



U.S. ARMY

SITE CHARACTERIZATION OF A RESTORED COASTAL DUNE AND BEACH

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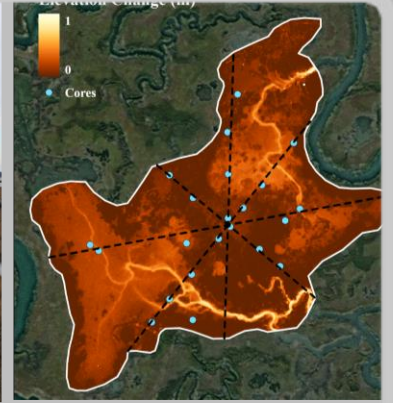
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Villanova University: Jonathan Hubler

University of Florida: Nina Stark

ISC – Barcelona, Spain

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US Army Corps of Engineers



DISCOVER | DEVELOP | DELIVER

Motivation – Coastal Threats



LSU
Department of Civil &
Environmental
Engineering

Berkeley
Civil & Environmental
Engineering



T.S. Cristobal (2020)

RAPID NHERI
Natural Hazards Reconnaissance



Hurricane Ida (2021)



Gulf of
Mexico

Knowledge Gaps and Study Goal

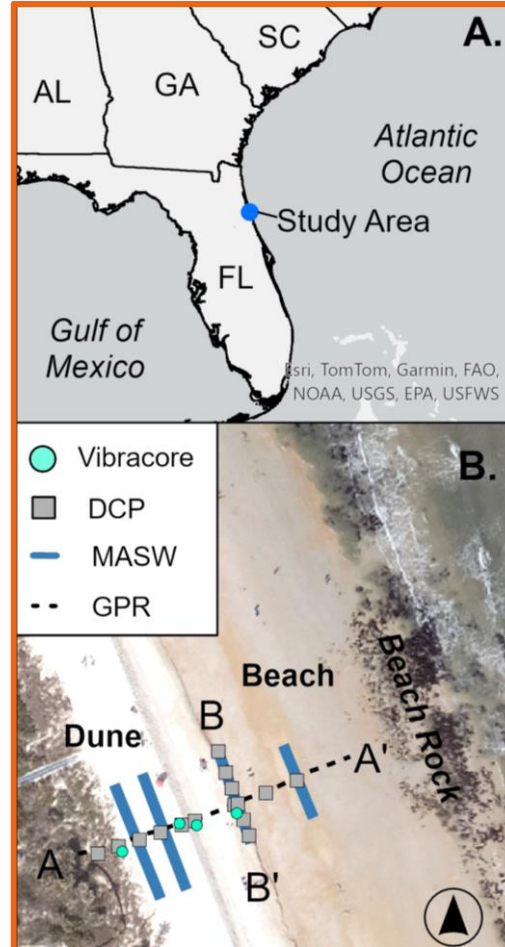
- Knowledge gaps:
 - How do restored systems compare to natural?
 - How does vegetation impact resiliency to erosion?
 - How to best incorporate findings into numerical modeling?
- Goal: quantify geotechnical properties at a recently restored dune on Florida's east coast to inform coastal models.
 - (1) What are the best methods for measuring dune systems?
 - (2) How much variability in the cross- and alongshore directions?



Study Site

• MalaCompra

- Timeline:
 - Restored - Jan. 2023
 - Planted - April 2023
 - Surveyed - June 2023
- Textbook dune restoration (trapezoidal)
- Captured transition from restored to natural dune



Methods

• Dynamic Cone Penetrometer



Dual Mass DCP



PANDA

- Dual-Mass DCP
 - 4.8 and 8 kg weights
 - Vertek's Smart System
- PANDA DCP
 - Variable energy system (mallet)
 - Sol Solution

ATOM MASW

- Wireless system
- NSF Rapid Facility
- 24 geophone array
- Active or passive measurements



MASW

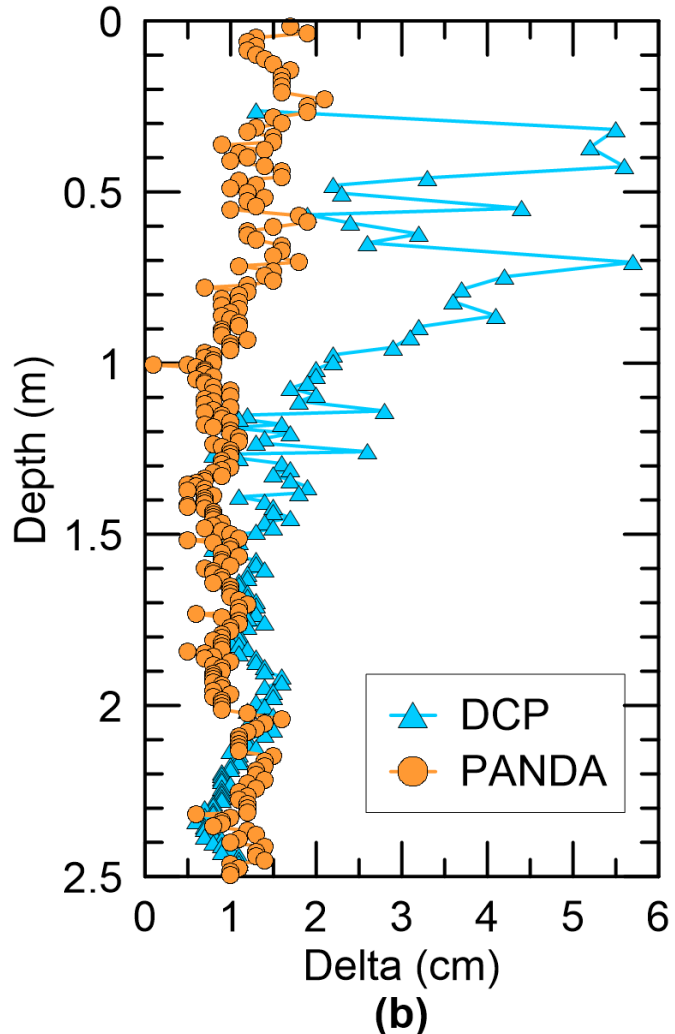
Ground Penetrating Radar (GPR)

- Zond Aero 500 (500MHz unit)
- Cart-based
 - Also be mounted on sled
- Trimble RTK for xyz



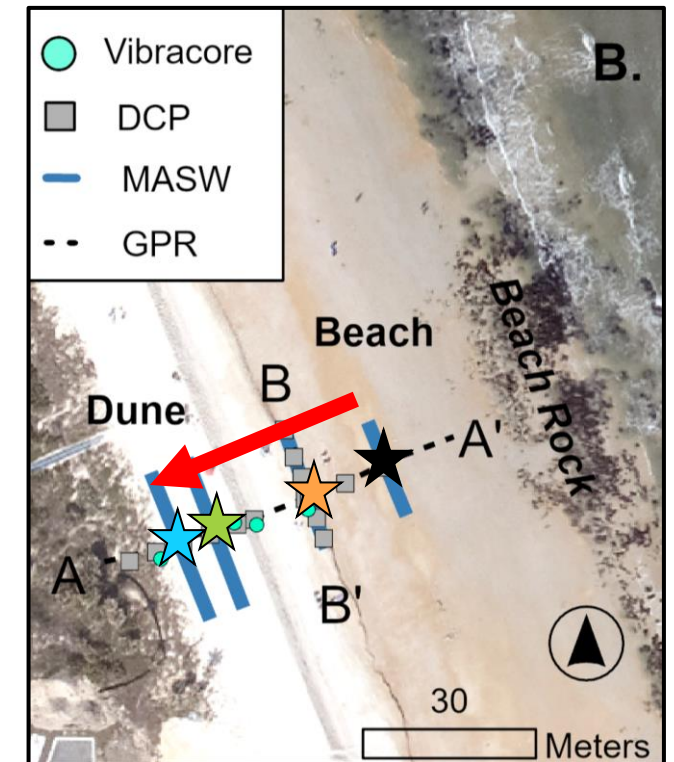
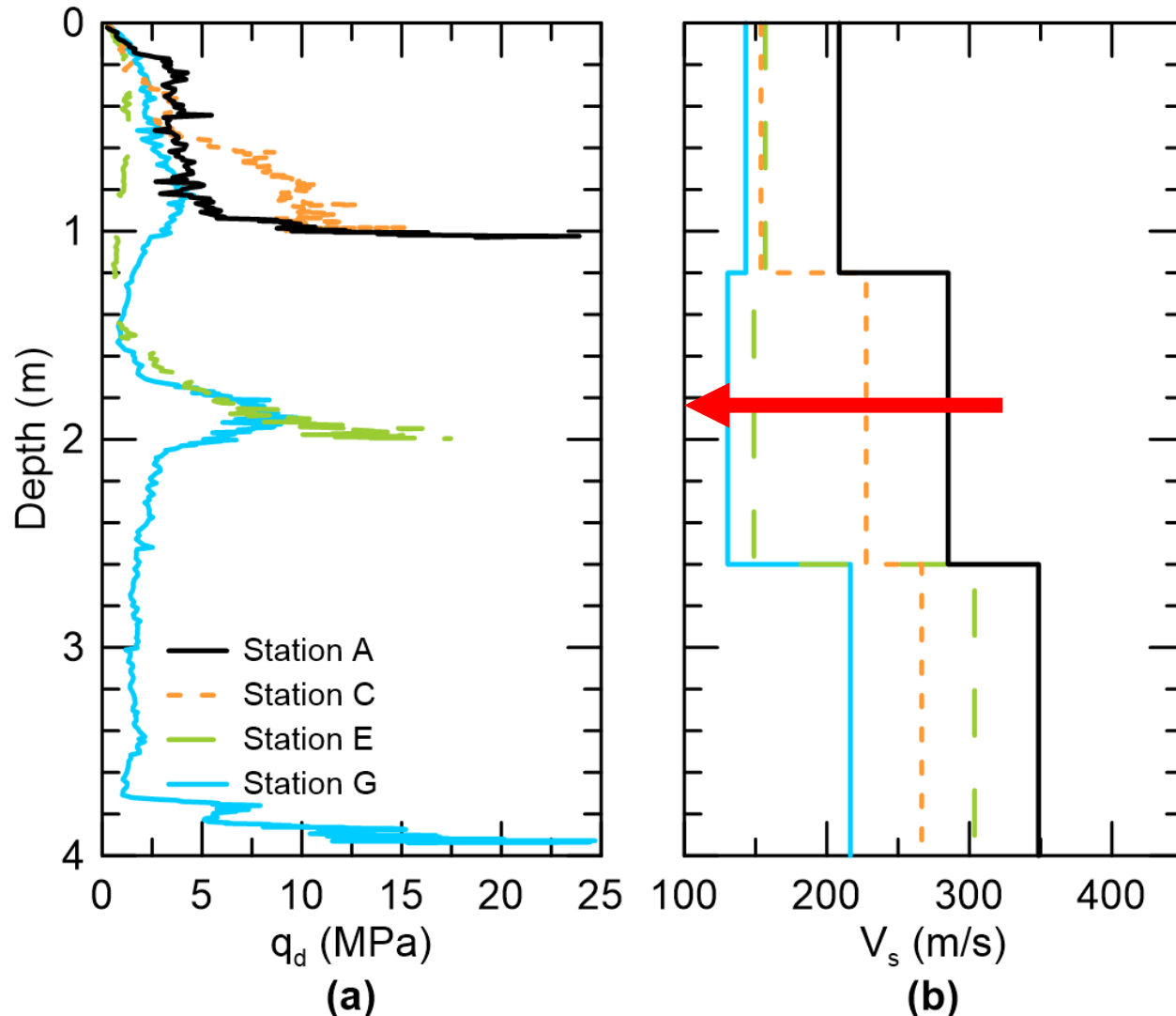
Cart-mounted GPR

Results (1/3) – DCP Comparison



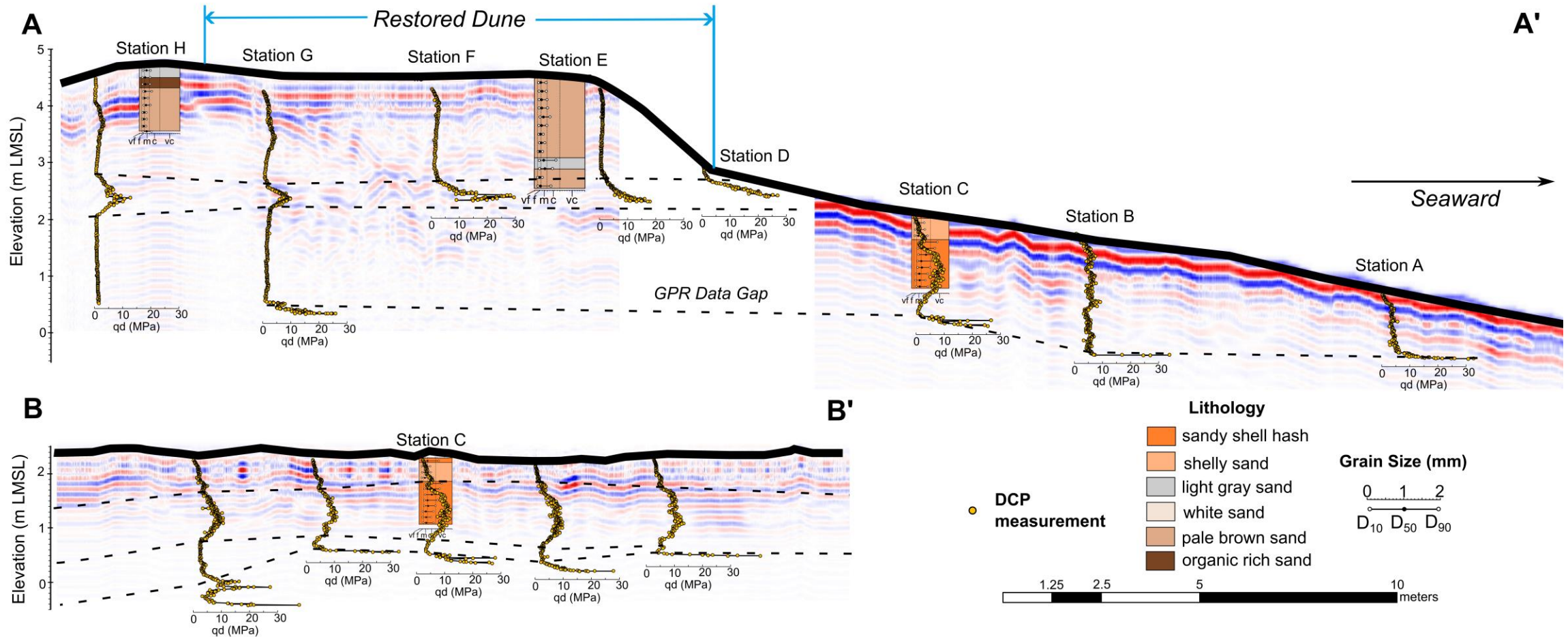
- Resolution: PANDA provided much higher resolution in shallower reaches which is most likely to be eroded
 - PANDA: 1 to 2 cm cm/blow
 - Dual Mass DCP: 1.5 to 9 cm/blow
- Speed and Efficiency: PANDA system offered many benefits over dual-mass system
 - *Faster, more efficient (depth), and offered greater control*

Results (2/3) – DCP vs MASW



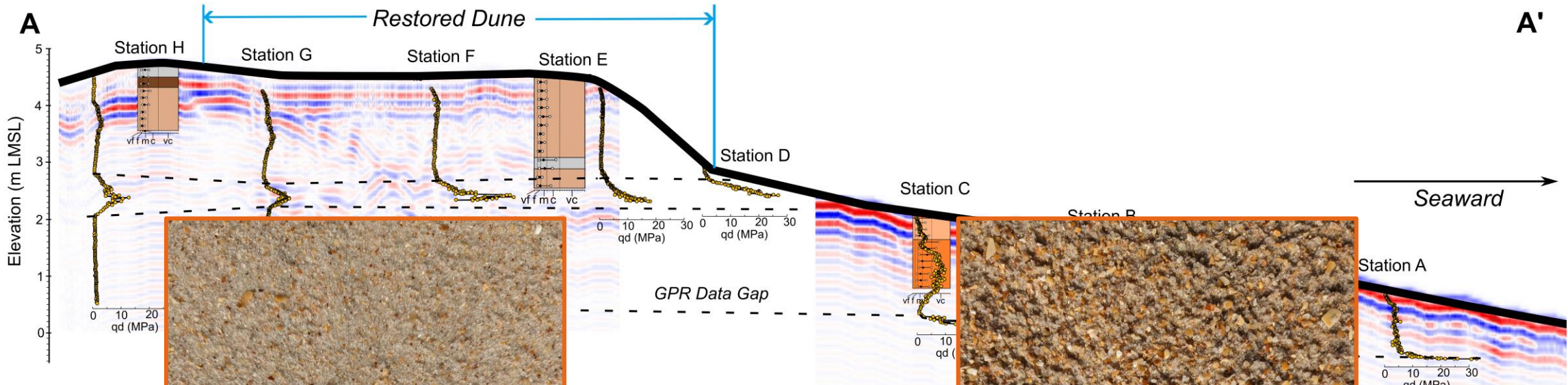
- Methods: DCPs performed at center of MASW array and 5-m off-end hits were used
- Comparison: Both methods showed decreasing stiffness as you move away from ocean
- Depth: MASW provided deeper data than DCP

Results (3/3) – Cross and Alongshore Summary



- Formation Process: Parallel and consistent layering in *restored dune*
- Grain Size: Less shell content, finer grains, and poorly-graded in *restored dune*

Results (3/3) – Cross and Alongshore Summary



- **Formation** Restored Dune consistent layering in restored dune
- **Grain Size** Restored Dune D50 = 0.13 mm fine grains, and poorly-graded in Beach

Restored Dune
D50 = 0.13 mm

Beach
D50 = 0.40 mm

Summary

(1) Best methods and how do they compare?

- Combination of **Geotechnical** and **Geophysical** methods provided ***holistic understanding***
- DCP, GPR, MASW all proved to be ~quick, relatively non-destructive methods
 - Great for sensitive dunes systems with restricted access
- PANDA system provided higher resolution vs dual mass DCP

(2) Cross- and Alongshore Variability:

- Greater variability in cross-shore vs alongshore
- Cross-shore: decreasing resistance moving from swash (beach) to restored dune
- Age and formational component: older, naturally formed dunes are more resilient than recently nourished/planted sites



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Thank You!



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