

# Investigating Future Worlds with Google Earth (Part 2) Teacher Guide

## Driving Question: How will predicted sea level rise affect our coastal environments?

In this activity, students will use Google Earth to explore future climate scenarios that may happen by the year 2100. Students will...

1. Use the Google Earth elevation profile tool to understand the effects of sea level rise in 5 low lying coastal areas.
2. Use Google Earth to explore changes in sea level in the Chesapeake Bay region.
3. Understand that climate change will continue to affect our planet into the future.



### Background Information

Scientists investigate past climates to understand what may happen in the future. We cannot predict exactly what will actually happen in the future, but scientists have developed several likely future climate scenarios from computer models that are based on past changes of global temperature and carbon dioxide concentrations. These two factors play an important role in ice/glacier melting that ultimately affects sea level rise. The Intergovernmental Panel on Climate Change (IPCC) outlines the future scenarios in their Fourth Assessment Report (AR4) report. The data in this activity focuses on the IPCC's worst case scenario of future climate projections in which sea levels could rise up to 2 meters by the year 2100. It is important to note that although this is the IPCC's worst case scenario, critics of the AR4 report suggest that many of IPCC's analyses are underestimates of both rates and magnitudes. Critics say that sea levels could rise in excess of 2 meters because the land is rising at the shore due to plate tectonic processes and the slow rebound of the crust as the weight of Pleistocene glaciers is removed.

Model the following procedural instructions with your students. It is recommended that you display your computer image at the front of the classroom.



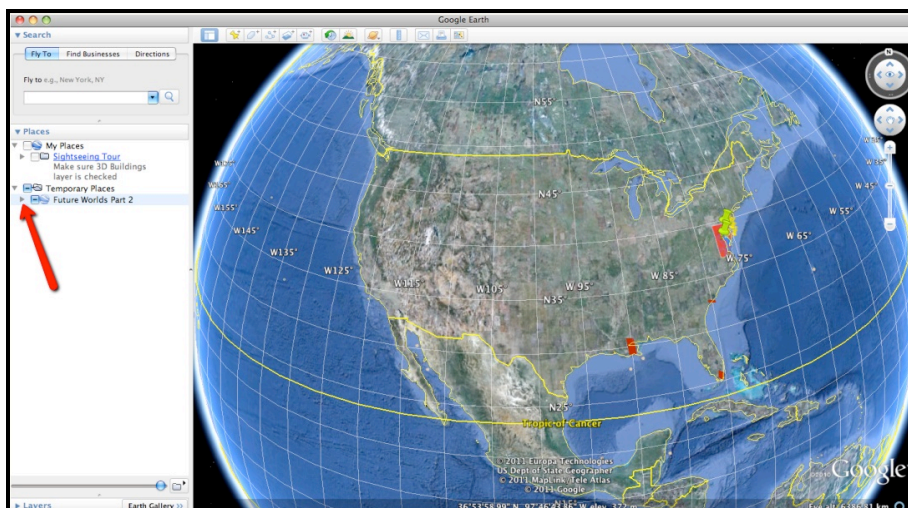
### Step 1: Download Data

- a. Open your Web browser. Go to **[www.ei.lehigh.edu/learners/cc/](http://www.ei.lehigh.edu/learners/cc/)**.
- b. Under Future Worlds, click on **Future Worlds Part2.kmz**.

The file is displayed in Google Earth.

Note: If the file download does not automatically launch Google Earth, double-click on the downloaded file **futureworldspart2.kmz** to launch Google Earth.

- c. Click the arrow to the left of “**Future Worlds Part 2**” in the left panel (see red arrow below).



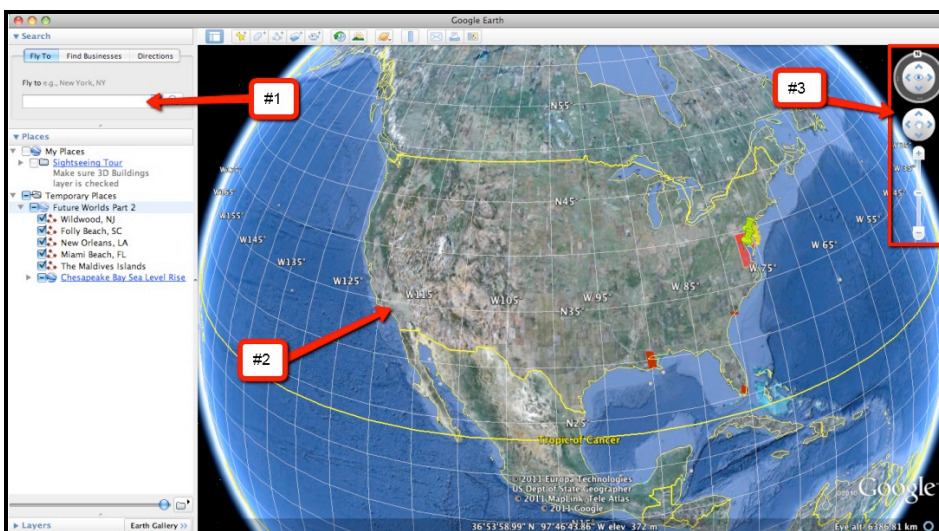
d. The “Future Worlds Part 2” drop-down list will extend (see below). If you cannot see the whole list, scroll down.



## Step 2: Basic Features of Google Earth

Note the following Google Earth features, tools, and navigation controls in the figure below.

1. **Search Panel** (arrow #1) – Type in the white box to find a location.
2. **3-dimensional (3D) Viewer** (arrow #2) – This window shows the Earth and its terrain.
3. **Navigation Controls** (arrow #3) – Use these controls to zoom, look, and move around. If the navigation controls are not visible, click on View>Show Navigation>Always.



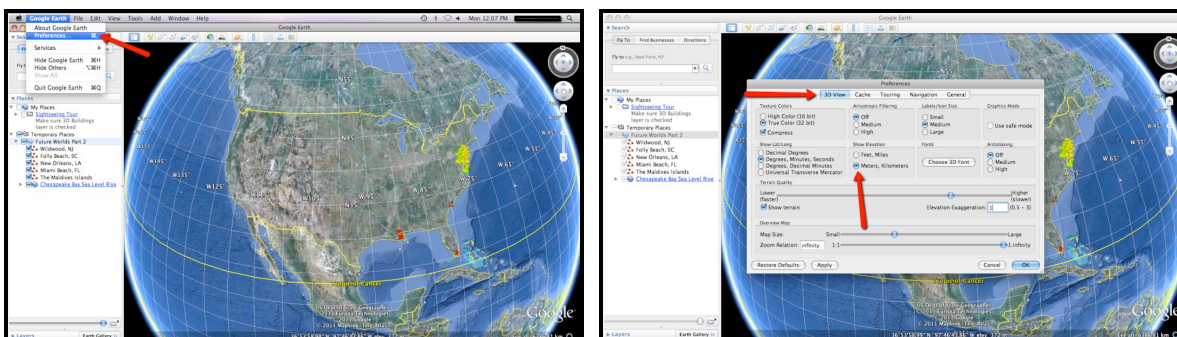
## Step 3: Elevation Profile Tool

The elevation profile tool is a unique feature that was first introduced in Google Earth Version 6. Below are instructions on how to use the elevation profile tool. It is best if you show your students an example of how the elevation profile tool works before they begin the activity.

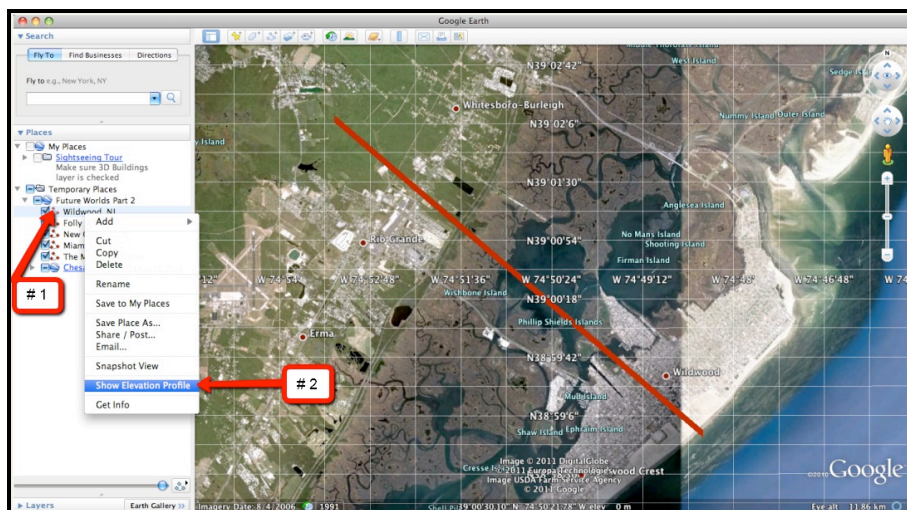
**Note:** Before beginning this activity, make sure that Google Earth is set to metric units. To do this on a Macintosh computer, select **Preferences** from the Google Earth drop-down menu bar. Click the **3D View** tab as shown in the image below. In the dialogue box under **Show Elevation**, select the check box next to **Meters, Kilometers**. Then click **OK**.

To set metric units on a PC computer, go to the **Tools** menu bar and select **Options**. Then follow instructions above for the 3D View tab.

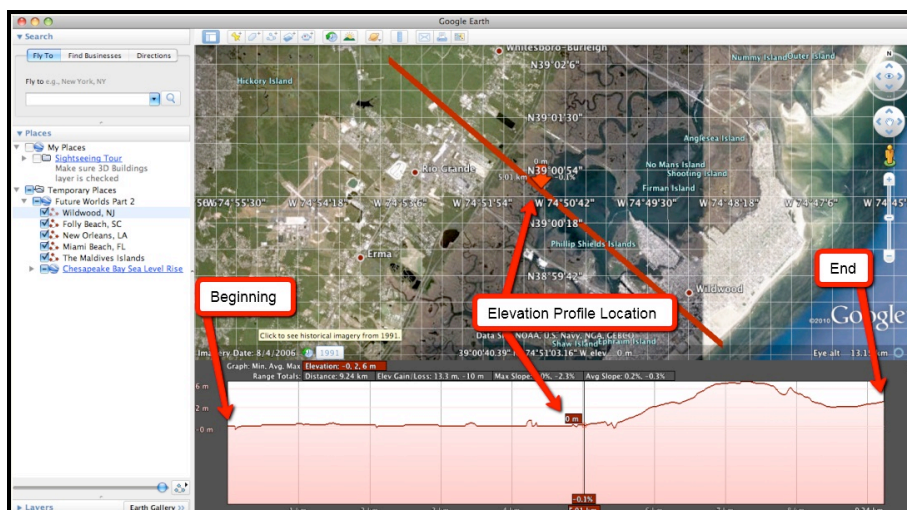




1. The elevation profile is part of the path tool. Students can draw their own paths in Google Earth to analyze. In this investigation, 5 sites have been preselected to clearly illustrate the effects of sea level rise on coastal land areas.
2. In the **Places** window, navigate to Wildwood, NJ. Click the check box to display the red-lined path (#1). **Ctrl + mouse click** (Mac) or **right click** (PC) on the path name in the Places toolbar to display the drop-down menu as shown in the image below. In the drop-down menu, select **Show Elevation Profile** (#2).



A box will open along the bottom of the screen that shows the elevation profile of the red line that is displayed in Google Earth. This can be observed in the image below.



- As can be seen above, the elevation is shown for the entire red line path. The Y-axis of the graph displays the elevation and the X-axis of the graph displays the distance. When you move the cursor through the various parts of the Elevation Profile, the arrow in the Google Earth viewer moves along your path and displays the elevation (left side of arrow) and the cumulative distance (above the arrow). This data is also displayed in the Elevation Profile graph. You can drag your mouse along the profile as shown in the image above. A red arrow depicts your exact location along the profile path in the Google Earth viewer.
- During this investigation, students should observe changes in land elevation in the profile as the red line moves further away from the 0 meter sea level position at the coastline.



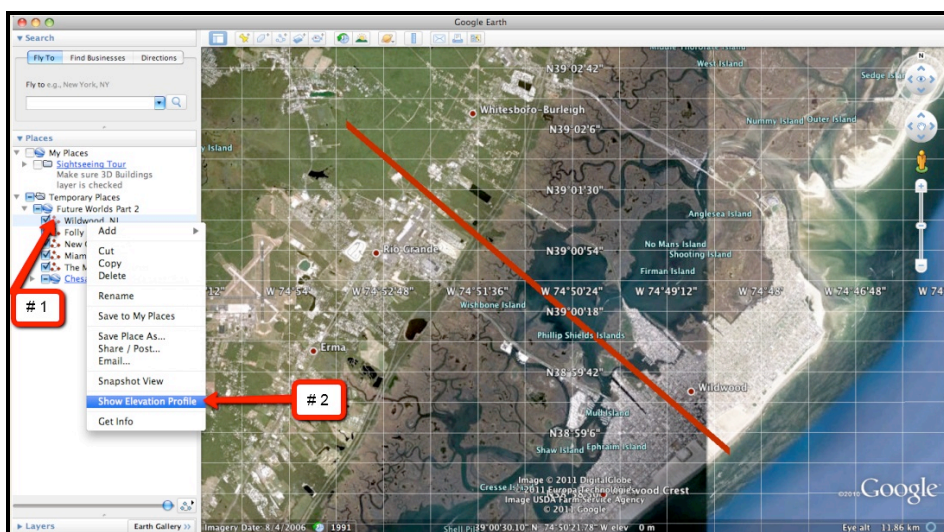
#### Step 4: Future Worlds Part 2 Investigation

Your students will explore the effects of a 2 meter rise in sea level on the existing landscape over the next 100 years. This investigation will help them to understand how changes in climate over the next 100 years could alter our coastal areas the future.



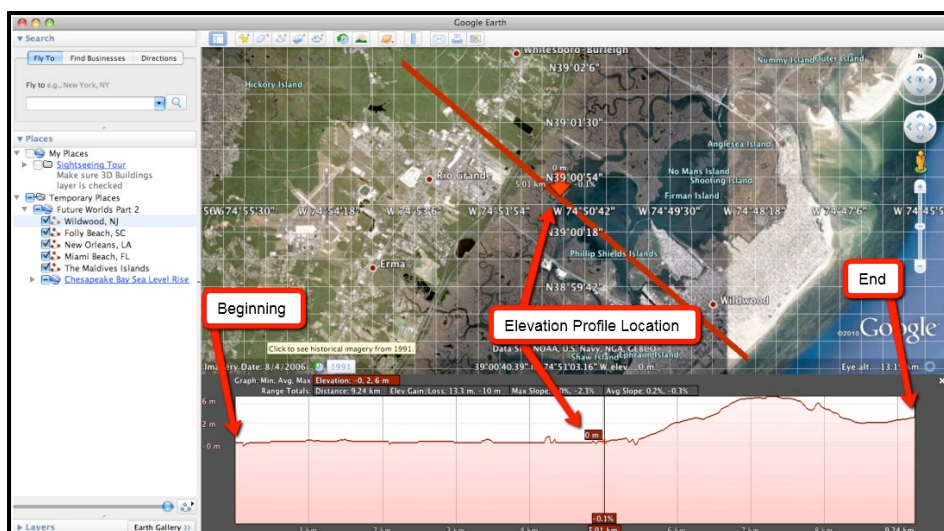
Distribute the **Investigating Future Worlds with Google Earth (Part 2) Student Guide** and **Investigation Sheet** to each student. Instruct students to follow the directions outlined in their investigation guide.

- Begin the investigation with **Wildwood, NJ**. Navigate to the Wildwood, NJ path by double-clicking on **Wildwood, NJ** in the Places window. Click the check box to display the red-lined path. Press Ctrl+mouse click (Mac) or right click on a PC over the Wildwood, NJ name. In the menu that opens, select **Show Elevation Profile**.





- Instruct students to observe the elevation profile drawn across Wildwood, NJ. The red arrow on the map indicates the location in the profile as shown in the image below.



- Assuming that sea level is going to rise 2 meters in the next 100 years, the students should determine the maximum distance inland that the water will travel. Instruct students to determine the furthest distance inland in kilometers (km) that the water would travel if there were a 2 meter rise in sea level. Instruct students to record this distance in the data table on their **Student Investigation Sheet**. Instruct students to use Google Earth to determine the type of land cover that this water will cover and record this information on their data table. This may include farmland area, residential area (houses), or marsh areas (low-lying vegetated areas located in coastal areas that are often affected by tides). More than one landscape can be recorded below in the data table. Students may need to zoom in to the landscape with Google Earth to observe the land use type.

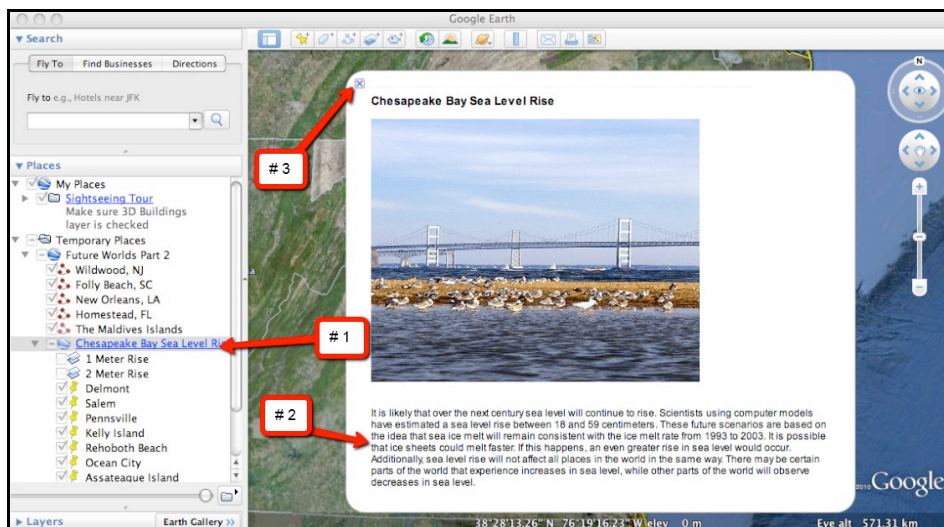
**Implementation Suggestion:** Some students may not be familiar with how to interpret land cover areas using Google Earth. You may wish to explicitly model how to interpret a farmland area, a residential area, and a marsh area in Google Earth.

- When finished, students should close the elevation profile box by selecting the “x” in the corner of the Elevation Profile.

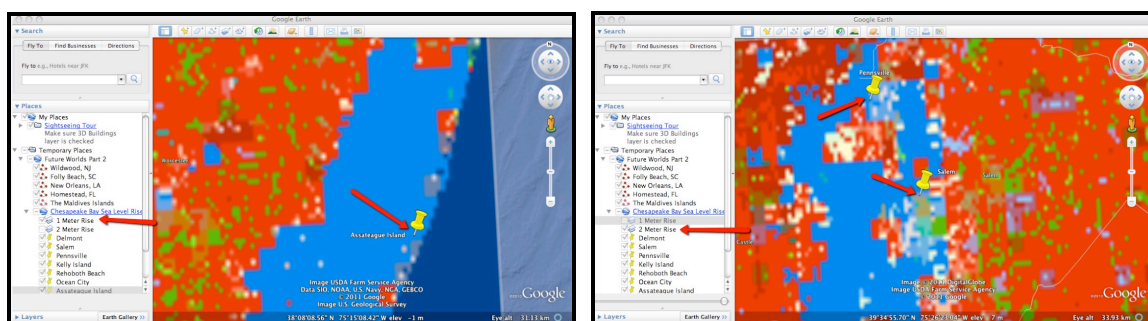
**Implementation Suggestion:** You may wish to highlight to students that they should locate the first point inland from the shoreline that is 2 meters in elevation. Note to students that if sea level were to rise to a 2-meter level, all the land from the shoreline to that 2-meter elevation location would be under water from rising sea level.

- The students should then navigate to the four other path line locations in Google Earth (Folly Beach, SC; New Orleans, LA; Homestead, FL area; and the Maldives Islands). Similar to the Wildwood, NJ location, they should determine the furthest distance inland in kilometers (km) that the water would travel if there were a 2 meter rise in sea level and determine the type of land cover that would be affected. Instruct students to record this data in the data table on their **Student Investigation Sheet**.
- Instruct students to answer **analysis questions # 1-2** on their Student Investigation Sheet.

- Next, instruct students to navigate to the Chesapeake Bay by double clicking on Chesapeake Bay Sea Level Rise in the Places window (# 1). Students should read the associated text (# 2). When finished, they should select the “x” in the upper corner (# 3) of the box.



- Tell students that they will navigate to 13 different cities in the Chesapeake Bay watershed to determine which cities will succumb to sea level rise in the event that it rises 1 meter or 2 meters. Students can navigate to **each city by double-clicking** on the city name or using the navigation tools to observe that city.
- In the two Chesapeake Bay sea level rise layers, the color blue indicates water. All other colors indicate a form of land.
- Once at a specific city or island location, students should activate the **1 Meter Rise** layer by selecting the check box next to that layer to see if that city would be under the water if sea level were to rise 1 meter. The students should then uncheck the 1 Meter Rise layer and activate the **2 Meter Rise** layer. In this manner, they can navigate to each location and toggle back and forth between the 1 meter and 2 meter rise layers to see which scenario would impact a particular location. A city or island is considered underwater if it is mostly covered by blue color. An example of a city or island that sinks underwater during a 1 Meter Rise scenario can be found in the image below on the left. An example of a city that sinks underwater during a 2 Meter Rise scenario can be found in the image below on the right.



- Instruct students to record in the data chart on their **Investigation Sheet** which Sea Level Rise Scenario (1 Meter Rise or 2 Meter Rise) would place a location under water.
- Instruct students to answer **analysis questions # 3-6** on their **Investigation Sheet**.