Modeling Coastal Erosion in Western Alaska – a proposed approach

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Why do coastal erosion modeling in Western Alaska?

- To forecast coastal erosion and shoreline change in near term (due to individual storms) and in long term.
- To assess vulnerability of coastal communities and coastal infrastructure.
- To enable thoughtful planning and wise capital expenditures.

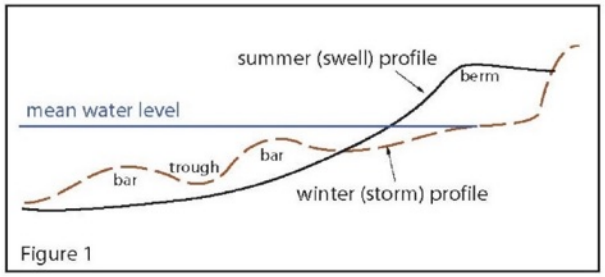


Figure 1

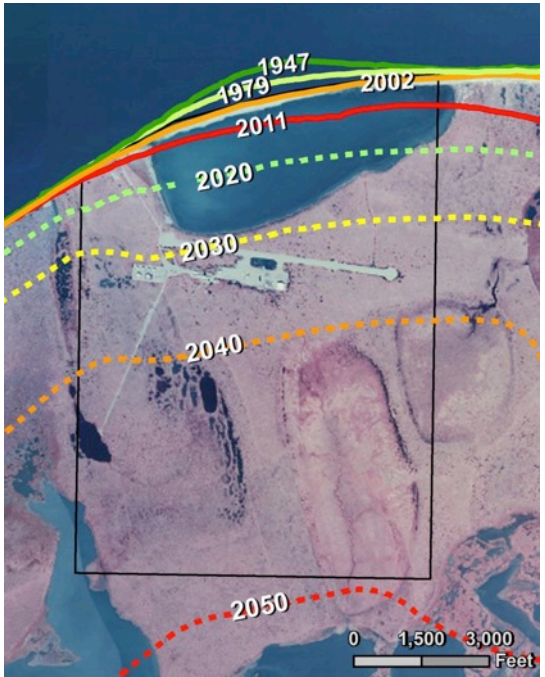
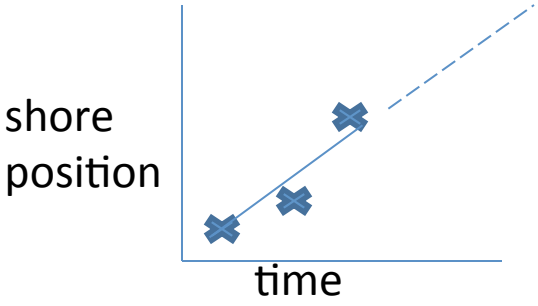


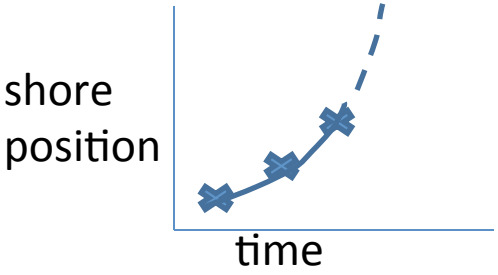
Image courtesy of BEM systems

Coastal erosion modeling approaches

1. Linear interpolation.



2. Non-linear interpolation.

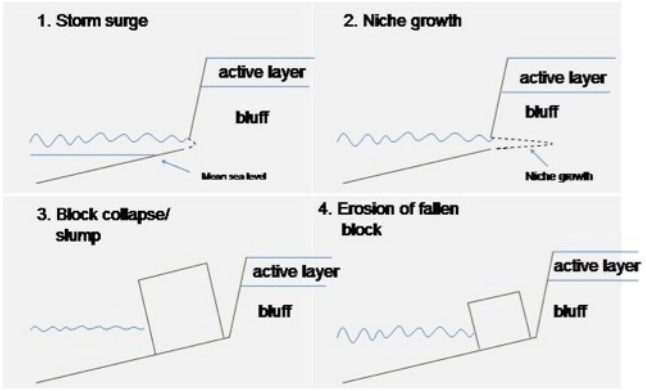


3. Semi-empirical modeling.

Erosion rate = f(η,H,T)

4. Process-based modeling.

Increasing sophistication,
Increasing cost,
Increasing precision / accuracy

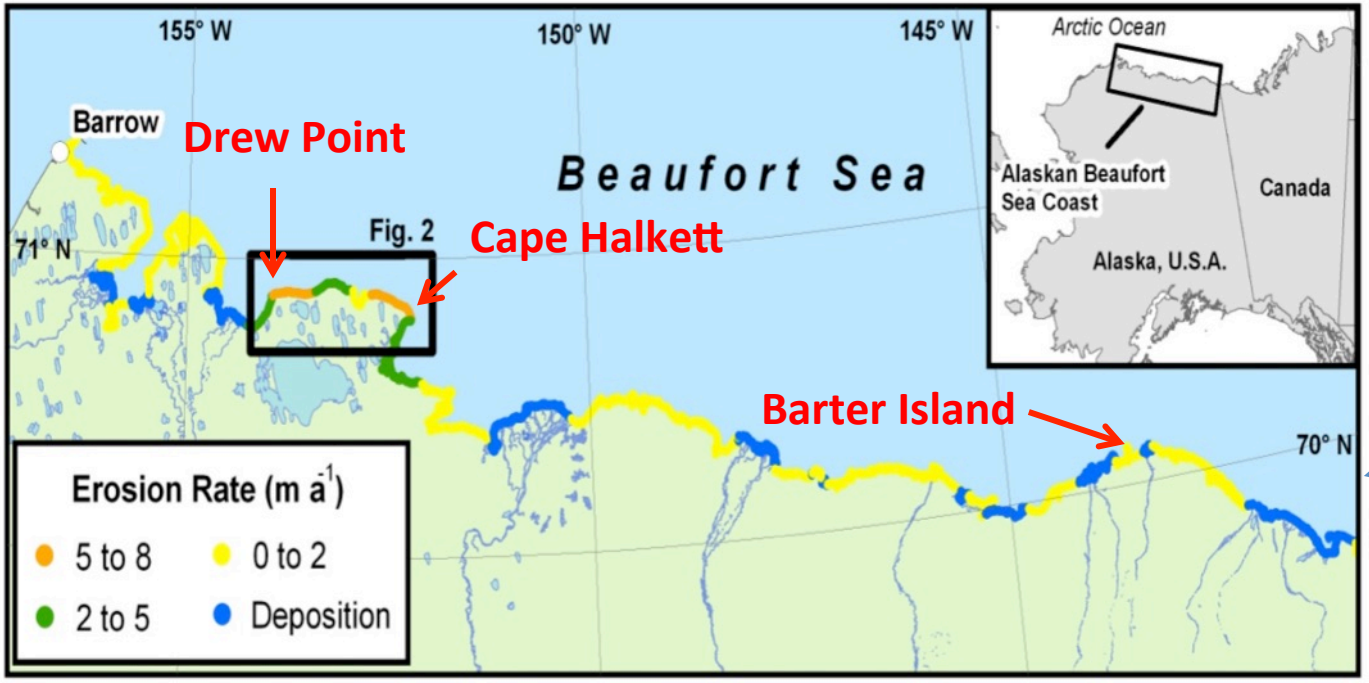


Arctic Coastal Erosion Mechanisms:

Niche erosion / block collapse

Bluff face thaw / slumping

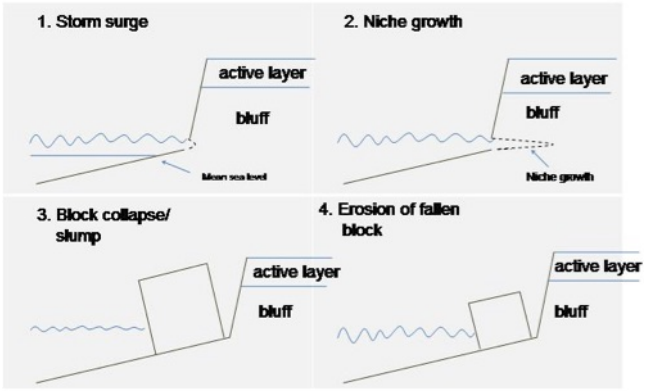
Cape Halkett
Ben Jones, USGS



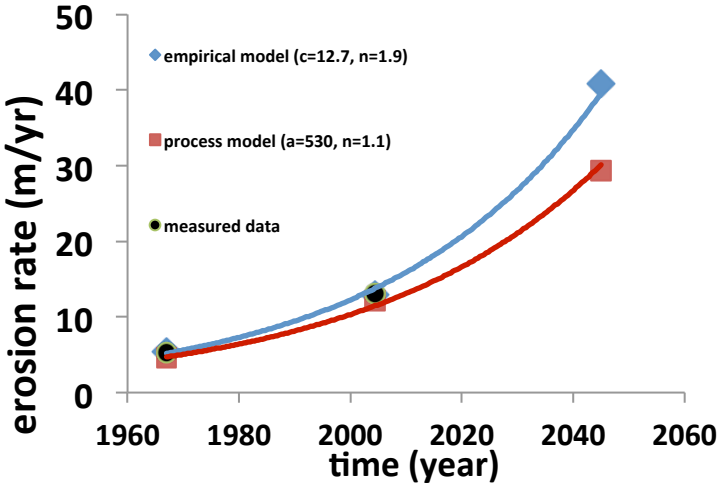
Erosion rates on north coast of Alaska (1980's era rates)

Ben Jones, USGS

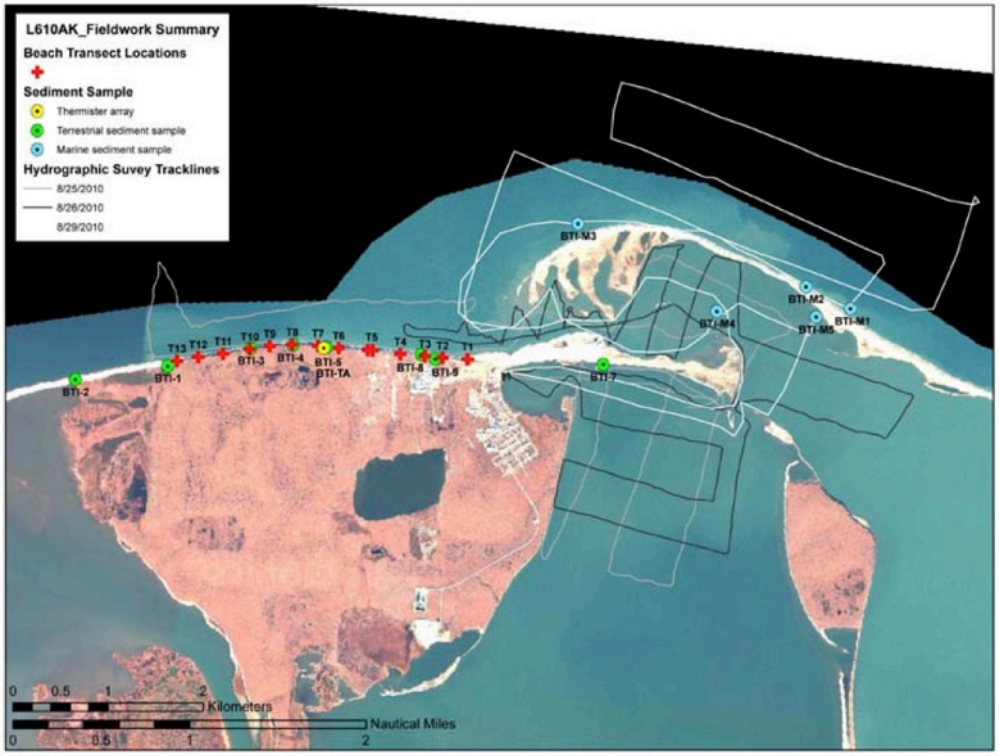
Niche erosion / block collapse – Drew Point

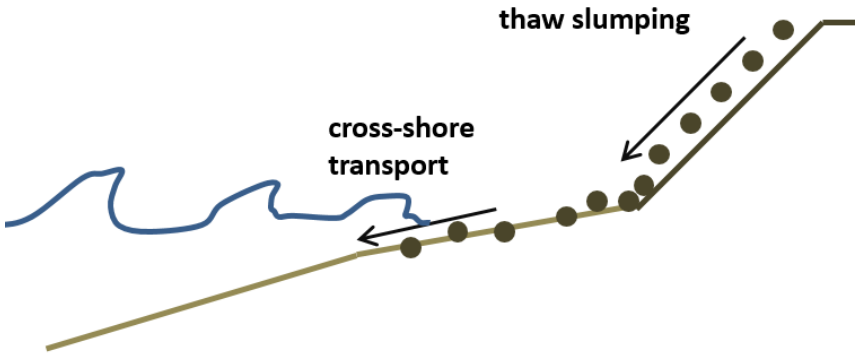


Time period	Measured erosion rate (m/yr)	Calculated erosion rate (m/yr)	Calculated fraction of time shoreline is block-free (%)
Aug. 1979 – July 2002	8.0 ± 0.9	8.0 ± 0.8	68 ± 3
Aug. 2002 - July 2007	14.1 ± 1.7	14.9 ± 1.4	78 ± 2



Bluff face thaw / slump - Barter Island

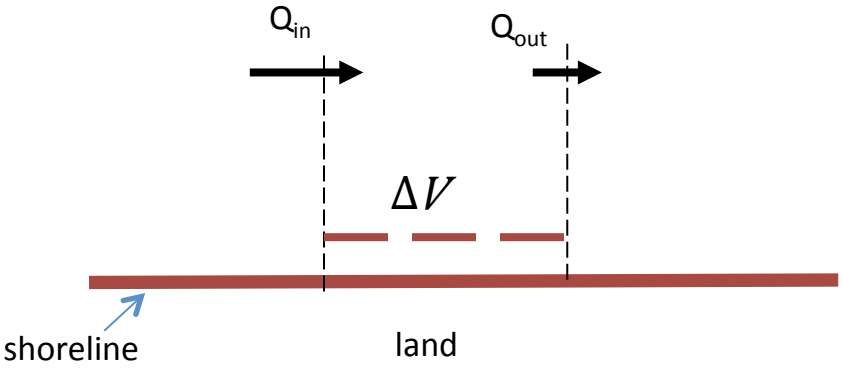


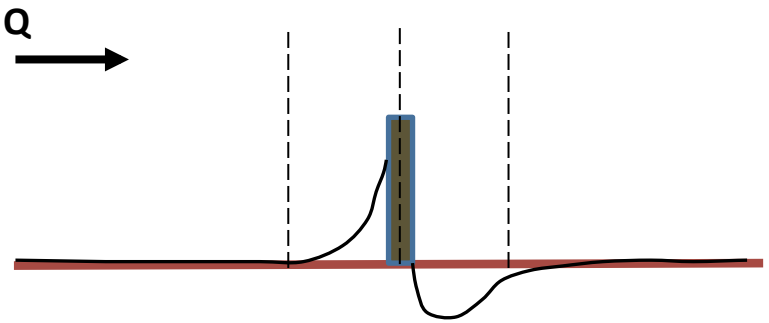


Bluff face thaw /slump video (Ben Jones, USGS)

Longshore transport and coastal erosion

- key to next generation modeling and forecasting in Alaska.



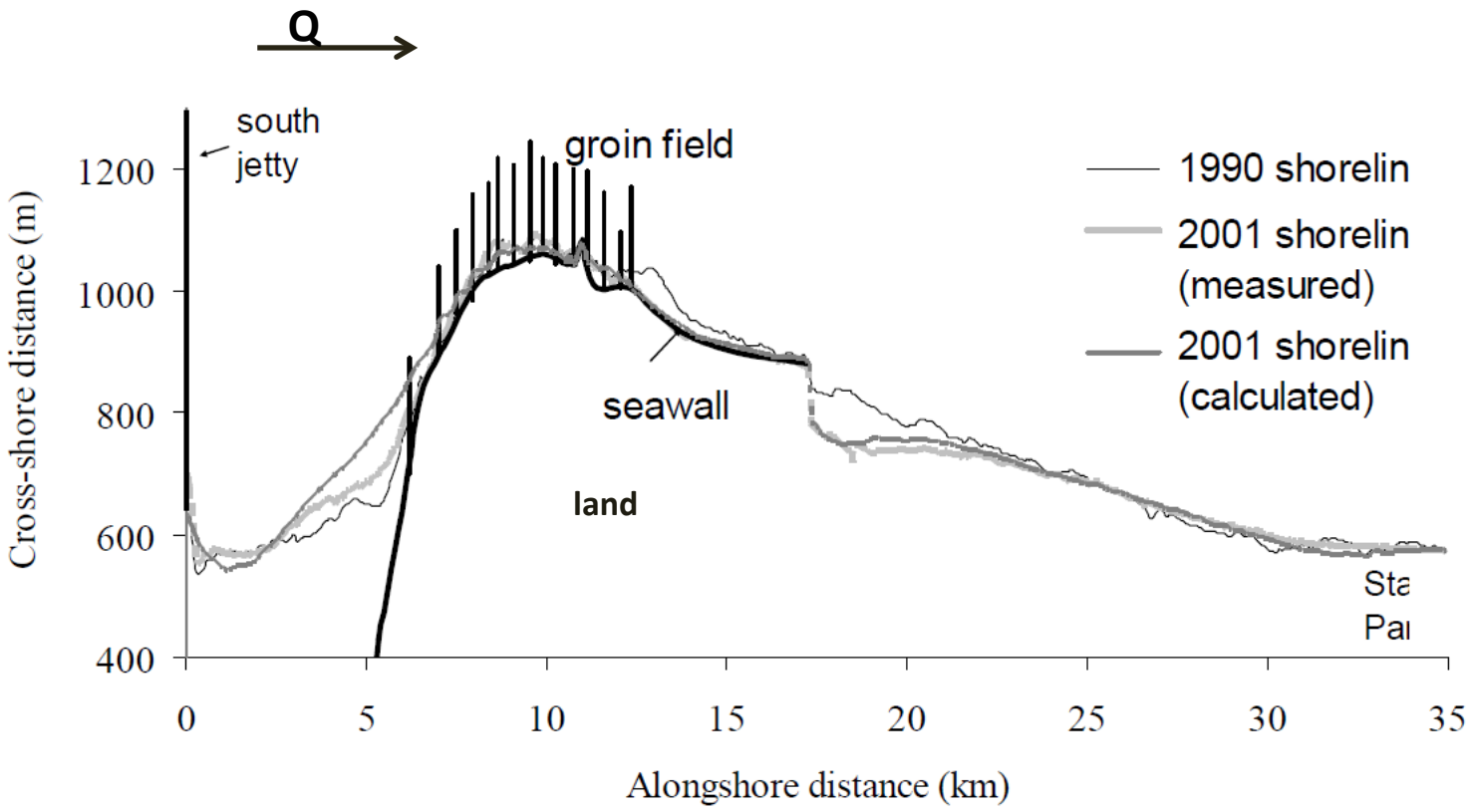


$$\Delta V = Q_{in} - Q_{out}$$

Erosion can occur due to longshore variation in the longshore sediment transport rate (Q),

where: $$Q = C\, H_b^{5/2} \sin(2\alpha_b)$$

Example study of non-arctic coastal erosion driven by longshore variation in alongshore sediment transport. (Galveston Texas)



Conclusions and Recommendations

1. Semi-empirical coastal erosion modeling approach recommended for Western Alaska.
2. The model should account for:
   - Thermal and mechanical processes,
   - Cross-shore and long-shore transport,
3. Use historic shoreline position and environmental data for model calibration and validation.
4. Use projected environmental conditions (down-scaled climate models) for model forecasts.

Thanks!

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