May 1st, 3:30 PM - 5:00 PM

Assessing tidal marsh vulnerability to sea-level rise in the Skagit Delta

W. Gregory Hood
Skagit River System Cooperative, ghood@skagitcoop.org

Eric Grossman
U.S. Geological Survey

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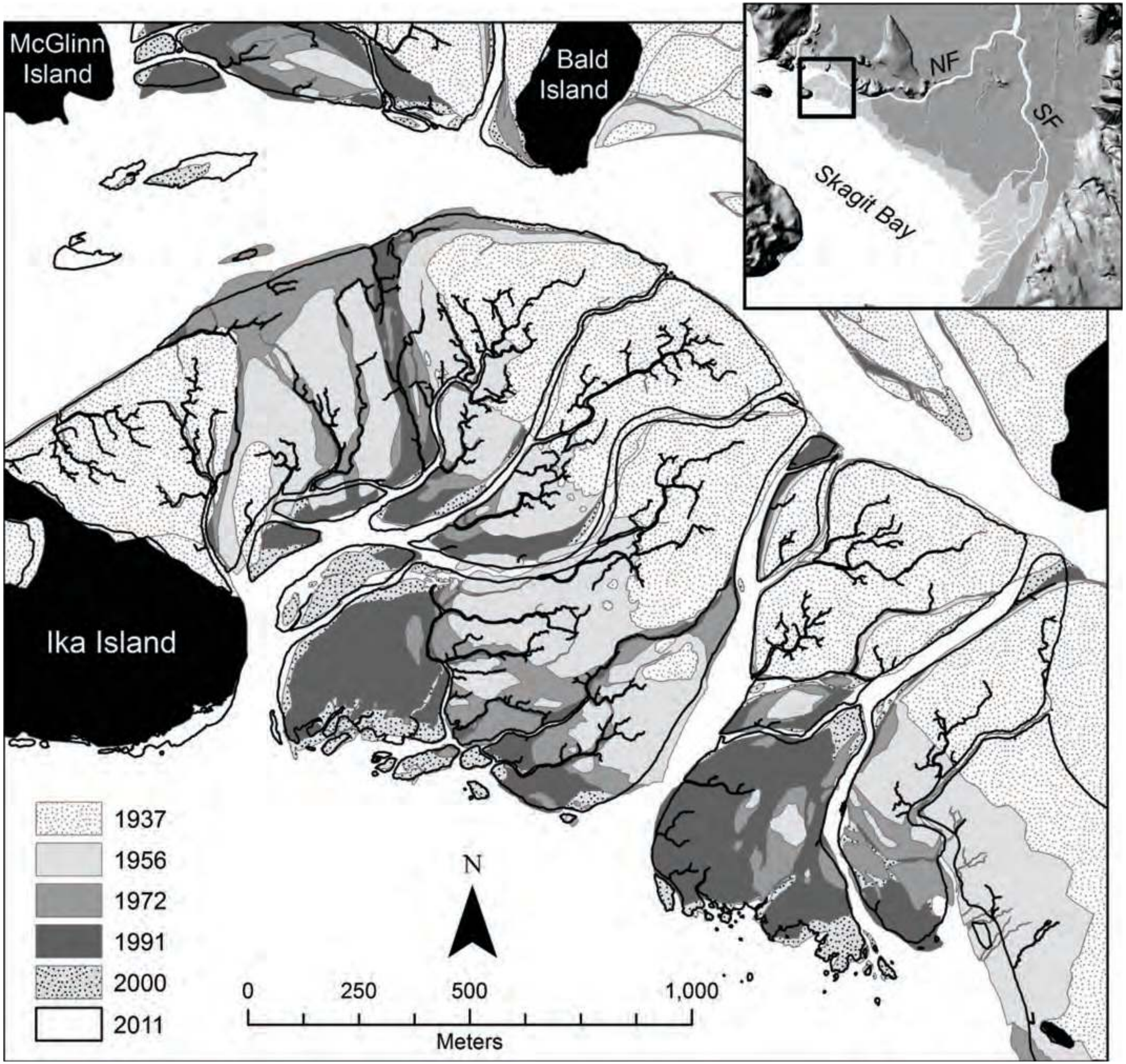
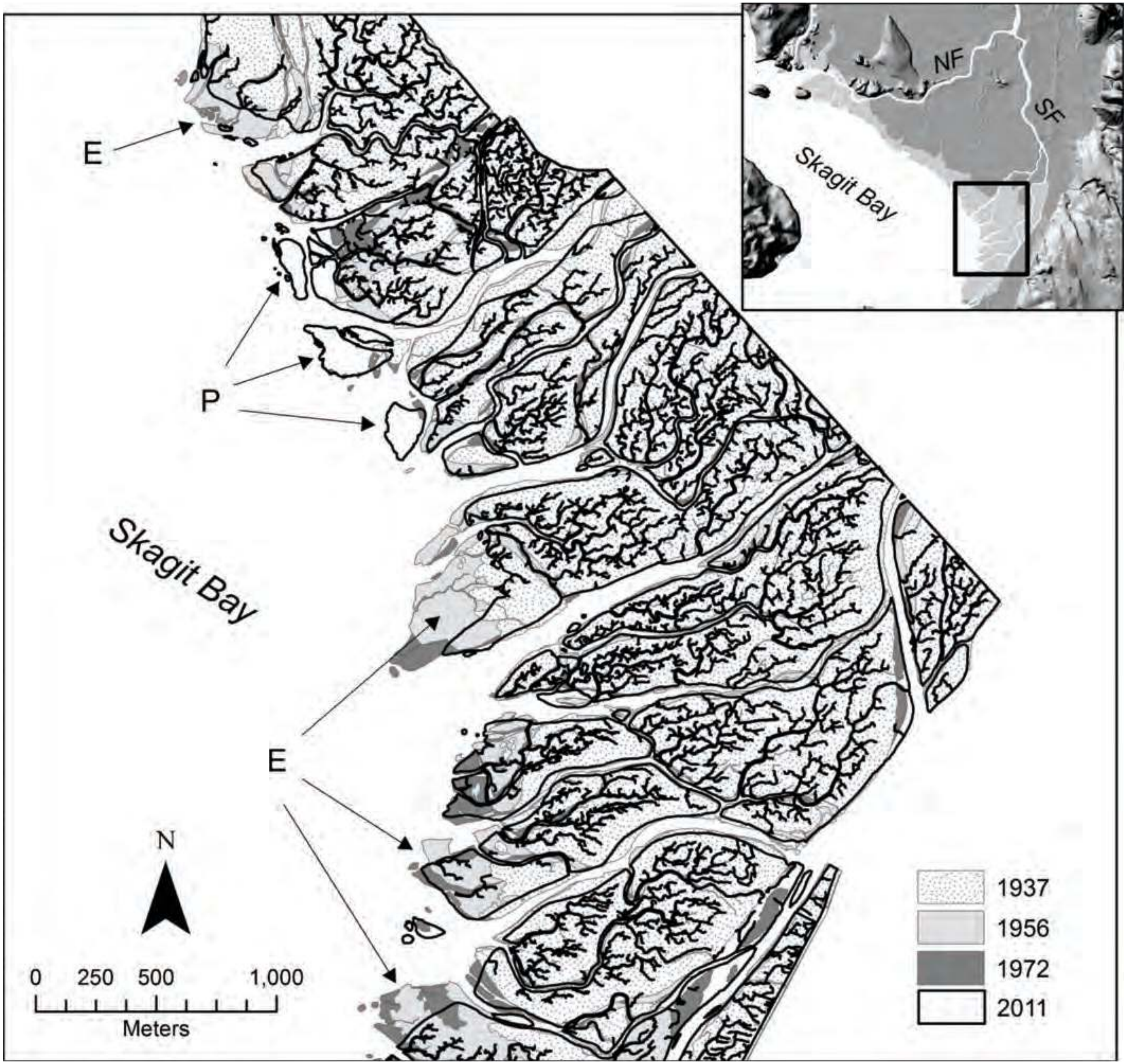
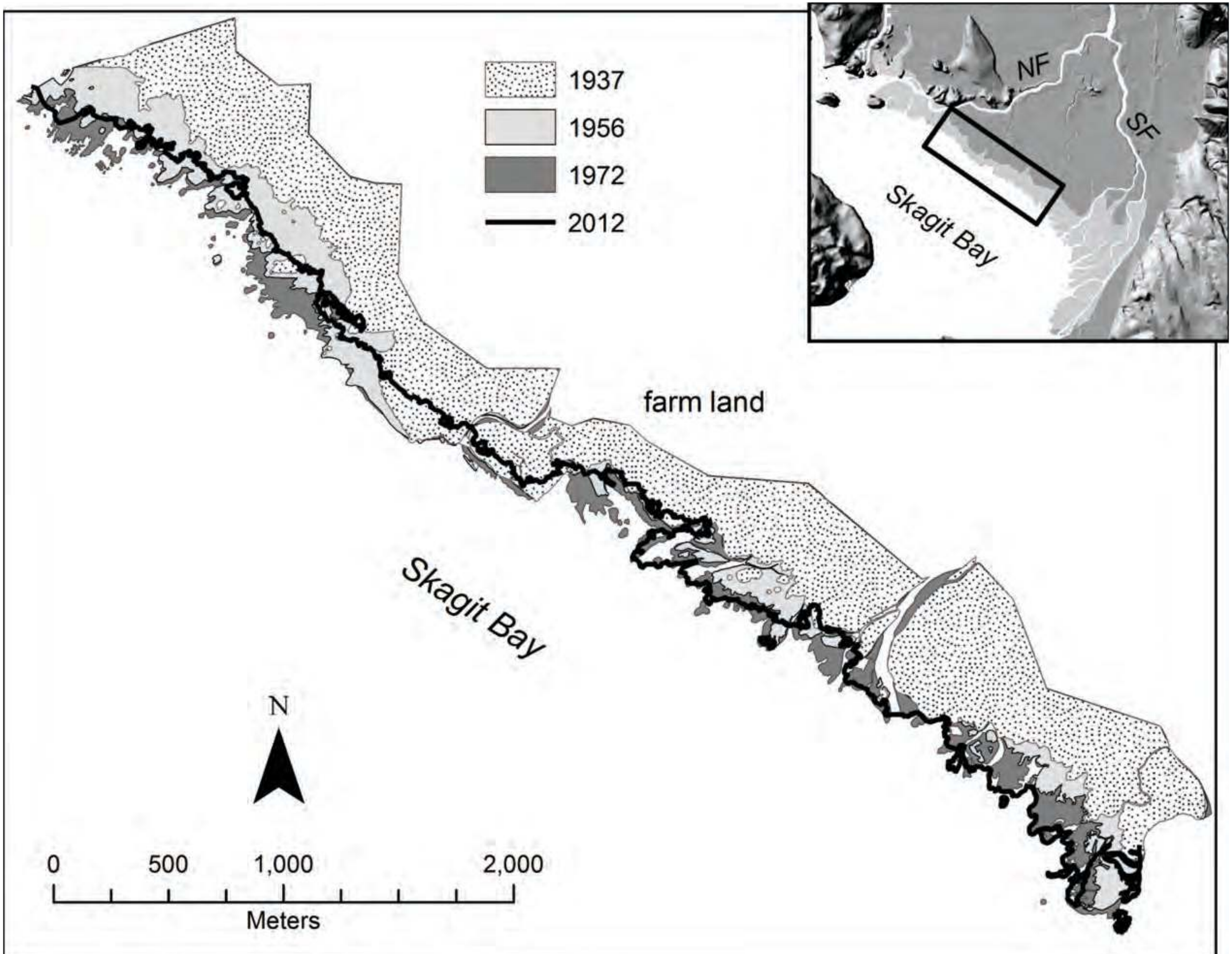
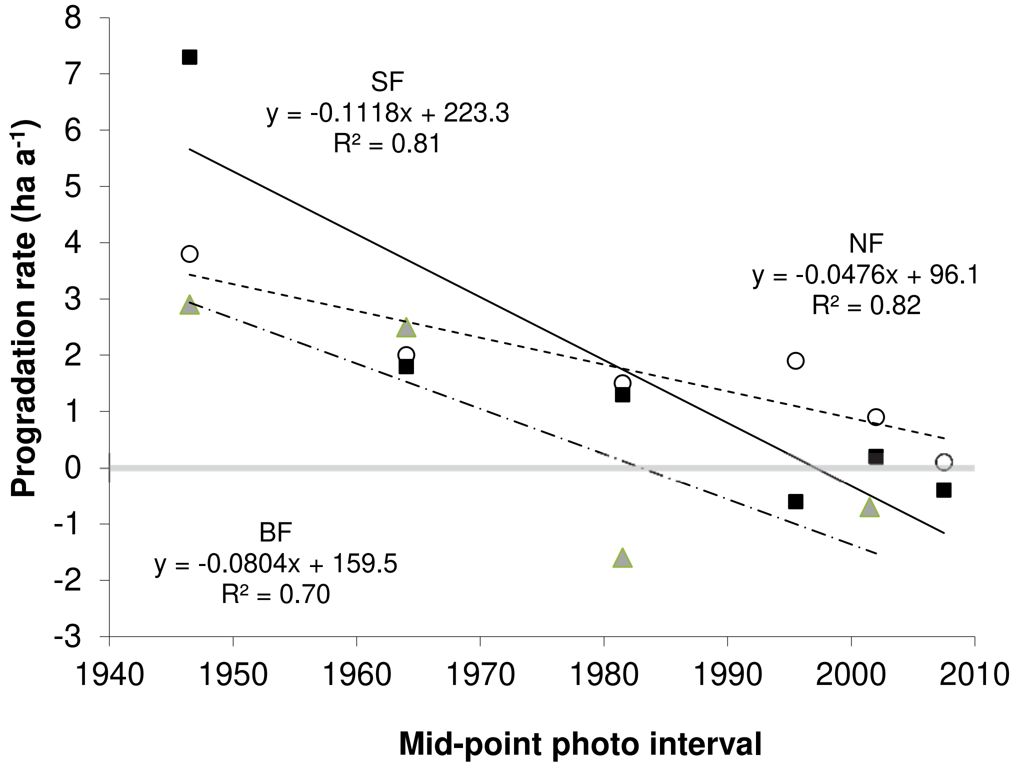
W. G. Hood
Skagit River System Cooperative

Historical Observations in the active Skagit Delta


McGlinn Island
Bald Island
Ika Island
NF
SF
Skagit Bay
1937
1956
1972
1991
2000
2011
N
0
250
500
1,000
Meters


NF
SF
Skagit Bay
E
P
Skagit Bay
E
N
0
250
500
1,000
Meters
1937
1956
1972
2011


1937
1956
1972
2012
NF
SF
Skagit Bay
farm land
Skagit Bay
N
0
500
1,000
2,000
Meters



	Marsh area lost (ha) 2012 to 2100	Marsh area in 2012 (ha)	% loss (2012 to 2100)	Adjusted total loss (ha)
North Fork	238	420	56.7%	238
South Fork	559	1176	47.5%	559
Bay fringe	402	255	157.6%	255

56.8%

Complication 1: Sediment Supply and Fate

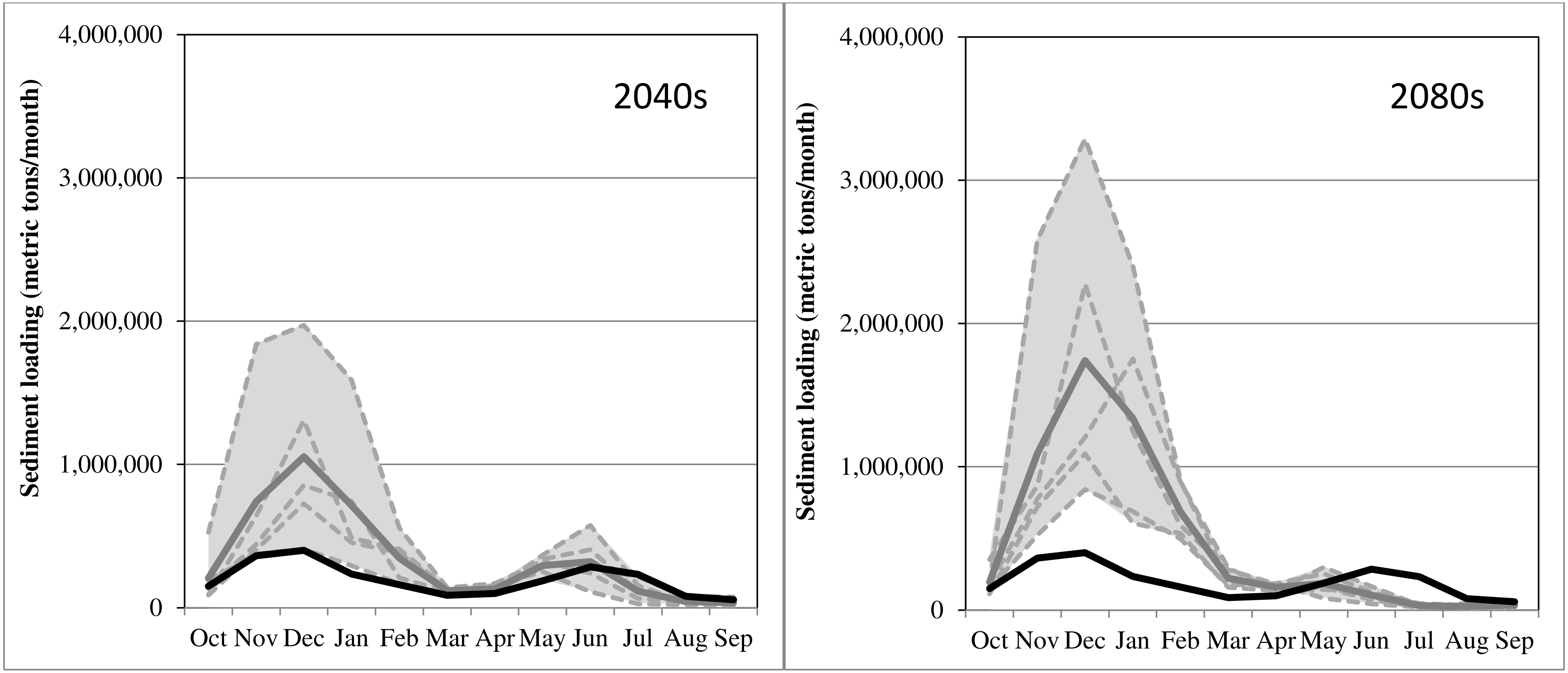
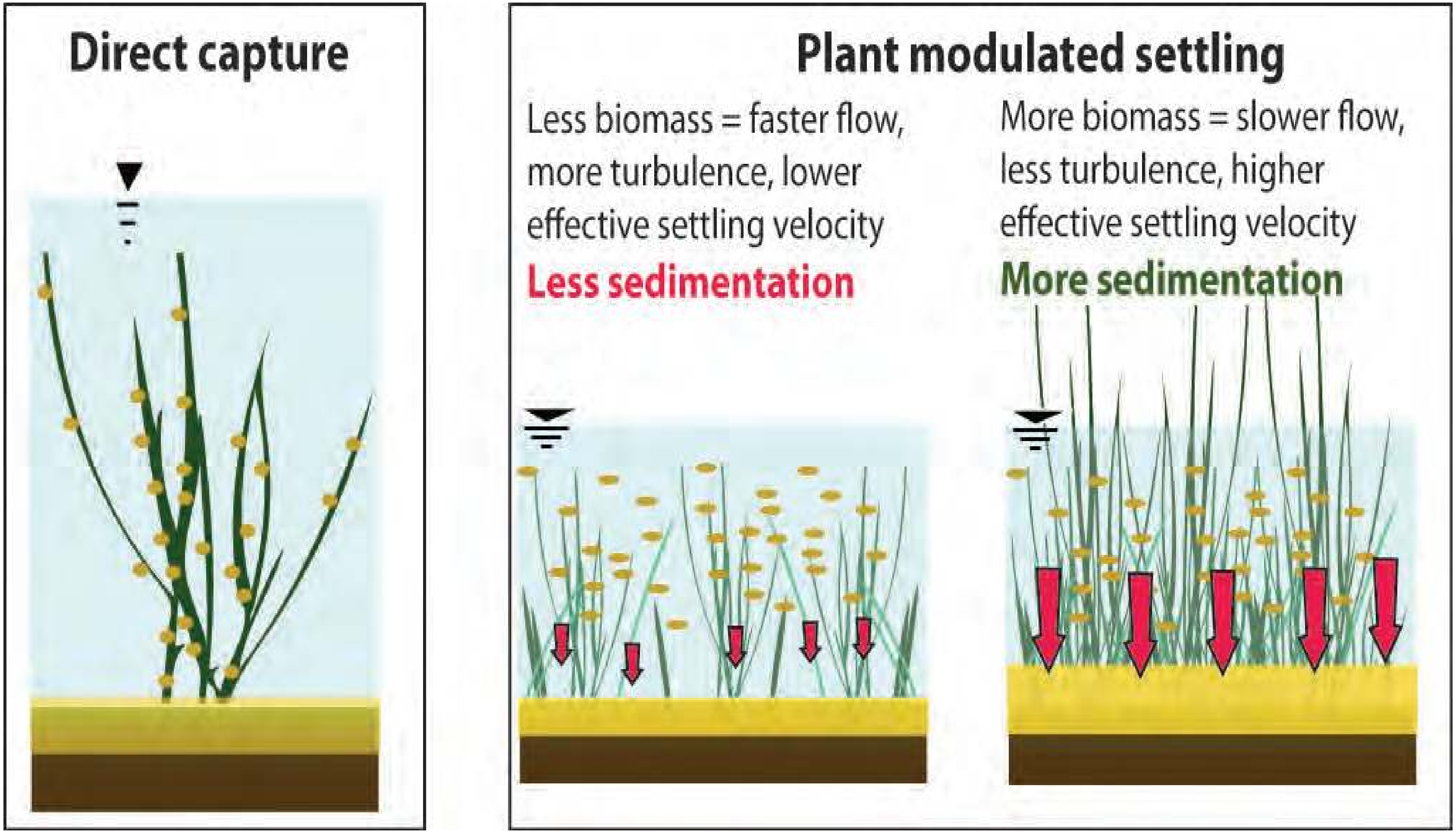


Figure 6. Simulated long-term mean, sediment loading for the Skagit River at Mount Vernon for two future time periods of the 2040s (left panel) and 2080s (right panel). Solid black traces show monthly averages for historical conditions, the gray bands show the range of values from five climate change scenarios, gray dotted lines represent monthly averages from each climate change scenario, and the solid gray lines show the average of the five future ensemble.

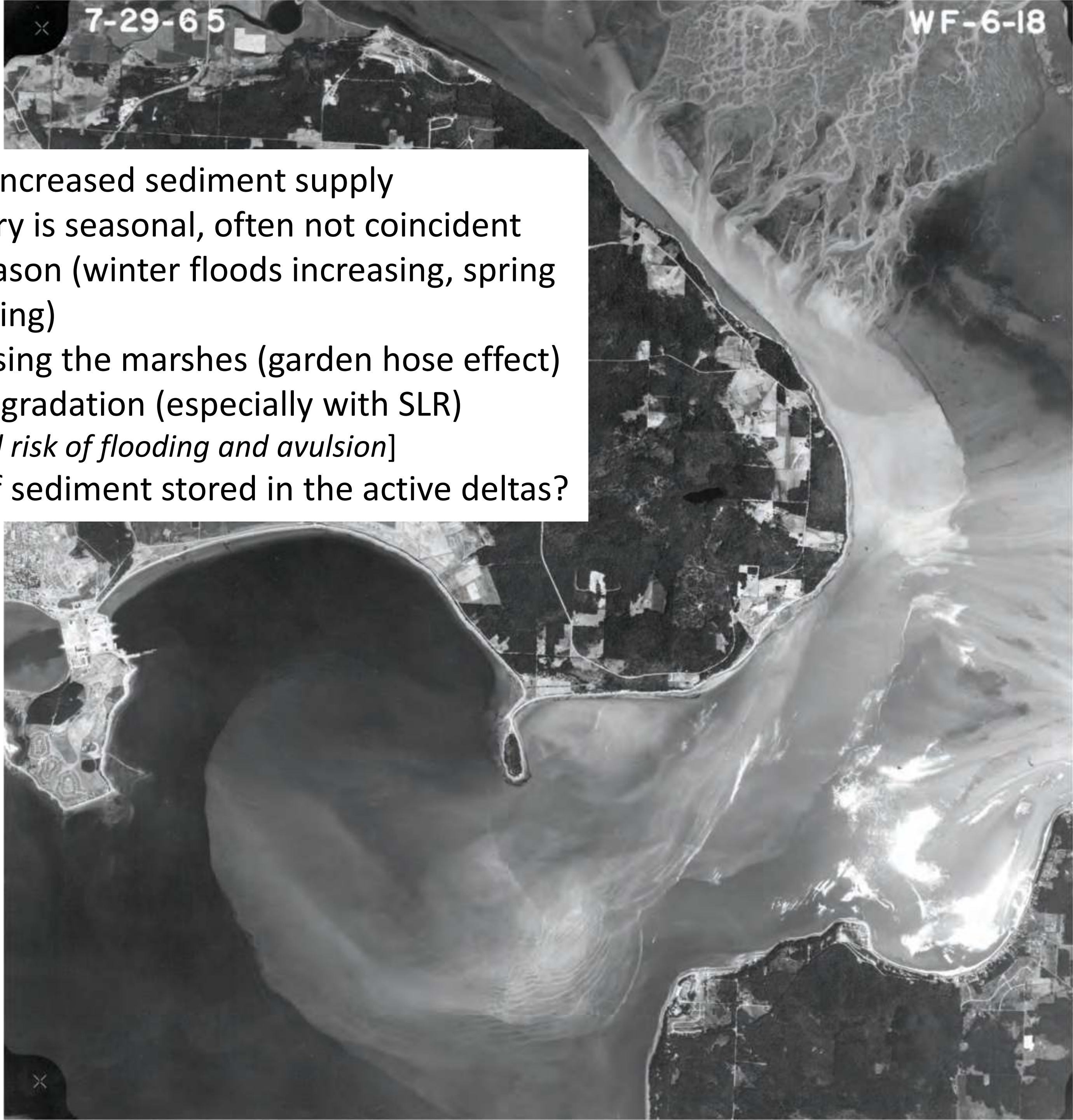
Hamlet et al. 2012



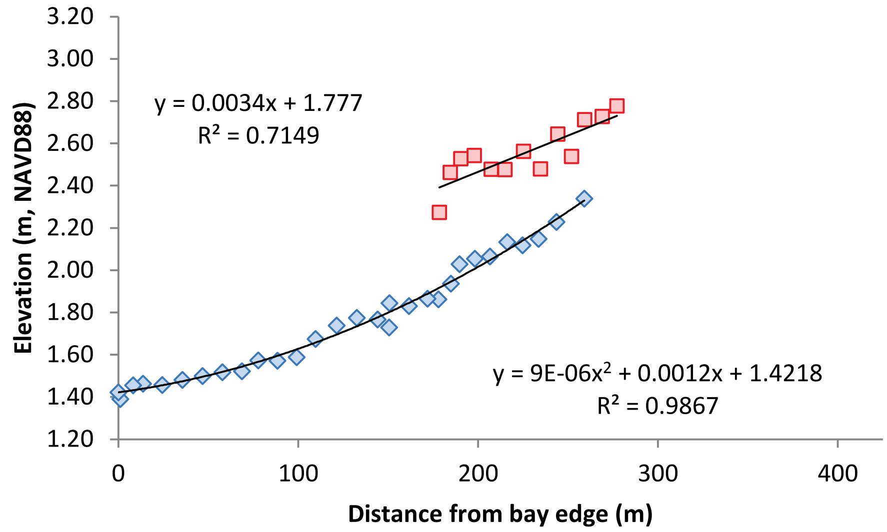
Seasonality: maximal accretion when sediment delivery coincides with the growing season.

Uncertainty over fate of increased sediment supply

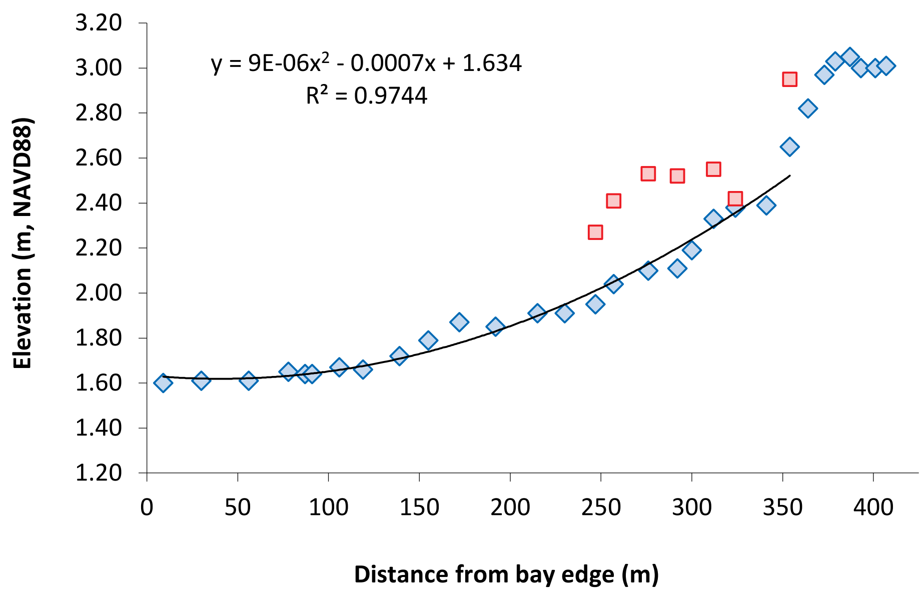
1. Sediment delivery is seasonal, often not coincident with growing season (winter floods increasing, spring freshets decreasing)
2. Sediment bypassing the marshes (garden hose effect)
3. River channel aggradation (especially with SLR) [*leads to increased risk of flooding and avulsion*]
4. Some fraction of sediment stored in the active deltas?



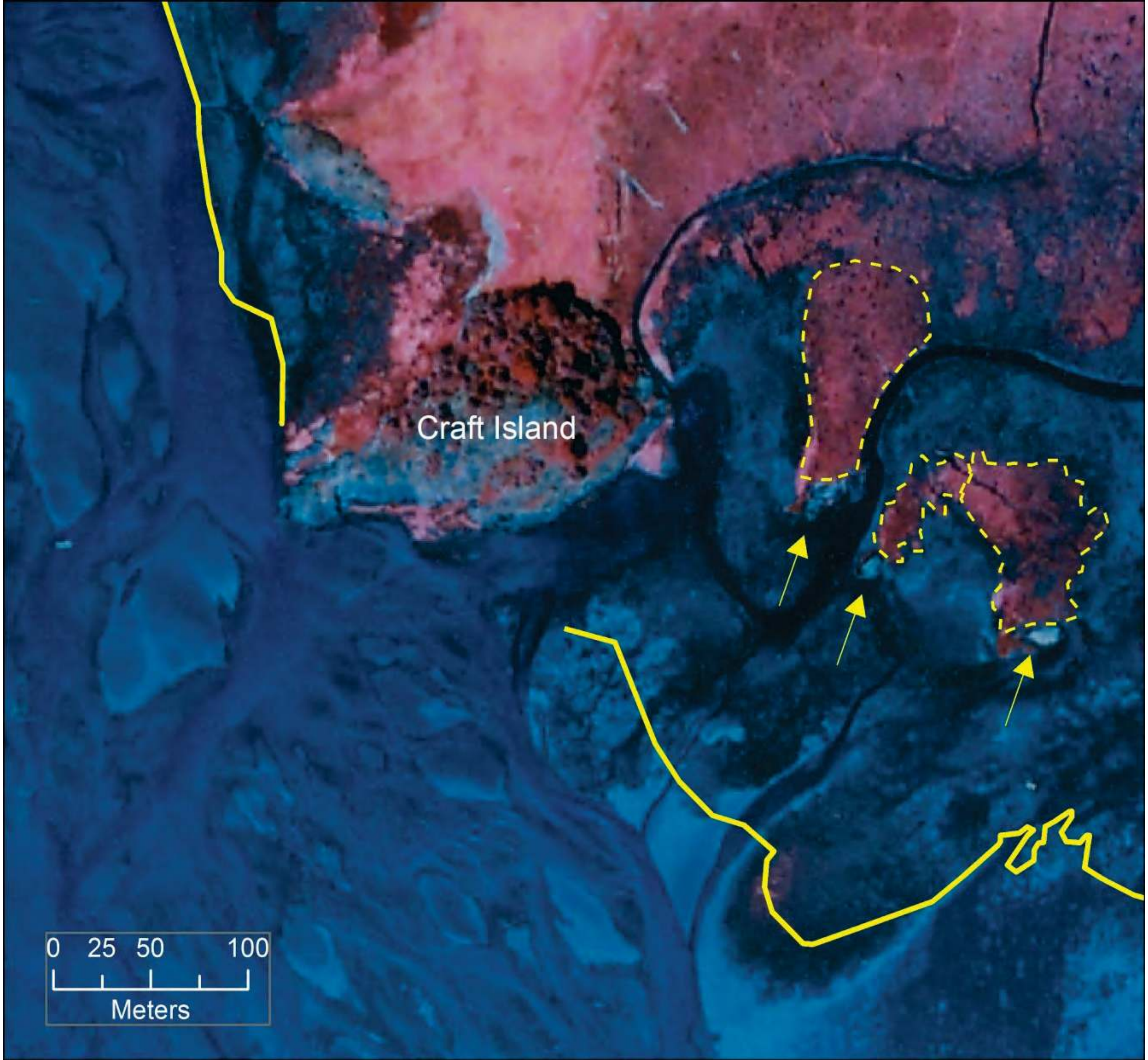
Complication 2: Wave Attack and Erosion



y = 0.0034x + 1.777
R² = 0.7149
y = 9E-06x² + 0.0012x + 1.4218
R² = 0.9867
Elevation (m, NAVD88)
Distance from bay edge (m)

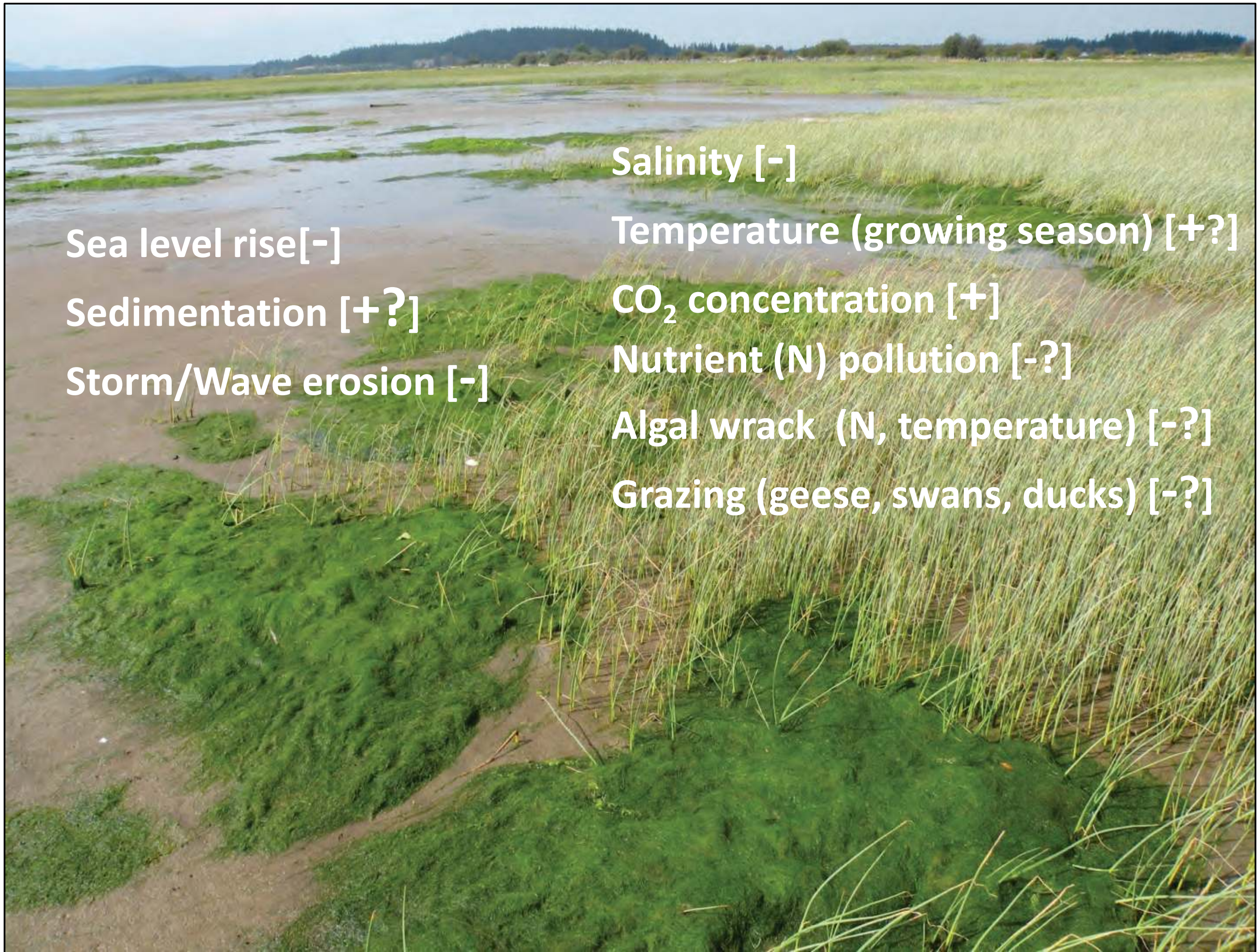


y = 9E-06x² - 0.0007x + 1.634
R² = 0.9744
Elevation (m, NAVD88)
Distance from bay edge (m)


Craft Island
0 25 50 100
Meters

Sea Level Rise and Marsh Vegetation Vulnerability

Additional Complications



Reconsider our habitat restoration goals for salmon recovery.

We need to run faster just to stay in place. We have likely underestimated the amount of tidal habitat restoration necessary to recover Chinook salmon, because we have not accounted for the need to compensate for sea level rise impacts.

Reduce other system stresses.

Reduce nutrient pollution, waterfowl grazing impacts, water withdrawals, sediment trapping (by dams), sediment diversion and by-passing (by levee construction and reduction of distributaries—garden hose effect).

Monitor landscape change.

Develop early warning system—monitor change in vulnerable areas, e.g., bay fringe erosion, change in woody vegetation distribution, effects of waterfowl grazing.

Support research on data gaps and predictive models.

Priorities: sediment supply and fate, marsh accretion rates (change over time), storm-wave erosion, vegetation distribution (salinity + elevation), impact of algal wrack, waterfowl grazing, seasonality of the preceding, predictive model development.