

# The Science of Coastal Erosion

Capitola Pier 2020



Capitola Pier 2023



Capitola Pier 2100?



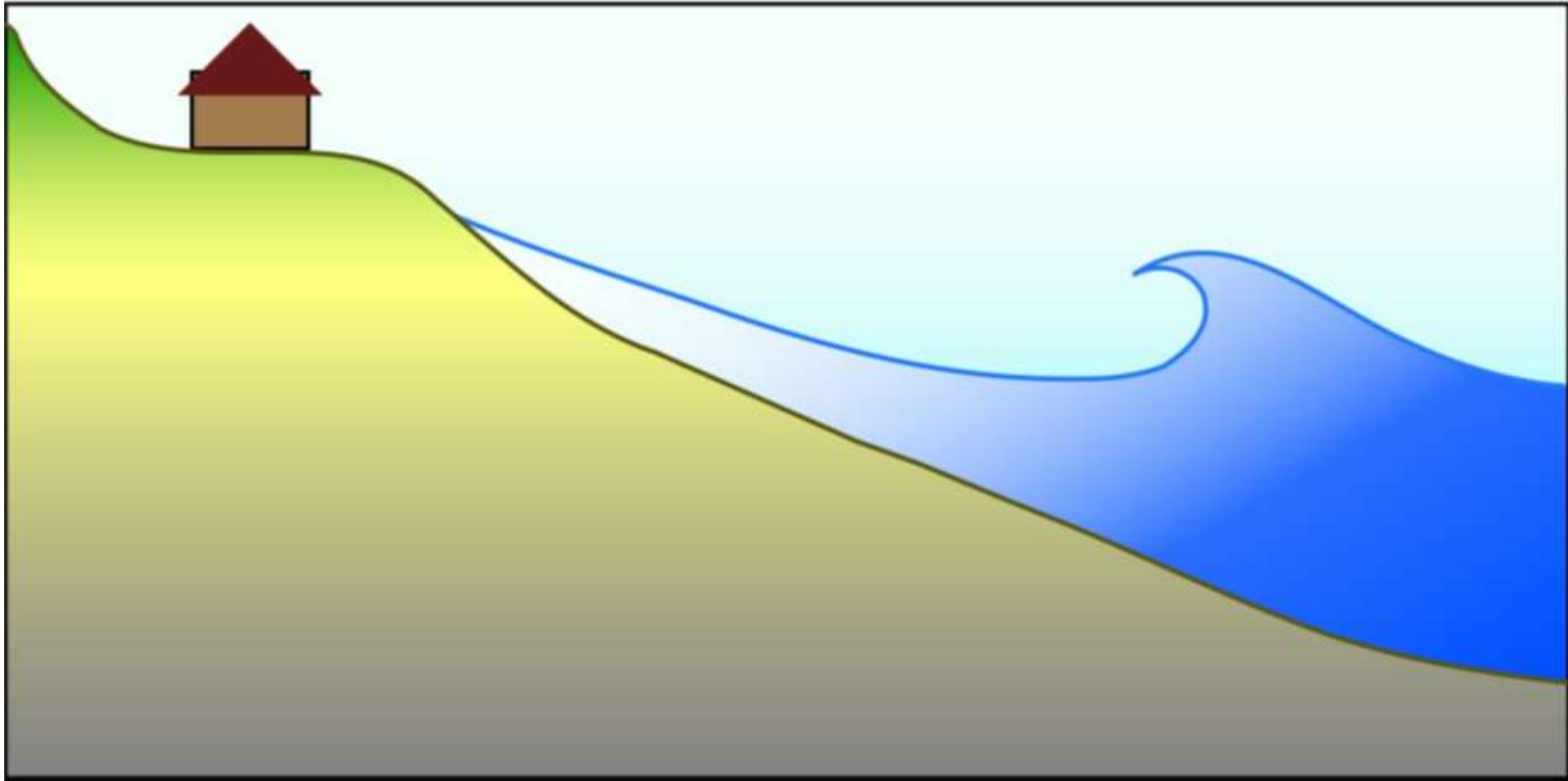
**Sean Vitousek, PhD**



Research Oceanographer, Pacific Coastal & Marine Science Center, Santa Cruz, CA

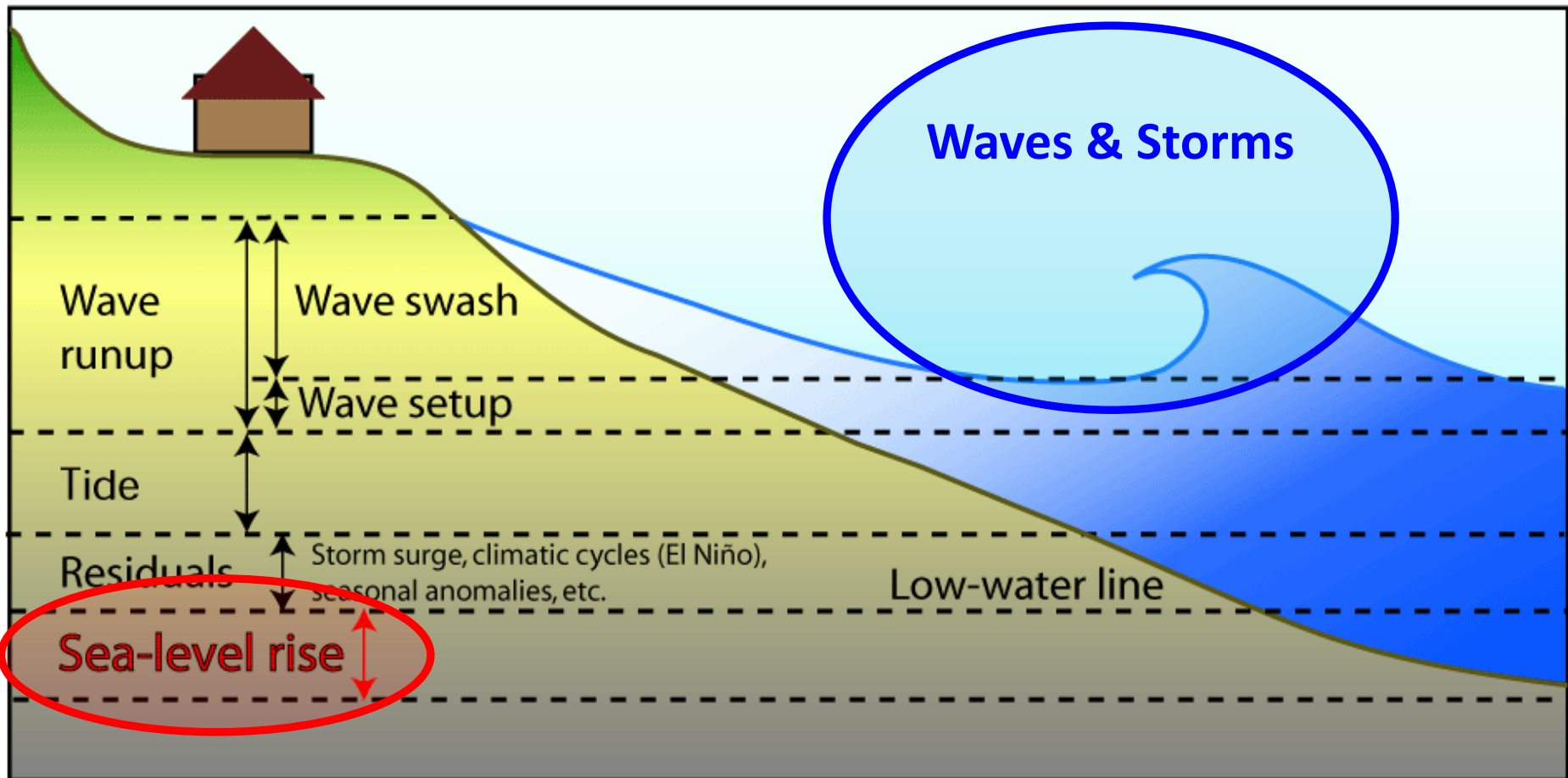
# Coastal Hazard Assessment & Prediction:

To assess **flooding** and **erosion** on a given beach, what are the processes we must consider?



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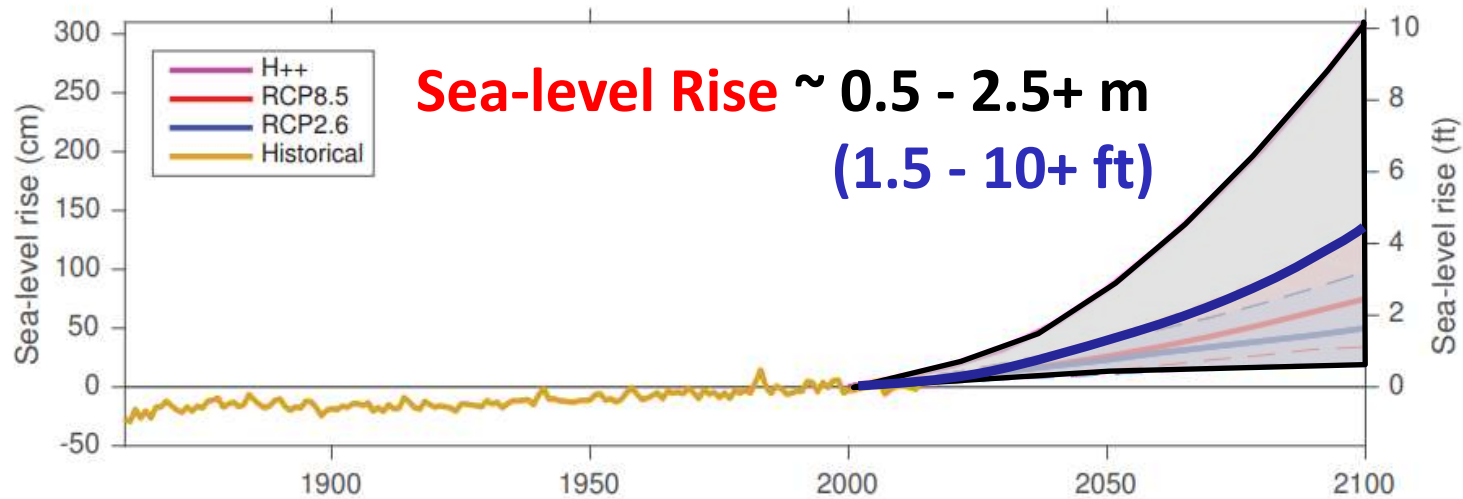


“Doubling of coastal flooding frequency within decades due to sea-level rise” – Vitousek et al. (2017)  
Scientific Reports

# Coastal Hazard Assessment & Prediction:

To assess **flooding** and **erosion** on a given beach, what are the processes we must consider?

(b) Relative sea level in San Francisco, California



Griggs, G, Árvai, J, Cayan, D, DeConto, R, Fox, J, Fricker, HA, Kopp, RE, Tebaldi, C, Whiteman, EA (California Ocean Protection Council Science Advisory Team Working Group). Rising Seas in California: An Update on Sea-Level Rise Science. California Ocean Science Trust, April 2017.

# California's sediment supply:

- **Fluvial sediment inputs**

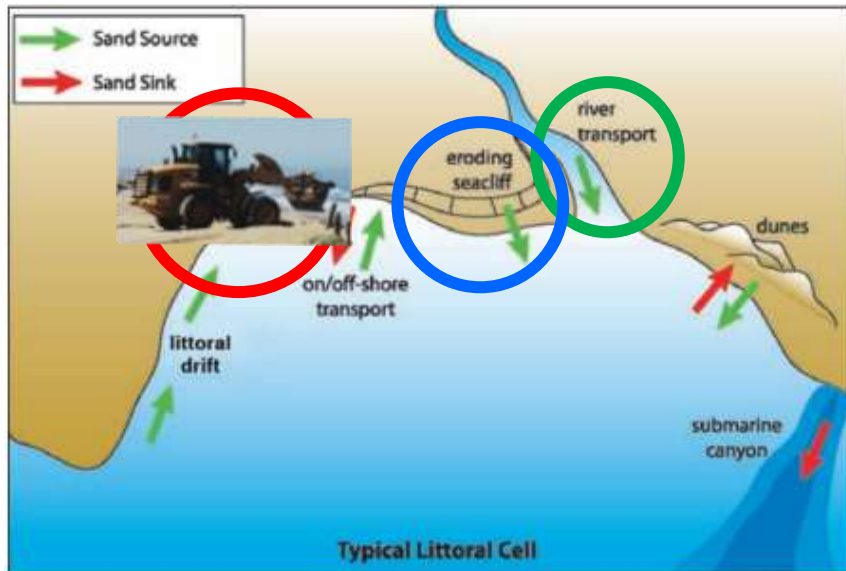
(Willis & Griggs 2003, Warrick & Milliman 2003)

- **Eroding cliffs, dunes**

(Young & Ashford 2006, Limber et al., 2018)

- **Artificial Beach Nourishments**

(Flick 1993)



Patsch, K., & Griggs, G. B. (2006). Littoral cells, sand budgets, and beaches: understanding California's shoreline (p. 40). Institute of Marine Sciences, University of California, Santa Cruz.

# Factors contributing to *erosion*:

- **Waves**

(Pelnard-Considere 1956, Wright et al., 1985)



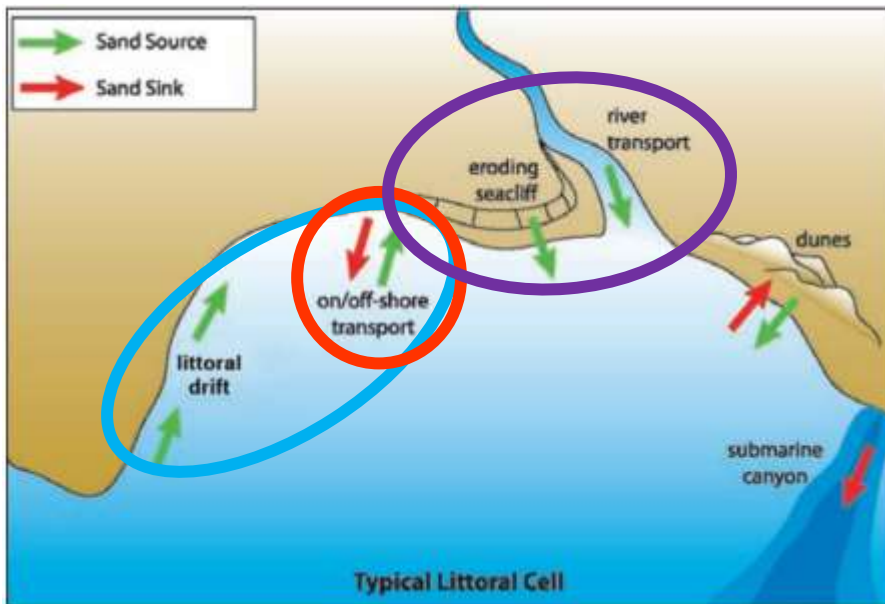
- **Sea-Level Rise**

(Bruun 1962, Anderson et al., 2015, Atkinson et al., 2018)



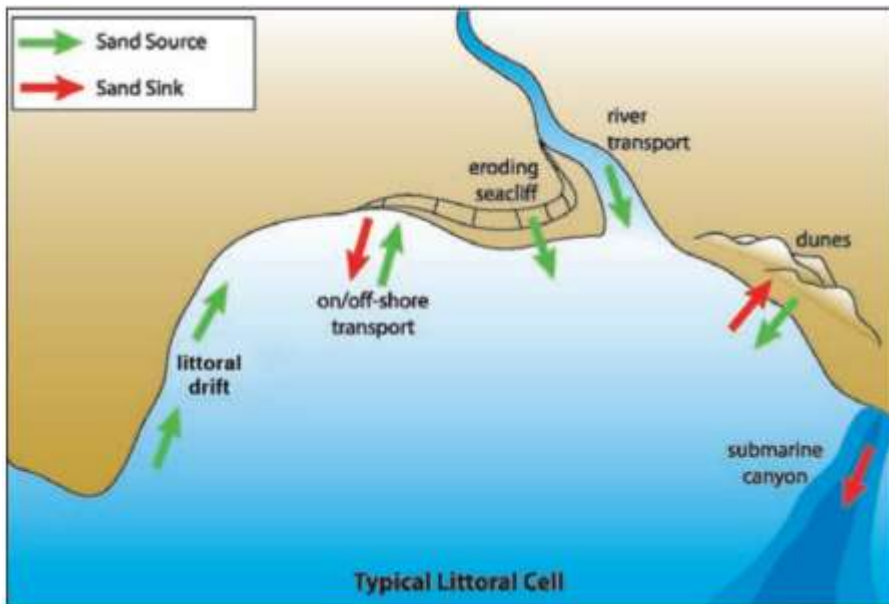
- **River Damming & Shoreline Armoring**

(Fletcher et al., 1997, Runyan & Griggs 2003, Griggs 2005)



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# Wave-driven coastal change:

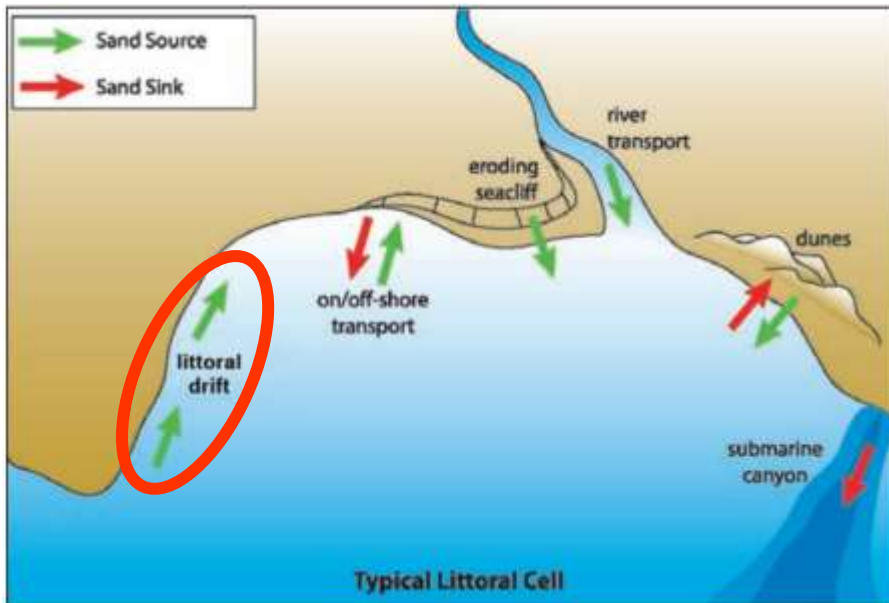


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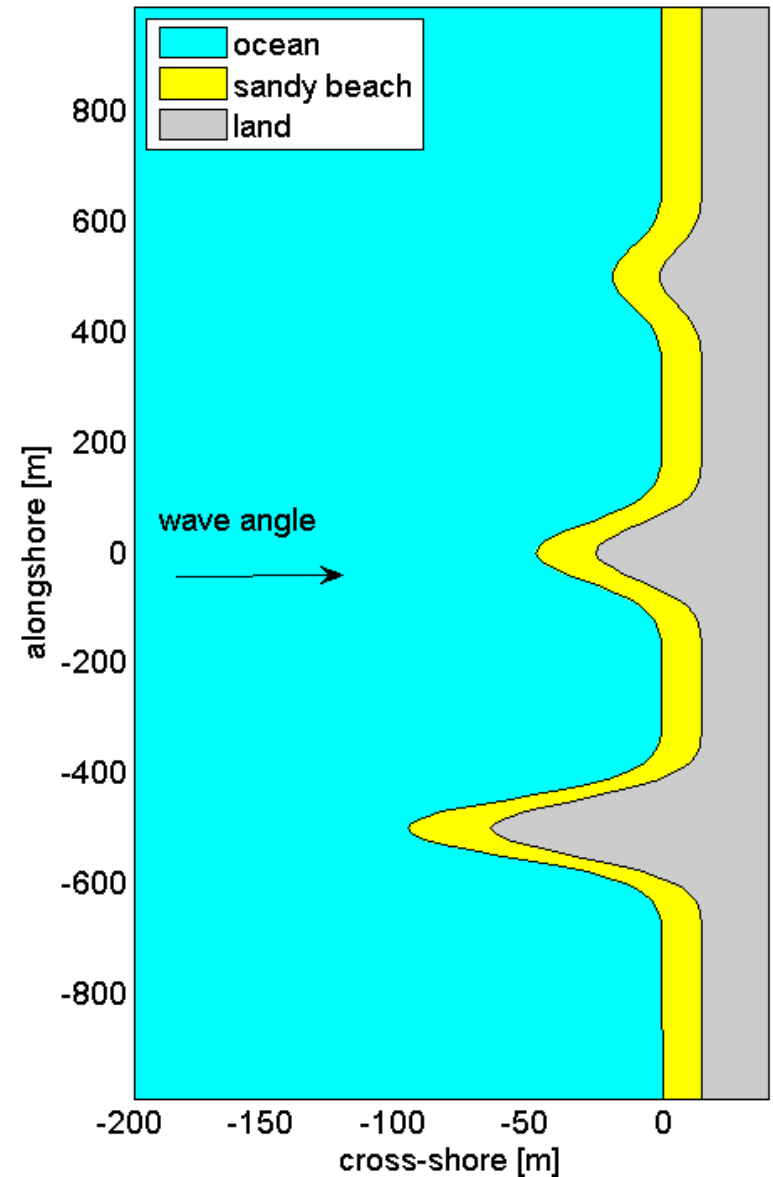
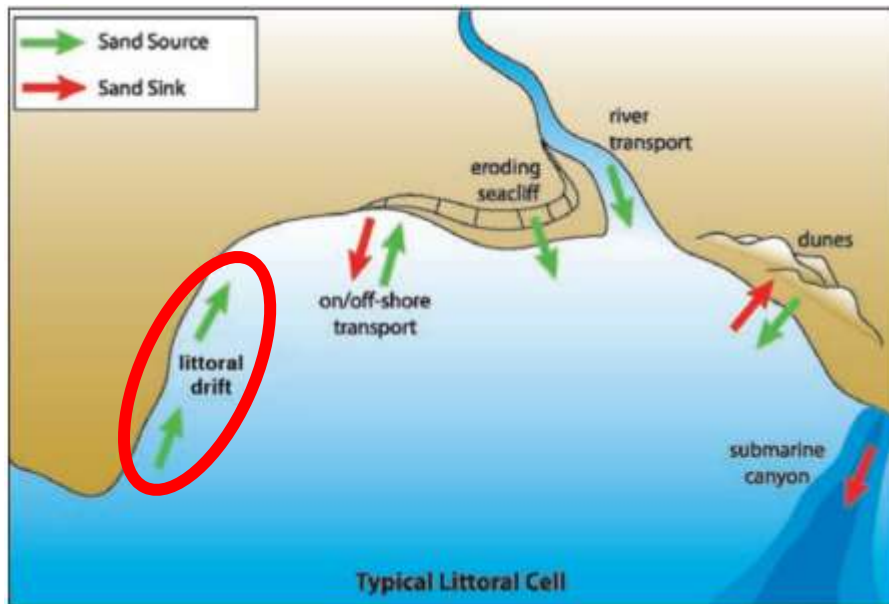
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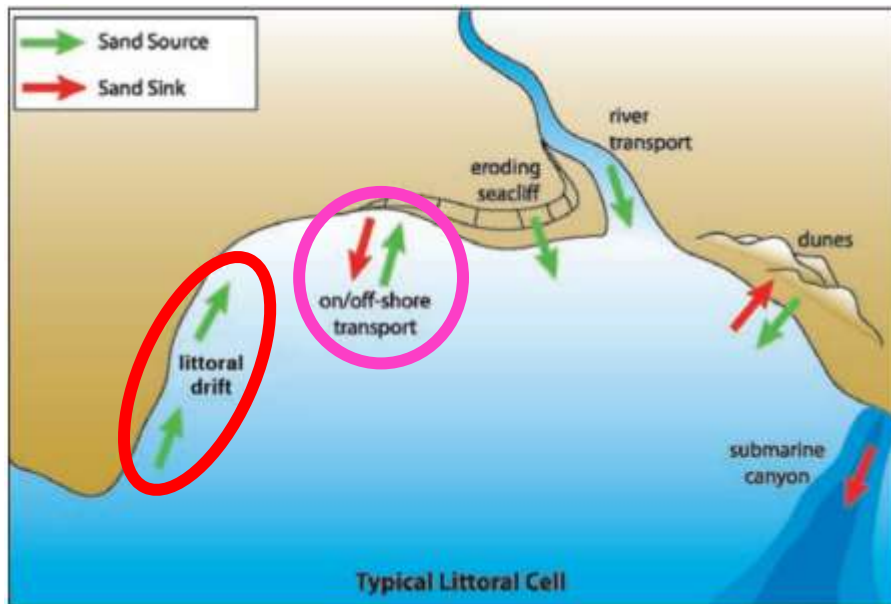
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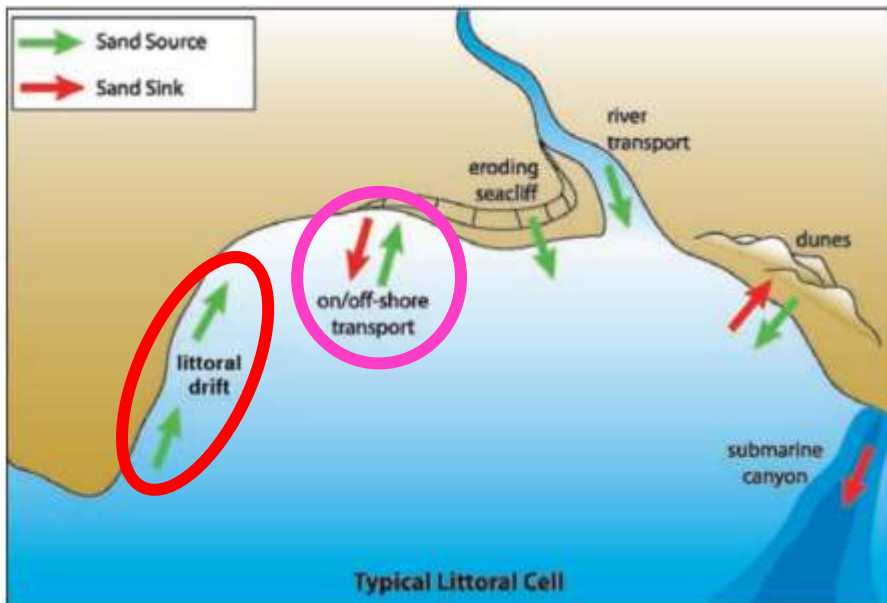
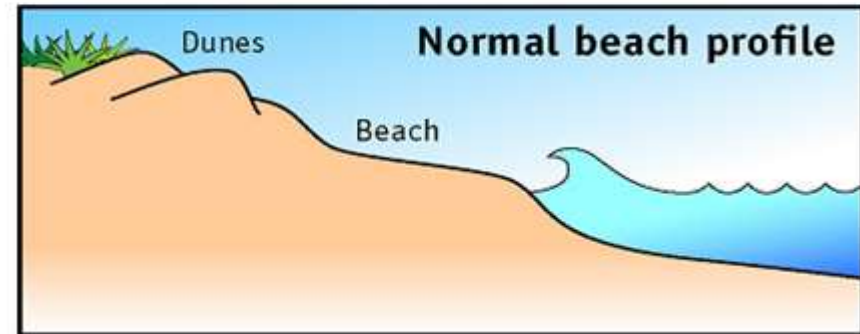
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## Seasonal beach profile adjustments



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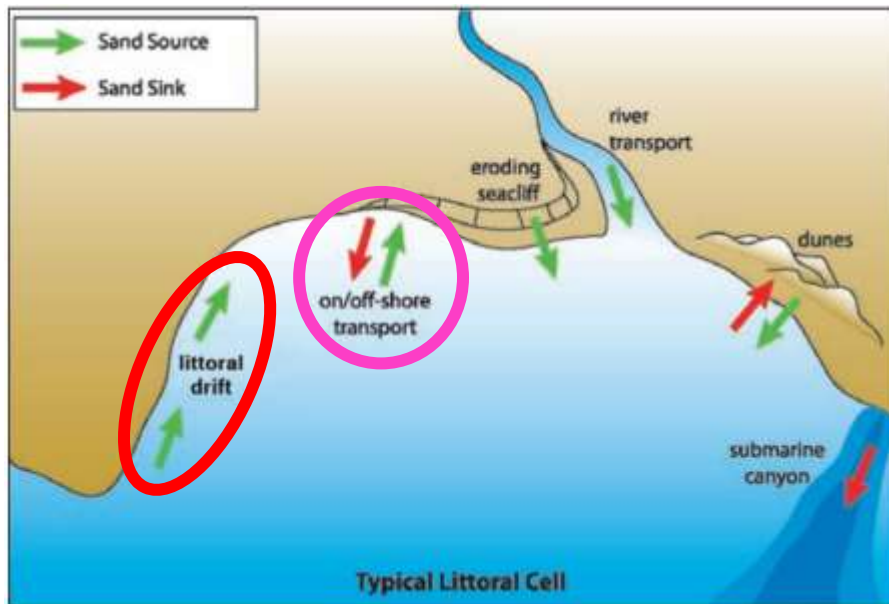
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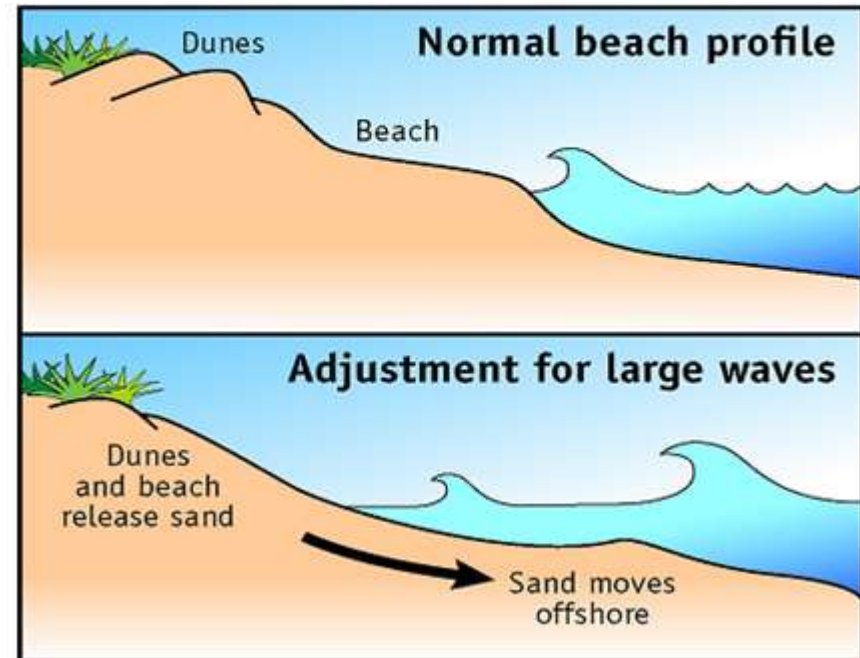
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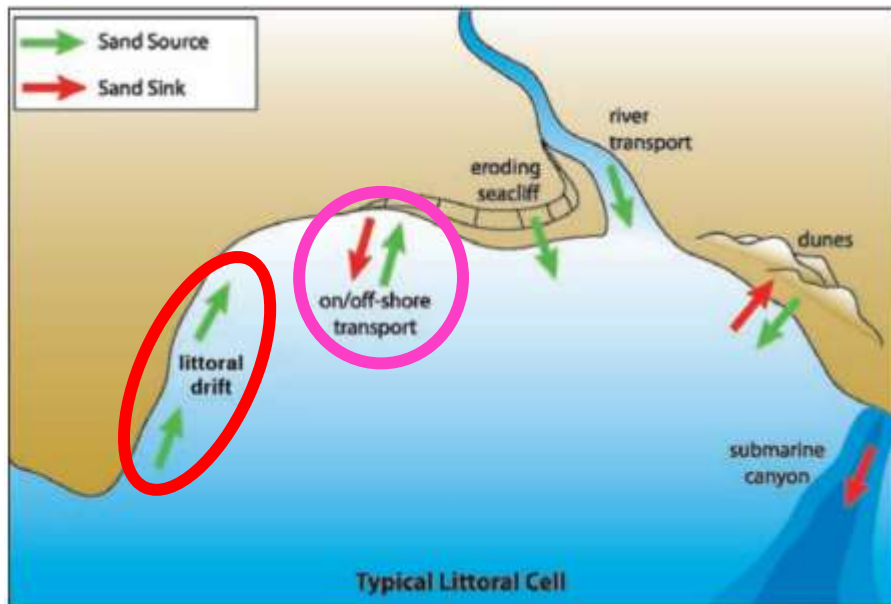
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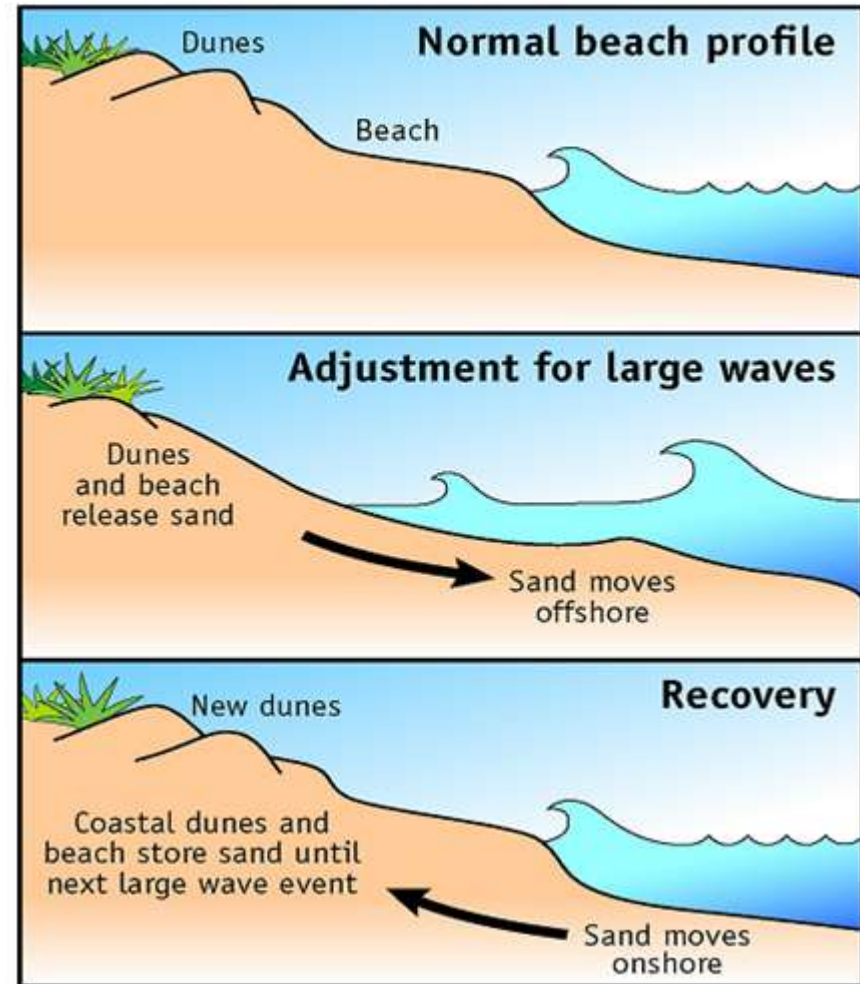
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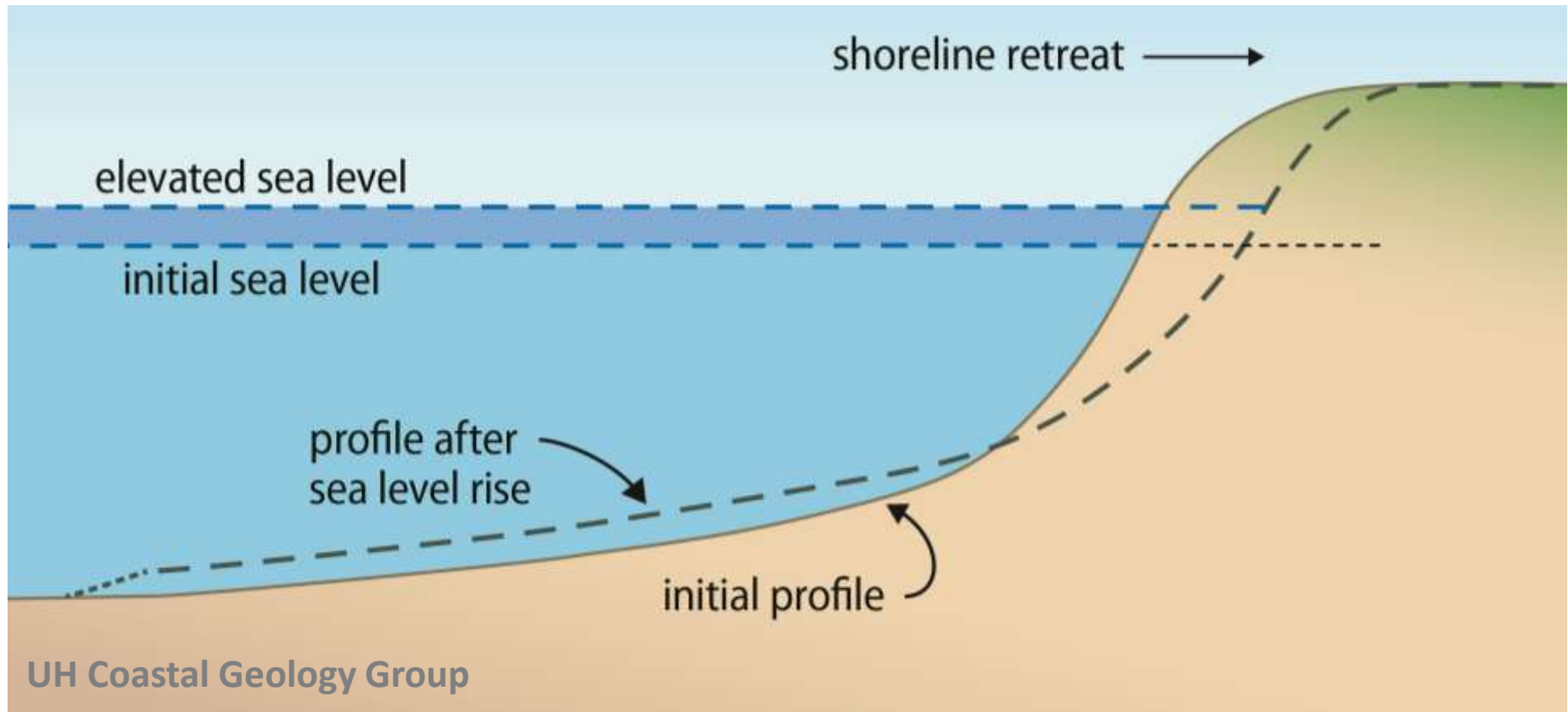
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**Credit: UH Coastal Geology Group**

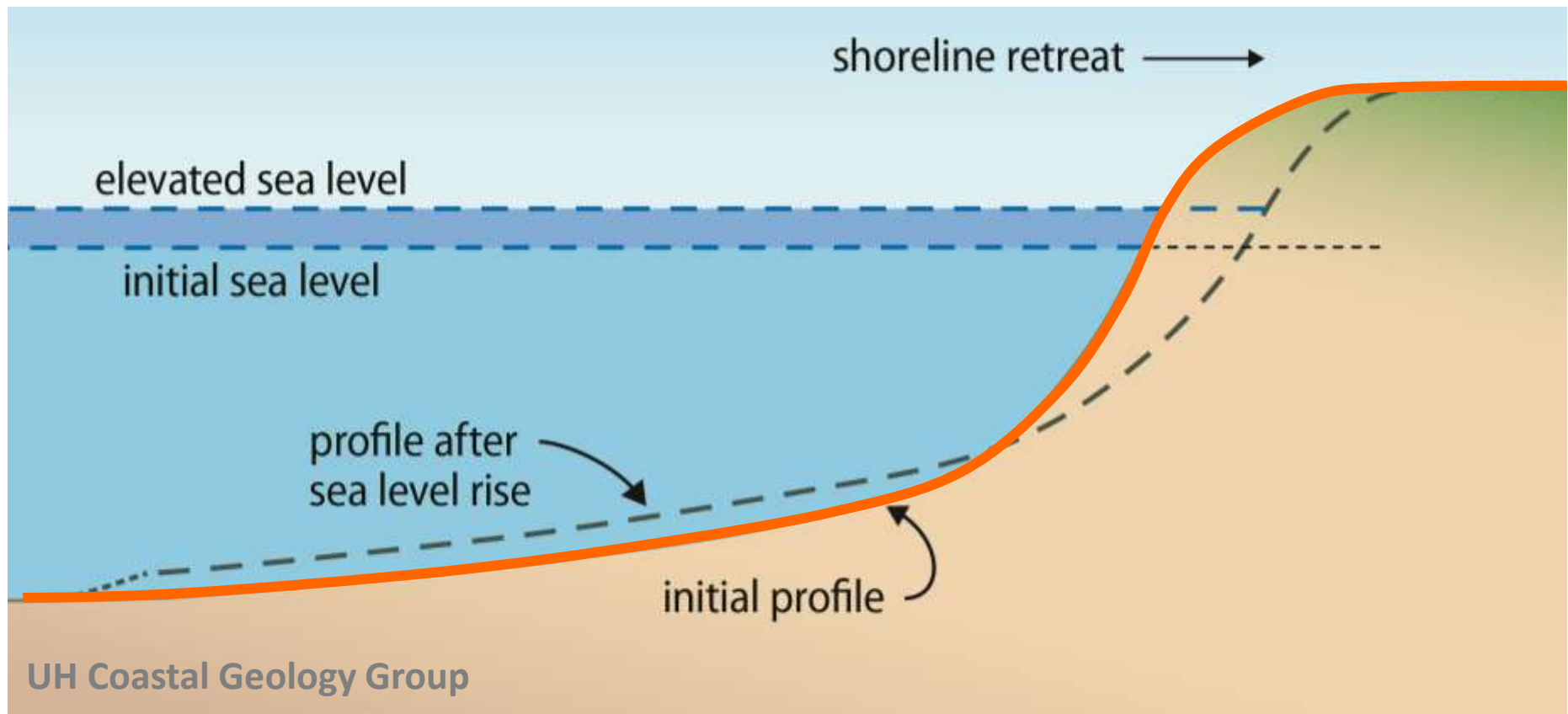
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Beach maintains an equilibrium profile (shape) as sea level rises.



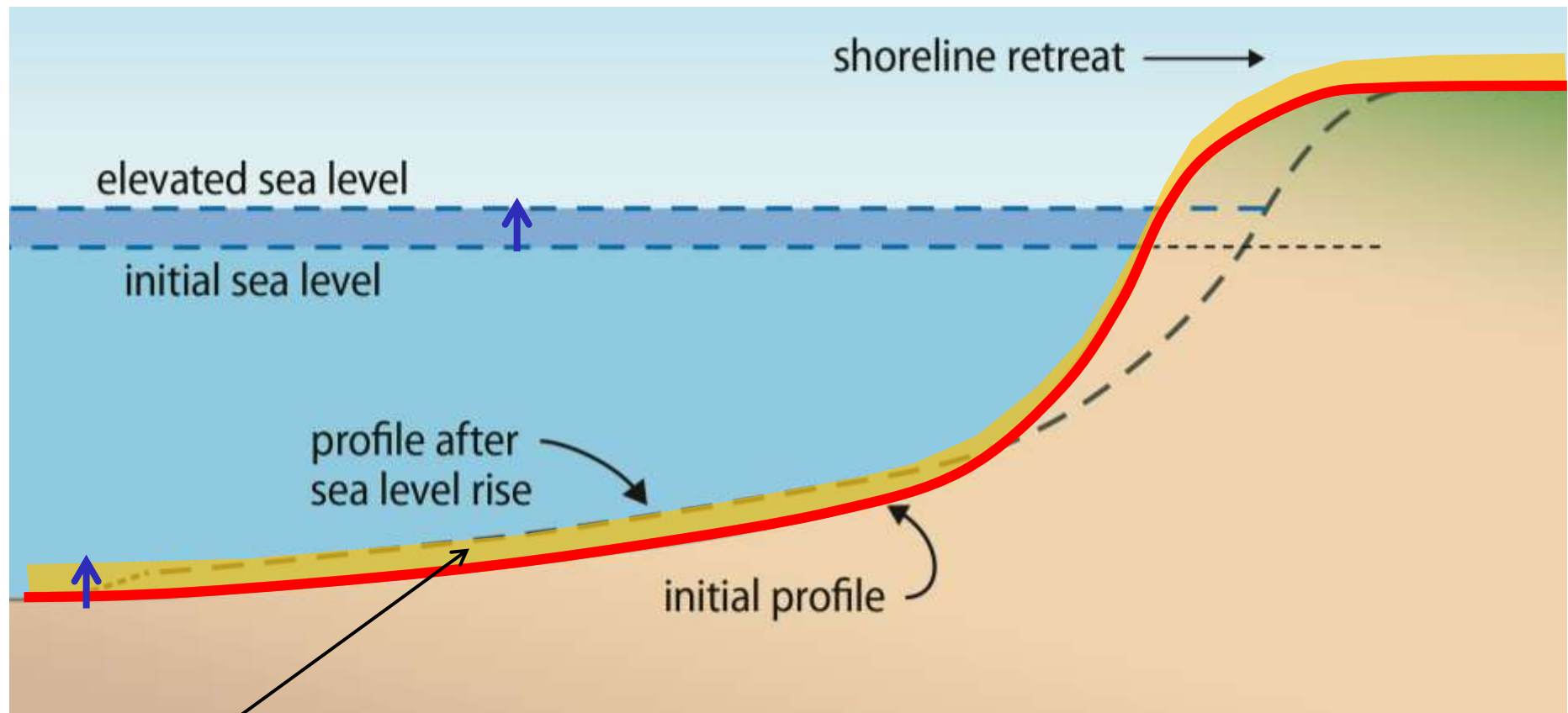
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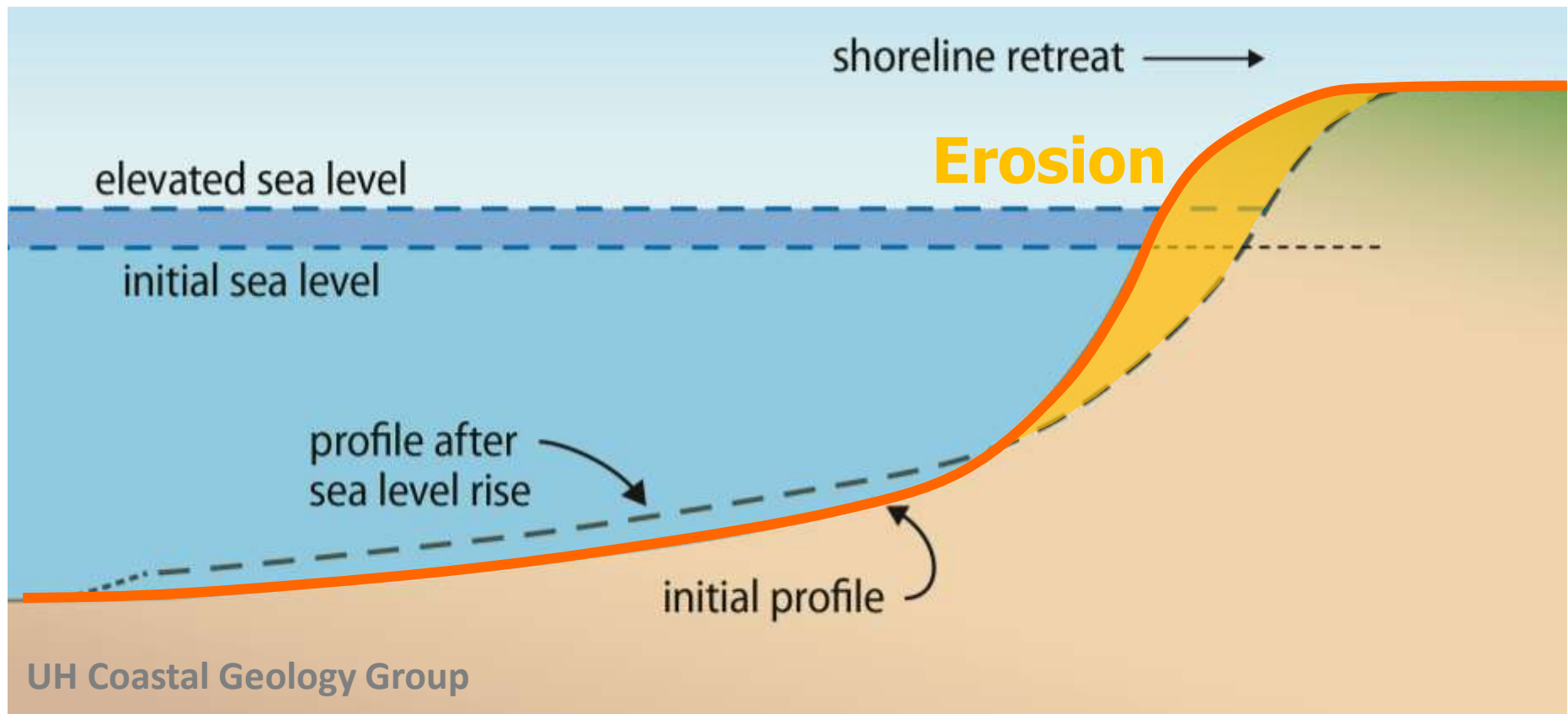


**Sand volume** is not conserved (if beach profile is translated upwards only)!



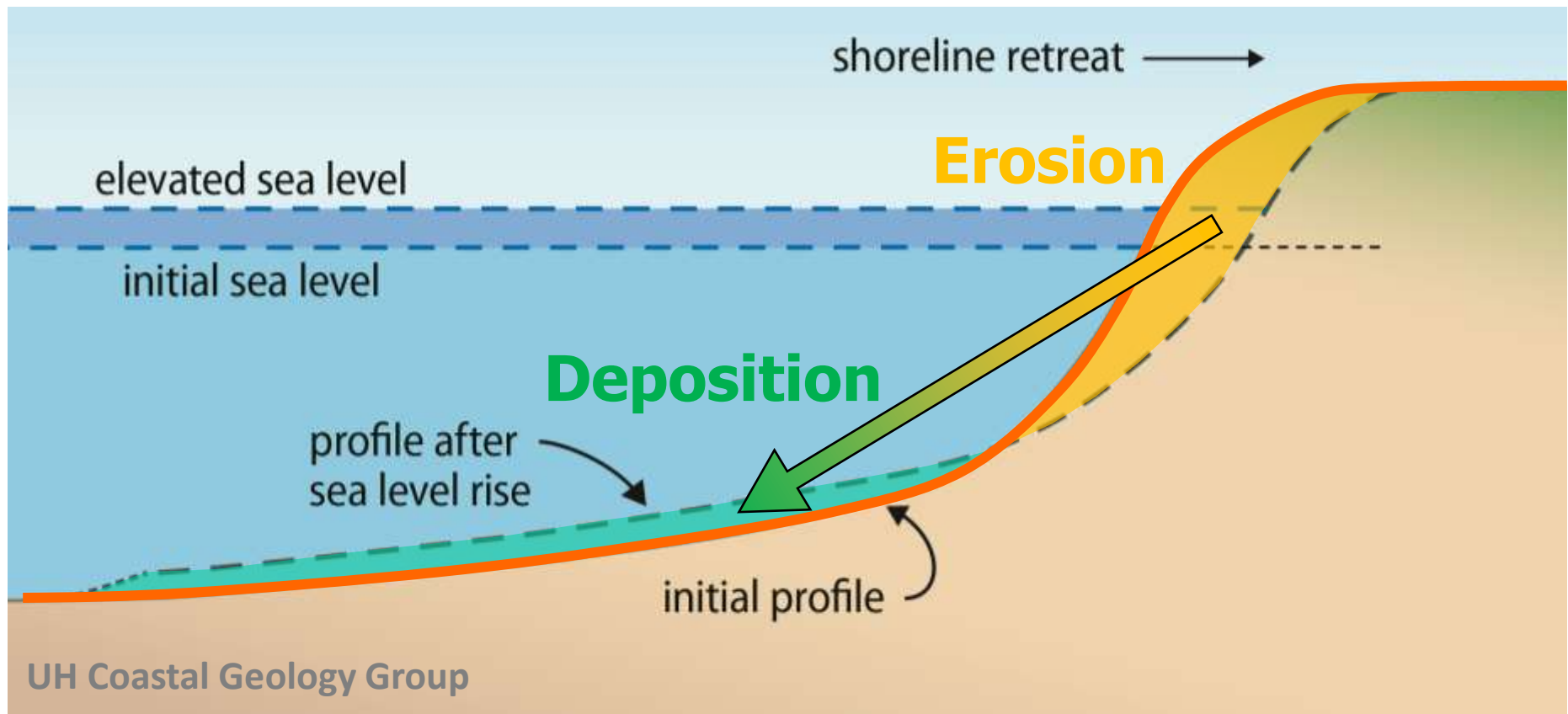
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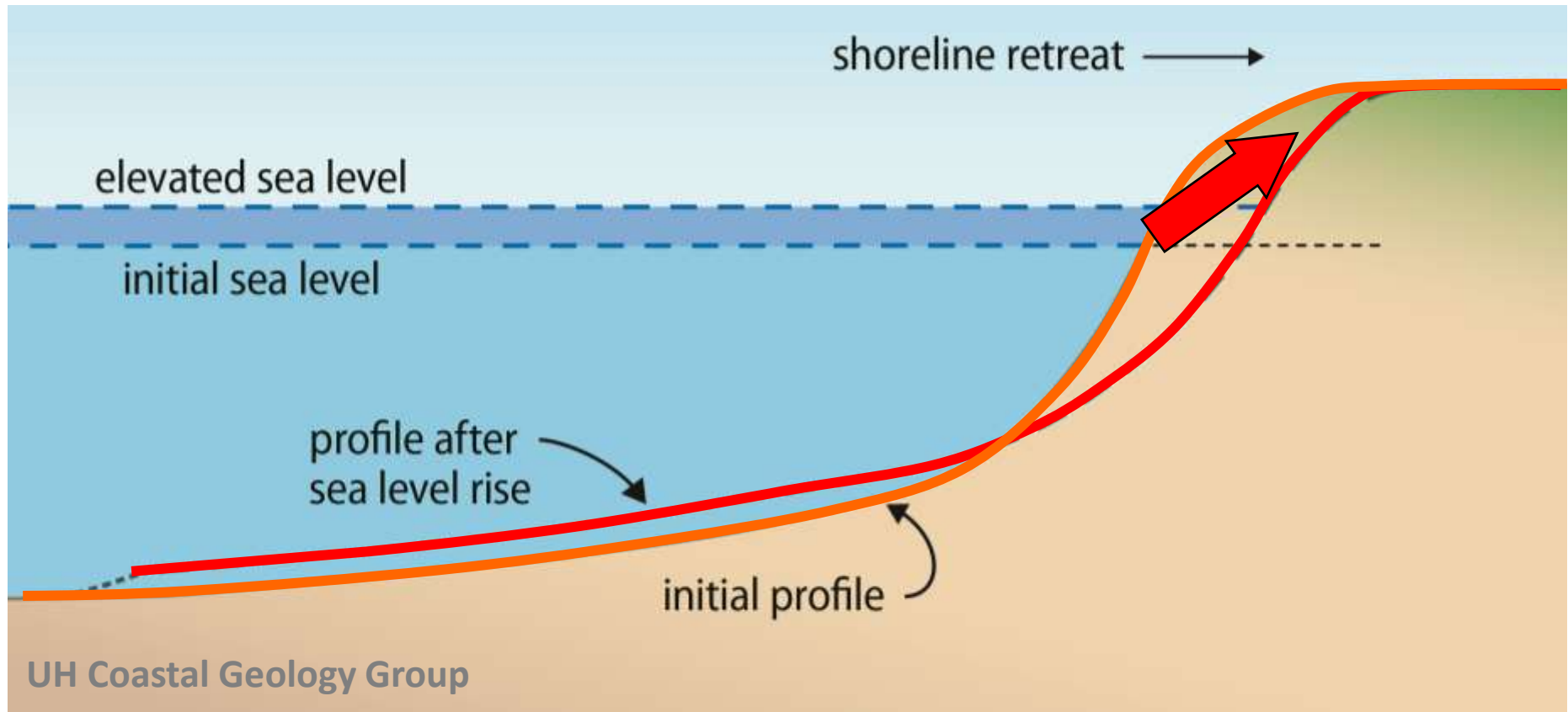
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**Sand volume is conserved** (if beach profile is translated upwards & landwards)!

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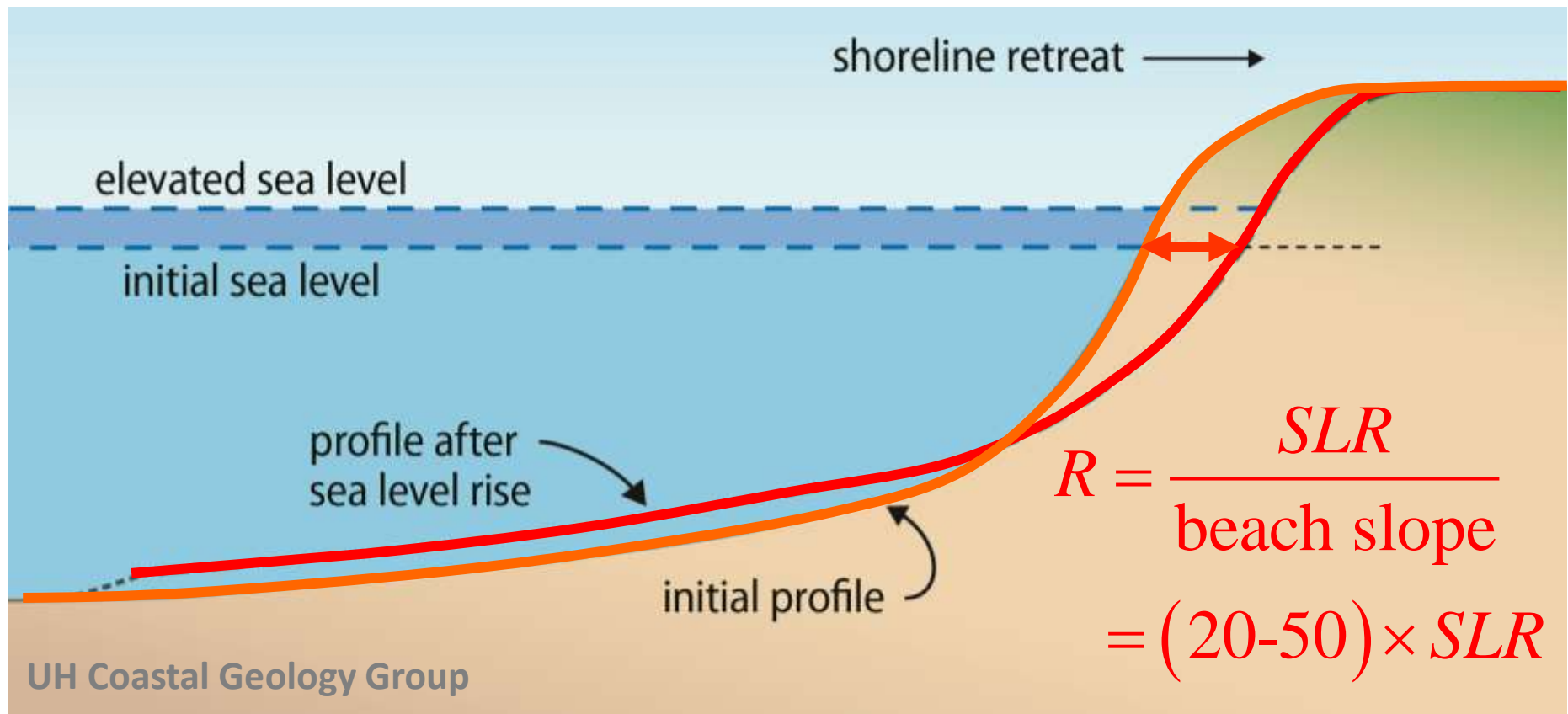


**Old beach profile**

**New beach profile**

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Using historical aerial photos ...



**the National Assessment of Shoreline Change & the Coastal Storm Modeling System (CoSMoS)**

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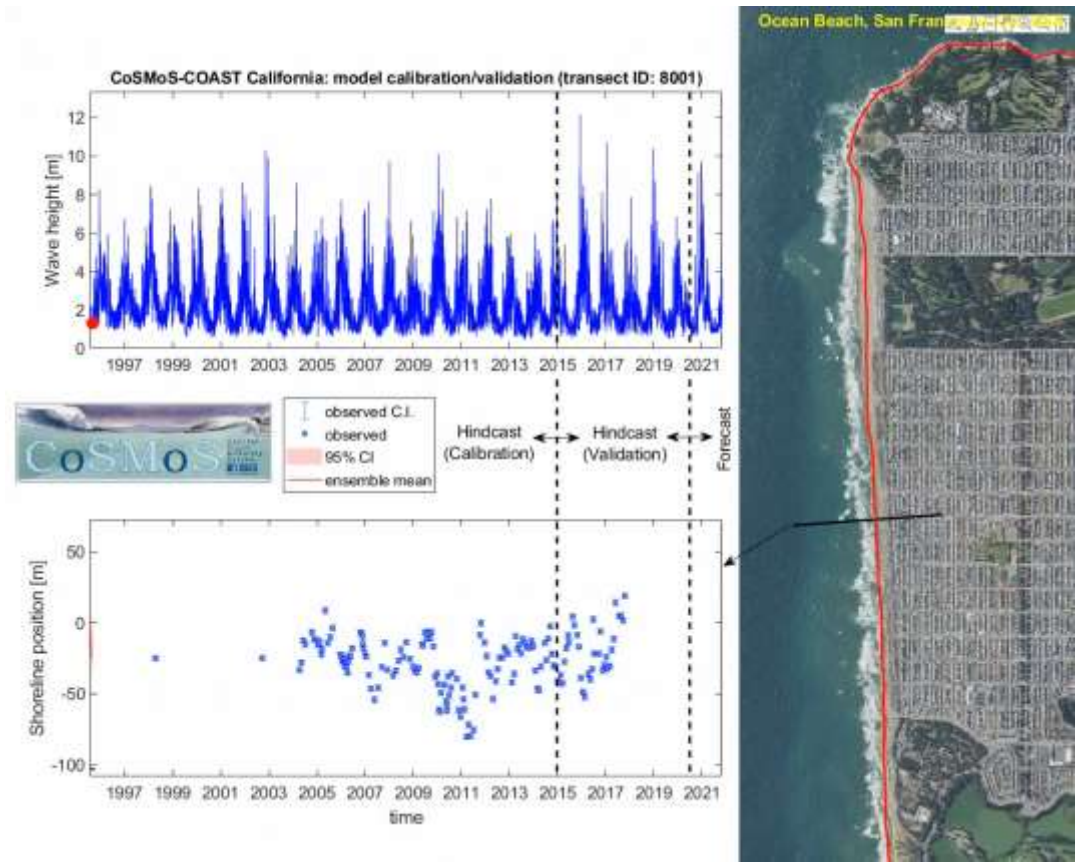
Using historical aerial photos ... satellites ...



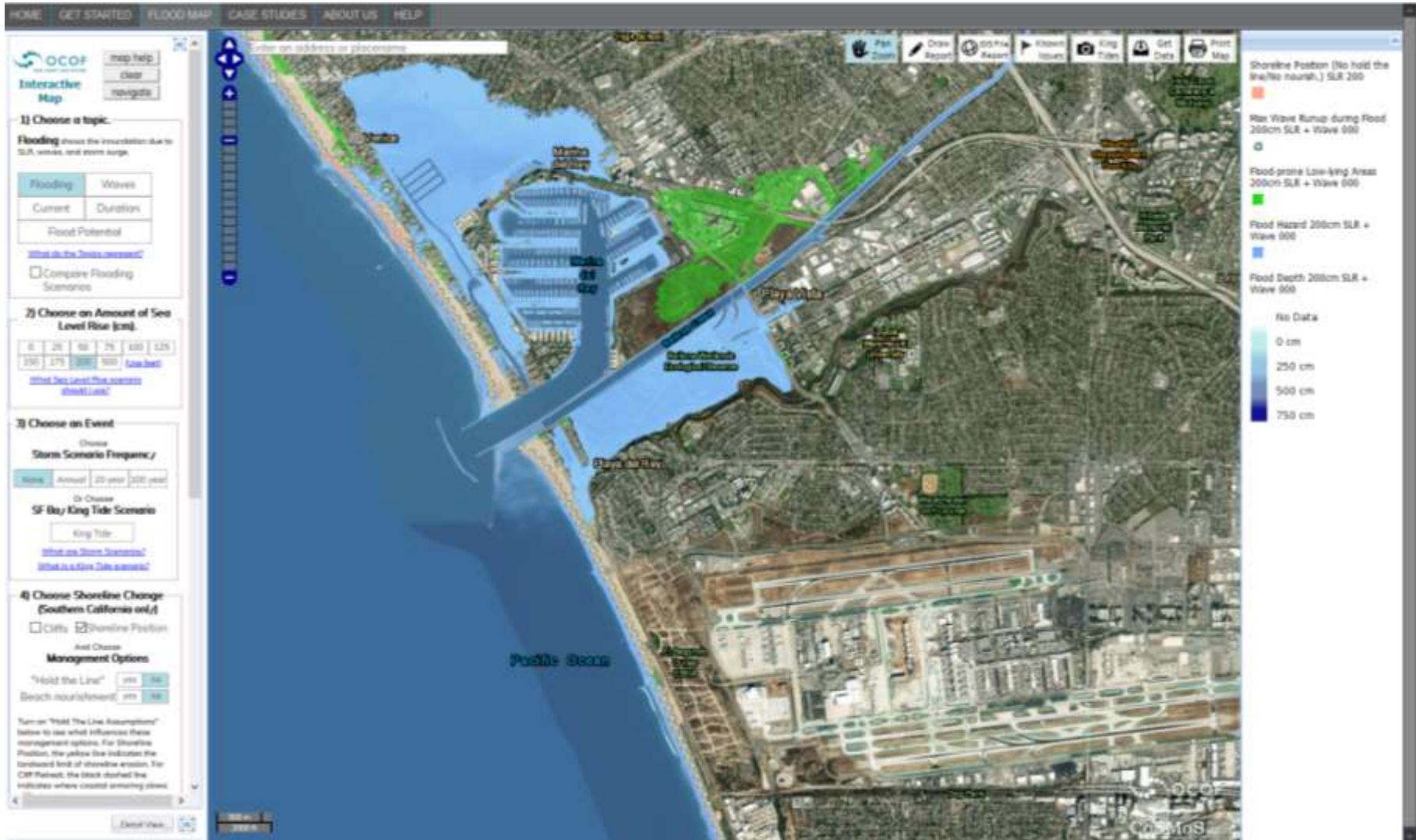
the National Assessment of Shoreline Change & the Coastal Storm Modeling System (CoSMoS)

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Using historical aerial photos ... satellites ... and computer models



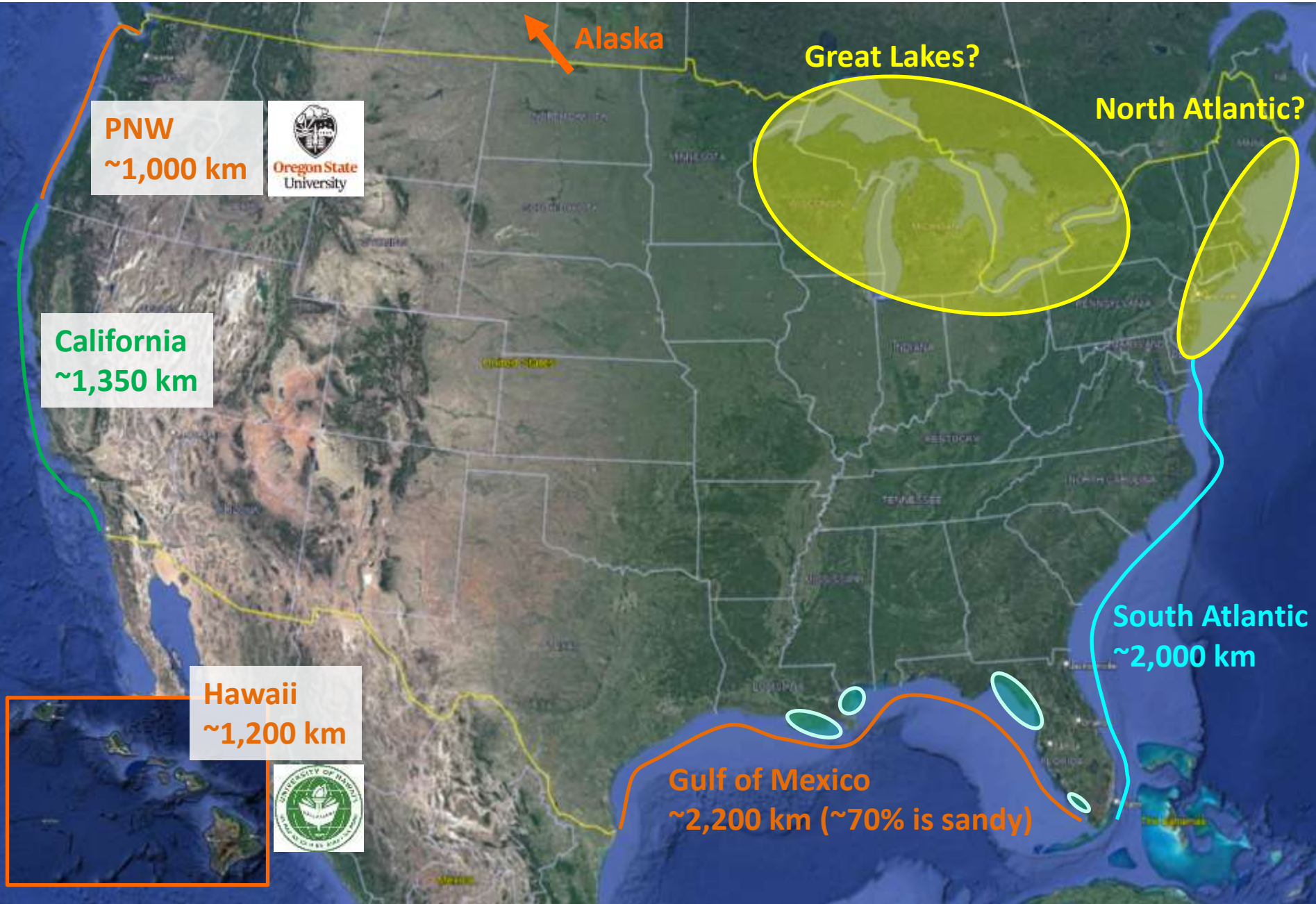
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**Our Coast, Our Future ([ourcoastourfuture.org](http://ourcoastourfuture.org))**



# Future Work:



# The Science of Coastal Erosion

Capitola Pier 2020



**The End**

Capitola Pier 2018



**Thanks!**

■ ■ ■ Capitola Pier 2100?



**EXTRAS**

# The Myth & Reality of Southern California Beaches



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**The beaches are the essence of California** and provide its most important aesthetic and recreational asset.

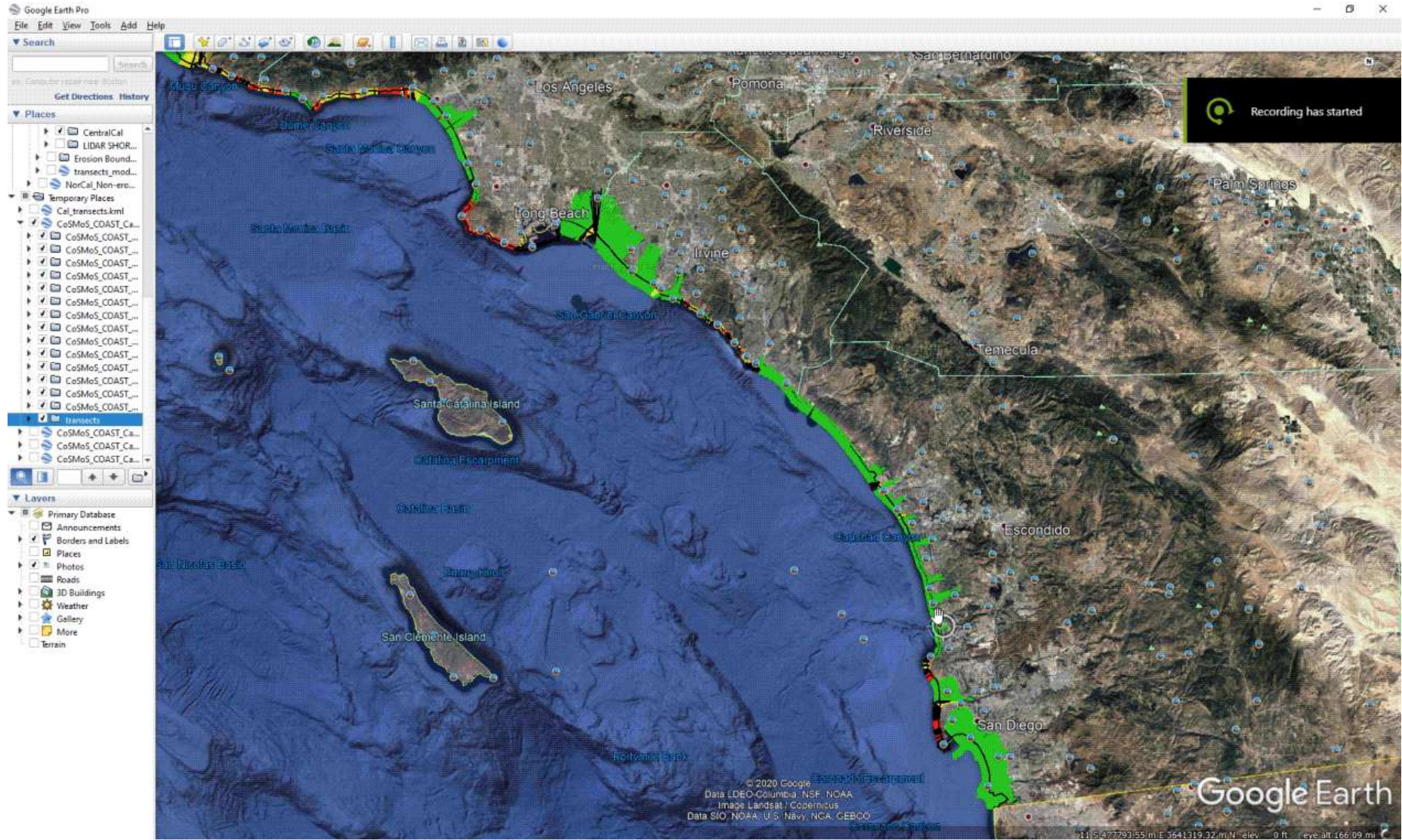
Yet, the widest sand beaches in southern California **have been created and are maintained by human activity.**

**Human interventions include massive amounts of sand placement and construction of groins, jetties and breakwaters. ...**

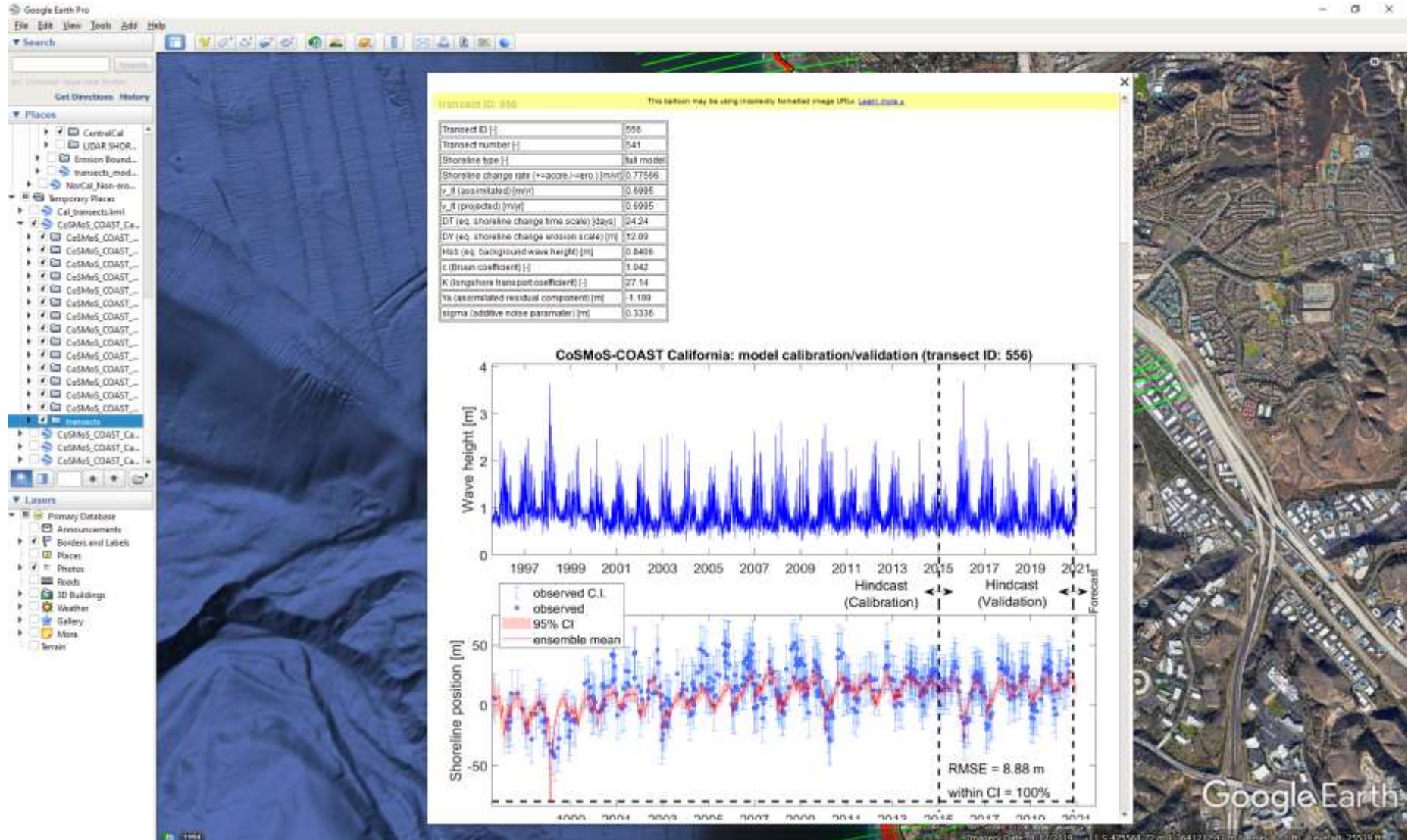
These ideas seem "radical" to many Californians who often regard any engineering works on the beach as an **unnecessary intrusion into nature ...** - R. Flick (1993)



# Towards operational, national-scale predictions of coastal change



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*(Photo by Patrick Barnard)*

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*(Photo by me)*

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