Measuring Earth with GPS, Unit 4: Groundwater Additional Assessment Questions

Karen M. Kortz (Community College of Rhode Island) and Jessica J. Smay (San Jose City College)

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

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

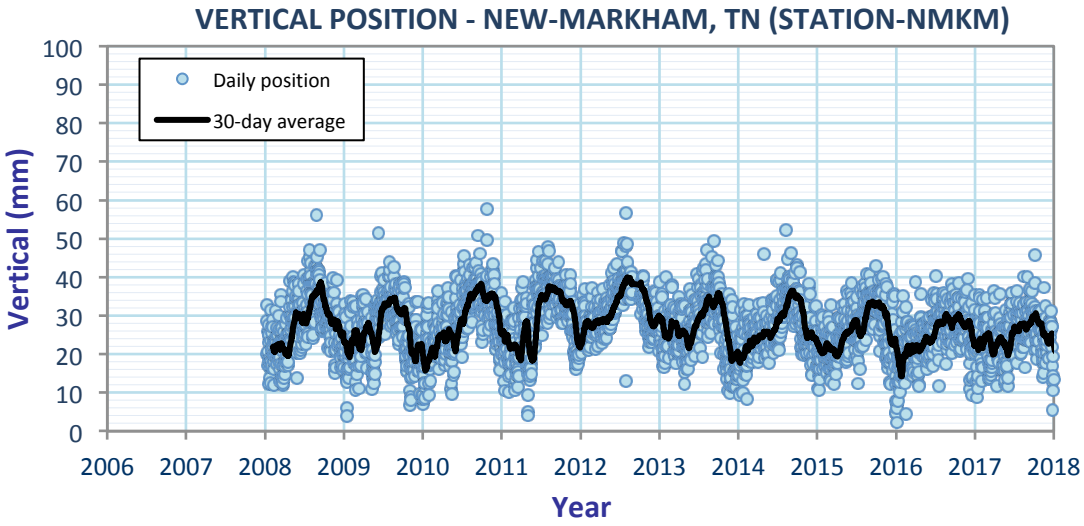

Figure 1. Vertical GPS data from station NMKM in Tennessee from the beginning of January 2008 to the end of December 2017.

Examine the GPS and precipitation data provided to you in graphs. (a) Describe using words and numbers how the GPS data change on an annual basis, being sure to include the months of the highest and lowest point as well as the range. (b) Write a hypothesis that describes why the ground is moving the way it is moving each year.

Example #2: Assess Part 3 (Module Goals 1, 2; Unit Learning Outcomes 1, 2, 3, 4)

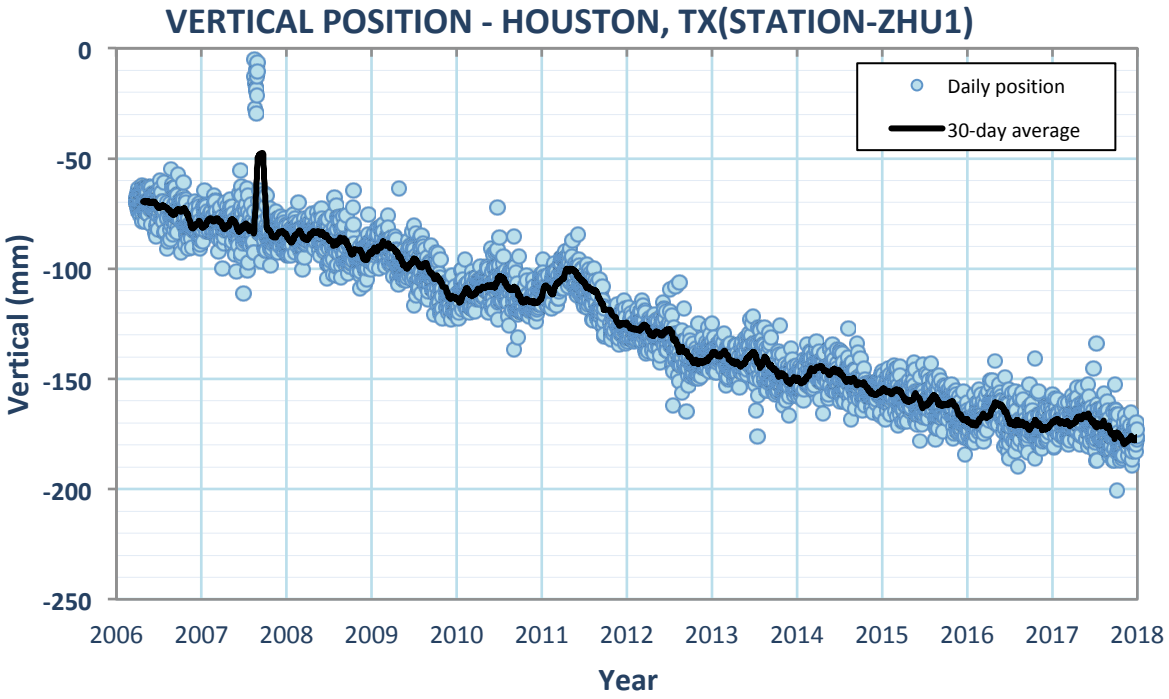

Figure 1. Vertical GPS data from station ZHU1 in Houston, Texas, from the beginning of March 2006 to the end of December 2017.

Examine the GPS data provided for Houston, Texas. Houston's population is exploding, growing faster than most other cities in the United States. Currently, its primary source of water is surface water, although about 13% of water used is groundwater. The city is built on sediments in a flat area about 50 feet above sea level. Analyze the GPS data showing ground motion, and make a recommendation to your community about whether or not there should be restrictions put on the use of groundwater, using GPS data to support your argument. You will need to explain how GPS stations can play a role in learning about the future of the use of groundwater resources in Houston.

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

•You include a clear statement about whether or not there should be restrictions put on the use of groundwater.

•You use words to describe the data supporting your argument.

•You use numerical rates (numbers plus units) of GPS data to support your argument. Correctly include what the rate you calculated measures.

•You explain the link between GPS motion and the amount of groundwater.

•You explain the link between groundwater withdrawals and the amount of groundwater.

Example #3: Assess Parts 1, 2, and/or 3 (Module Goals 1, 2; Unit Learning Outcomes 1, 3, 4)

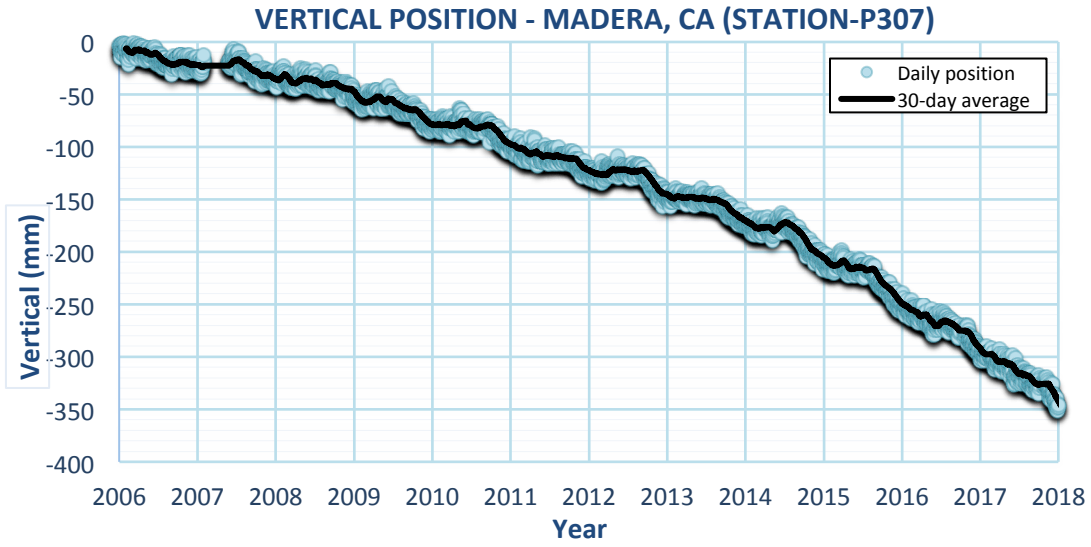

Figure 1. Vertical GPS data from station P307 in California from the beginning of January 2006 to the end of December 2017.

Use the graph showing ground motion of a GPS station on sediments in an area that is partially dependent on groundwater as a source of water to answer the following questions.

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

a. -30 mm / year

b. -50 mm / year

c. -150 mm/year

c. -375 mm

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

a. The trend is lowering because groundwater is pushing the ground down less, which means groundwater is decreasing

b. The trend is lowering because groundwater is pushing the ground down more, which means groundwater is increasing

c. The trend is lowering because groundwater is holding the sediments in the ground up less, which means groundwater is decreasing

d. The trend is lowering because groundwater is holding the sediments in the ground up more, which means groundwater is increasing

Which of these is a recommendation you can make based on this GPS data in the area? (Part 3; Module Goal 2; Unit Learning Outcome 4)

a. Avoid withdrawing more groundwater than what is replaced because the GPS data indicate the groundwater levels are lowering.

b. Avoid using too much surface water in reservoirs because the GPS data indicate the reservoirs are emptying.

c. Avoid allowing too much water to soak into the ground because the GPS data indicate the groundwater levels are increasing