



VISUALIZING HURRICANES



NAME:

DATE:

Scientific visualization is an integral part of the process of simulating natural phenomena. In the computational sciences, the main goal is to understand the workings of nature. In order to accomplish this, the scientist proceeds through a number of steps from observing a natural event or phenomenon to analyzing the results of the phenomena. Visual representation of this data is often indispensable in gaining an understanding of the process involved. For this activity, you will be using a scientific visualization tool called REAL (Rapid Estimates of Approaching Landfall), to learn about the effects of storm surge to coastal communities. We will be visualizing a simulated hurricane model through Google Earth.

Download Instructions

Go to the NGCHC/ DISL storm surge website:

Stormsurge.disl.org

Click on the '**Student Resources**' link

If your computer does not have Google Earth, you will need to download this program from the student resource page before starting.

Find and select the "**Natasha vs. Camille**" link.

When the 'Opening REAL Natasha vs. Camille.kmz' dialog box opens, select **OPEN** with Google Earth.

For younger grades, teachers might need to have the program pre-set on the computers.

BEFORE STARTING THE WORKSHEET: Turn off all layers by clicking the boxes EXCEPT those selected in 'My Places' and the 'Primary Database' in the Google Earth REAL Visualization KEY (next page). This will help the program run with greater speed and prevent an overabundance of information in the Google Earth Viewer. Throughout the exercise, you will need to 'turn off' or 'turn on' certain layers in 'My Places'. If the box next to the layer is green, or has a green check mark, the layer is 'on' and showing on the viewer.



Google Earth REAL Visualization

Use this key throughout the activity to answer the questions. Click on the [+] to see more place/layer choices.

Places

- My Places
 - NGCHC 'Natasha' vs 'Camille'
 - BestTrack
 - BestTrack
 - Track Line
 - FstTrack
 - FstTrack
 - Track Line
 - JOS6009D
 - Synthetic Storm Track
 - Synthetic Storm Values
 - Elevation
 - Water Depth
 - Hydrograph
 - TimeSeries of Elev
 - Temporary Places

Layers Earth Gallery >>

- Primary Database
 - Borders and Labels
 - Places
 - Photos
 - Roads
 - 3D Buildings
 - Ocean
 - Weather
 - Gallery
 - Global Awareness
 - More

Path of Hurricane Camille
Best Track = path from storm formation up to 24 hrs prior to landfall
Fst Track = path 24hrs prior to landfall through exiting Alabama

Run of Model Storm 'Natasha'
Storm Track = synthetic path of model storm
Storm Values = central pressure and radius of model storm eye
Elevation = depth of water from mean local sea level: storm surge
Water Depth = water depth above land (inundation)
Hydrograph = predicted water level at NOAA data stations
Time Series = animation of storm surge values as model storm travels its path

Standard Google Earth Layers
 For ease of the exercise, be sure to only select the 'OCEAN' layer and the 'BORDERS and LABELS' layer from the primary database



USING THE REAL VISUALIZATION TOOL IN GOOGLE EARTH, ANSWER THE FOLLOWING QUESTIONS

Hurricane Camille struck the Gulf coast on August 17, 1969. When Camille made landfall near the mouth of the Mississippi River, it was a category 5 storm with sustained winds of 190 mph. While it was an intensely strong storm, it was relatively small in size. Of the 500 models of storms hitting the Mississippi coast, JOS6009D 'Hurricane Model Run Natasha' was found to be the most closely correlated to Camille's historical track 24hrs prior to landfall. However, these tracks vary quite dramatically in their start and conclusion.

Hurricane Camille's **HISTORIC TRACK** is shown by two track lines:

'**Best Track**' is Camille's path up until 24hrs prior to landfall. This path is shown in teal moving into the Gulf of Mexico after passing over Cuba.

'**FST Track**' is Camille's path from 24hrs prior to landfall through the time that Camille reached the Alabama Tennessee state border.

'**JOS6009D**' is the model run of Hurricane Natasha designated by a green track line extending from the Bahamas through to the Mississippi Arkansas state border.

1. Using the image on Google Earth, give the coordinates where the historic track and model track first converge. (TIP: zoom in to get the most accurate coordinates located at the bottom of the screen)

Latitude North:

Longitude West:

2. Give the coordinates of Camille's historic track after landfall, where the Camille and the model track JOS6009D significantly diverge.

Latitude North:

Longitude West:

3. The REAL models are used to look at storm surge and inundation possibilities for the coast. The paths of the model run JOS6009D and Camille's historical track diverge after landfall. Why do you think this model was chosen as the closest 'match'/correlation to the historic track?



Turn off (un-select) the **'Elevation'** layer under **'JOS6009D'**.

Turn on (select) the **'Water Depth'** layer under **'JOS6009D'**.

The **'Water Depth'** layer shows the maximum inundation level during the entire track of the model storm. Inundation for the REAL model is the height of water over land OR still waters such as marshes, rivers and inland lakes.

$$\text{Inundation} = (\text{storm surge} + \text{wave setup} + \text{tide (assumed to be zero)}) - (\text{elevation of land OR still water})$$

8. Looking at the 'Water Depth' layer and the coastline affected by model run JOS6009D, what is the maximum inundation depth predicted by the model?

9. Find Mobile Bay, Alabama on the map.

What inundation depth does the model predict in Mobile Bay during model run JOS6009D?

Where in the bay does inundation occur?

Why do you think the inundation occurs primarily in this location? Explain your answer.

10. Find Bay St. Louis, Mississippi on the map.

Where is Bay St. Louis located in relation to the path of model run JOS6009D?

Is inundation at this location just at the edges of the bay?

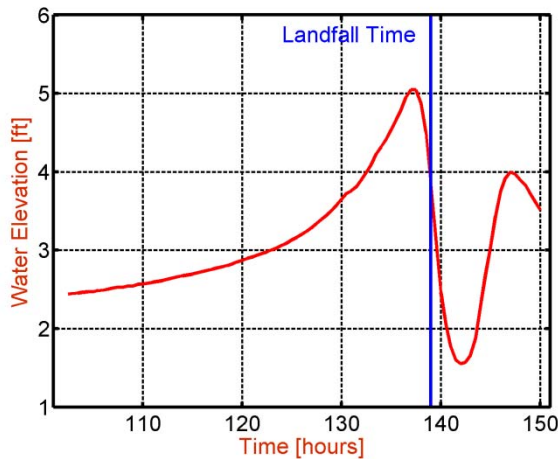
What landforms does the storm surge seem to follow? Why? Explain your answer.



Leave the **'Water Depth'** layer on.

Turn on (select) the **'Hydrograph'** layer under **'JOS6009D'**

The **'Hydrograph'** layer predicts the time and depth of the storm surge at different USGIS tide stations (United States Geological Survey). The stations are marked by bright green squares. When you click on the green station square, a graph will appear showing the change in water depth during the track of the model storm. The passing of the storm is marked by a red landfall line.



This is an example of a hydrograph from the REAL tool. The time since the model hurricane formed is on the x-axis. The water elevation at the specific USGIS tide station is on the y-axis. This shows, in graph form, how the water levels change due to storm surge during the approach and landfall of the hurricane.

11. Select three stations from the map. Give the station name, the hour of storm landfall, the maximum water elevation predicted, and the hour of maximum water depth for each station.

Station Name/Location	Storm Landfall (hour)	Maximum water elevation (ft)	Hour of Max Water Elevation



12. Using the chart in question 11, did the maximum water elevation occur before, during or after the landfall of the model storm at each station? Give an explanation why the maximum storm surge elevation occurred when it did for each station.

Location:

Maximum elevation occurred (BEFORE or AFTER) the model hurricane made landfall.

Why did max surge elevation occur at this time?

Location:

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Location:

Maximum elevation occurred (BEFORE or AFTER) the model hurricane made landfall.

Why did max surge elevation occur at this time?



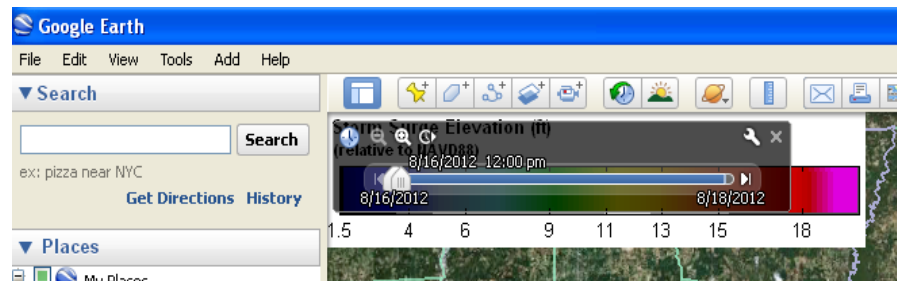
Turn off (un-select) the **'Hydrograph'** layer under **'JOS6009D'**.

Turn off (un-select) the **'Water Depth'** layer under **'JOS6009D'**.

Turn on (select) the **'Time Series of Elevation'** layer under **'JOS6009D'**

NOTE: Depending on the speed of your computer, this layer might not function properly. You can still answer questions 13 and 14.

The 'Time Series of Elevation' layer shows a time lapse of the model storm 'Natasha' as it approaches shore. By hovering over the Elevation Color Key on the top left of the Google Earth viewer, a 'Play Bar' will appear: this allows you to watch the changes of the storm surge as the model storm follows the path. Click on the clock with the triangle to start the animation. (4th symbol in the gray box.)



Watch the time series of the model storm as it approaches shore between 8/16/2012 12:00pm and 8/18/2012 12:00pm. Do this at least 2-3 times. (If you are having trouble viewing the animation, make sure all other browsers and unnecessary programs are closed)

13. Thinking about the uses of the REAL Storm Surge Visualization Tool, who might benefit the most from the predictions of this program?

14. What are 3 advantages of the REAL Storm Surge Visualization Tool for coastal communities? What are three disadvantages of this tool for coastal communities?