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Losing Nature's Little Speed Bumps

Introduction:

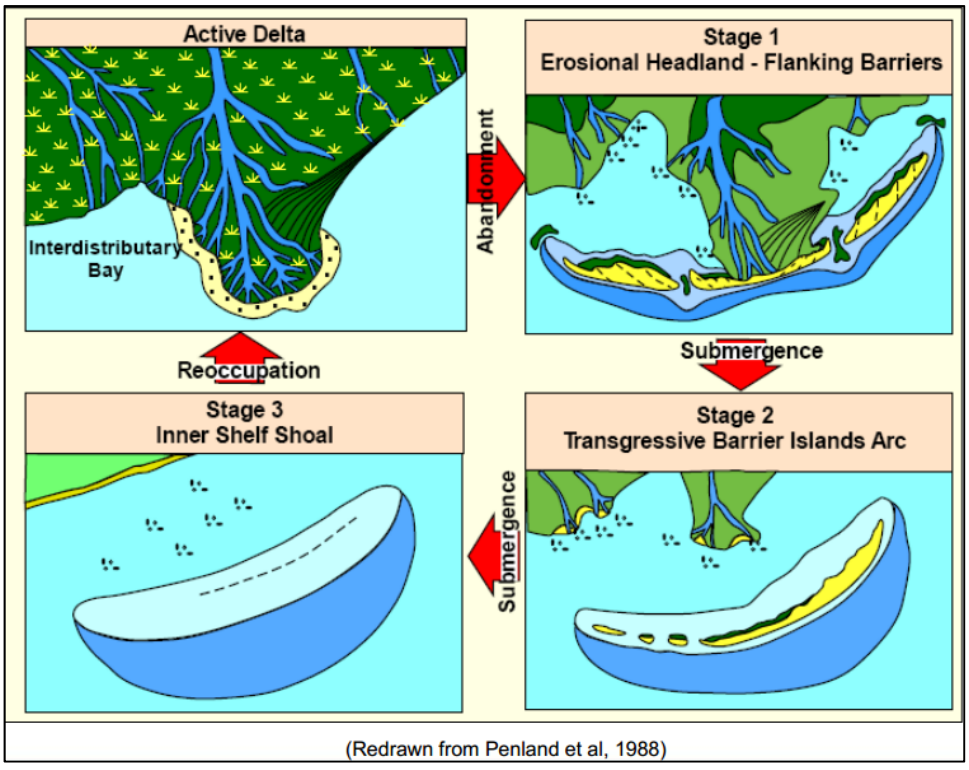
Barrier islands play an important role in protecting and providing valuable resources for Louisiana. Formed by the process of the Mississippi River Delta Lobe Cycle, Louisiana's barrier islands act as natural speed bumps- slowing down storms, reducing storm surge, and protecting the coast from the intense wave action of the Gulf of Mexico. Barrier islands provide resting spots for migrating birds and a permanent residence for a variety of plants and animals. Though these islands are excellent habitats for numerous species, they are not meant to last forever.

In this activity, we will use Google Earth Pro, to measure one of Louisiana's own barrier islands. We will look at Wine Island, one of the Isle Dernieres islands, or Last Islands, about 5 miles south of LUMCON's DeFelice Marine Center. The island chain used to be one single island until it was broken apart by a hurricane in 1856. Using Google Earth Pro, we will measure Wine Island's perimeter and area at different times from January 2004 through March 2020 to see how much it has changed during those 16 years.

Formation of Barrier Islands by means of the Delta Lobe Cycle

Barrier Island formation can be explained using the 3 stage model developed by Penland and his colleagues in 1988 as represented below in the diagram.

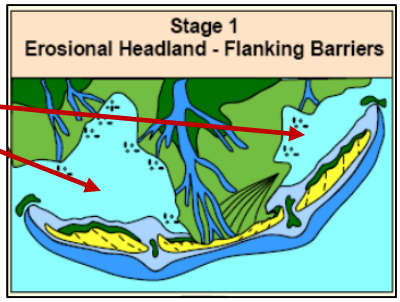
Active Delta Stage: Barrier island formation begins as a delta lobe. A delta lobe is formed when a river deposits sediment at the mouth (or end) of the river. As sediment builds up and land becomes too high for the river to easily flow over it, the river will change course. When a river changes course this is called Abandonment.



(Redrawn from Penland et al, 1988)

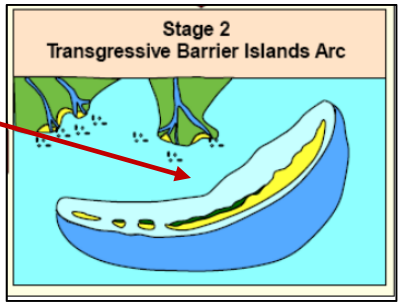
Stage 1: When a river changes course, the rate of sediment deposition (land building) cannot keep up with the rate of erosion. Removal of sediment can happen in many ways. It can happen by 1) natural forces, 2) lack of sediment delivery by a river, and 3) subsidence (the sinking of land). These all lead to the degradation of the delta lobe over time. When this process starts with the areas just inside of the coastline, it can lead to the creation of a barrier island.

Notice the how the mainland is starting to become detached from the headland in the diagram.



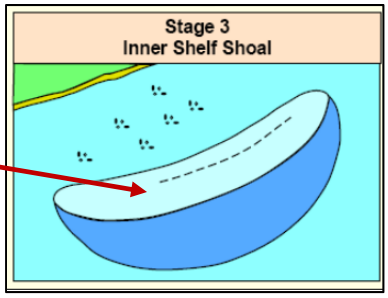
Stage 2: As the former delta lobe continues to be submerged and become more exposed to sea level rise and forces of nature such as wind, waves, currents, tides, and subsidence the land continues to be covered up and erode until the coastline completely separated from the rest of the mainland. This area of land is now a transgressive barrier island arc. Transgressive barrier islands are usually thin, elongated islands, parallel to the mainland. While seemingly stationary, they constantly change and move.

Notice the how the mainland is now completely detached from what was one the headland.



Stage 3: Sea level rise, wind, waves, and currents continually act on barrier islands. Islands move laterally as sediment is transported along the length of the island, while wave action pushes sediment from the front side of the island to the back. High energy events such as major storms and hurricanes also decrease the elevation of barrier islands. As the island erodes and subsides, it becomes a shoal, a naturally submerged sandbank, beneath the surface of the water.

Notice how the entire island has become completely submerged.



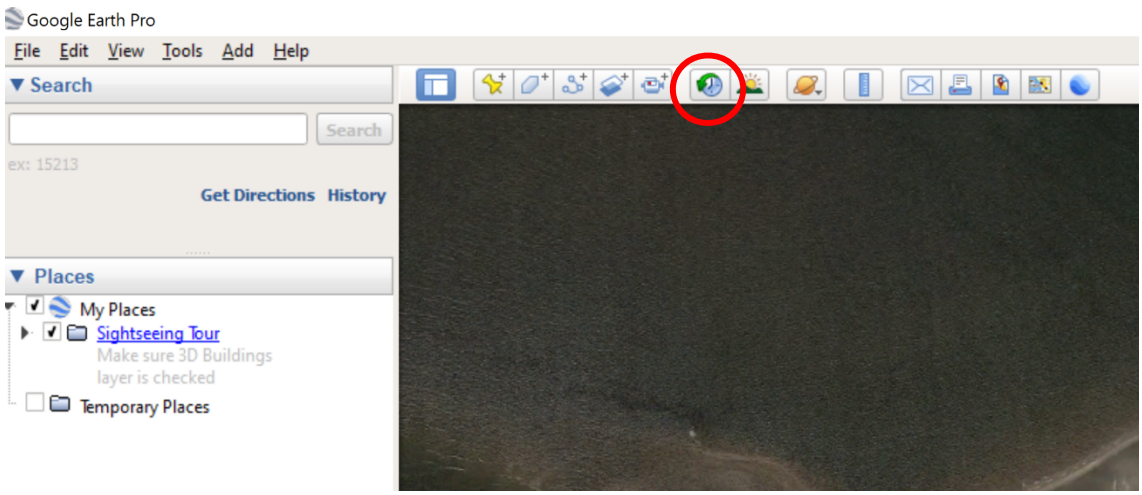
Protection from Storm Surge

Barrier islands provide crucial protection to coastlines when storm events take place. Barrier Islands have been protecting the Louisiana coast for centuries. When hurricanes and other storm events make their way across the Gulf of Mexico they often bring high winds, heavy rains, and storm surge. When a hurricane is close to making landfall, often they must pass over one of the many barrier islands found on the Louisiana coast. When a hurricane encounter a barrier island the wave energy (storm surge) is significantly decreased. The islands act like speed bumps, reducing much of the force that would otherwise impact the mainland. However, there is often a price to be paid. The high energy of the waves and wind experienced during a strong hurricane can often break a bigger sized island into a smaller one or multiple smaller ones.

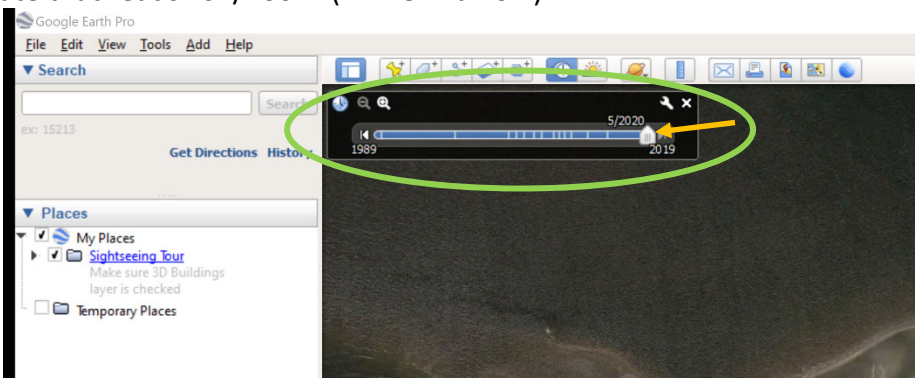
Let's use an online tool (Google Earth Pro) to see what kind of changes Wine Island has seen over time.

How to get started:

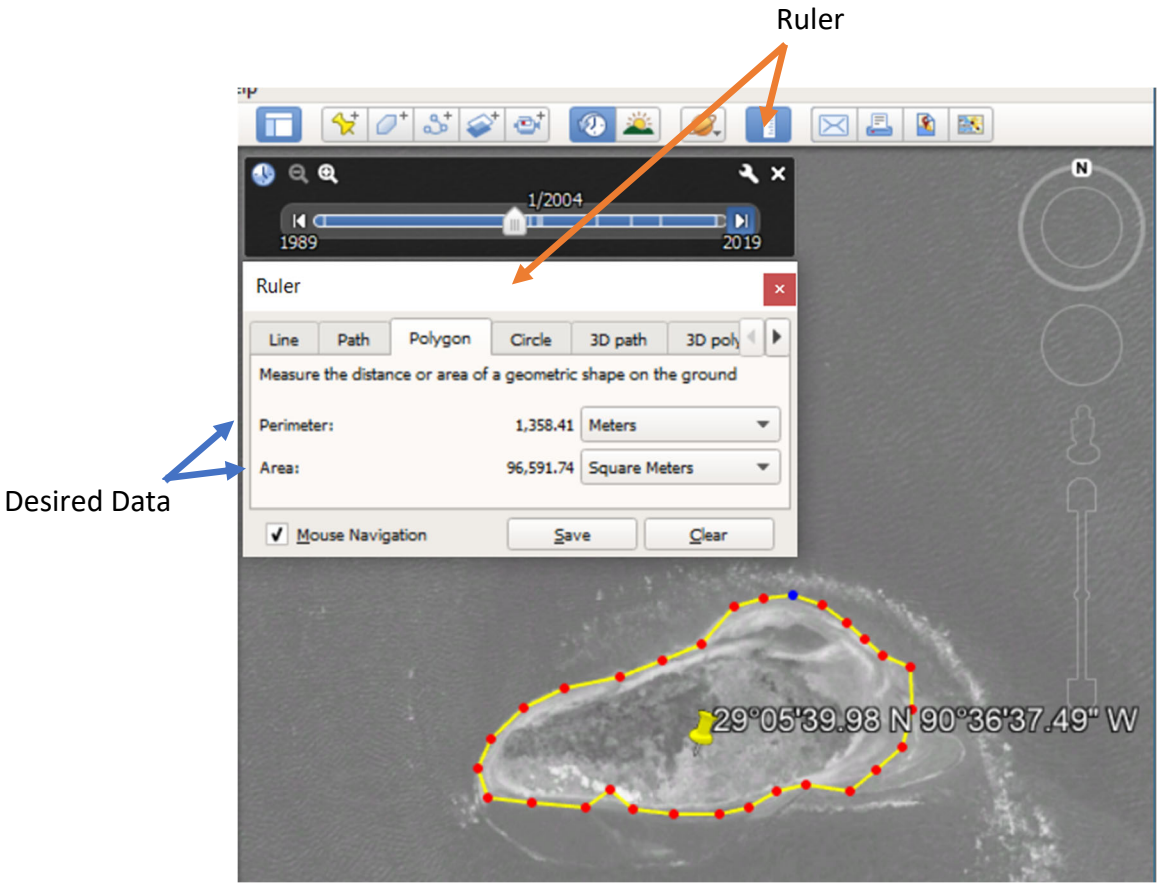
1. Download Google Earth Pro on your computer (if you do not already have it) https://www.google.com/earth/versions/#download-pro
2. Zoom in to Wine Island located in Terrebonne Bay at the following coordinates: 29°05'39.98" N 90°36'37.49" W
3. You will be using the Time Slider Tool on the tool bar at the top of the screen. Time Tool looks like a clock with an arrow pointed in the counterclockwise direction (RED circle).



4. Click on the Time Tool button. A Time Tool Scale should appear just underneath the button on the Image that is displayed (GREEN circle). Slide the arrow along the scale to the date that reads “01/2004” (YELLOW arrow).



5. Now we will use the Polygon tab for the ruler, we will measure the perimeter (in meters) and the Area (in Square Meters) of Wine Island over the course of roughly 16 years. On the tool bar select the “Show Ruler” icon. It looks like a vertical Ruler. For this activity, you will need to select the “Polygon” tab of the Ruler (ORANGE arrows). We will be measuring in meters, so you need to select meters in the drop-down menu within the Polygon tab (BLUE arrows).



6. To measure the parameters, outline the shape of the island as accurately as possible by clicking all along the edge of the island going clockwise. You will see a polygon form as soon as three dots are on the screen. DO NOT WORRY!
    a. Continue clicking clockwise along the island and the polygon will ultimately form around the whole island.
    b. The more times you click moving around the island the more accurate your measurement will be.
7. Once you have outlined the island, record the Date found on the Time Slider Tool, the perimeter (in Meters), and the Area (in Square Meters) on the datasheet provided on Page 4.
8. When you have finished recording the data for "01/2004", simply click on the ▶| at the right end of the Time Slider Tool to move on to the next available image of Wine Island (notice the images are not taken once a year, the dates vary).
9. Record the Perimeter and Area of Wine Island all the way up to the most current date on Google Earth Pro (03/2020) and observe how the land has changed. Remember to record all your measurements on the datasheet as you go.

Today's Date: _____

Name of Land Feature: _____

Location (GPS Coordinates given in "How to Get Started"):

_____°_____ N _____°_____W

Date: (MM/YYYY)	**Perimeter (Meters)**	**Area (Square Meters)**
01/2004		

Follow-up Questions:

We can use the data that we have collected to question and learn different things about what is happening to Wine Island and other barrier islands.

1. How much has the **perimeter** of Wine Island changed? How much has the **area** changed? Subtract the last recorded number from the first recorded number from each column.

Perimeter: _____ Meters
Area: _____ Square Meters

2. What is the *percent change* of the **perimeter** of Wine Island changed from 01/2004 to 03/2020? _____%

To answer this question, take the last recorded perimeter (03/2020) and subtract it from the first recorded perimeter (01/2004). Next, divide the number by the first recorded perimeter (01/2004). This will give you a very small number. To find the percent change, multiply by 100. This will give you the percent change of Wine Island's perimeter from 01/2004 to 03/2020.
*If the number is NEGATIVE the change was a decrease.

Percent Change:

$$\frac{\text{Last recorded \# – First Recorded\#}}{\text{First Recorded \#}} \times 100 = \_\_\_\_\_\%$$

3. Using the same formula used in Question 2, what is the percent change in **area** of Wine Island?

4.Which stage of the diagram shown in the introduction is Wine Island in? What process are you observing as you record your data?

5. Below is a table of Hurricanes that had paths through Louisiana. Looking back at Google Earth Pro, are there any noticeable differences between the years a hurricane came through? Did the Category of the hurricane make a difference?

Name	Intensity	Date
Cindy	Category 1	July 6, 2005
Katrina	Category 3	August 29, 2005
Rita	Category 3	September 24, 2005
Humberto	Category 1	September 13, 2007
Gustav	Category 2	September 1, 2008
Isaac	Category 1	August 28, 2012
Nate	Category 1	October 7, 2017
Barry	Category 1	July 13, 2019