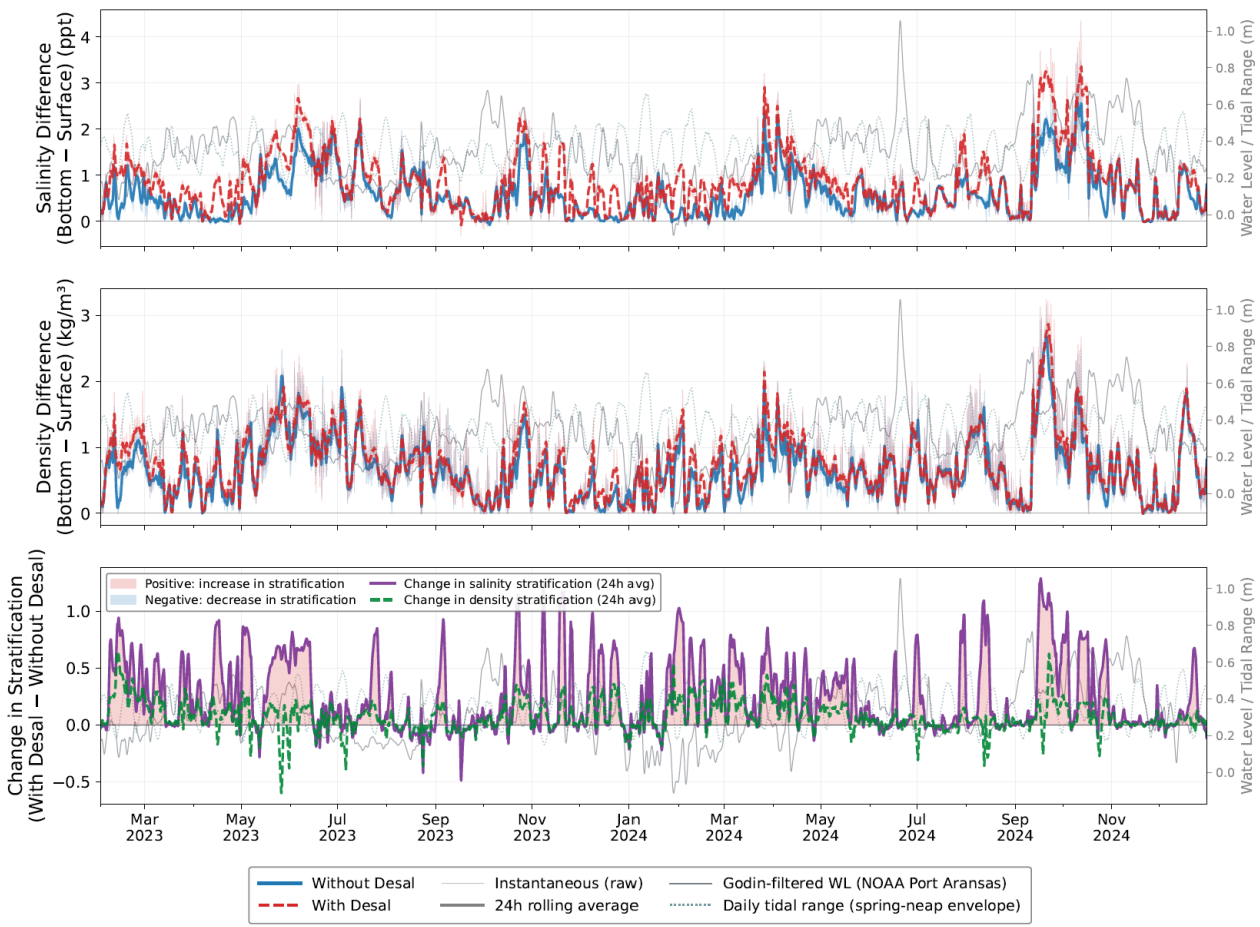

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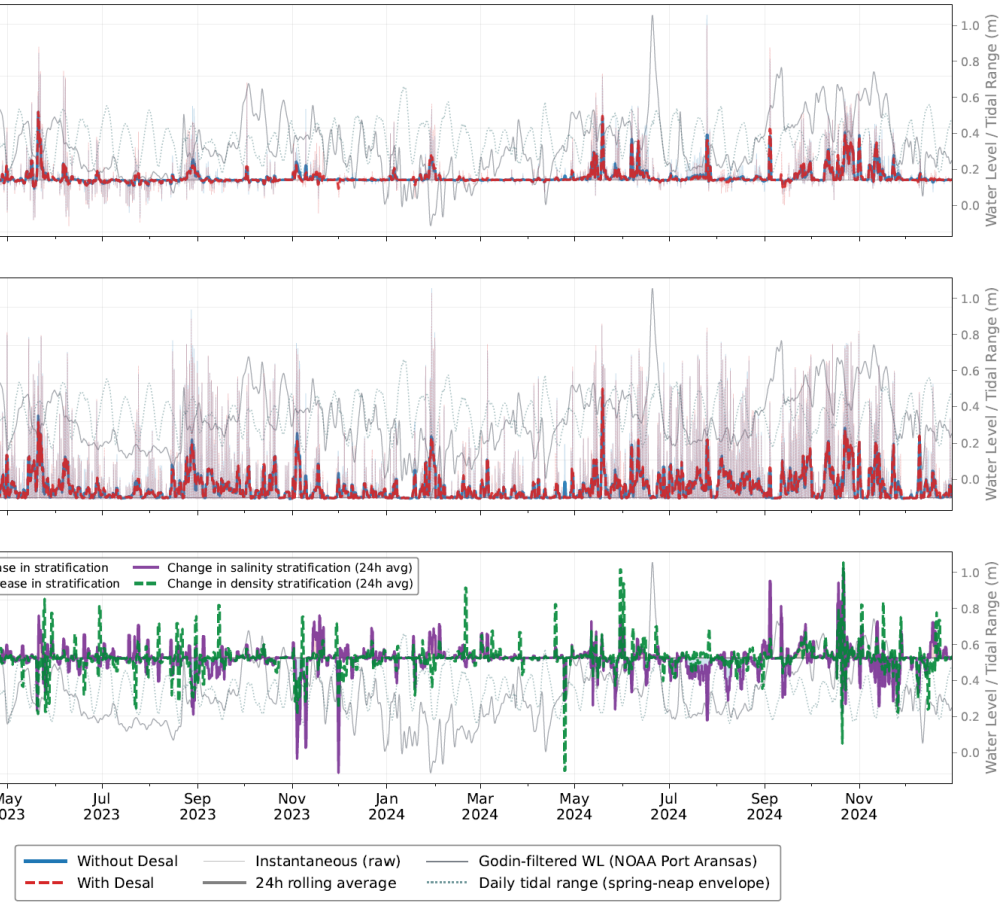
mulation of Brine Discharge – 10 L vs 20 L: edicted Changes within Nueces Bay

10 Layer Model



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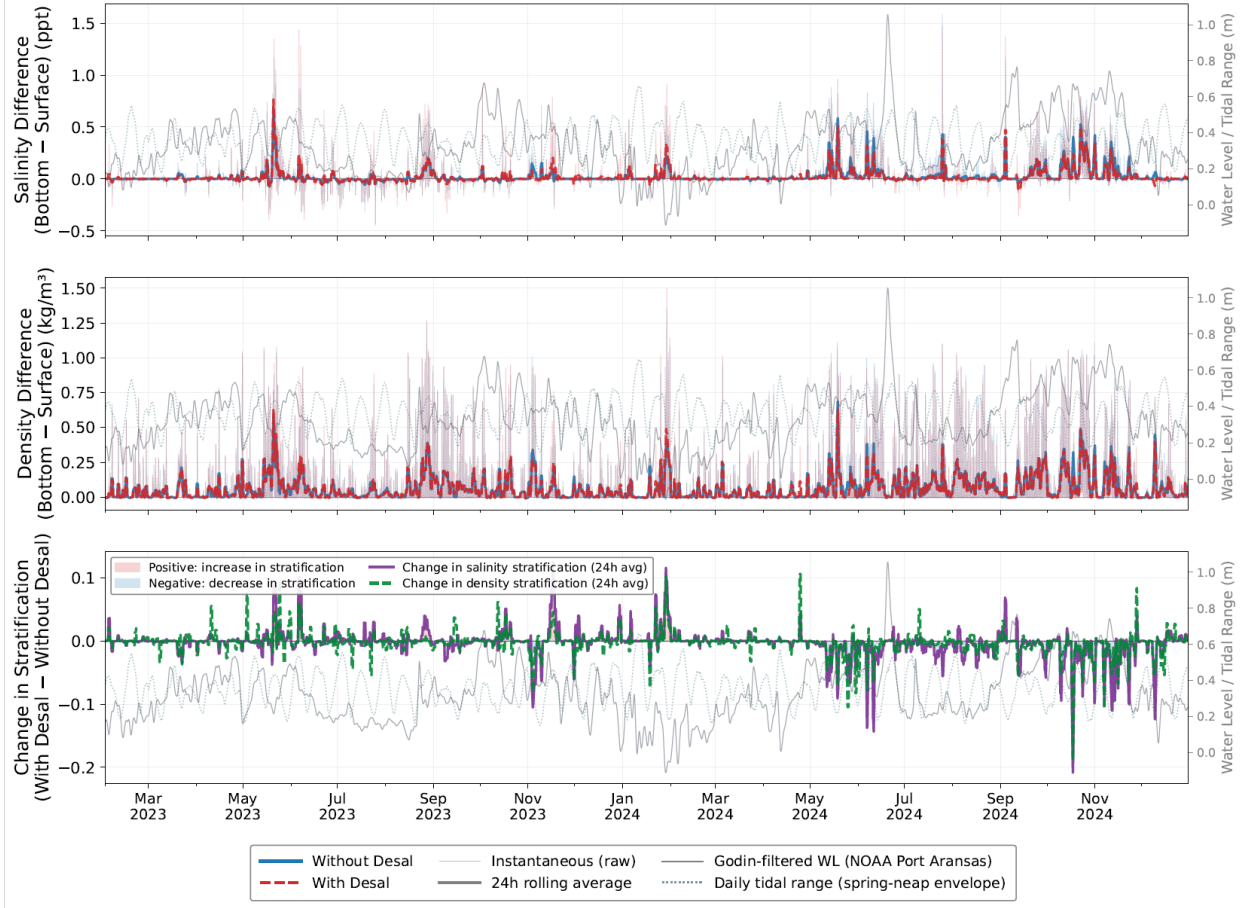

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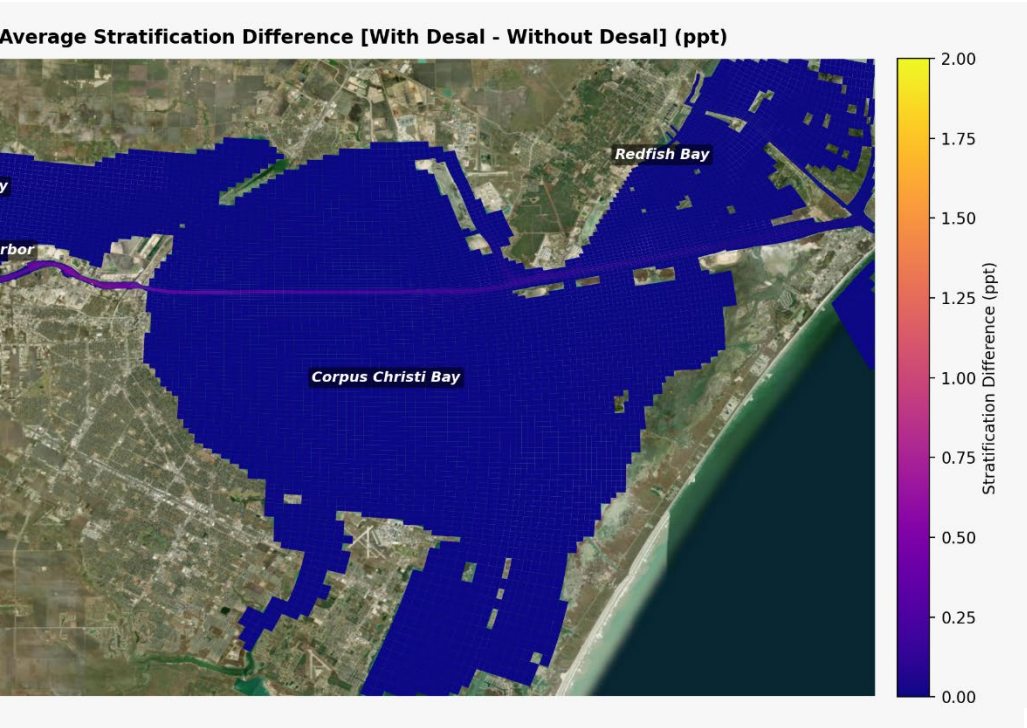
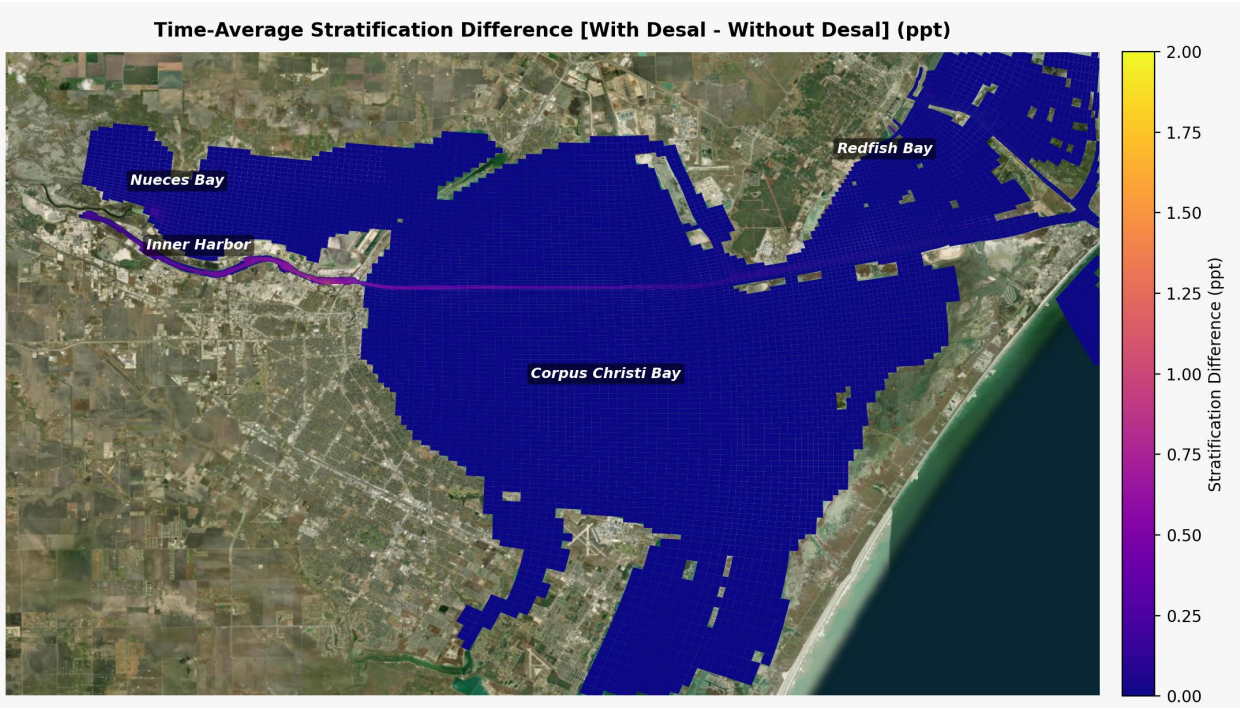
atification Changes Areal Extent: 10 L vs 20 L

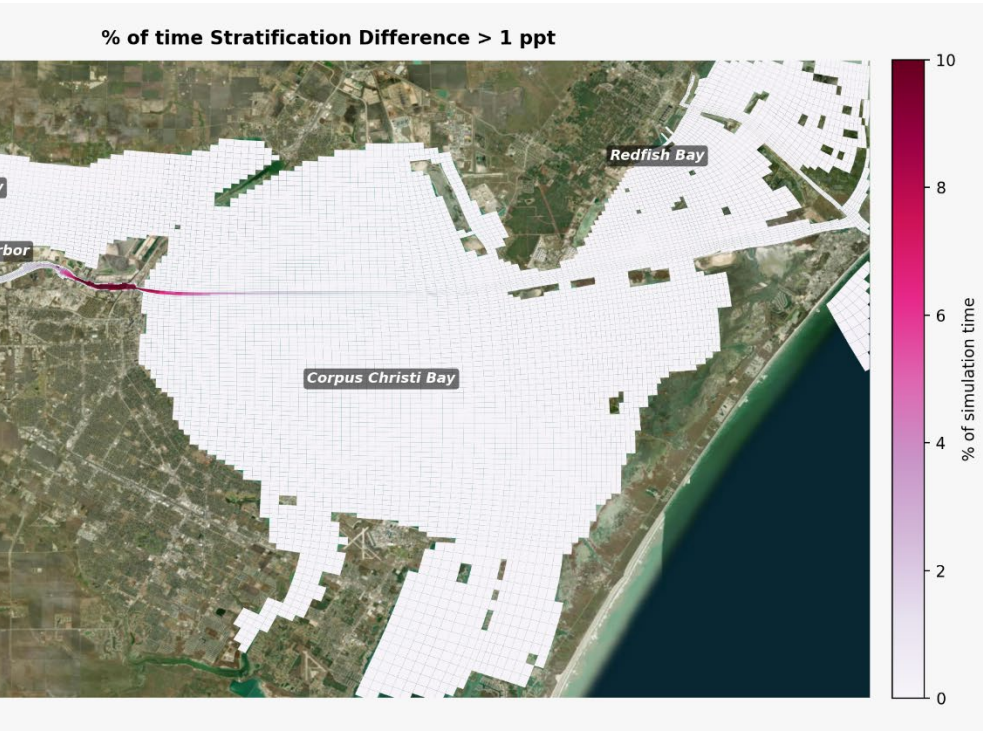
10 Layer Model

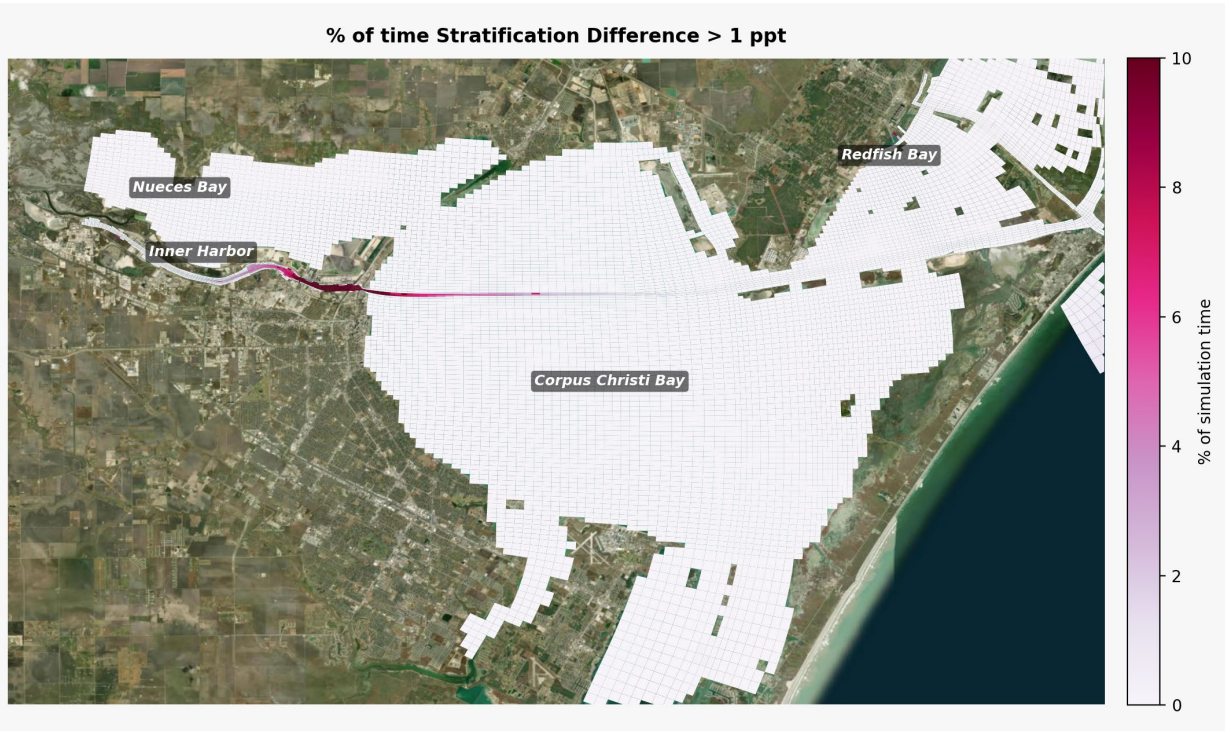


20 Layer Model



atification Changes Duration: 10 L vs 20 L





ypothetical Worst Case

FFAC recommendation to include in scenarios

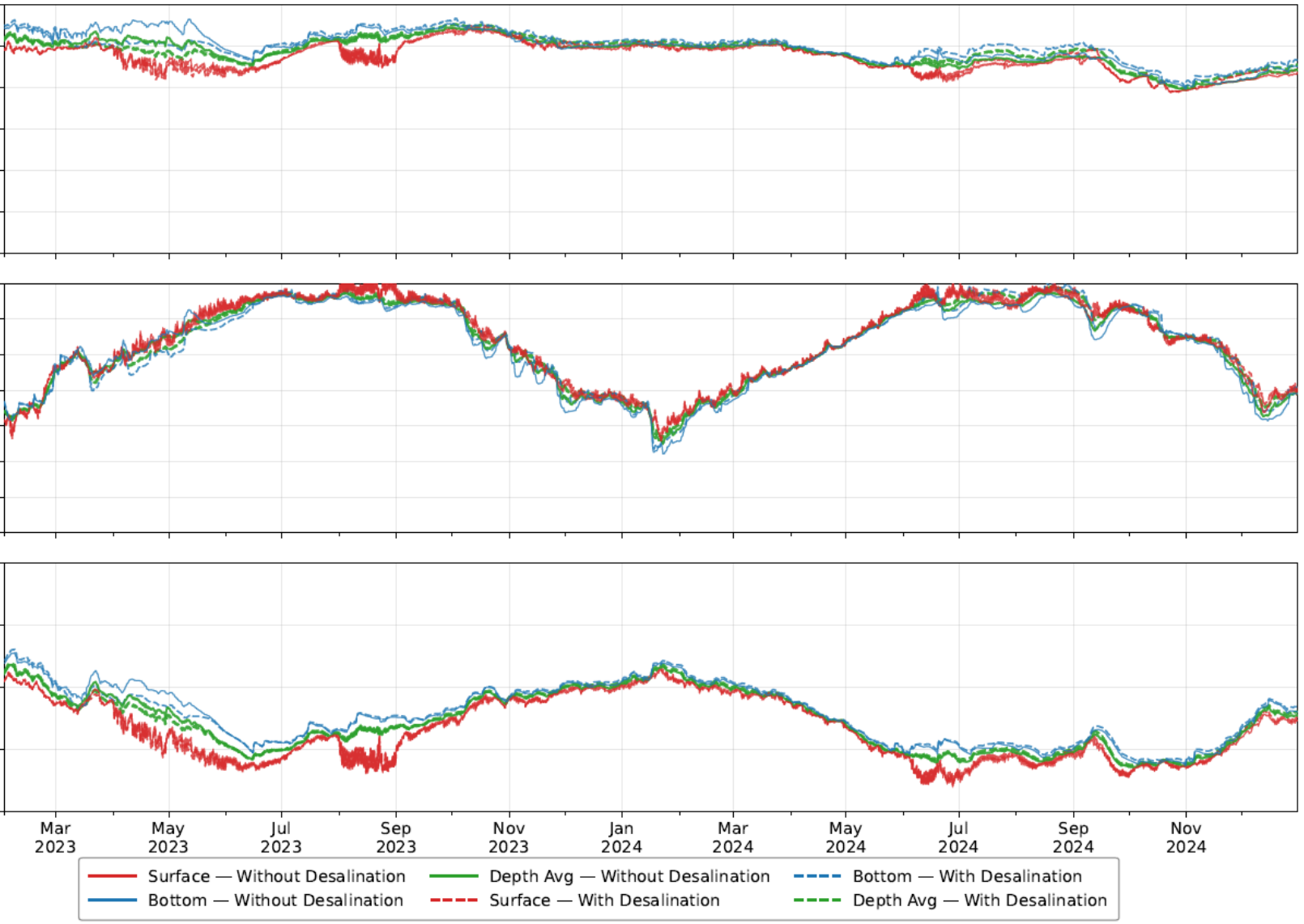
Climate change projections - 1.2°C water temperature increase and 120 mm seal level rise

Zeroed out freshwater inflow from Nueces River

Added CC Polymer desalination discharge – assumed intake will be as per water right permit, and 50% consumptive use for freshwater production

Removed Oso Facility and Allison Facility discharges

mulation of Brine Discharge under Hypothetical orst Case: Predicted Changes in Inner Harbor



SPHEROS

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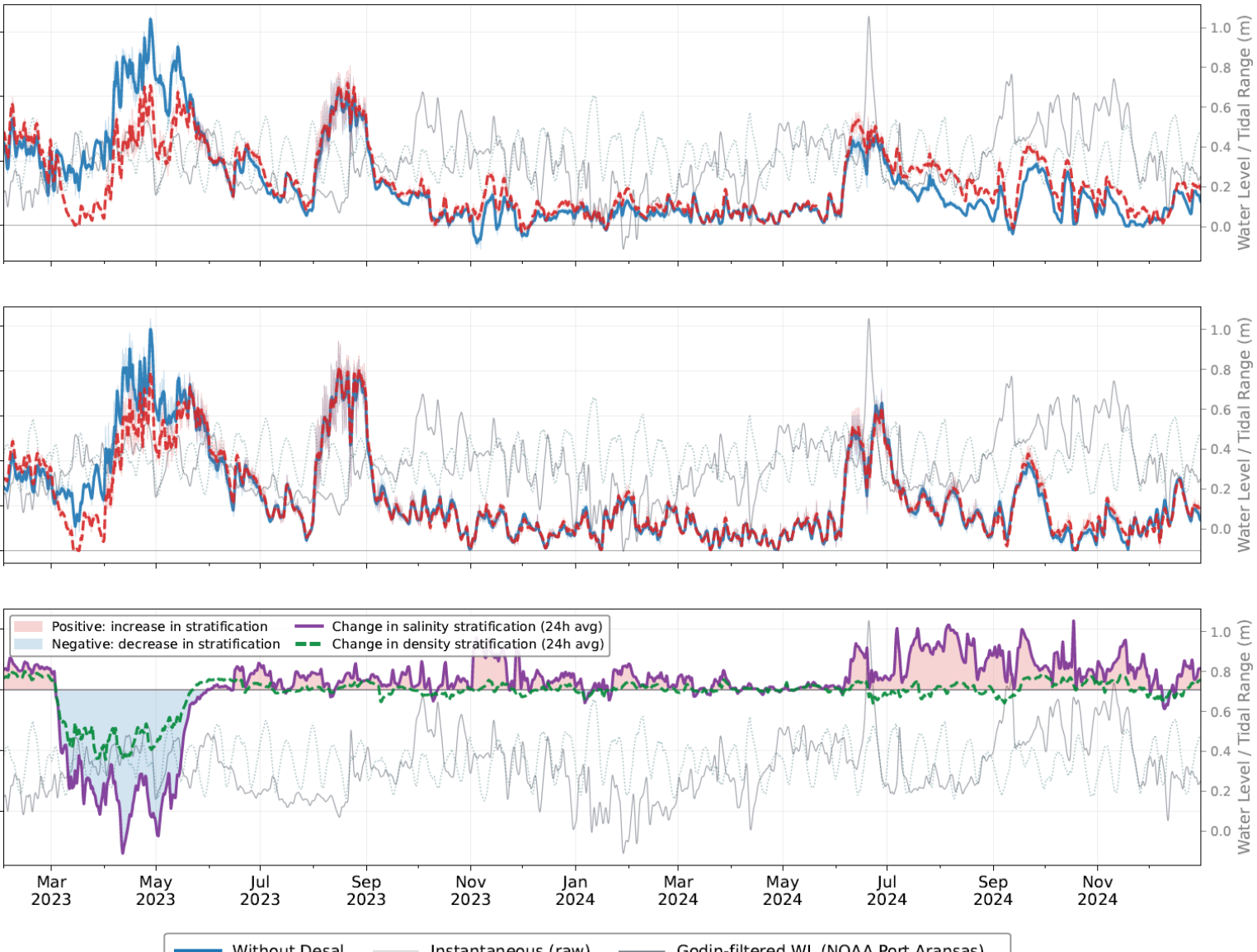

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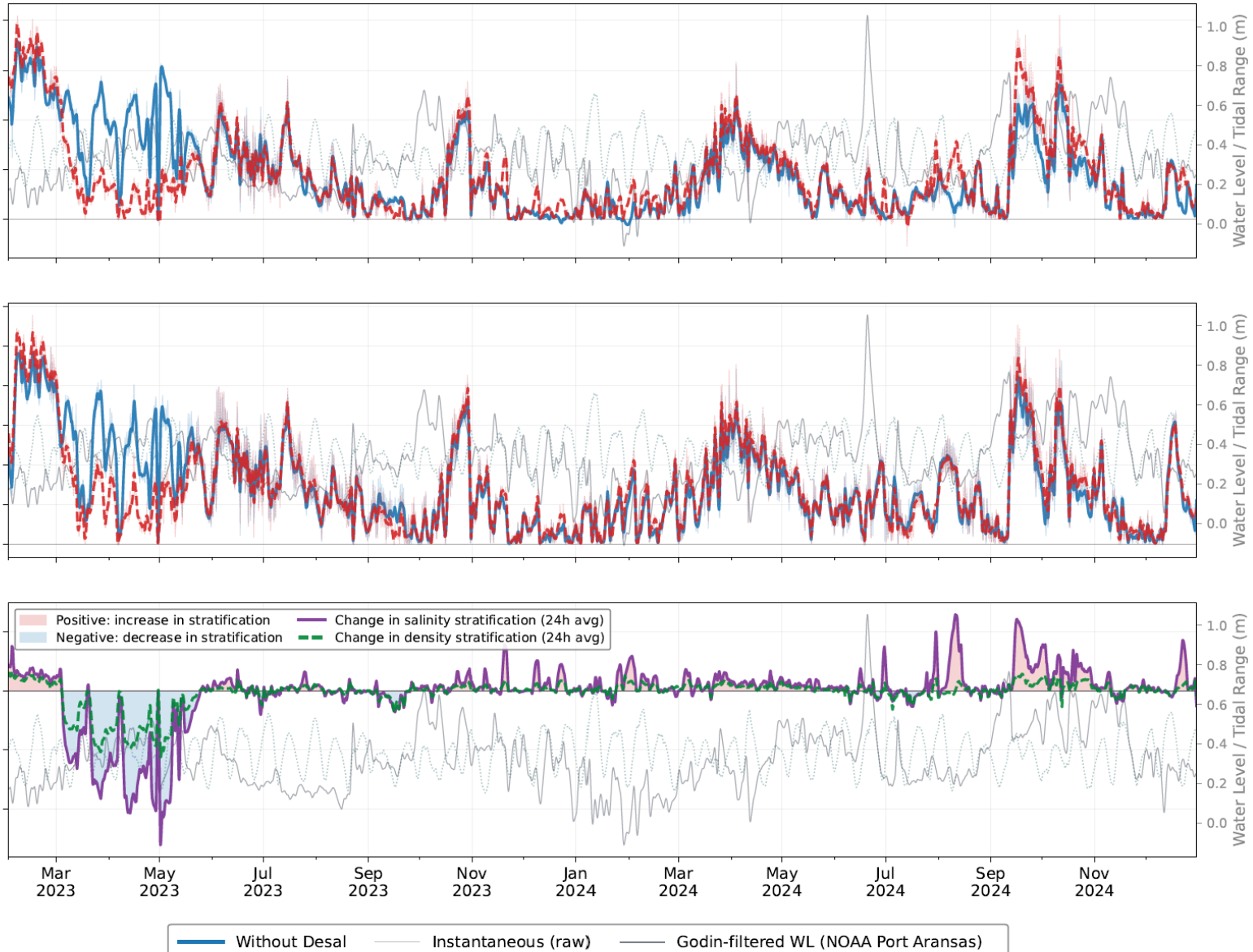
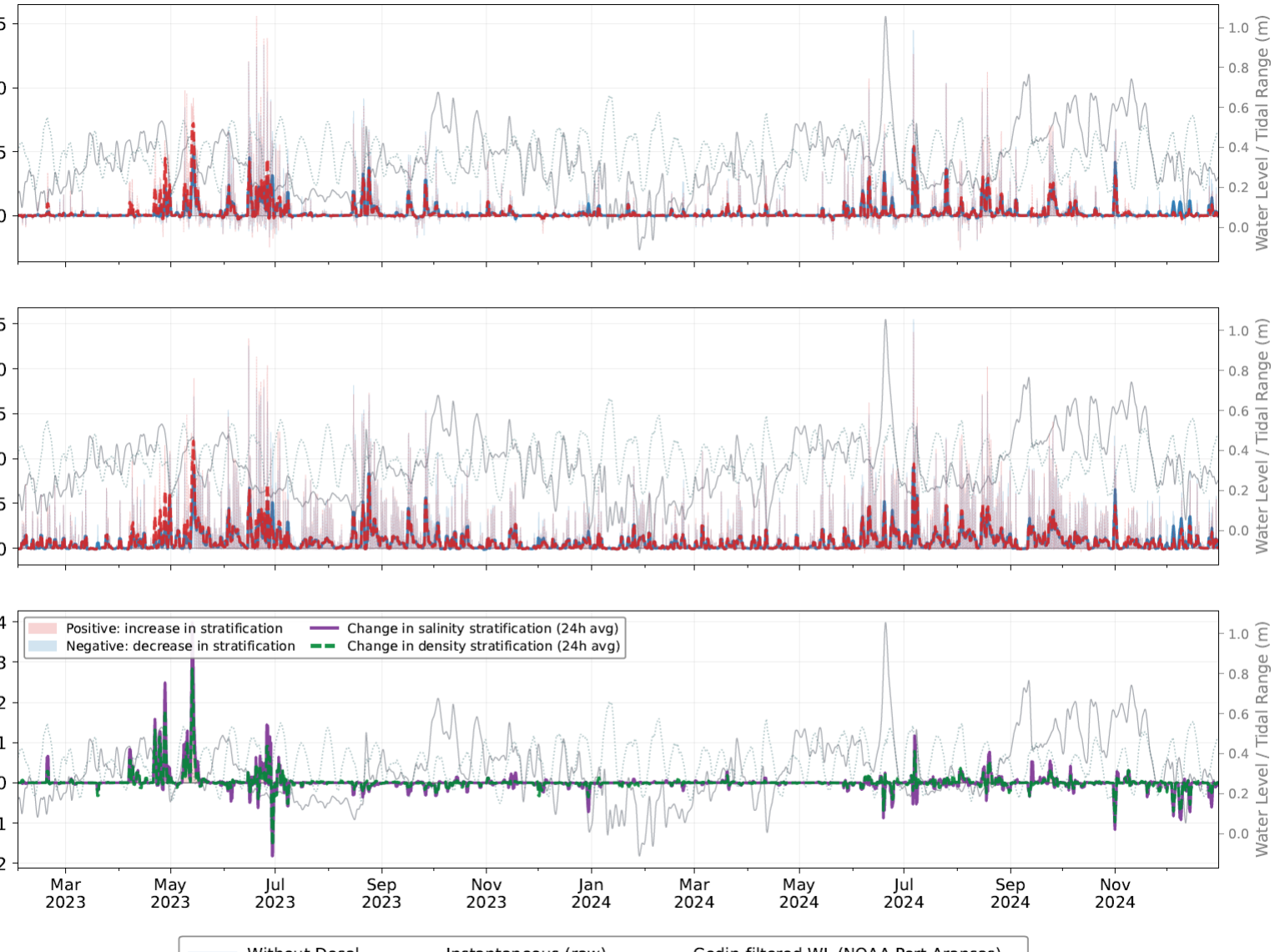
nulation of Brine Discharge under Hypothetical Worst se: Predicted Changes in Corpus Christi Ship Channel



nulation of Brine Discharge under Hypothetical Worst se: Predicted Changes at Corpus Christi Bayfront



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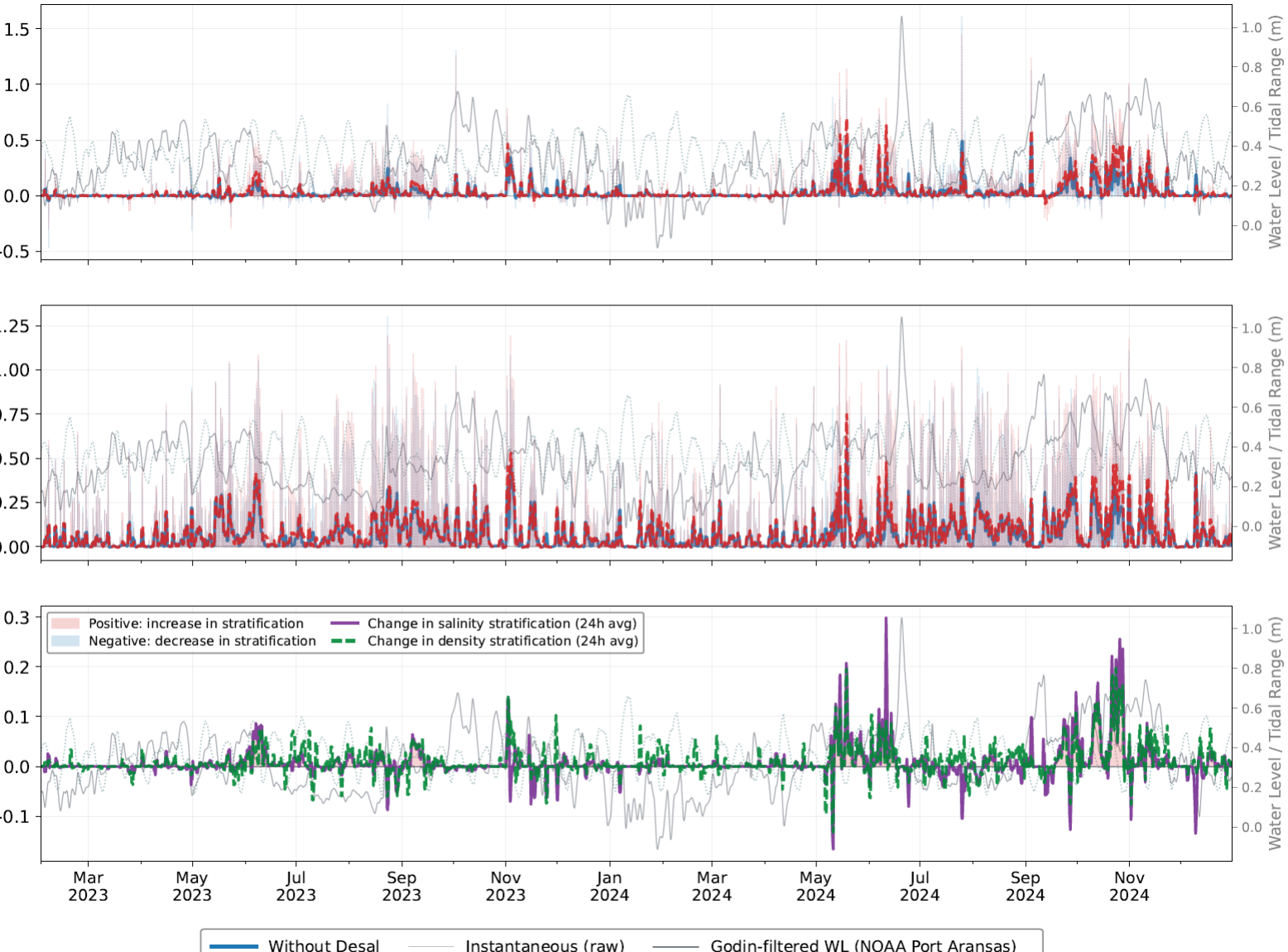
mulation of Brine Discharge under Hypothetical
orst Case: Predicted Changes within Nueces Bay



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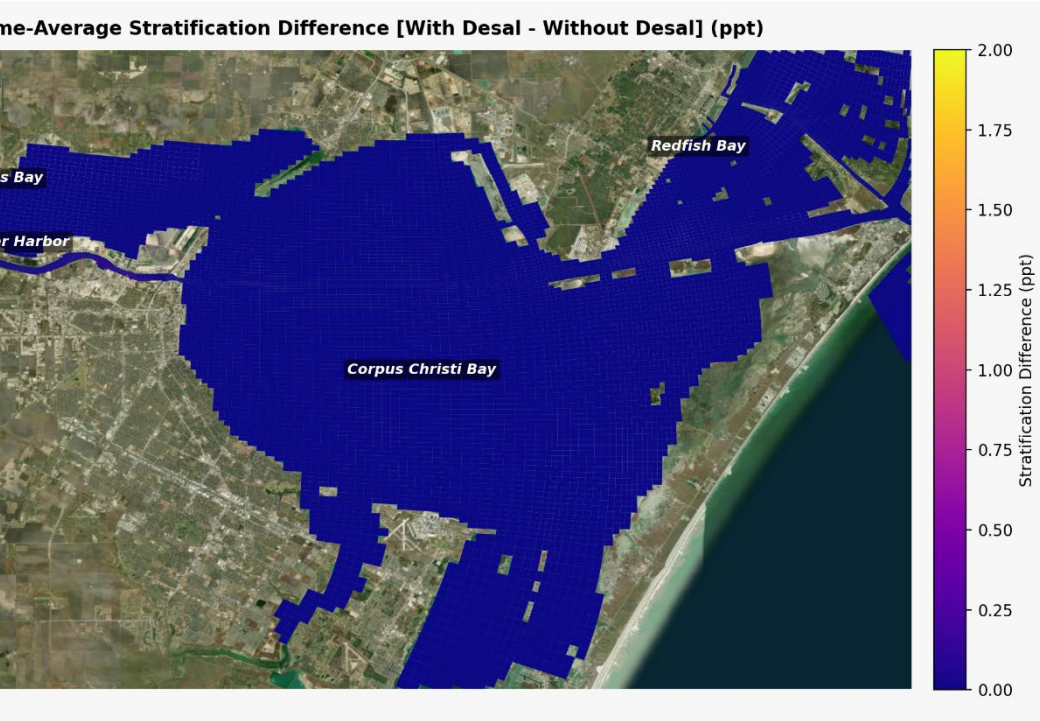
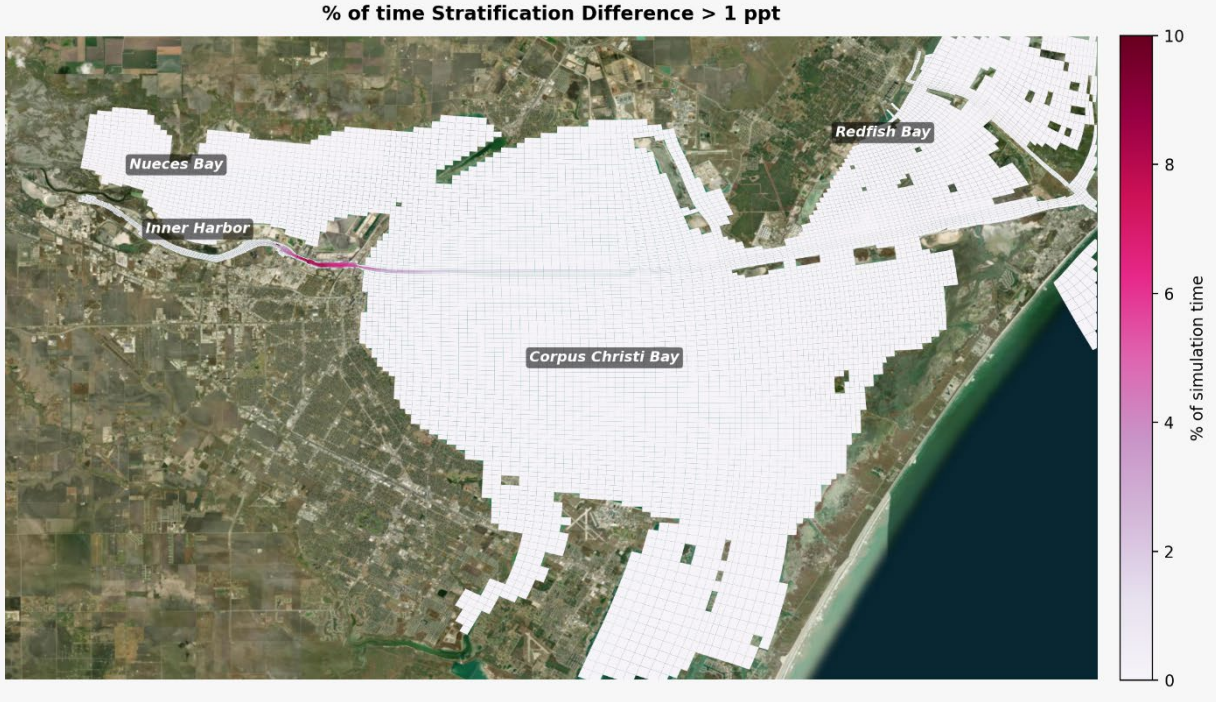
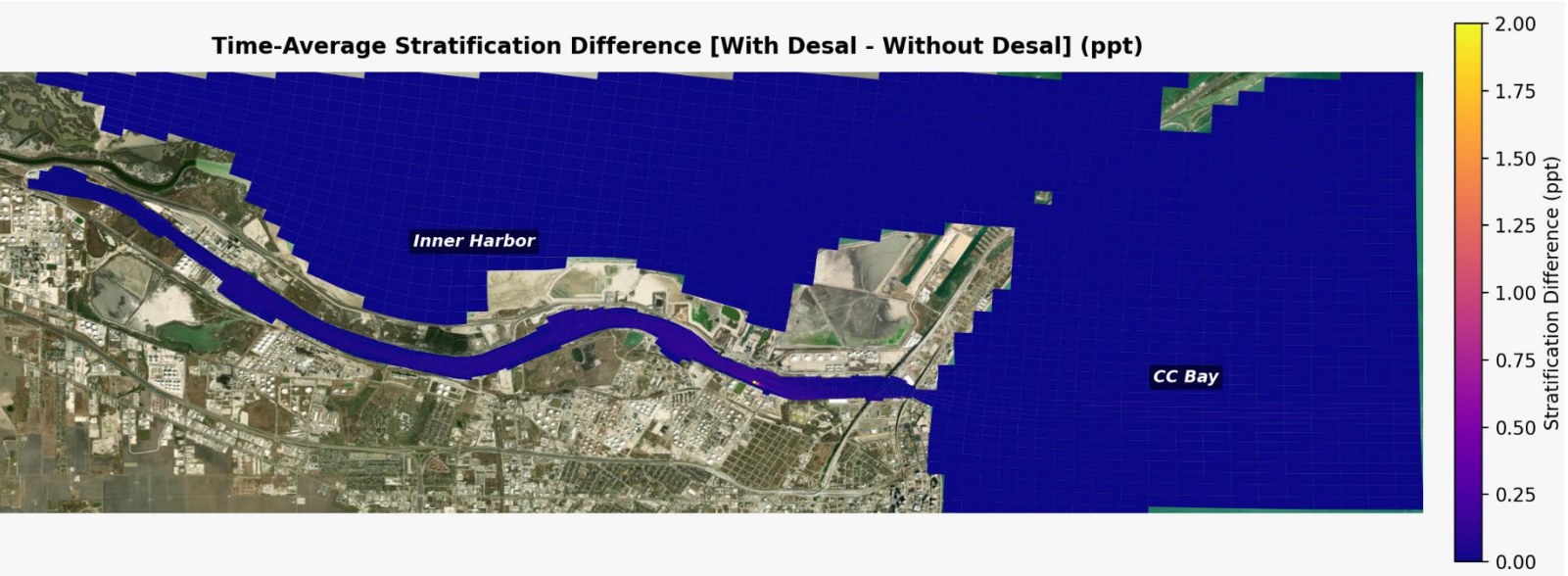
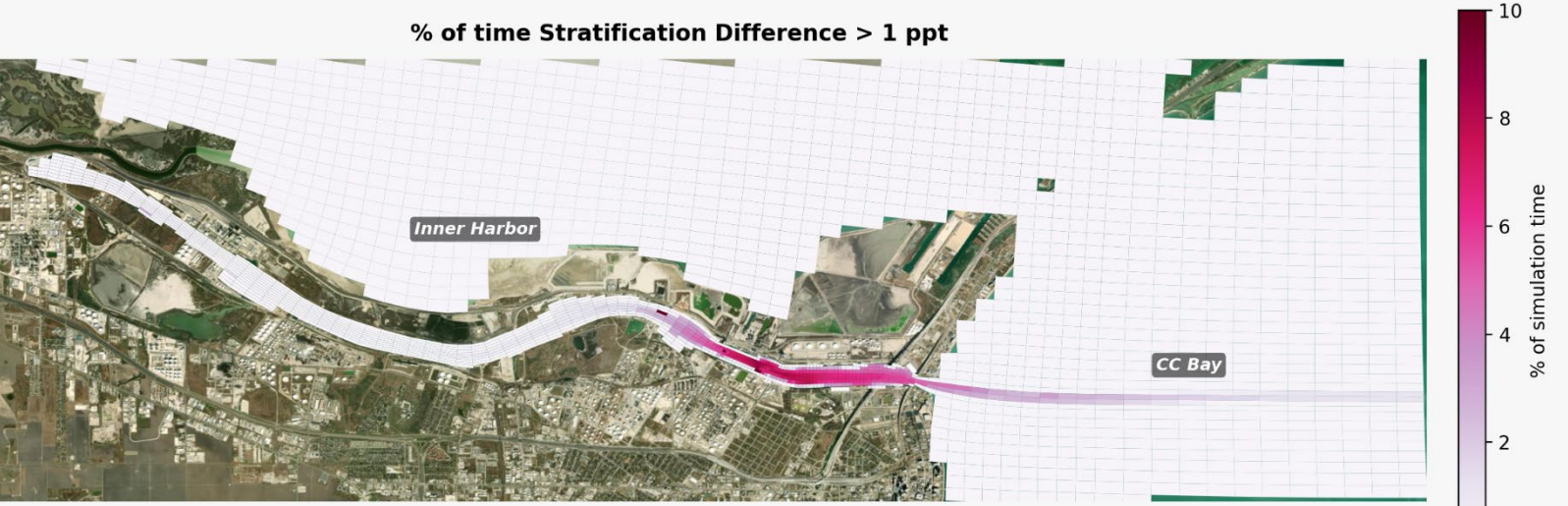
atification Changes: Hypothetical Worst Case





atification Changes: Hypothetical Worst Case – ner Harbor



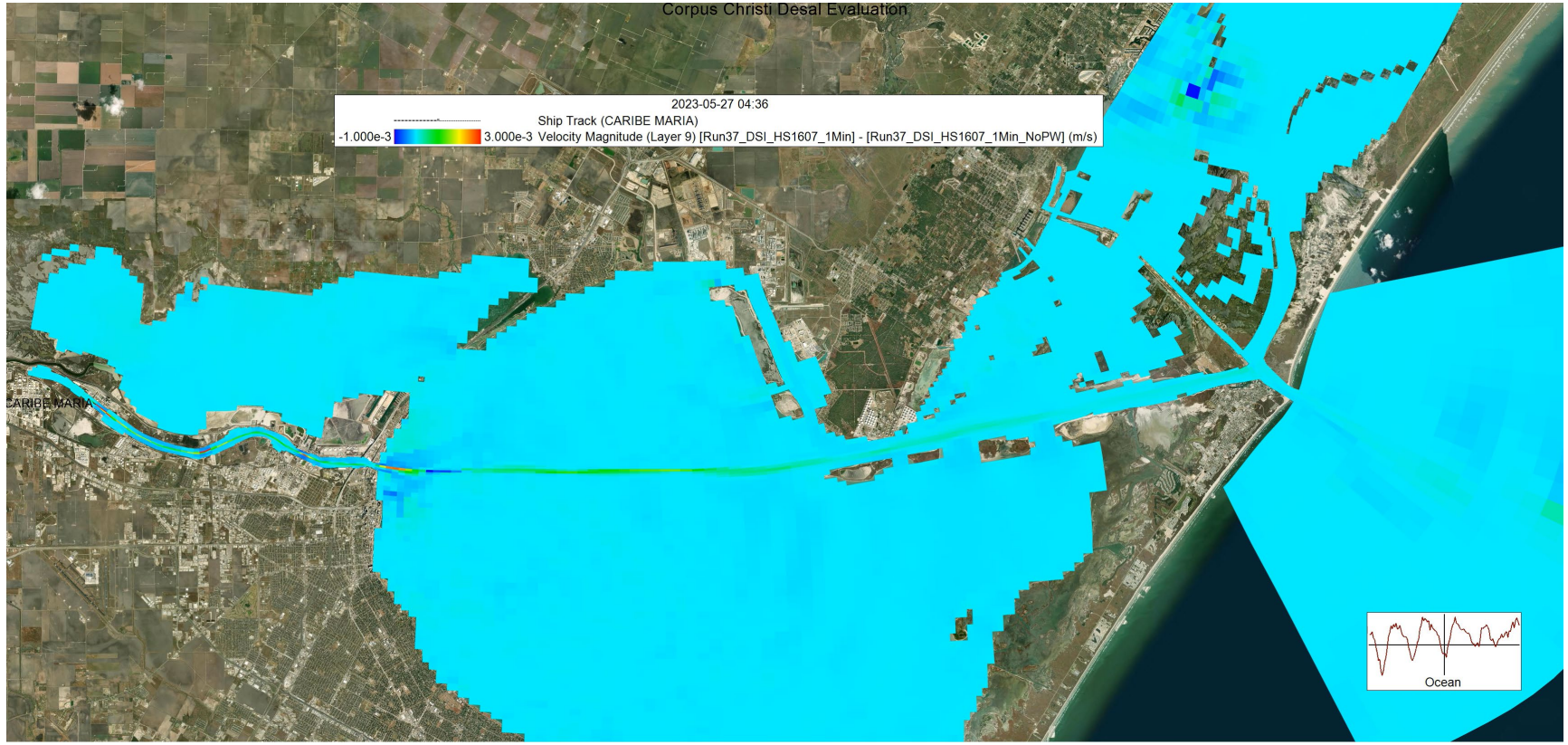


ndings from Ship Traffic Simulations

edicted changes in locities are small

linities are comparable th and without ship ffic

- Mixing effect not apparent
- Probably an artifact of the assumptions used (one ship in and out)



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ndings Summary

D far-field modeling shows that introduction of desalination discharge into
he Inner Harbor may increase daily stratification locally by up to 2 ppt

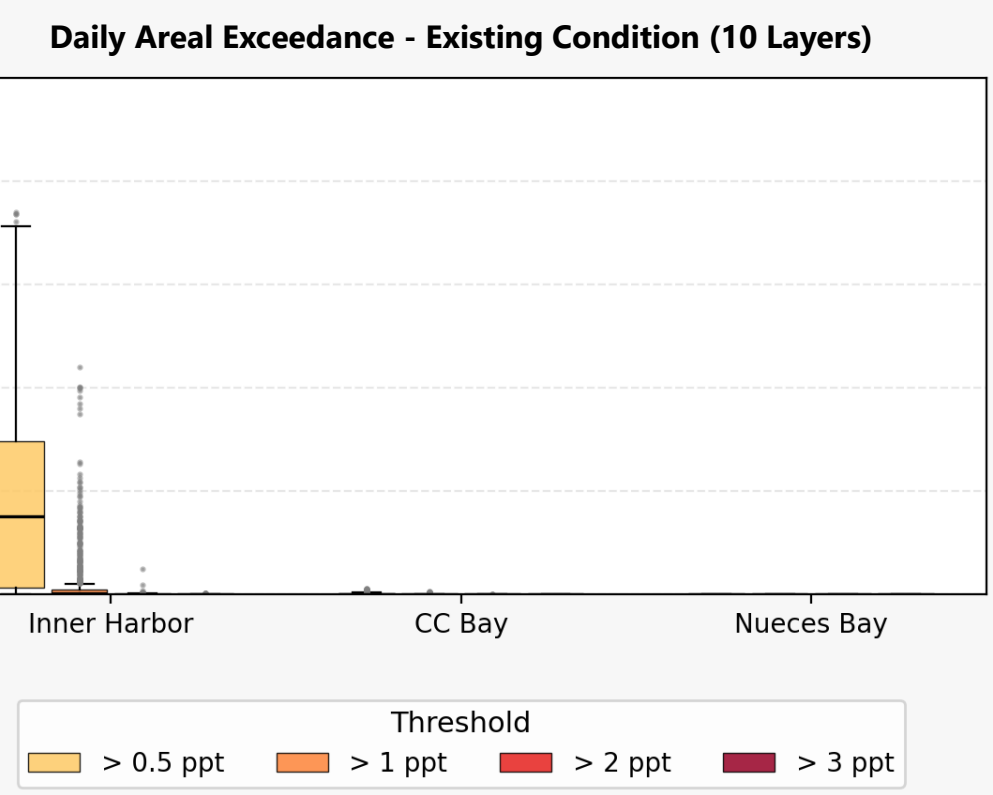
- Changes to stratification events dissipate due to tides and other environmental conditions over time scales of 2 weeks to 1 month

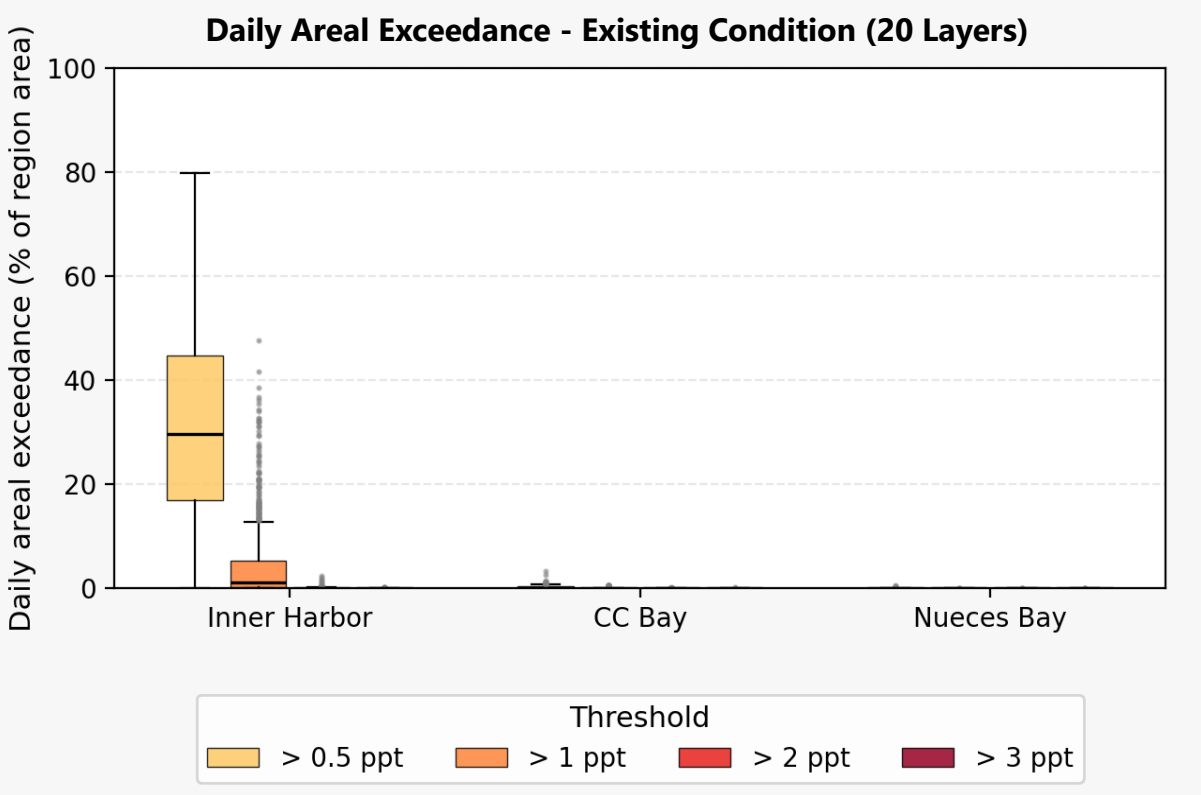
utside of Inner Harbor and Corpus Christi Channel stratification changes are
enerally less than 0.5 ppt

O was not modeled in this study – however, these findings suggest risk of
esalination discharge exacerbating DO deficits in areas outside of the Corpus
hristi Channel and Inner Harbor appear to be minimal

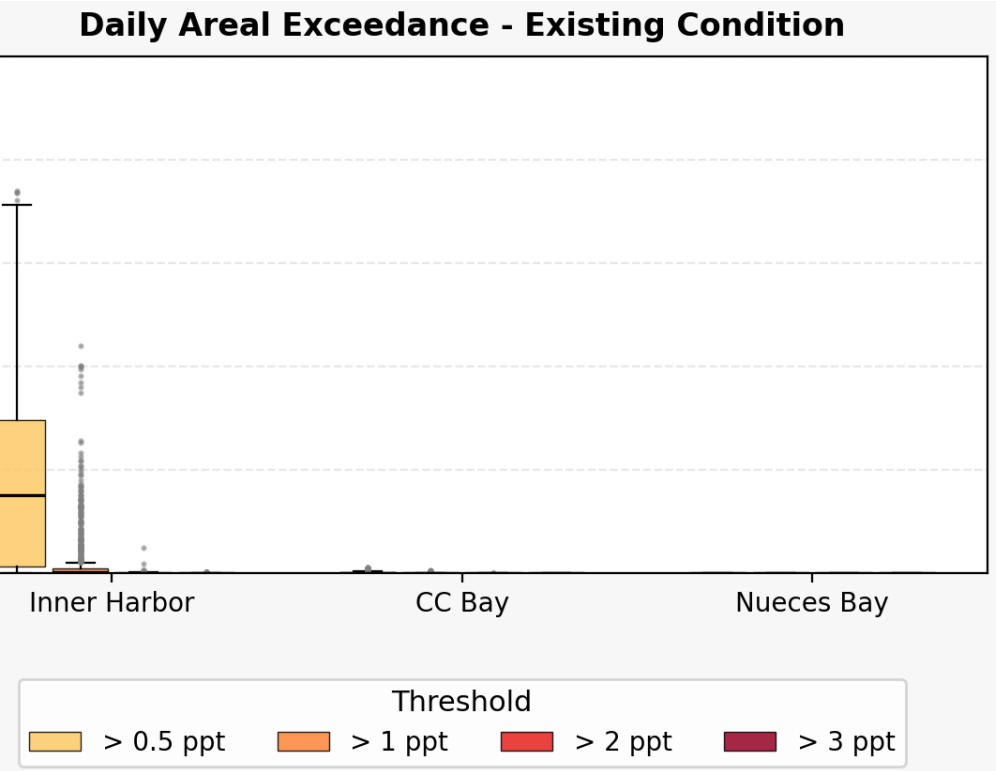
SPHEROS

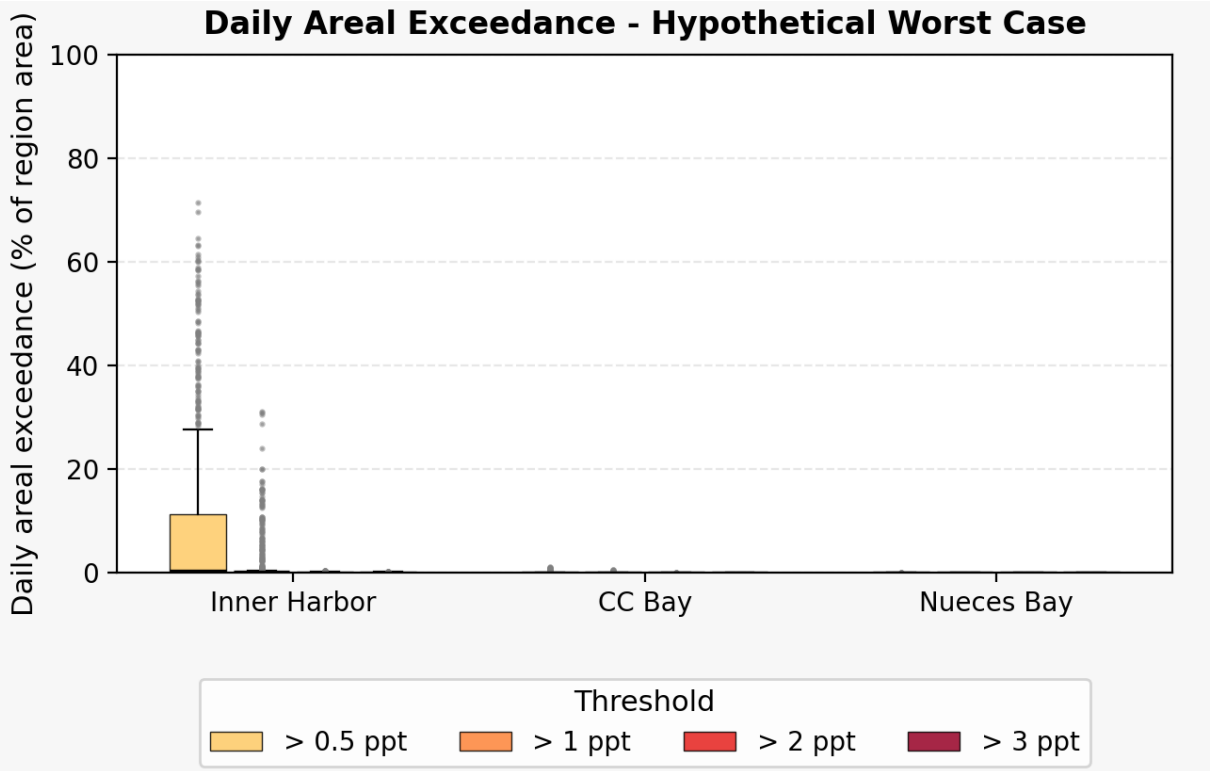
dings Do Not Change with Increased Vertical solution





dings Do Not Change under Hypothetical Worst se Scenario





hank you

Spheros Environmental appreciates the opportunity to support the City and collaborate with the Far Field Advisory Committee on this important project

CITY OF CORPUS CHRISTI

CORPUS CHRISTI WATER