

Investigating Future Worlds with Google Earth (Part 1) Teacher Guide

In this activity, students will use Google Earth to explore evidence of climate change during 1980 - 2010. Students will...

1. Use Google Earth to explore changes in Arctic Sea ice extent over a recent 30-year period.
2. Use Google Earth to explore changes in the distribution of coral reefs in the Caribbean Sea.
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.



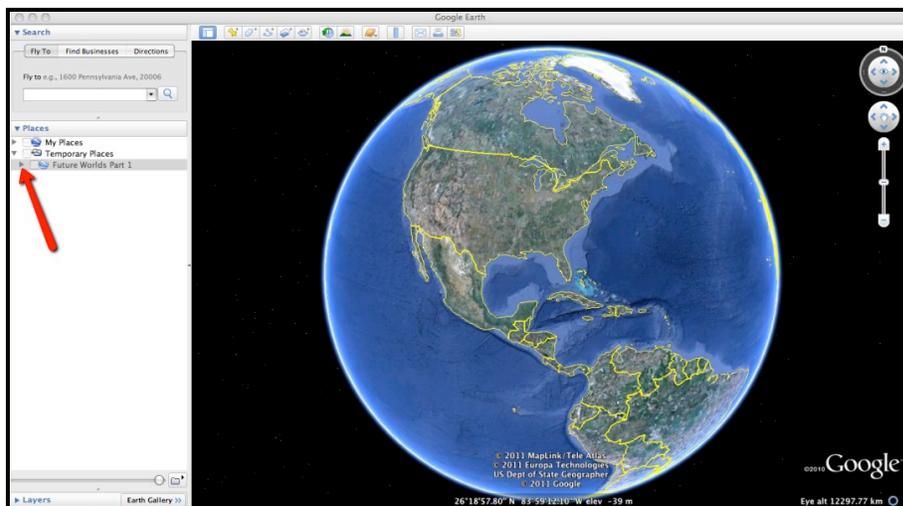
Step 1: Download Data

- a. Open your Web browser. Go to www.ei.lehigh.edu/learners/cc/.
- b. Under Future Worlds, click on **Google Earth file: Future Worlds Part1.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 **futureworldspart1.kmz** to launch Google Earth.

- c. Click the arrow to the left of "**Future Worlds Part 1**" in the left panel (see red arrow below).



d. The “Future Worlds Part 1” drop-down list will extend (see below). If you cannot see the whole list, scroll down.



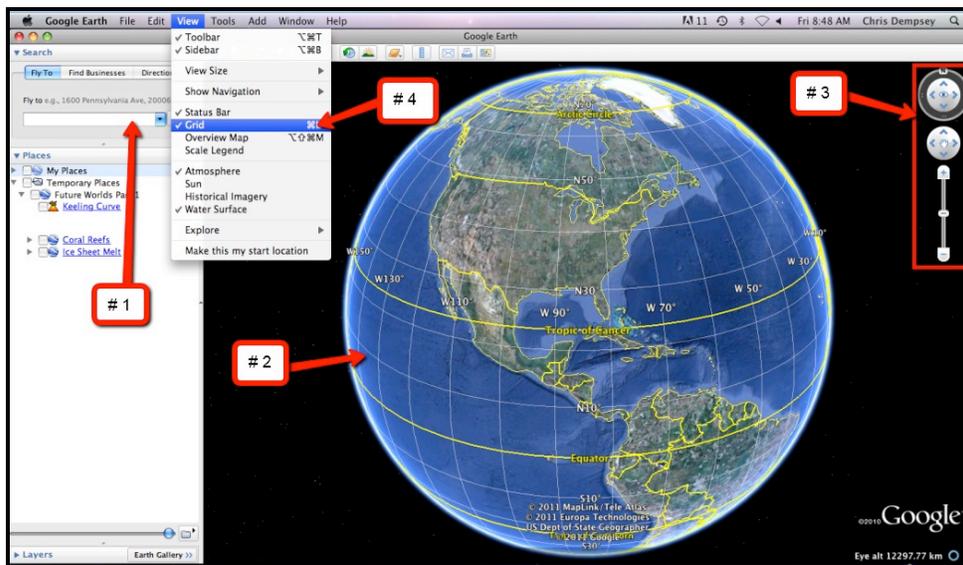
Step 2: Basic Features of Google Earth

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.



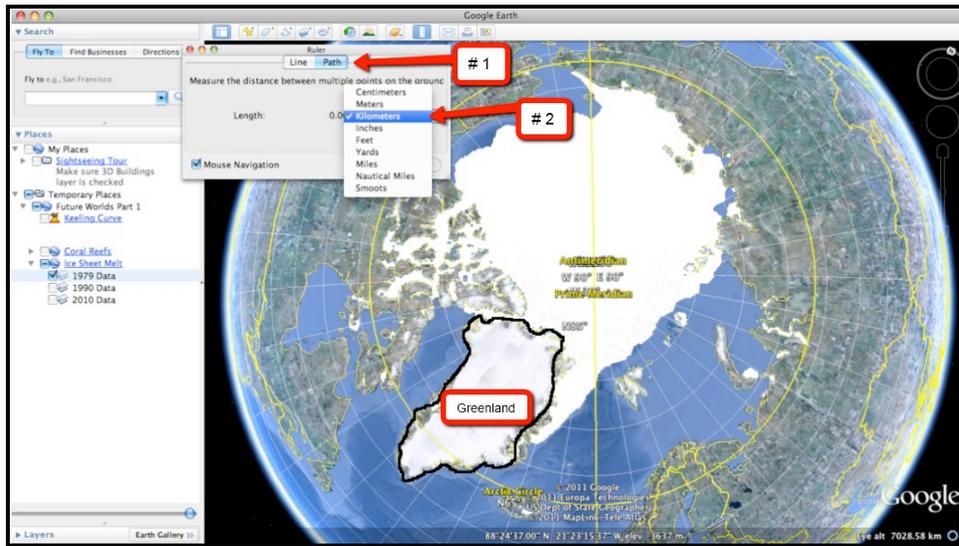
Instruct the students to turn on the Google Earth Gridlines if they are not activated. Select “View” and then “Grid” as shown below (#4).



Step 3: Google Earth Measuring Tool

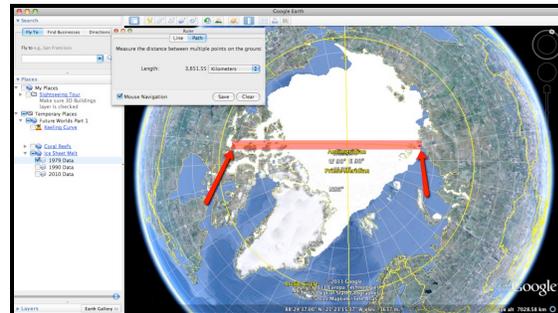
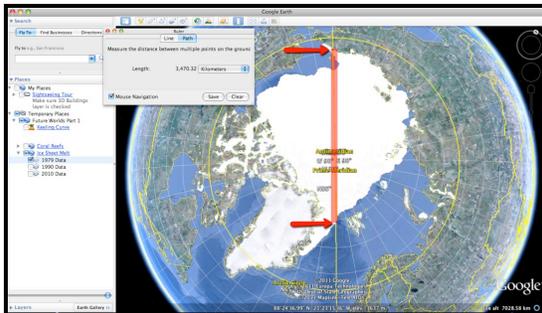
1. Students will need to become familiar with the measuring tool in Google Earth for this activity. It is recommended that you model how to use the **Ruler Tool** when students complete the **Ice Sheet Melt** measurements below.
2. Click on the **Ruler tool**  on the tools menu at the top of the screen. The ruler dialog box appears (see below). If the dialog box covers up the ice sheet, move it to a different area on your screen.

3. Click on **Path** (arrow #1 below). Click on the drop-down arrow (arrow #2 below) and select **Kilometers** if it is not already selected.



NOTE: We recommend that you explicitly explain to students how to measure the area of the ice sheet. The students should measure the continuous ice sheet displayed in the Google Earth viewer. **The students should NOT include Greenland in their area measurements.** This is shown in the picture above. They do not need to take into account the ice islands that are found in the 1990 and 2010 images.

4. The continuous ice sheet area should be measured in a manner similar to that shown in the images below. Be sure to emphasize to your students the importance of being consistent in how they measure the continuous ice sheet. Be sure that the gridlines are activated in order to follow the instructions below.
- Students should use the Ruler tool to determine the length of the ice sheet. Instruct students to measure the length of the continuous ice sheet at the **Prime Meridian**.
 - Have the students record their measured length in the data table on their **Student Investigation Sheet**.
 - Next, students should use the Ruler tool to draw a line that is perpendicular to the **Prime Meridian** along the middle of the continuous ice sheet as shown below.
 - Have the students record their measured width in the data table on their **Student Investigation Sheet**.



5. The area of the continuous ice sheet can be calculated by multiplying the length and the width together. Students should record their final area of the continuous ice sheet in the provided space in the data table on the **Student Investigation Sheet**.



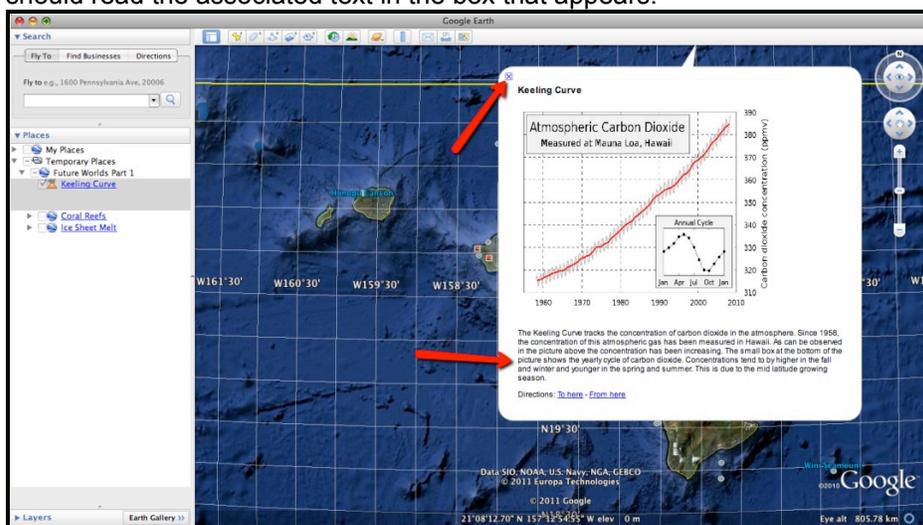
Step 4: Future Worlds Part 1 Activity

Your students will explore climate change during the last four decades. This investigation will help them to understand how changes in climate over the next 100 years could affect their future.

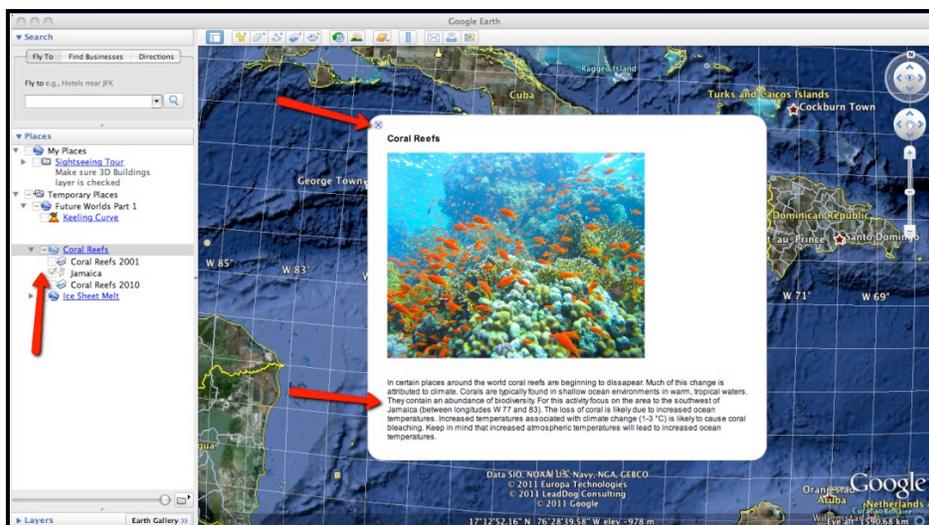


Distribute the **Investigating Future Worlds with Google Earth (Part 1) Student Guide** and **Investigation Sheet** to each student. Instruct students to follow the directions outlined in their guide.

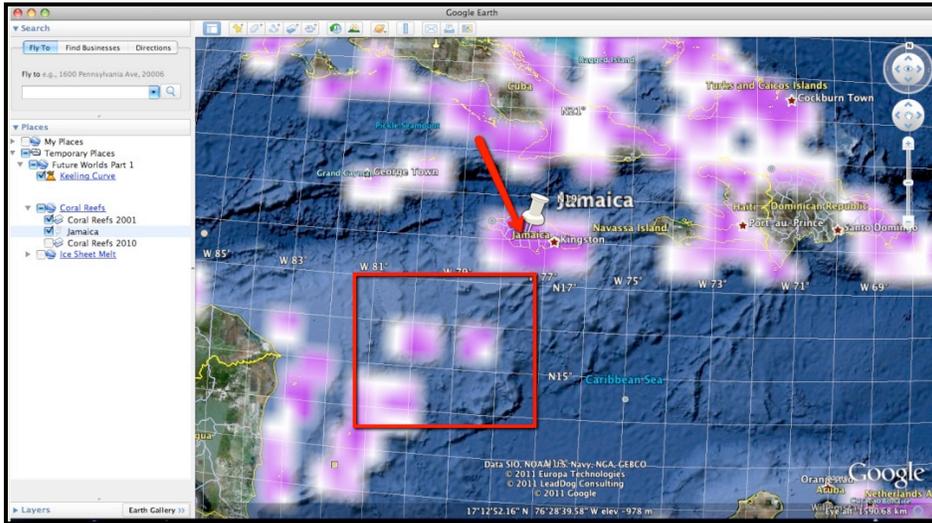
1. In the Google Earth drop down menu, students should check the **Keeling Curve** box in the Places window and double click the Keeling Curve underlined text to display the image shown below. They should read the associated text in the box that appears.



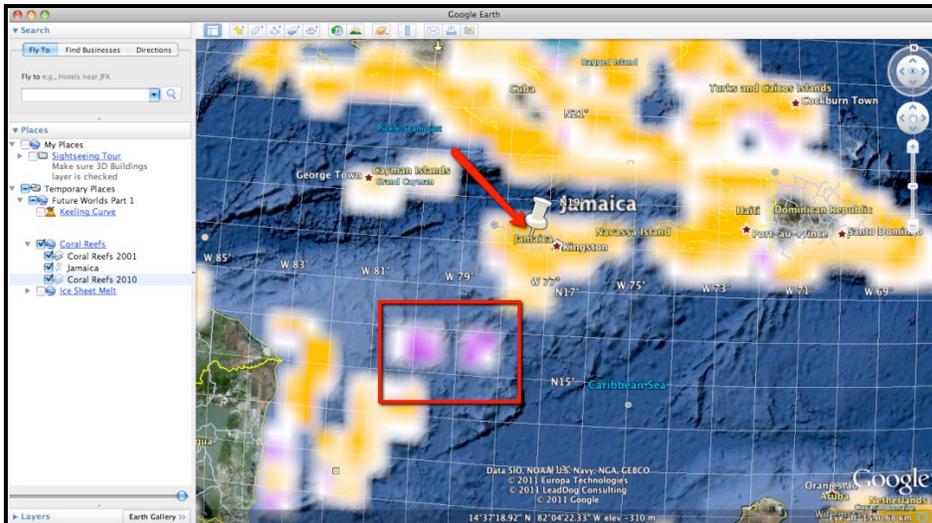
2. Instruct students to answer analysis **questions # 1-2** on their **Student Investigation Sheet**. When finished, students should close the box by selecting the “x” at the top of the box.
3. Next, students should navigate to **Coral Reefs**. Instruct students to double click the **Coral Reefs** underlined text in the Places window to display the image shown below. Instruct students to read the associated text as shown below. When finished, students should close the box by selecting the “x” at the top of the box.



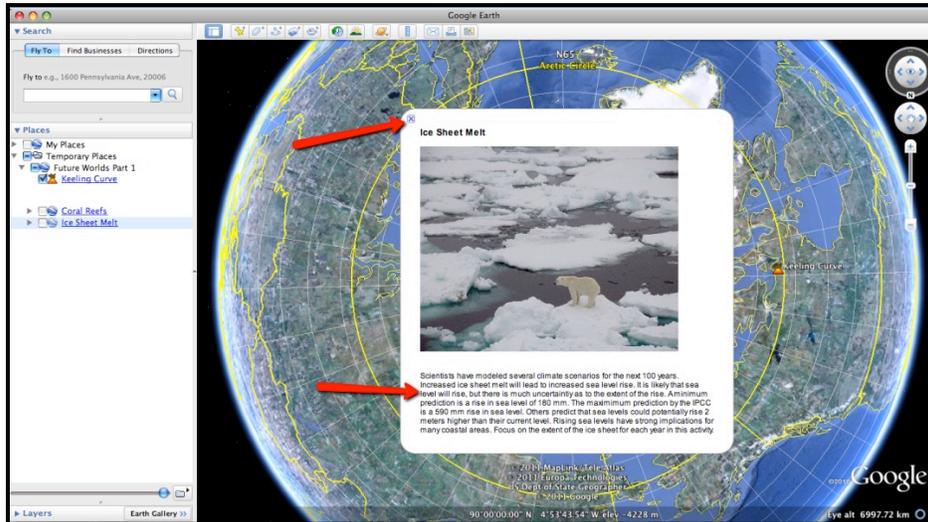
4. Instruct students to display the **Coral Reefs 2001** layer and the **Jamaica** layer as shown below. These layers are displayed by checking the box to the left of each layer. The students should pay particular attention to the area between longitude W 77° and 83°.



5. Instruct students to observe the locations where coral reefs were present in 2001. These are indicated by the purple color on the screen. The students should then activate the **Coral Reefs 2010** layer to observe where coral reefs were found in 2010. This is indicated by the yellow color. The students should focus on the area to the southwest of Jamaica. This is one location where coral reefs were present in 2001, but are not found anymore in 2010. For reference, please see the image below.



6. Students should answer analysis question # 3 on their **Student Investigation Sheet**.
7. Instruct students to double click the **Ice Sheet Melt** underlined text in the Places window to display the image shown below. Instruct students to read the associated text as shown below. When finished, students should close the box by selecting the "x" at the top of the box.



The students should then proceed to observe the ice layers in order from **1979, 1990, and 2010** by selecting each yearly data layer. If a layer does not immediately appear, uncheck the active box and then re-check the box.

- ▼  **Ice Sheet Melt**
-  **1979 Data**
-  **1990 Data**
-  **2010 Data**

Instruct students to measure the length and width of each ice layer as described in Step 3: Google Earth Measuring Tool section above. Emphasize to students that they are to measure the continuous ice sheet displayed in the Google Earth viewer. **The students should NOT include Greenland in their area measurements.** They do not need to take into account the ice islands that are found in the 1990 and 2010 images.

Instruct students to measure the length of the continuous ice sheet at the **Prime Meridian**. Have the students record their measured length in the data table for analysis question **#4** on their **Student Investigation Sheet**. Next, students should use the Ruler tool to draw a line that is perpendicular to the **Prime Meridian** along the middle of the continuous ice sheet to measure the width. Instruct students to record their measured width in the data table on their **Student Investigation Sheet**. Tell students they should be consistent with measuring the width of the ice layer in the same location for each of the three time periods.

8. Students should answer analysis questions **#4-6** on their **Student Investigation Sheet**.