7 Observing Earth's Moving Surface

INVESTIGATION

IN THE LAST activity, you used technology to determine where there are earthquakes and volcanoes on Earth's surface. But Earth's surface is constantly changing. How can we predict these changes? You may have heard of a phone or car having GPS. You can find GPS in many cellphones, cars, ships, and aircraft; hand-held devices that are used when out hiking or running; and even in wristwatches. **GPS** stands for global positioning system, which refers to a network of satellites around Earth that communicate with GPS receivers located on the ground. Once a ground receiver communicates with at least four satellites, the receiver's location on the ground can be determined.

A person using GPS in a moving car can be instructed to turn left at the next intersection. That is very helpful. But there is a more highly sophisticated GPS used in studying Earth. Using this type of GPS, a particular receiver's position on Earth's surface can be determined with great precision—amazingly, to within a few millimeters (mm). Scientists view thousands of data points a day to track receiver stations' locations to see the amount and direction of ground movement. Since stations are firmly anchored into the ground, the only way the GPS station will move is if the ground to which it is connected moves.

GPS satellites in space and receivers on Earth communicate to determine precise distances between each other.

Geologists study data from GPS stations around the world. Those data help geologists determine how Earth's surface is moving. GPS data recorded over time allow scientists to visualize movements happening far too slowly to observe directly. In this activity, you will analyze and interpret GPS data from a variety of stations. You will determine the direction and speed that Earth's surface is moving.

GUIDING QUESTION

How can GPS data help us understand Earth's surface?

MATERIALS

For each student

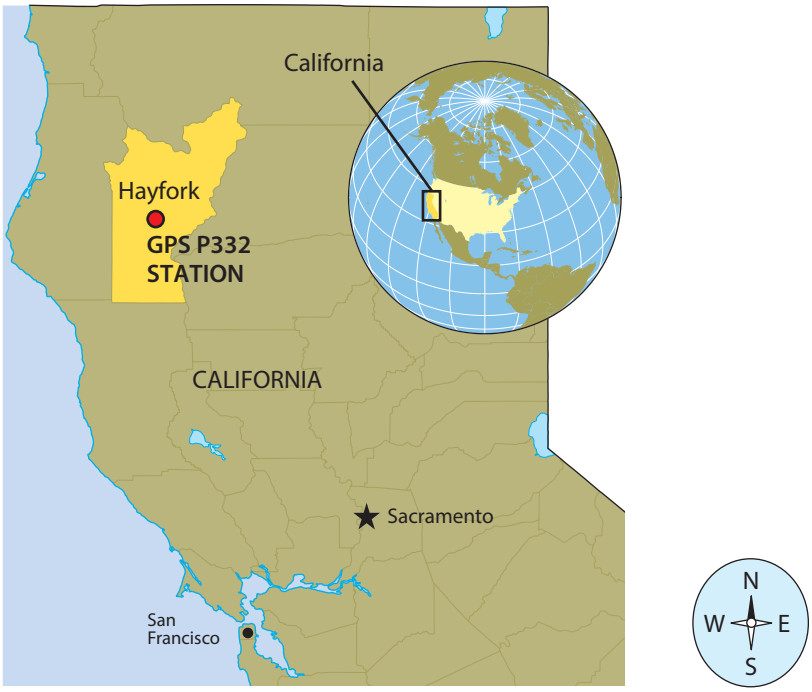
- 3 copies of Student Sheet 7.1, "Analyzing and Interpreting GPS Data"
- 1 clear metric ruler

PROCEDURE

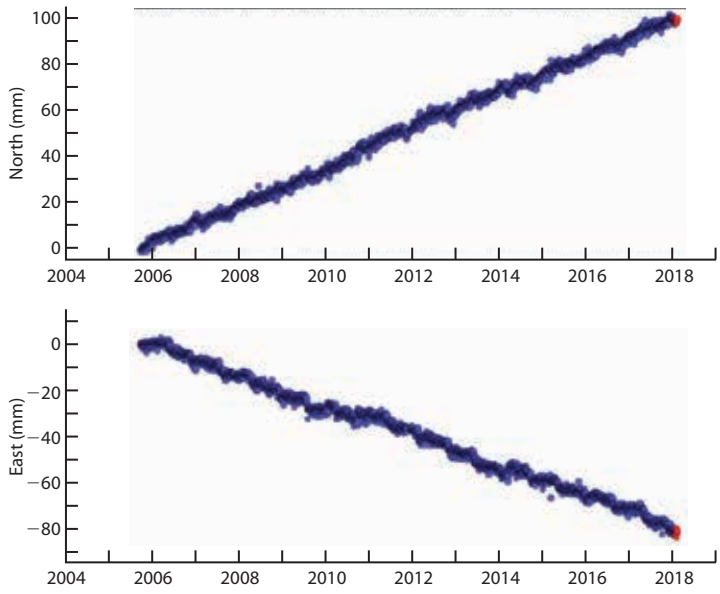
1. Follow your teacher's directions to complete Student Sheet 7.1, "Analyzing and Interpreting GPS Data," for the GPS station at Hayfork, California, USA.
2. In your group of four, decide which pair of students will analyze the GPS data for Alaska (USA) and who will analyze the data for Iceland.
3. Work with your partner to analyze the data using a fresh copy of Student Sheet 7.1.

   Hint: Refer to the maps of Alaska or Iceland in the Student Book to help you answer question 2 on Student Sheet 7.1.
4. Share your analysis with the other members of your group.
5. Follow your teacher's directions to complete the analysis of GPS data for the stations in Southern California.

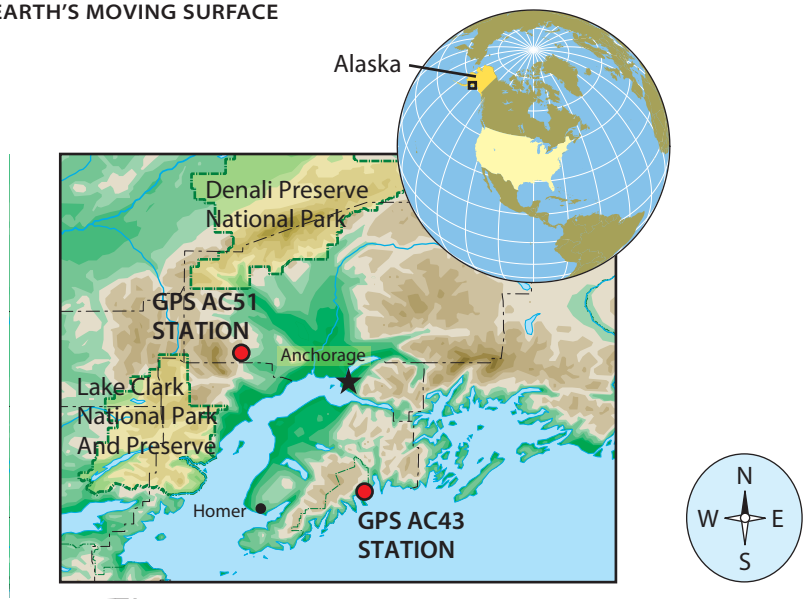
Hayfork, CA



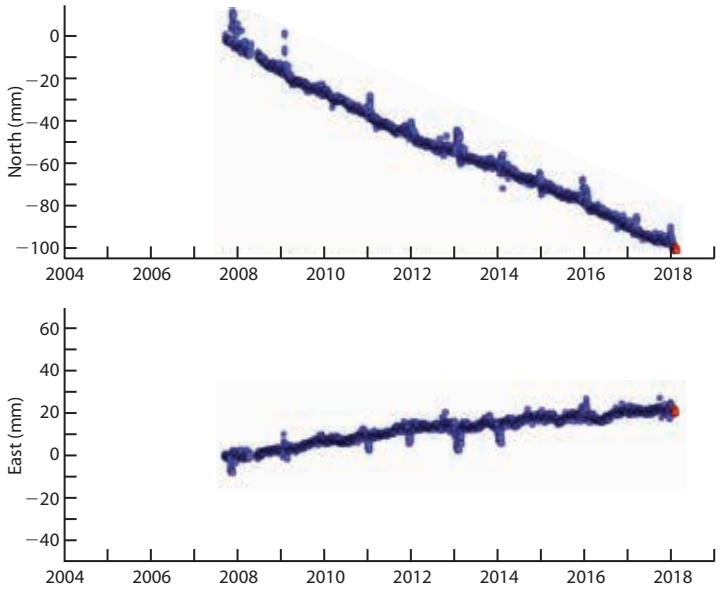
GPS time-series plot for station P332



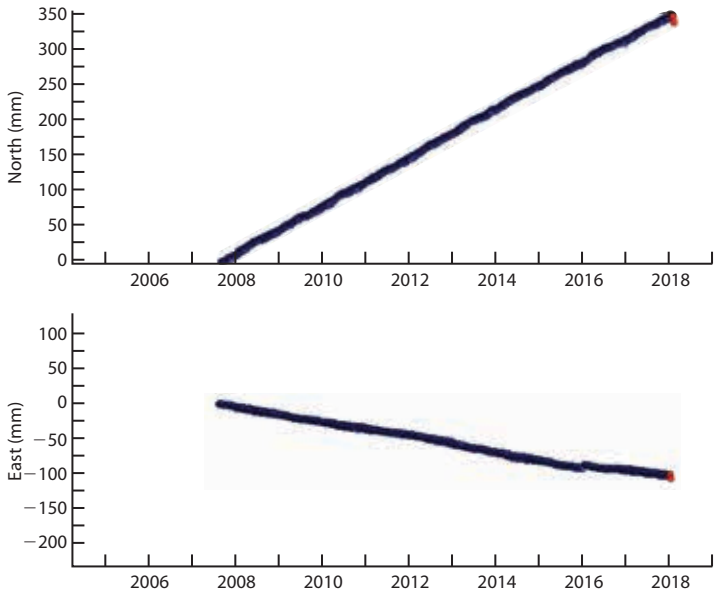
Alaska, USA

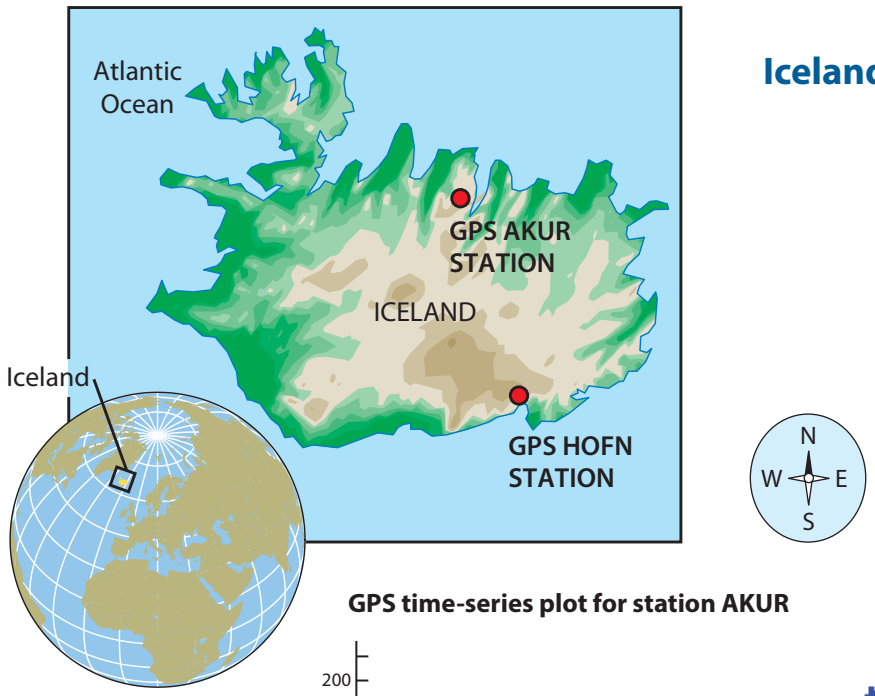


GPS time-series plot for station AC51



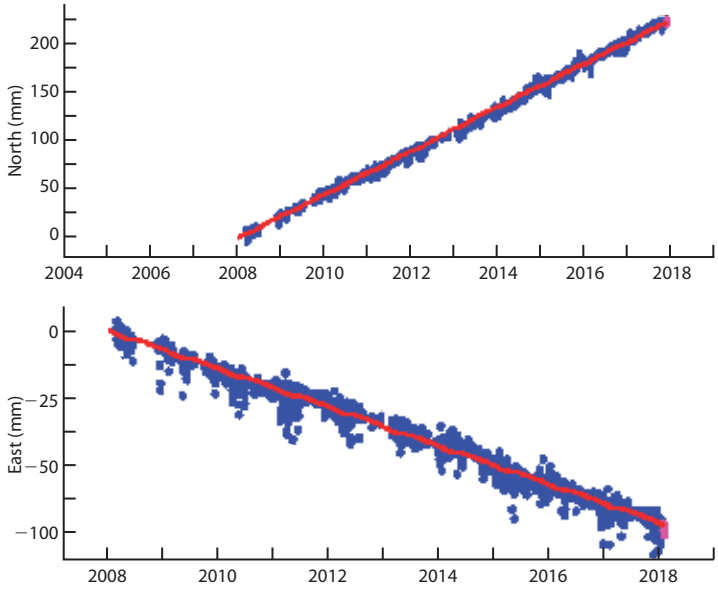
GPS time-series plot for station AC43



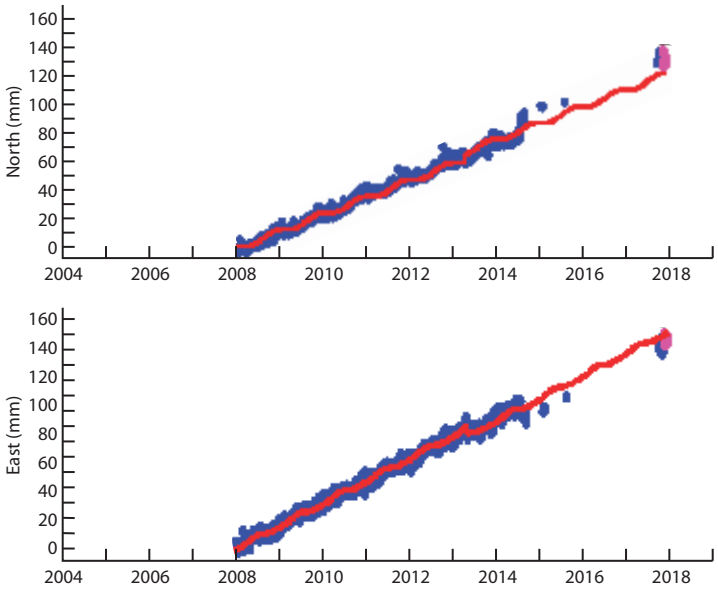


Iceland

GPS time-series plot for station AKUR

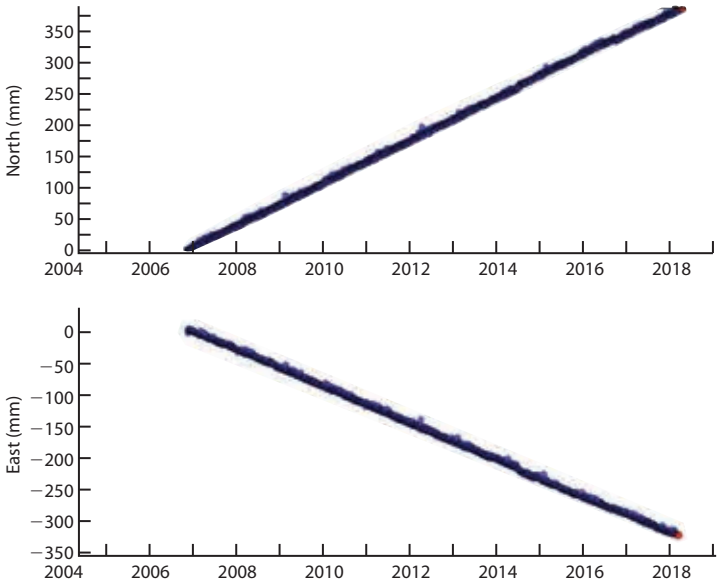


GPS time-series plot for station HOFN

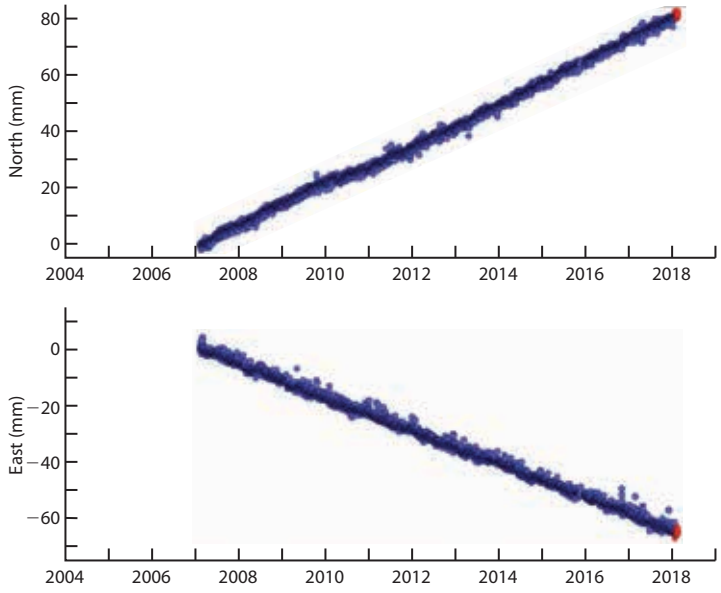


Southern California, USA

GPS time-series plot for station P514

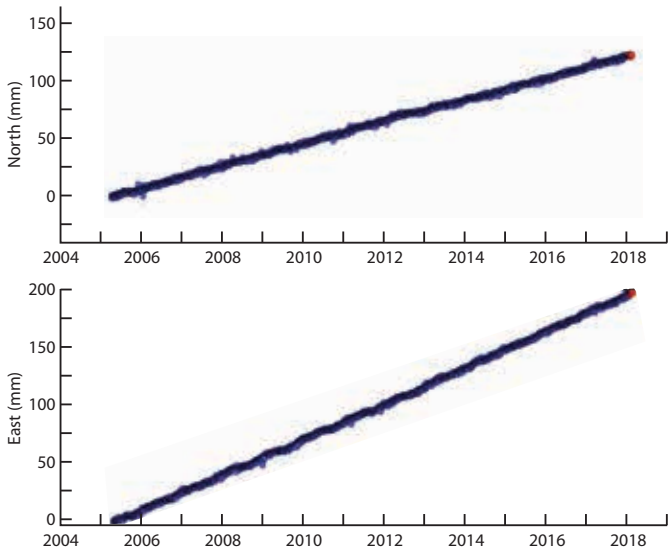


GPS time-series plot for station P580

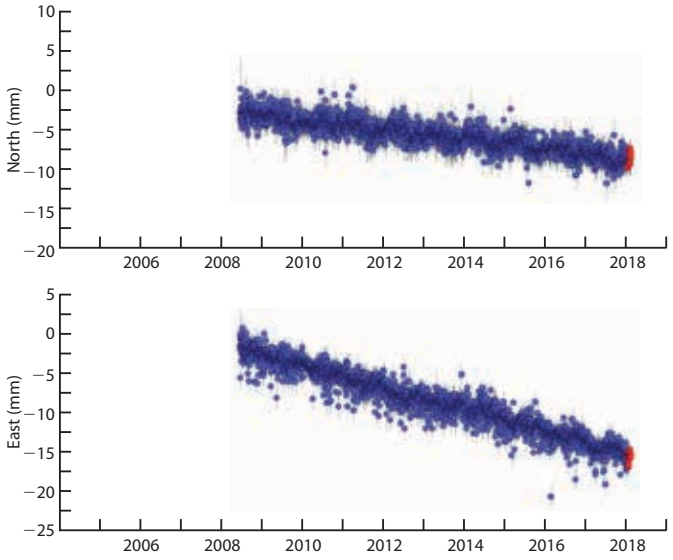


ANALYSIS

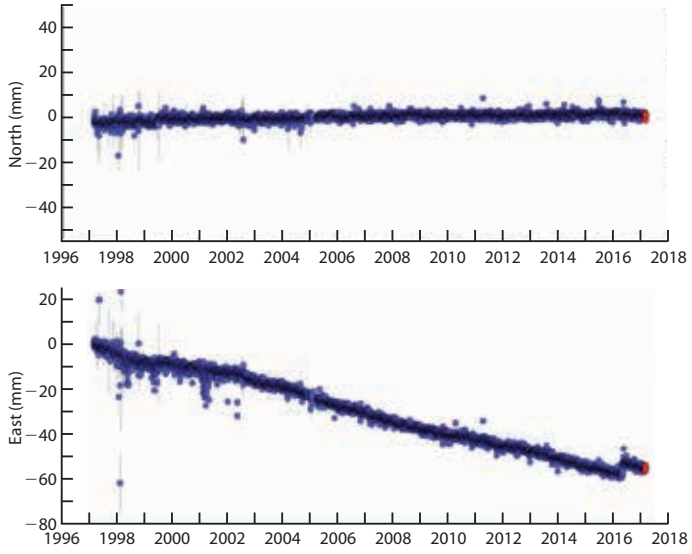
1. Here are some time-series plots from a variety of GPS stations. In what overall directions are they moving, and how do you know?



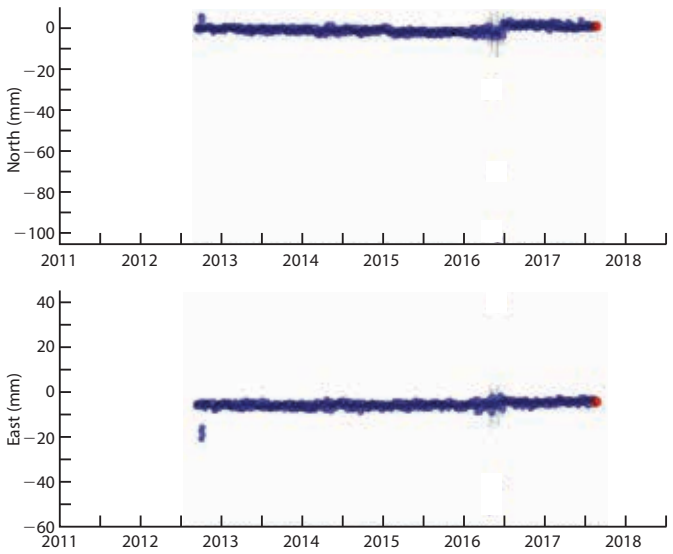
a



b

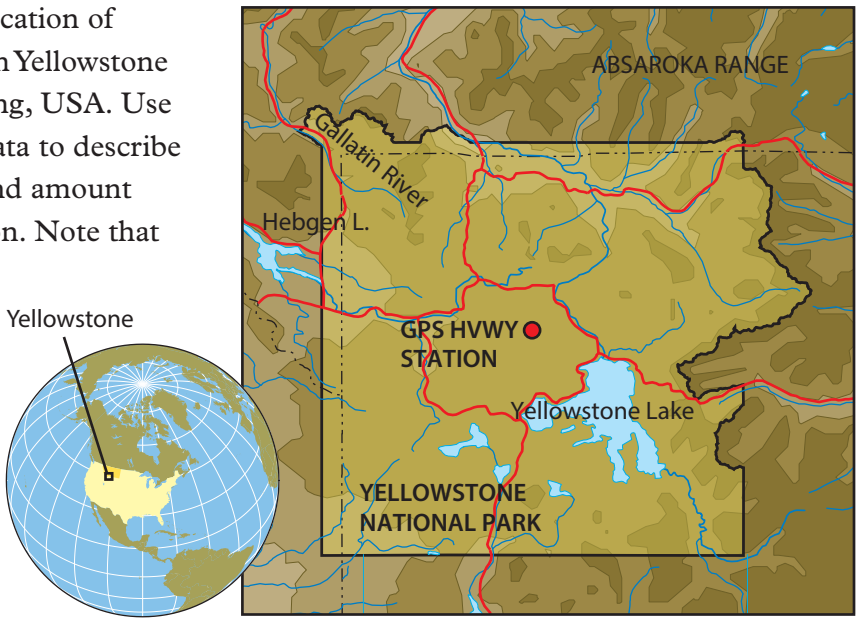


c

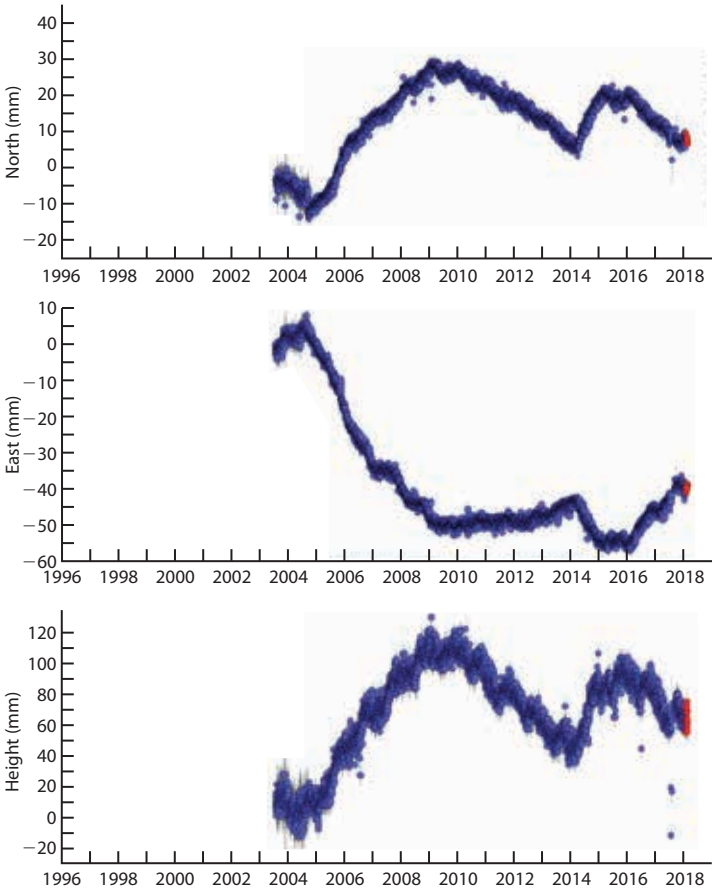


d

2. This map shows the location of GPS Station HVWY in Yellowstone National Park, Wyoming, USA. Use the GPS time-series data to describe the overall direction and amount of motion of this station. Note that for this station, the vertical component of the time series has been included to show up–down movement.



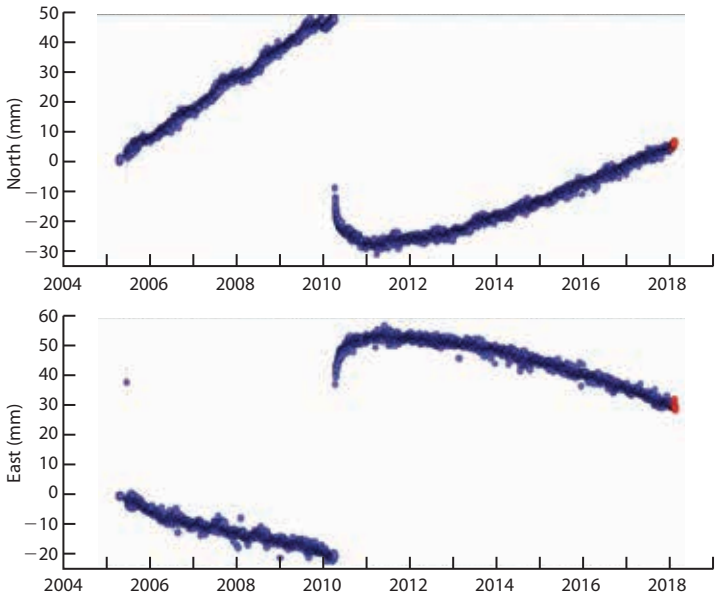
GPS time-series plot for station HVWY



3. Below is an example of a time-series plot that shows a peculiar event. What might have caused this shift to happen? Explain your reasoning.

   Hint: Use your understanding of how to read GPS time series and what you know about Earth's movement to explain what the GPS data show in terms of motion over time.

GPS time-series plot for station P500



4. The data from the Hayfork, California, GPS station show about 15 mm of northwest motion annually, which might not seem like much. Assuming the rate does not change, how far would that station, and therefore the earth below it, move in the following time periods:

   a. 100 years

   b. 10,000 years

   c. 10,000,000 years

5. Scientists continually look for new ways to learn about their field of study. In your own words, explain how GPS has helped geologists to better understand changes on Earth's surface.

6. How do you think GPS data can be useful for predicting future hazards and deciding where to store nuclear waste? Explain your ideas.

EXTENSION

Visit the *SEPUP Third Edition Geological Processes* page of the SEPUP website at *www.sepuplhs.org/middle/third-edition* to find information about the GPS station nearest you.