Estuarine Tidal Flat Evolution at the Decadal Time Scale

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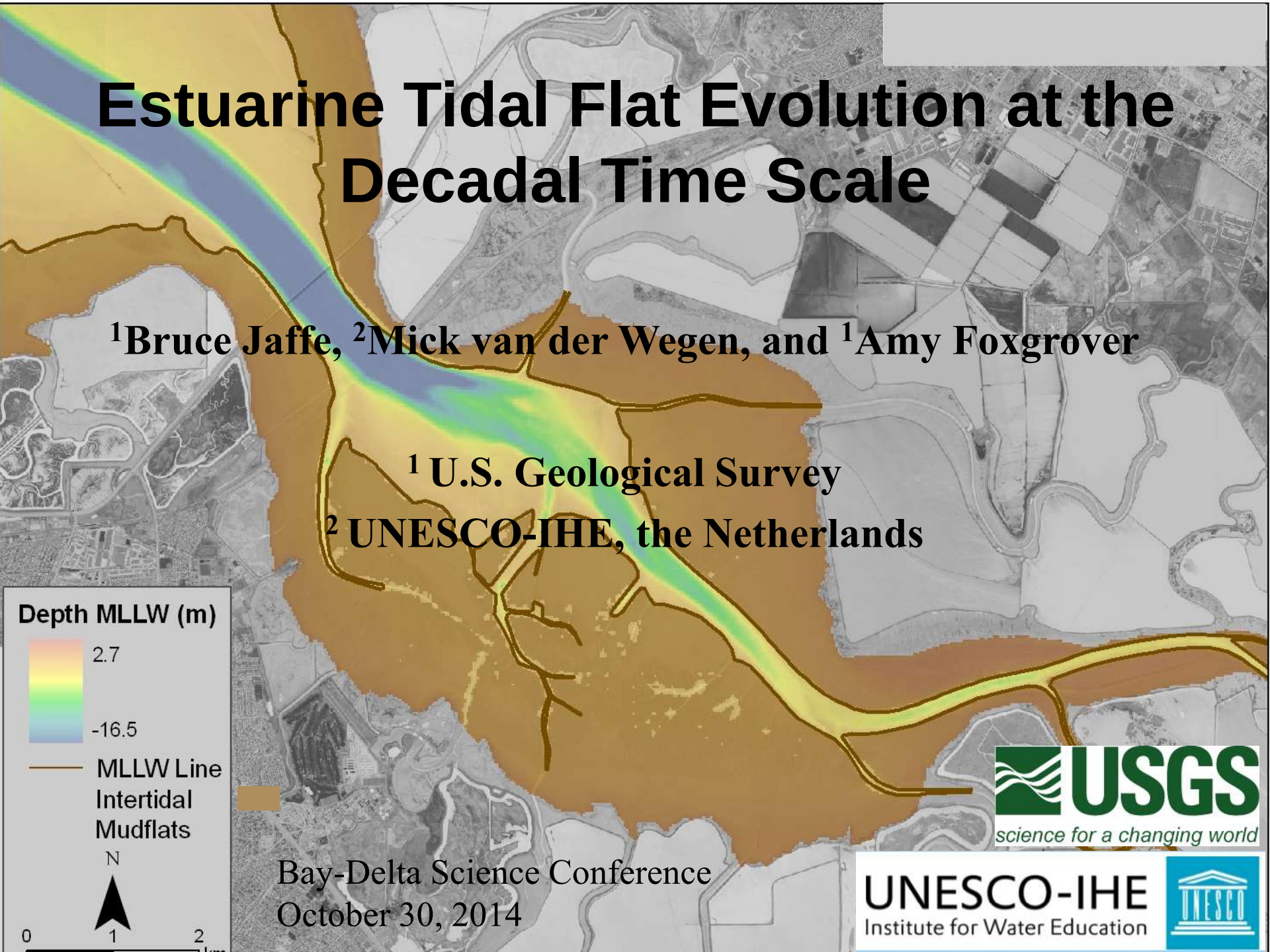
[1] U.S. Geological Survey

[2] UNESCO-IHE, the Netherlands



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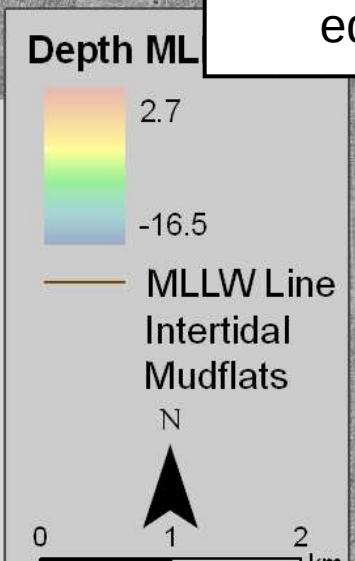
Main Points

1) Intertidal flat width in South San Francisco Bay narrowed and widened in the past in response to changes in sediment supply

2) 1D modeling indicates that timescales for profile evolution are long and that South San Francisco Bay intertidal flats are not in equilibrium



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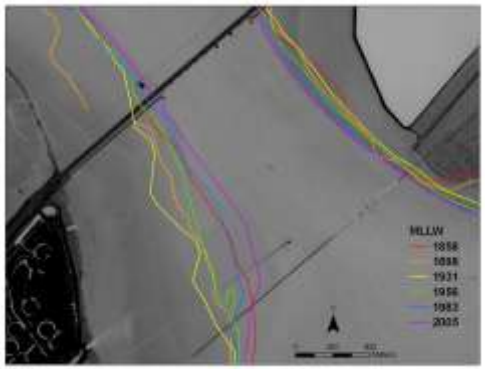
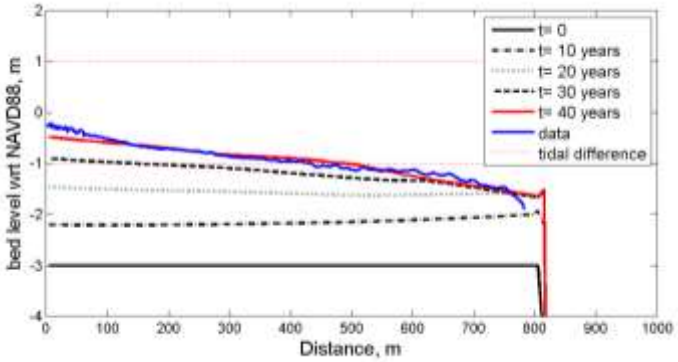
Outline

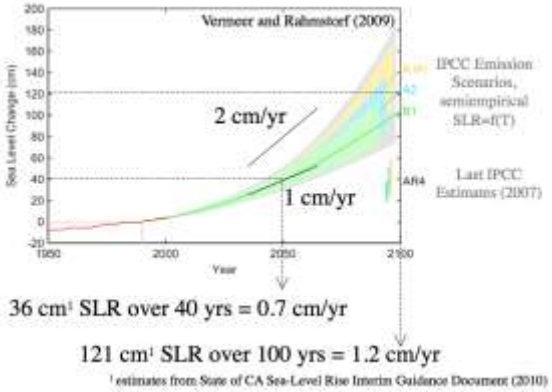
Long-term changes in intertidal flat width in South San Francisco Bay



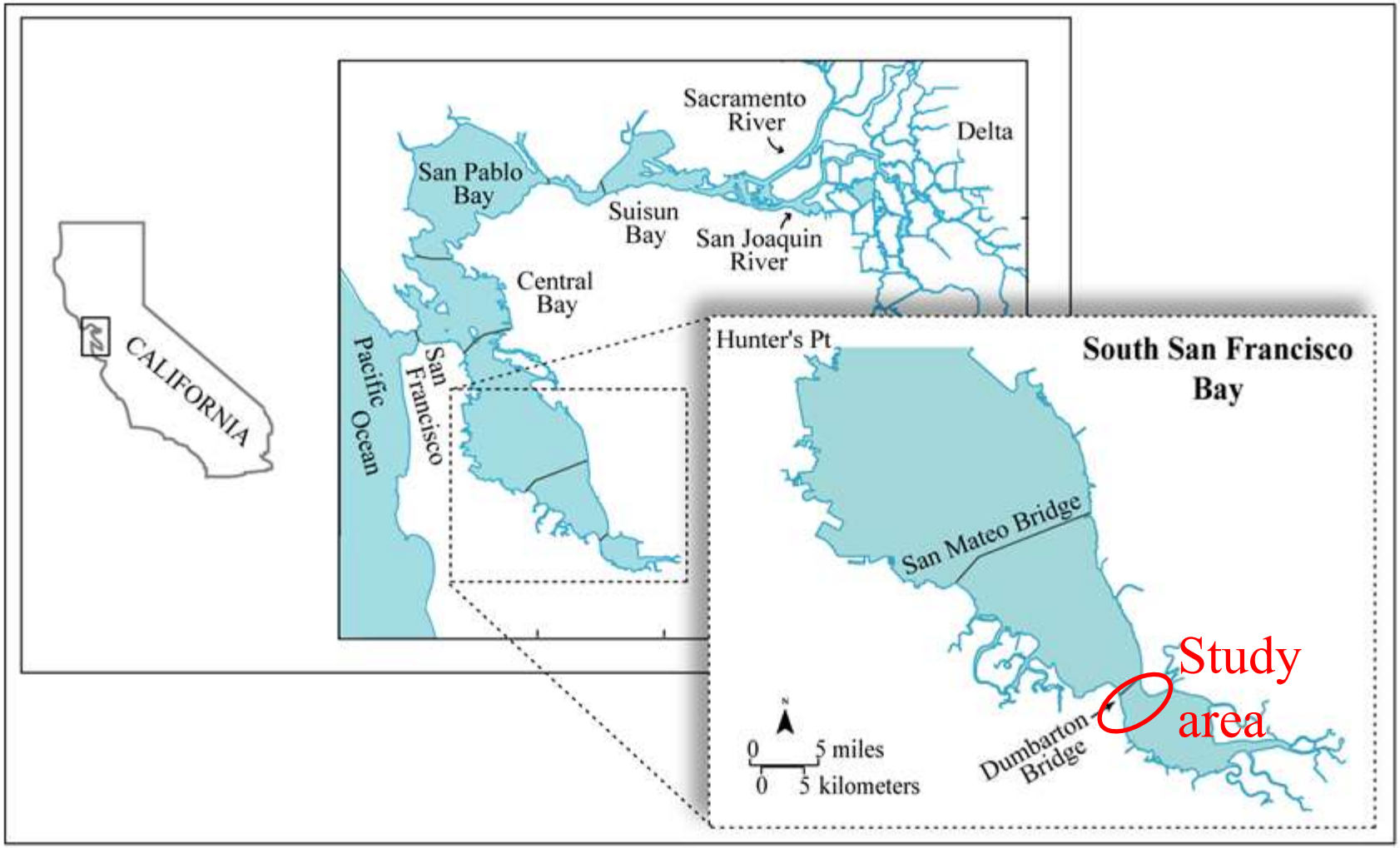
1D modeling of intertidal flat development



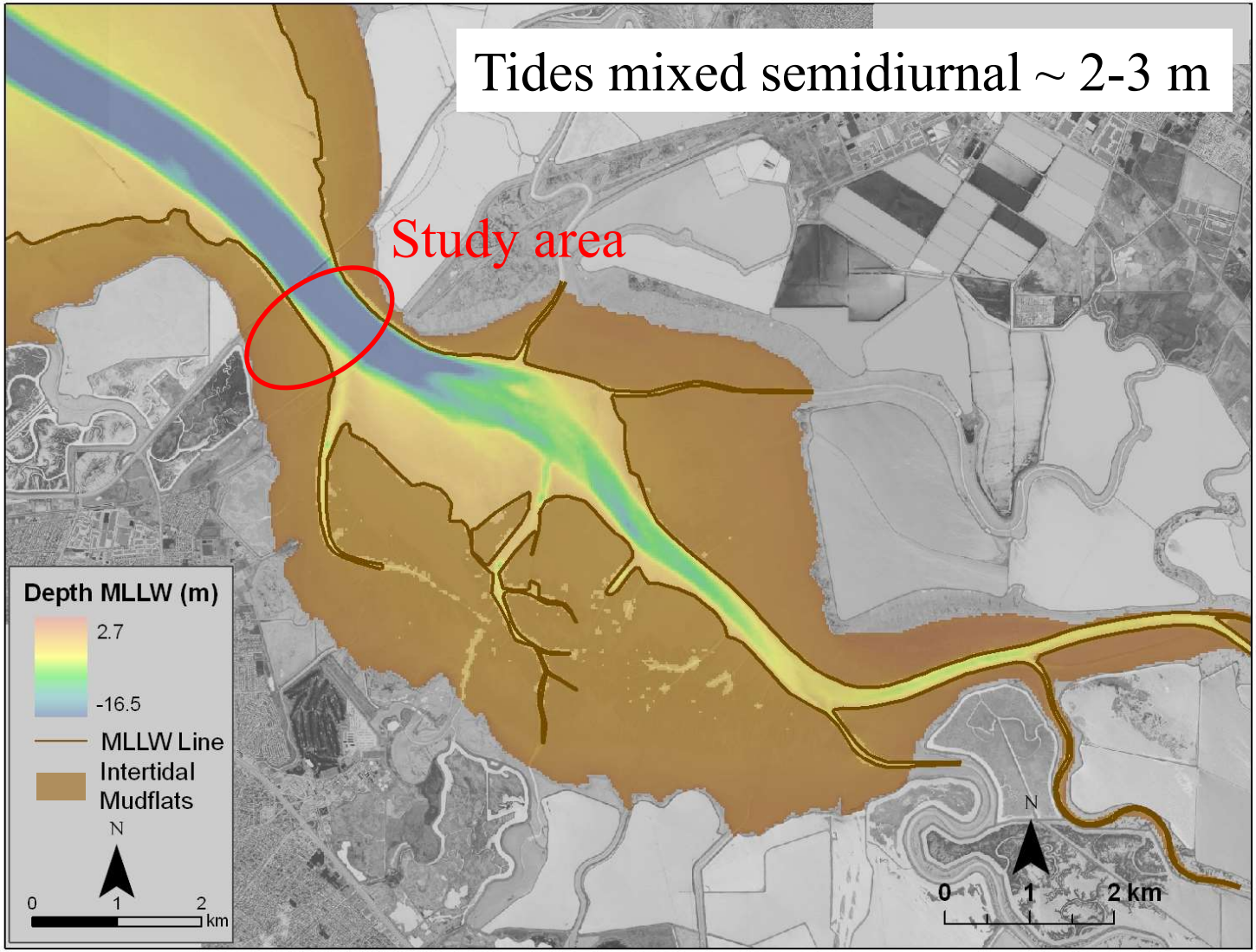
Future Work



Study Area


CALIFORNIA
Sacramento River
Delta
San Pablo Bay
Suisun Bay
San Joaquin River
Central Bay
Pacific Ocean
San Francisco
Hunter's Pt
South San Francisco Bay
San Mateo Bridge
Study area
Dumbarton Bridge
0 5 miles
0 5 kilometers

South SF Bay Bathymetry

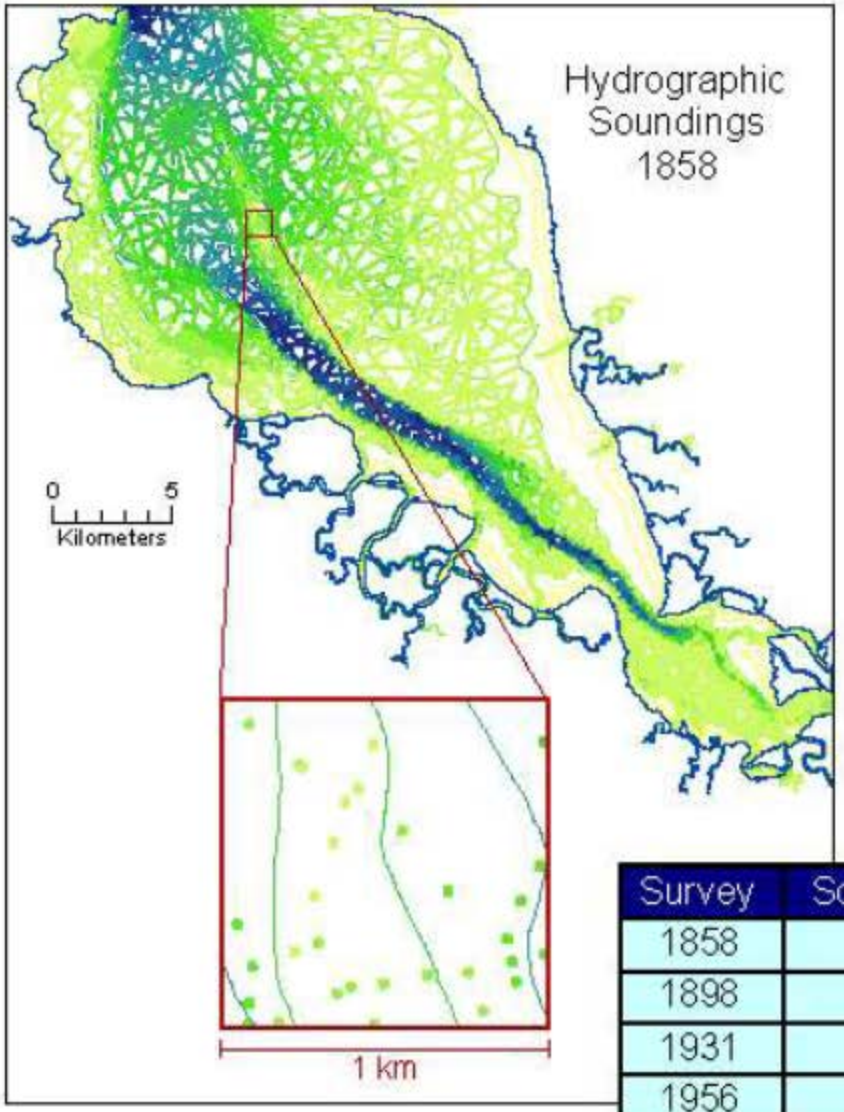


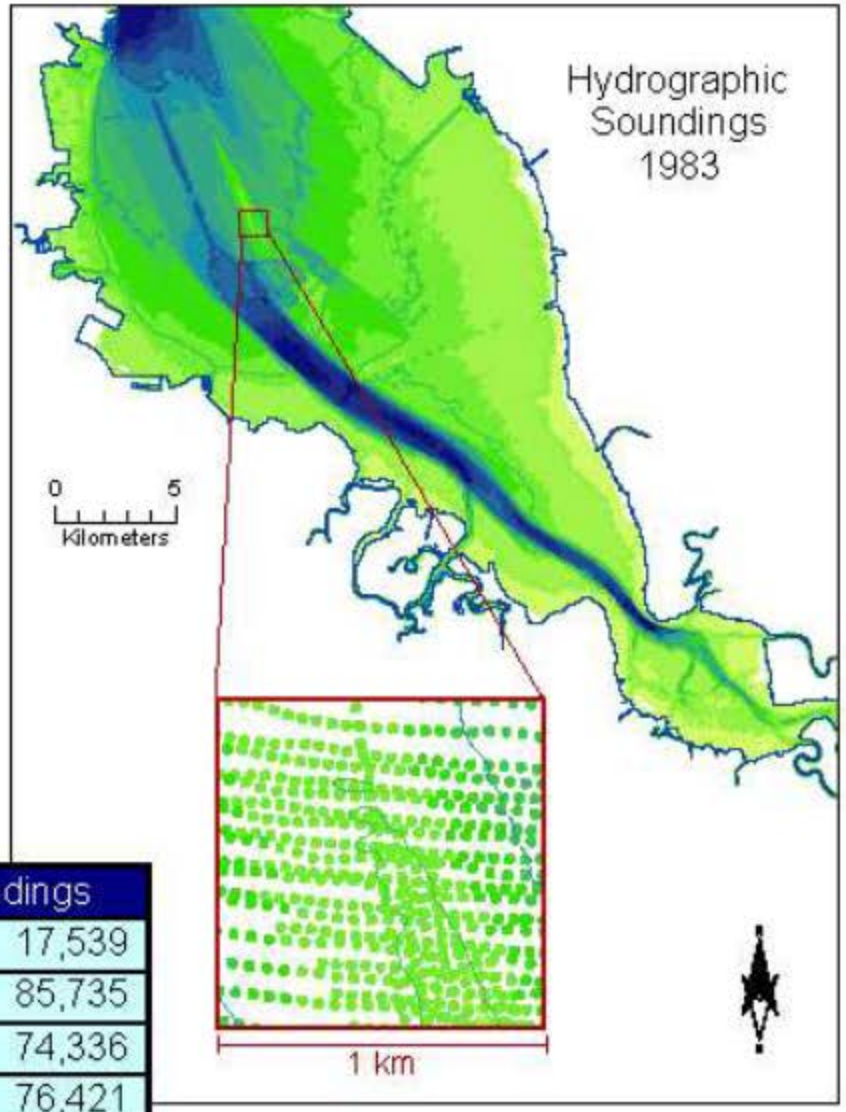
2004 and 2005 data

South SF Bay Bathymetry

Image obtained from NOAA photo library (www.photolib.noaa.gov)

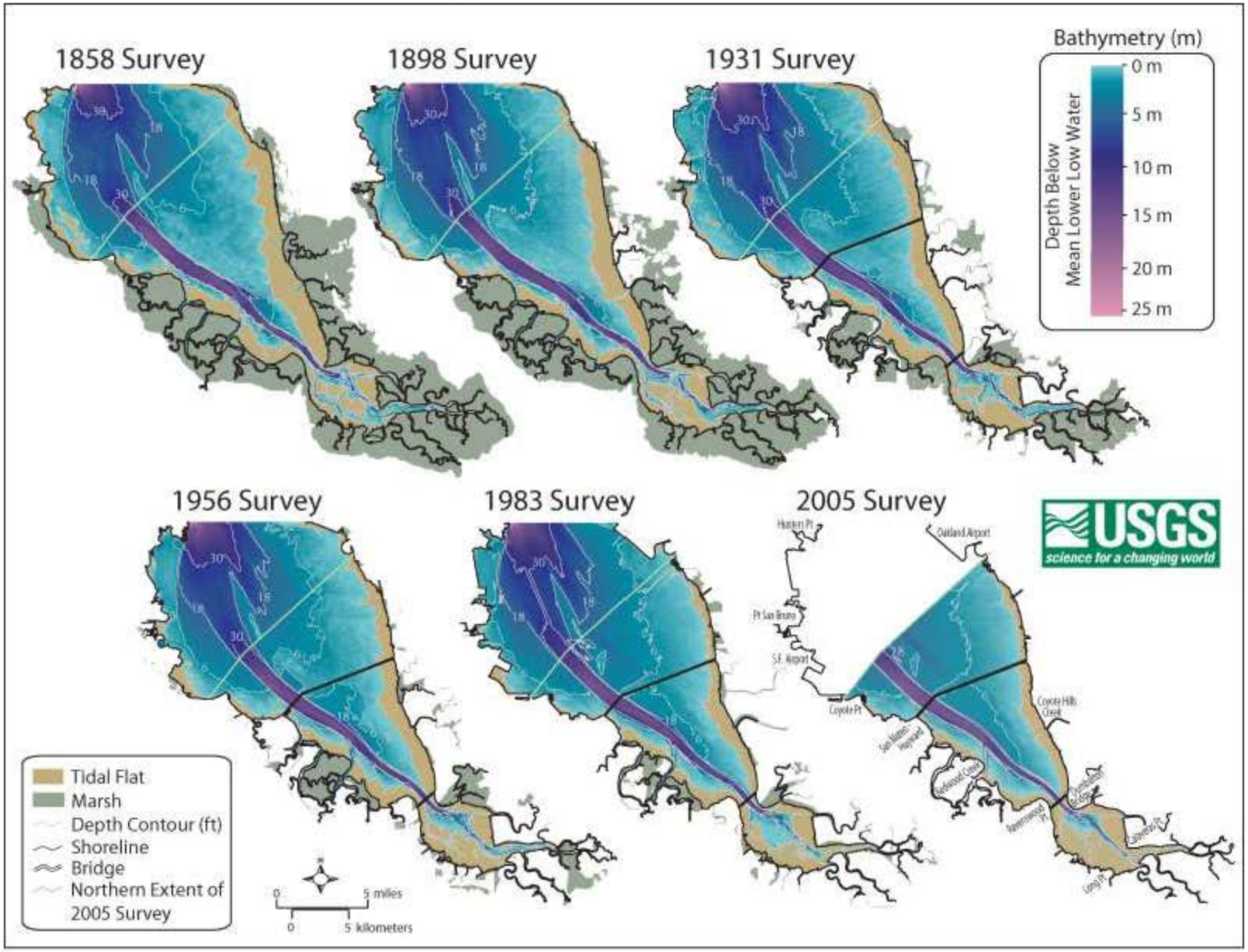
Bathymetric Data



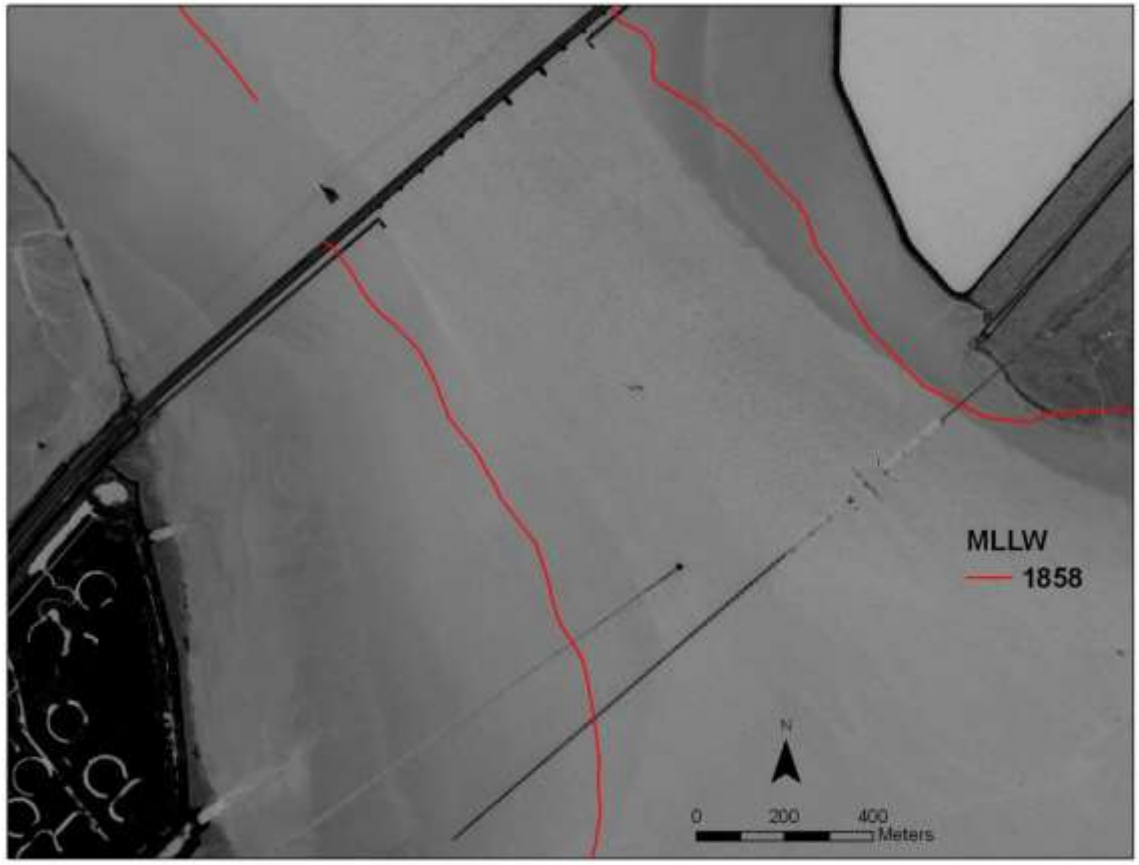


Survey	Soundings
1858	17,539
1898	85,735
1931	74,336
1956	76,421
1983	127,624

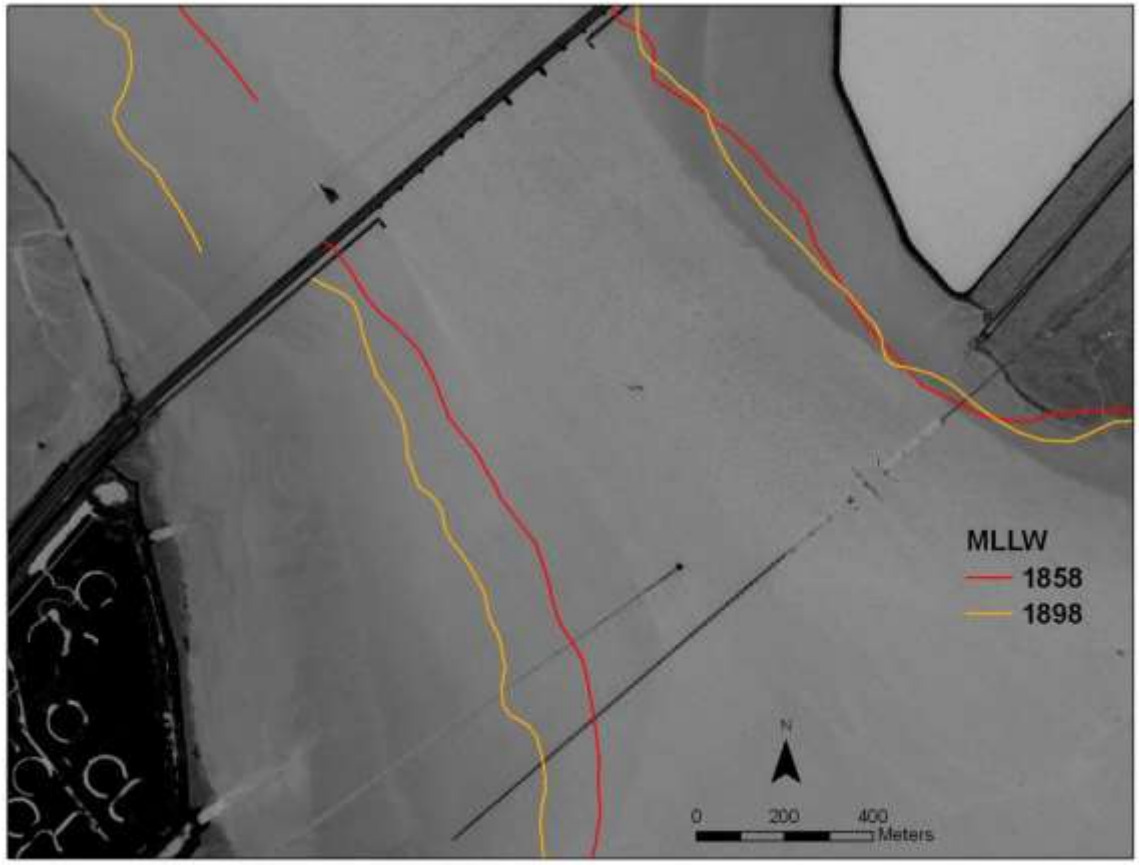
Bathymetric Grids



Long-term change in intertidal flat width



Long-term change in intertidal flat width



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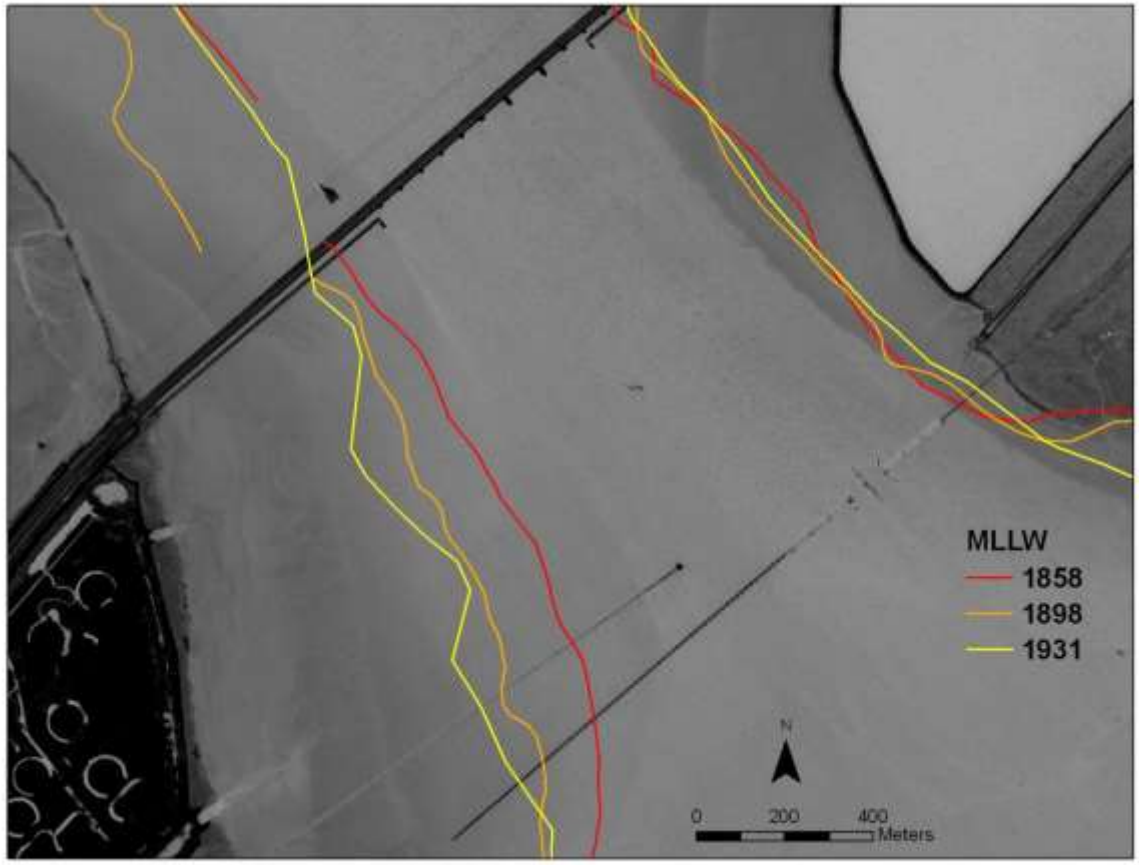

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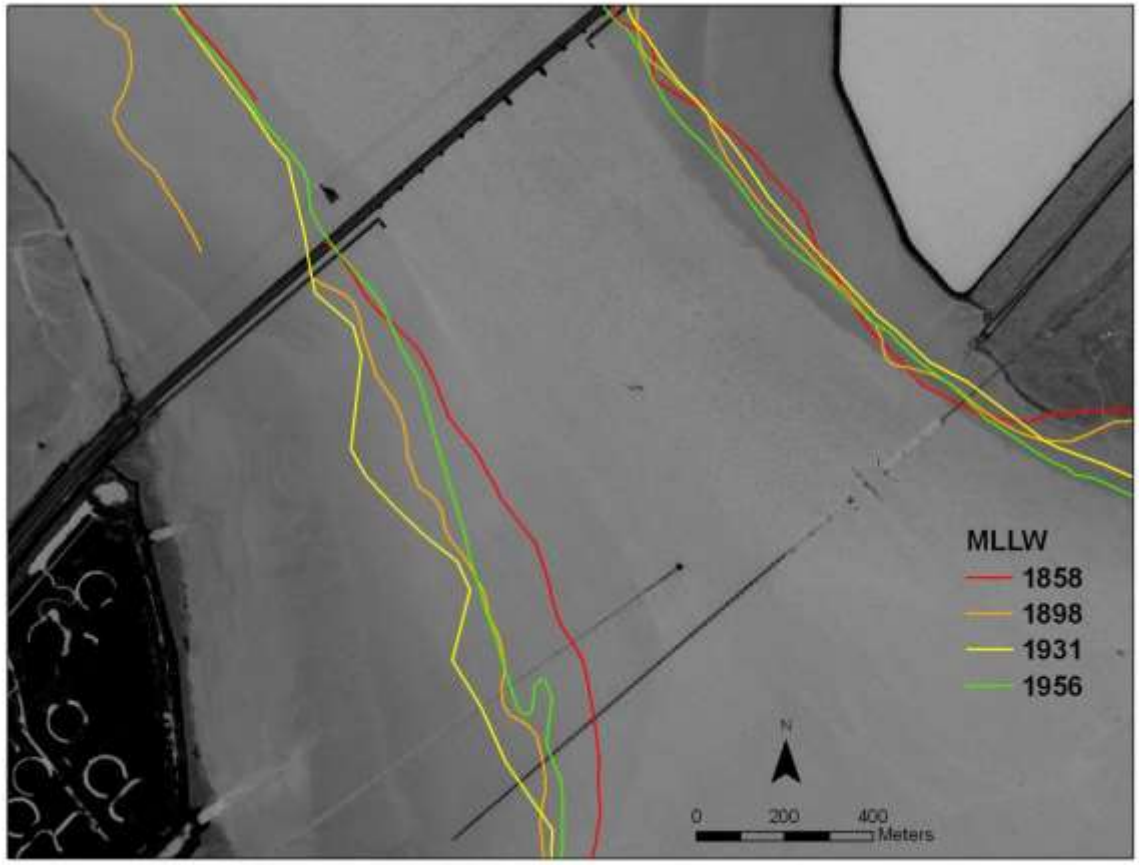

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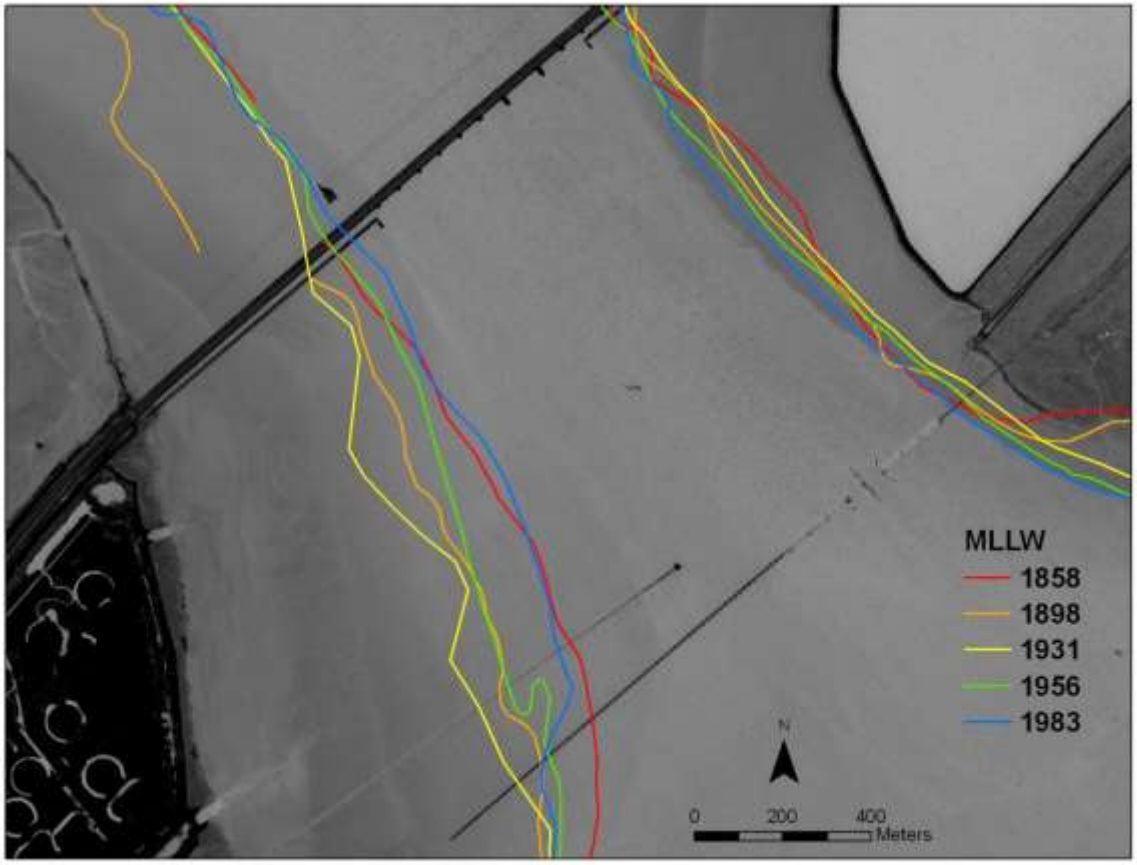
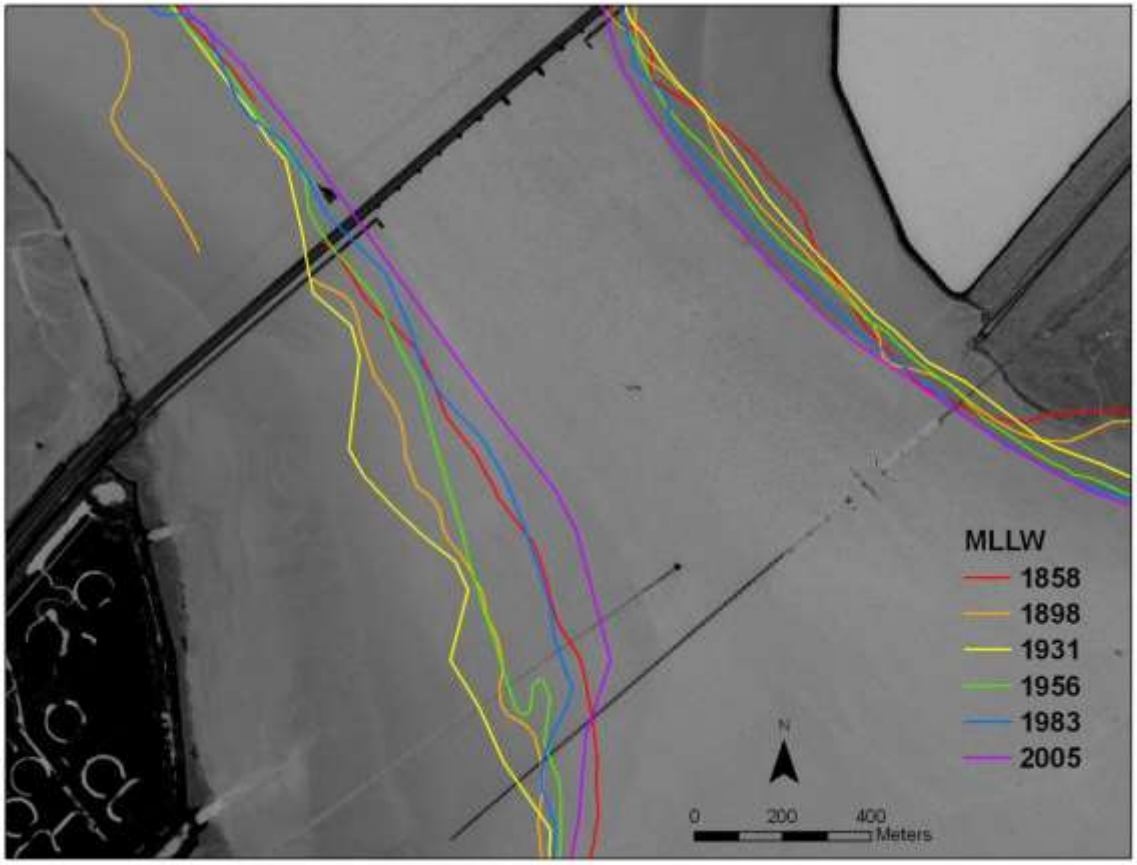
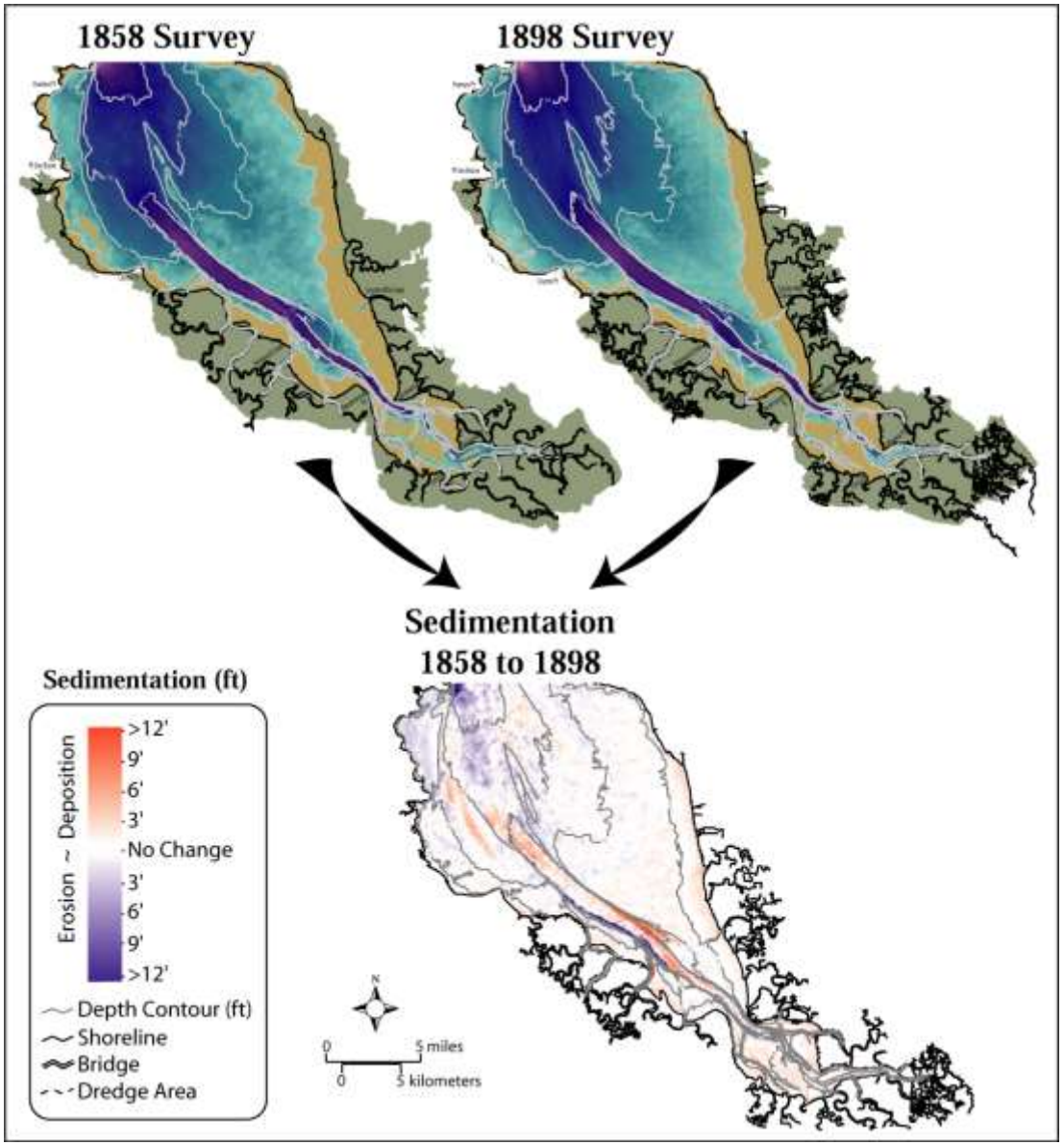
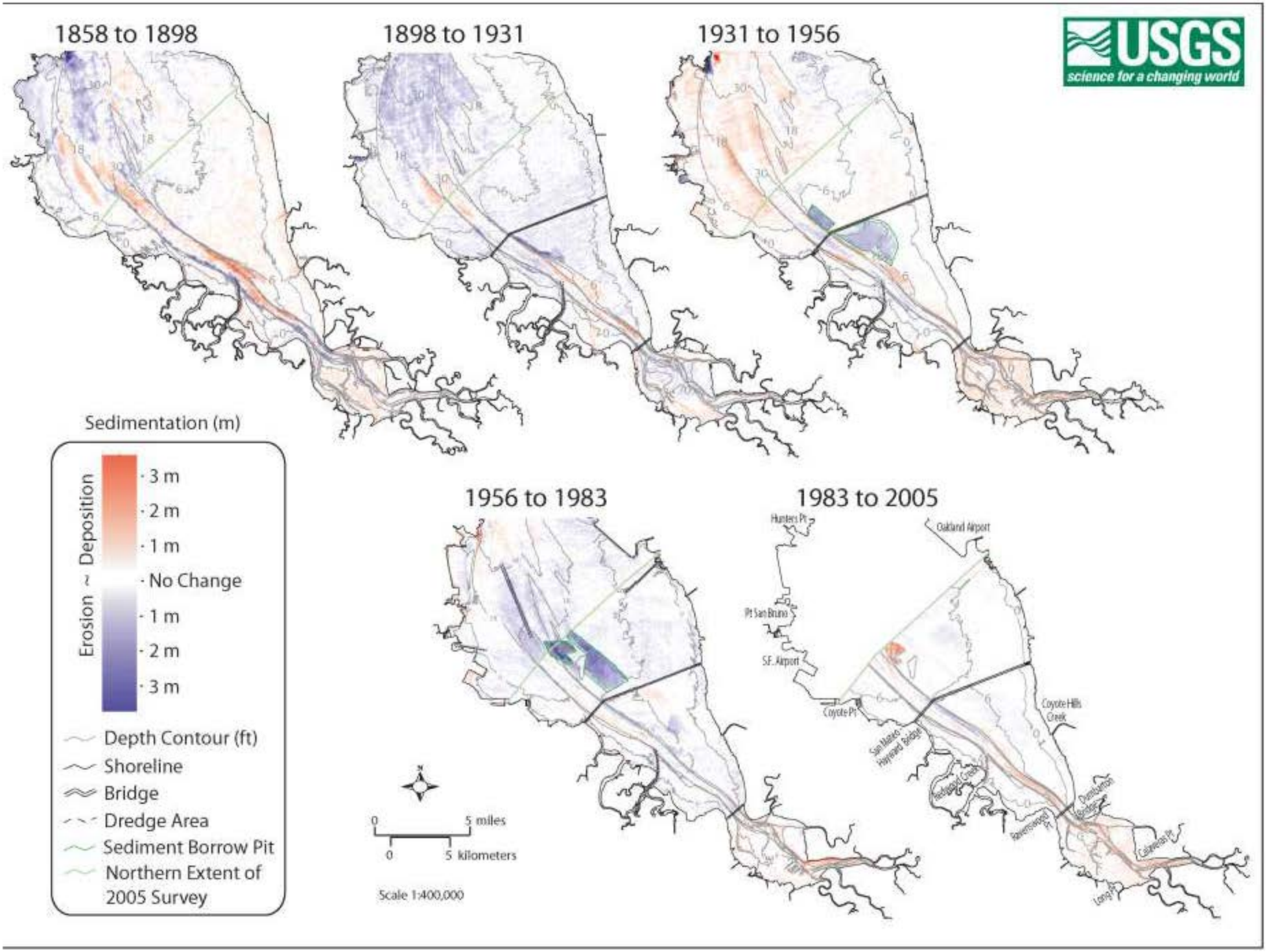


Long-term change in intertidal flat width



Sedimentation Grids




1858 to 1898
1898 to 1931
1931 to 1956
1956 to 1983
1983 to 2005
USGS
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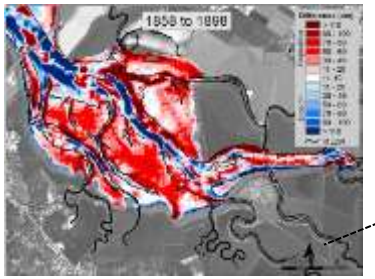
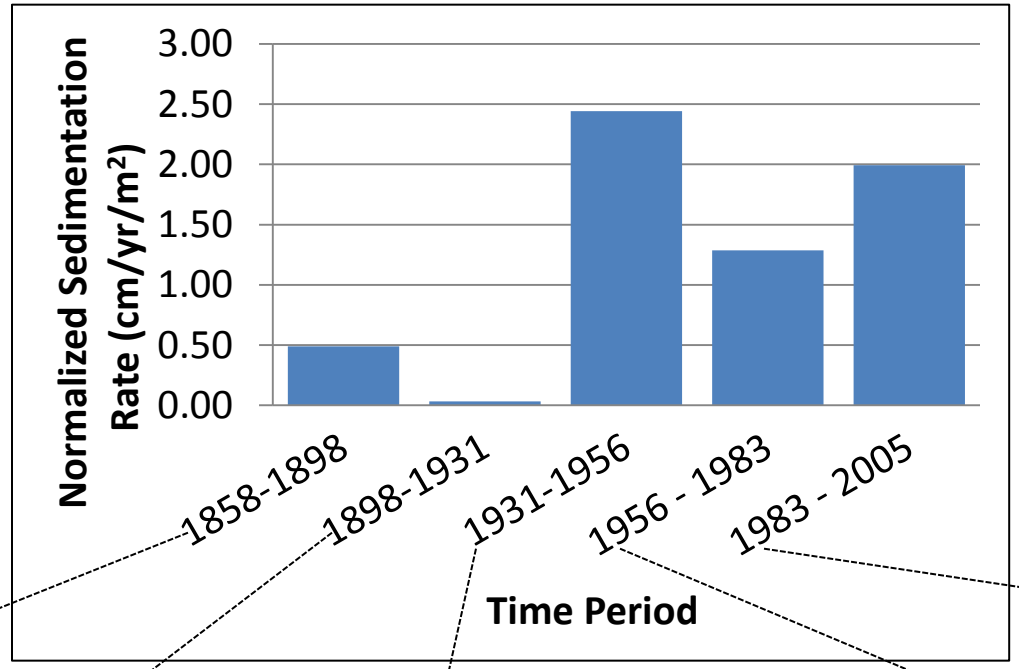
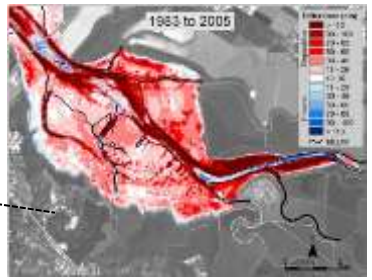
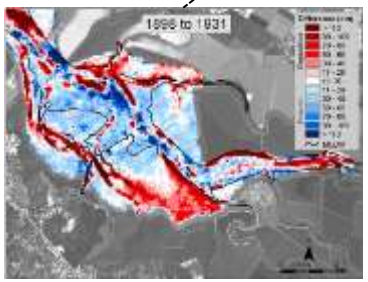
Sedimentation (m)
Deposition
Erosion
3 m
2 m
1 m
No Change
1 m
2 m
3 m
Depth Contour (ft)
Shoreline
Bridge
Dredge Area
Sediment Borrow Pit
Northern Extent of 2005 Survey
0
5 miles
0
5 kilometers
Scale 1:400,000
Hunters Pt
Oakland Airport
Pt San Bruno
S.F. Airport
Coyote Pt
Coyote Hills Creek
San Mateo - Hayward Bridge
Dumbarton Bridge
Calaveras Pt
Long Pt

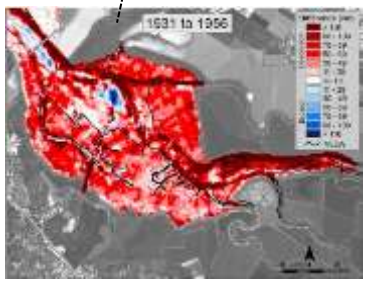
Historical Net Deposition

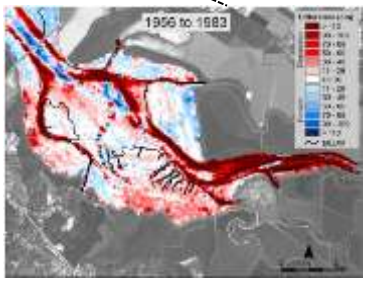




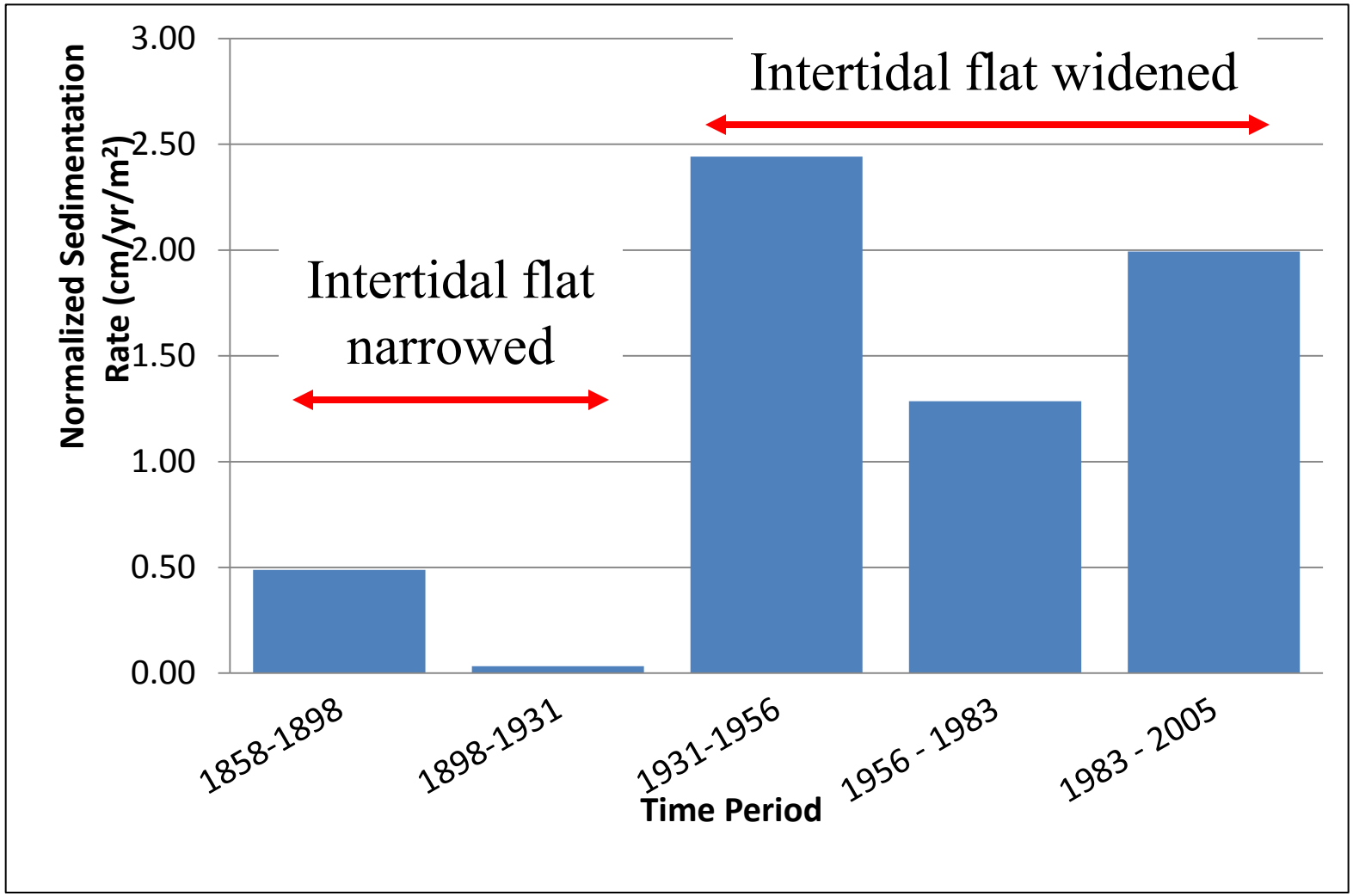






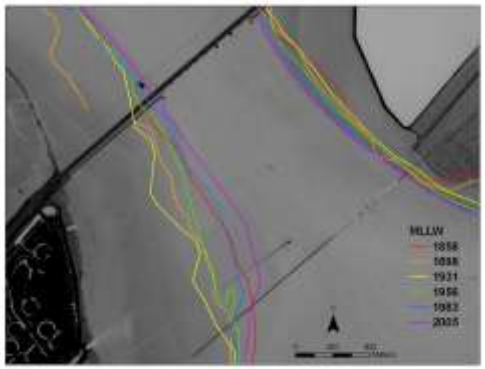


Intertidal flat width related to net deposition in far South Bay

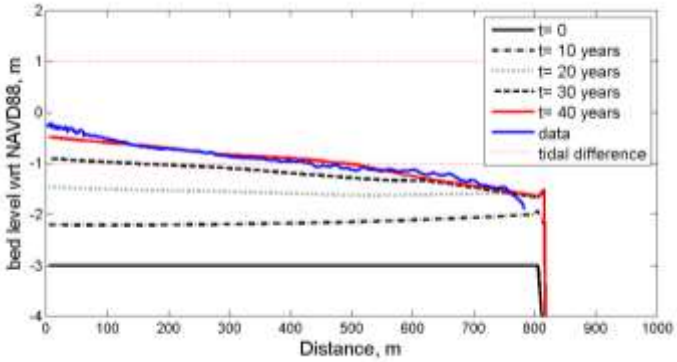


Outline

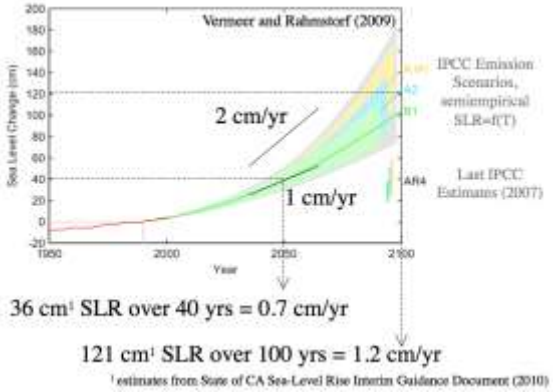
Long-term changes in intertidal flat width in South San Francisco Bay



1D modeling of intertidal flat development

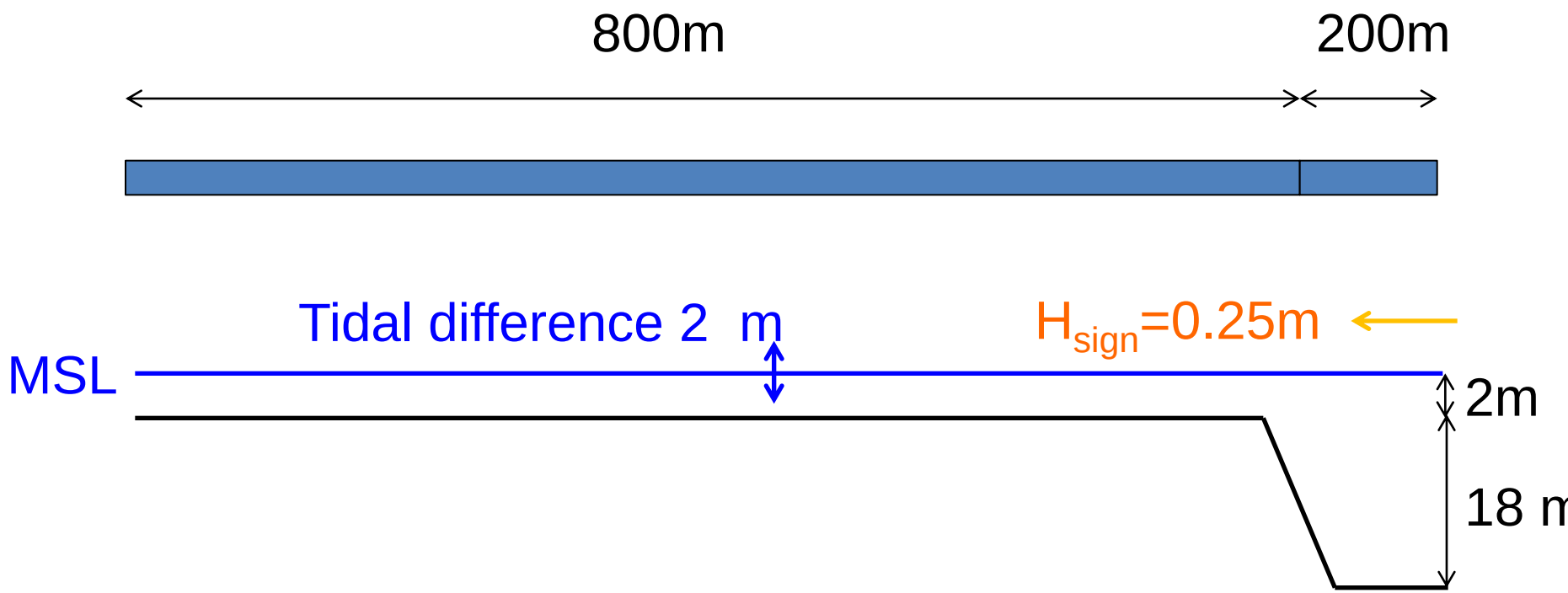


Future Work

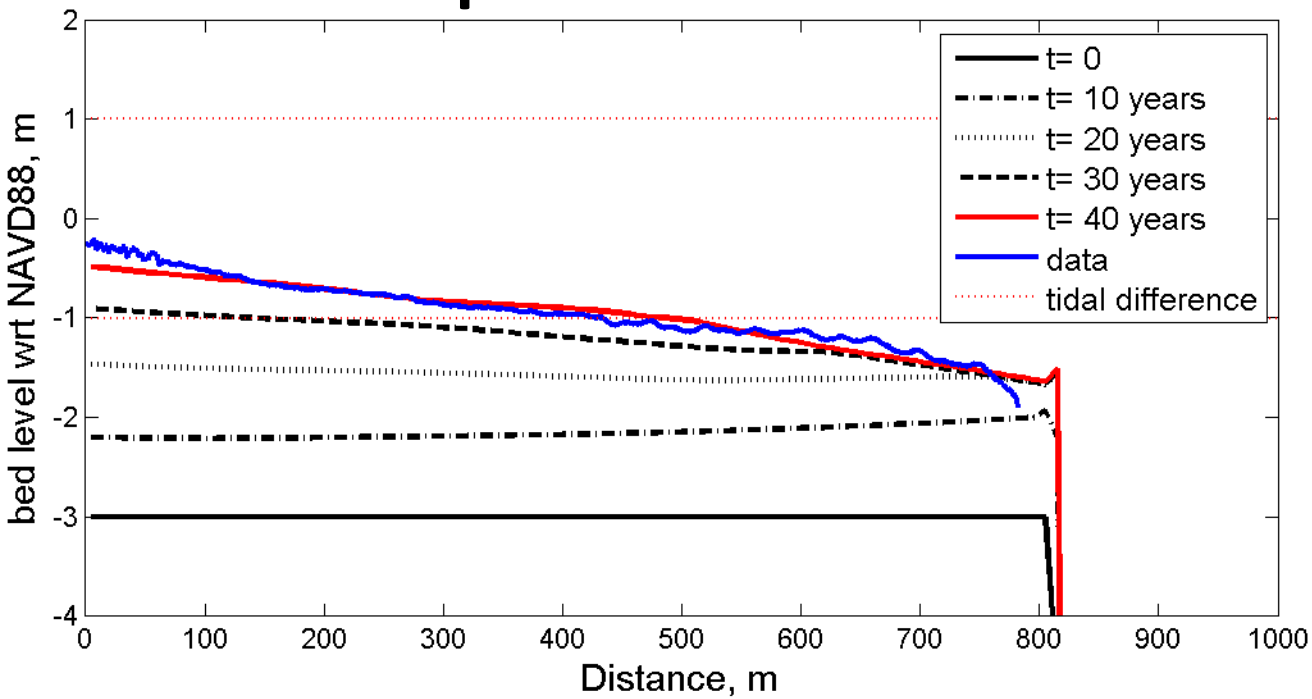


Delft 3D model specification (1D mode)

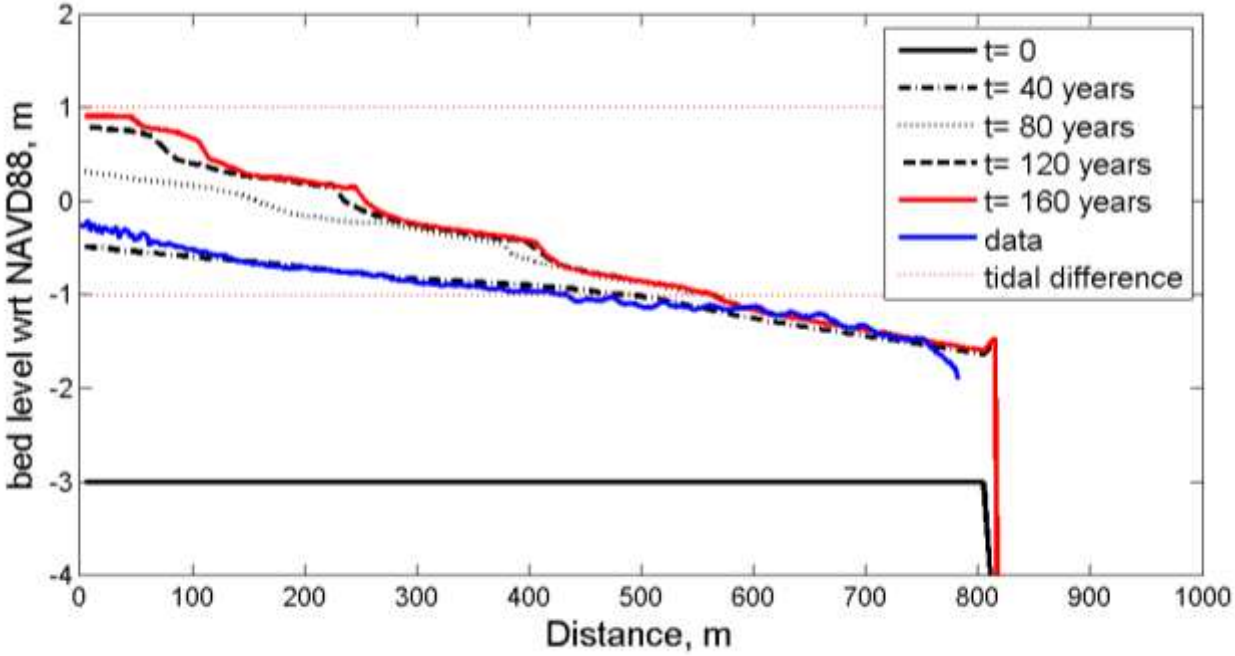
Dx=10 m
Dt=12 s



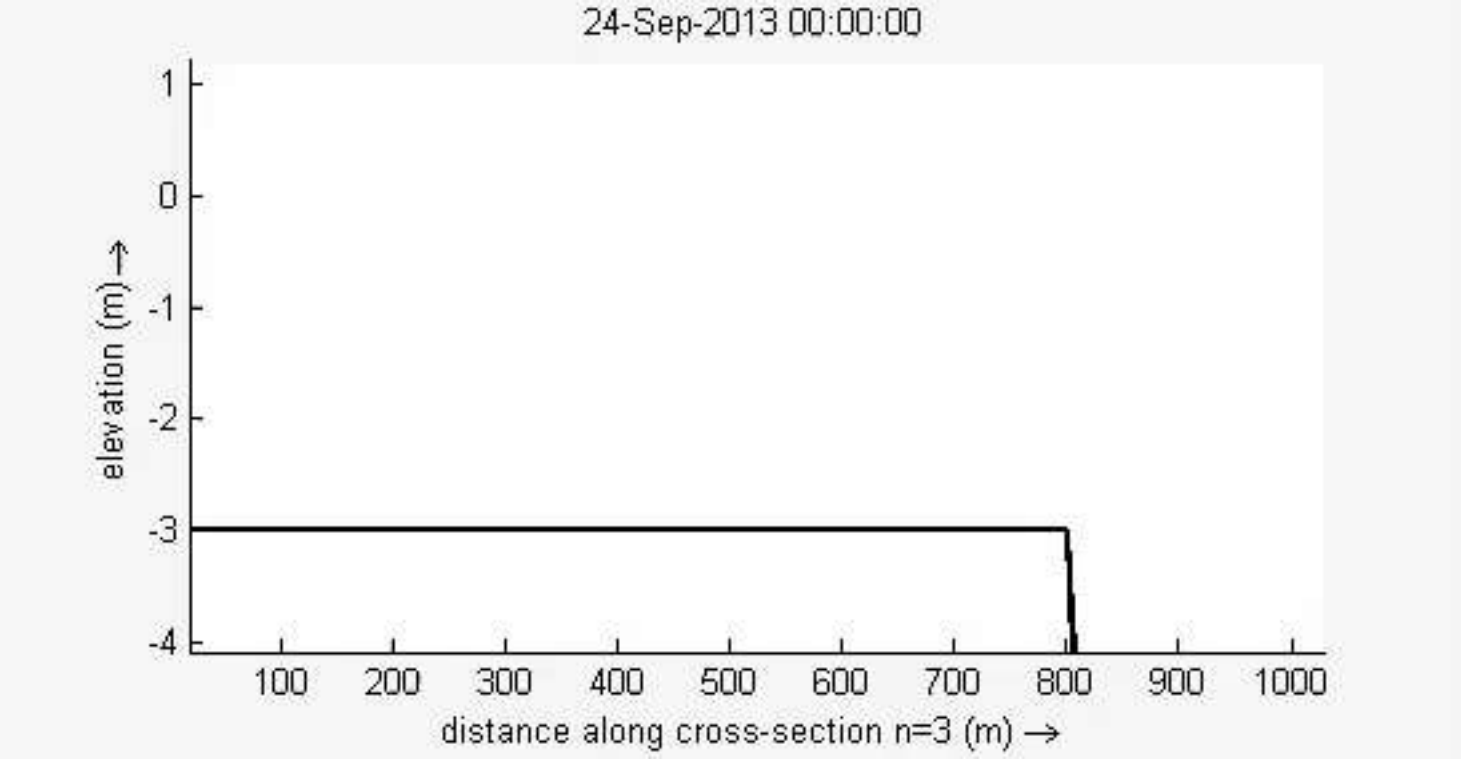
Model reproduces measured profile.....



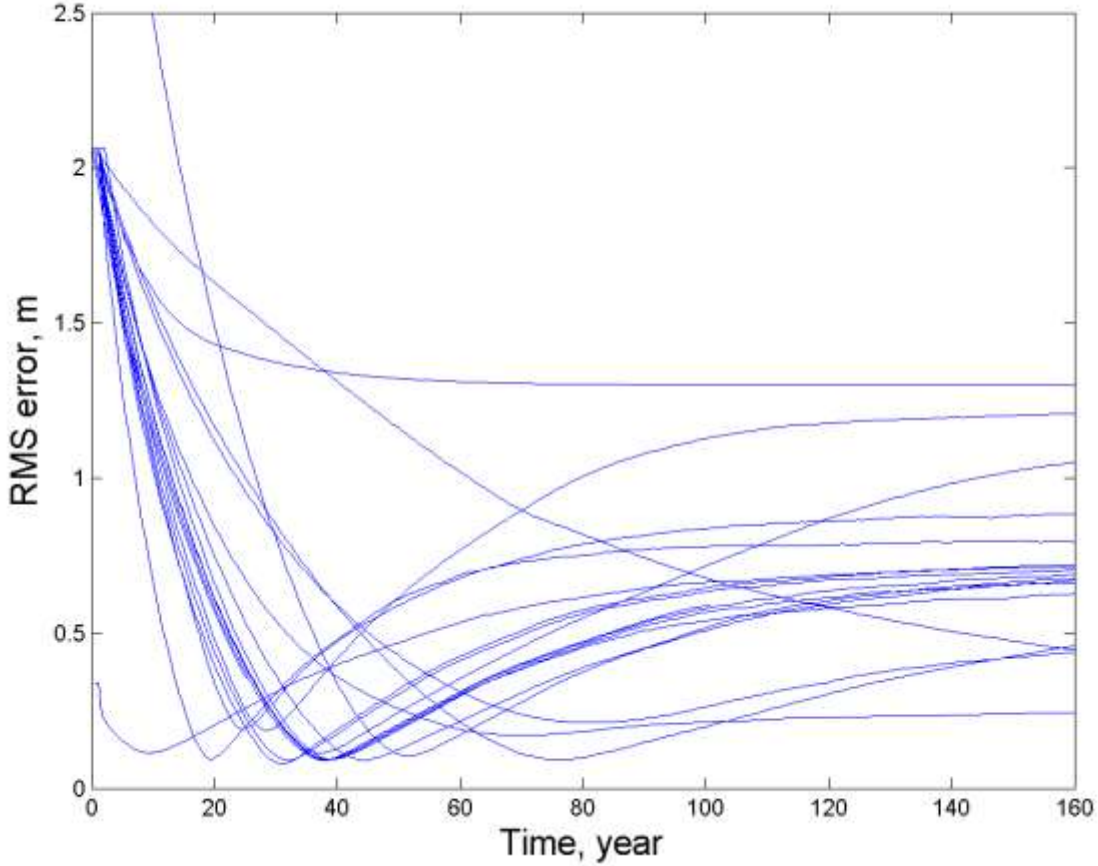
...but not as equilibrium..



Profile evolution



...independent of all possible sensitivities



Implying that (if model is right)

- profile is currently not in equilibrium
- steepening of the profile will occur
- adaptation time scales are long (~ decades)

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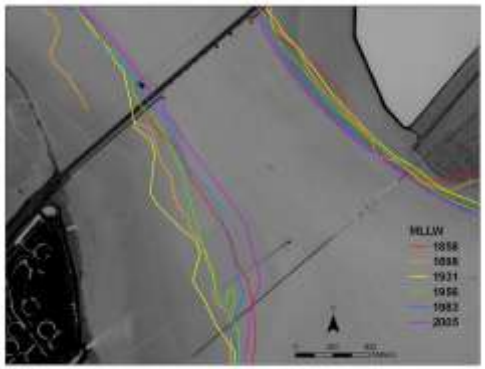

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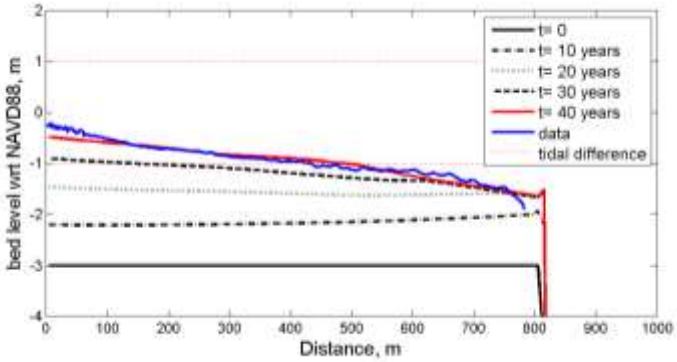
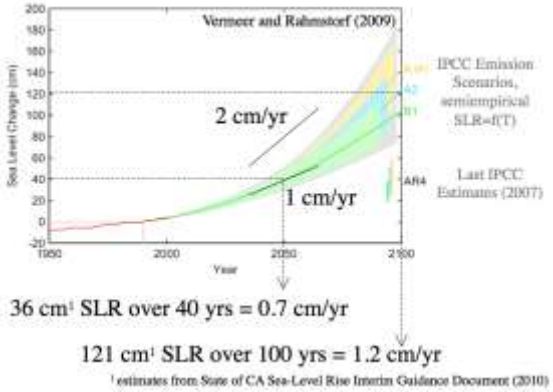
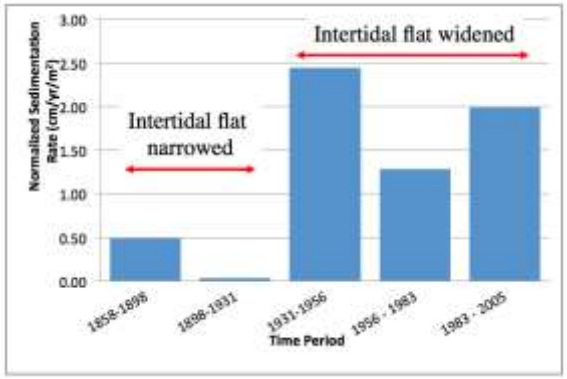


Future Work

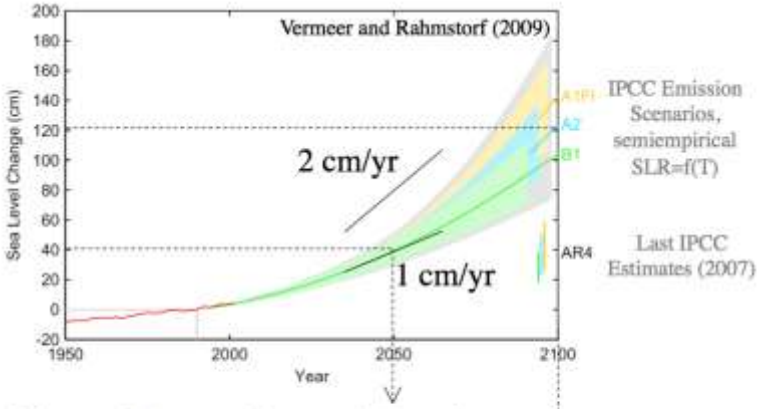


Future Work

- Exploring the influence of changing sediment supply on intertidal flats



- Model the influence of sea level rise on intertidal flats



36 cm[1] SLR over 40 yrs = 0.7 cm/yr

121 cm[1] SLR over 100 yrs = 1.2 cm/yr

[1] estimates from State of CA Sea-Level Rise Interim Guidance Document (2010)

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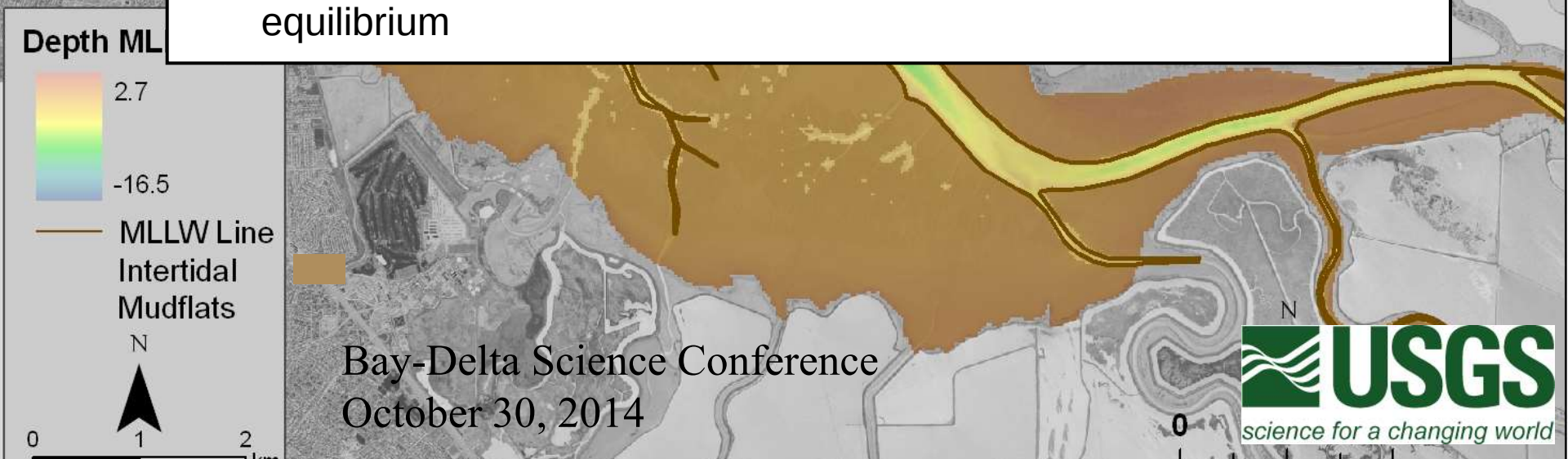

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