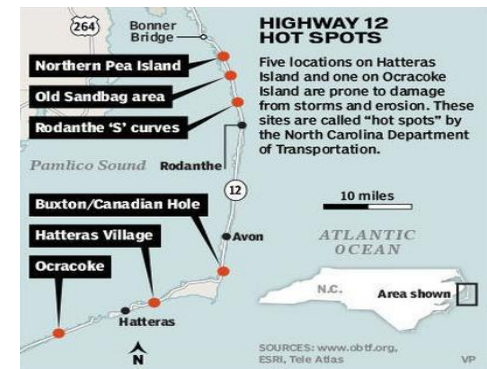


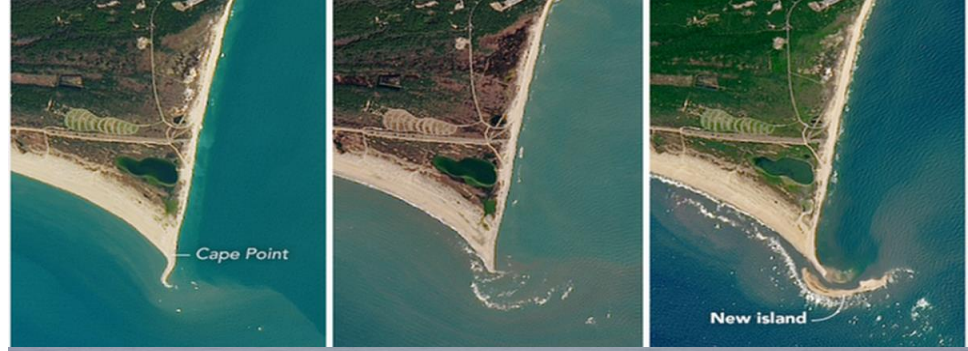
Surf Science and Shoreline Change



- Barrier Islands naturally “rollover”
- We use beach nourishment to combat erosion and protect vulnerable infrastructure.
- Federal, State, and Local governments have spent more than \$828 million to restock beaches in NC since 1939



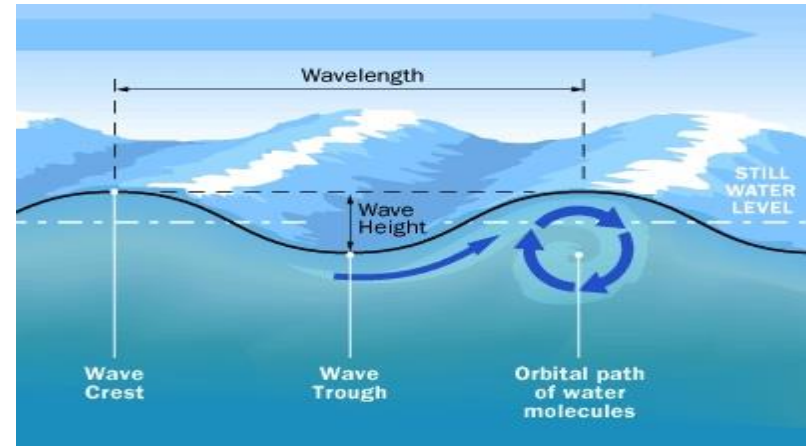
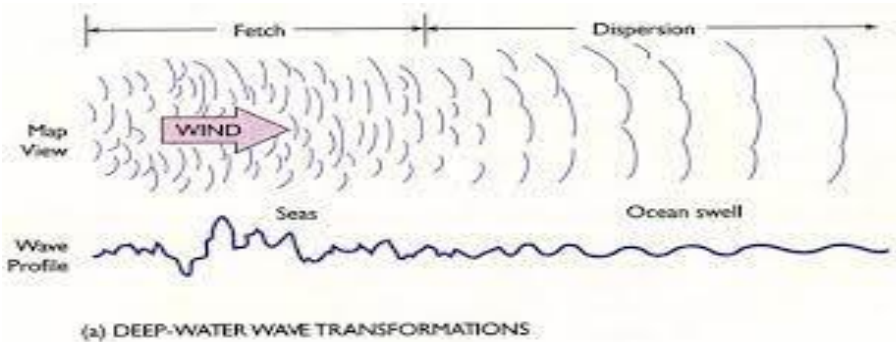
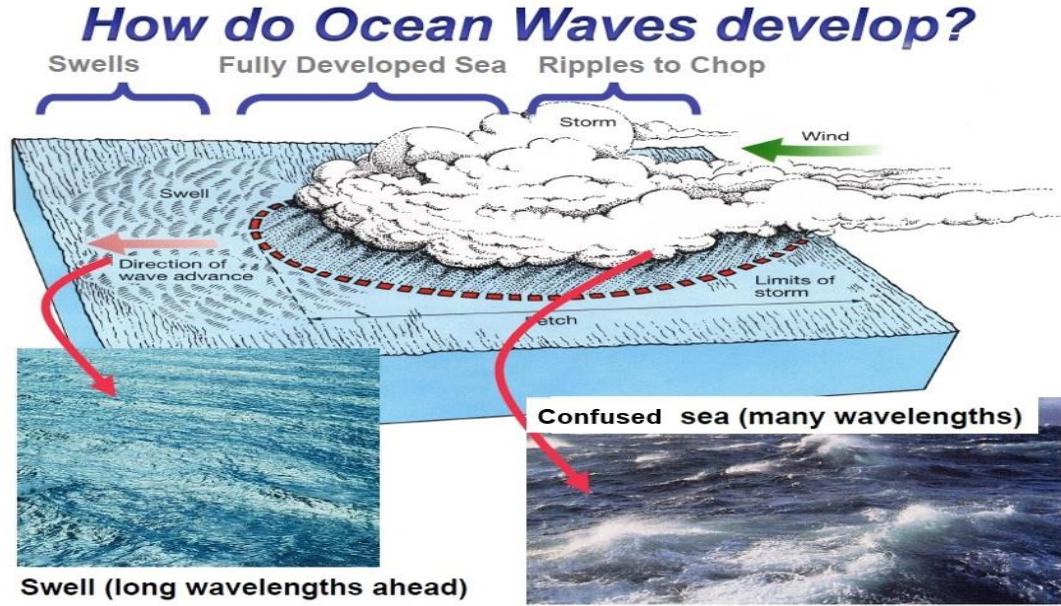
- Sand is set in motion by wind waves and tide
- Shifting sand and shoreline change have the potential to affect surf breaks
- These shifts have the potential to change beach features



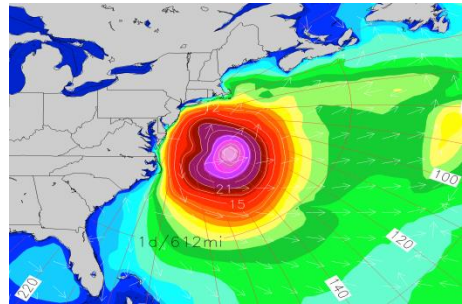
Ocean waves that we surf are wind driven

Wave size is determined by:

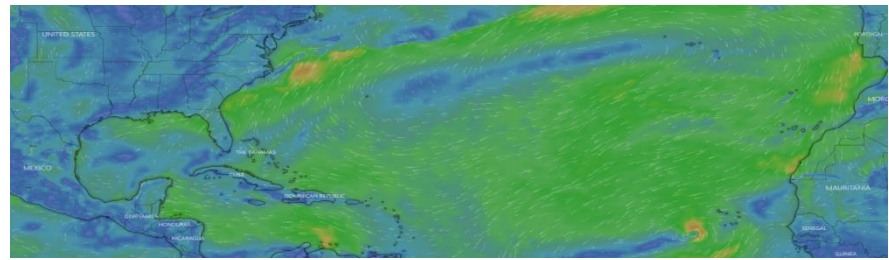
- Wind Speed
- Wind Direction
- Fetch - Distance of Open Water
- Duration



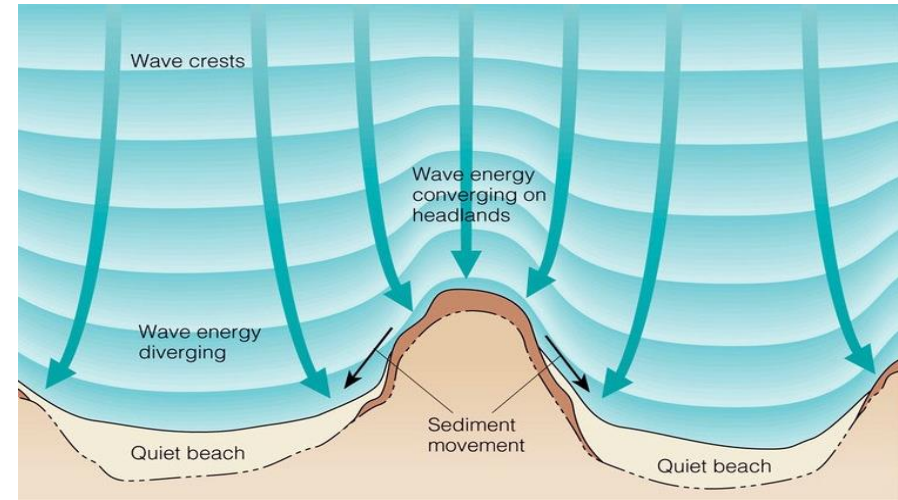
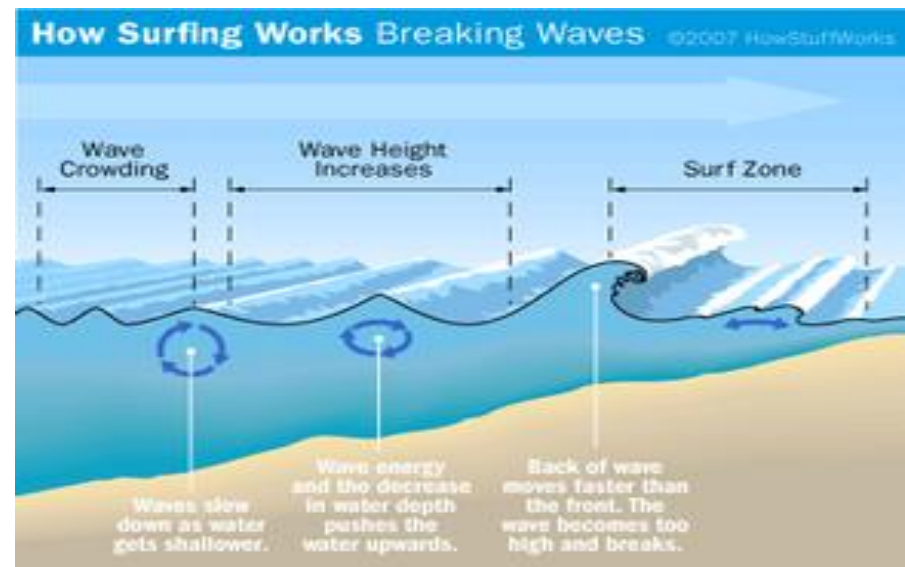
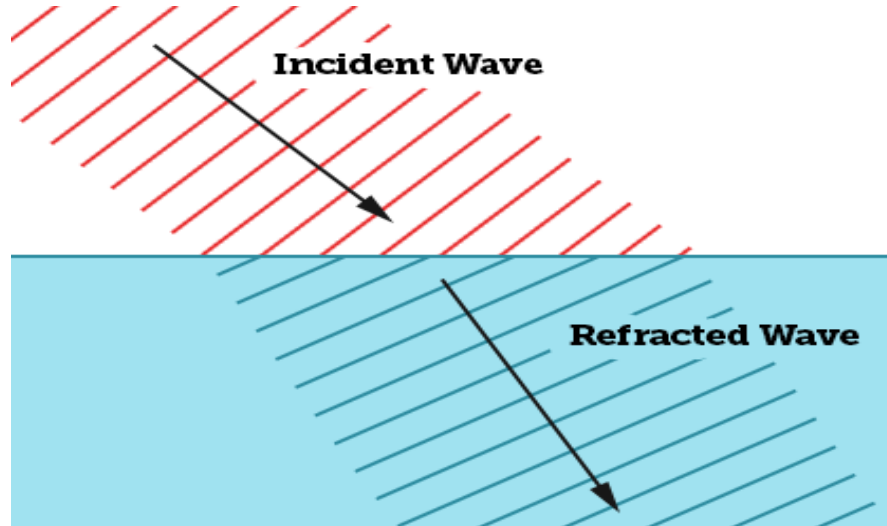
- Just as weather varies throughout the year, so do waves.



Jan	Feb	Mar	Apr
Swell Consistency 30%	Swell Consistency 33%	Swell Consistency 32%	Swell Consistency 30%
Average Swell Height 7ft	Average Swell Height 8ft	Average Swell Height 7ft	Average Swell Height 7ft
Average Swell Period 9s	Average Swell Period 9s	Average Swell Period 9s	Average Swell Period 9s
Dominant Wind ↘	Dominant Wind ↘	Dominant Wind ↘	Dominant Wind ↘
Dominant Swell ↘	Dominant Swell ↘	Dominant Swell ↘	Dominant Swell ↘
May	Jun	Jul	Aug
Swell Consistency 27%	Swell Consistency 14%	Swell Consistency 9%	Swell Consistency 15%
Average Swell Height 6ft	Average Swell Height 4ft	Average Swell Height 3ft	Average Swell Height 4ft
Average Swell Period 8s	Average Swell Period 8s	Average Swell Period 8s	Average Swell Period 9s
Dominant Wind ↙	Dominant Wind ↙	Dominant Wind ↗	Dominant Wind ↙
Dominant Swell ↘	Dominant Swell ↘	Dominant Swell ↘	Dominant Swell ↘
Sep	Oct	Nov	Dec
Swell Consistency 45%	Swell Consistency 34%	Swell Consistency 33%	Swell Consistency 26%
Average Swell Height 6ft	Average Swell Height 6ft	Average Swell Height 6ft	Average Swell Height 6ft
Average Swell Period 9s	Average Swell Period 9s	Average Swell Period 9s	Average Swell Period 9s
Dominant Wind ↙	Dominant Wind ↙	Dominant Wind ↗	Dominant Wind ↘
Dominant Swell ↘	Dominant Swell ↘	Dominant Swell ↘	Dominant Swell ↘



- As waves approach shore, they begin to “feel” the bottom.
- Wave height increases until they break
- Waves will tend to parallel shore as they come in.



Factors that effect wave breaking:

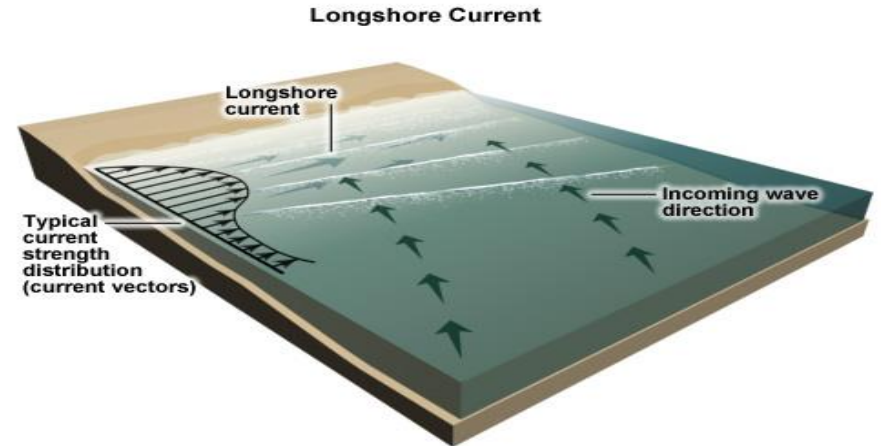
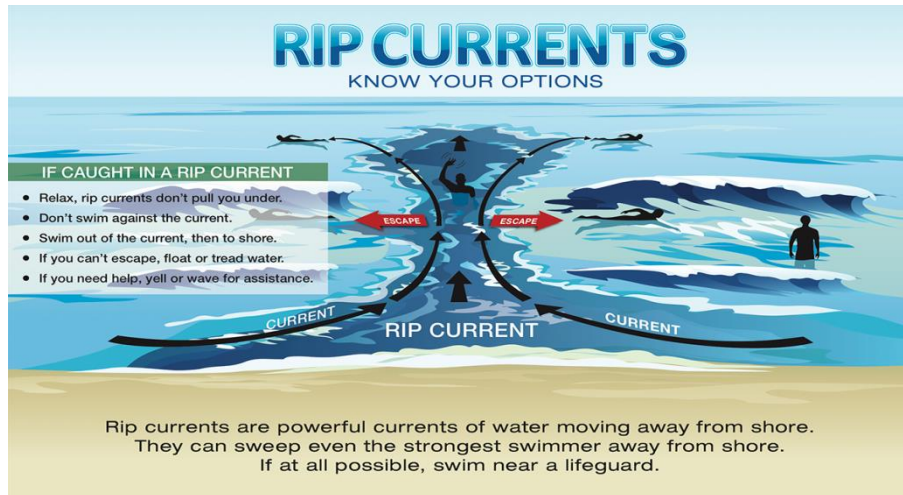
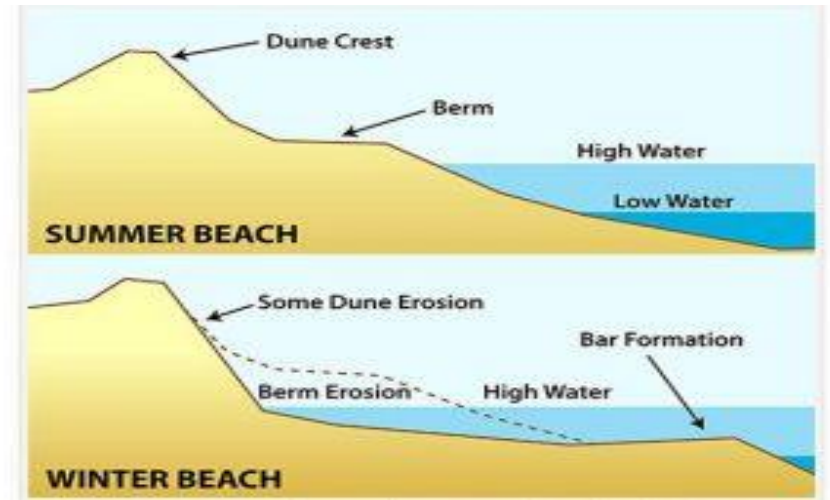
- Wave height/direction/period
- Bathymetry, the shape/orientation of sandbars, rocks, and reef
- Tide.
- Winds. Onshore vs. offshore winds.



Type	Diagram	Example	Description
Spilling $\xi_0 < 0.5$			-Wave crest becomes unstable and spills down while introducing air bubbles inside. -Characteristic foamy water. -High-steepness waves over mild slopes.
Plunging $0.5 < \xi_0 < 2.5$			-Wave shoreward face becomes first vertical, curls over and finally plunges into the water ahead. -Air can be trapped inside the curl. -Medium steepness waves over intermediate slopes.
Collapsing $2.5 < \xi_0 < 3.7$			-Wave crest becomes vertical, until the base collapses arriving to the shoreline as a thin water layer. -Low steepness waves over steep slopes.
Surging $\xi_0 > 3.7$			-Wave crest remains unbroken, and the wave arrives to the shoreline with small shape changes. -Low steepness waves over very steep slopes.



- Wave breaking releases the wave energy, and transports sand via currents.
- Ultimately, this process shapes the beach and shoreline.
- Currents will depend on the direction of the incoming waves and their height.



Case Study: Skeleton Bay – Shifting Sands and the World's Best Lefthander?

- Introduced to the world by Surfing Magazine in a Google Earth contest in 2008.
- Located on the edge of one of the world's oldest deserts.
- Has only existed since the 1970s.
- Considerable change in shape over the last 40 years.



Skeleton Bay



Swell Direction

W through SW, although the more W it is, the more swell gets in and the “easier” it is to surf.



Wind

Manageable winds range from SE to E, with SE being ideal.



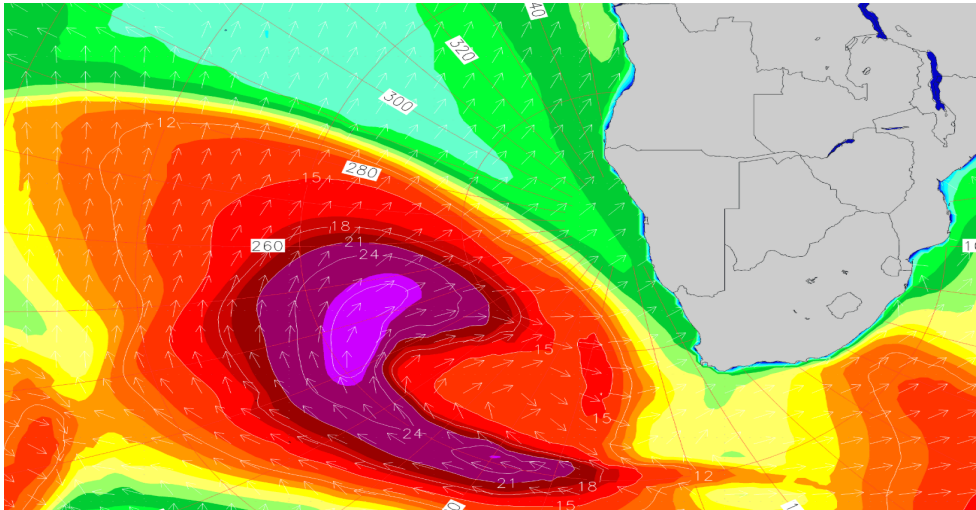
Surf Height

The wave becomes makeable once it hits the head-high+ mark, and becomes increasingly more difficult to surf with every foot above double-overhead.



Tide

Breaks on all tides, but gets increasingly gnarly as the tide gets lower.



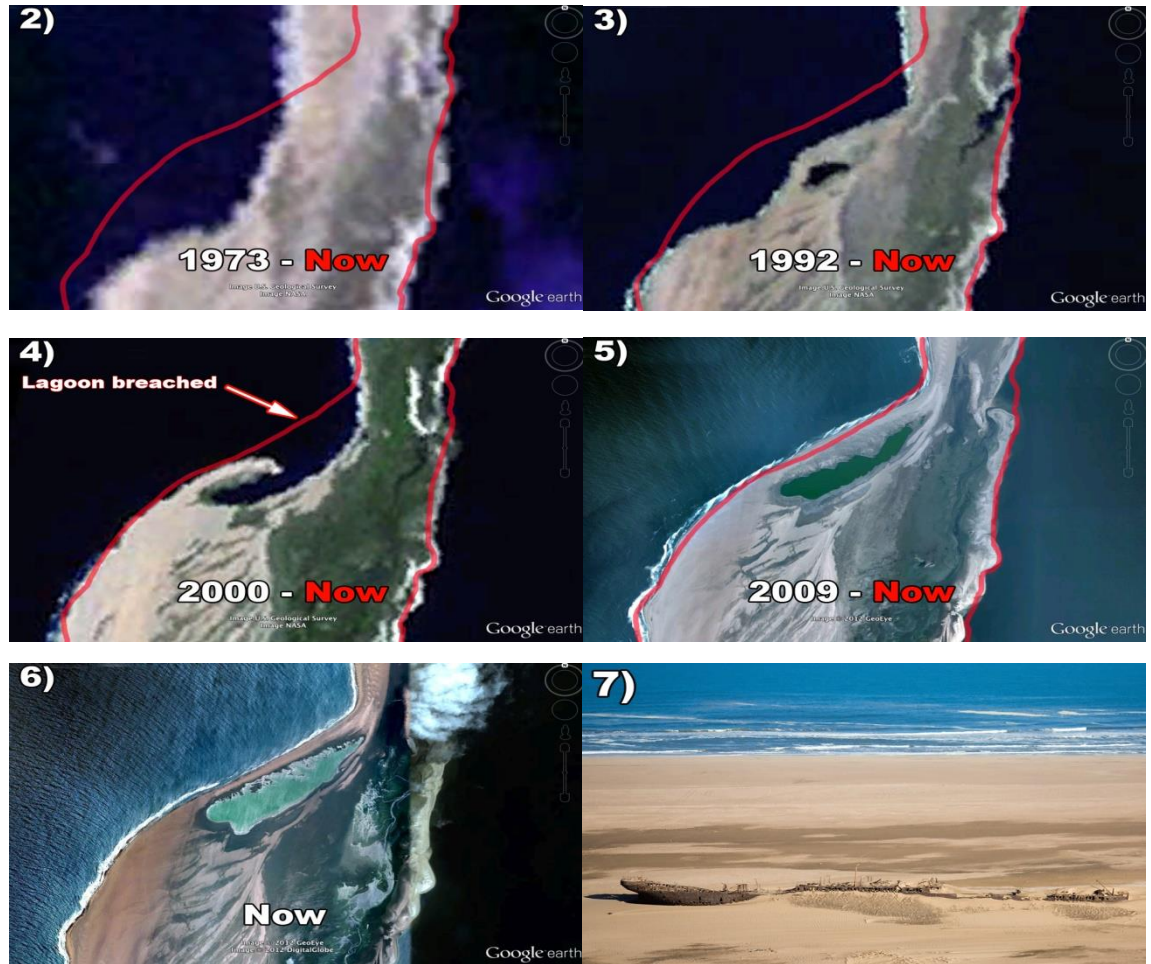
Over 35 million cubic feet of sand flows past the break each year

Growing Northwest into the Southern Atlantic Ocean

The break is 0.5 miles further north than where it would have been in 1973.

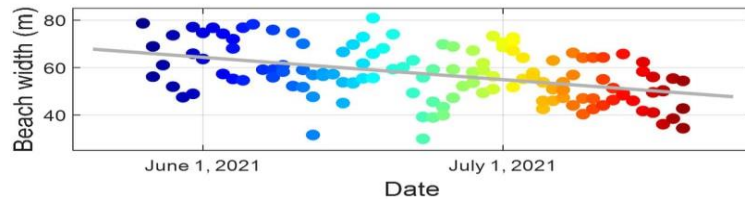
Eduard Bohlen ran aground in 1909.

Now 100+ years later it lies 1200 feet inland from the shore.



<https://www.youtube.com/watch?v=EDmJPNHo-c4>

Let's bring our discussion back to North Carolina.



Beach width trend
-7.2 feet per week

Keep surfing! Questions?

