



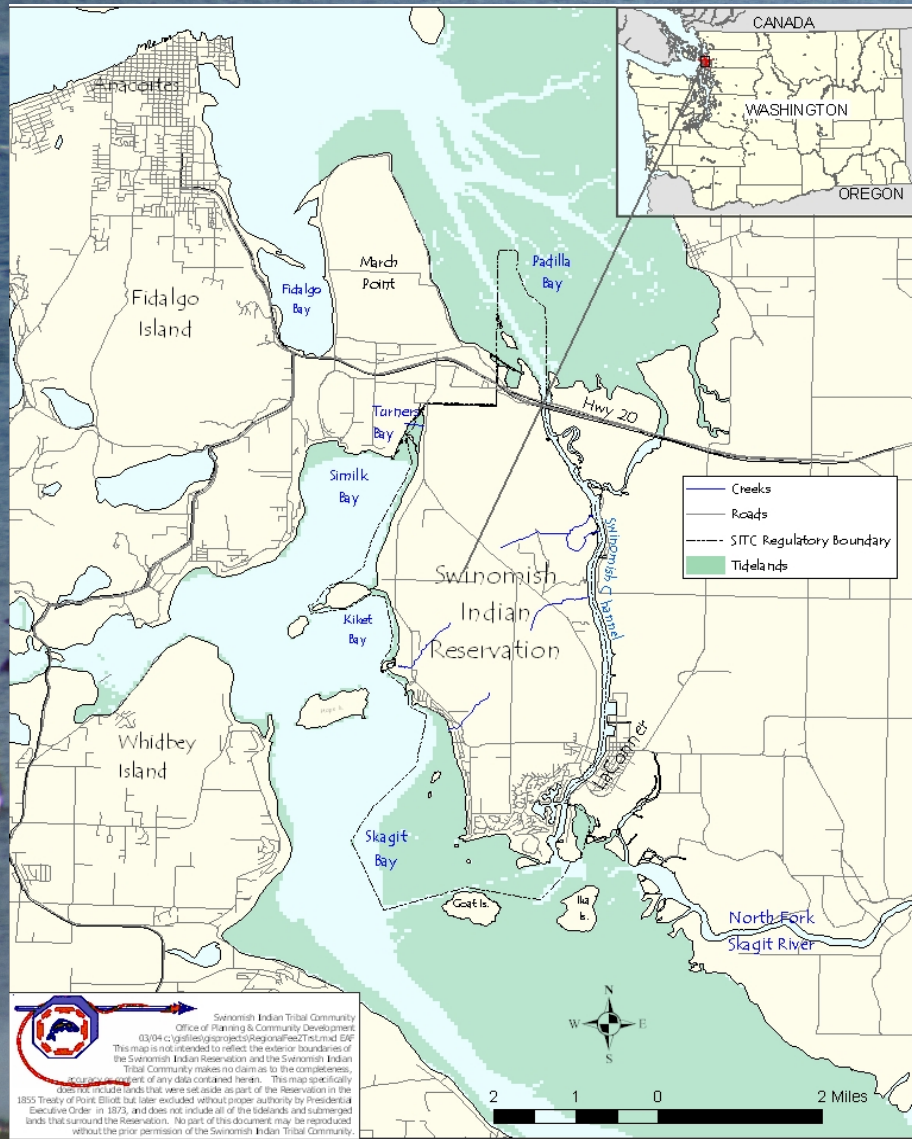
# Including Indicators of Indigenous Community Health in Climate Change Impact Assessments

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Waututh First Nation**



# Swinomish



- Coast Salish people
- 1855 Treaty of Point Elliott: Sovereign nation
- Reservation: ~3,000 acres tidelands + ~7,000 acres uplands
  - Reservation 90% surrounded by water
- ~900 enrolled members

***“When the tide is out,  
the table is set.”***



# Health and Well-being model

A healthy community encompasses all aspects of tribal relationships and tribal priorities that affect a community. This includes physical, social, mental and spiritual health on individual, familial and community levels, as well as relations between people, the environment, and natural resources.

*How do you evaluate these relationships?*



# Community-based Indigenous health indicators (IHIs):

**Natural  
Resources  
Security**



**Community  
Connections**



**Cultural Use**



**Self  
Determination**



**Education**



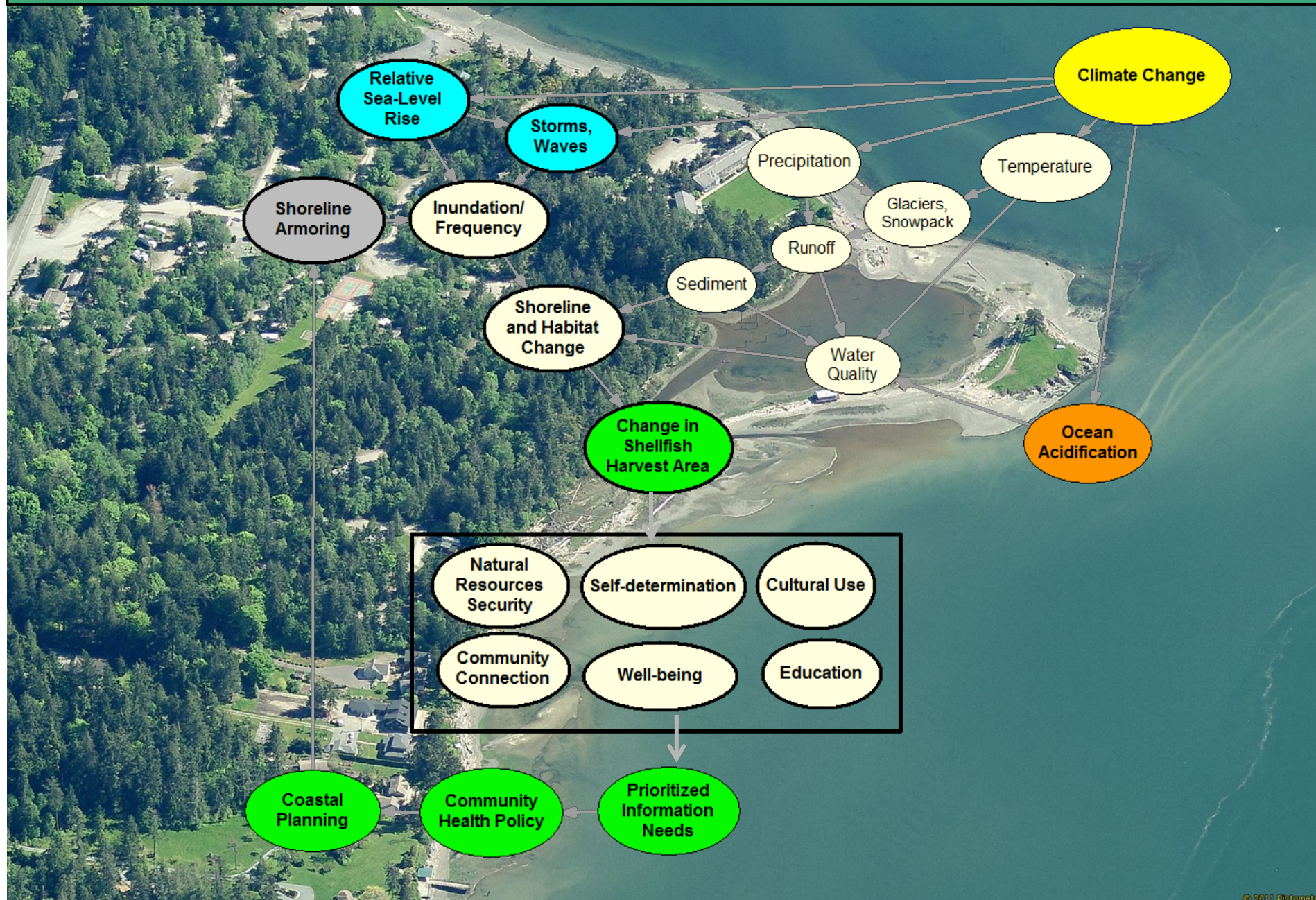
**Calm Mind  
(Emotional  
Security)**



<http://www.swinomish-nsn.gov/ihi/>



# Modeling Physical Process and Responses between Sea-Level Rise, Climate Change, Shoreline Armoring and Harvestable Shellfish





# Motivation: Higher Wave Energy with Higher Water Level

West Point Annual Max Wind (1984-2003)

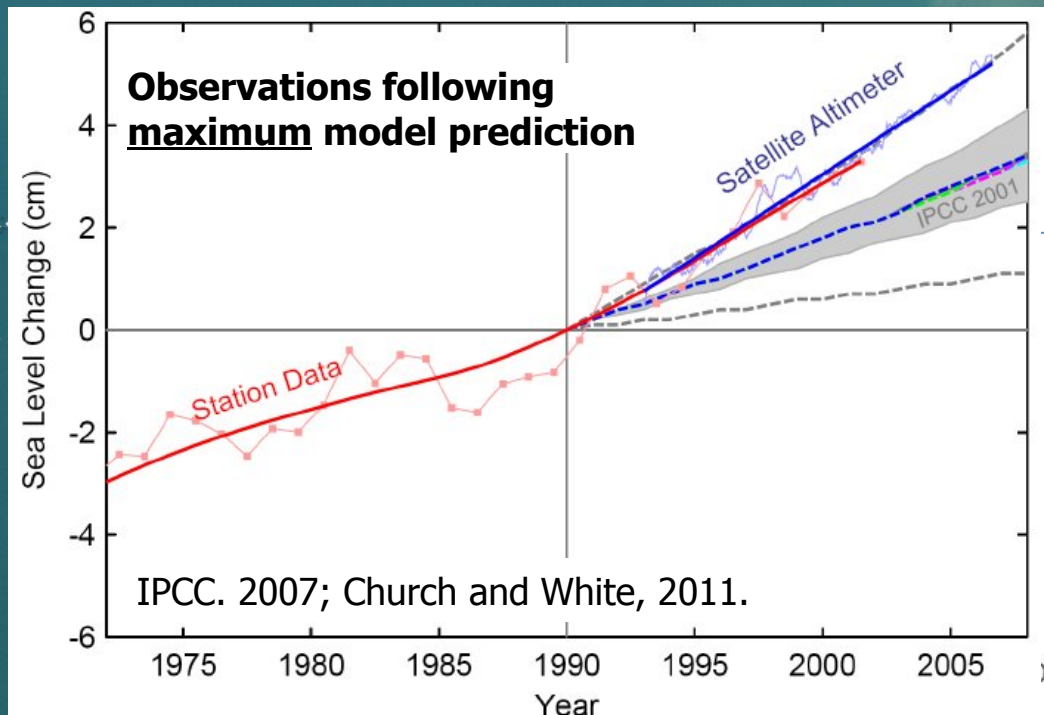


**Trebaldi (2012)**  
**12" SLR, 100-yr event becomes 10-yr**  
**24" SLR, 100-yr event becomes 1-yr**



**Approach:** Vulnerability Modeling (Phase1, this study)  
Process-modeling (Phase2, EPA-STAR)  
- Evaluate extent and probability of likely change and impacts

Synthesis and GIS Intersection of:  
Sea-level rise scenarios and  
coastal habitat traits



129 cm  
(0-143 cm, NAS)

NAS 2012 modified for vertical land movements (subsidence) within Puget Sound

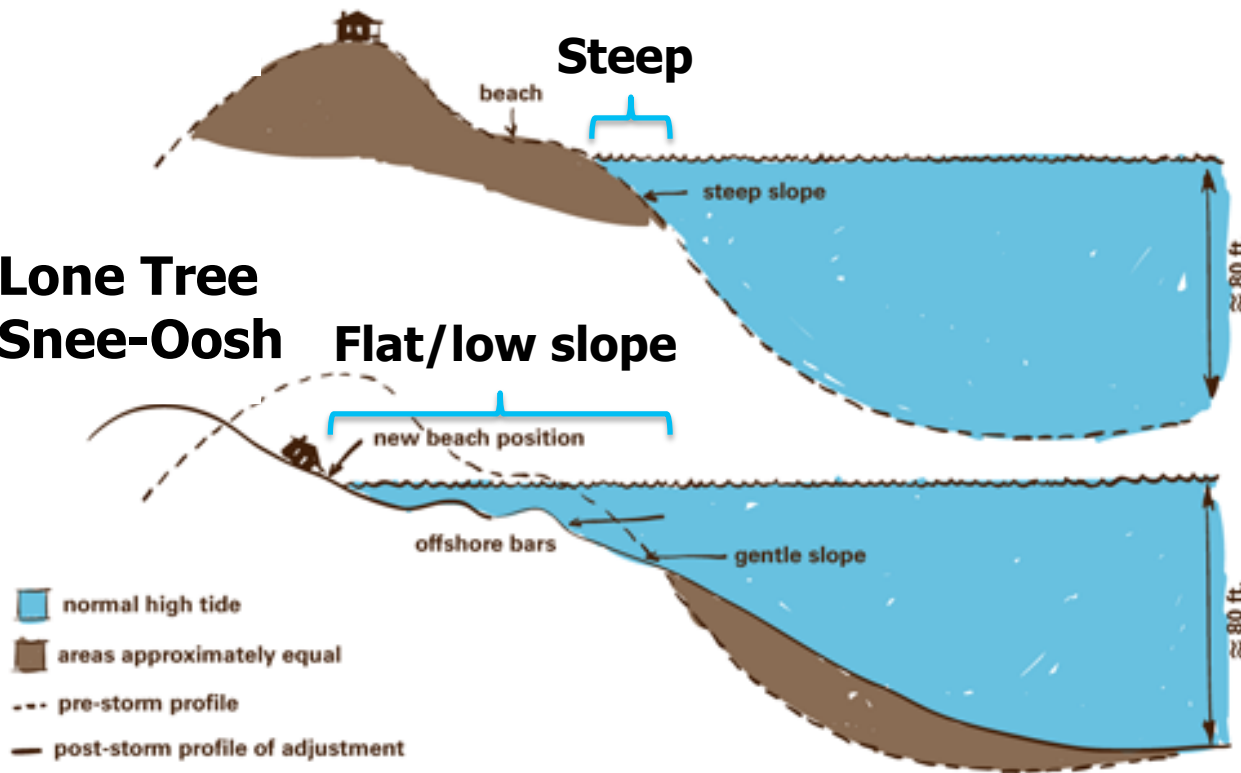


## Habitat Traits:

- A. Coastal morphology: Complex-irregular topography (new DEMs)
- B. Clam distribution
- C. Substrate (particle size)
- D. Harvest area: MLLW limit to access
- E. Shoreline armoring: affects shoreline migration

**Lone Tree**

**Snee-Oosh Flat/low slope**




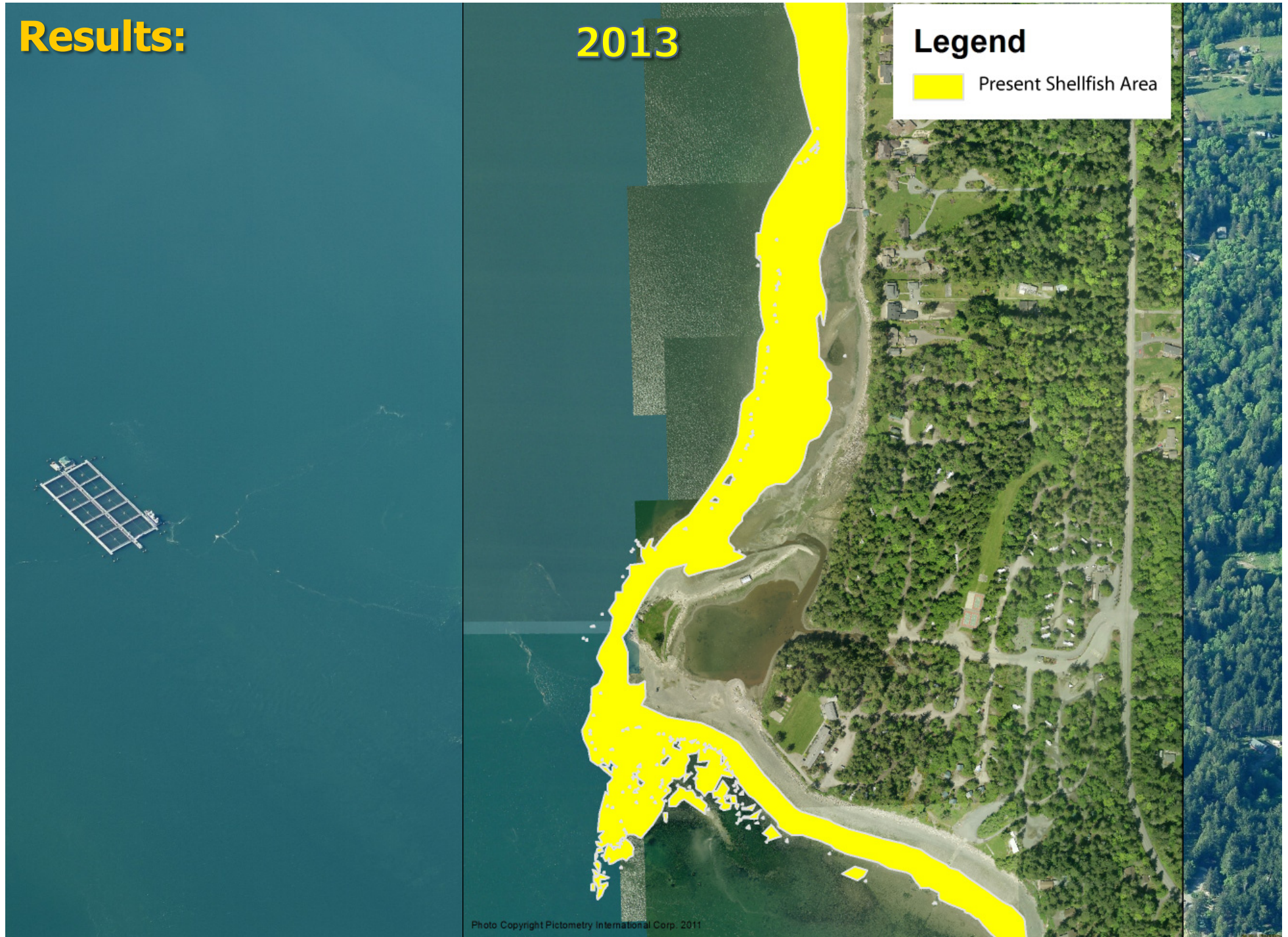


# Results:

2013

## Legend

 Present Shellfish Area





## Results:

**By 2100 the area of beach suitable for growing and harvesting shellfish will decrease by 27%**

**Seawalls line 30% of the shore; beaches are narrower.**

**2100**

← Seawall

← Seawall



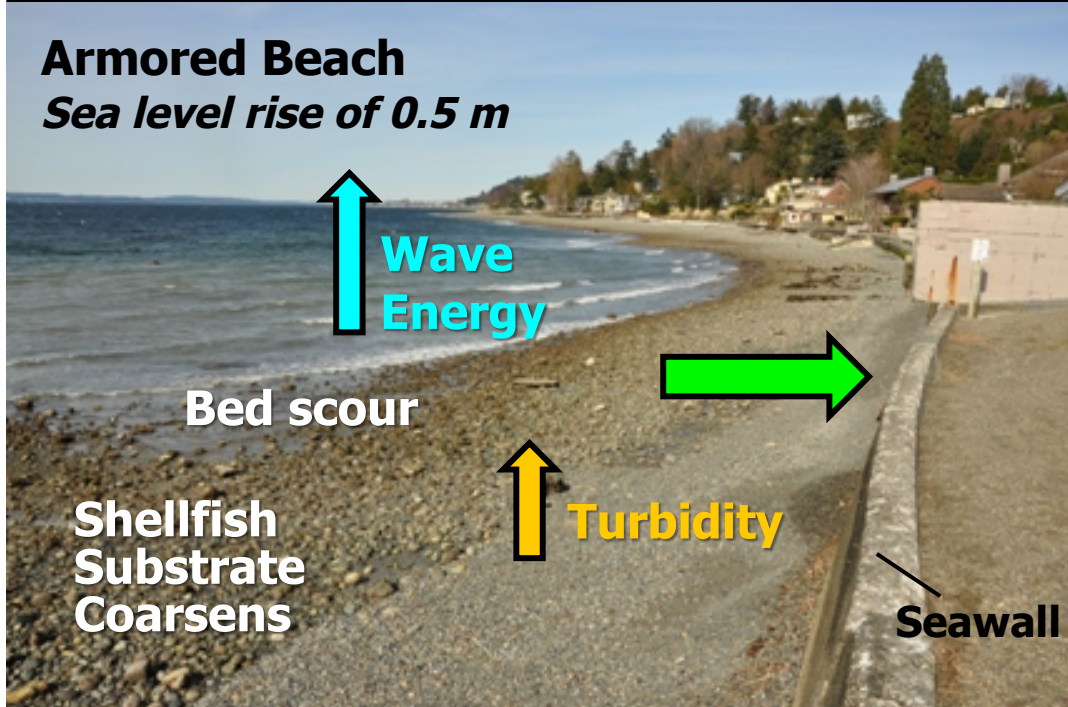
## Effects of shoreline armoring on shellfish harvest area resilience

**Unarmored Beach**  
*Sea level rise of 0.5 m*



Harvest area can migrate with sea level rise, coastal erosion, and landward movement of suitable shellfish substrate.

**Armored Beach**  
*Sea level rise of 0.5 m*



Harvest area is lost where armoring prohibits coastal change/migration.

Wave energy increases with reflection off of seawall and causes bed scour and higher turbidity.

Shellfish substrate coarsens with greater wave energy and scour.

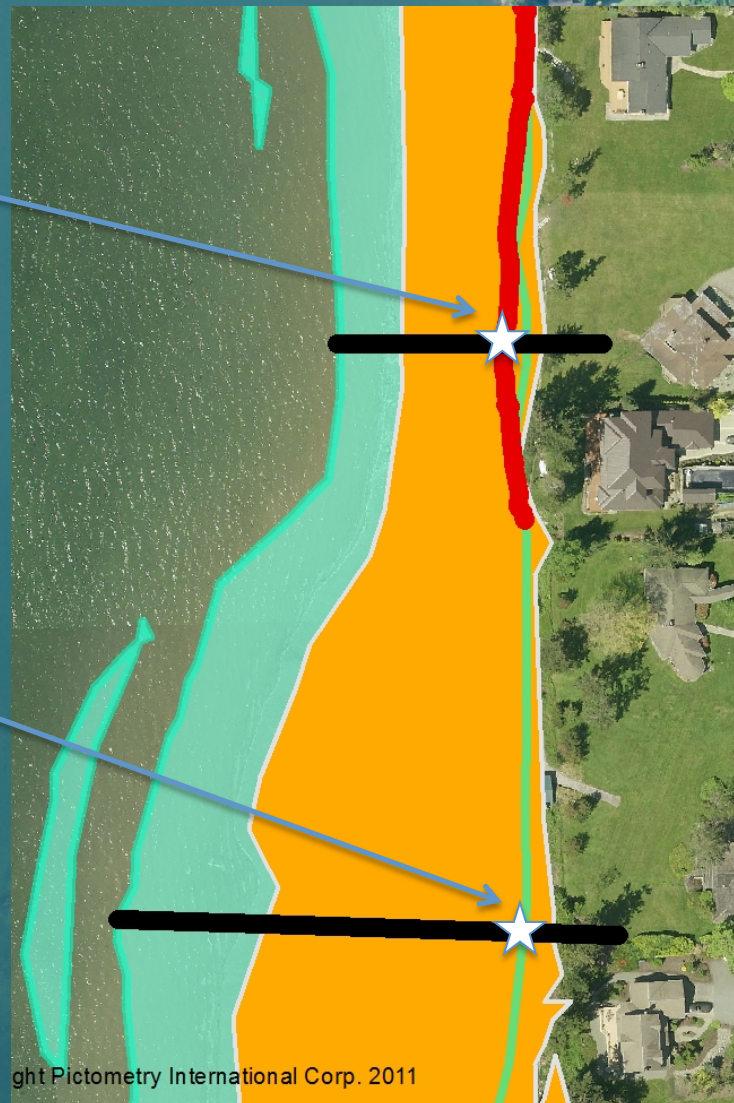


# Waves and Shoreline Evolution

Seawall



No Seawall



Seawall



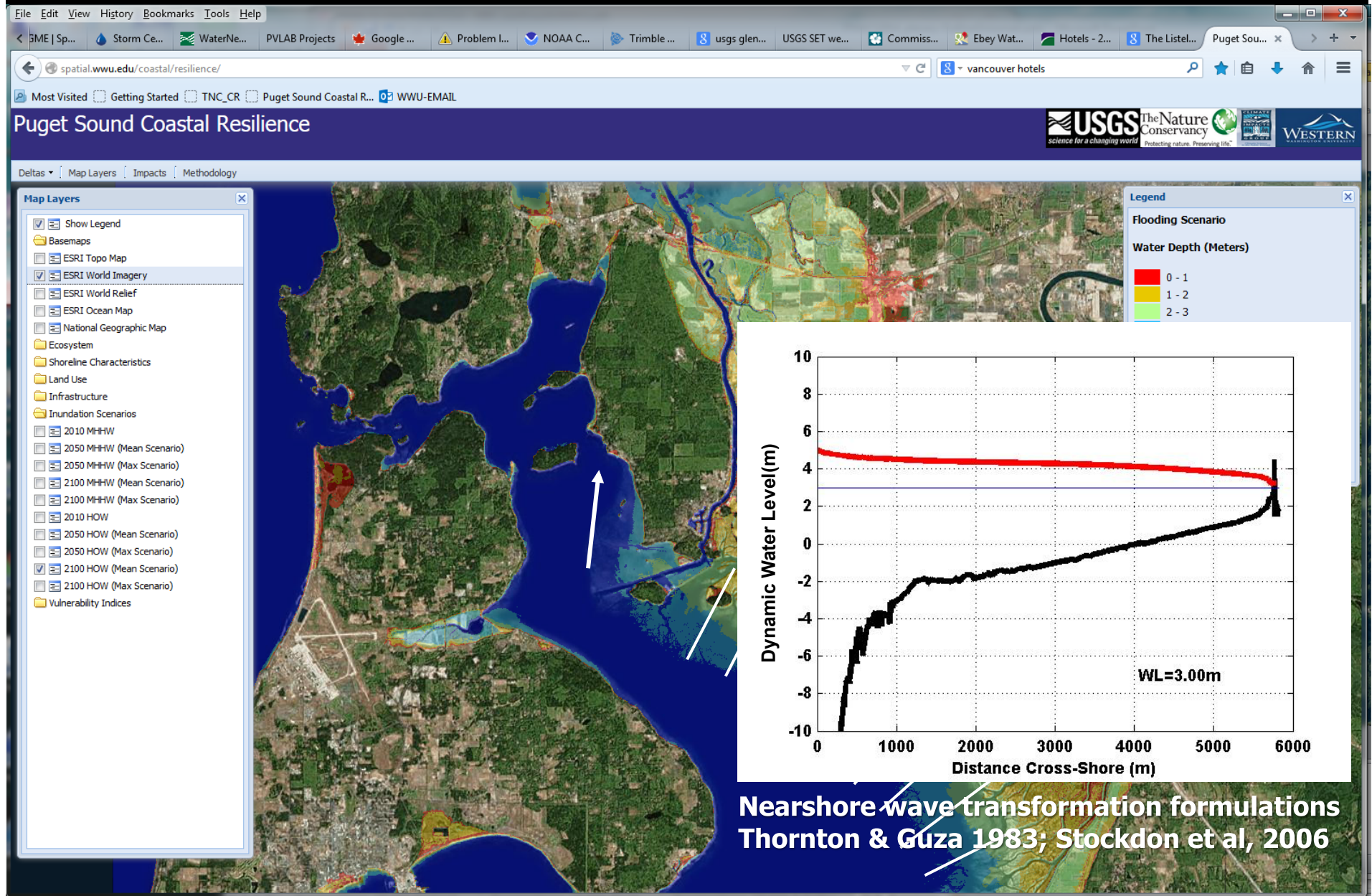
No Seawall





# Next Steps EPA-STAR: Process-based model Delft3D-Xbeach

## Alongshore variability in waves, storm surge runup and inundation





# Evaluating the IHIs: Hosting workshops

Often when thinking about health, the main consideration is individual, physical health. This concern is important. But many other concerns are not discussed, so you don't get the full picture.

Examples of concerns that are left out of climate change risk assessments:

- ability to educate youth about harvest practices
- staying connected to important outdoor locations
- ability to “feed the spirit” when traditional foods are polluted



## Ex: Ranking Resources Security

Access: On a scale of 1-4, are there enough locations available to harvest?

Access: On a scale of 1-4, will there be enough locations available to harvest in 2100?

	<u>Now:</u>	<u>2100:</u>
1. Things are very bad	0%	18%
2. Not very good	46%	64%
3. Looking pretty good	46%	18%
4. We're doing great	8%	0%



# Swinomish Community Health Sensitivity Matrix

	Projected Impacts: <i>Low</i> → <i>High</i>				
	Potential opportunity (+ % Δ)	Low (0 to -25% Δ)	Medium (-26 to -50% Δ)	Medium-high (-51% to -75% Δ)	High (> -75% Δ)
Priority concerns:			CC		CU
<i>Low</i>	ED	CM	SD		
↓			NRS		
<i>High</i>					

Δ = change; results are not representative of the community; results are for discussion purposes only

**NRS = Natural Resources Security**

**ED = Education**

**SD = Self-Determination**

**CU = Cultural Use**

**CC = Community Connection**

**CM = Calm Mind (Emotional Security)**



# Thank you.

## For more information:

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Donatuto, J., E.E. Grossman, J. Konovsky, S. Grossman and L.W. Campbell. 2014. Indigenous community health and climate change: Integrating biophysical and social science indicators. *Coastal Management Journal*, 42(4): 355-373.



Beach seining at Lone Tree.—Photo by: Tyler Long



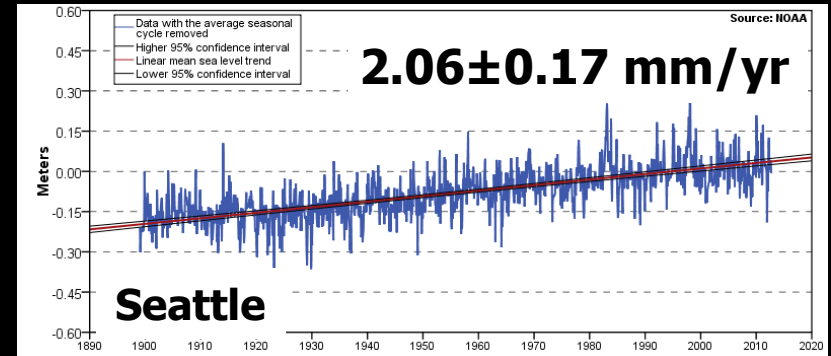
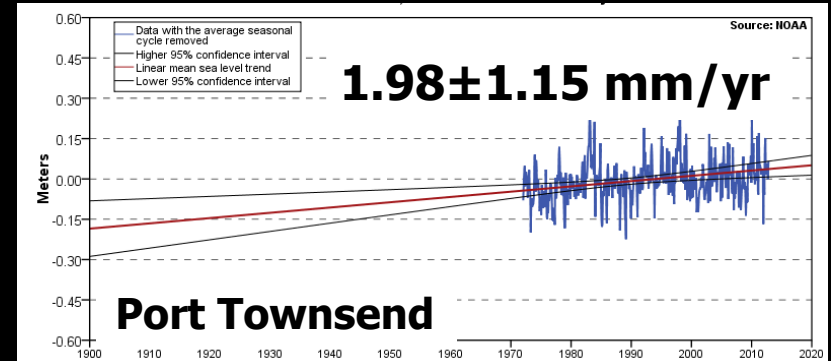
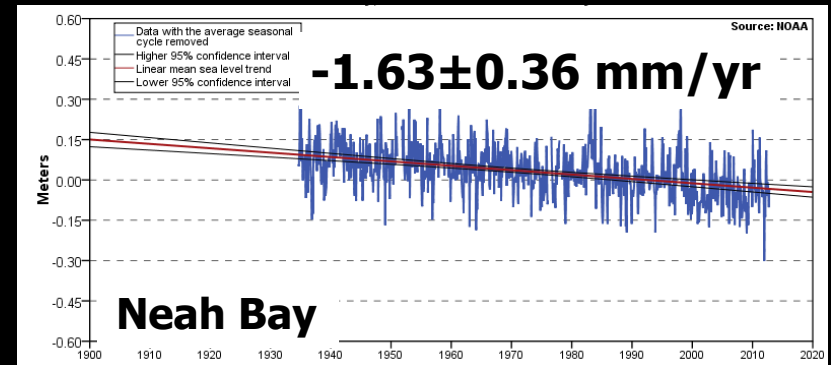
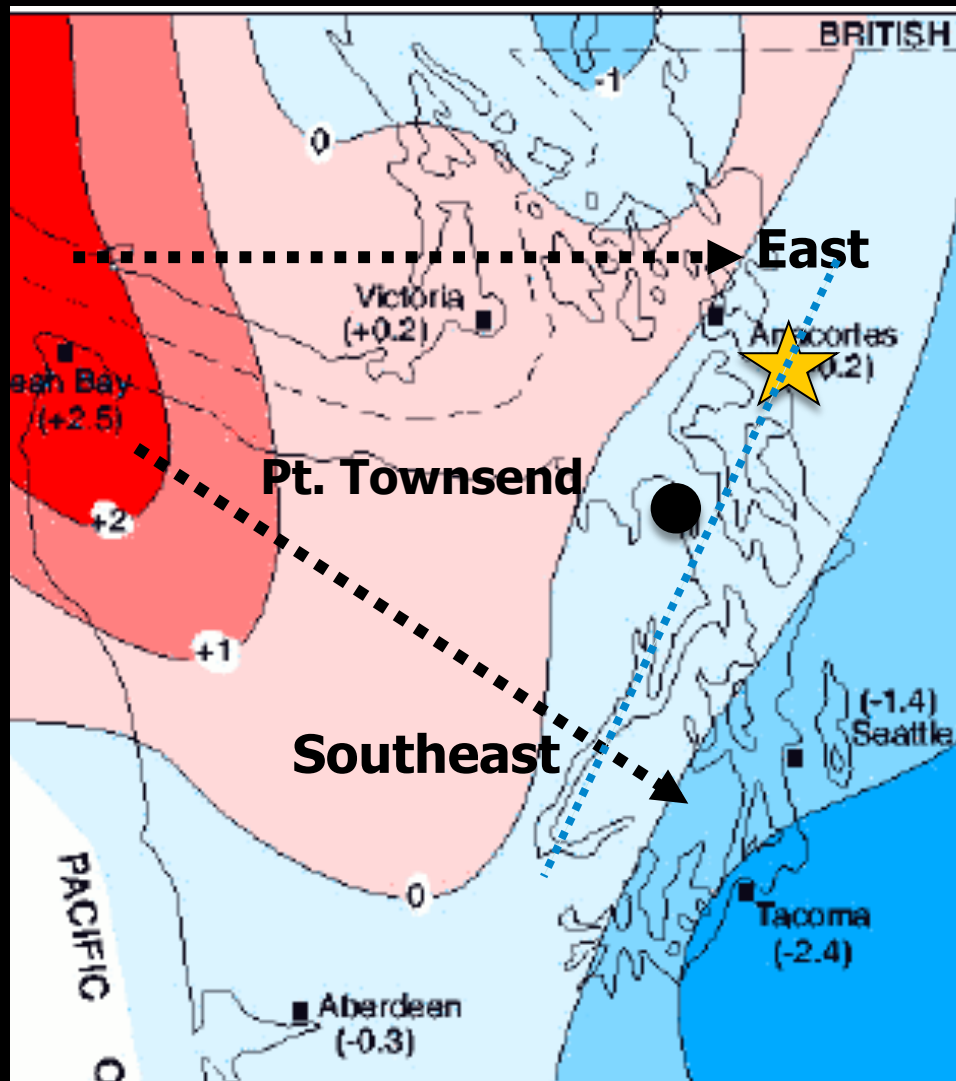




# Vertical Land Movement - Relative Sea Level Rise

Uplift

Subsidence



Verdonk, 2006; Holdahl et al. 1989



# Results:

Changes in inundation frequency and shellfish area

