# Earth 107: Module 4 Lab

Important! We advise you to either print or download/save this document as it contains the steps you need to take to complete the Lab in Google Earth. In addition, it contains prompts for questions that you should take note of (by writing down or typing in) as you work through the Lab.

Once you have worked through all of the steps and answered the questions, you will go to the **Module 4 Lab** **in Canvas** to complete the Lab by answering multiple-choice questions available in quiz format. The answers to questions on this Lab worksheet will match choices in the multiple-choice questions in Canvas. Submit the quiz in Canvas for credit.

## Module 4 Lab Overview

There are two parts to this Lab.

* Part I is Analyzing Sea Level Change Using Tide Gauge Data. You will download the tide gauge data using the PSMSL site on the course web site: Module 4 Lab page. Use the tide gauge data to answer questions 1-14.
* Part II is the NOAA Sea Level Rise Viewer. After spending time exploring and figuring out how to manipulate the viewer to give you the information for projected sea levels at the location of interest for different years, use the viewer to answer questions 15 -20.

### Part I: Analyzing Sea Level Change Using Tide Gauge Data

**Procedure**

*(Note: you were prompted to download the tide gauge data using the PSMSL site on the course web site: Module 4 Lab page.)*

### Boston (Example directions)

1. First, go to your Temporary Places and click on “2016 or after” folder. This will open a list of tide gauges with green buttons beside each. Scroll down the list to find Boston on the list of tide gauges (a little less than half way down). Click on the green button and you will zoom in to Boston.
2. Click on the green dot that indicates the tide gauge in Boston. A box will open for navigating to the PSMSL data for this gauge (# 235). Click on the number and this will take you to the data for Boston on the PSMSL site. This site may open in your default browser.
3. Note the details of the Boston Data given on this page. The data cover the time period 1921 – 2016. They are 99% complete. Therefore, these are valuable data for seeing trends in sea level change.
4. Scroll down and click on the link to open a “larger image of annual data plot” version of the data plot for annual data (bottom of two plots). You will answer questions about this plot in the lab on Canvas (see questions below).
5. Now go back to the site and click on “download annual mean sea level data” This will give you a string of values in 4 columns. The left-hand column is the year. The next column to the right is the sea level in millimeters. The other two columns are not relevant to our task.
6. Calculate the change in sea level from 1921 to 2016. Find the rate per year using this value.
7. Using the data, answer questions 1 - 4.

***Boston***

##### Questions 1-4

1. The best description of the Boston data plot is:
2. Use the difference in sea level between 1921 and 2016 to calculate the rate per year in mm/yr. What is the closest value?
3. In Standard U.S. units (ft.), the change in sea level in 95 years is close to:
4. What is the change in sea level in the first 5 years of data for Boston (1921-1926)?

***San Francisco***

1. Repeat steps 2 -5 for the San Francisco tide gauge and answer questions 5-8.

##### Questions 5-8

1. The best description of the San Francisco data plot is:

1. Use the difference in sea level between 1855 and 2016 to calculate the rate per year in mm/yr. What is the closest value?
2. What is the change in sea level in the years 1921-1926 of data for San Francisco?
3. What is the change in sea level in the first 5 years of data for San Francisco (1855-1860)?

***Grand Isle, LA***

1. Repeat steps 2 -5 for the Grand Isle, LA tide gauge and answer questions 9-10.

##### Questions 9-10

1. The best description of the Grand Isle, LA data plot is:
2. Use the difference in sea level between 1947 and 2016 to calculate the rate per year in mm/yr. What is the closest value?

***Galveston, TX***

1. Repeat steps 2 -5 for Galveston, TX tide gauge.
2. Answer questions 11. And 12. to compare the data between sites.

##### Questions 11-12

1. Which of the four cities we have looked at experience the greatest rate of sea level rise per year?
2. Which of the following would best explain the differences in observed rates of sea level rise?

### Part II: NOAA Sea Level Rise Viewer

In Part II of this Lab, you will use the NOAA Sea Level Rise Viewer to help you visualize what these levels would look like in particular locations around the U.S. You will keep your calculated rates in mind for each place from Part I as you work with the viewer and consider the factors that influence the future projections of increased sea level rise.

**Procedure**

Note: The NOAA Sea Level Rise Viewer seems to work better in Chrome than in other browsers. You may want to try it in your favorite browser and compare to Chrome to decide which to use. After exploring each location, we recommend you close the viewer and re-open in a new window before going to a new location.

1. Go to the NOAA Sea Level Rise Viewer. *(Note: link on the Module 4 Lab page on the course web site).* The viewer allows you to perform a variety of actions to visualize what sea level rise actually means to a particular location at a particular time in the future, using the five GMSL rise scenarios of Intermediate-Low, Intermediate, Intermediate-High, High and Extreme. It allows you to manipulate the sea level in 0.3 m (~1 ft.) increments.
2. Let’s start in Boston to explore the viewer. To quickly arrive there, type in the name of the city in the search bar at the top of the page. Set the units to meters before you begin. On the left side of the screen are themes by which we can explore sea level rise in our places of interest. We will use the Sea Level Rise button and the Local Scenarios button for this exercise.
3. Begin by clicking on the Sea Level Rise Button and explore how increasing the sea level with the slider causes low lying areas to show as inundated.
4. Next, click on the yellow Local Scenarios icon, go to the Information (i) button below the left-hand list to read important information and directions or using the local scenarios data. Also click the (?) button to the top right of the left hand-pane. This provides simple directions for choosing a scenario location and gives a link tutorial provided for using the Local Scenarios.
5. After spending time exploring and figuring out how to manipulate the viewer to give you the information for projected sea levels at the location of interest for different years, use the viewer to answer questions 13-17.

##### Questions 13-14

1. At the HIGH sea level rise scenario for BOSTON, what is the projected sea level rise for 2040 and 2100 respectively?
2. Starting with the “view by Scenario” turned on; what are the sea level rise projections at the “HIGH” level for San Francisco for 2040 and 2100 respectively?

***Boston***

With the sea level rise viewer set on a scenario of 1.5 m sea level rise and the Local Scenario set on View By Scenario and the HIGH sea level rise scenario, observe the areas in Boston that would be inundated at 1.5 m rise, and answer the following questions.

***San Francisco***

After completing your exploration of Boston, close the viewer and re-open before navigating to your next location: San Francisco.

##### Questions 13 - 14

1. At the HIGH sea level rise scenario for San Francisco, what is the projected sea level rise for 2040 and 2100 respectively?
2. Starting with the “view by Scenario” turned on; what are the sea level rise projections at the “HIGH” level for San Francisco for 2040 and 2100 respectively?

***Grand Isle, LA***

After completing your exploration of San Francisco, close the viewer and re-open before navigating to your next location: Grand Isle, LA.

##### Questions 15 – 16.

1. Starting with the “view by Scenario” turned on; what are the sea level rise projections at the “HIGH” level for Grand Isle for 2040 and 2100 respectively?
2. What time frame would Grand Isle be completely inundated, according to the sea level rise projection viewer (all land area – except for the thin gray line representing the levee - turned to blue)?

***Galveston, TX***

After completing your exploration of Grand Isle, close the viewer and re-open before navigating to your next location: Galveston, TX.

##### Question 17.

1. Now you should be proficient with manipulating the viewer. Using the Sea Level Rise and Local Scenario measures, find the sea level rise level at which the landmark – Galveston Airport is inundated and by what year this is projected to occur