



Measuring Earth with GPS, Unit 3: Glaciers

Activity 2 Student Exercise: Animation Questions

Karen M. Kortz (Community College of Rhode Island) and Jessica J. Smay (San Jose City College)
Modified from Ice Mass & Sea Level, Unit 4: Animation Questions by Becca Walker and Leigh Stearns

In this activity, you will watch an animation that illustrates how GPS can be used to determine the amount of ice in a glacier. It describes the relationship between changing glacier mass and vertical bedrock motion.

Part 1: Animation

Watch the animation titled, *Glaciers are Retreating: How can we measure the full ice loss? An example from the Greenland Ice Sheet*. Watch the entire animation first, and then watch it a second time to answer the questions below.

1. When scientists want to measure vertical motion relative to a particular glacier, where do they install GPS units?

On the glacier ice On the bedrock next to the glacier

2. Circle the two phrases that describe how ice sheets flow in Greenland.

uphill downhill toward the ocean toward the mountains

3. What causes ice in a glacier to flow?

gravity crevasses fjords grounding line

4. Where does ice go when it leaves the glacier?

crevasses ocean snow

5. What happens to the bedrock's vertical surface when glacial mass is added to the ground?

It goes down. It goes up.

6. What happens to the bedrock's vertical surface when glacial mass is removed?

It goes down. It goes up.

7. Circle the two factors that cause the bedrock to move vertically.

amount of glacial ice amount of snow amount of clouds

8. How does the vertical movement of a GPS receiver change during winter and why?
It goes _____ (up / down) because _____.
9. How does the vertical movement of a GPS receiver changes during summer and why?
It goes _____ (up / down) because _____.
10. Which of the following statements about elastic adjustment and snow accumulation is true?
- a. The thickness of the snow that accumulates in winter is much less than the distance the bedrock moves in winter.
 - b. The thickness of the snow that accumulates in winter is much more than the distance the bedrock moves in winter.
 - c. The thickness of the snow that accumulates in winter is about the same as the distance the bedrock moves in winter.
11. Referring to the graph at the upper right-hand corner of the animation screen, what is shown on each axis?
- X-axis: _____
- Y-axis: _____
12. How did each of the following change for Helheim Glacier between 2004 and 2011, as shown in the animation?
- Helheim Glacier's thickness: became thinner became thicker
- the elevation of the bedrock surface next to Helheim Glacier: went up went down
- by how much? _____ mm
- the amount of ice being added to the ocean: increased decreased
13. Summarize what causes the yearly sawtooth pattern of bedrock vertical motion.
14. Summarize what causes the long-term trend of increased bedrock elevation.
15. Is the phenomenon illustrated in this animation unique to Helheim Glacier? Yes No