



## Measuring Earth with GPS, Unit 3: Glaciers Additional Assessment Questions

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*Below are additional summative assessment questions, beyond those in the three activities.*

### Example #1: Assess Parts 1, 3 (Module Goal 1; Unit Learning Outcomes 1, 2)

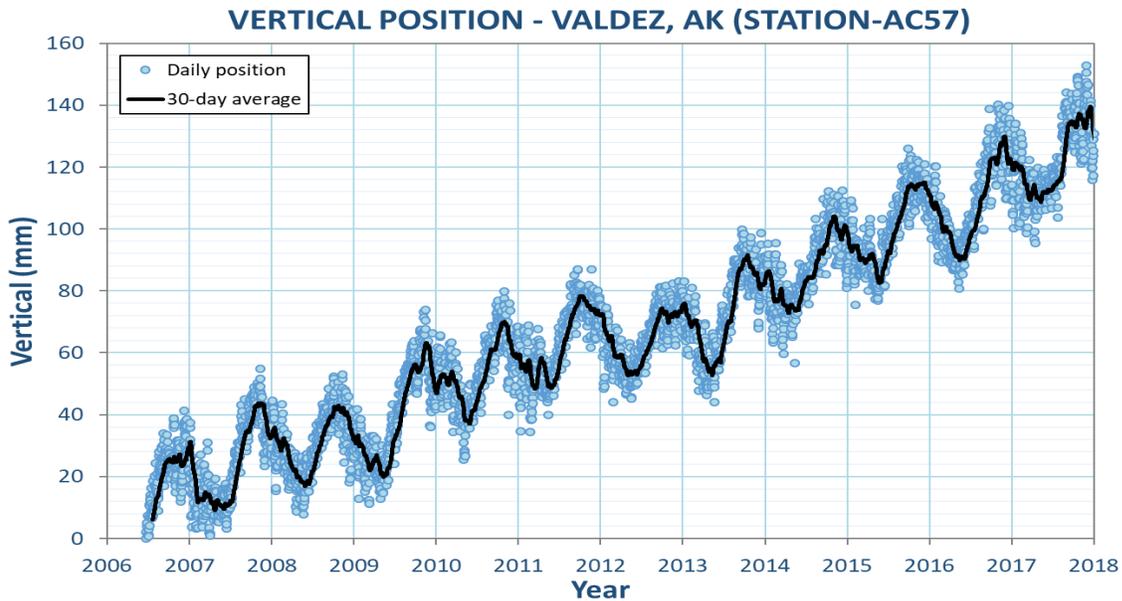


Figure 1. Vertical GPS data from station AC57 in Alaska from the beginning of January 2006 to the end of December 2017.

Write a summary sentence describing the vertical bedrock movement near the glacier that combines (a) the timing (month) of the high point; (b) the timing (month) of the low point; and (c) the range of vertical movement (in millimeters).

**Example #2: Assess Part 3 (Module Goals 1, 2; Unit Learning Outcomes 1, 2, 3)**

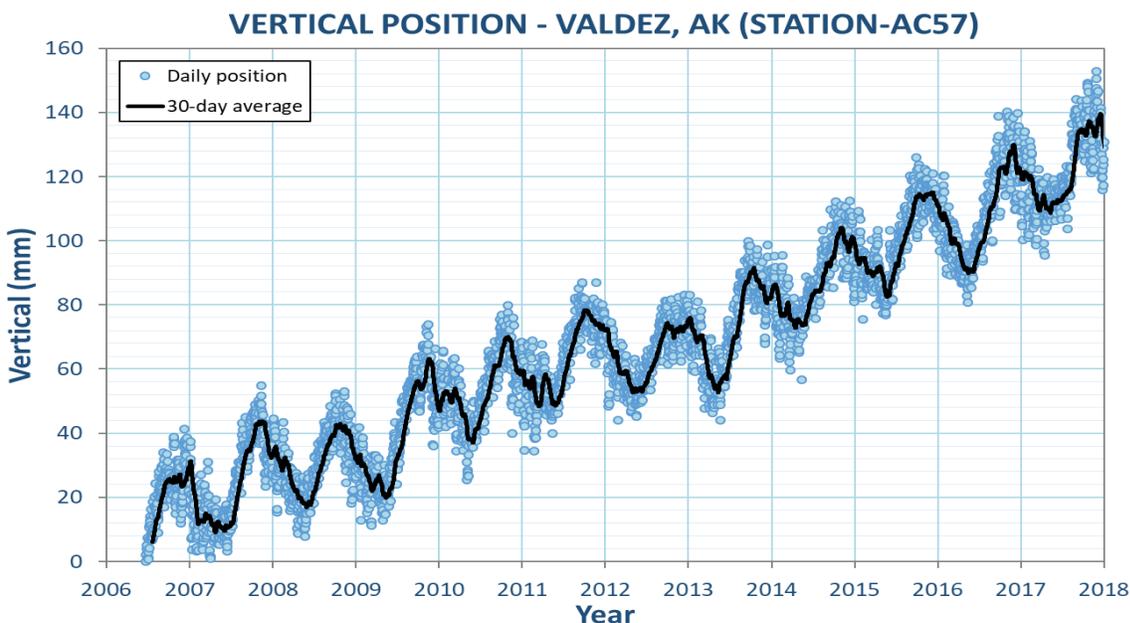


Figure 1. Vertical GPS data from station AC57 in Alaska from the beginning of January 2006 to the end of December 2017.

Imagine the community in which you live uses water that melts from a glacier as your primary supply of drinking water (there are many parts of the world where this is the case). You are worried that your supply of glacial melt water will disappear if the glacier becomes too small to fill your needs. Analyze the GPS data showing bedrock motion near the glacier, and make a recommendation to your community about whether or not you should find a new source of drinking water, using GPS data to support your argument. You will need to explain how GPS near glaciers can play a role in learning about the future of drinking water.

Be sure to include the following points in your recommendation to receive full credit:

- You include a clear statement about whether or not your community should find a new source of drinking water.
- You use words to describe the data supporting your argument.
- You use numerical rates (numbers plus units) to support your argument. Correctly include what the rate you calculated measures.
- You explain the link between GPS motion and the change in glacier size.
- You explain the link between the change in glacier size and drinking water.
- You judge how confident you are in your recommendation by justifying one assumption you made.

**Example #3: Assess Parts 1, 2, 3 (Module Goals 1, 2; Unit Learning Outcomes 1, 2, 3)**

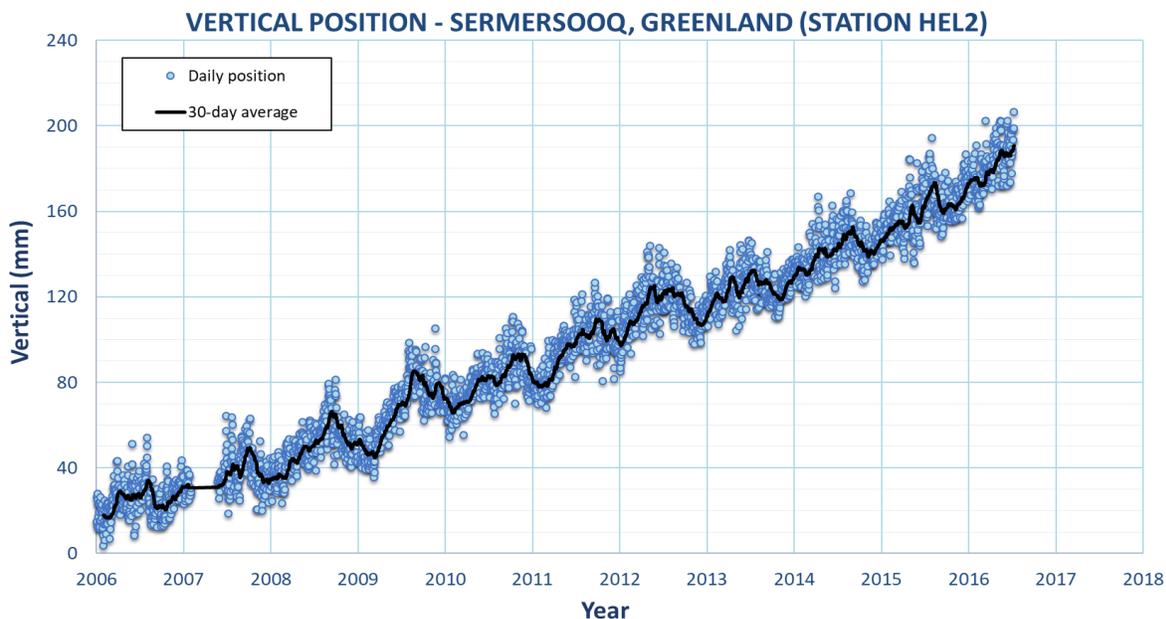


Figure 1. Vertical GPS data from station HEL2 in Greenland from the beginning of January 2006 to mid-2016.

Use the graph showing ground motion near a glacier as measured by GPS over time to answer the following questions.

What is the long-term rate of change? (Part 3; Module Goal 1; Unit Learning Outcome 1)

- a. 40 mm
- b. 160 mm
- c. 16 mm/year
- d. 30 mm/year

Which phrase explains how the nearby glacier causes the annual bedrock motion over one year? (Part 3; Module Goal 1; Unit Learning Outcome 2)

- a. Snow and ice melt cause the bedrock to move up during summer months
- b. Snow and ice melt cause the bedrock to move down during summer months
- c. Snow and ice melt cause the bedrock to move up long-term over many years
- d. Snow and ice melt cause the bedrock to move down long-term over many years

What can be interpreted about a nearby glacier based on the long-term trend of bedrock motion? (Part 2 and 3; Module Goal 1; Unit Learning Outcomes 1, 2)

- a. The trend is rising because the glacier is pushing the ground down less, which means the glacier is getting smaller.
- b. The trend is rising because the glacier is pushing the ground down less, which means the glacier is getting larger.
- c. The trend is rising because the glacier is pushing the ground down more, which means the glacier is getting smaller.
- d. The trend is rising because the glacier is pushing the ground down more, which means the glacier is getting larger.

What is NOT a recommendation you can make based on this GPS data near a glacier? (Part 3; Module Goal 2; Unit Learning Outcomes 3)

- a. Avoid building next to the ocean elsewhere in the world because the GPS data indicate the glacier is causing the sea level to rise.
- b. Avoid depending on the glacier for water in future because the GPS data indicate it may not be there.
- c. Avoid investing in a tourism company that will plan visits to the glacier in the future because the GPS data indicate the glacier is shrinking.
- d. Avoid relying on ocean fishing as a local source of food because the GPS data indicate that ground next to the glacier is rising.