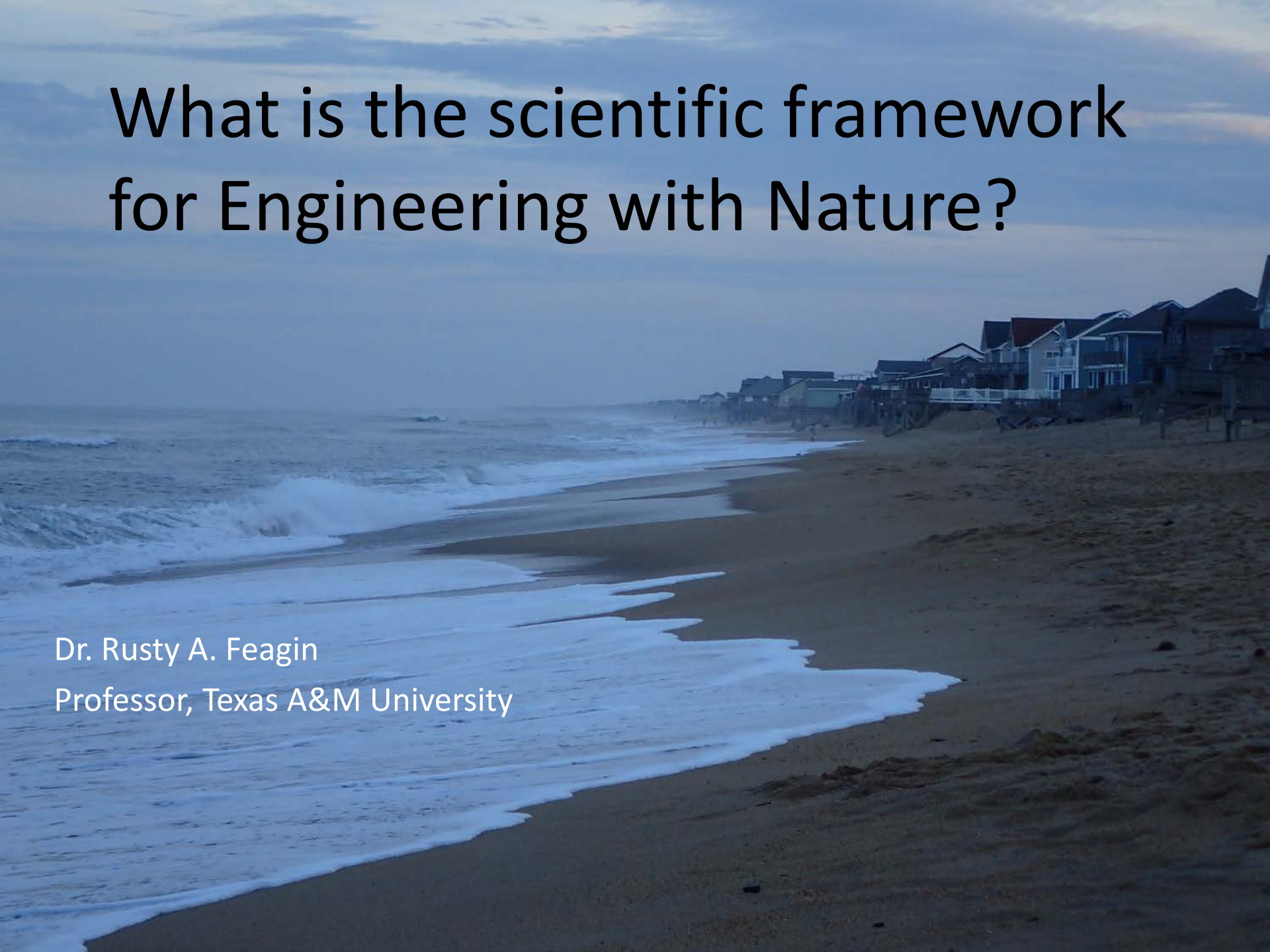


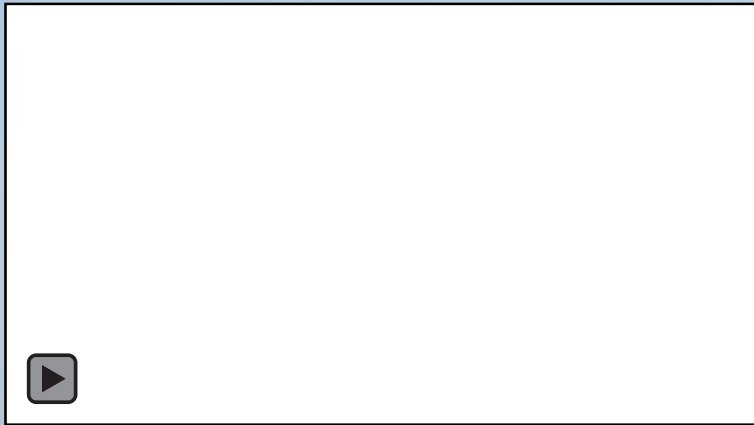
What is the scientific framework for Engineering with Nature?

Dr. Rusty A. Feagin
Professor, Texas A&M University



Coasts are naturally dynamic places





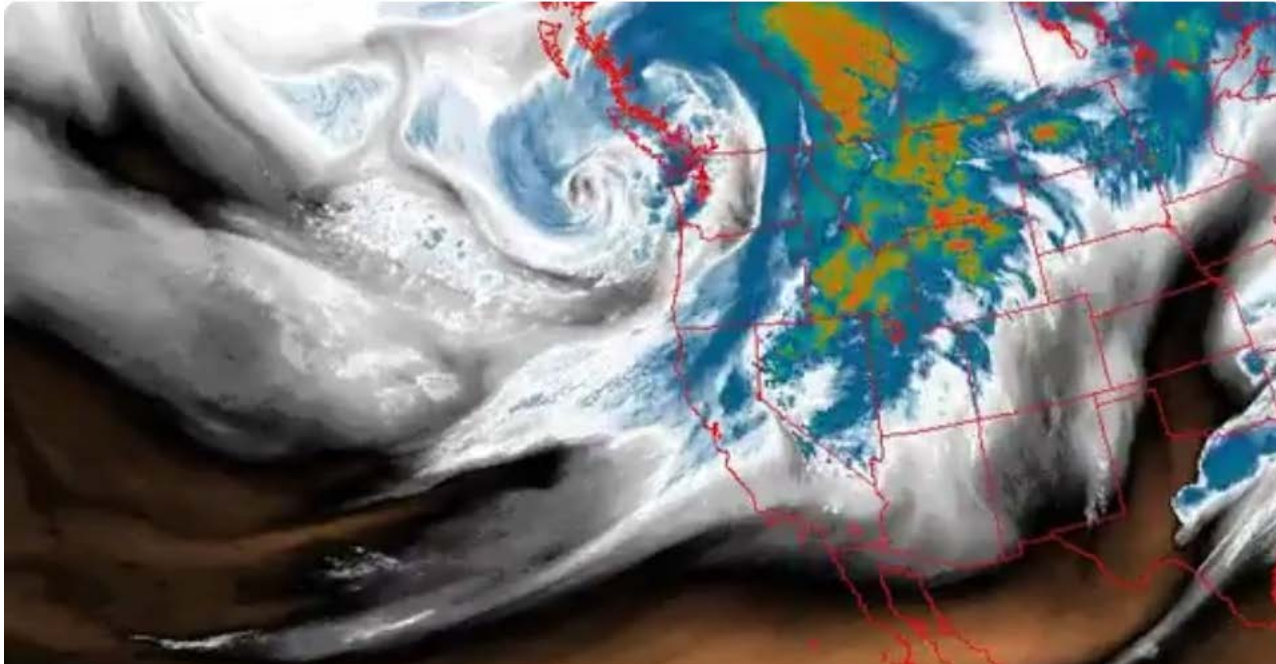




Relative sea level is changing



Storm frequency and intensity is changing



Oct. 14, 2016: “The Ides of October” storm



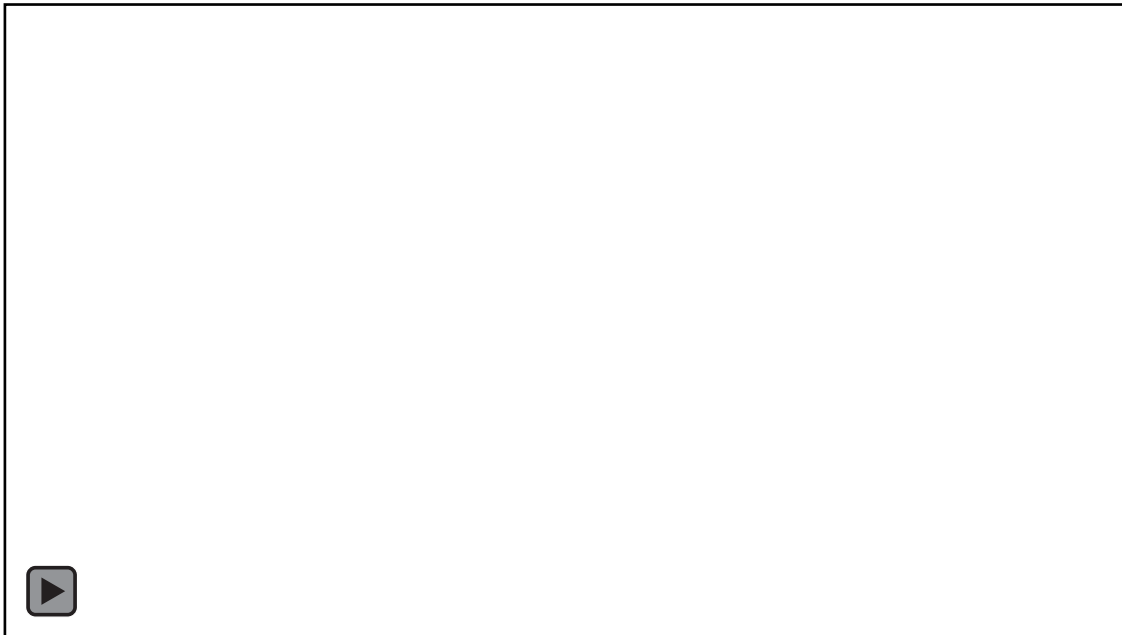
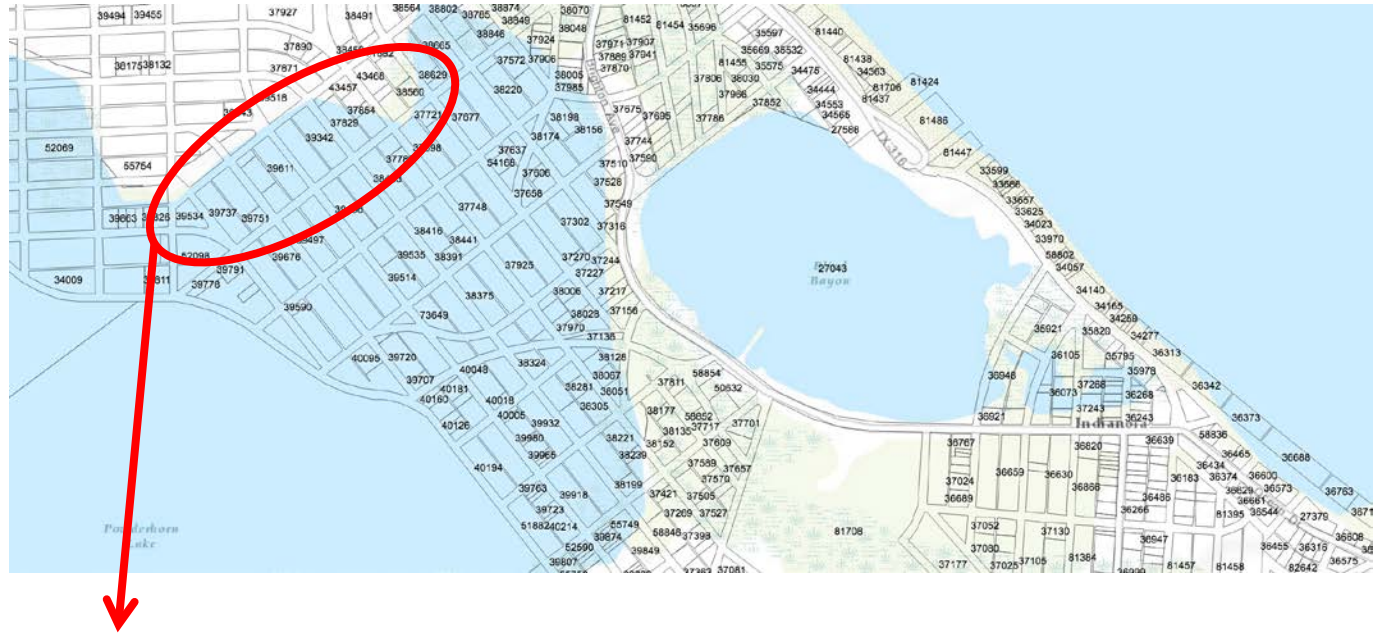




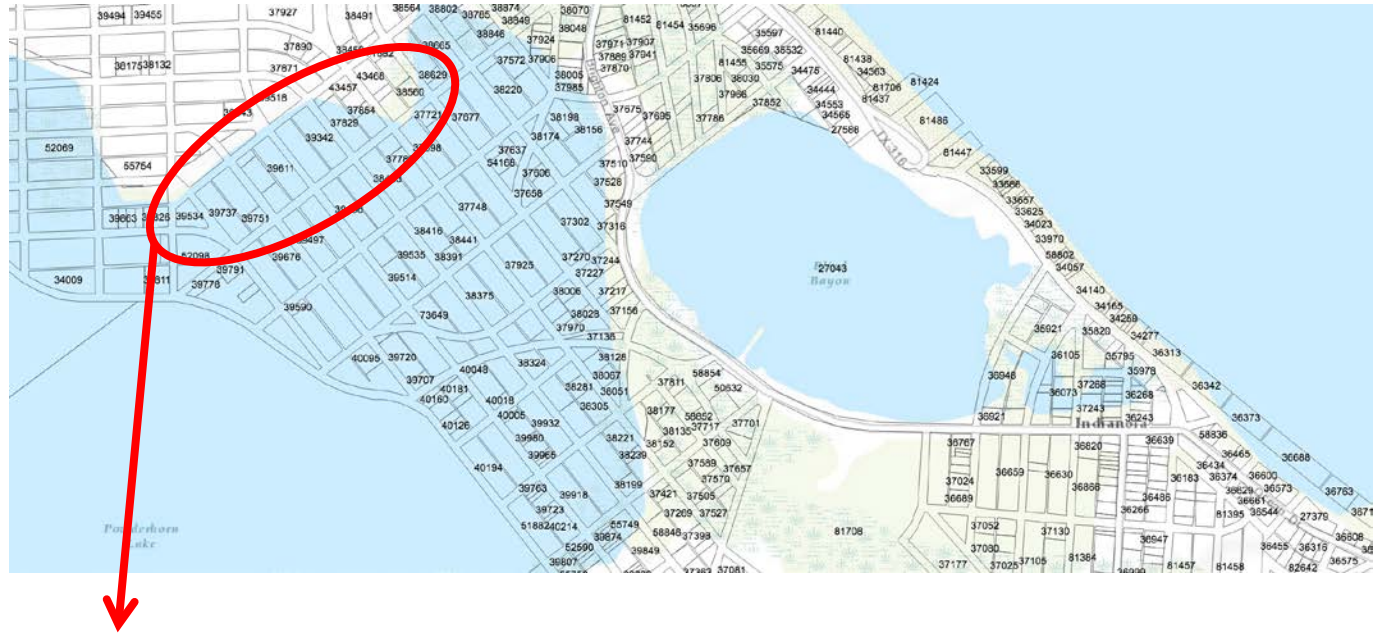
Image courtesy of NASA

Our laws and property assume the coast is static...





Map courtesy of
Calhoun County



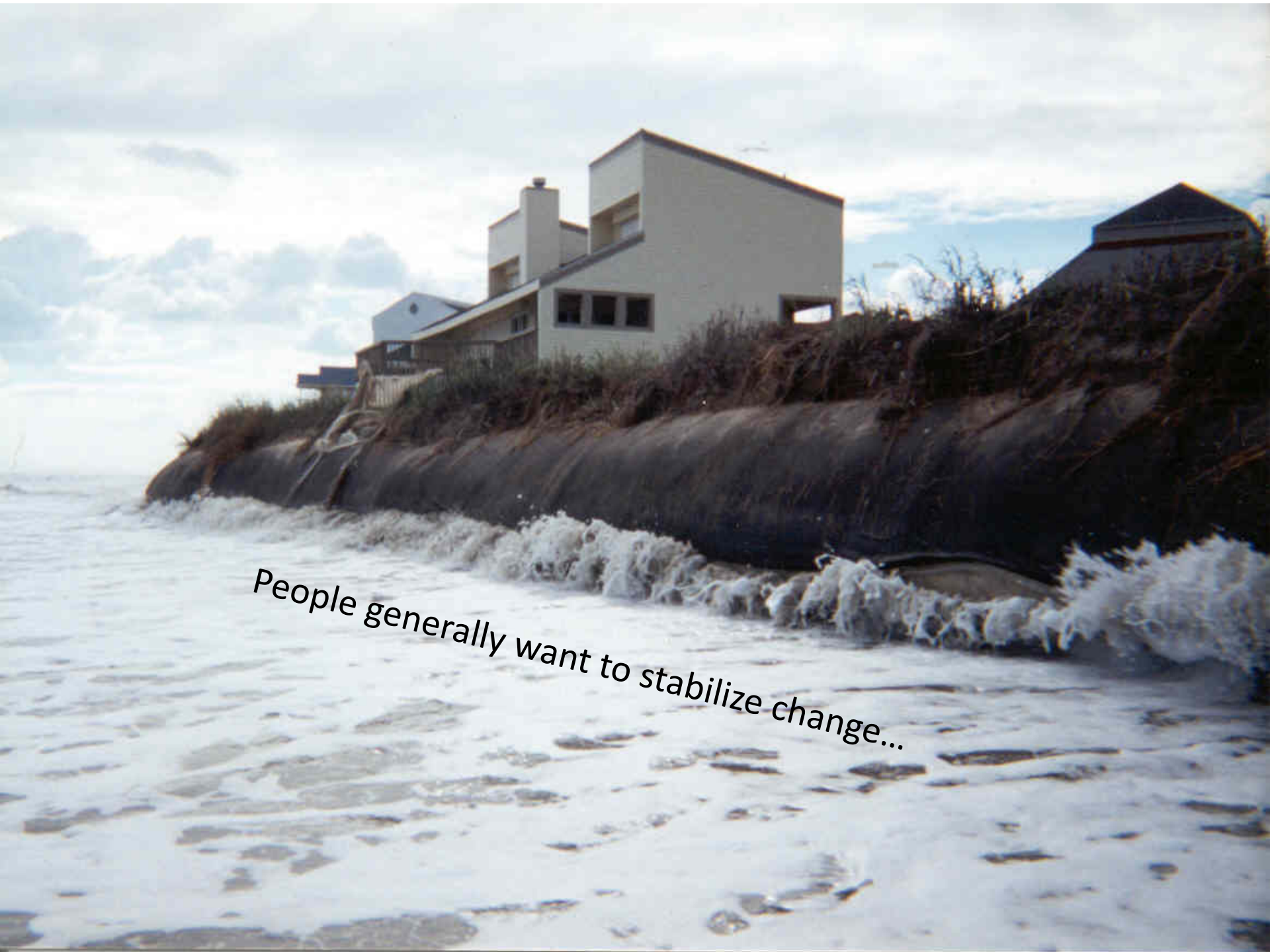
...and dead...



...and change is seen as a problem







People generally want to stabilize change...

100 m



Jackson et al. 2013: *Geomorphology*

N



100 m



...and engineer
new
possibilities.

Palm Jumeirah, Dubai,
United Arab Emirates





Photo Credit: Francisco Anzola (creative commons)

We can build the world we want to live in.



Homeplate, Houston Ship Channel, Texas, USA

Imagery courtesy of TNRIS

So...our coasts are naturally dynamic,
but people want stability.

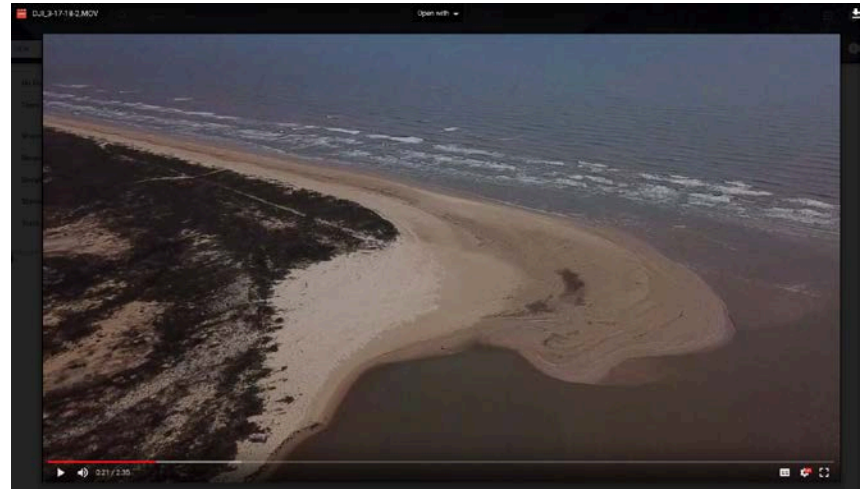
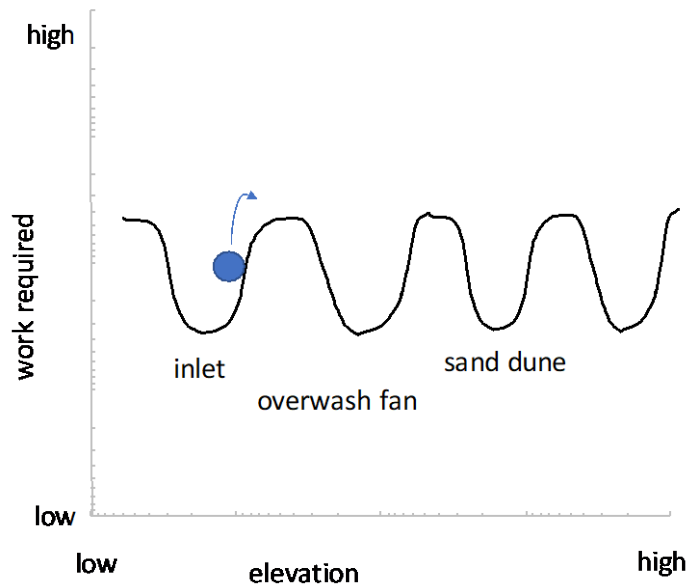
How can we put these 2 things together?



EWN: Remove any formal distinction between natural and artificially-engineered components

Principles that emerge:

1. Manipulation of dynamical equilibrium 'pressure points' within the system



Principles that emerge:


2. Interchangeability of natural versus artificial materials



We can use mimicry across form, and better integrate green and civil construction materials science...



Photo Credit: Dave Buzan (Freese & Nichols, Inc.)

A photograph of a sand dune. The crest of the dune is covered with dense, tall grasses, some green and some brown. The sand face of the dune is exposed, showing a network of roots and some small green plants growing from the sand. The sky is blue with scattered white clouds. The lighting suggests it might be late afternoon or early morning.

...or use biological materials for stabilization...



...of substrate by plants...



...or by other organisms...



Williams et al. 2008: *Shore and Beach*

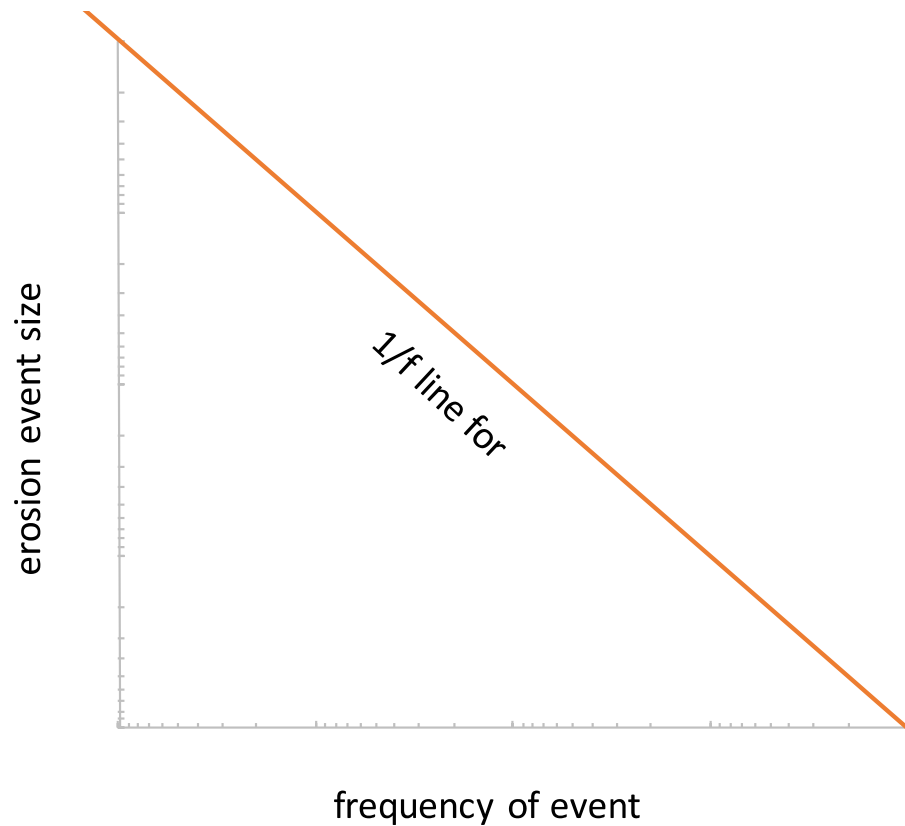
...or even use hybrid solutions.



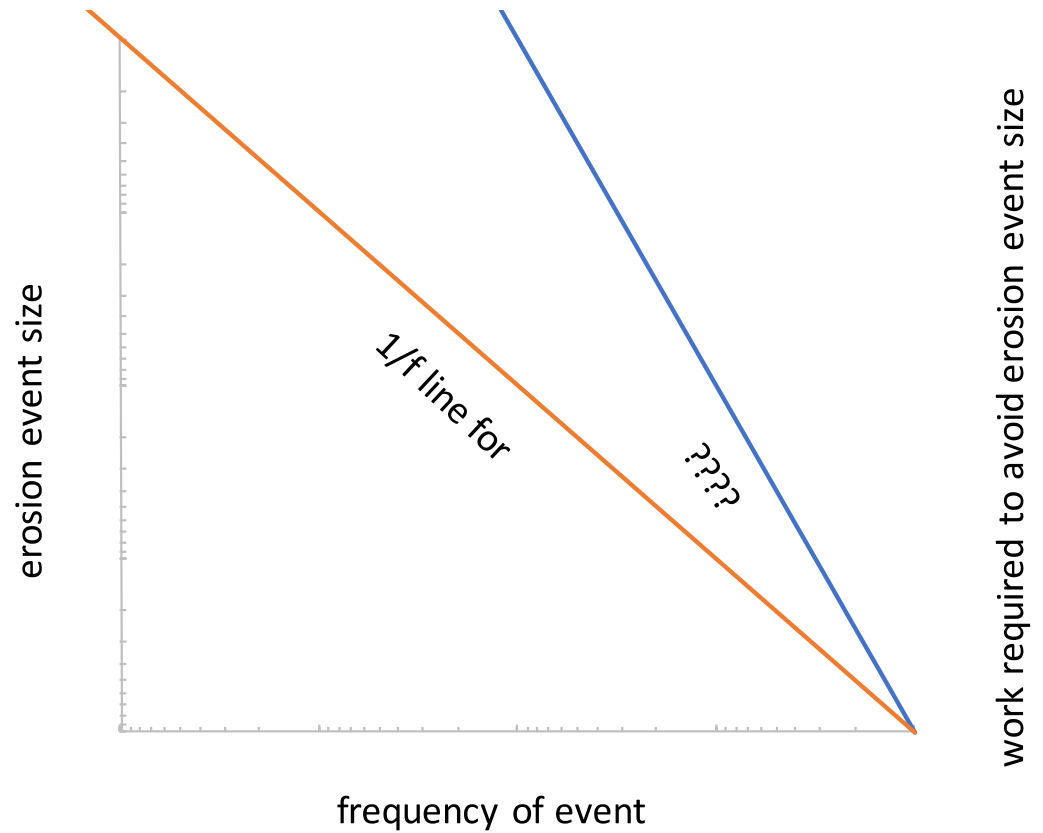
Feagin/Martinez et al. 2010;
Restoration of Coastal Dunes

3. Use of a unified decision framework to assess the viability of hybrid engineered-natural solutions

-Fragility and risk assessment can be applied across the artificial-natural spectrum...

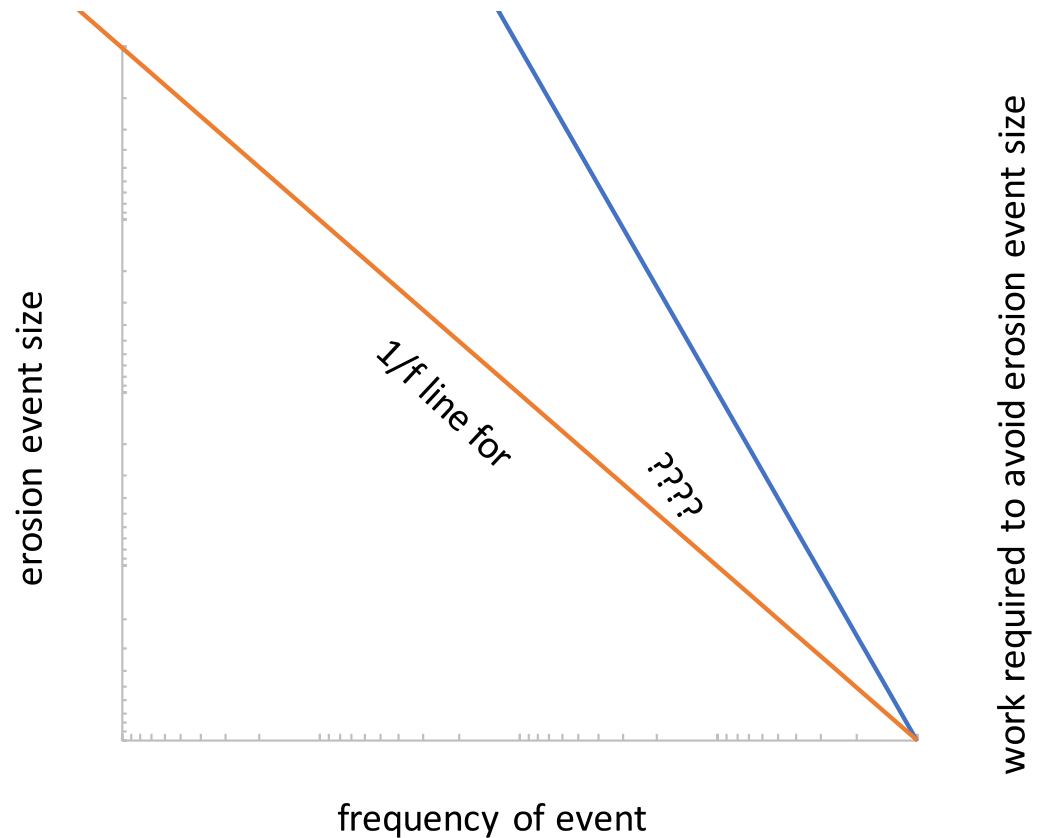


3. Use of a unified decision framework to assess the viability of hybrid engineered-natural solutions



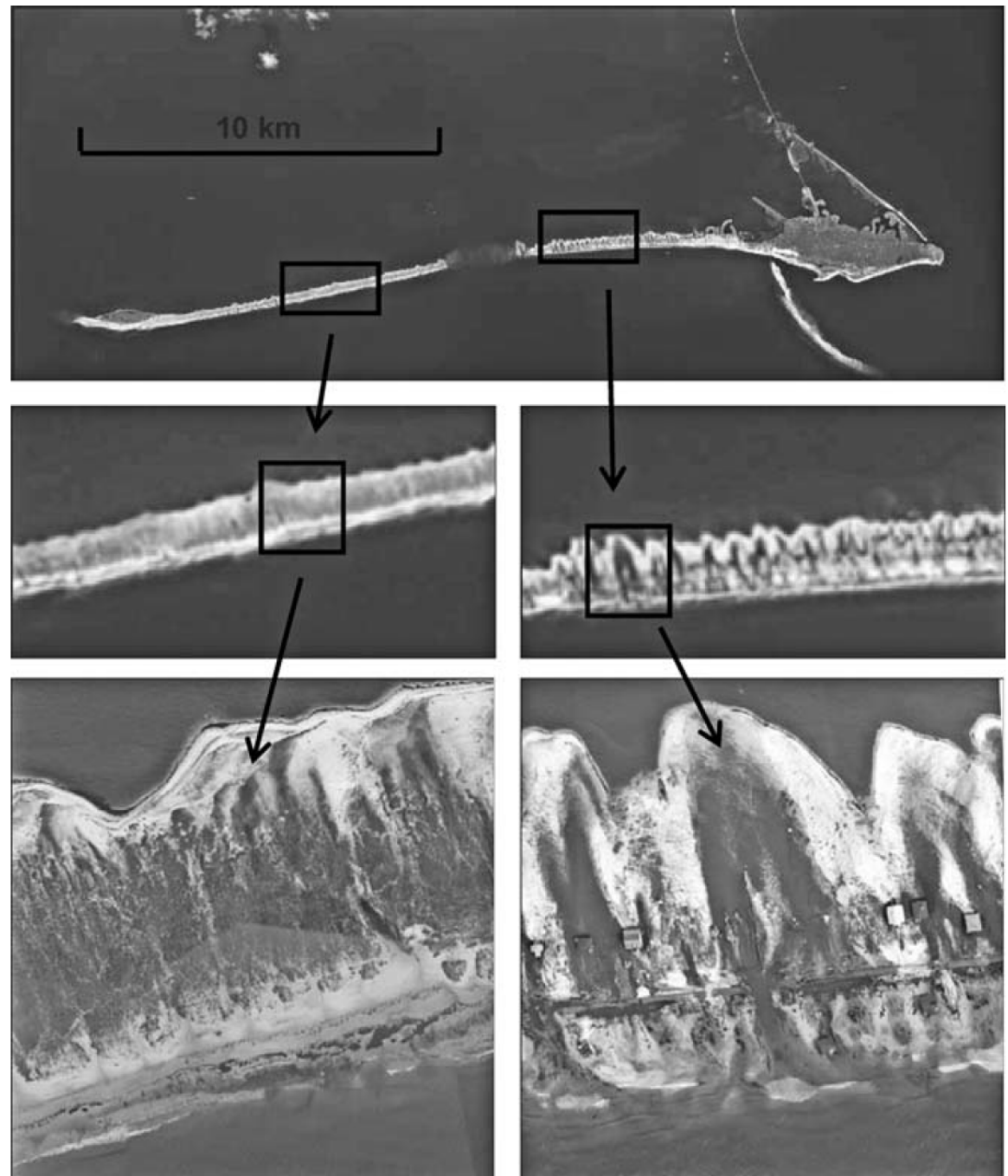
3. Use of a unified decision framework to assess the viability of hybrid engineered-natural solutions

..what matters is the efficiency of a given solution relative to the time scale, the spatial scale, and the severity of the force.



The best use of ecosystem materials in engineering is not to provide structural resistance to a given force, but rather to maintain dynamic ecological processes that build the structure. Processes need to be integrated into fragility and risk assessments, but this requires longer time-scales to see the benefits.

Dauphin Island, AL
after Hurricane Katrina



To ask 'What is the ROI for EWN projects?', we have to begin using Ecosystem Service Valuation to account for non-market goods and services, and assess them over longer terms.



1. Manipulation of dynamical equilibrium 'pressure points' within the system
2. Interchangeability of natural versus artificial materials
3. Use of a unified decision framework to assess the viability of hybrid engineered-natural solutions

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