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NC BEACHES, INLETS & WATERWAYS ASSOCIATION

Repeat Observations and Emerging Analytics for Improved Coastal Monitoring and Resilience

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RCOAST · Wilmington, NC

mapping change · measuring resilience · mitigating risk

50+ YEARS ON NC'S OUTER BANKS

Decades of expertise and investment

PEOPLE ARE CONTRIBUTING THEIR EXPERTISE

- **Scientists** studying processes
- **Coastal engineers** designing solutions
- **Local managers** serving constituents

COMMUNITIES ARE INVESTING

Beach nourishment	Dune management	Nature-based solutions

State is investing 10s of millions, annually, in coastal protection

RCOAST / NCBIWA / REPEAT OBSERVATIONS & EMERGING ANALYTICS



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Is coastal erosion outpacing our ability to manage it?

Yes.

But why?

We're still more reactive than proactive.

THE REASONS ARE COMPLEX

Political | **Cultural** | **Governance** | **Economic**

AND A BIG PART IS AN INFORMATION GAP

- **We see change too late**
  Infrequent, sparse surveys miss what happens between snapshots
- **We respond after the damage**
  Decisions are often made under pressure, after each storm
- **We don’t always know what worked**
  Rigorous evaluation of mitigation performance is limited, so lessons don't carry forward

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Repeat, high-resolution data for coastal decisions

01 Measure coastal change

Shoreline position, beach and dune height, and volu

02 Assess mitigation performance

Is the project holding? Where and when did it chan

03 Determine return on investment

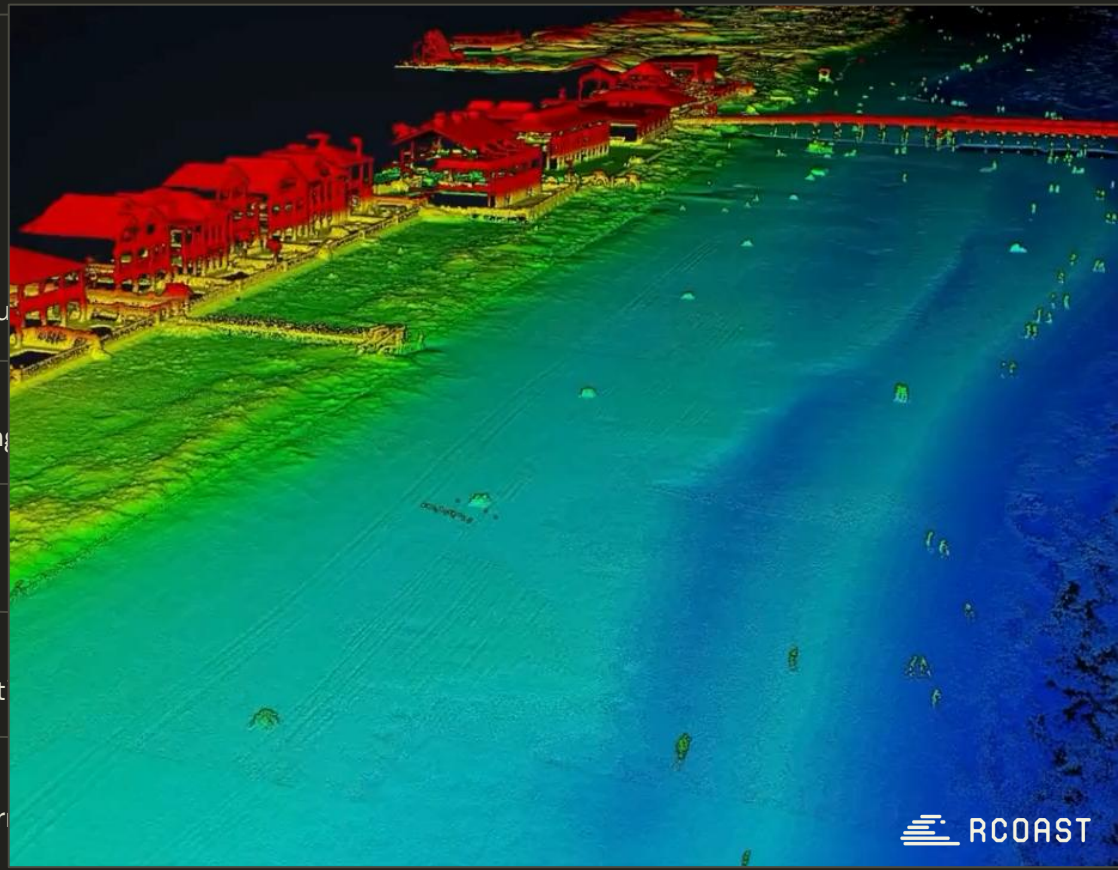
Protection gained per resilience dollar invested

04 Guide planning decisions

System-wide baselines to identify hotspots, priorit

05 Strengthen funding requests

Monitoring evidence for cost-share, grants and per



Lidar – Sept 2026 - South Padre Island, TX

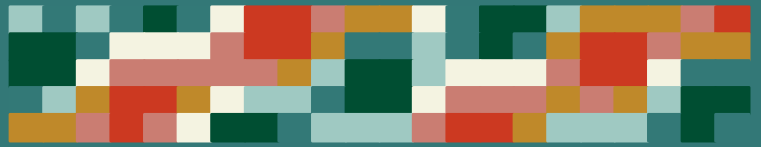
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Compliance vs. performance monitoring



Built for compliance

- Sparse profile lines with gaps between them
- Annual or semi-annual surveys
- Scoped to the permitted beach profile
- Designed to confirm design and permit conditions



Built for performance

- Full-coverage 3D surfaces of beach, dune and back-barrier
- Seasonal plus rapid post-storm surveys
- Reveals complexity of whole-system interactions
- Designed to show what's working and its return

Both are important. Performance monitoring adds to engineering surveys; it doesn't replace them.

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Three converging trends



Low-cost, high-res remote sensing

Drone LiDAR, RGB and multispectral sensors make frequent, detailed surveys affordable.



Computing and machine learning at scale

Large, repeated 3D datasets can now be processed, compared and learned from quickly.

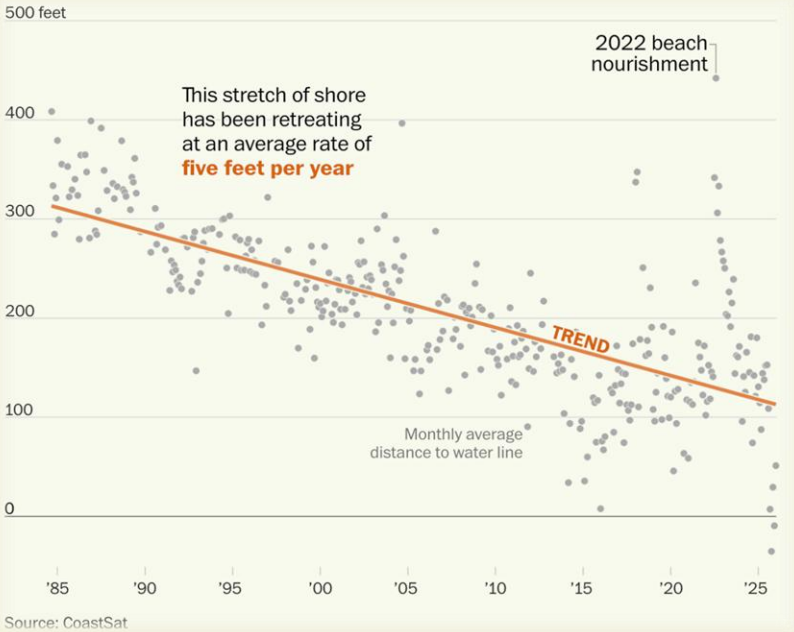


Accelerating coastal hazards

Rising water levels and storm impacts raise the stakes on every resilience dollar.

Applied across the project lifecycle, they add a complementary layer of data, analysis and decision support.

Buxton: from reactive to proactive



Reactive fixes are expensive. The right data reveals the complexity of problem so solutions can be evaluated before millions are spent on short-term fixes.

01 **Know the problem**
Measured erosion rates, causes and hotspots

02 **Learn from what's been done**
Test options against measured conditions before spending

03 **Invest in what lasts**
Saves money, headaches and sometimes lives

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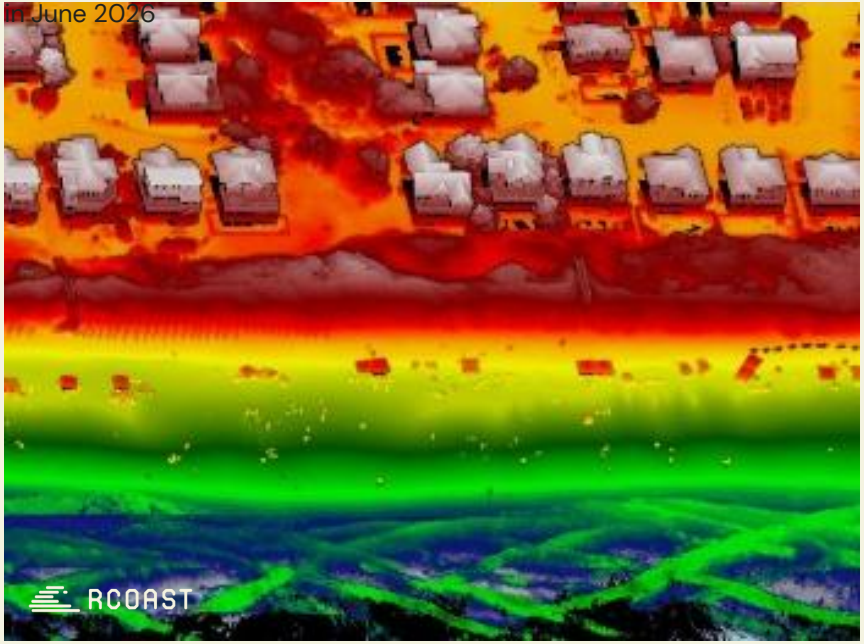
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~$40-50M

For renourishment in NC community. Can we use some funds to develop hybrid approaches focused on long-term wins?

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Lidar-based elevation of Buxton beach and dunes in June 2026



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Identifying the threshold before it is crossed

Measuring baseline conditions makes it possible to be proactive from the start, while there are more options and lower costs.

01 **Baseline conditions**

Beach, dune and shoreline position documented today

02 **Early warning**

Erosion trends caught before they become chronic

03 **Planning advantage**

Act while options are wider and less costly



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Duck: measuring living shoreline performance

Nature-based projects need performance measures beyond sand volume.

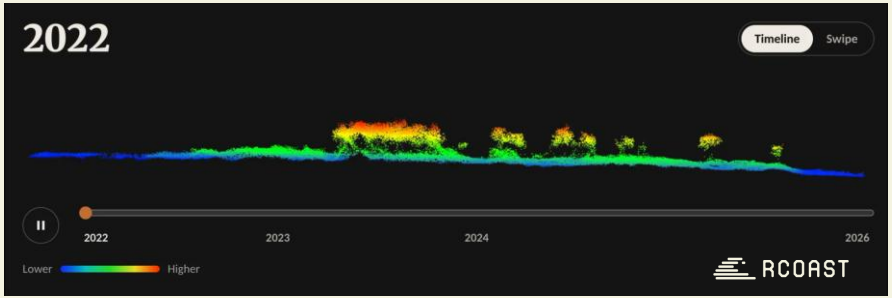
01 **Shoreline position and elevation**
Soundside change tracked season to season

02 **Vegetation extent and health**
Are the plantings maintaining, growing?

03 **Habitat and structure**
How is the project performing through storms?

NC 12 Living Shoreline and Resiliency Project
2026 ASBPA Best Restored Shore Award





Cross-section of vegetation growth in marsh.

The coast is a whole system

One repeat survey captures ocean to sound and serves many users.

Ocean | Beach | Dune | Community | Marsh | Sound



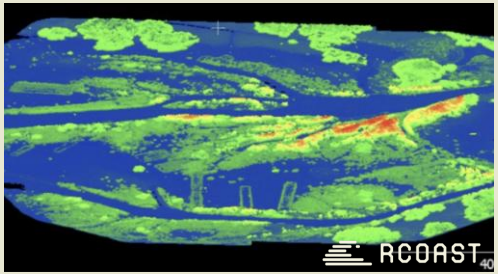
Towns & engineers

Beach, dune and inlet change; nourishment and dune performance



Sandbar Oyster Company / Audubon North Carolina

Sound-side shoreline, bird nesting, and habitat change



National Wildlife Federation

Marsh restoration, channel migration

South Padre Island: evidence that unlocks funding

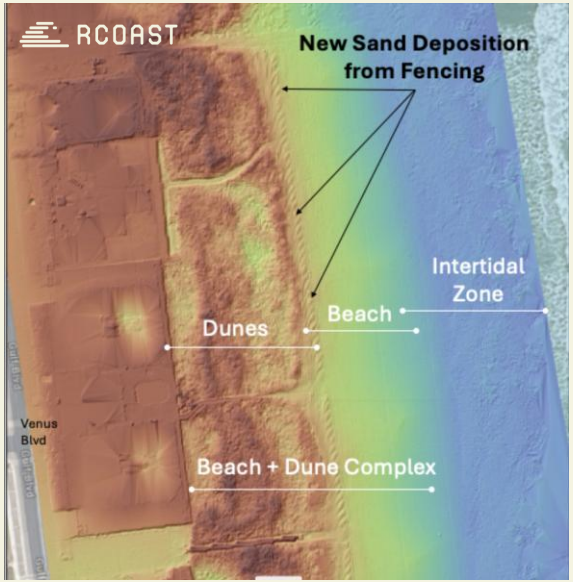
75%

of the town's project funded by the state (Texas General Land Office)

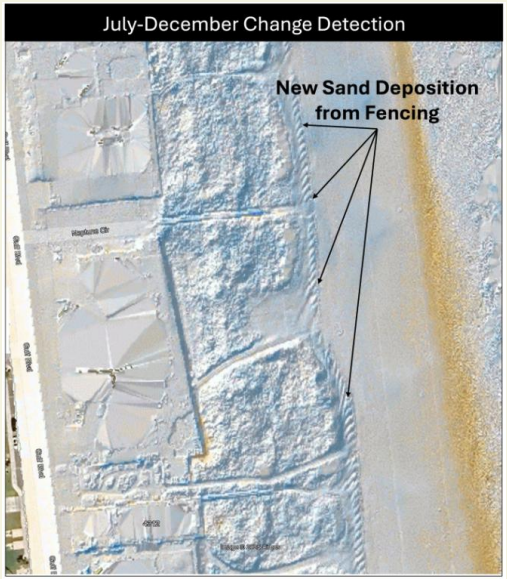
426

dump trucks of sand gained in 6 months

Seasonal monitoring · Priority identification · Rapid post-storm response

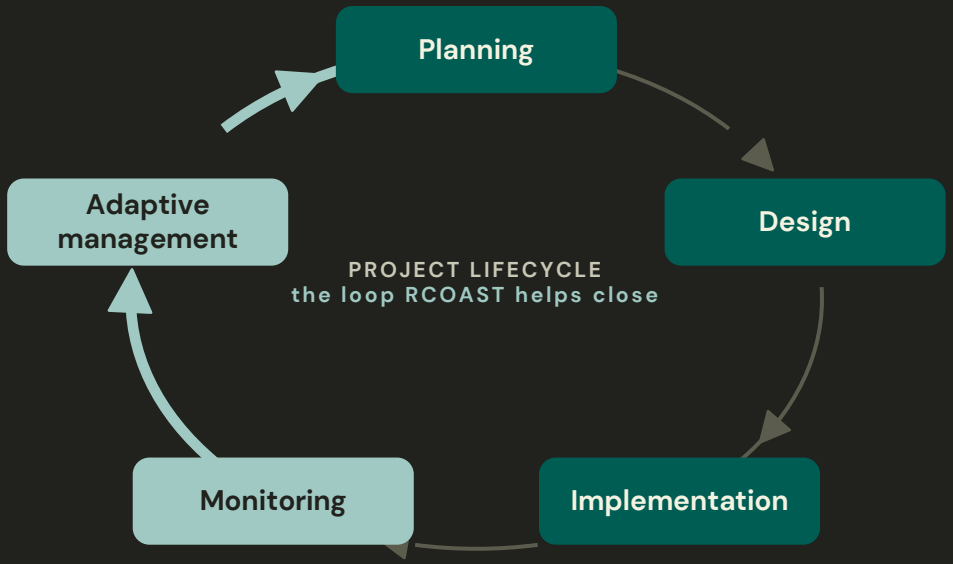


Lidar DEM: beach and dune complex



Change detection: new sand from fencing

RCOAST capabilities within the project lifecycle



TODAY

Projects are planned, designed and built, but monitoring can be too sparse to show what worked and under what conditions. The next decision starts over with limited data.

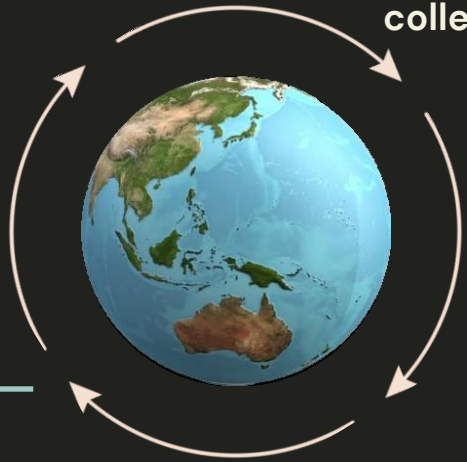
WITH REPEAT MONITORING

Seasonal and post-storm data turns monitoring into evidence: what held, what didn't, and why. That evidence feeds adaptive management and the next plan.

Cities and engineers lead every stage.
RCOAST supplies the data that connects them.

Every project builds a shared evidence base





01 Data collection

02 Expand 4D library; train ML on data

03 Predict mitigation, locally and beyond

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What would we do differently if we knew what was working?

Recognize the gap. Close it together.

Identify Where are we making decisions without enough information?

Evaluate Which approaches work and what investments pay off?

Close Build monitoring into every project
Input updates into every forecast and risk assessment.

Hilary Stockdon · Christy Swann

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