



AERIAL PHOTOGRAPHY AND MAPPING LESSON PLAN

Images of Katrina

Theme

Hurricane damage assessment

Links to Overview Essays and Resources Needed for Student Research

<http://oceanservice.noaa.gov/topics/navops/mapping/>

Subject Area

Earth Science

Grade Level

9-12

Focus Question

How can aerial photographs be used to quickly assess damage from a major natural disaster such as Hurricane Katrina?

Learning Objectives

- Students will use maps and online data resources to locate the specific geographic areas included in aerial photographs.
- Students will use aerial photographic imagery to assess some impacts of Hurricane Katrina.

Materials Needed

- (optional) Computers with internet access; if students do not have access to the internet, download copies of materials cited under “Learning Procedure” and provide copies of these materials to each student or student group
- Copies of “Aerial Surveillance of Impacts from Hurricane Katrina Worksheet,” one copy for each student group

Audio/Visual Materials Needed

None

Teaching Time

One 45-minute class period, plus time for student research

Seating Arrangement

Groups of 3-4 students

Maximum Number of Students

30

Key Words

Hurricane Katrina

Aerial photography

Damage assessment

Background Information

The coastal zone is a region of constant change. Some changes occur relatively slowly over decades, while other dramatic changes can happen overnight. These changes may be the result of natural events such as erosion and severe storms, or may be caused by coastal development and other human activities. Whatever the cause, the ability to recognize and quantify these changes is vital to many coastal resource uses, including commercial shipping, fishing, recreation, tourism, as well as to the people who make their homes in these areas. High resolution aerial photographs are the primary source of information about coastal change. Obtaining these photographs for the 95,000 mile U.S. shoreline is the responsibility of the National Geodetic Survey, part of NOAA's National Ocean Service (NOS). Data from these photographs are used to produce nautical charts, define jurisdictional boundaries, such as boundaries between property owners, federal, state, and local jurisdictions, boundaries of territorial seas, and the Exclusive Economic Zone. Aerial photographs are publically available for any area in the United States and its territories through the NOS Data Explorer Web site (<http://oceanservice.noaa.gov/dataexplorer/>)

In some cases, the need for this information is extremely urgent and may literally be a matter of life and death. Such was the case when Hurricane Katrina made landfall in Plaquemines Parish on August 29, 2005. This extremely powerful storm caused widespread destruction in heavily populat-

ed areas of the U.S. Gulf of Mexico coast. In the days immediately following the storm, there were many urgent questions, including

- Which major roads and bridges can be used by rescuers and relief agencies?
- Where is flooding taking place?
- Is there evidence of oil spills or other contamination from industrial facilities?

In addition, thousands of evacuees simply wanted to know whether their homes and businesses were still standing after the storm.

Because hundreds of miles of coastline were simultaneously affected, aerial photography provided the quickest and most effective means of answering many of these questions. On August 30, the day after the hurricane, NOAA's National Geodetic Survey began a series of missions to obtain high resolution aerial photographs of the affected coastal areas in Alabama, Louisiana, and Mississippi. In this lesson, students will acquire hands-on experience with some of the ways aerial photography can be used to answer practical questions about coastal resources.

Learning Procedure

1.

To prepare for this lesson:

- Read the introductory essay on Aerial Photographic and Shoreline Mapping (<http://oceanservice.noaa.gov/topics/navops/mapping/>); and
- Work through the “Aerial Surveillance of Impacts from Hurricane Katrina Worksheet.”

If students do not have access to the internet, download referenced images, and make copies for student groups to work with.

One of the most challenging aspects of working with aerial photographs of unfamiliar areas is to know the exact geographic locations that correspond to the photographic images. When these images are made, their precise location is determined using global positioning satellites. When the images are analyzed (for example, in a geographic information sys-

tem), location data are usually transferred onto the image. But rapid assessments may require initial evaluation before such analyses have been completed. Under these circumstances, topographic features such as highways, shorelines, water bodies, large structures, etc. can be used to locate areas on maps or other images that correspond to the areas in the photographs. Note that some recent internet mapping engines now include overlays of Katrina aerial imagery and map data, but an important aspect of this lesson is for students to acquire practice in relating “raw” photographic images to map features.

2.

Lead a brief discussion of why aerial images are needed of the nation’s shorelines, and how this information might be useful following natural disasters such as Hurricane Katrina. Provide each student group with a copy of the “Aerial Surveillance of Impacts from Hurricane Katrina Worksheet” (and copies of relevant images if students do not have access to the internet). If time is short, you may want to assign a smaller number of images for each group to analyze. All groups should complete Steps 1 through 5. The remaining steps may be divided among several groups if desired.

3.

Lead a discussion of students’ answers to problems on the worksheet. The following points should be included:

- A large vessel, possibly a barge, appears to be aground on the beach along the portion of the Biloxi shoreline examined in the image titled “24333378.jpg”.
- This same image shows extensive roof damage to the motel at 1865 Beach Boulevard; several vehicles appear to be piled into one corner of the parking lot next to the building and piles of debris are scattered over the site.
- Image 24333287 shows that the portion of US 90 that crosses Biloxi Bay between Biloxi and Ocean Springs, MS is completely destroyed; only concrete supports remain above the water.

- The structures surrounding the two swimming pools to the northwest of the intersection of Front Beach Drive and Martin Avenue in Ocean Springs, MS are totally destroyed.
- Image 24333396 shows a single structure, apparently intact, between Beauvoir Avenue and Brady Drive. There is a large pile of debris to the east of the structure. Reports posted on the Friends of Beauvoir website indicate that the main building at Beauvoir survived better than many more modern structures, but did sustain considerable damage. Other buildings, including the one in which Davis penned his post-war memoirs, were destroyed.
- Image 24334575 shows that bridges connecting Bay St. Louis, MS to Biloxi along US 90 are destroyed.
- The on-off ramp at the intersection of Interstate Highway 10 and Orleans Avenue in New Orleans was not useable because it was underwater.
- Sheening is evident on the portion Mississippi to the south of the two storage tanks visible near the center of image 24727673. The aerial image shows many trees lying on the ground in the surrounding area. Note that the total size of this spill was estimated at 3.78 million gallons.

The Bridge Connection

<http://www.vims.edu/bridge/> – In the “Site Navigation” menu on the left, click on “Ocean Science Topics,” then “Atmosphere,” then the link to “Storms” at the top of the “Climate & Atmosphere” page for links to activities and information concerning extreme weather events.

The Me Connection

Have students write a brief essay describing how they might personally use aerial photography following an event similar to Hurricane Katrina.

Extensions

1. Have students research a specific individual, business, or community that was affected by Hurricane Katrina, and locate aerial images of the area involved.

2. Another use of aerial photography and shorelines mapping is the creation of “Environmental Sensitivity Index Maps.” These maps are intended to provide information on the location of critical coastal resources so that responders to oil and chemical spills can quickly determine the most vulnerable areas that should be protected. Visit http://oceanservice.noaa.gov/news/features/supp_jun03.html for more information, and <http://response.restoration.noaa.gov/esi/exercise/maps.html> for an exercise using ESI maps.

Resources

<http://oceanservice.noaa.gov/dataexplorer/> – NOS’s Data Explorer web site providing access to coastal maps, shoreline surveys, coastal aerial photography, environmental sensitivity index maps, geodetic control points, maritime boundaries, estuarine bathymetry, and water level stations

<http://www.geodesy.noaa.gov/RSD/coastal/cscap.shtml> – Web site for the National Geodetic Survey’s Coast and Shoreline Change Analysis Program, which analyzes shoreline changes by comparing recent high-resolution satellite imagery or high-altitude reconnaissance aerial photography with existing NOAA nautical charts

<http://alt.ngs.noaa.gov/katrina> – Web site for Hurricane Katrina aerial photographic images from NOAA’s National Geodetic Survey

National Science Education Standards

Content Standard B: Physical Science

- Motions and forces

Content Standard D: Earth and Space Science

- Energy in the earth system

Content Standard E: Science and Technology

- Abilities of technological design
- Understandings about science and technology

Content Standard F: Science in Personal and Social Perspectives

- Personal and community health

- Natural resources
- Environmental quality
- Natural and human-induced hazards
- Science and technology in local, national, and global challenges

Links to AAAS “Oceans Map” (aka benchmarks)

5D/H1 – Ecosystems can be reasonably stable over hundreds or thousands of years. As any population of organisms grows, it is held in check by one or more environmental factors: depletion of food or nesting sites, increased loss to increased numbers of predators, or parasites. If a disaster such as flood or fire occurs, the damaged ecosystem is likely to recover in stages that eventually results in a system similar to the original one.

5D/H3 – Human beings are part of the earth’s ecosystems. Human activities can, deliberately or inadvertently, alter the equilibrium in ecosystems.



AERIAL PHOTOGRAPHY AND MAPPING WORKSHEET

Aerial Surveillance of Impacts from Hurricane Katrina Worksheet

Features on the aerial images are not labeled, so unless you are familiar with the area included in the image, it may be difficult to find specific locations. In addition, the geographic orientation of aerial images varies from image to image (that is, the top of the image may correspond to any direction; north, south, east, west, etc.). To overcome this problem, you can use an online mapping engine to locate street names and other features for the areas you want to examine. Matching conspicuous features on aerial images (such as shorelines, major highways, lakes, etc) with labeled images from online maps will help identify specific areas on aerial photographs. The following directions use the Google™ mapping engine to help locate specific features in the vicinity of Biloxi, MS.

1. Open the mapping Web site (<http://maps.google.com/>), and enter “biloxi” in the “Search” box at the top of the page and click on the “Search” button. A map of the greater Biloxi area will appear. Click on the “Hybrid” button in the upper right corner of the map to display a satellite image of the area with major streets outlined and labeled. Locate the “+” button in the upper left corner of the map, and click this button once to zoom in. Locate the intersection of state route 15 (in an oval box) and US route 90 (which is also named Beach Boulevard). Use the left arrow box to move the mapped area toward the west until the intersection of Beach Boulevard and Veterans Avenue is near the center of the window. Poppo Ferry Road (toward the west) and Pass Road (toward the north) should also be visible.
2. Move the window containing the hybrid map to one side of your desktop. Open a second window, and adjust the size and position of the windows so that both are visible.
3. In the second window, open the Katrina base map index at <http://ngs.woc.noaa.gov/katrina/KATRINA0000.HTM>. Click on the square overlying the location of Biloxi, Mississippi. A

new index map should appear titled “Biloxi, Mississippi Image Index Map.” The green lines on the map indicate major roadways.

4. Use the hybrid map to locate the green lines that correspond to the intersection of Popp's Ferry Road and Pass Road. Just below this intersection you should see a horizontal series of squares that represent individual photographic images. Locate the square that includes the intersection of Beauvoir Road (which is the north-south road to the east of the Popp's Ferry Road intersection) and Beach Boulevard. You may need to zoom in once more on the hybrid map to see the label for Beauvoir Road. Click on the third square to the right of the square containing this intersection. This should open an image titled “24333378.jpg.” If a different image opens, try again until the correct number appears.
5. You now have an aerial photographic image of a portion of the Biloxi shoreline. The left side of the image corresponds to south, the top of the image is west, the right side corresponds to north, and the bottom of the image is east. Position your cursor over the image. The cursor will change to a magnifying glass containing a “+” sign. Click once to zoom in. The viewing window is now located in the upper left corner of the image where only water is visible. Use the scroll buttons to move the window to the right until the shoreline comes into view. Scroll down to scan the shoreline. Do you notice anything unusual along this portion of the beach?
6. Locate Veterans Avenue near the bottom right corner of the image. Follow Veterans Avenue south (toward the left of the image) until the intersection of Veterans Avenue and Beach Boulevard is visible. Describe the apparent condition of the motel at 1865 Beach Boulevard (the northwest corner of the intersection).
7. Use your hybrid map and the Biloxi index map to locate a photographic image that includes the portion of US 90 that crosses Biloxi Bay between Biloxi and Ocean Springs, MS. Describe the condition of this portion of US 90.

8. Use your hybrid map and the Biloxi index map to locate a photographic image that includes the intersection of Front Beach Drive and Martin Avenue in Ocean Springs, MS (note that Front Beach Drive is on the southwestern shore of Ocean Springs, and the Martin Avenue intersection is conspicuous because a long pier extends into the Gulf on the opposite side of Front Beach Drive). Zoom your hybrid map to show the maximum detail at this intersection. Describe the post-Katrina condition of the structures surrounding the two swimming pools to the northwest of the intersection (one swimming pool has a figure-8 shape, and the other has a keyhole shape).
9. Beauvoir, the retirement estate of Confederate President Jefferson Davis, was among many irreplaceable historic sites in Katrina's path. Beauvoir is located at 2244 Beach Boulevard in Biloxi (number 2244 is about halfway between Beauvoir Avenue and Brady Drive). What can you determine from aerial imagery about the estate's condition following the hurricane?
10. Use the Katrina base map index to open an index map for Bay St. Louis, MS (see Step 3), and locate an aerial photographic image that includes bridges to the east of the city connecting to Biloxi along US 90. What is the condition of these bridges?
11. Use the Katrina base map index to open an index map for New Orleans, LA (see Step 3), and create a hybrid map to locate the intersection of Interstate Highway 10 and Orleans Avenue. Use the hybrid map as a guide to locate an aerial photographic image that includes this intersection. Was the on-off ramp at this intersection useable when the image was acquired?
12. The Mississippi River is the major waterbody in the dominant watershed in North America, and drains 41% of the United States. The lower Mississippi River supports a variety of wetland, open-water and floodplain habitats, but has been extensively modified for commercial shipping and other human activities. Because Louisiana is a major oil producing state with abundant crude oil reserves, exten-

sive facilities have been developed to refine, store, and distribute petroleum products and other chemicals. Louisiana has the second highest petroleum refining capacity in the U.S. (after Texas). Many of these facilities are located on the lower Mississippi River or near the coast, and consequently are vulnerable to damage by severe storms. As of September 20, 2005, the National Ocean Service had detected visible sheening (the rainbow colored appearance of oil floating on water) in aerial images of approximately 80 spill sites.

One such spill was reported from a refinery located near Cox Bay. Use an online mapping engine to locate Cox Bay. The aerial image that includes this area is located at <http://ngs.woc.noaa.gov/storms/katrina/24727673.jpg>. Do you see any evidence of sheening in this image? Where? (Note: sheening in these images looks sort of like confetti on the water surface). If you look at a hybrid image of this area, you will see extensive tree cover along the Mississippi River shoreline. What do the aerial images show about the post-Katrina condition of these trees?