

SkyTruthing for Students: Petit Bois Island Teachers Guide

SkyTruthing for Students demonstrates how satellite imagery can enhance environmental analysis and help solve environmental problems. Module 2 explores the natural and human processes affecting barrier islands in the Gulf of Mexico, and asks students to address a real-life dilemma facing the Gulf Islands National Seashore: namely, the loss of land on Petit Bois Island.

Using historic maps and modern satellite images, Google Earth Pro software, and links to government documents and other background materials, module 2 forces students to weigh competing environmental values and recommend solutions for resolving them.

Step 1: Understand the issues

Step 1 introduces students to Petit Bois Island and the larger barrier island chain hugging the Gulf Coast from the Florida panhandle to Mississippi. It describes the natural and human processes driving island size and reveals the conflict between dredging for navigation to the Port of Pascagoula and preserving wilderness on Petit Bois Island.

Go to the SkyTruthing for Students website <http://skytruth.org/schools> and click on the Petit Bois Island link on the left hand column to read the background information.

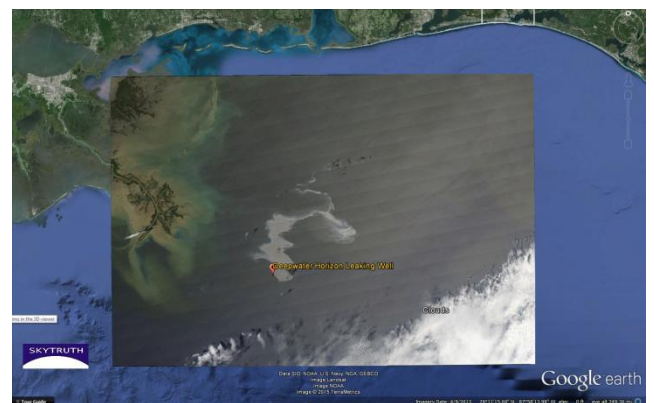
More detailed descriptions of the physical changes to Petit Bois Island over time and the processes affecting that change can be found in Robert A. Morton, "[Historical Changes in the Mississippi-Alabama Barrier Islands and the Roles of Extreme Storms, Sea Level, and Human Activities](#)," "[U.S. Geological Survey Coastal and Marine Geology Program Open File Report 2007-1161](#)" and "[Geologic Resource Scoping Summary, Gulf Islands National Seashore, Geologic Resources Division, National Park Service 2007- 0302.](#)"

Step 2: Use satellite imagery to track changes on Petit Bois Island

Step 2 gives students hands-on opportunity to analyze satellite images of Petit Bois Island and measure changes in island size over time. It also asks them to observe other changes on the island that might be evident from the images. The exercises require students to analyze satellite images in Google Earth, document trends, and draw conclusions about change from satellite imagery.

To complete the exercises, the students will need to use:

- [KMZ file](#) that stores the satellite images of Petit Bois Island from 4 separate years: 1984, 2004, 2006, and 2015.



- [Google Earth Pro](#) to trace the outline of the island on the satellite images.
- The [Guide to using Google Earth Pro](#) and [worksheet](#) to calculate the size of the island on each of the dates and calculate the current rate of land loss.

As a first step, go to [the SkyTruthing for Students](#) website and download the [Guide to using Google Earth Pro](#) provided in the left-hand column. Following the steps in the guide, have the students select a satellite image provided in the KMZ to practice using Google Earth by outlining the area of the island on that date. Once students have mastered maneuvering in Google Earth Pro, they can outline and measure the area of Petit Bois Island for each of the 4 years presented, record their measurements on the Calculations Worksheet, and identify trends (quantitatively) over time.

The exercise also asks students to observe qualitative changes visible on the imagery. The loss of forest cover should be apparent when comparing the 2004 image (taken before Hurricane Katrina) with the 2006 image (taken after Hurricane Katrina). See if any students notice this and discuss the implications for island size over the long term. Forest cover can help stabilize islands, and so its loss due to severe hurricanes can accelerate the island's disappearance.

Step 3: Explore options for management

Step 3 divides the class into 3 groups to examine different aspects of the issue. Each group first examines the implications of island decline on a particular set of resource uses and values. Students then examine options for protecting those uses and values. Finally, the class collectively makes a recommendation about the preferred course of action for protecting those values, based on the information presented by each group and the full class discussion.

Implications:

- *Group A will explore the implications of island loss for fish and wildlife.* The links provided in the lesson outline basic information about threatened and endangered species that use Petit Bois, and economically important fisheries that rely on its shoreline habitats for nursery areas. The exercise requires students to read portions of Chapter 3 of the [Gulf Islands National Seashore General Management Plan](#), pinpoint relevant information and extract key facts from the chapter, agree on which facts are most relevant to the issue at hand, and succinctly present those findings to others.
- *Group B will examine how barrier islands protect local coastal communities from the impact of storms, and the economic and recreational value of that protection.* The exercise requires students to read two portions of Chapter 3 of the [Gulf Islands National Seashore General Management Plan](#) outlining the economic, social and recreational values generated by the presence of the National Seashore's barrier islands, and two short articles ([here](#) and [here](#)) explaining how barrier islands protect coasts. Students will need to pinpoint relevant information and extract key facts from the documents, agree on which facts are most relevant to the issue at hand, and succinctly present those findings to others.

- *Group C will compare and contrast the economic benefits to the nation generated by dredging the navigation channel to the Port of Pascagoula, with the recreational, spiritual, and environmental benefits to the nation generated by maintaining wilderness on Petit Bois Island. This exercise requires students to search the [Port's website](#) for relevant information, and read an [essay](#) describing the importance of wilderness. Relevant port information includes [Port Stats and Facts](#), [Economic Impact](#), and [Location](#). They must confront the conflict between these two sets of values, and explain both sets of values to others.*

Options:

After each group has presented its set of findings to the others, it will analyze potential solutions. The solutions reflect the primary causes of island loss: climate change (triggering sea level rise and increased storm intensity) and dredging. Two groups will explore different dredging options: one will consider environmentally preferable approaches to continued dredging, and the other will explore alternative navigation routes.

- Group A will explore solutions for addressing climate change. To focus the discussion, students should explore what climate change solutions (if any) will resolve land loss on Petit Bois Island, considering time frames (including their estimated rate of land loss from Exercise 2 and the predicted lag time for changes in sea level rise and storms) and scope of influence (local, national and international efforts).

Some overview sources on climate change include [Climate Change 101](#) prepared by the Center for Climate and Energy Solutions, a [video](#) featuring Bill Nye that explains the science of climate change produced by Smithsonian.com, and an article highlighting current solutions by David Biello in [Scientific American](#). Depending on student ability and knowledge, teachers might want to assign some or all of these sources as background material. The Climate Change 101 overview document is 11 pages long and includes climate change science and solutions.

The UN International Panel on Climate Change, the international body formed by the United Nations Environment Programme to provide scientific understand of climate change, has a link to its scientific Summary Report for Policymakers [here](#), which provides more detailed information about current scientific thinking on climate change.

- Group B will explore whether dredging could occur in a more environmentally sustainable manner. The lesson includes links to two brief websites ([here](#) and [here](#)) that explain how dredged material can be used for beneficial purposes in some cases (such as to recreate wildlife habitat) and a [Landsat image of current dredge spoil sites](#) in the Gulf of Mexico. The materials should lead them to consider where dredge material should be placed to reduce the loss of habitat on Petit Bois Island.

The U.S. Army Corps of Engineers, responsible for dredging the Horn Island Pass adjacent to Petit Bois Island for navigation, has studied the issue of land loss and dredging in the Gulf Islands in detail in the [Mississippi Coastal Improvement Program Comprehensive Barrier Island Restoration, Hancock, Harrison and Jackson Counties, Mississippi](#), March 2014, and in Mark R. Byrnes, et al, "[Littoral Sediment Budget](#)

[for the Mississippi Sound Barrier Islands](#)“ (Appendix B). US Army Corps of Engineers, Engineer Research and Development Center. July 2012. These are lengthy technical documents and inappropriate as lesson tools. However, they can provide valuable background information for those wanting to learn more.

- Group C will study shipping routes outlined on a [LandSat image](#) and combine that information with their previous research on goods traveling into the Port of Pascagoula to determine if dredging could cease in the Horn Island Pass to protect Petit Bois Island while still supporting trade in the Port.

Recommendation: Based on presentations made by each group, the full class will discuss what it would recommend to the U.S. Army Corps of Engineers, the National Park Service, and coastal communities to protect environmental , economic, recreational and other values. This discussion requires students to integrate the information from multiple source, weigh conflicting values and reach a decision on a real life environmental issue.

Standards addressed in Shifting Sands on Petit Bois Island

Marine Science Standards

ELD.K12.ELL.SC.1 English language learners communicate information, ideas and concepts necessary for academic success in the content area of Science.

LAFS.1112.RST.3.7 Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem

LAFS.1112.SL.1.2 Integrate multiple sources of information presented in diverse formats and media (e.g., visually, quantitatively, orally) in order to make informed decisions and solve problems, evaluating the credibility and accuracy of each source and noting any discrepancies among the data.

SC.912.L.17.16 Discuss the large-scale environmental impacts resulting from human activity, including waste spills, oil spills, runoff, greenhouse gases, ozone depletion, and surface and groundwater pollution.

SC.912.L.17.4 Describe changes in ecosystems resulting from seasonal variations, climate change and succession.

Environmental Science Standards

ELD.K12.ELL.SC.1 English language learners communicate information, ideas and concepts necessary for academic success in the content area of Science.

LAFS.1112.RST.3.7 Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.

LAFS.1112.SL.1.2 Integrate multiple sources of information presented in diverse formats and media (e.g., visually, quantitatively, orally) in order to make informed decisions and solve problems, evaluating the credibility and accuracy of each source and noting any discrepancies among the data.

LAFS.1112.SL.2.4 Present information, findings, and supporting evidence, conveying a clear and distinct perspective, such that listeners can follow the line of reasoning, alternative or opposing perspectives are addressed, and the organization, development, substance, and style are appropriate to purpose, audience, and a range of formal and informal tasks

SC.912.E.6.6 Analyze past, present, and potential future consequences to the environment resulting from various energy production technologies

SC.912.L.17.16 Discuss the large-scale environmental impacts resulting from human activity, including waste spills, oil spills, runoff, greenhouse gases, ozone depletion, and surface and groundwater pollution

SC.912.L.17.20 Predict the impact of individuals on environmental systems and examine how human lifestyles

affect sustainability

SC.912.L.17.4 Describe changes in ecosystems resulting from seasonal variations, climate change and succession

SC.912.L.17.8 Recognize the consequences of the losses of biodiversity due to catastrophic events, climate changes, human activity, and the introduction of invasive, non-native species.

Petit Bois Island Change in Size Worksheet

Use this worksheet to record your perimeter and area measurements for each year in the satellite imagery data set.

year	perimeter (km)	area (km ²)
1984		
2004		
2006		
2015		

- ① What is the average percentage of change in the area of Petit Bois Island per year for the following:
 - a) From 1984 to 2015?
 - b) From 1984 to 2004?
 - c) From 2004 to 2006?
 - d) From 2006 to 2015?

- ② Do your measurements show that the rate of change is increasing or decreasing over time? Other than change in size, what other trends do you see? In what other ways has the island changed over time?

- ③ Using the average rate of change in size of Petit Bois Island from 1984 to 2015 (from 1.a, above), in how many years might the island disappear altogether?