Little Egbert Multi-Benefit Project

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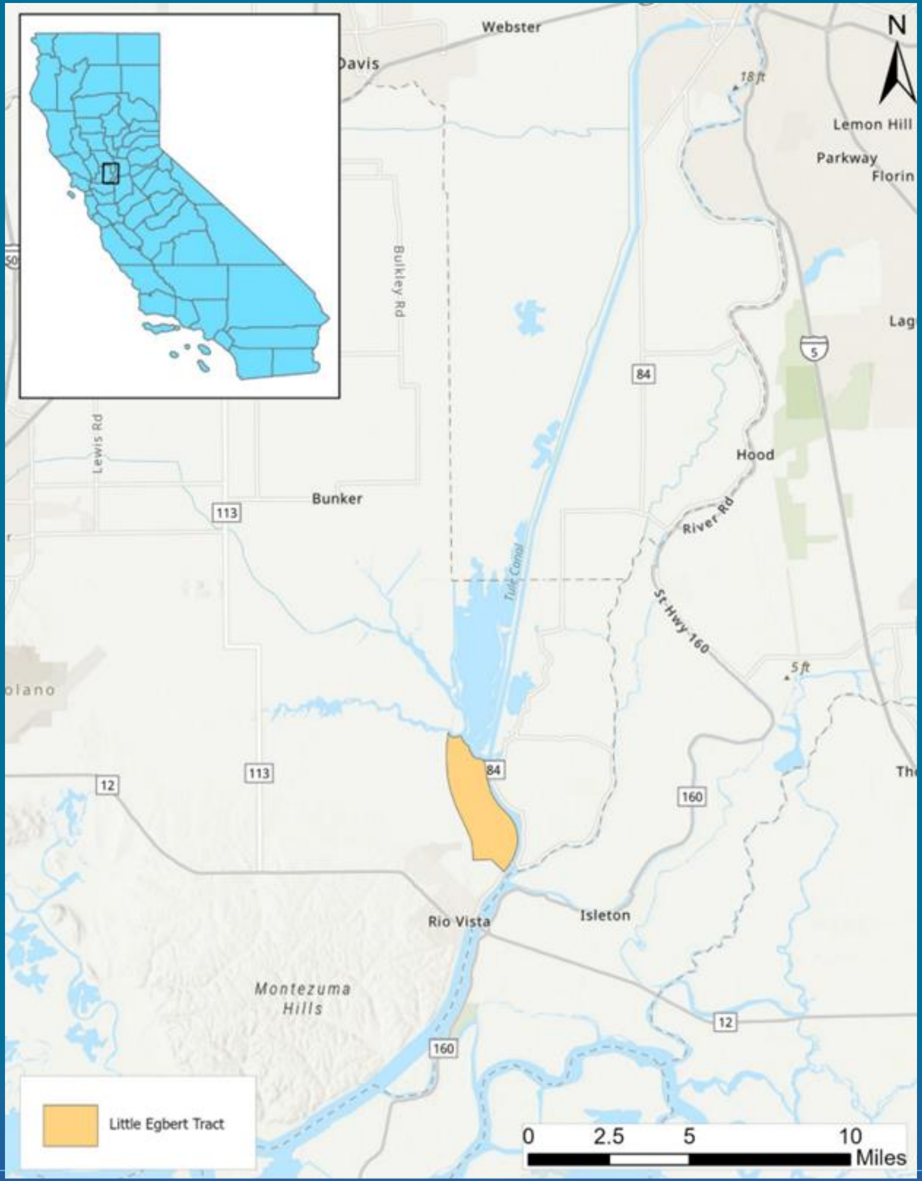
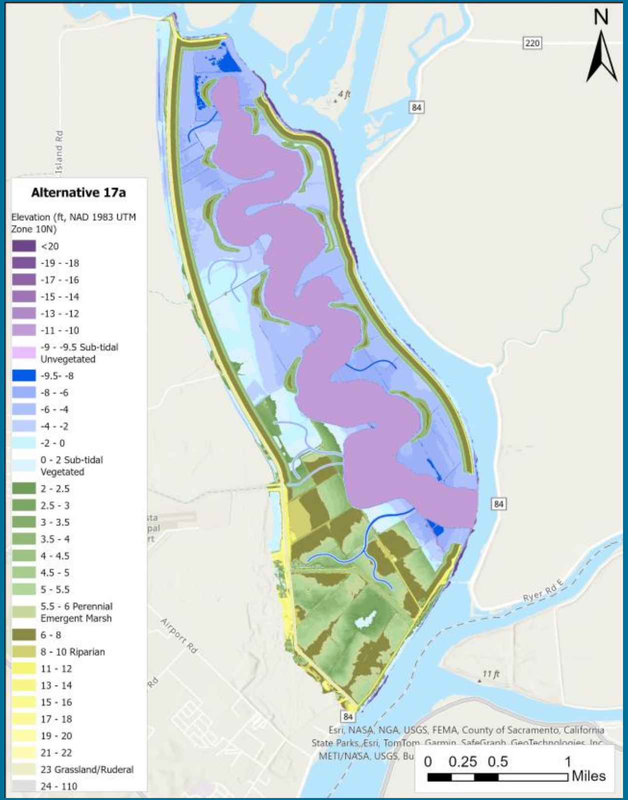
Project Location and Objectives

- Little Egbert Tract (LET) is located immediately to the north of Rio Vista, California in the Sacramento–San Joaquin River Delta.
- LET was historically tidal marsh prior to diking and draining for agriculture.
- The Eastern restricted height levee established in 1968 has historically been breached twice (in 1968 and 1997)
- Current efforts are focused on evaluating options for reintroducing tidal action to the tract. 4 alternatives considered for CEQA
- Project goals include flood risk reduction, habitat and species protection, protect opportunities for recreation, and promote regional agriculture

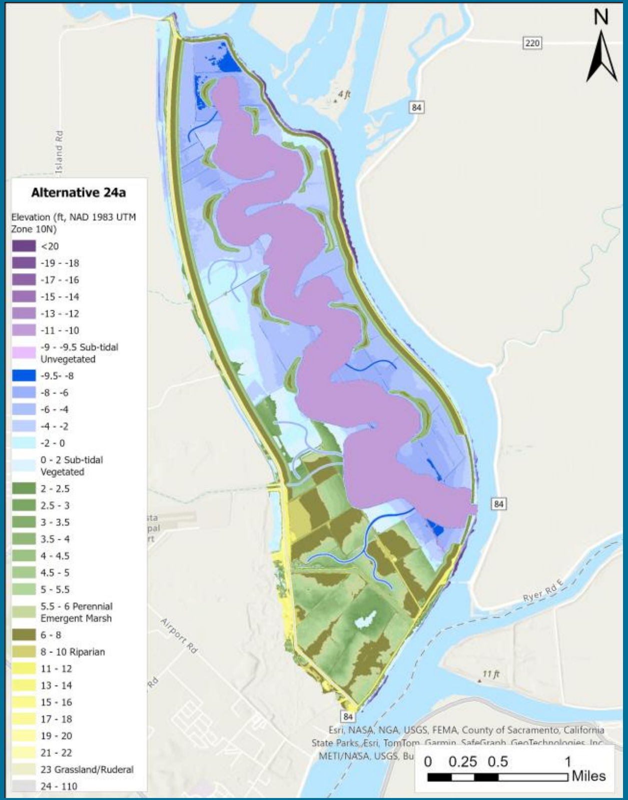


CEQA Alternatives

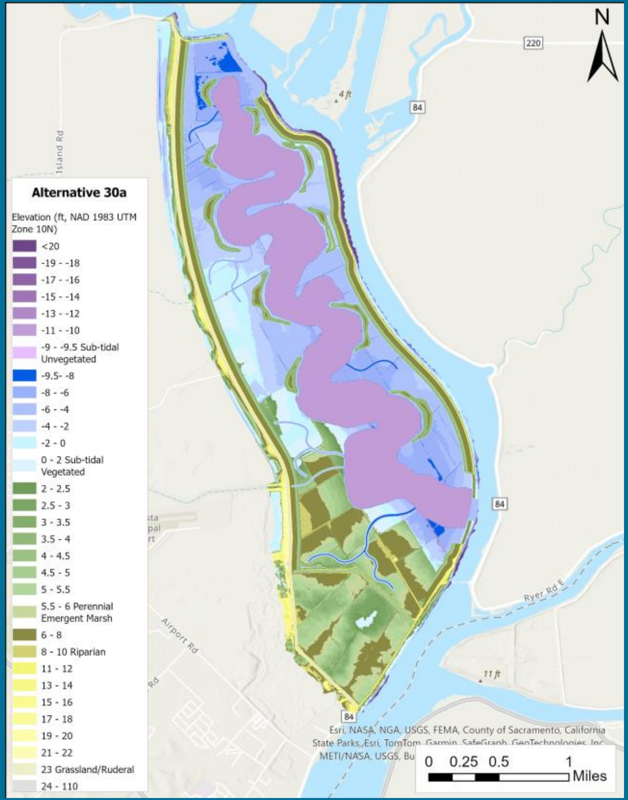
Alternative 17A



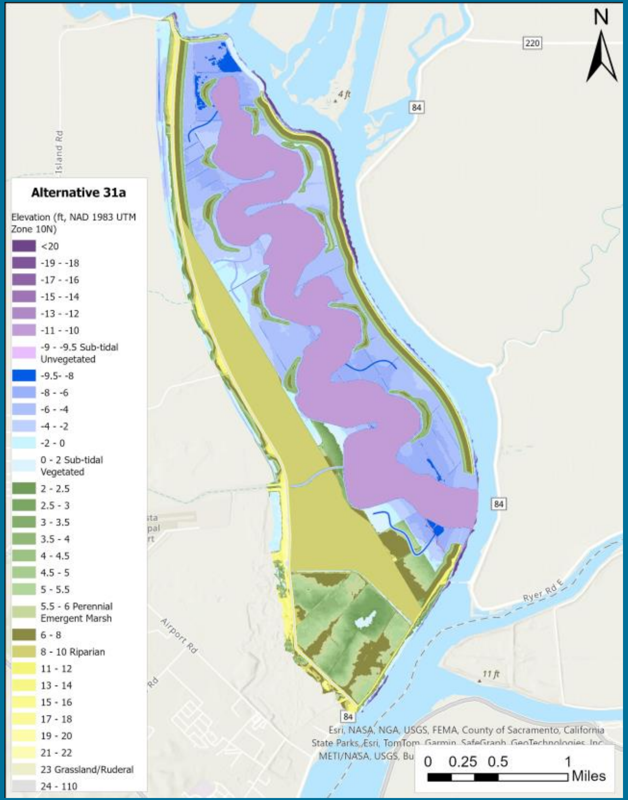
Alternative 24A



Alternative 30A



Alternative 31A



Common elements: Levee breaches at the north and south ends of Little Egbert Tract (different configurations), the meandering subtidal channel, habitat islands, habitat berms along the eastern and western levees

2 future without project (FWOP) conditions were also considered

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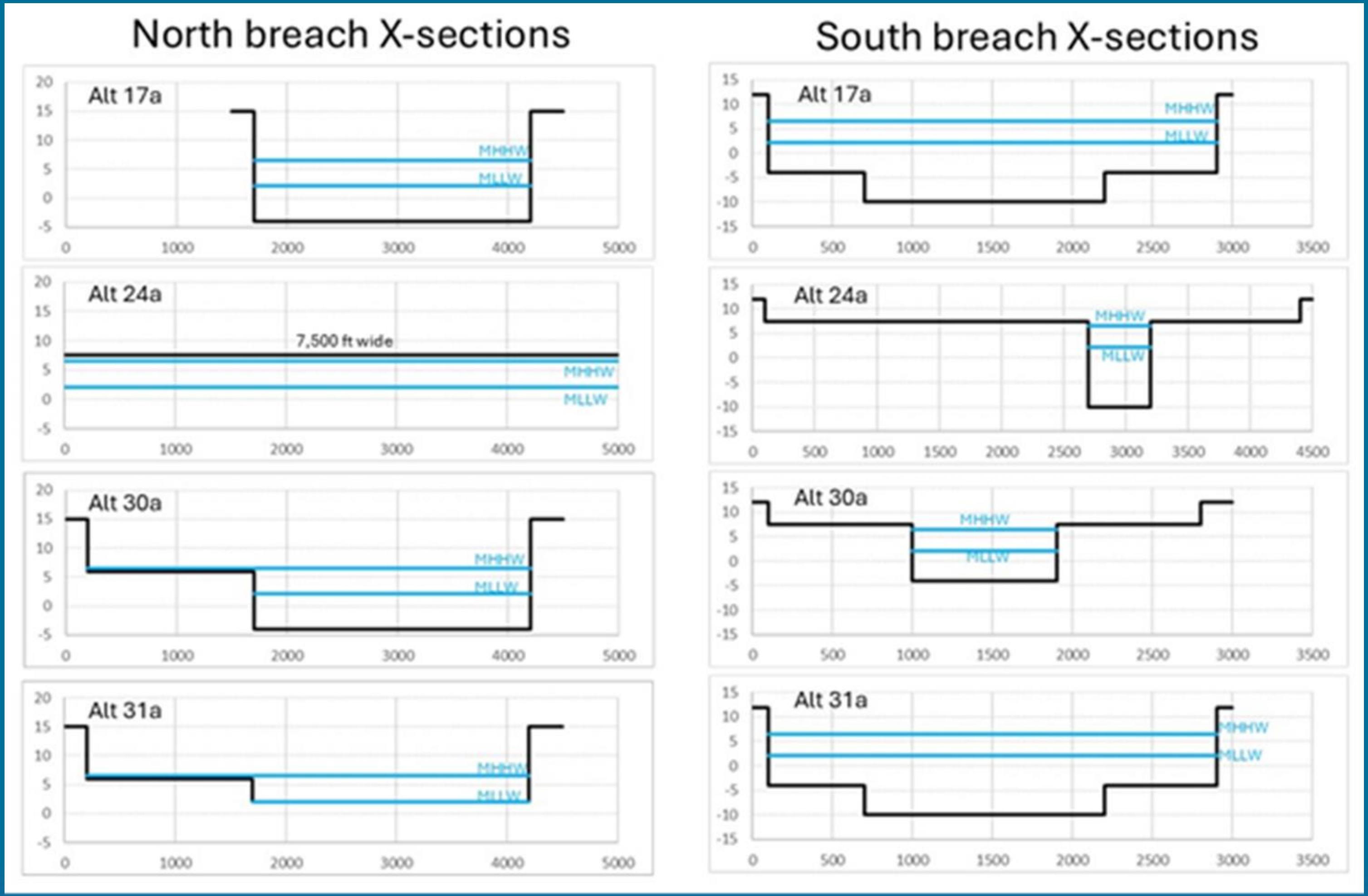
CEQA Alternatives – Breach Configurations



South Breach

- Alts 17A and 31A about 5X larger than 24A and 30A in the tidal elevation range
- 30A has higher invert (-4 ft)

North Breach

- Alts 17A and 30A about 4X larger than 31A in the tidal range
- Alt 31A muted with invert at MLLW
- Alt 24A invert above MHHW – disconnected from tides

The Delft3D Flexible Mesh Suite (Delft3D FM) allows you to simulate the interaction of water, sediment, ecology, and water quality in time and space. The suite is mostly used for the modelling of natural environments like coastal, estuarine, lakes and river areas, but it is equally suitable for more artificial environments like harbours, locks, urban areas, etc. Delft3D FM consists of a number of well-tested and validated modules, which are linked to and integrated with each other.

D-Flow Flexible Mesh
D-Flow Flexible Mesh (D-Flow FM), as the successor of Delft3D-FLOW and SOBEK-FLOW, is capable of handling curvilinear grids that provide very good performance in terms of computational speed and accuracy. In addition to this, the grid may also consist of...

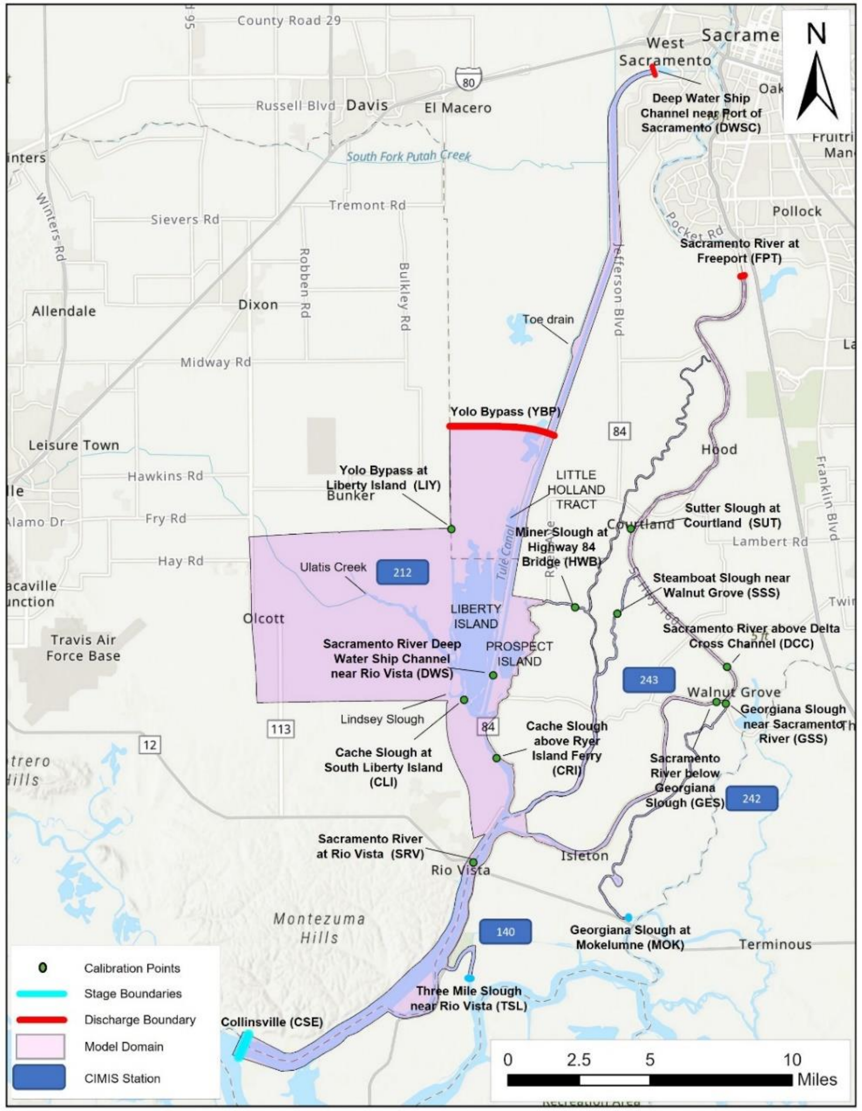
D-Waves
D-Waves, as the successor of Delft3D-WAVE, computes the non-steady propagation of short-crested waves over an uneven bottom, considering wind action, energy dissipation due to bottom friction, wave breaking, refraction (due to bottom topography, water levels and flow fields), shoaling and...

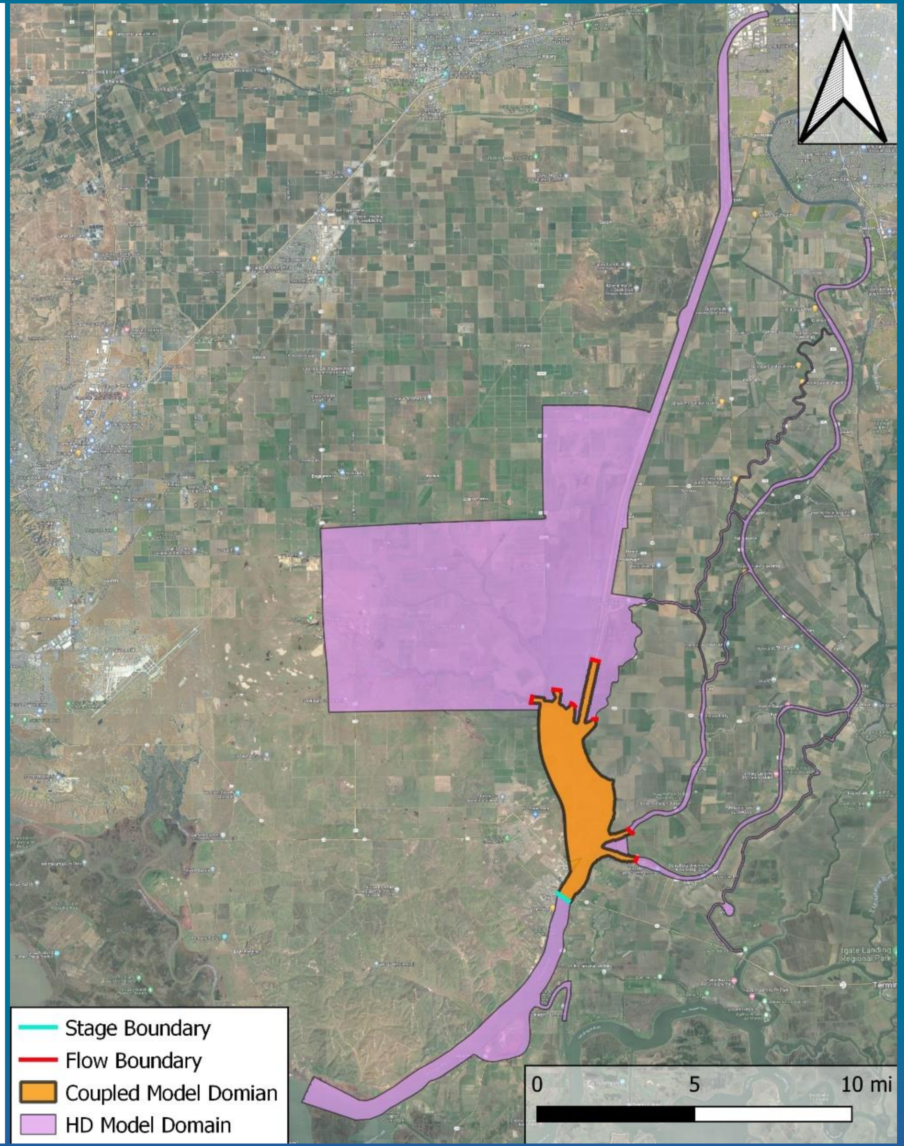
D-Morphology
The D-Morphology module, as the successor of Delft3D-MOR and SOBEK-MOR, computes sediment transport (both suspended and bed total load) and morphological changes for an arbitrary number of cohesive and non-cohesive fractions. Both currents and waves act as driving forces and...

Delft3D was chosen because it can do unsteady hydrodynamics, waves, sediment transport, and morphology

Applied in 2D depth-averaged mode

In-house particle tracking (PT) developed in Program R





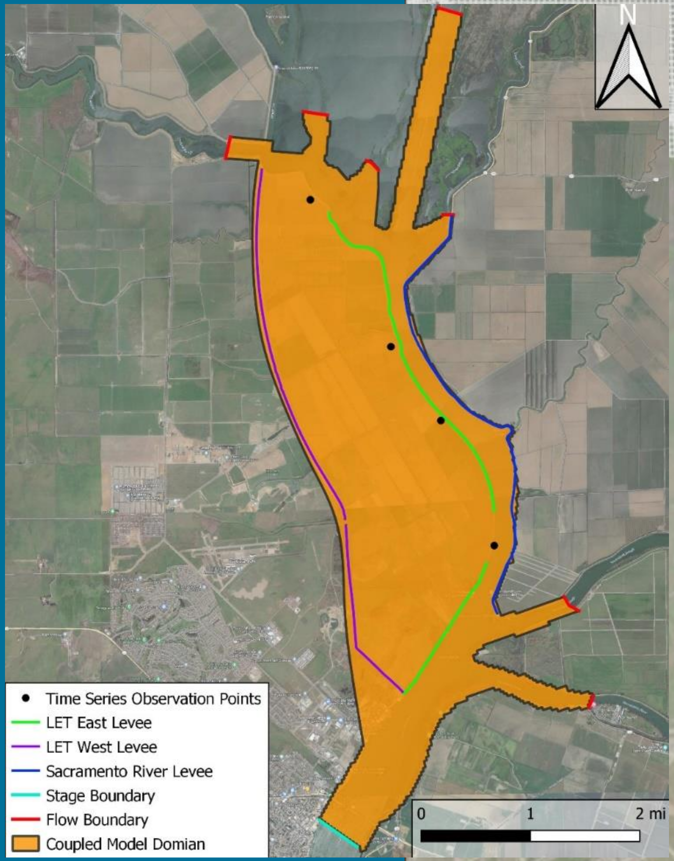
Modeling Periods & Truncated Model

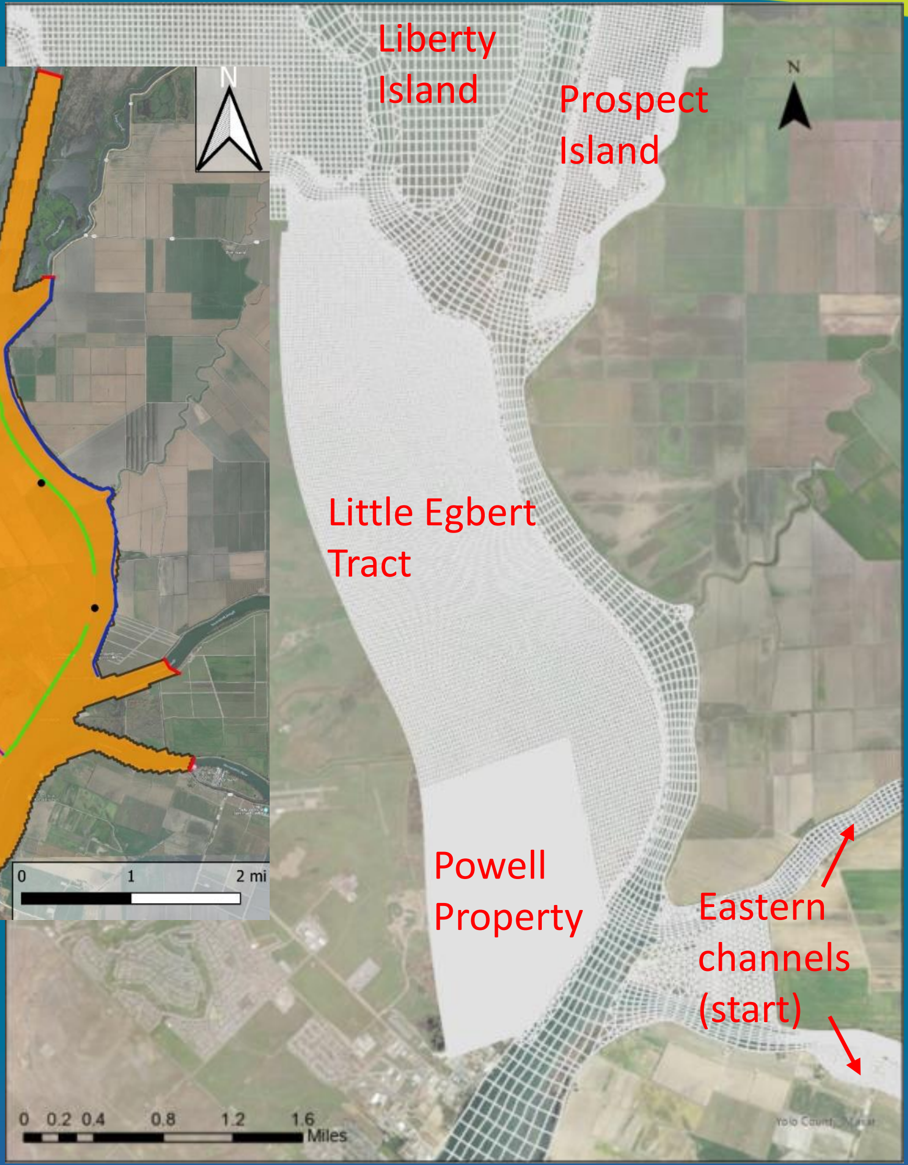
Flow Conditions	Period of Simulation	Purpose
Tidal	April 15 to May 15, 2016	Simulate typical tidal conditions with low upstream inflows to the Delta.
First flush	December 1, 2014 to January 10, 2015	Simulate an early season runoff with high sediment concentrations.
2017 flood	February 1 to March 3, 2017	Simulate high flow conditions from the Yolo Bypass and Sacramento River.
100-yr event	February 15, 1986 to February 22, 1986	Model 100-yr event with high flow conditions

Spatially varying resolution/

Flexible mesh in complex geometries

- LET (~25x30m)
- Powell Property (~11x9m)
- Eastern channels (~10x15m to 30x50m)
- Prospect Island (~45x45m)
- Liberty Island (~20x40m to 25x85m)

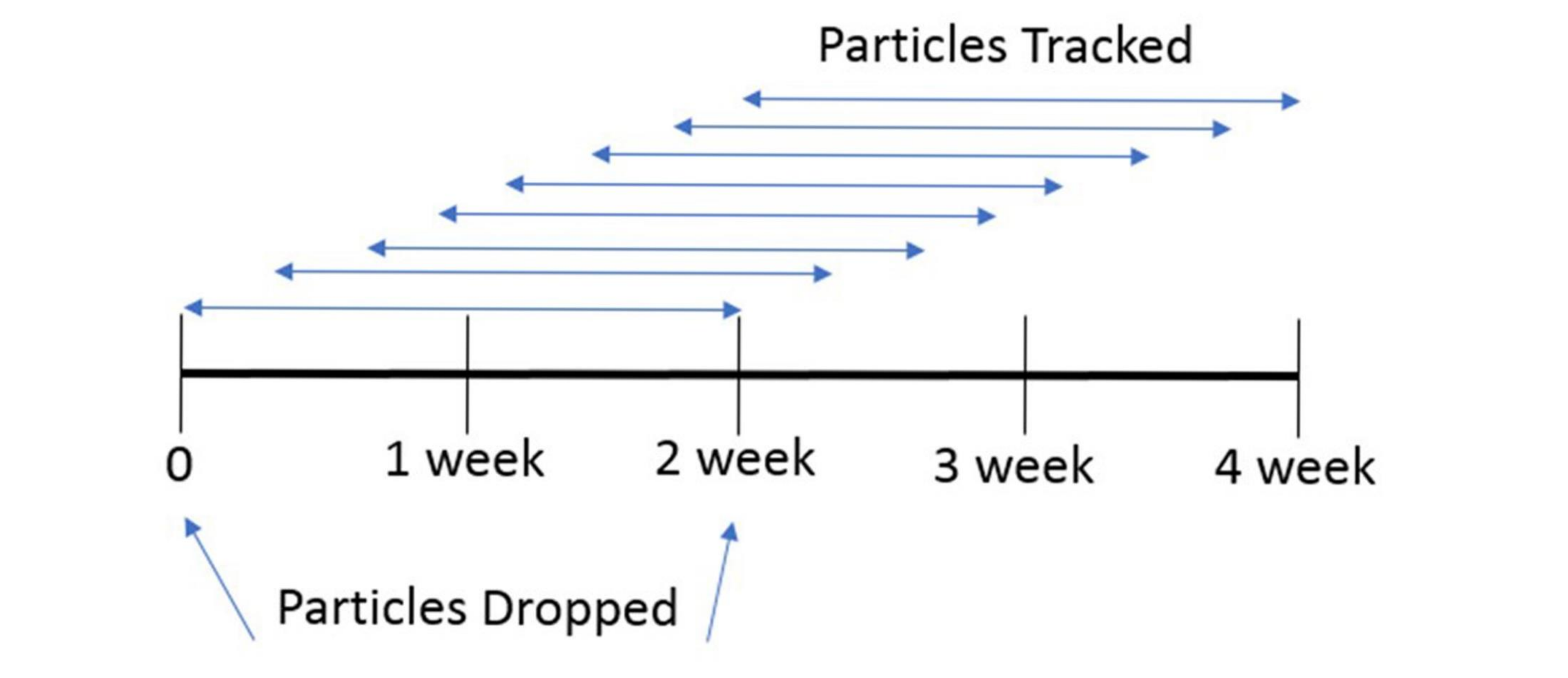




Particle Tracking Model

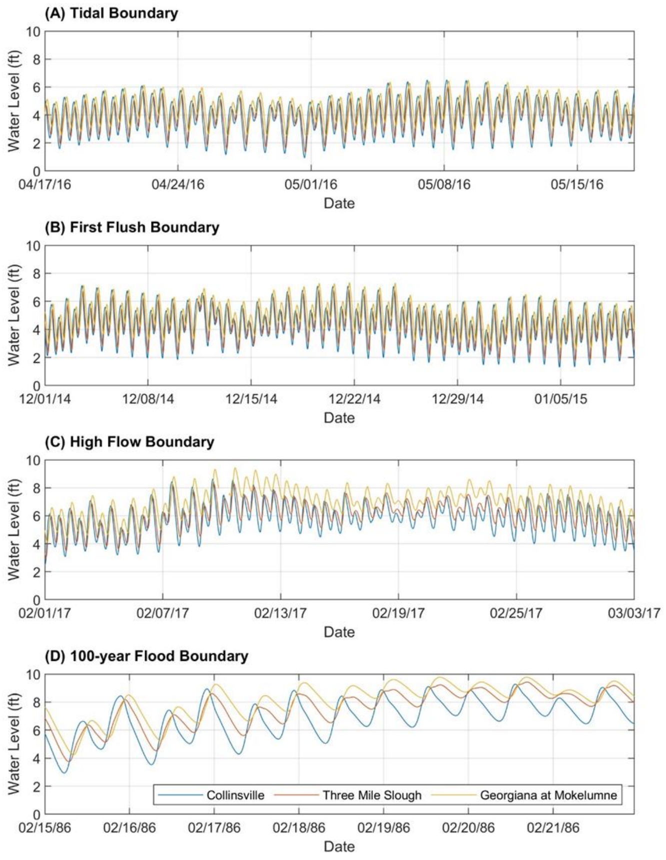
PTM was run for the tidal conditions to assess exposure/residence times

Tract seeded with particles for 2 weeks, tracked throughout simulation

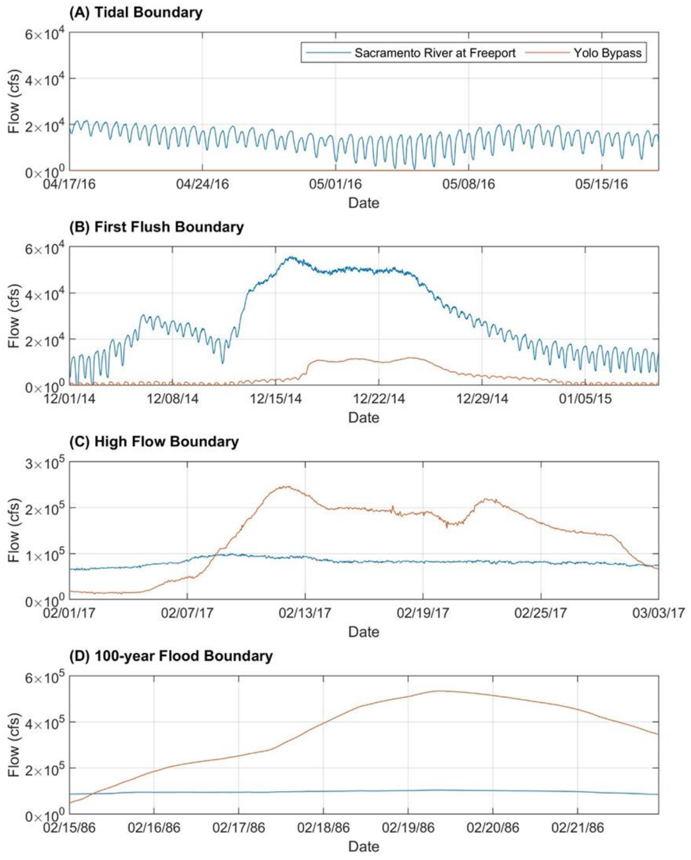


Model Boundaries

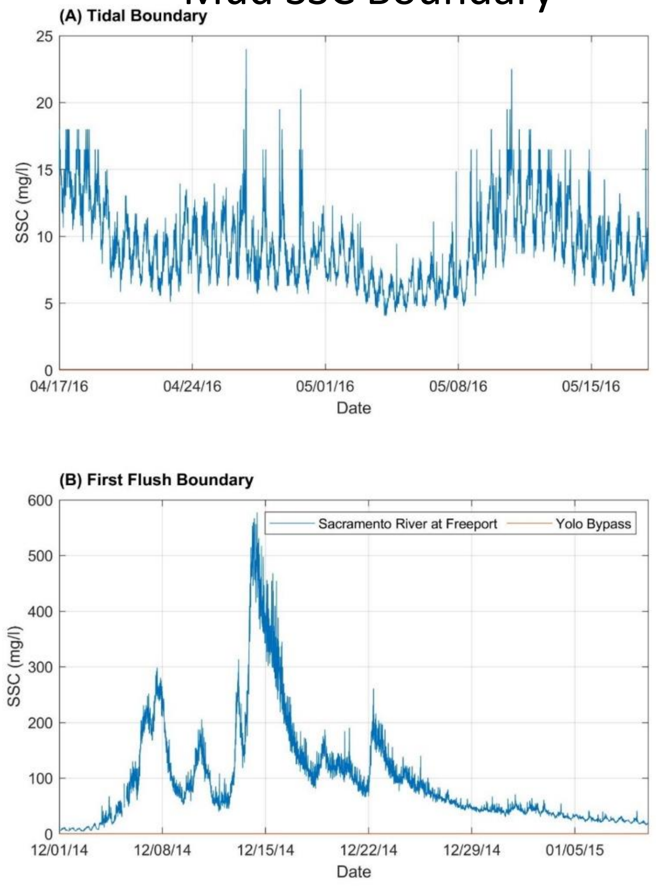
Stage Boundary



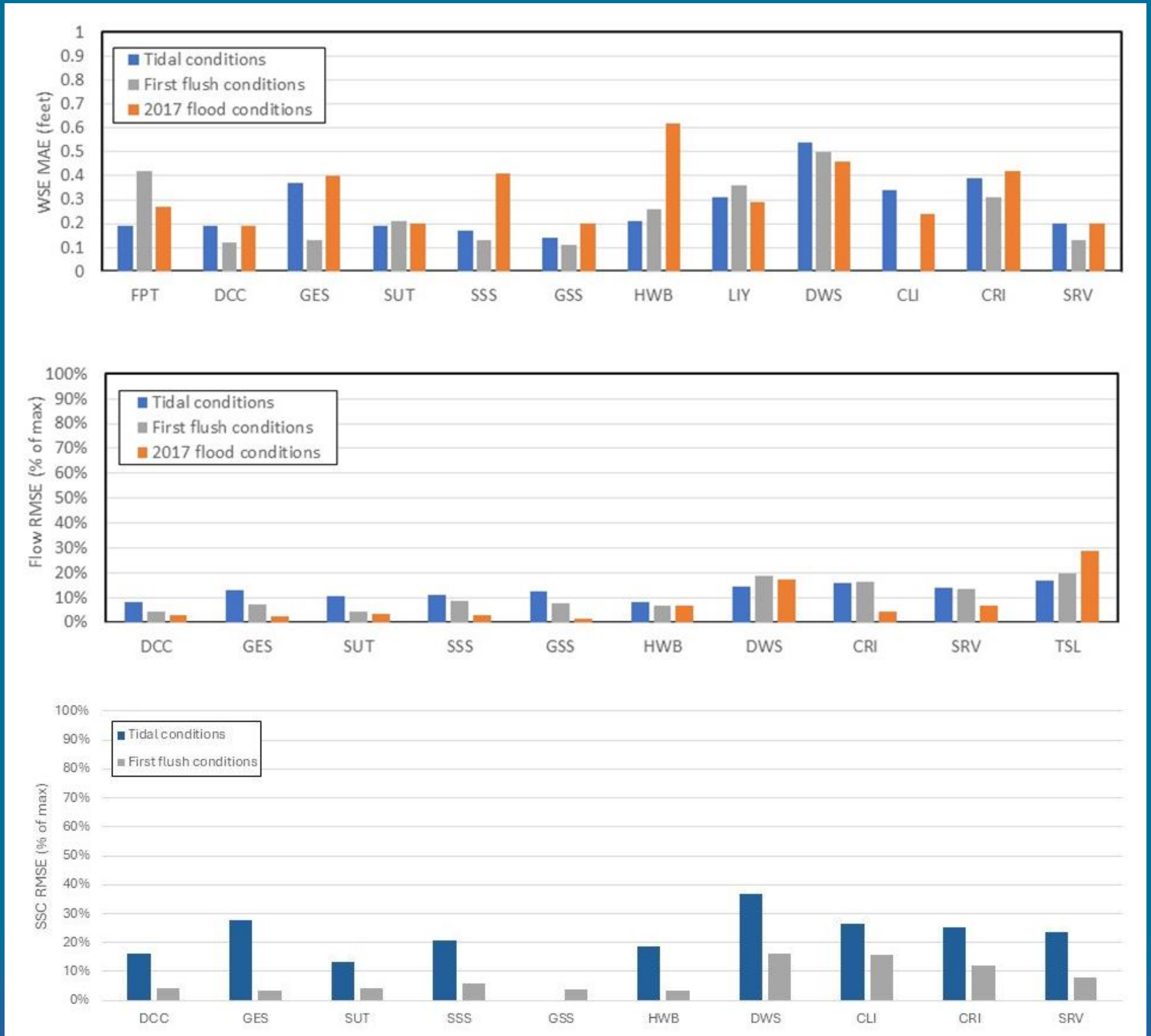
Flow Boundary



Mud SSC Boundary



Model Calibration Summary



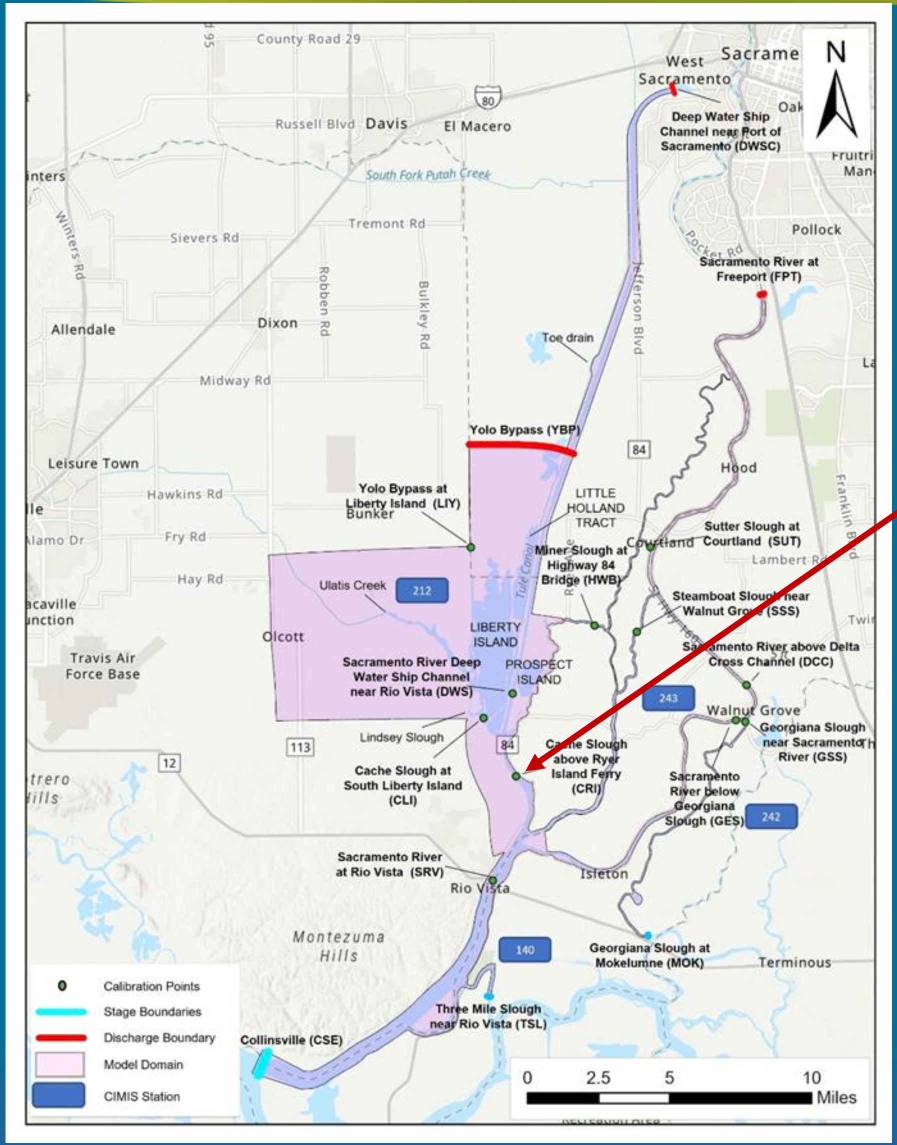
Mean water level errors typically less than 0.5 feet

Discharge errors typically less than 10-20% of max discharge

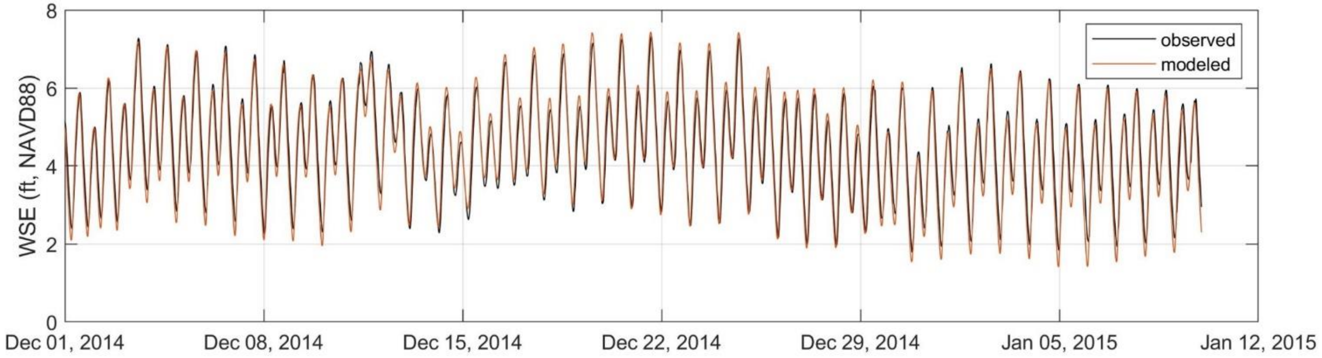
Mean SSC errors were typically 10-30% of max SSC for first flush and tidal conditions

This is good agreement for a sediment model

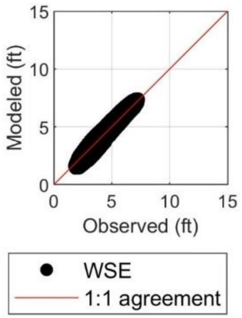
Model Calibration, WSE



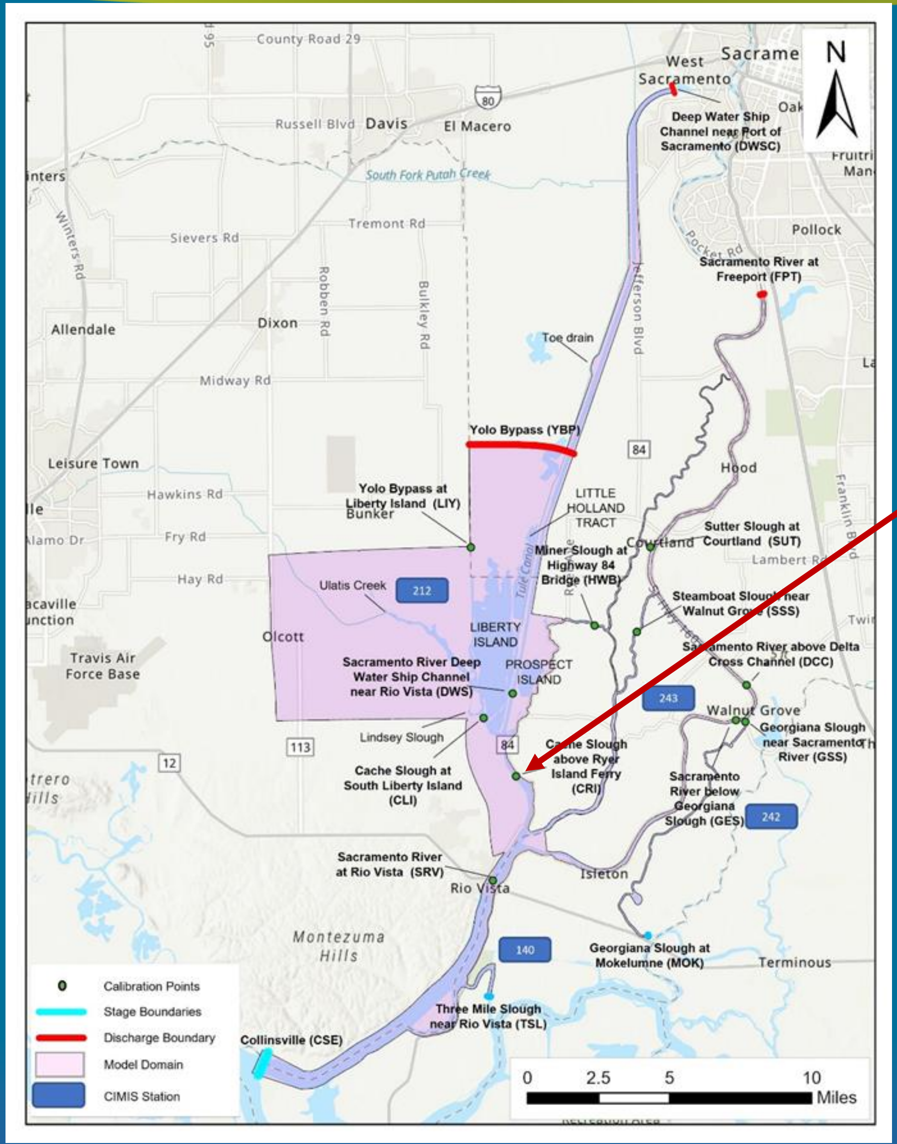
Calibration was achieved by adjusting bed roughness values across the model domain



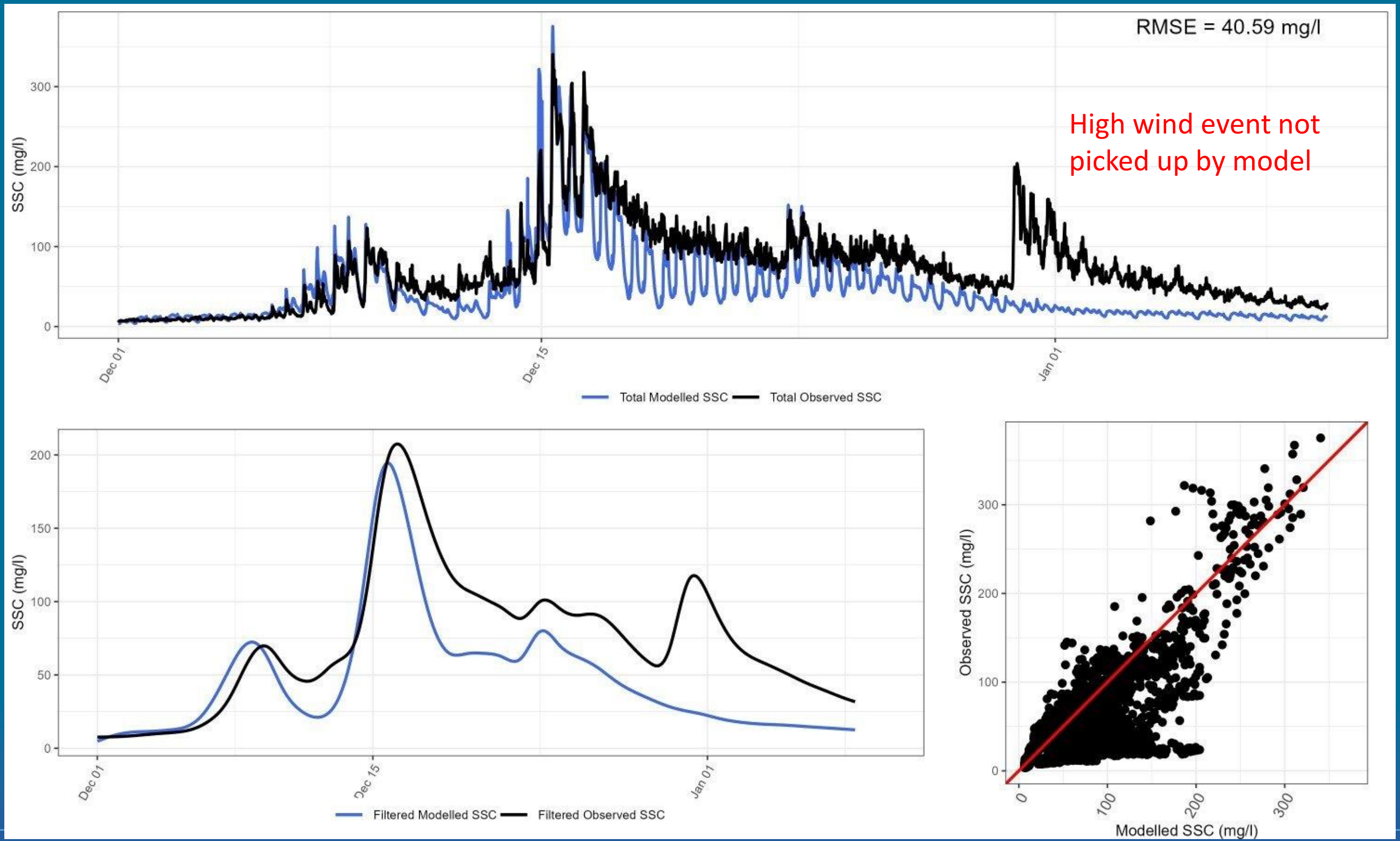
Constituent	Model Amplitude (ft)	Observed Amplitude (ft)	Amplitude Difference (ft)	Model Phase (deg)	Observed Phase (deg)	Phase Difference (deg)
M2	1.33	1.25	0.08	352	9	17
K1	0.98	0.94	0.04	312	320	-8
O1	0.35	0.36	-0.01	307	313	-7
MSF	0.22	0.27	-0.05	353	360	-7
N2	0.18	0.15	0.03	330	356	-26
S2	0.18	0.15	0.03	10	24	-14



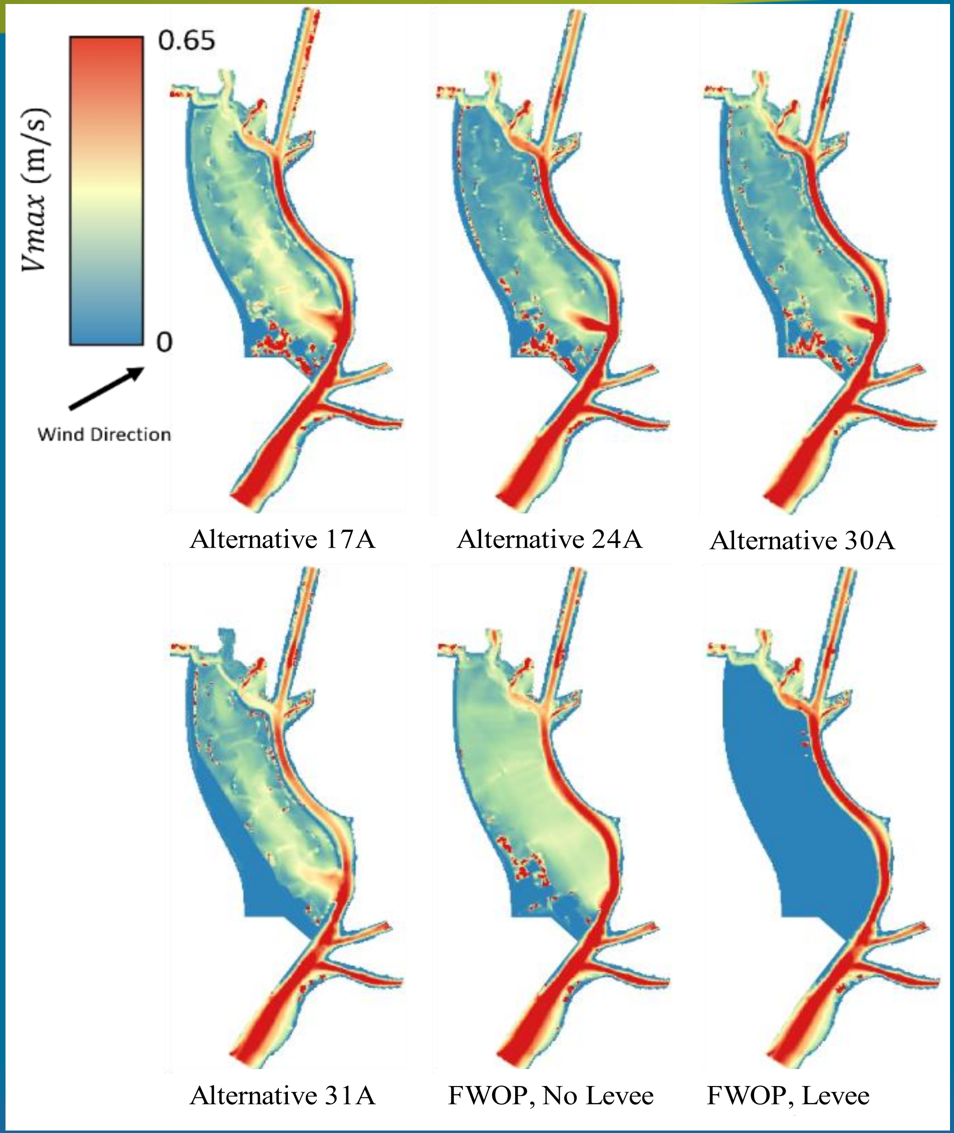
Model Calibration, SSC



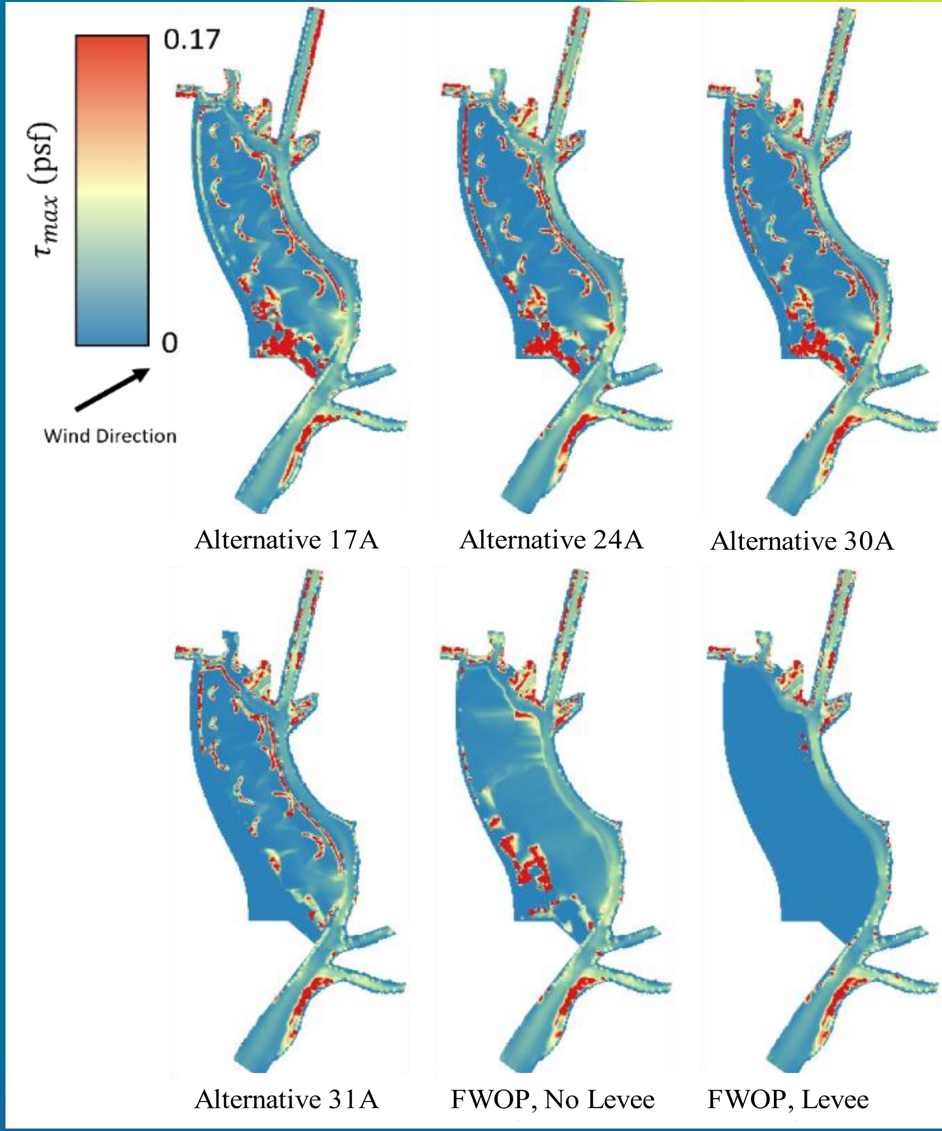
- 2 sediment size-fractions modeled (sand and mud)
- Calibration achieved by adjusting initial bed fractions, settling velocities, and critical shear stresses for erosion and deposition
- First flush hydrologic condition was chosen because of high concentration sediment pulse moving through the model domain



- Alternatives 17A and 31A experience the highest velocities within the tract
- The largest breaches allow the most flow through the tract
- Maximum stresses occur on the habitat islands and habitat berms
- Stresses on features are similar across Alternatives



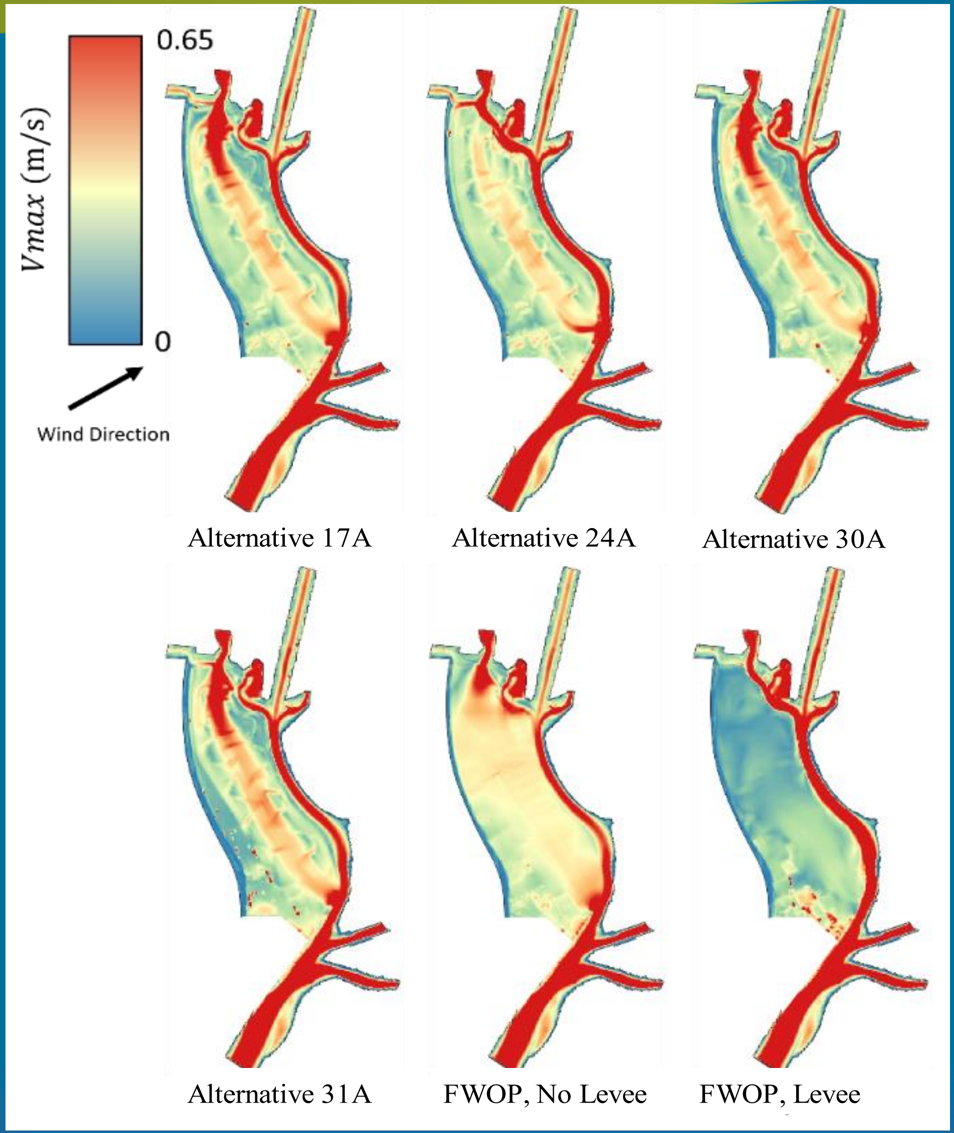
Maximum velocities for tidal conditions (240deg)



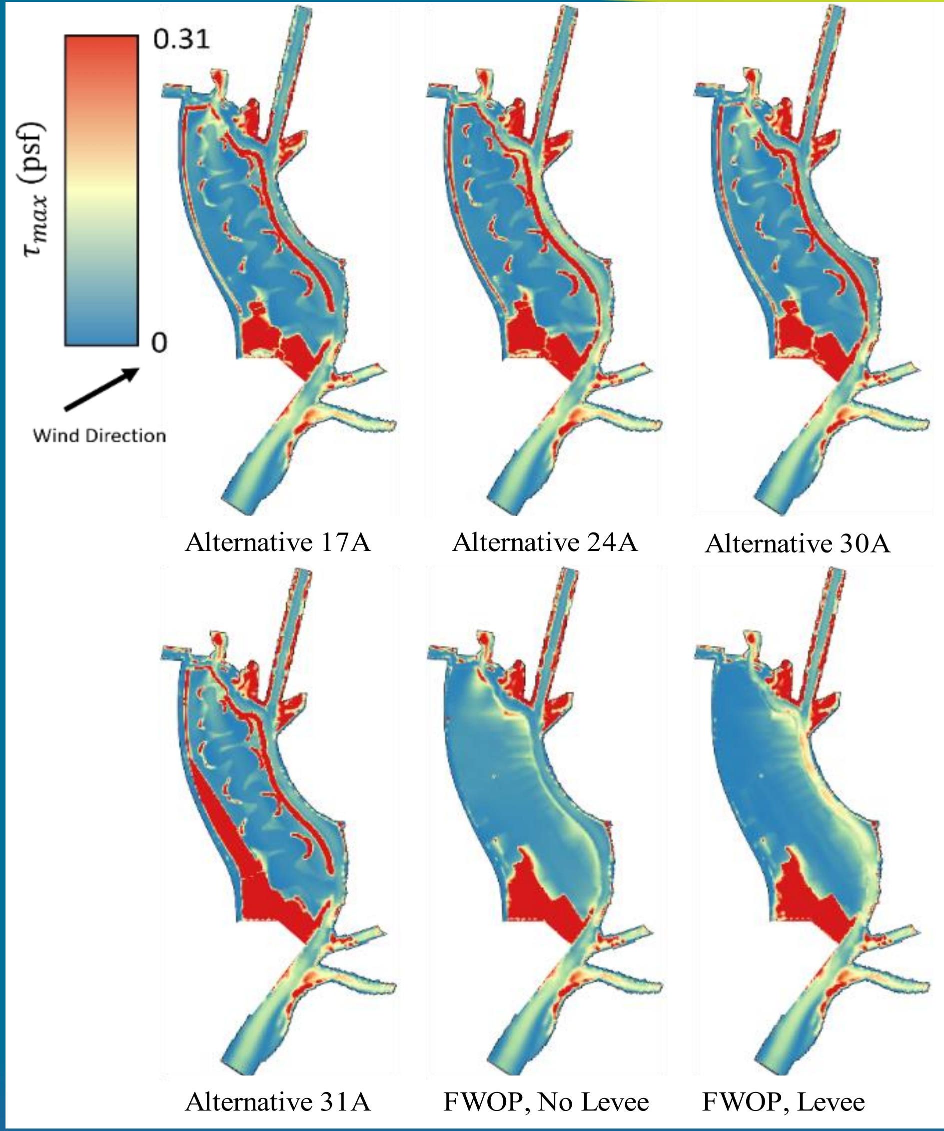
Maximum shear stresses for tidal conditions (240deg)

Model Results: Hydrodynamics

- Greater velocities in tract under 100-yr conditions
- Stresses are also more extreme under 100-yr conditions



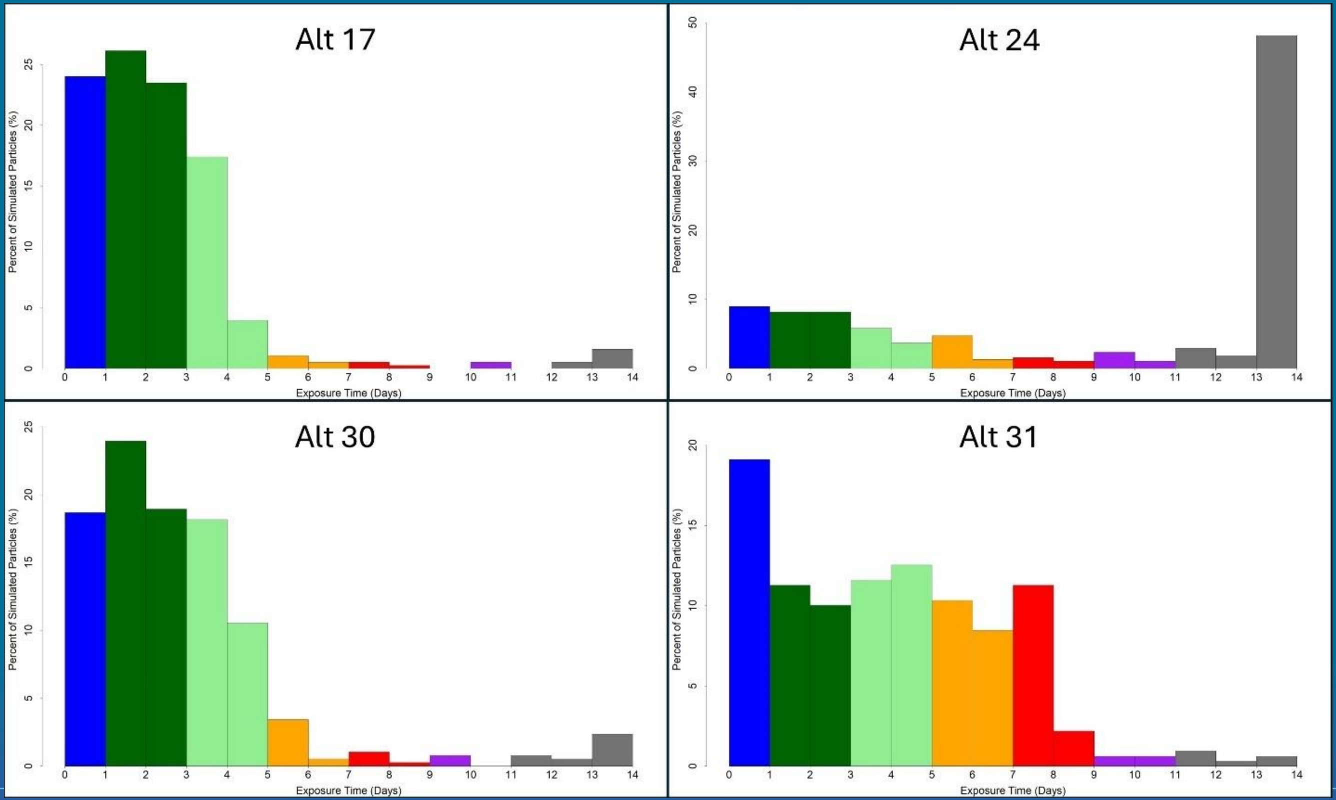
Maximum velocities for 100-yr conditions (240deg)

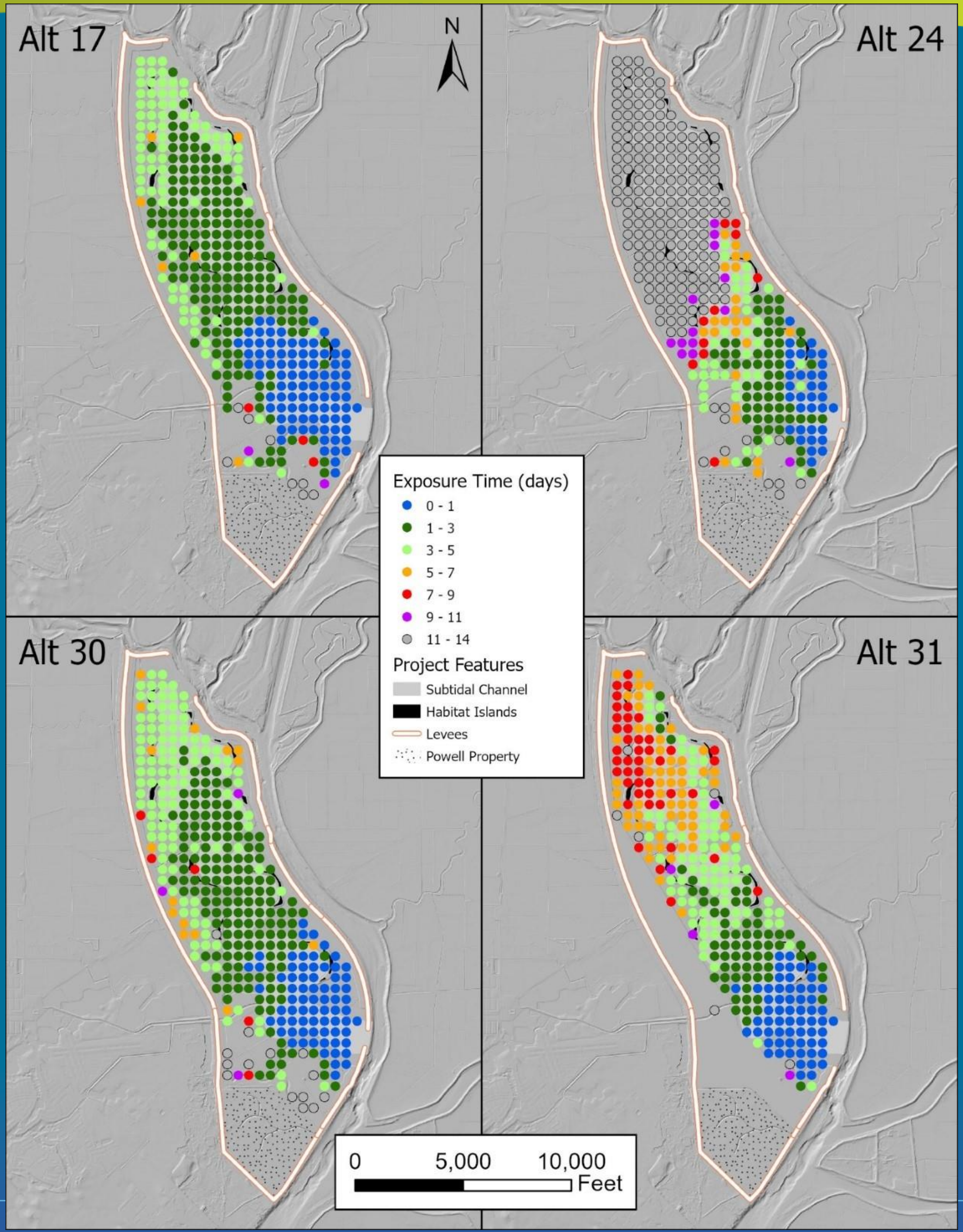


Maximum shear stresses for 100-yr conditions (240deg)

Model Results: Mixing and Exposure Time

Results from the PT model show that alternatives with the largest breach cross sections exhibit the most mixing and the shortest exposure times.





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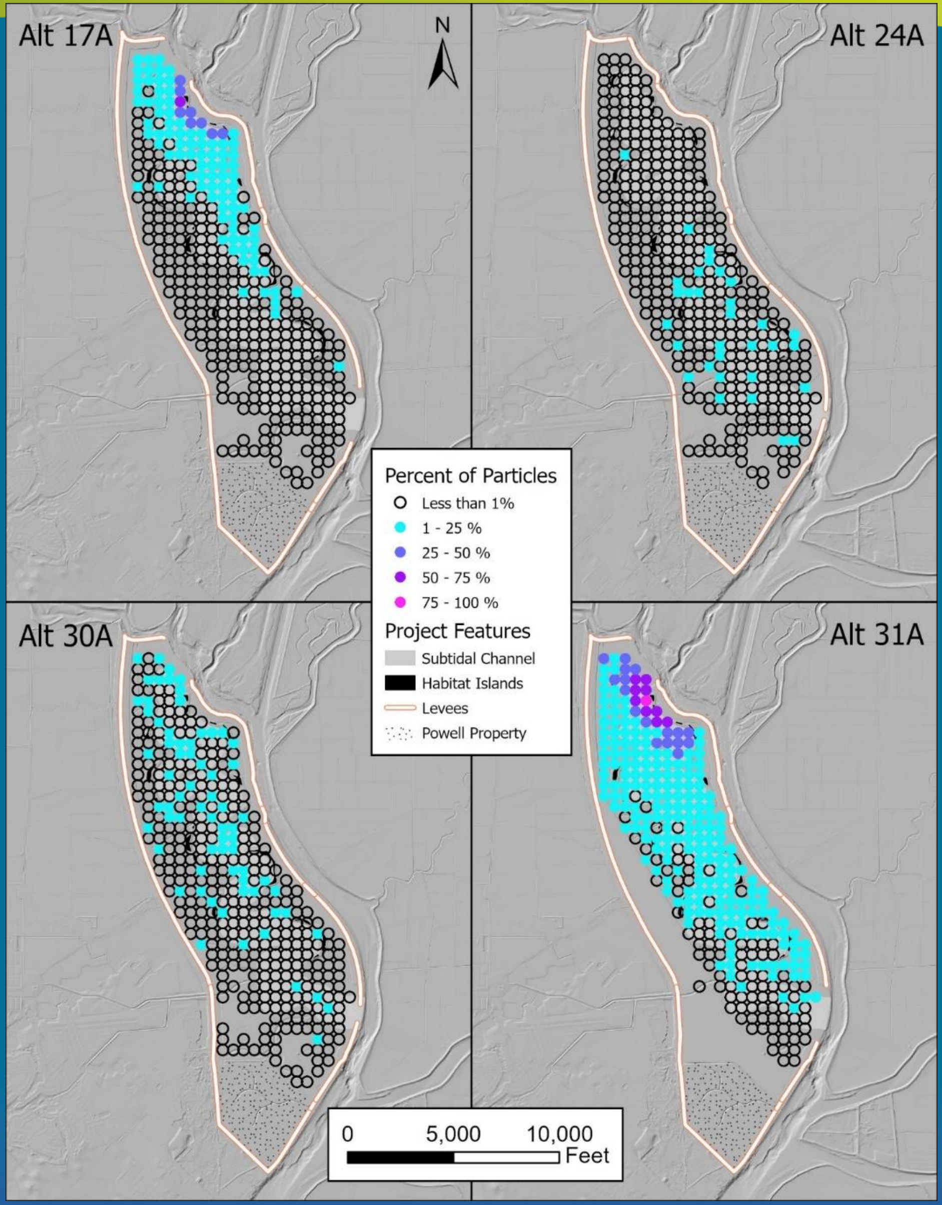
Model Results: Particle Tracking

- Most particles tracked were released downstream, but some particles take routes through other parts of Delta

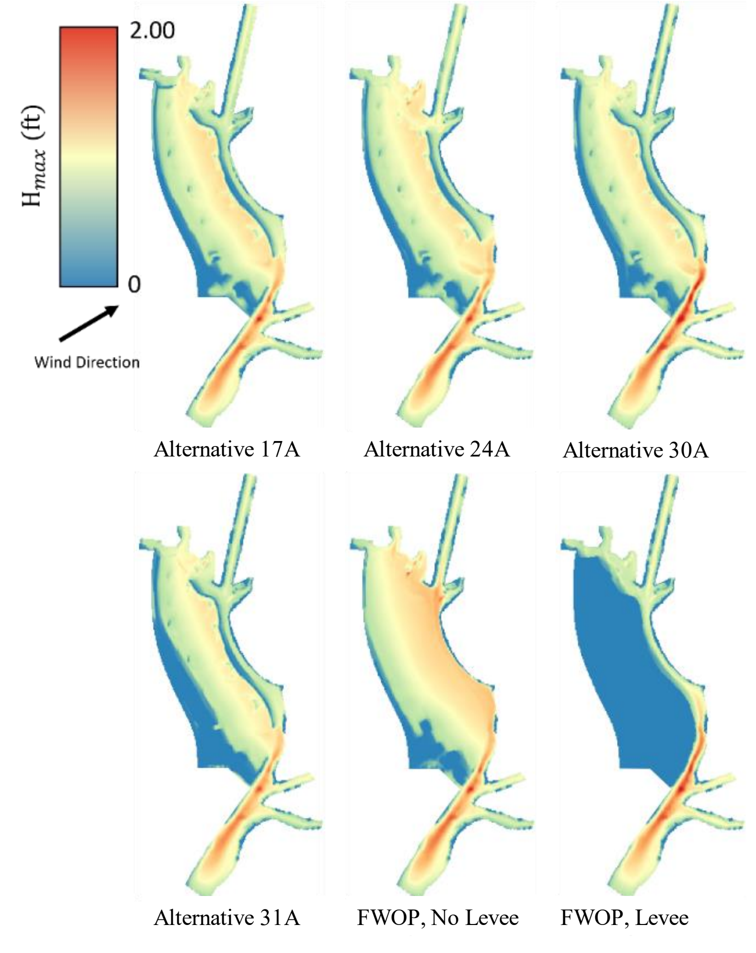
- Focus on particles moving north to Liberty Island – may provide food source for native fish in Cache Slough complex

- Alt 24A had least amount transported north, while Alt 31A had the most

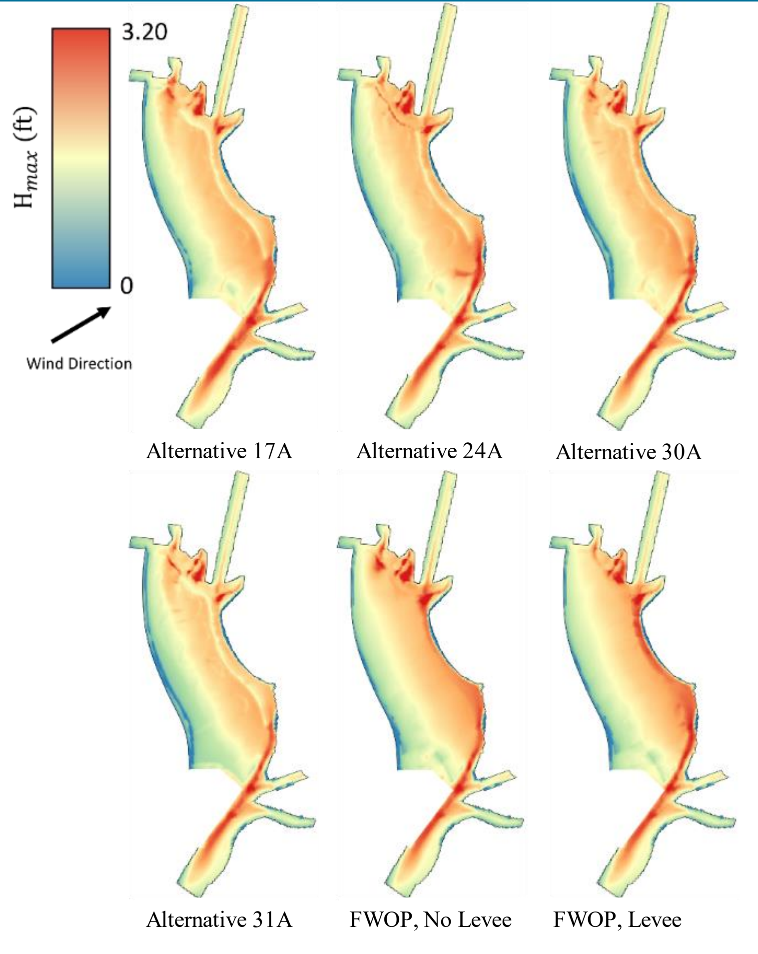


Model Results: Wind Waves

- Wave dynamics are primarily influenced by water depth and wind speed/direction
- Depths do not vary significantly between alternatives because water levels are controlled by tidal forcing when the tract is open to tidal action (which is the case for all alternatives).



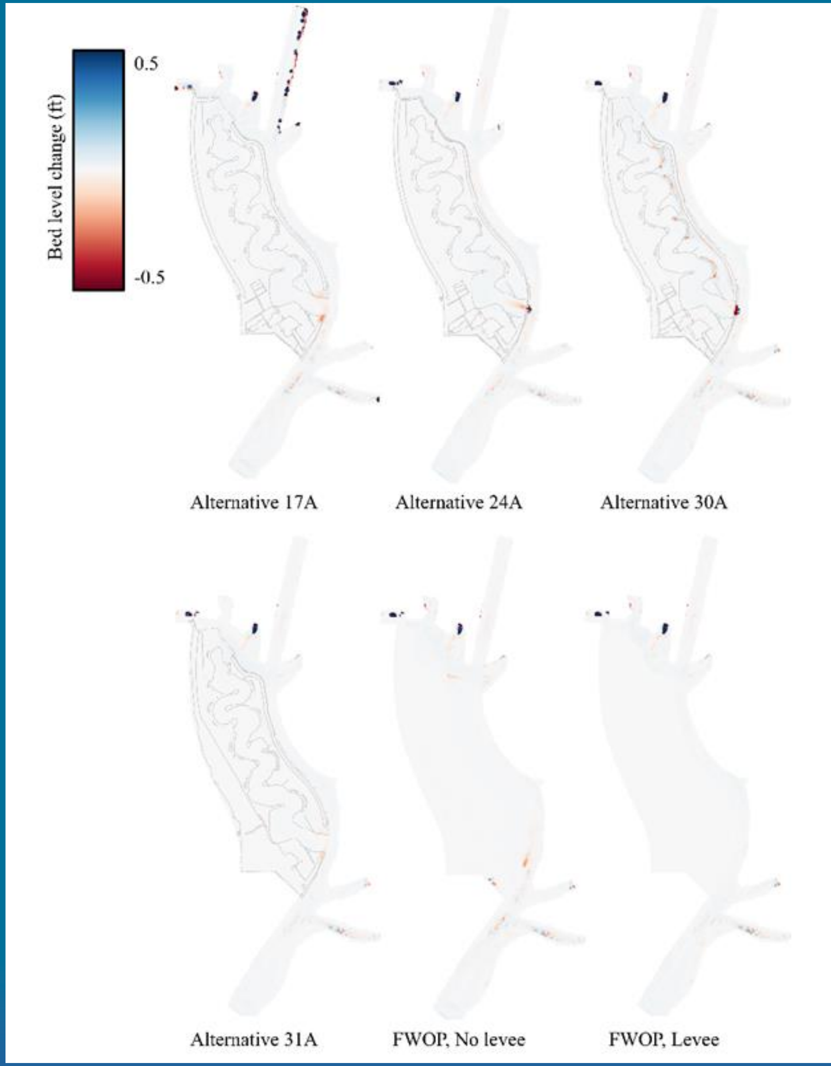
Maximum wave heights for tidal conditions



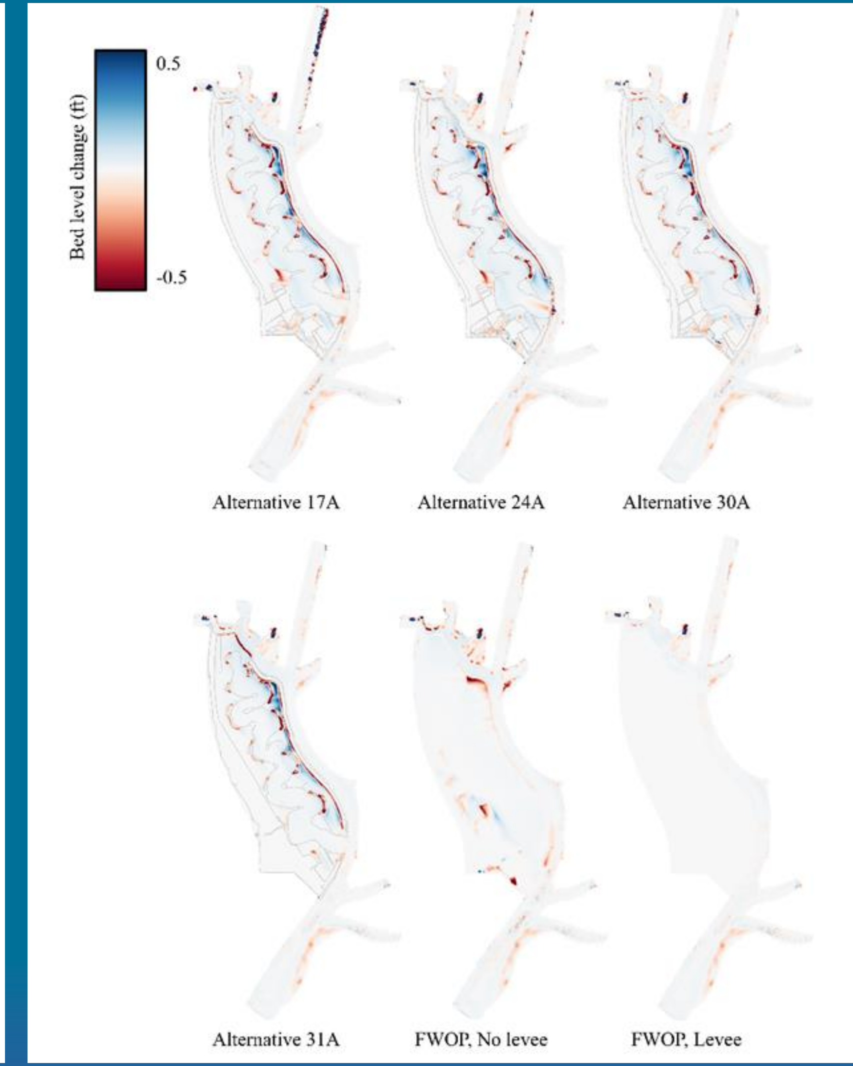
Maximum wave heights for 100-year conditions

Model Results: Erosion and Deposition

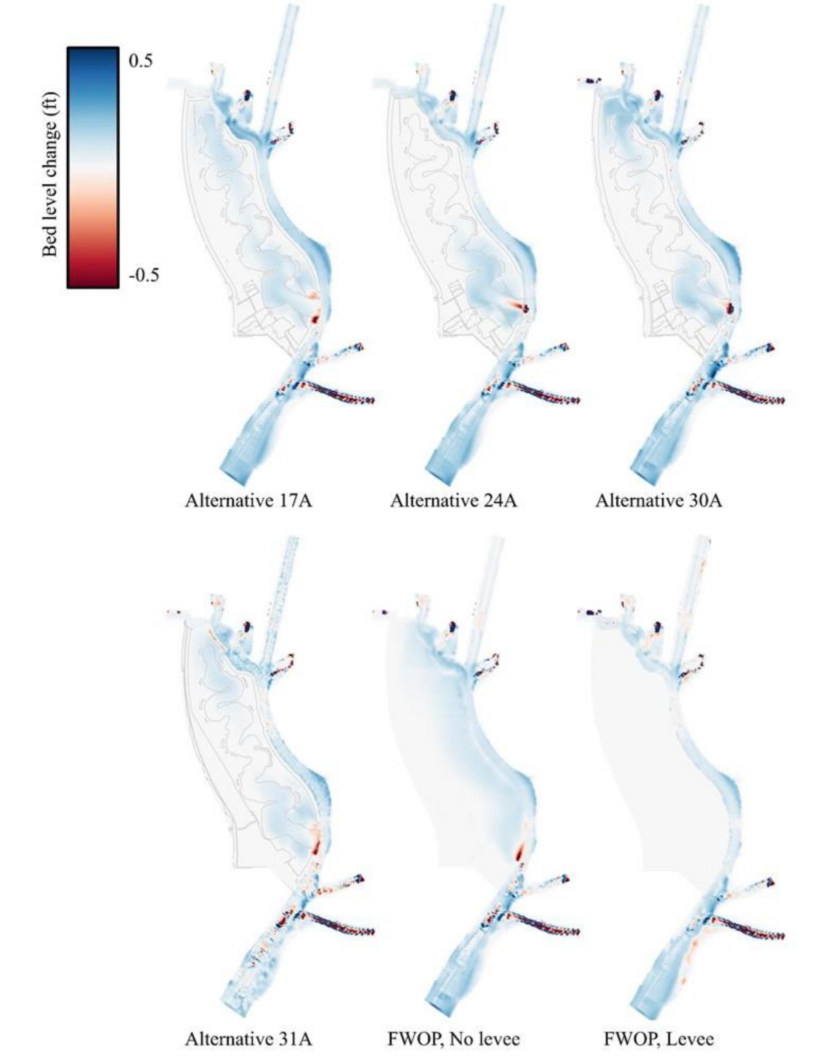
Tidal, Avg Wind



Tidal, High Wind



First Flush



Summary and Questions

- The largest breaches allow the most flow through the tract, resulting in higher overall net flows. This has implications for mixing and sediment transport within the tract

- Maximum stresses occur on the habitat islands and habitat berms due to wave-induced stresses in the shallow water surrounding these features.

- Wave heights do not vary significantly between alternatives because they have similar water depths, and water levels are controlled by tidal forcing when the tract is open to tidal action (which is the case for all alternatives).

- Wind speed is important for wave generation and erosion potential within the tract. Breach configurations impact shear stresses and velocities which in turn impact patterns of erosion and deposition between alternatives

References

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