

Sediment conceptual model for San Francisco Bay

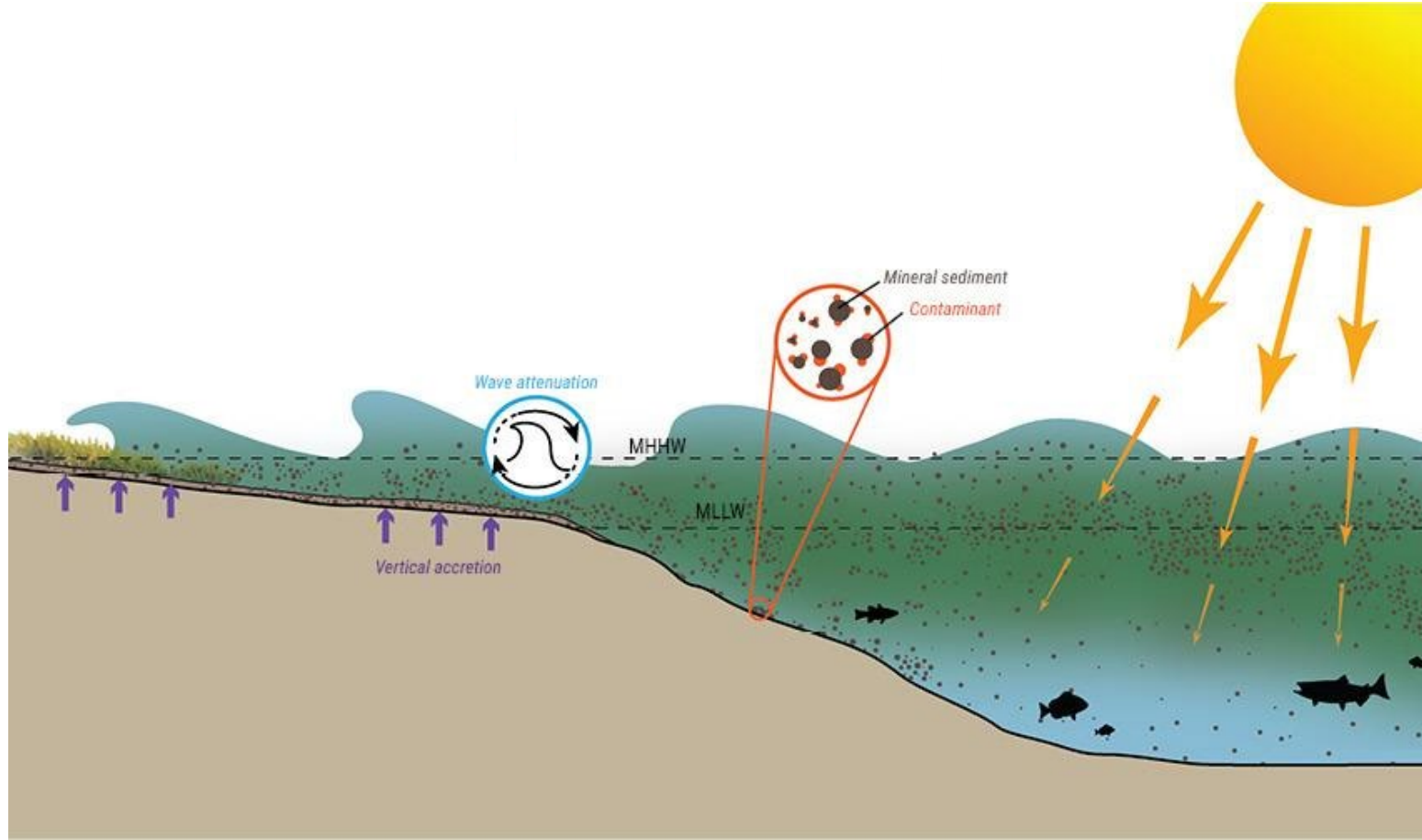
Katie McKnight, SFEI RMP Annual Meeting • Oct. 3, 2022

SFEI Project Team: Scott Dusterhoff, Alex Braud, Sam Shaw, Letitia Grenier,
Melissa Foley, Jeremy Lowe, Lester McKee

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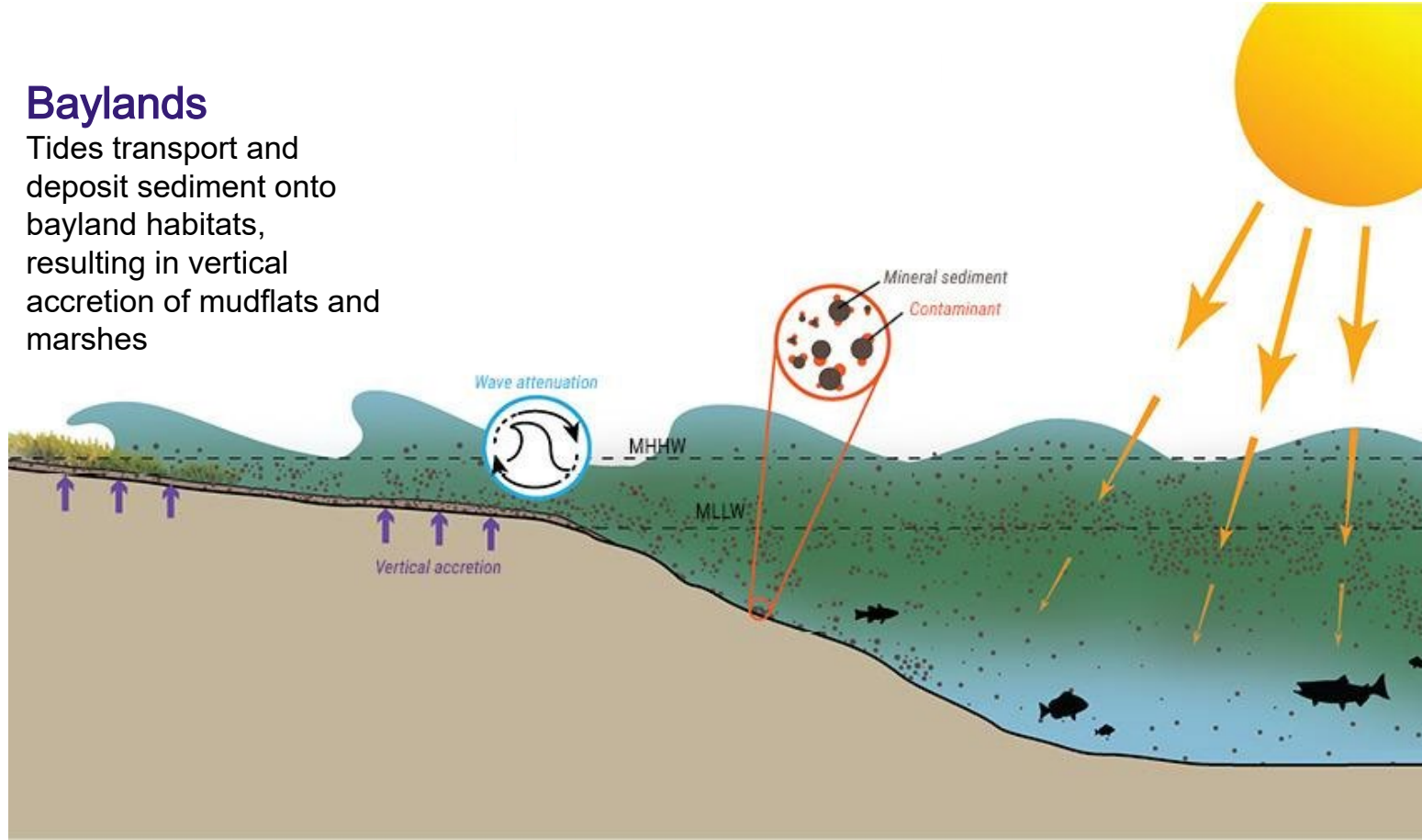
Key considerations of sediment



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Baylands

Tides transport and deposit sediment onto bayland habitats, resulting in vertical accretion of mudflats and marshes



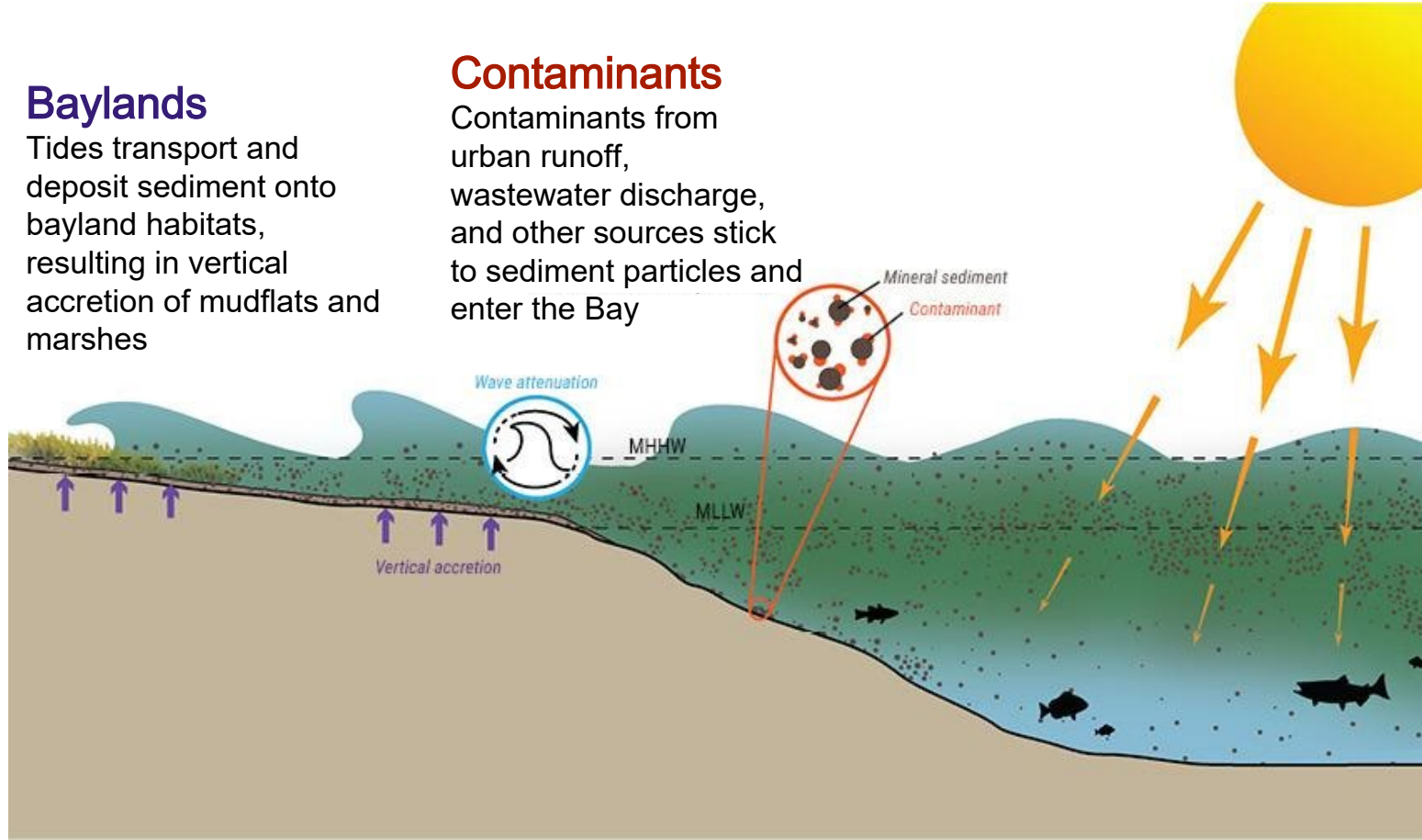
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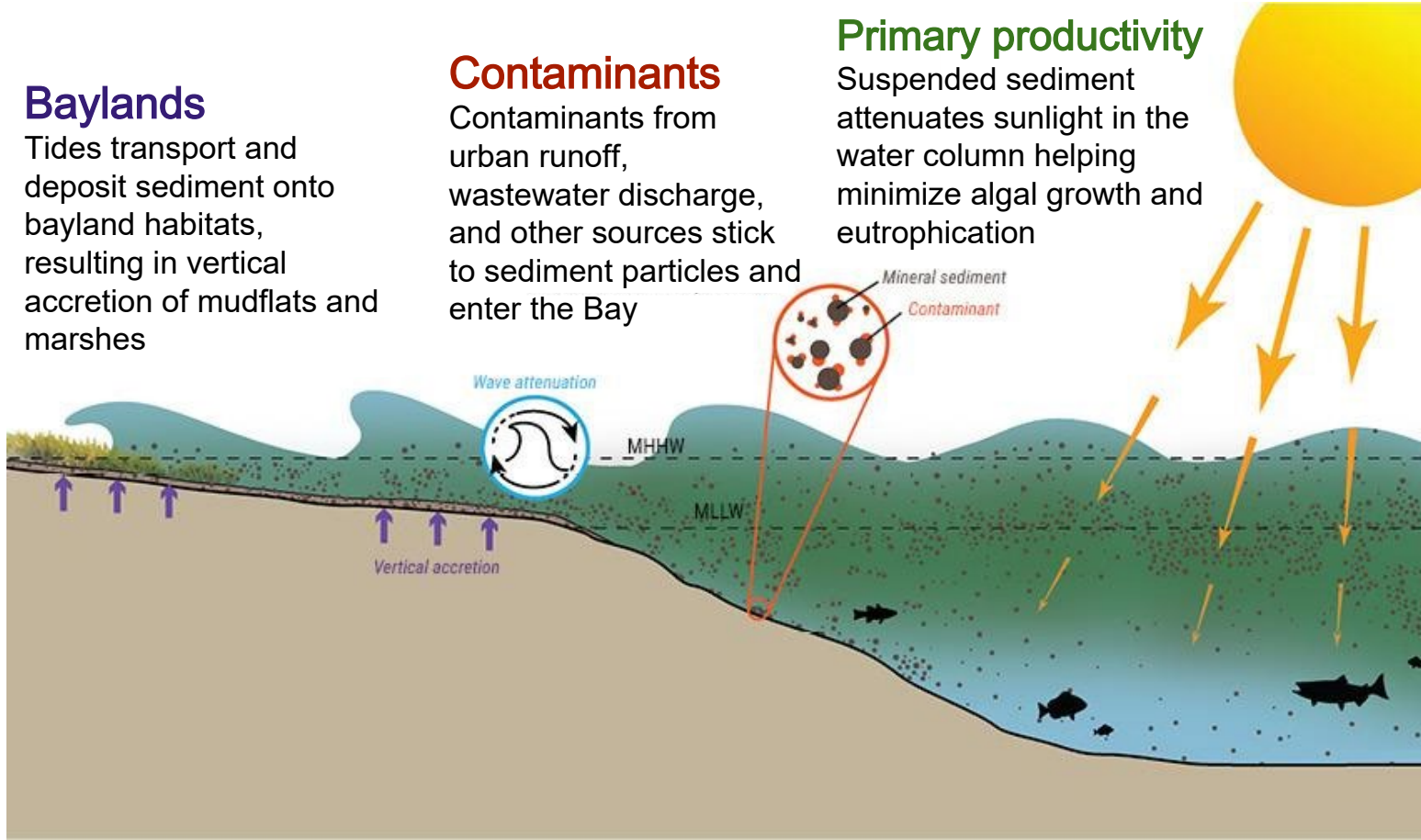
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Suspended sediment attenuates sunlight in the water column helping minimize algal growth and eutrophication



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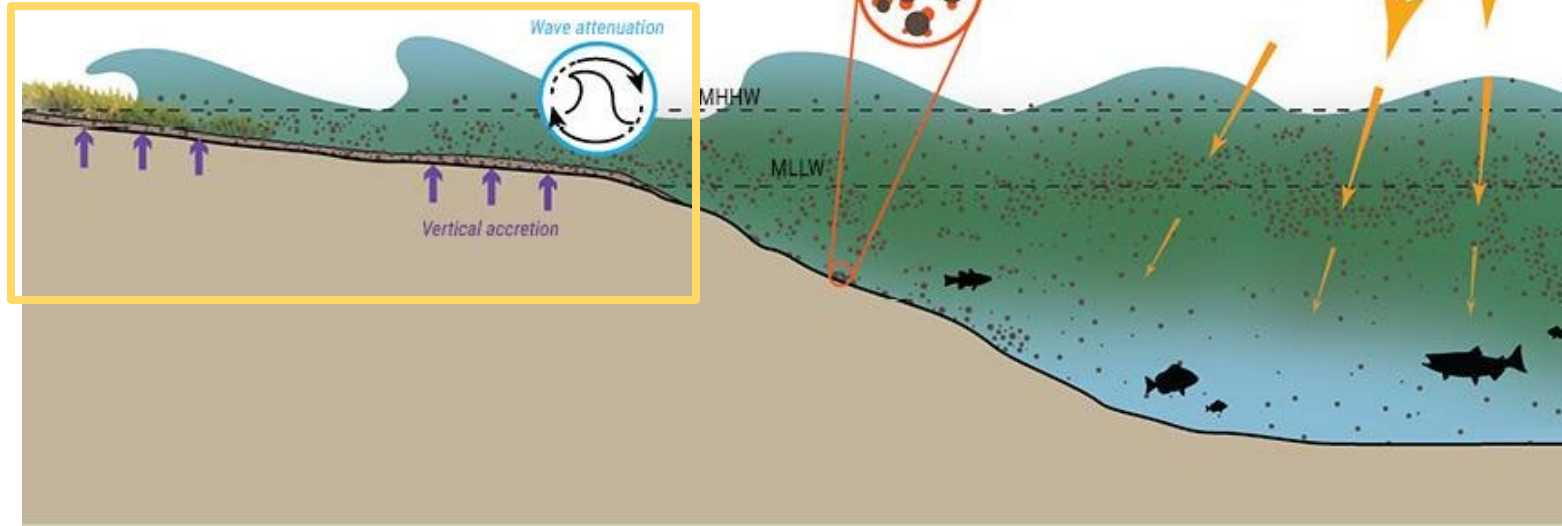
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What is meant by “sediment
conceptual model” ?

An abstraction of how sediment moves
around at different scales within the Bay
to **organize existing information** and
highlight key knowledge gaps

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around at different scales within the Bay
to organize existing information and
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**Goal: Improve Bay sediment
management**

The need



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- **Synthesize current data:** sediment transport pathways and rates for current and future conditions



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- **Synthesize current data:** sediment transport pathways and rates for current and future conditions
- **Communication tool:** digestible conceptual model that focuses on magnitudes and uncertainties



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The need

- **Synthesize current data:** sediment transport pathways and rates for current and future conditions
- **Communication tool:** digestible conceptual model that focuses on magnitudes and uncertainties
- **Clarify where to focus limited Bay RMP funds** to address questions regarding *sediment loading to the Bay* and *sediment delivery to marshes*

Objective

- Provide a conceptual level, common understanding of dominant sediment processes for open Bay and tidal wetland planning
- Highlight key sediment process data gaps

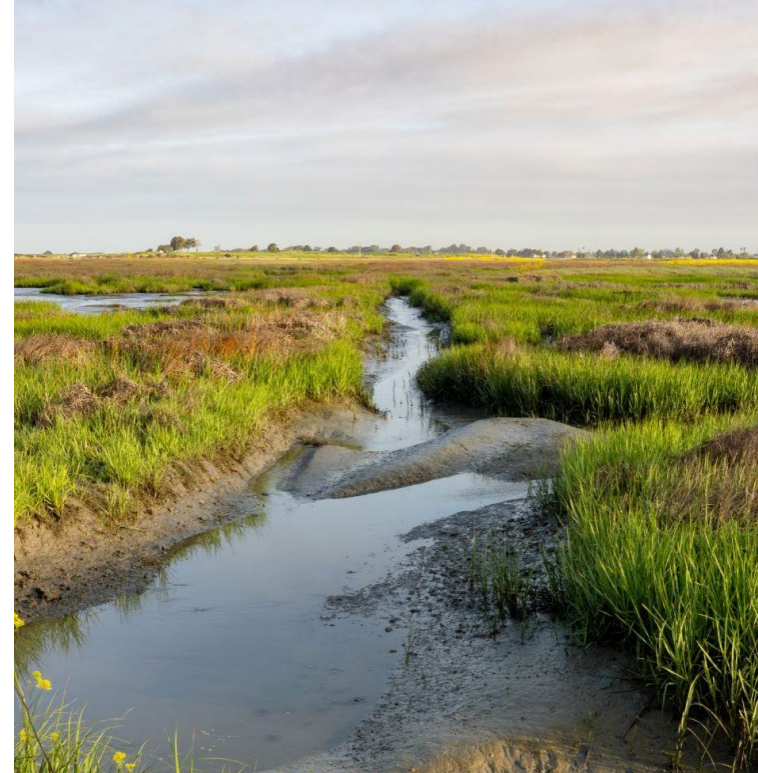


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Funder

- Supplemental Environmental Project funds (Bay RMP)



Shira Bezalel

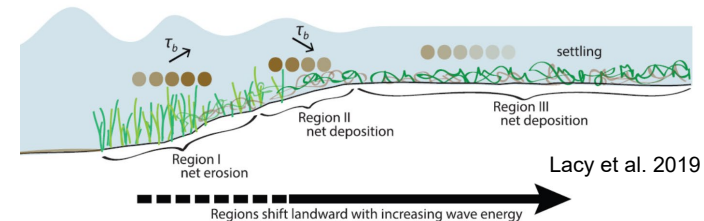
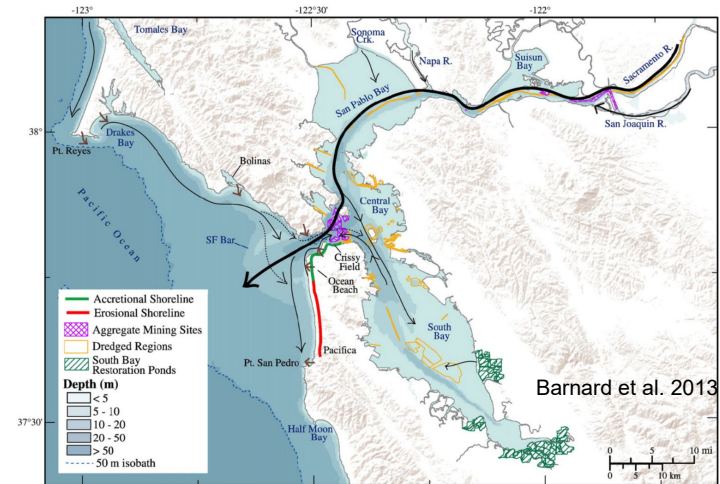
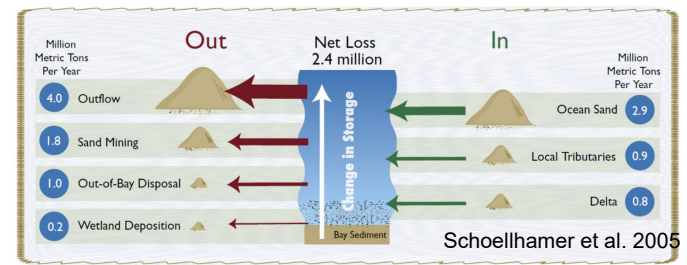
Intended audience

- Bay sediment management community
- Bayland restoration practitioners
- RMP stakeholders and Bay water quality management community



Building on previous efforts

- Bay Sediment Budget: Sediment Accounting 101 (Schoellhamer et al. 2005)
- Conceptual model of sand transport in Bay (Barnard et al. 2013)
- Baylands Goals Update conceptual model (2015)
- Sediment transport at marsh edge (Lacy et al. 2019)



An aerial photograph of a coastal city, likely San Francisco, showing the city skyline, a large bay, and a suspension bridge. The background features rolling hills and mountains under a clear sky. The image is used as a background for the slide.

Leveraging existing efforts

- USACE Regional Dredged Material Management Plan- Gaps Analysis
 - Will identify research priorities that support sediment placement decisions
- BCDC/SCC Sand Mining Studies Sand budget & transport analysis
 - Updating the contemporary sand (and silt/mud) budget at Bay and subembayment scales
- Bay RMP Watershed Dynamic Model
 - New tool for estimating sediment supply to marshes from adjacent watershed
- Bay RMP 2020 Sediment Monitoring & Modeling Strategy
 - Including more data sources and more overall data synthesis

Project Advisors

Technical Advisory Committee

- John Callaway (USF)
- Jessie Lacy (USGS)
- Dave Schoellhamer (USGS, emeritus)

Management Advisory Committee

- Tom Mumley (SFBRWQCB)
- Xavier Fernandez (SFBRWQCB)
- Christina Toms (SFBRWQCB)
- Brenda Goeden (BCDC)
- Jennifer Siu (EPA)
- Luisa Valiela (EPA)
- Tessa Beach (USACE)
- Julie Beagle (USACE)

Conceptualizing sediment at three scales

1. Bay scale



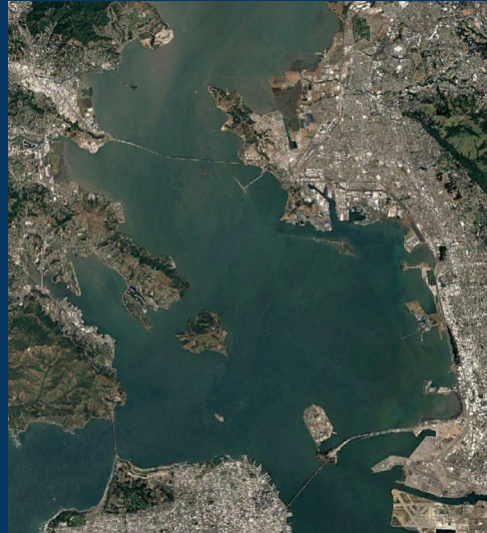
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Conceptualizing sediment at three scales

2. Subembayment scale

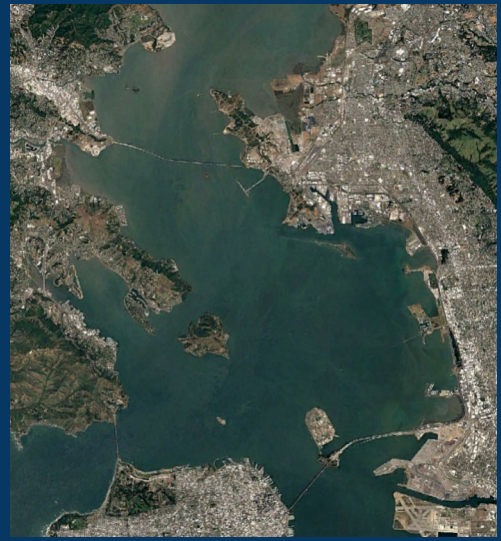


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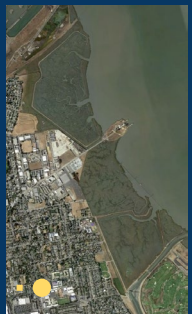


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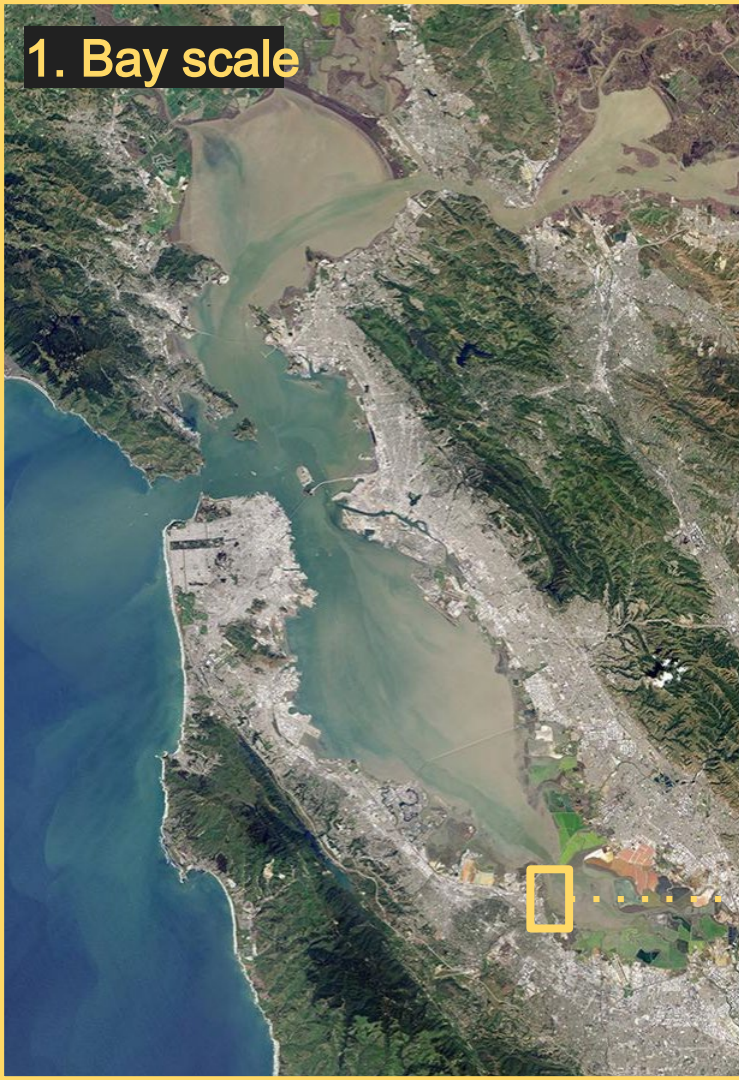
2. Subembayment scale



3. Marsh-mudflat scale

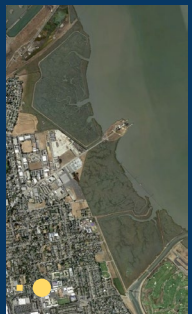


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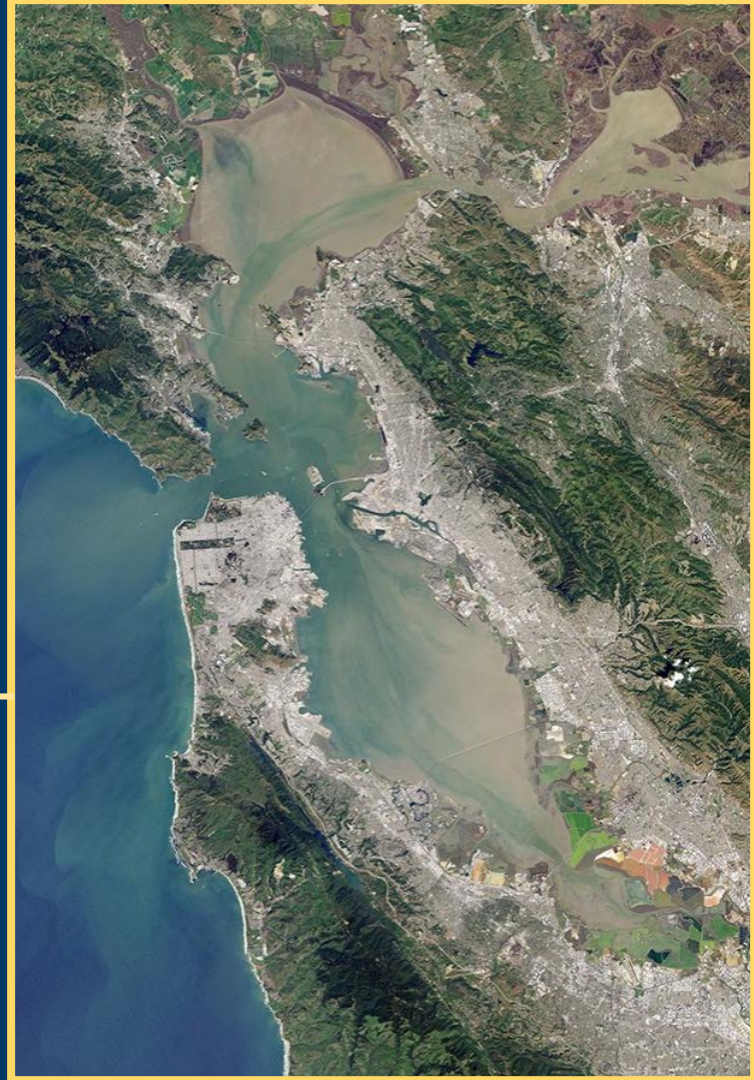
The focus today

3. Marsh-mudflat scale



Bay-scale conceptual model

Methods &
preliminary results



Methods: Bay-scale conceptual model

Compile existing Delta loading, tributary loading, and subembayment flux estimates

- Current and future conditions

Primary data sources:

- Ganju and Schoellhamer 2006
- McKee et al. 2013
- Delta Modeling Assoc 2015
- Schoellhamer et al. 2018
- Livsey et al. 2020
- Stern et al. 2020
- Anchor QEA 2021
- Dusterhoff et al. 2021
- Work et al. 2022 (in preparation)

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Categorize net fluxes by relative magnitude

- Current - seasonal flux (wet years, dry years)
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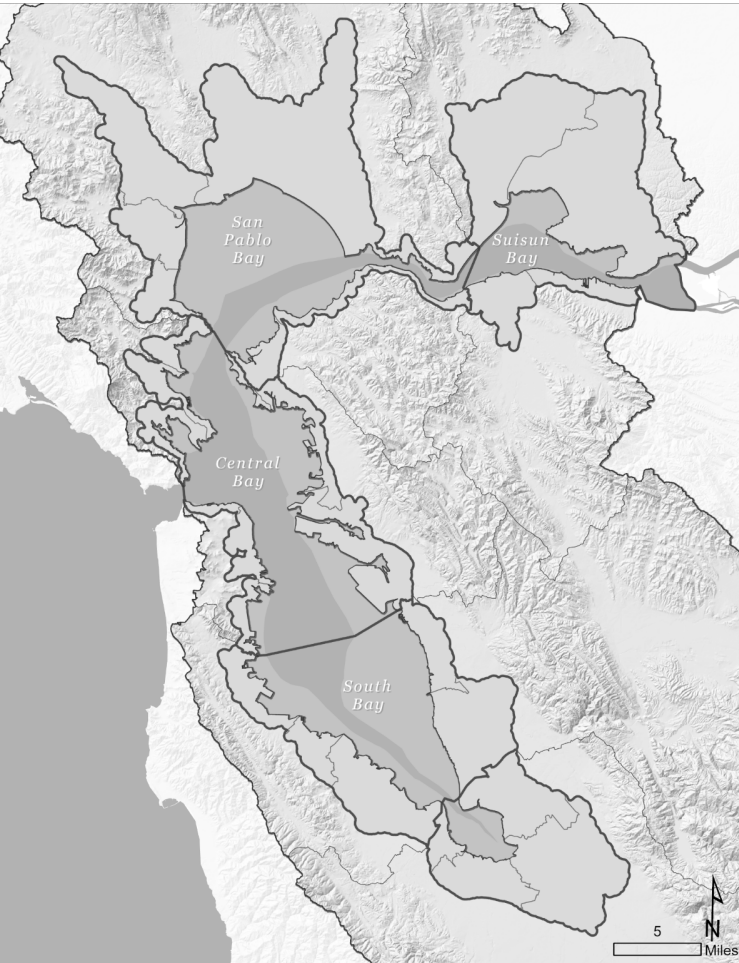
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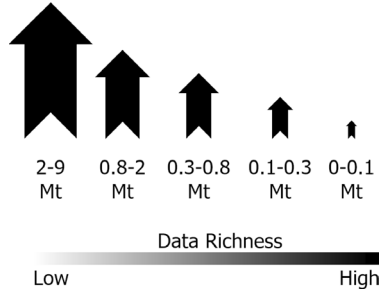
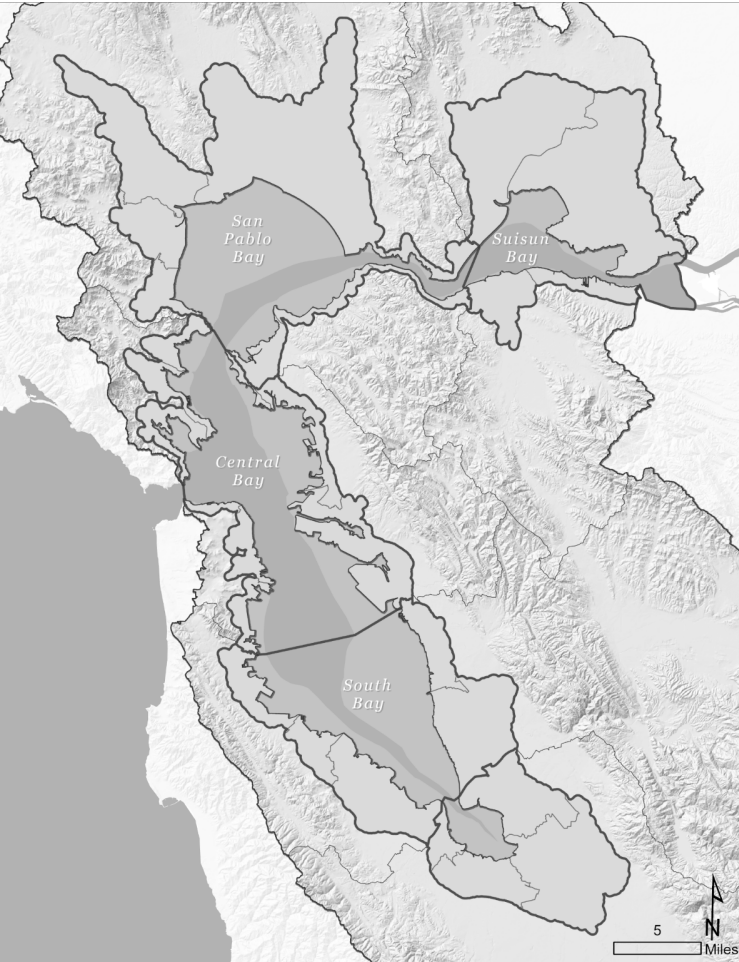
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Develop graphical depiction of net fluxes around the Bay by relative magnitude and relative uncertainty (i.e., data richness)

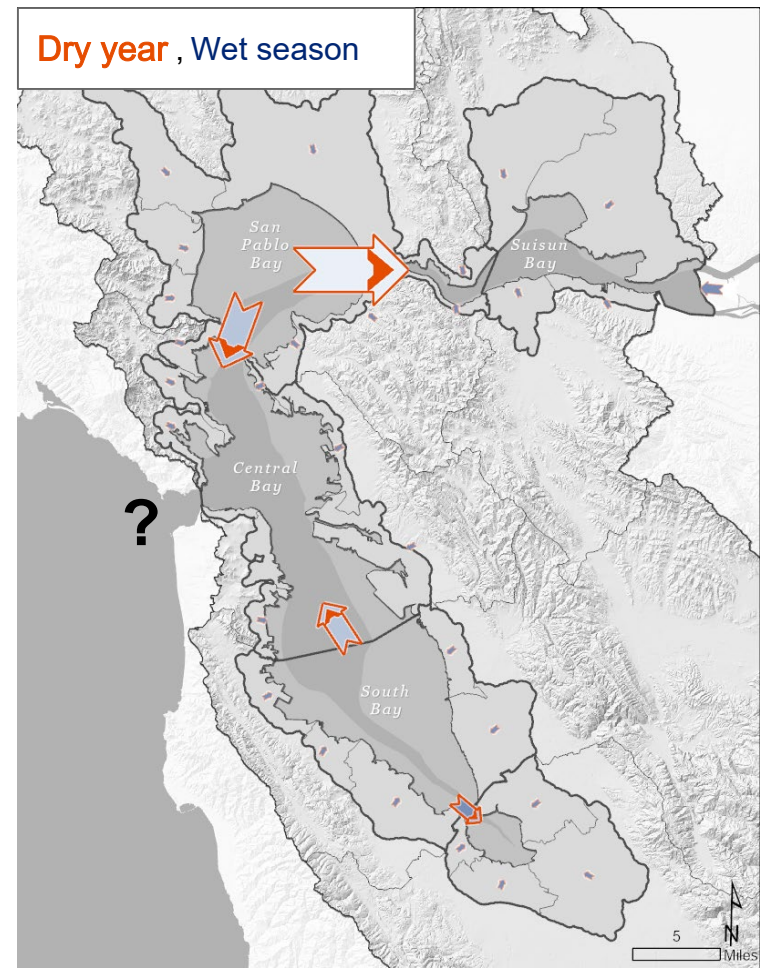
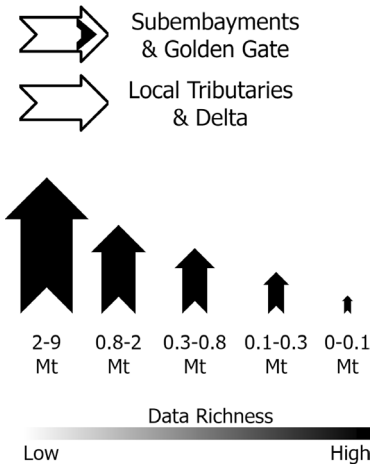
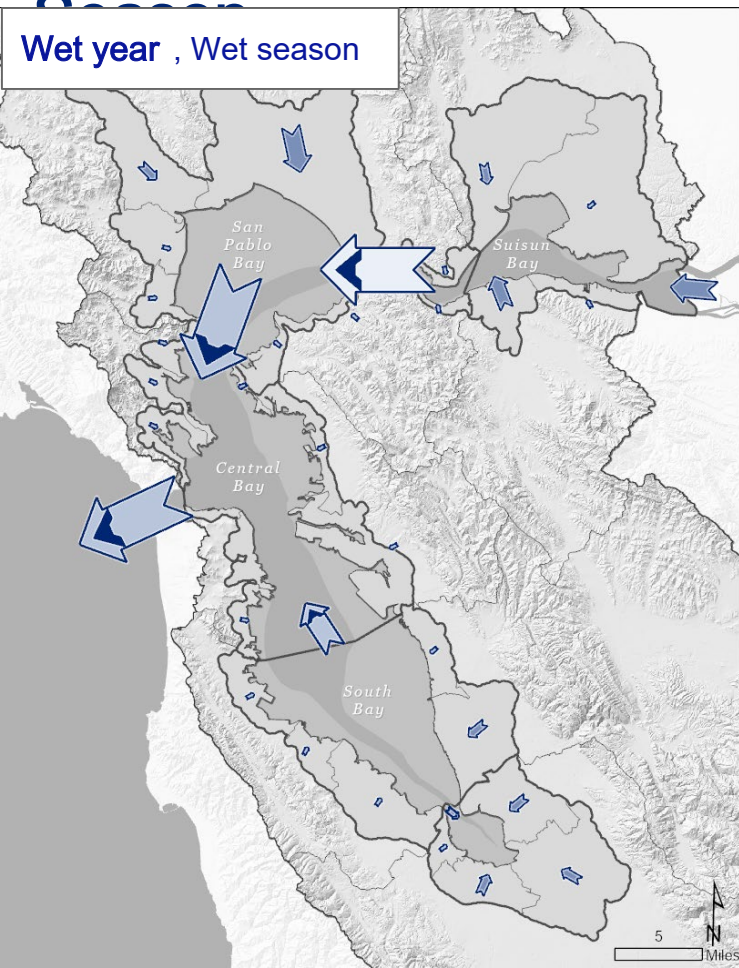
Bay scale: Current conditions (Avg. Net Flux)



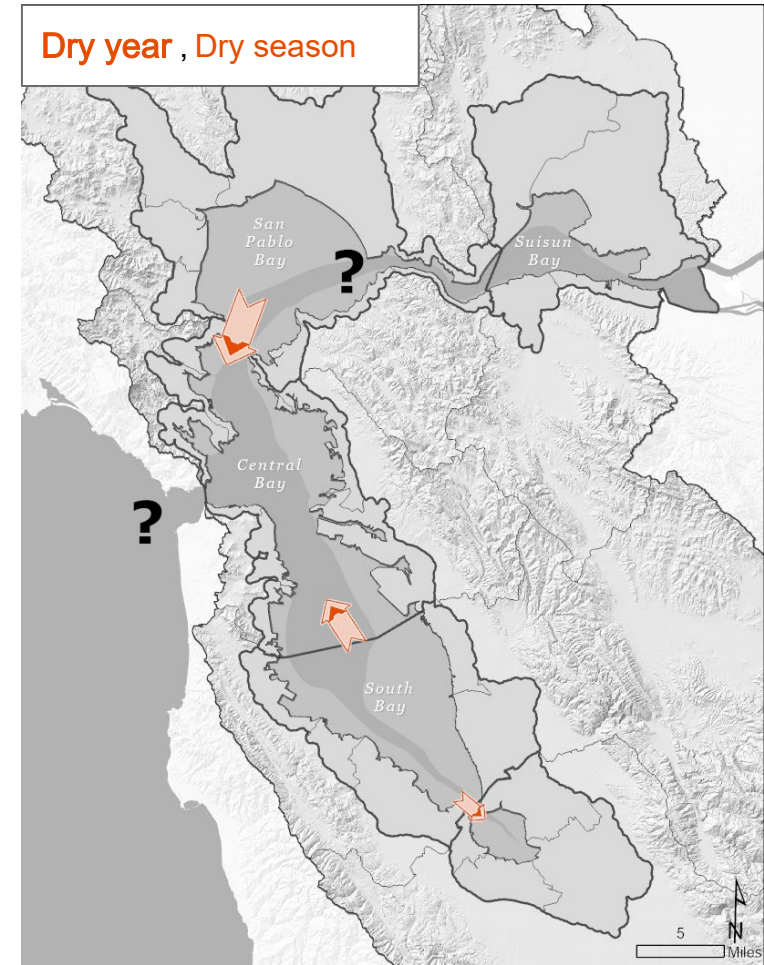
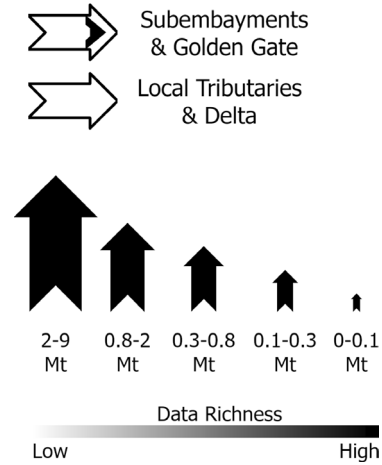
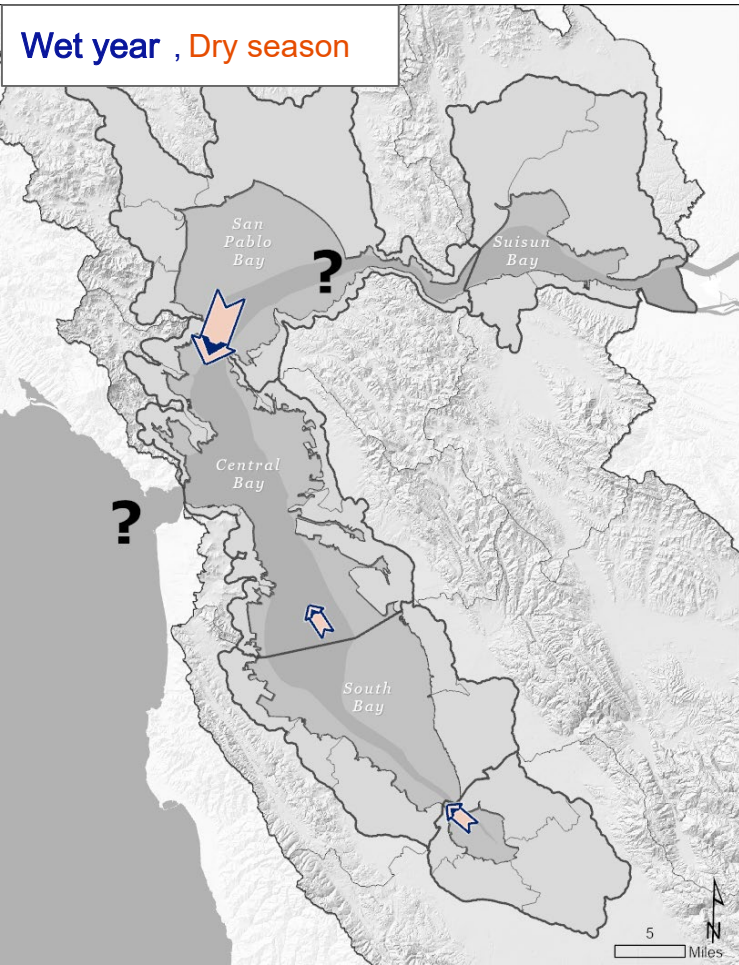
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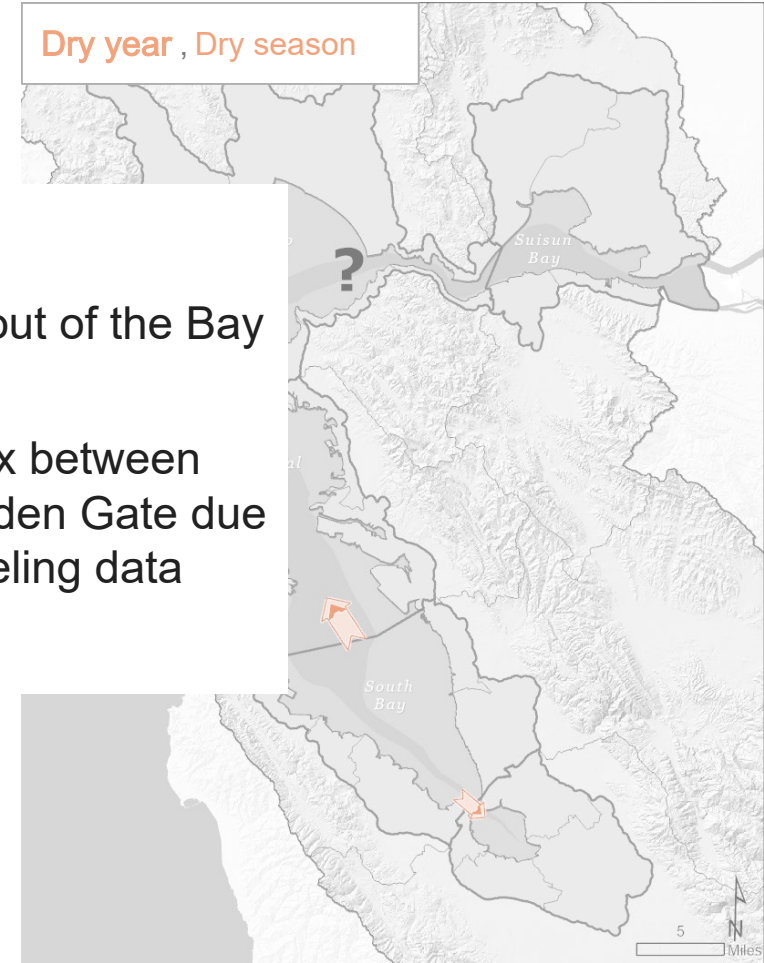
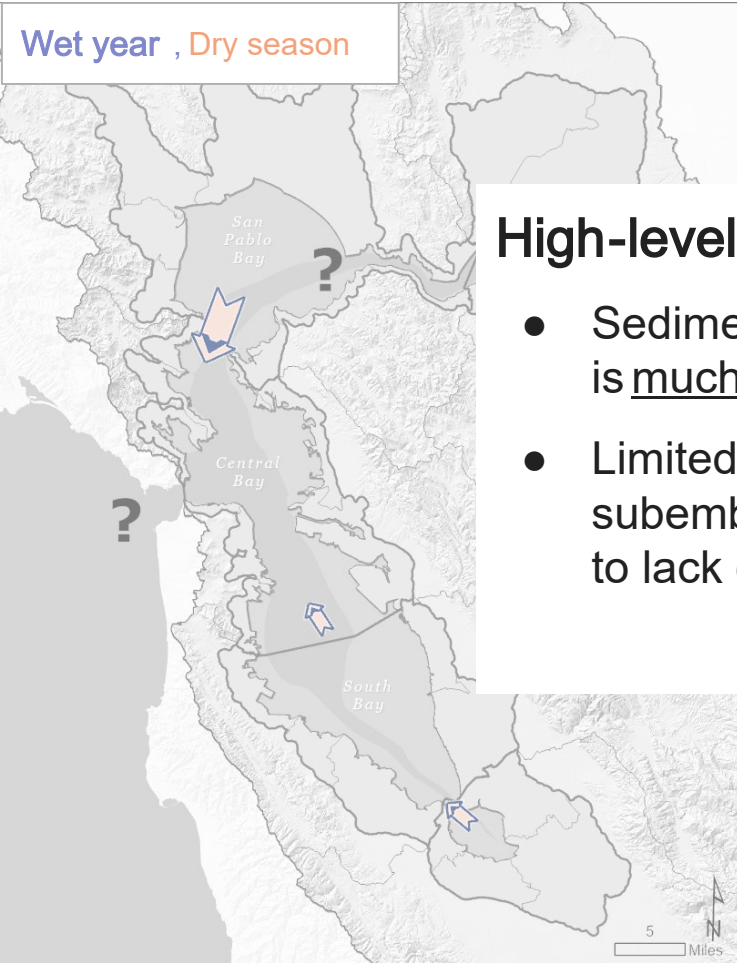
Bay scale: Current conditions (Avg. Net Flux) - Wet



Bay scale: Current conditions (Avg. Net Flux) - Dry Season



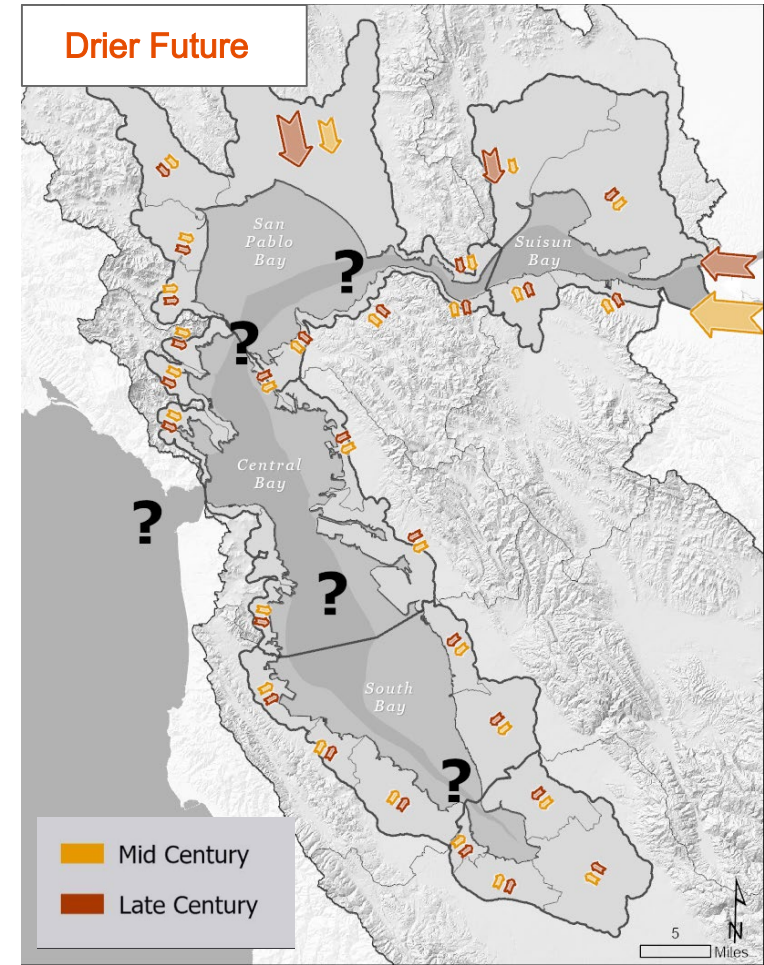
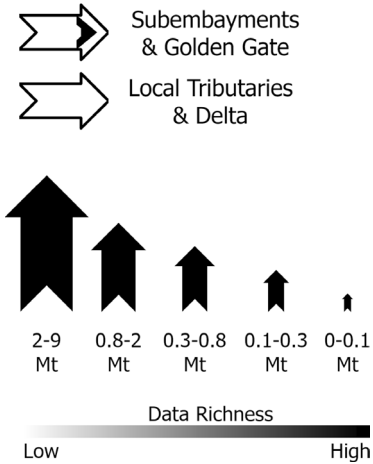
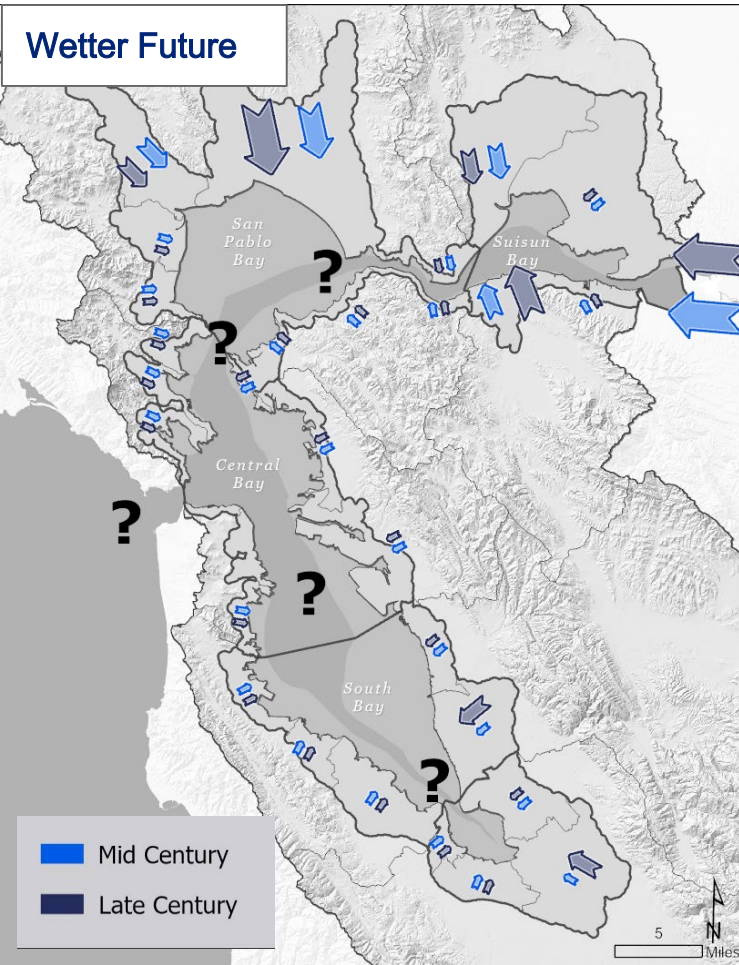
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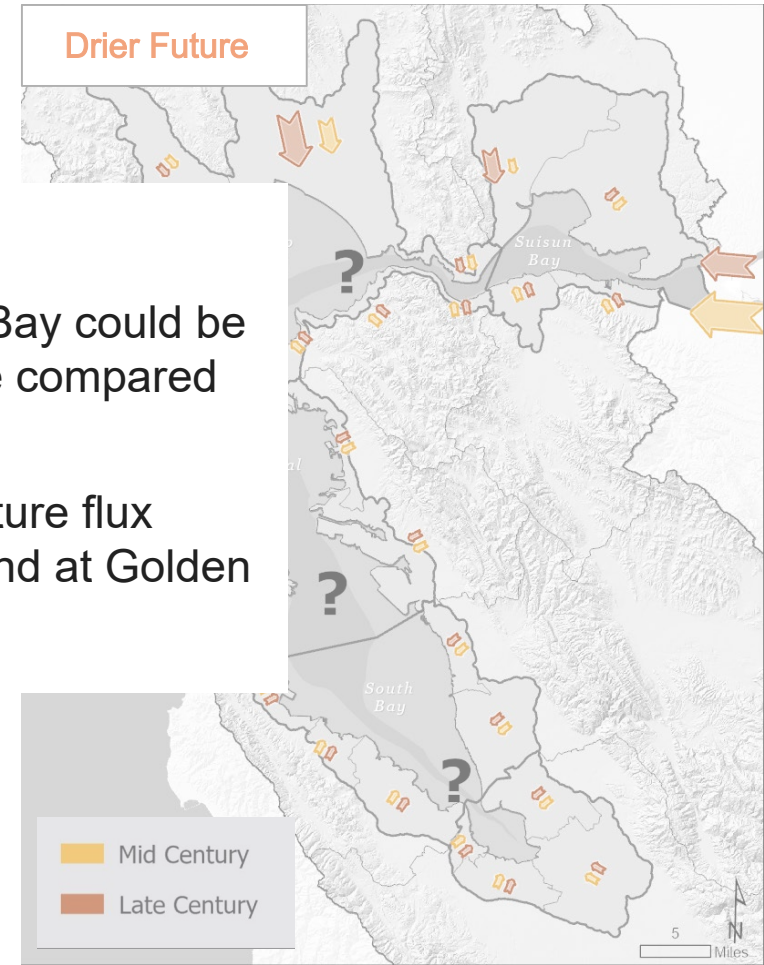
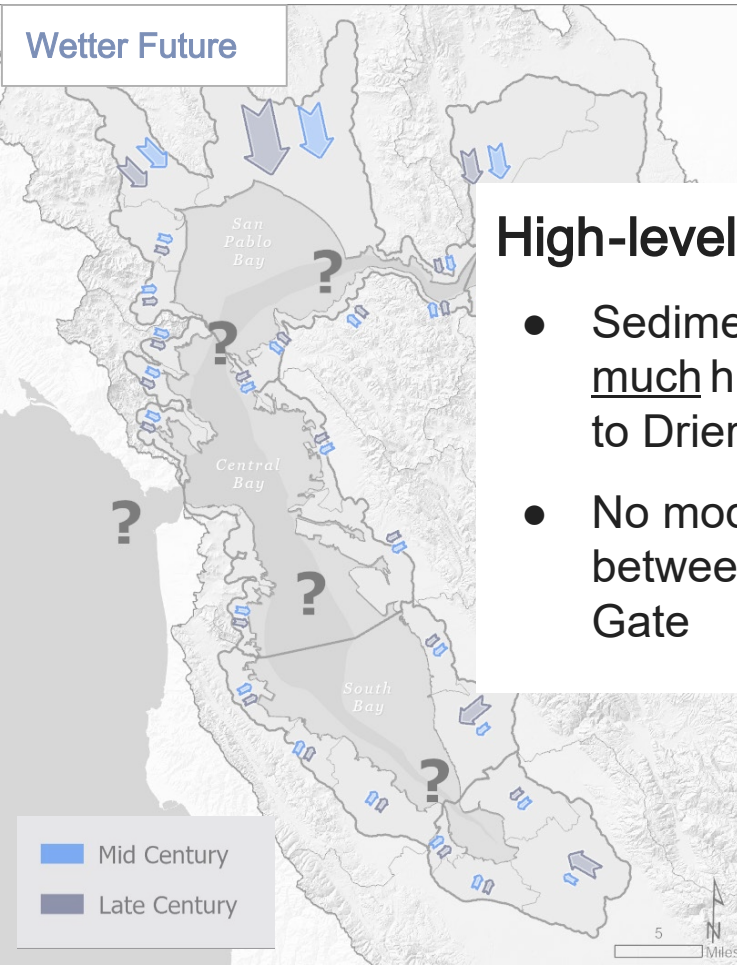
High-level “take homes”

- Sediment delivery into and out of the Bay is much higher in Wet years
- Limited understanding of flux between subembayments and at Golden Gate due to lack of monitoring & modeling data

Bay scale: Future conditions (Avg. Net Annual Flux)



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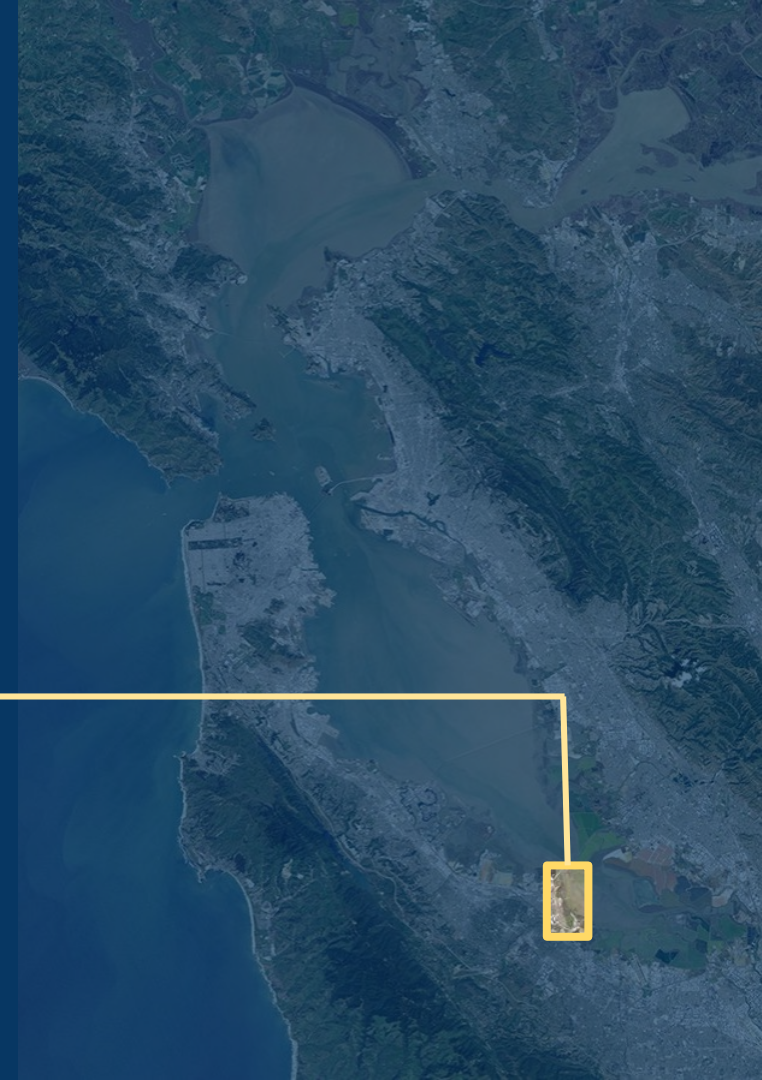


High-level “take homes”

- Sediment delivery to North Bay could be much higher in Wetter future compared to Drier future
- No modeled prediction of future flux between subembayments and at Golden Gate

Marsh-mudflat scale conceptual model

Methods &
preliminary results



Methods: Marsh-mudflat conceptual model

Illustrate general processes and pathways with a narrative description

- Relative differences based on geography and timescale
- Will be sparse due to limited data

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- Takesue & Jaffe 2013
- Jones & Jaffe 2013
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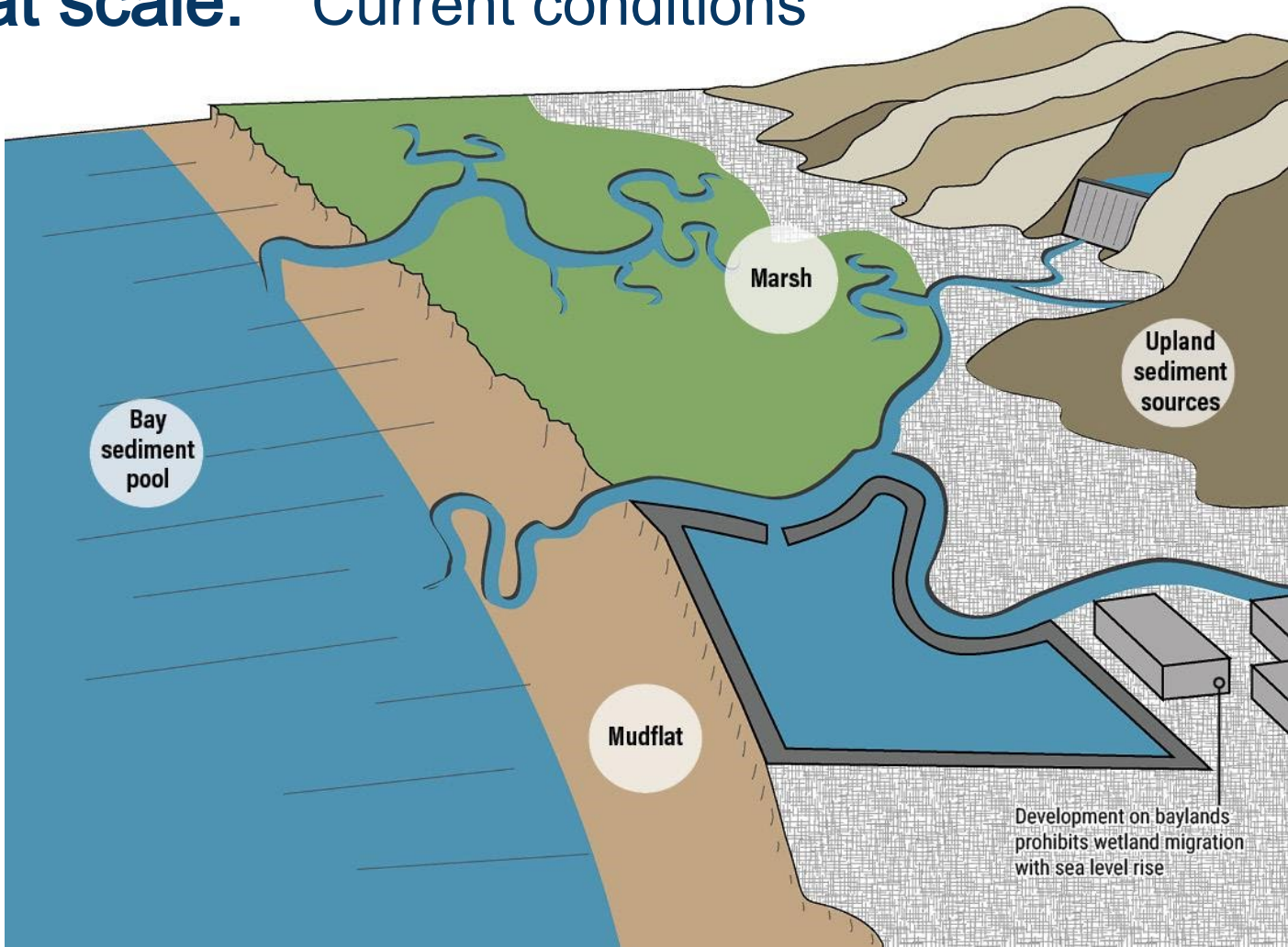
Identify data gaps

- Emphasize high magnitude fluxes with the greatest uncertainty

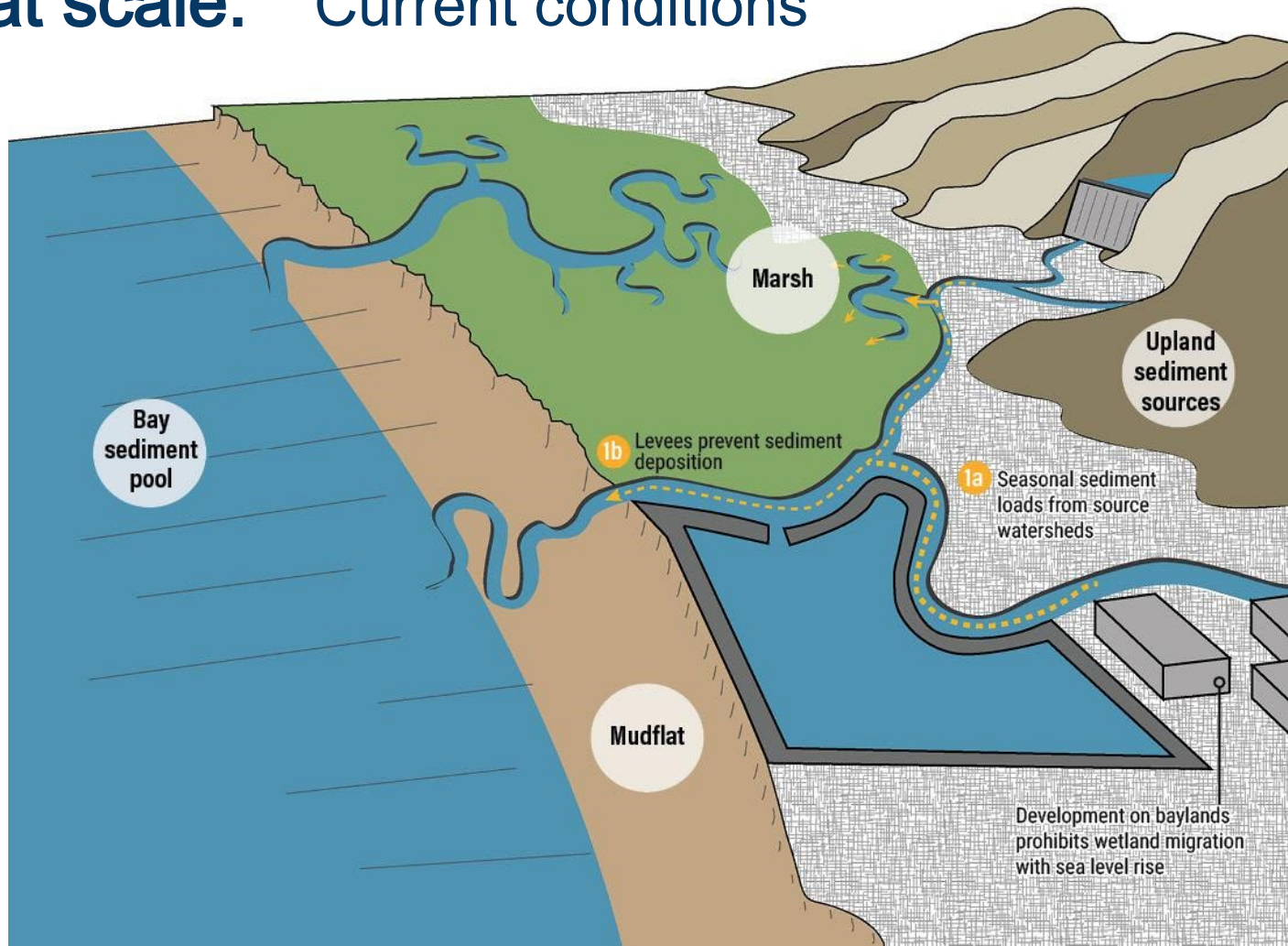
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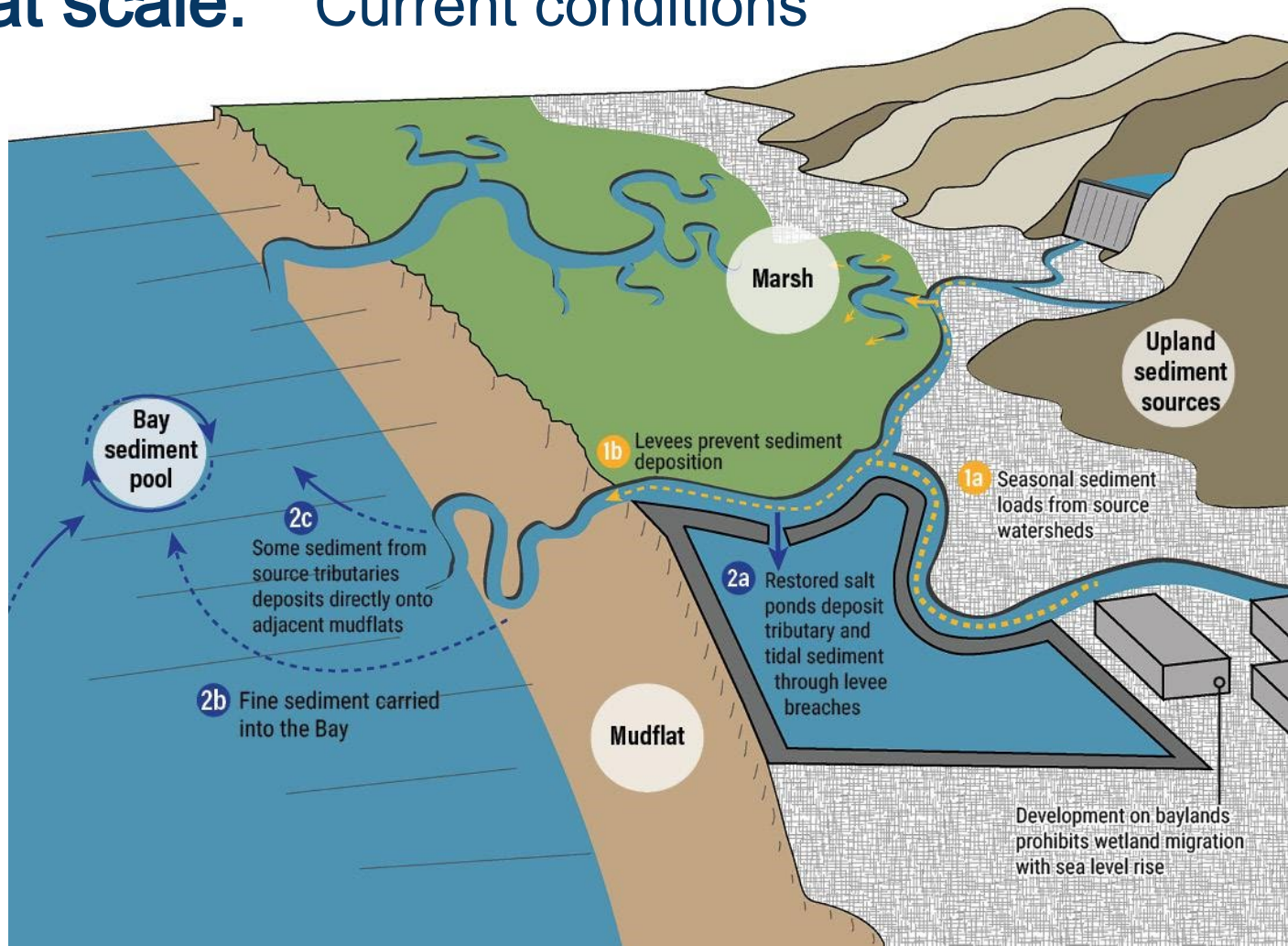
Marsh - mudflat scale: Current conditions



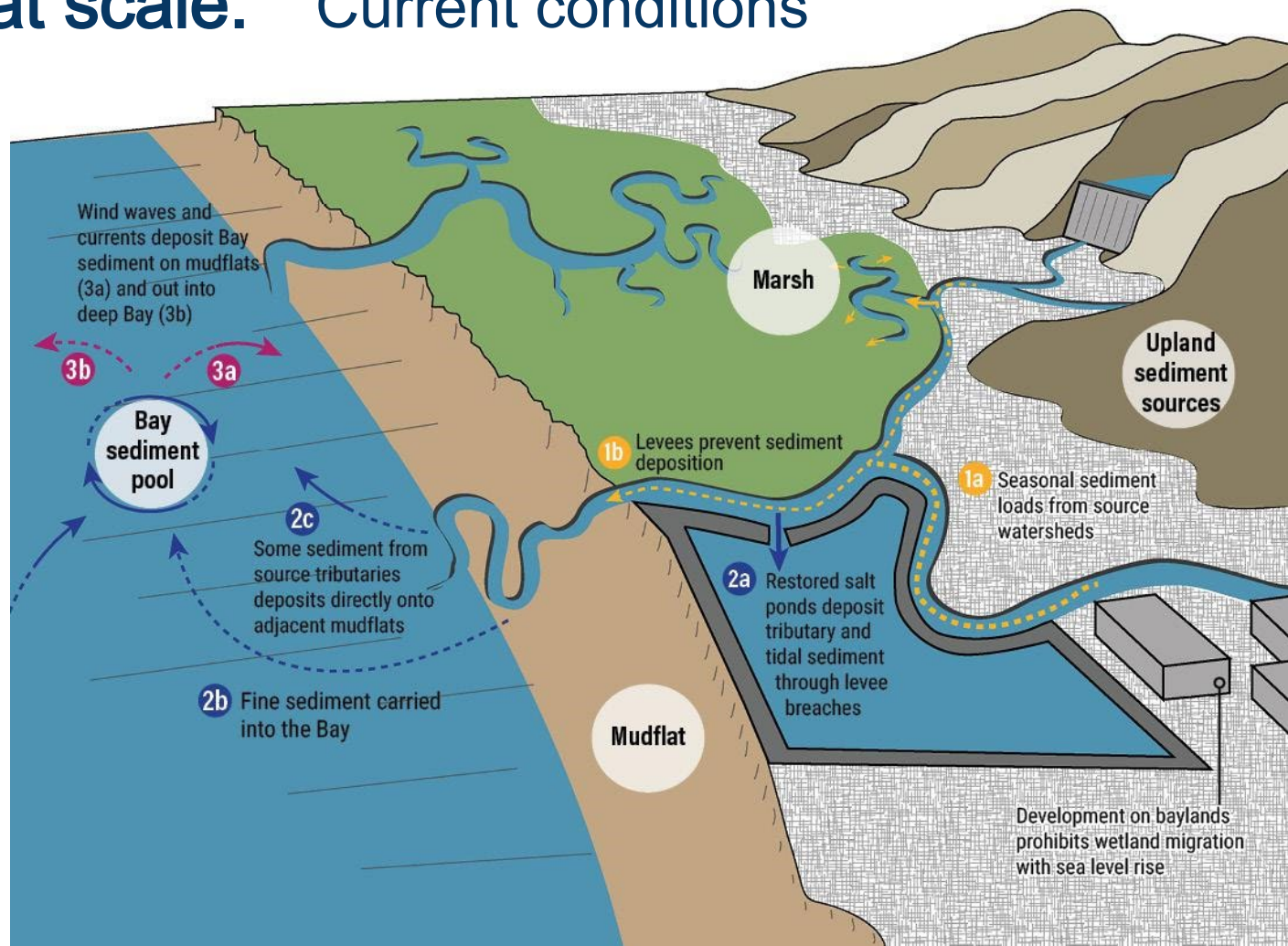
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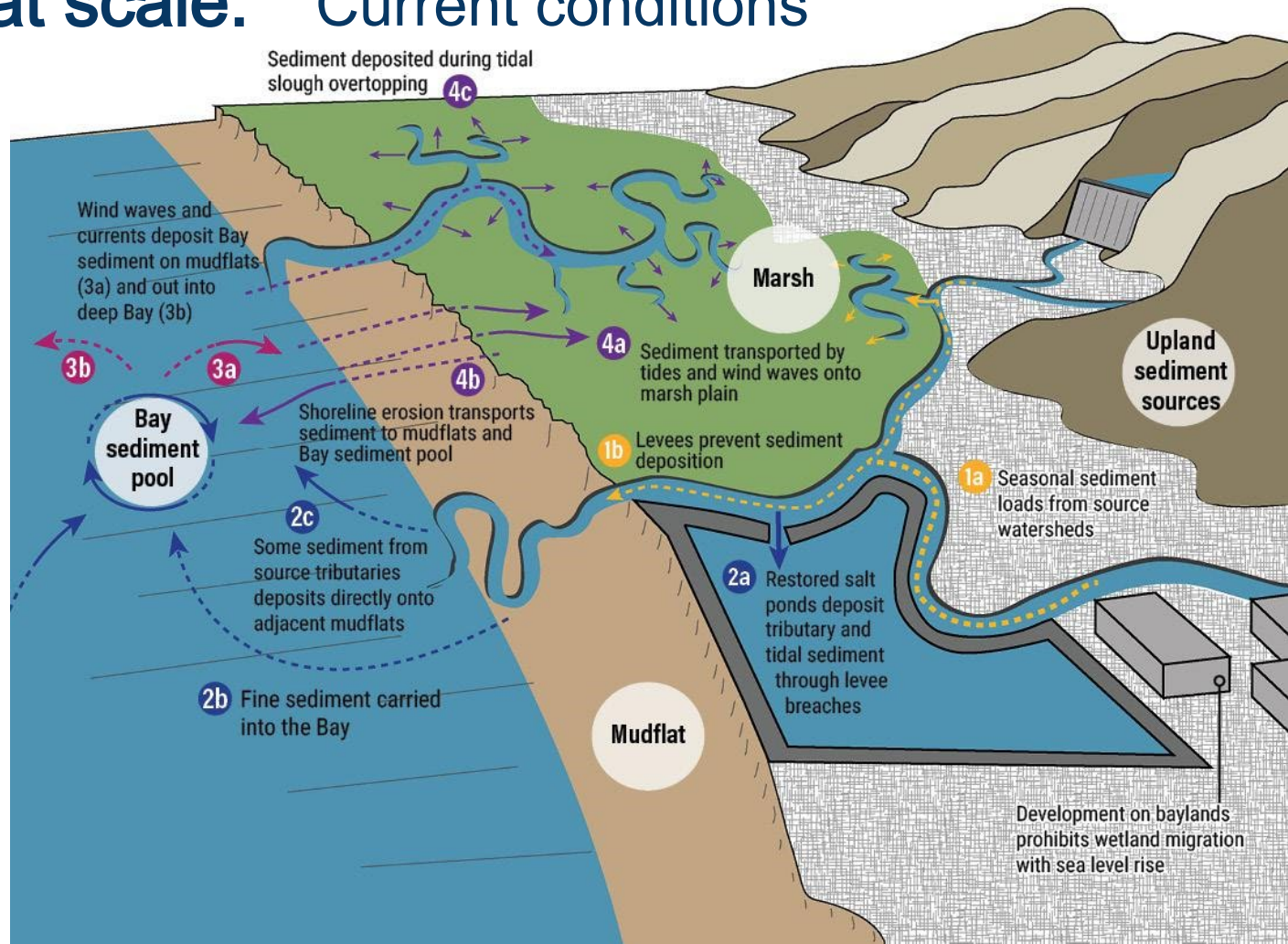
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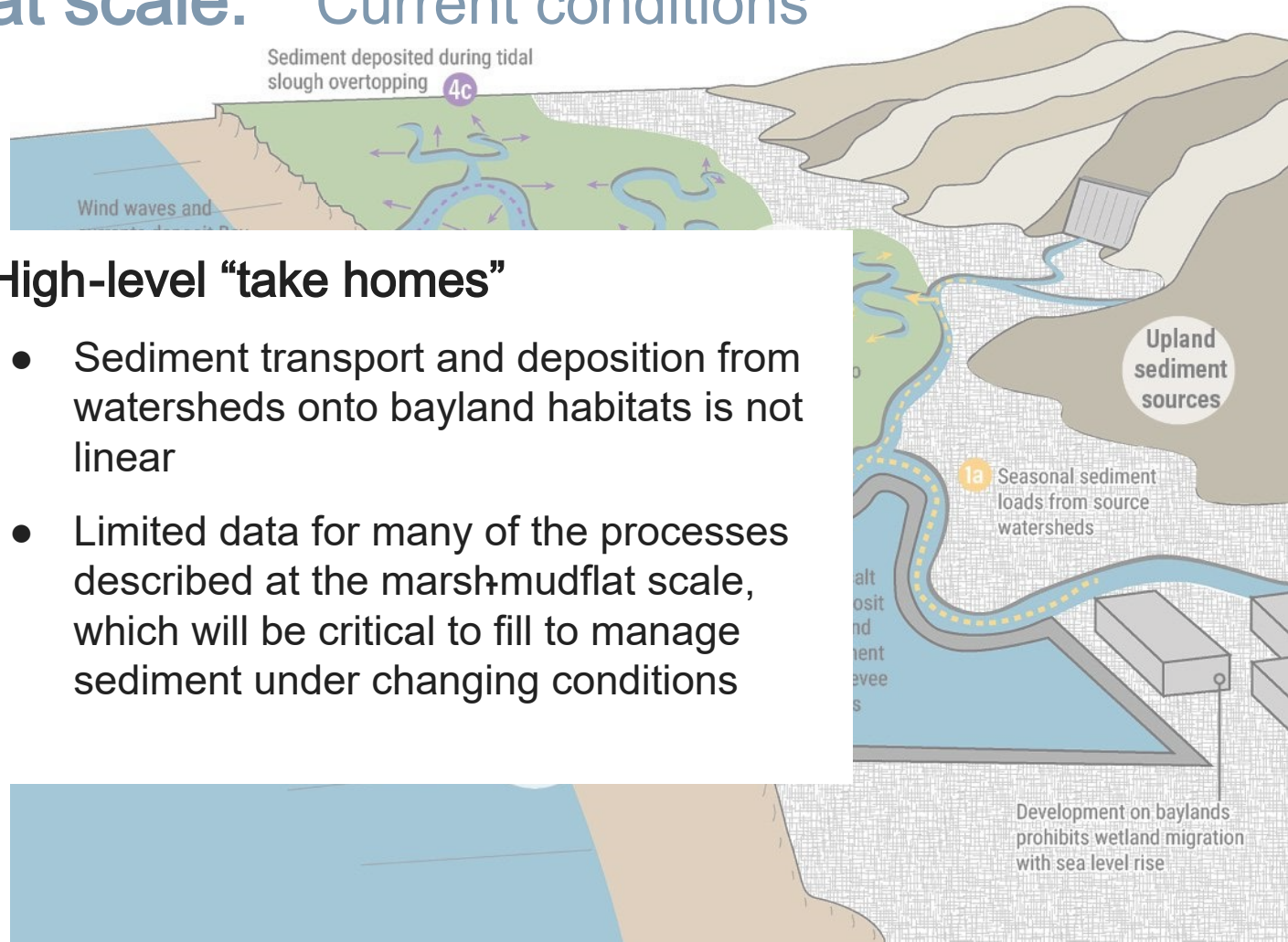
Marsh - mudflat scale: Current conditions



Marsh - mudflat scale: Current conditions



Marsh -mudflat scale: Current conditions



High-level “take homes”

- Sediment transport and deposition from watersheds onto bayland habitats is not linear
- Limited data for many of the processes described at the marsh-mudflat scale, which will be critical to fill to manage sediment under changing conditions



It's not so simple!

Marsh - scale variables affecting sediment transport:

- Elevation
- Levees/shoreline hardening
- Channel density/complexity
- Sediment supply/wave energy
- Vegetation density
- Concavity/convexity



Next steps



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- Technical advisory committee and management advisory committee to **review final draft in November**

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- Report will be released
- **Use as a communication tool** towards a shared conceptual understanding of sediment magnitudes and uncertainties in SF Bay
- **Use data gaps identified in the report to help make the best use of limited resources** to address questions regarding *sediment flux and deposition in the Bay and sediment delivery to marshes*



Thank you

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