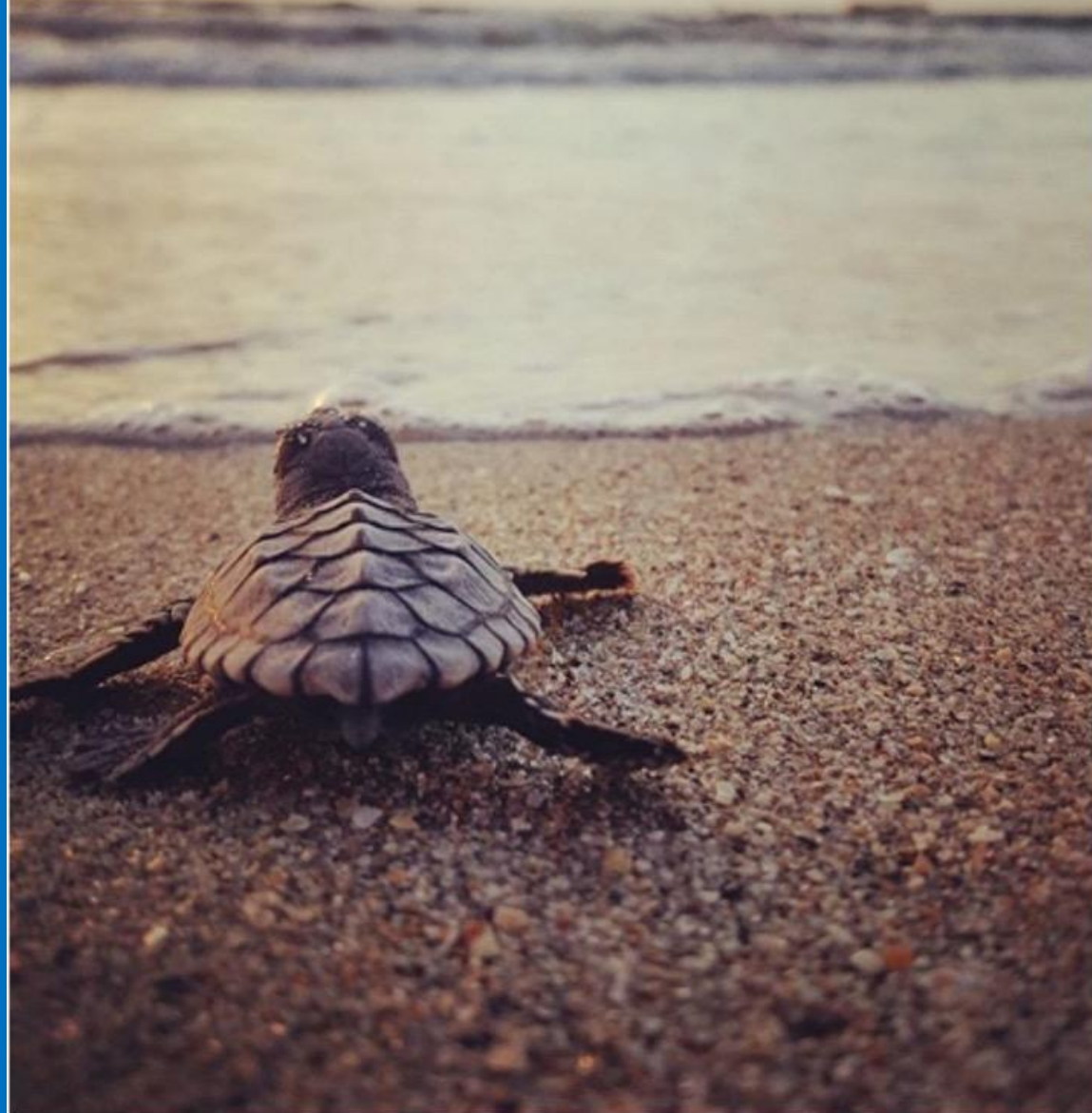
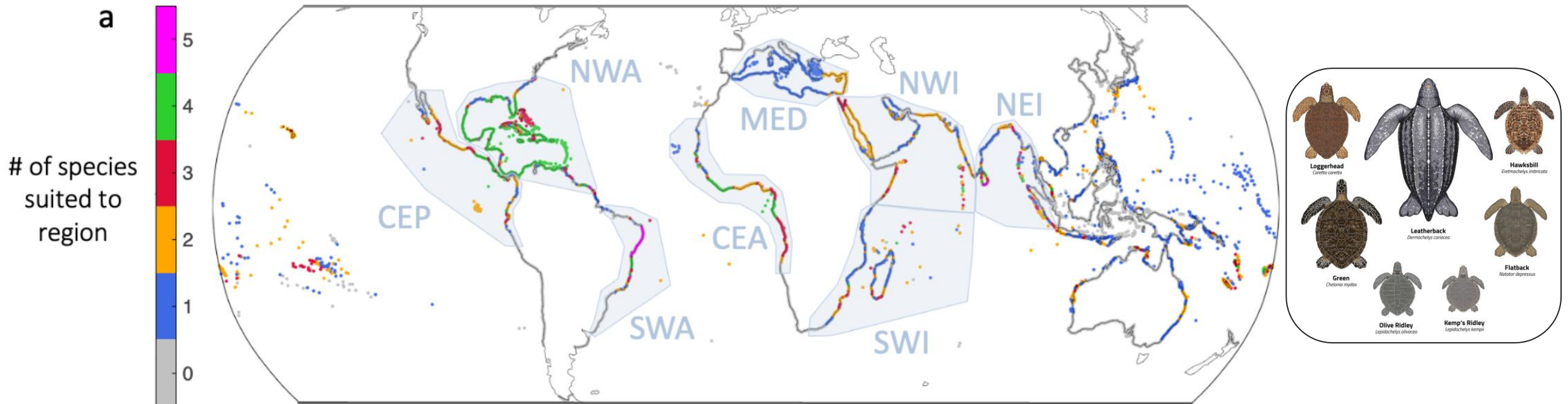
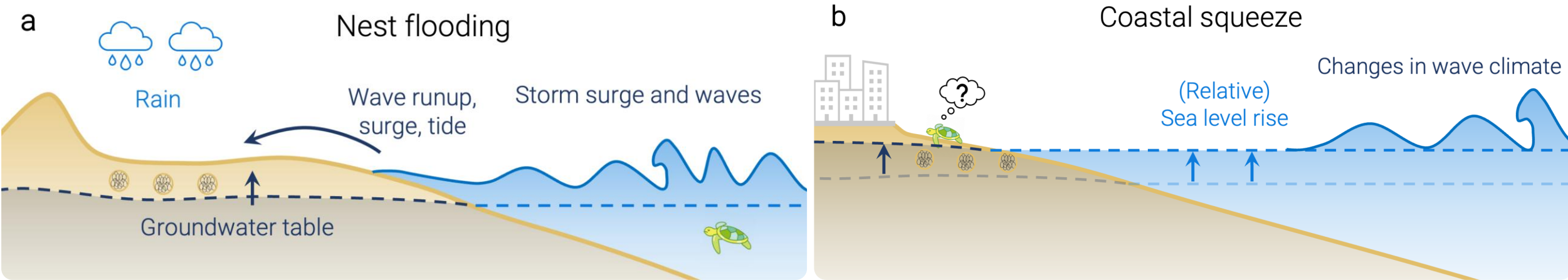




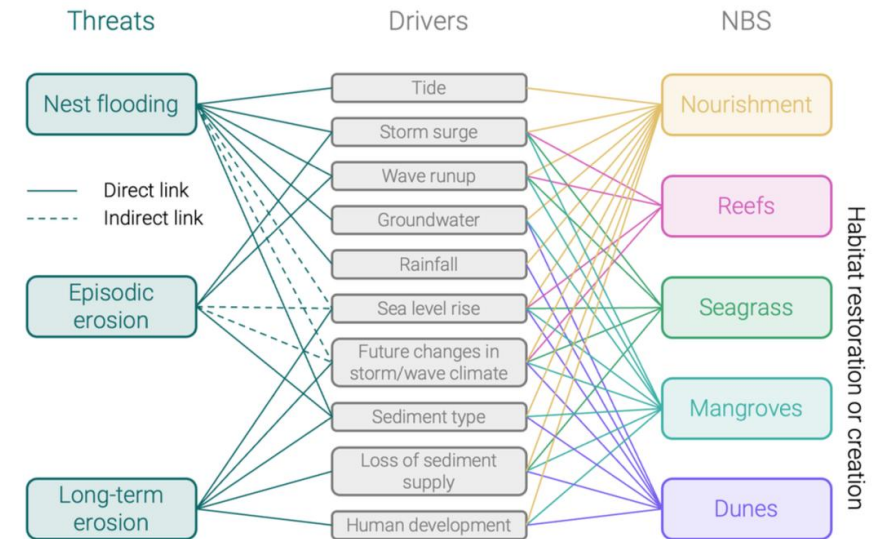
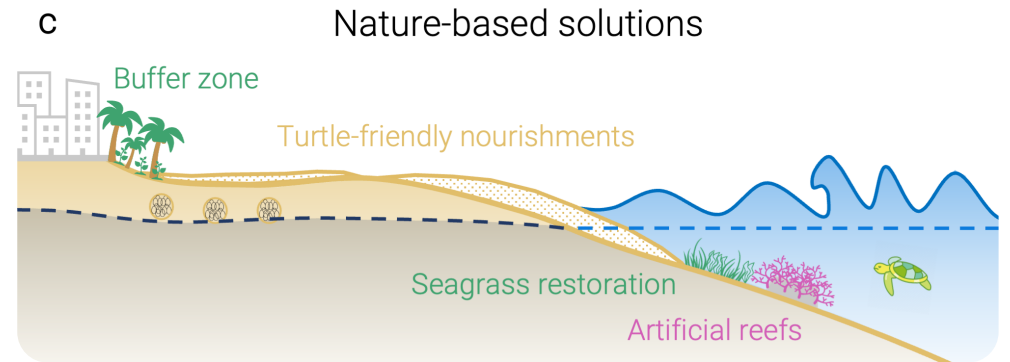
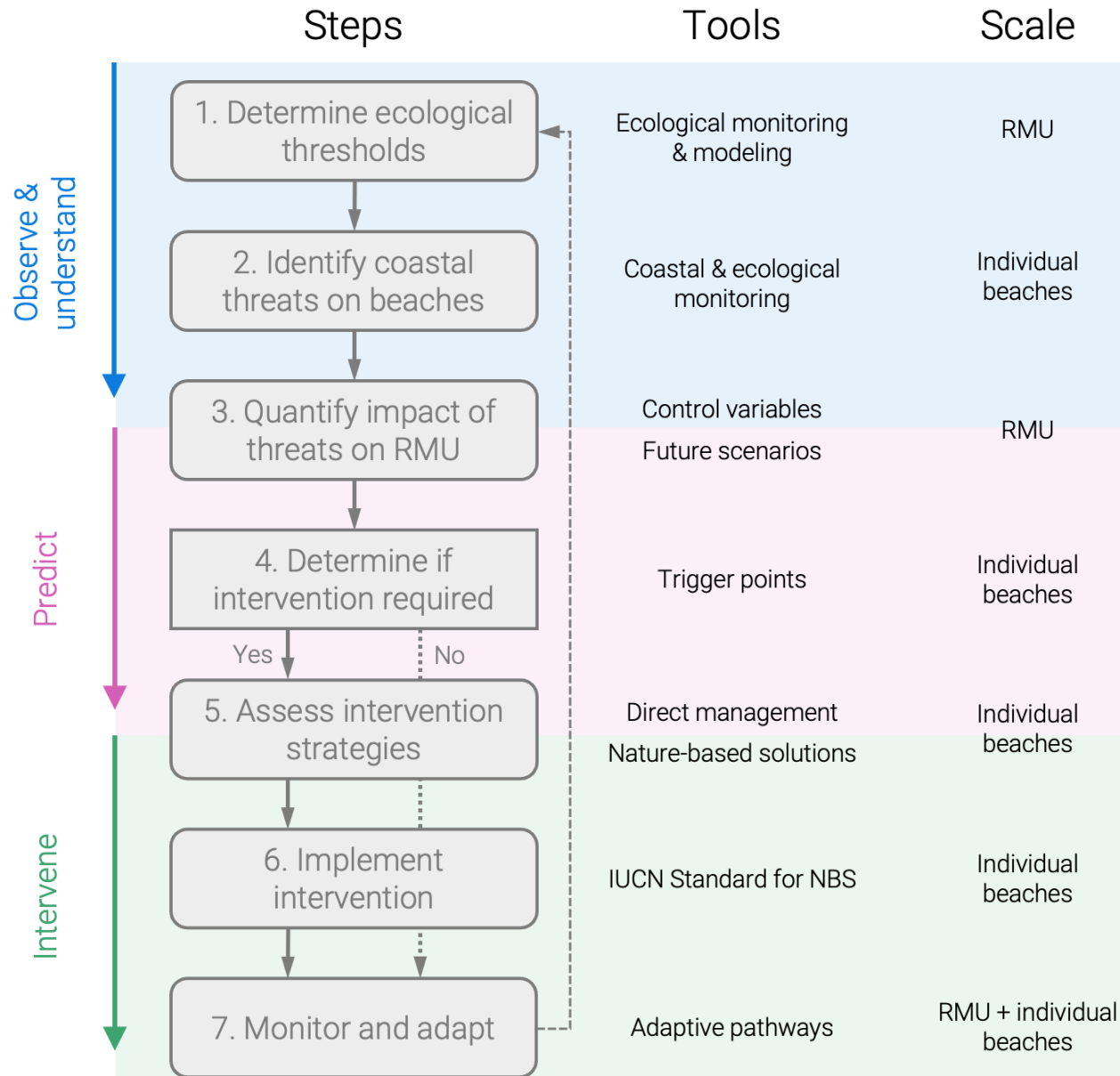
Coastal Science for flood and erosion proof sea turtle nesting beaches

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Nesting beaches under pressure



Enabling resilience of nesting beaches

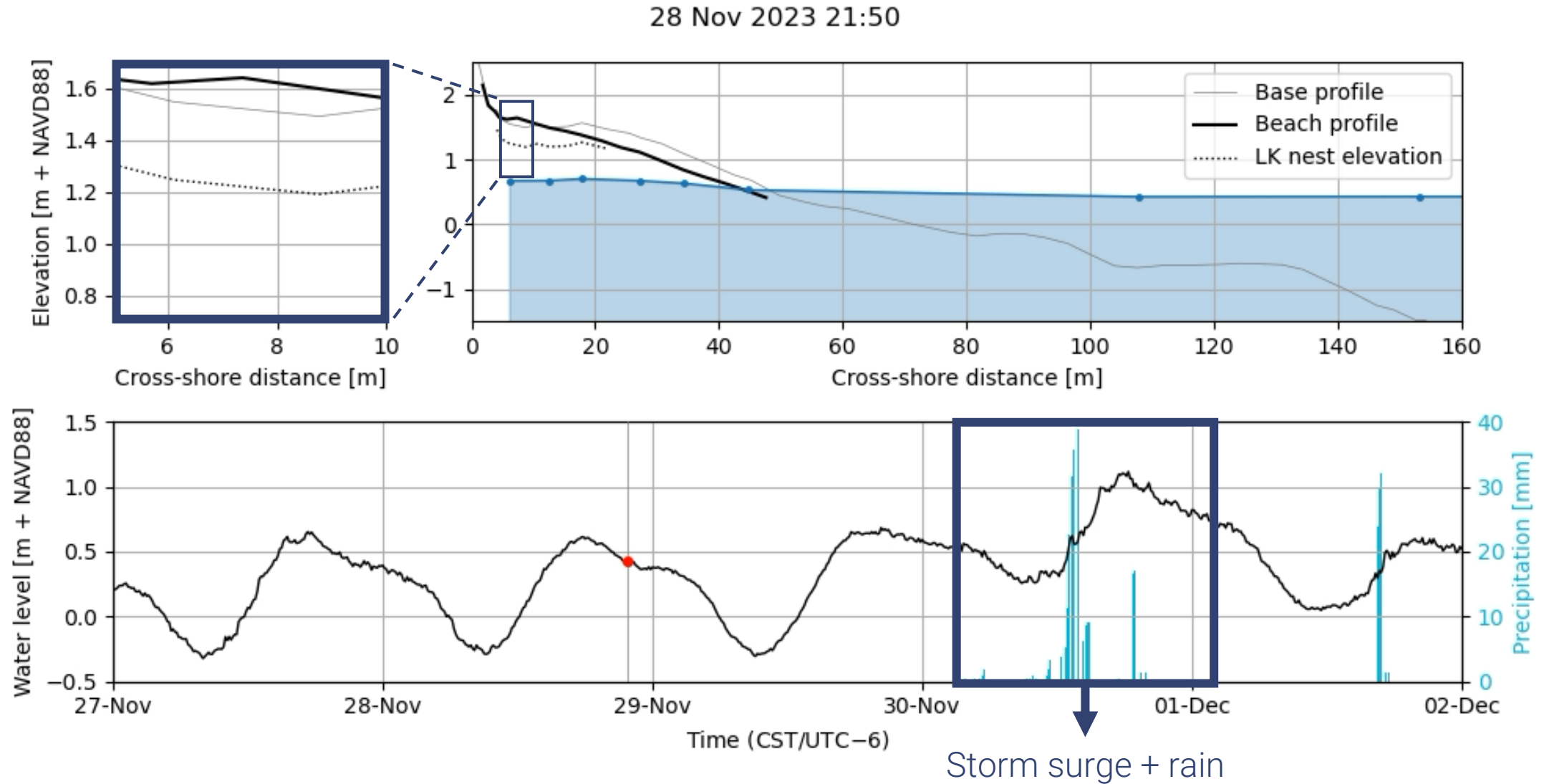


Field campaign Galveston Oct/Nov 2023

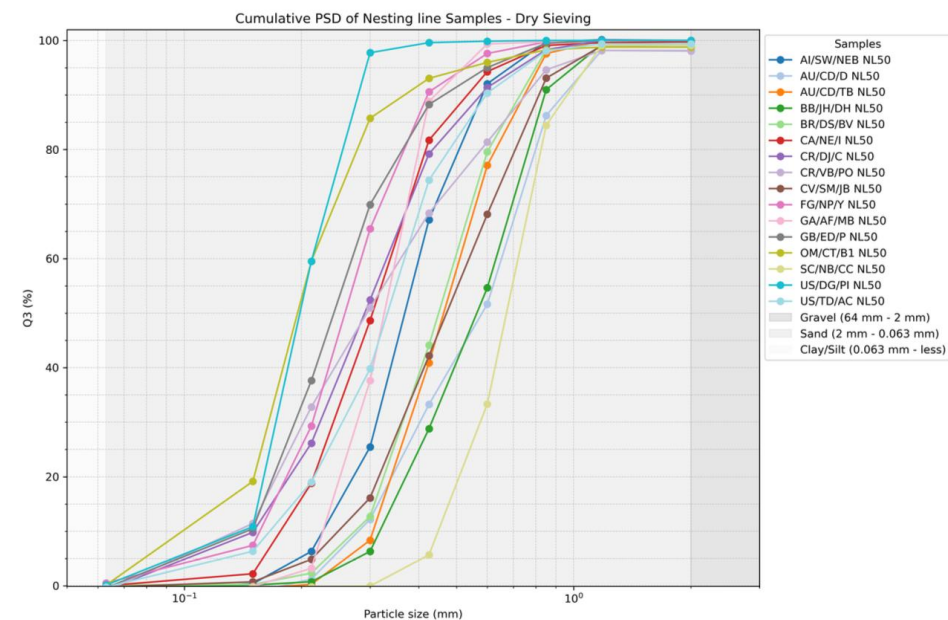
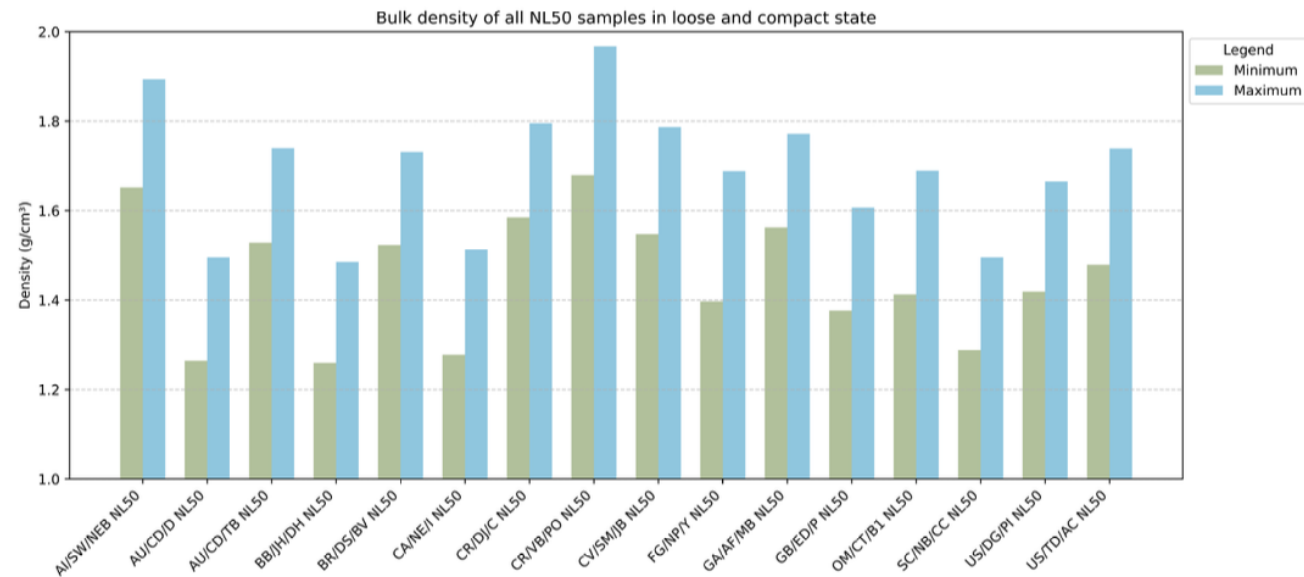
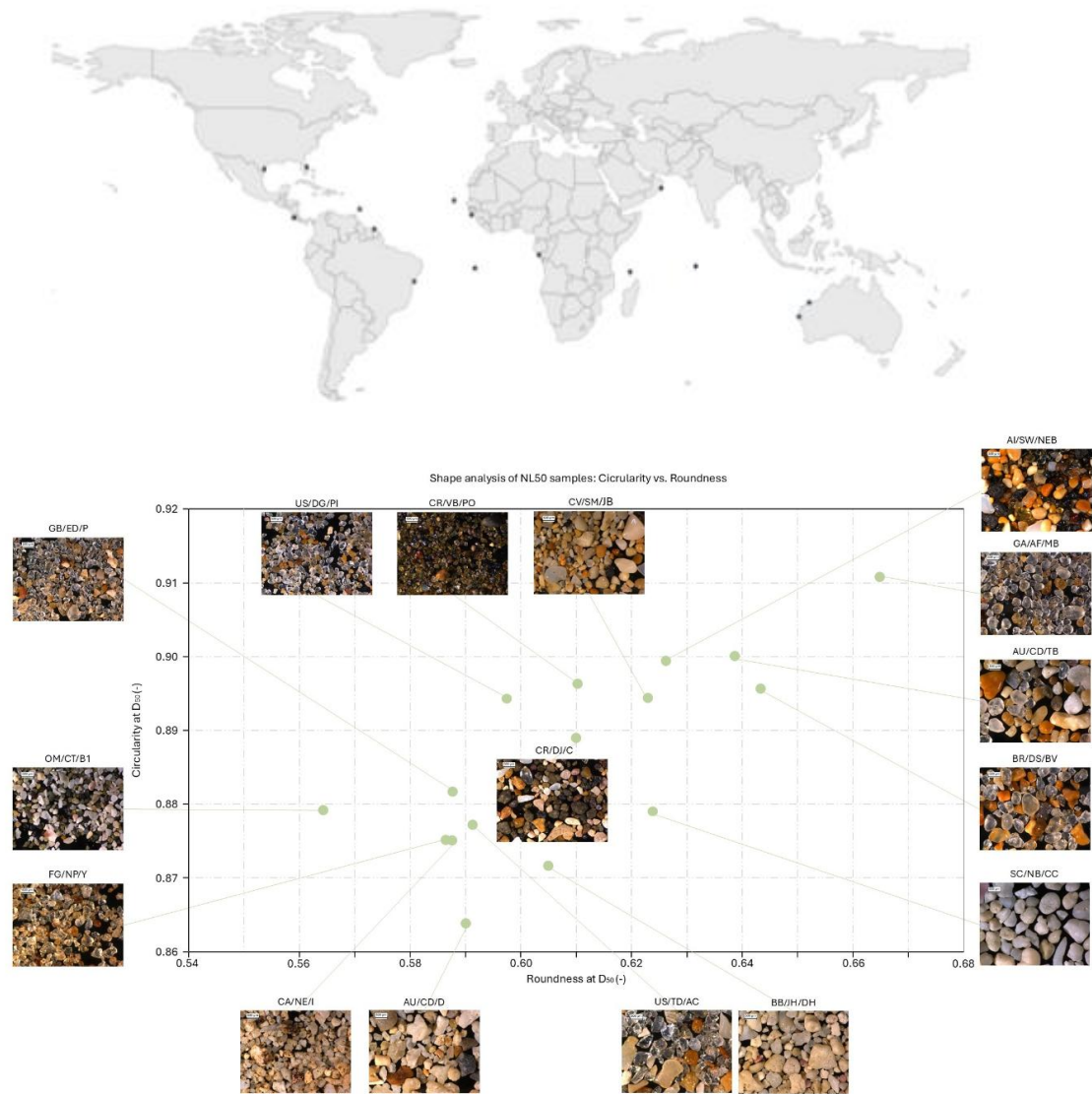


	Galveston, US	Ostional, CR
Main species	Kemp's ridley	Olive ridley (arribada)
Beach slope	Mild (≈ 0.04)	Moderate (≈ 0.1)
Grain size	Fine ($D_{50} \approx 150 \mu\text{m}$)	Medium ($D_{50} \approx 300 \mu\text{m}$)
Tidal range	$\approx 0.5 \text{ m}$	$\approx 2 \text{ m}$
Main forcing	Storm surge	Waves

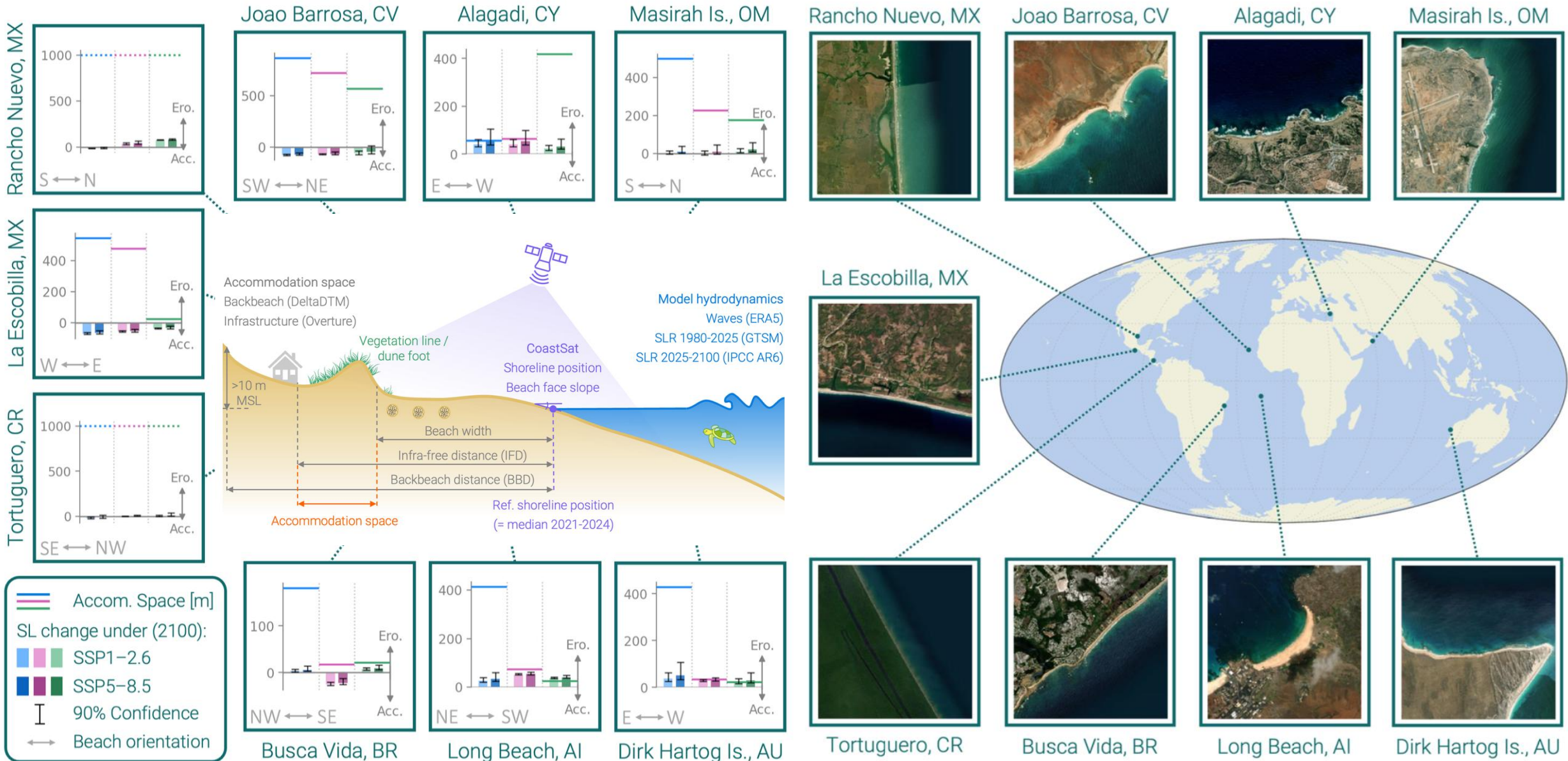
Groundwater & nest flooding



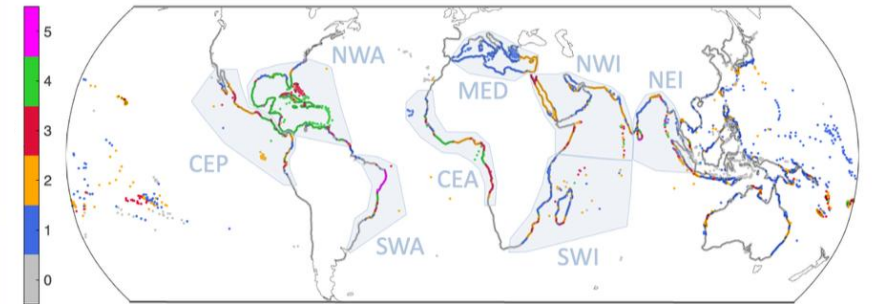
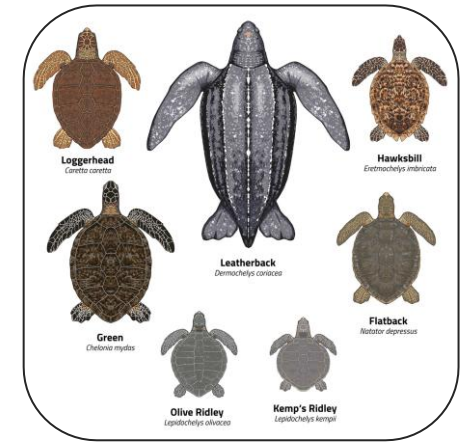
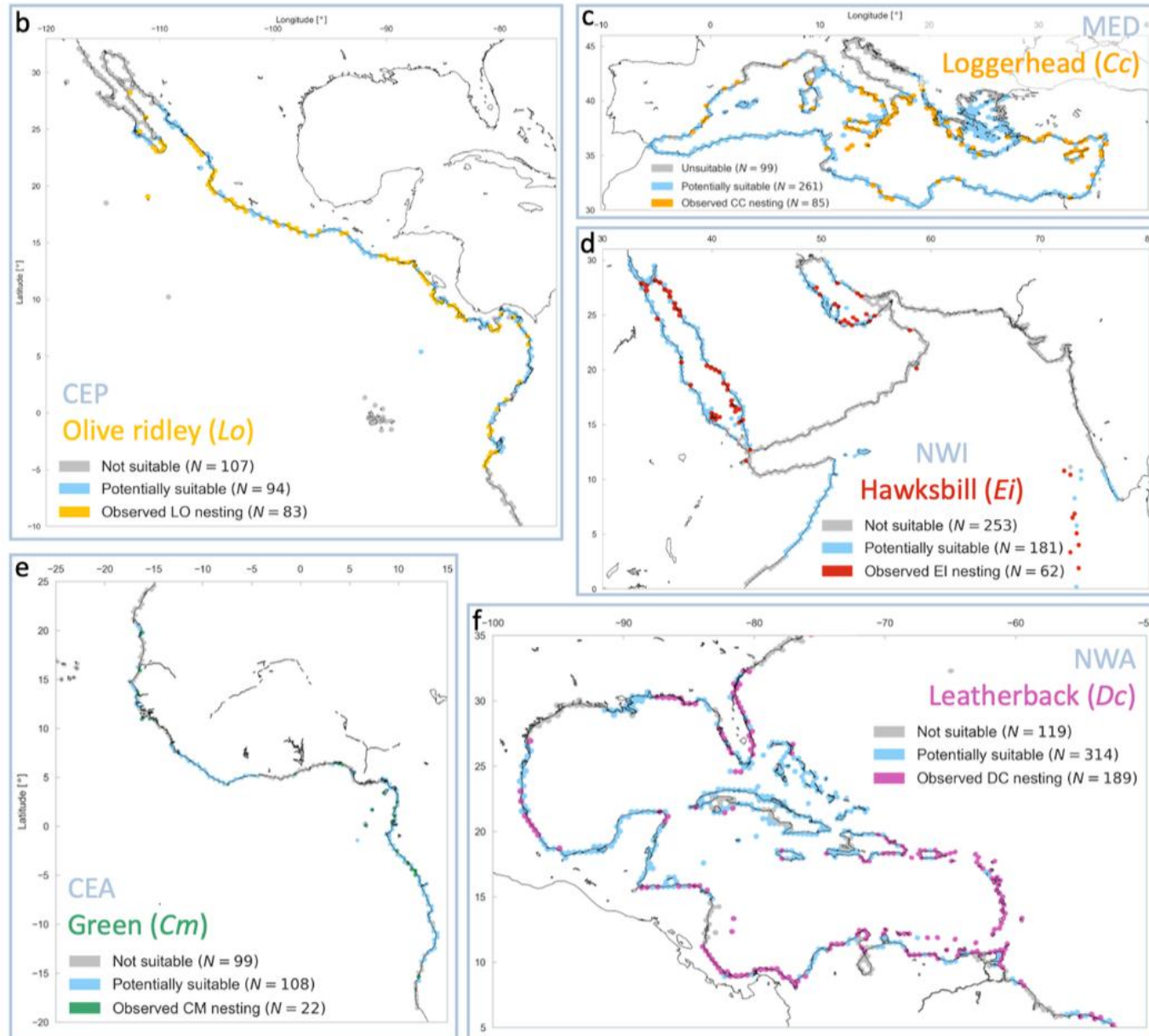
Sediment characteristics of sea turtle nesting beaches



Uncertain future for global nesting beaches



New horizons for sea turtles



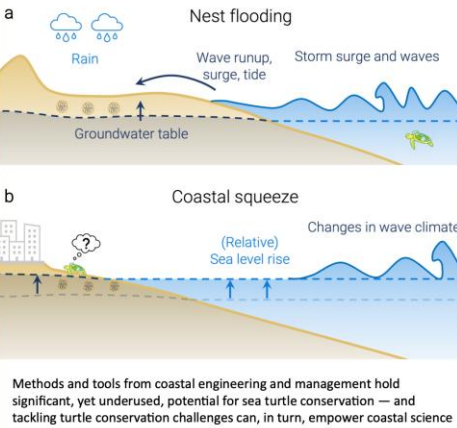
Coastal Science for flood and erosion proof sea turtle nesting beaches

José A. Á. Antolínez¹, Jakob C. Christiaan², Meye J. van der Grinten³, Merel Heijl¹, Falco Taal¹, Daniel Dedina⁴, Elias F. Ostertag⁵, Ad J. H. M. Reniers¹, Stefan Aarninkhof⁶, Jens Figlus⁷, Timothy M. Dellapenna⁸, Christopher D. Marshall^{9,10}, Felipe Calleja¹¹, Roldan Valverde¹², Brendan J. Godley¹³, Carlos M. Duarte¹⁴



1. Background

Climate change and human activity pose increasing challenges to sea turtles, which are key species in many marine ecosystems worldwide. Sea turtles balance these for over 100 million years, supporting seagrass beds and coral reefs. They mature after decades, returning to their birth beaches to nest. Three of the seven species (Hawksbill, Kemp's Ridley, and Green Turtle) are critically endangered.

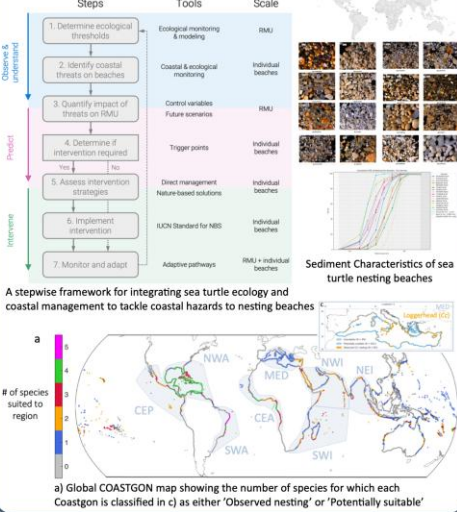


3. Conclusion & Outlook

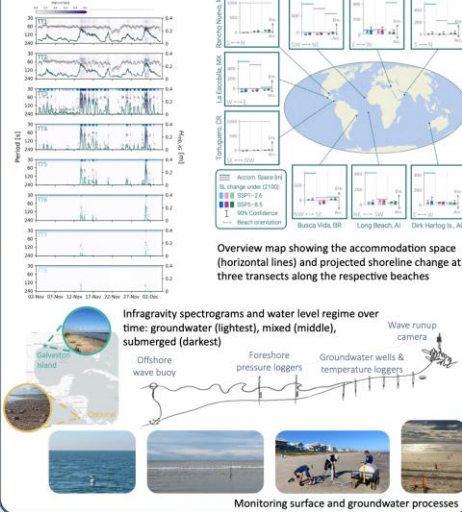
- Nest flooding on fine-grained, mild-sloping beaches is mainly driven by storm surge and rainfall, with prolonged groundwater rise making habitats unsuitable (e.g., Galveston Island).
- Vulnerability of nesting beaches to regional sea-level rise is highly site-specific; three globally important sites (Alagadi, Dirk Hartog, Long Beach) are at particular risk due to retreat and limited landward space for accommodation (coastal squeeze).
- At global scale, nesting suitability is mainly shaped by temperature, surge, tidal range, and proximity to coral and seagrass habitats.
- There is potential for sea turtle habitat expansion or assisted colonization, as the realized niche (7%) is significantly smaller than the fundamental niche (>20%).
- A stronger integration of coastal management and sea turtle conservation is needed to design and implement nature-based solutions at scale that sustain sandy beach nesting habitats under climate change.



2. Methods & Results



2. Methods & Results



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¹² Biological Sciences and Engineering Division, KAUST University, Thuwal, Saudi Arabia

