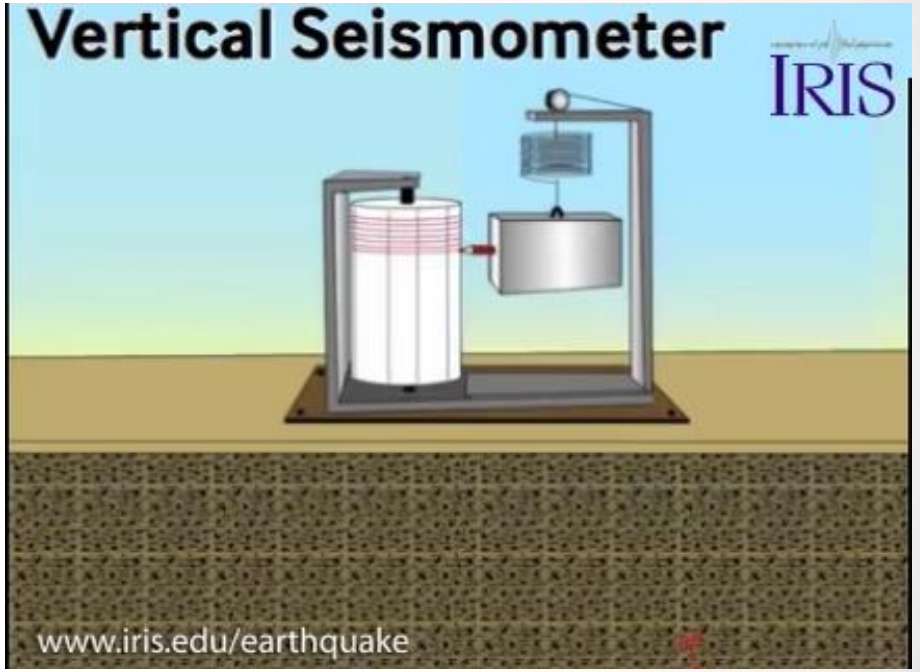
Seismology for "non-traditional" Performance Expectations

MS-ESS3-4. Construct an argument supported by evidence for how increases in human population and per capita consumption of natural resources impact Earth's systems.

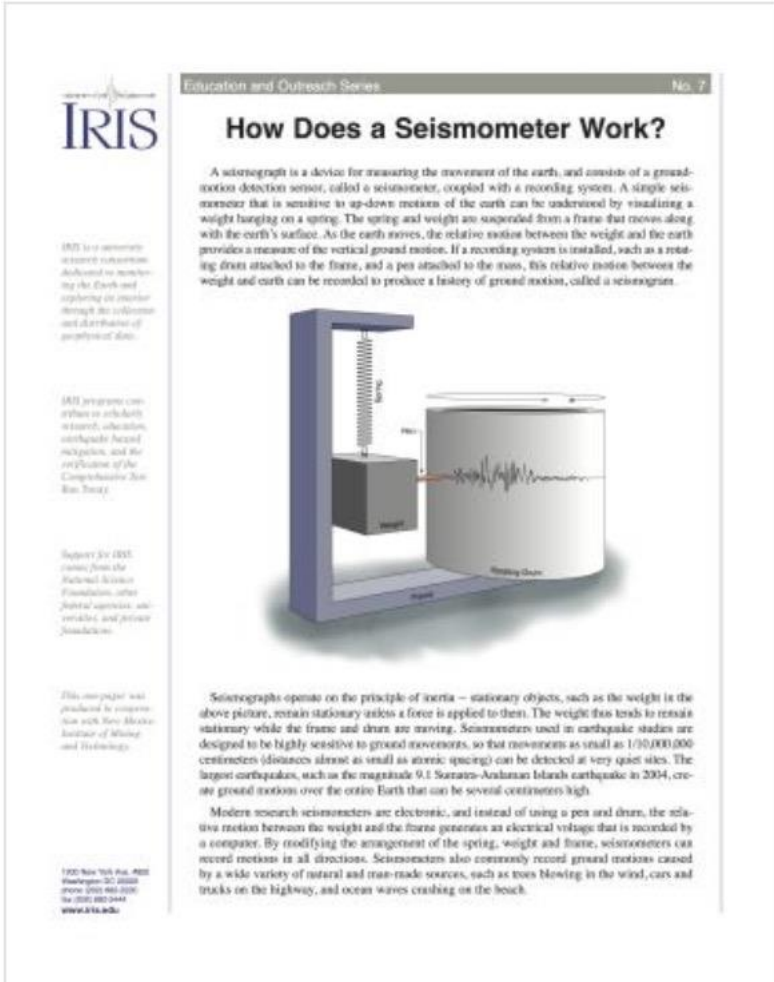
HS-ESS3-1. Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity.

Michael Hubenthal, Senior Education Specialist

Could a seismometer provide evidence that humans are impacting the Earth system? Why or why not?



Read “How Does a Seismometer Work?” and revisit your response



IRIS

Education and Outreach Series No. 7

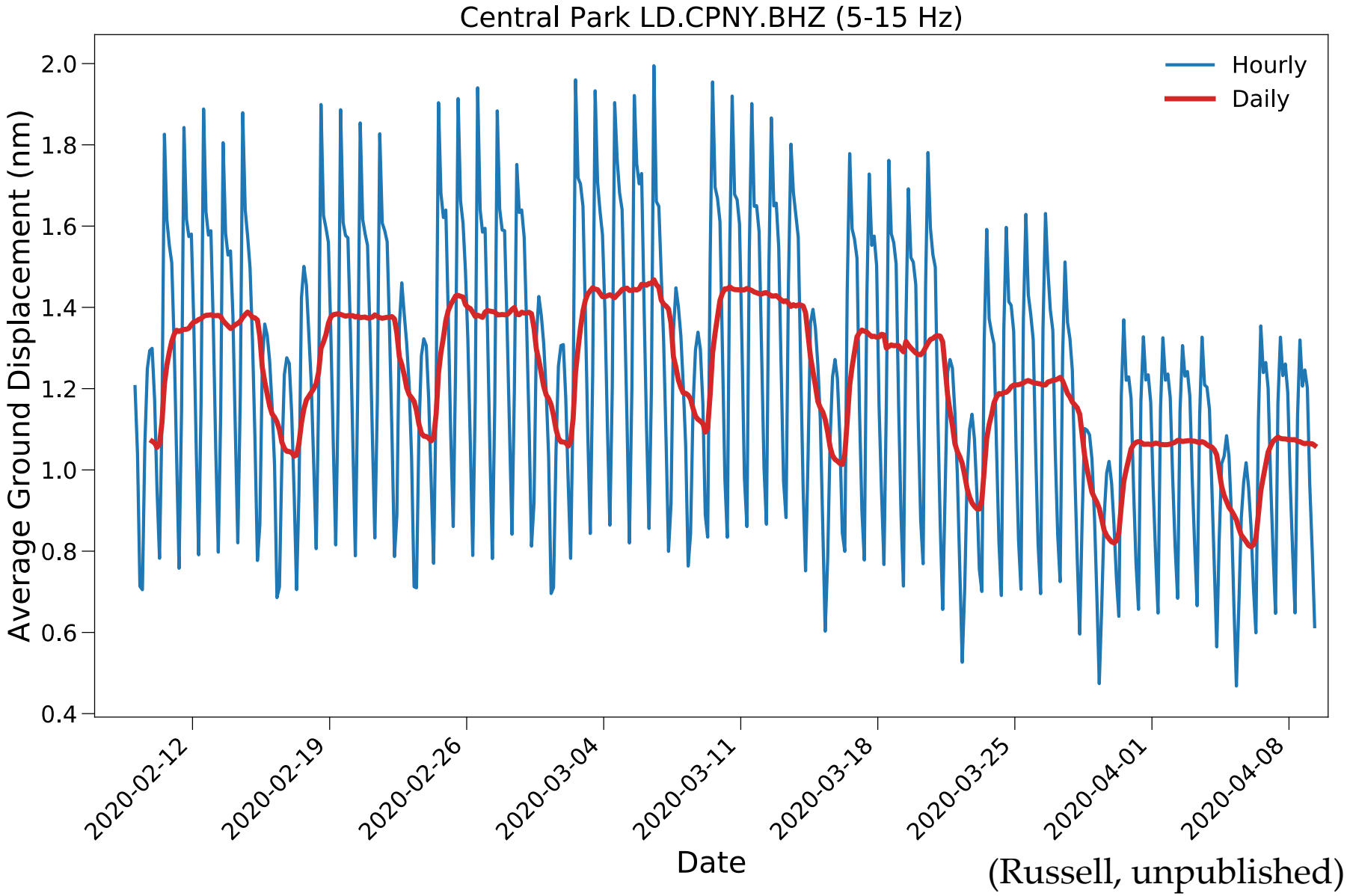
How Does a Seismometer Work?

A seismograph is a device for measuring the movement of the earth, and consists of a ground-motion detection sensor, called a seismometer, coupled with a recording system. A simple seismometer that is sensitive to up-down motions of the earth can be understood by visualizing a weight hanging on a spring. The spring and weight are suspended from a frame that moves along with the earth's surface. As the earth moves, the relative motion between the weight and the earth provides a measure of the vertical ground motion. If a recording system is installed, such as a rotating drum attached to the frame, and a pen attached to the mass, this relative motion between the weight and earth can be recorded to produce a history of ground motion, called a seismogram.

Seismographs operate on the principle of inertia -- stationary objects, such as the weight in the above picture, remain stationary unless a force is applied to them. The weight thus tends to remain stationary while the frame and drum are moving. Seismometers used in earthquake studies are designed to be highly sensitive to ground movements, so that movements as small as 1/10,000,000 centimeters (distances almost as small as atomic spacing) can be detected at very quiet sites. The largest earthquakes, such as the magnitude 9.1 Sumatra-Andaman Islands earthquake in 2004, create ground motions over the entire Earth that can be several centimeters high.

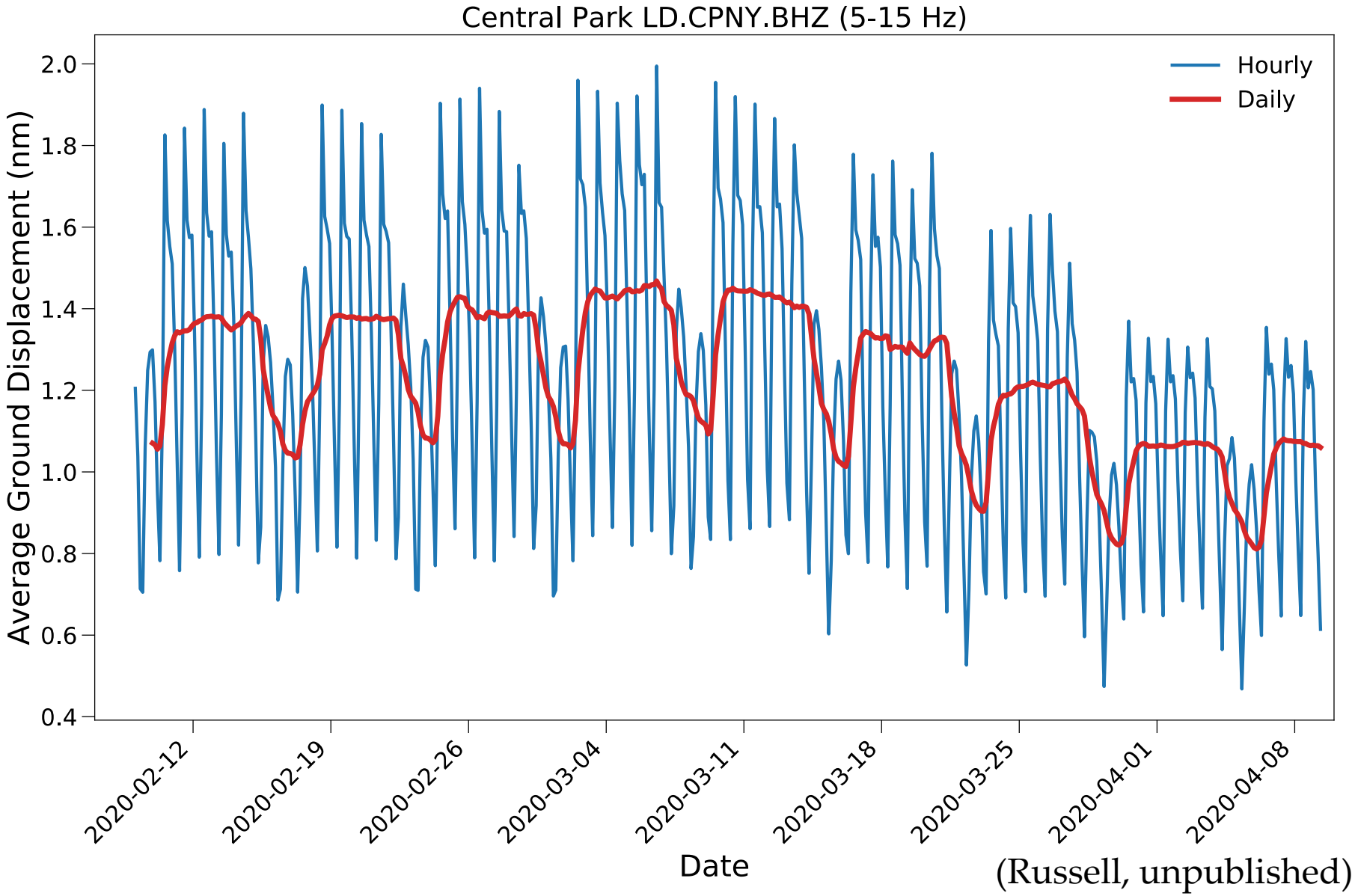
Modern research seismometers are electronic, and instead of using a pen and drum, the relative motion between the weight and the frame generates an electrical voltage that is recorded by a computer. By modifying the arrangement of the spring, weight and frame, seismometers can record motions in all directions. Seismometers also commonly record ground motions caused by a wide variety of natural and man-made sources, such as trees blowing in the wind, cars and trucks on the highway, and ocean waves crashing on the beach.

What information does this plot display?



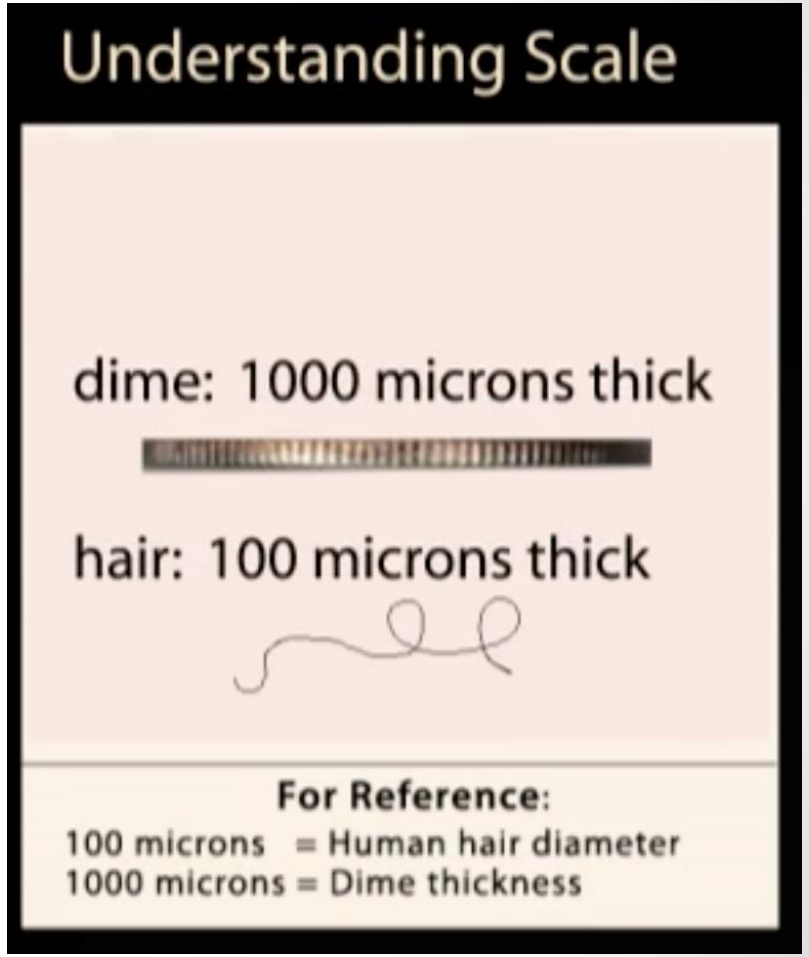
(Russell, unpublished)

This plot shows how much the ground goes up and down on average each hour and each day.



(Russell, unpublished)

Would New Yorker's feel this ground motion? Use the information here, and the plot to explain why or why not?

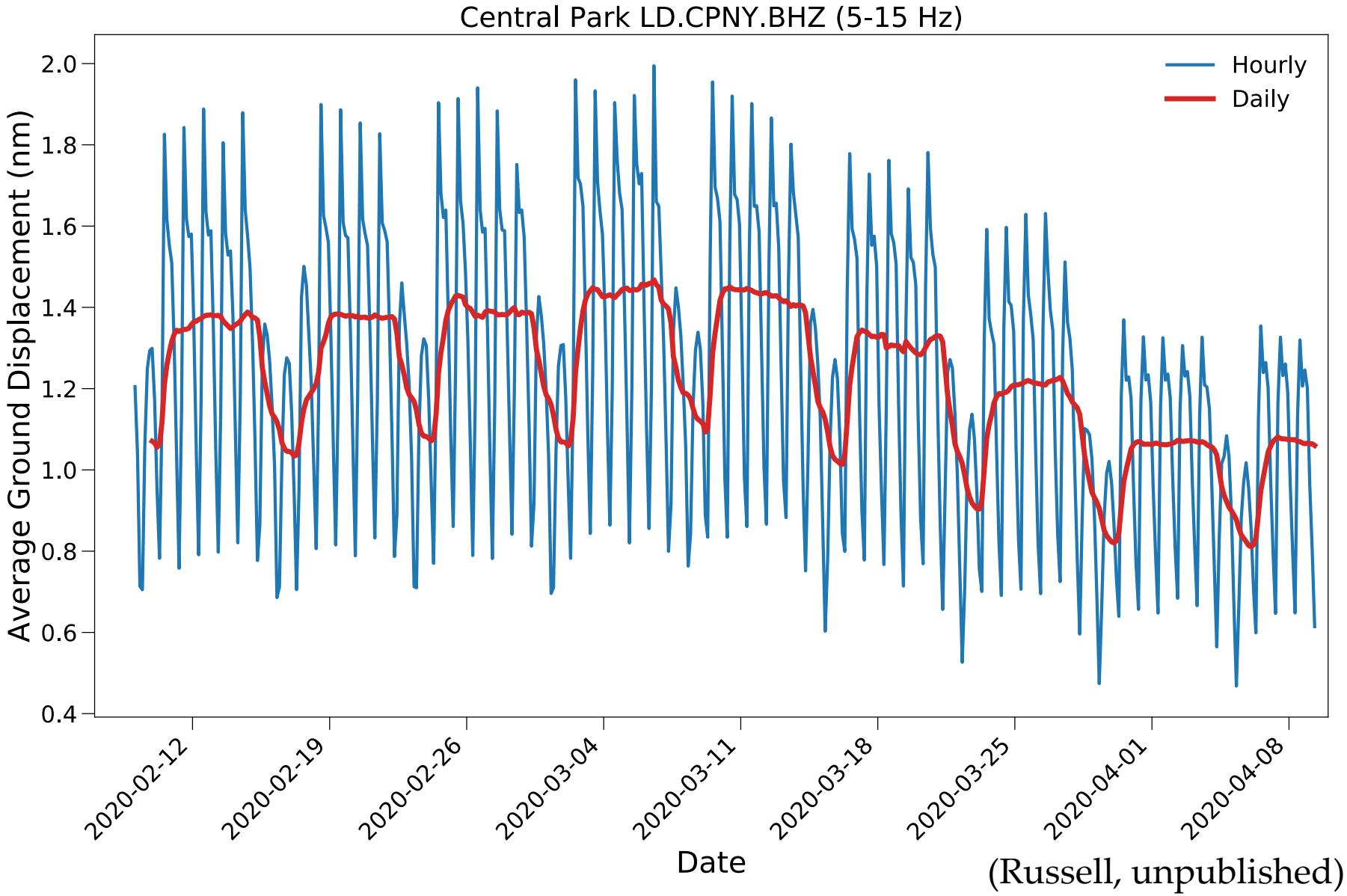


1 nanometer (nm) = .001 (microns)

So, hair is roughly 100,000 nm

Let's look at the data again. What broad patterns do you see?

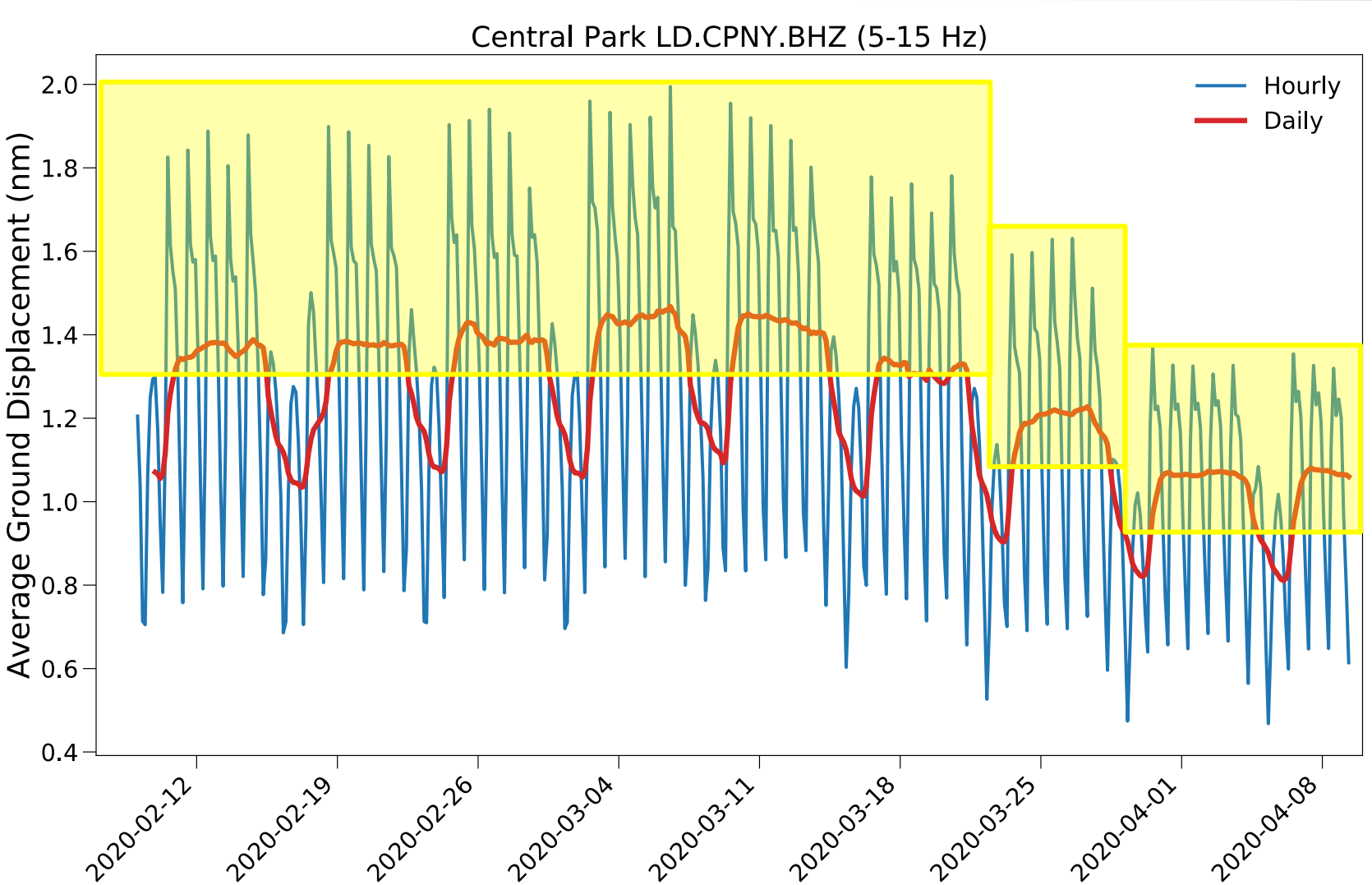
Make a list and annotate your plot. Consider what each pattern means?



(Russell, unpublished)

Day/Night

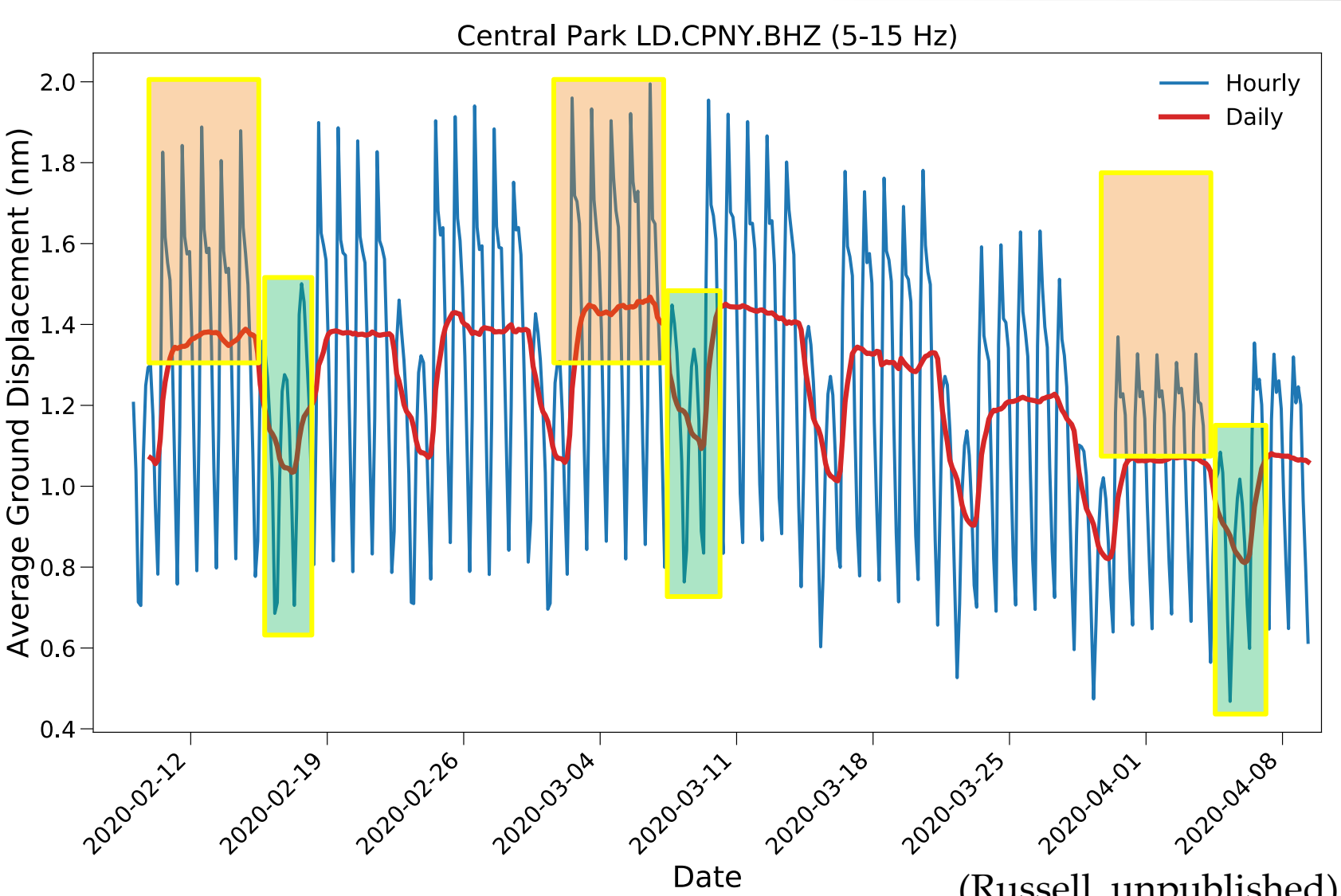
Looking at the blue line, the upper 50% of each wave is roughly equal to day, while the lower half is roughly night.



(Russell, unpublished)

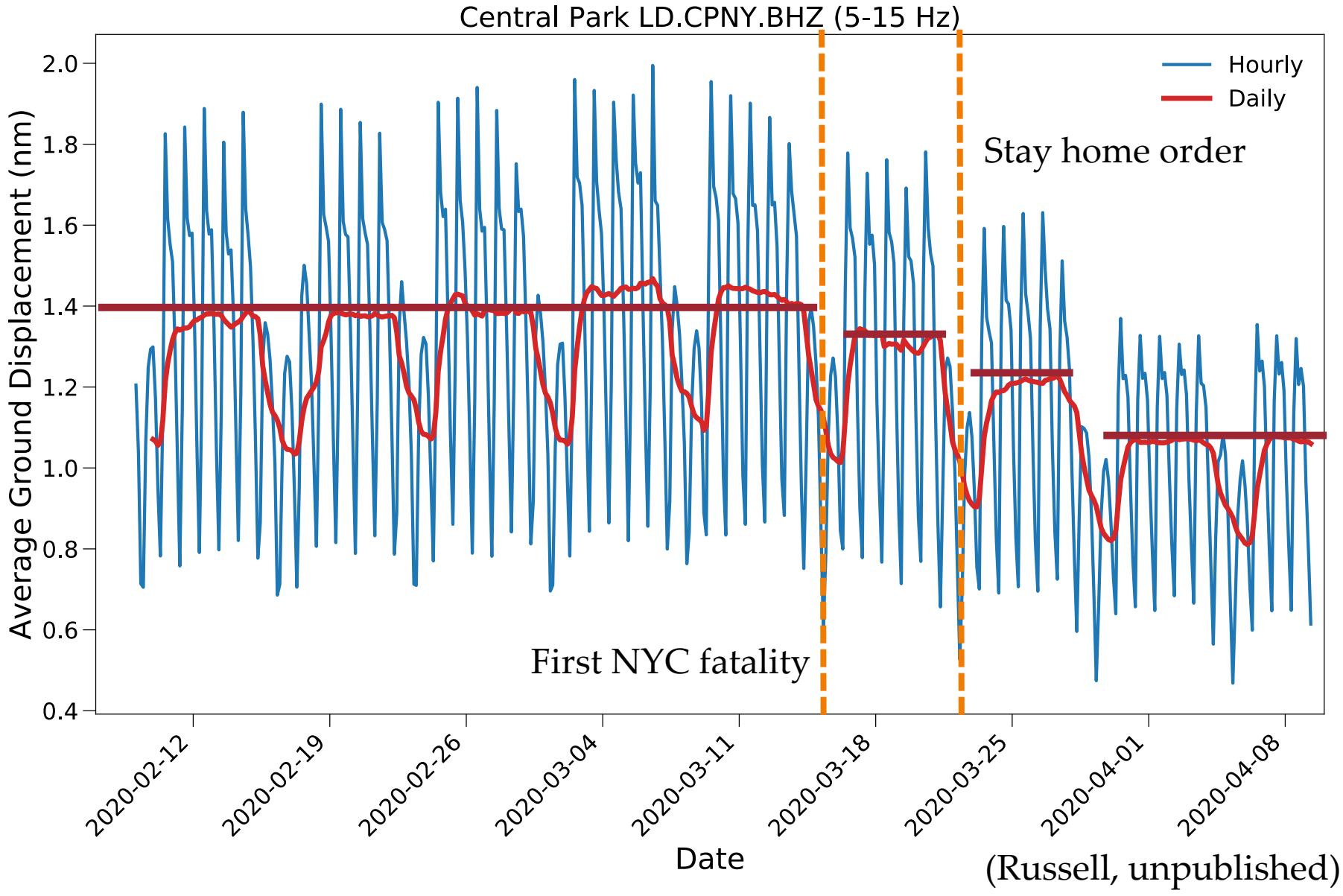
Weeks

Weekdays are highlighted in orange. Weekends are highlighted in green.



(Russell, unpublished)

Decreases in the daily average displacement over the course of two weeks correspond with the news and public policy



(Russell, unpublished)

Summarize your learning

- What are three ideas you have learned from this exploration of seismic data?
- Describe what you would expect to see over this same period if we were to look at a seismometer in Booneville, NY (a small rural town north of of Utica, NY. Population ~2072)?

Construct an argument supported by evidence for how increases in human population and per capita consumption impact Earth's systems.

Seismic data provides evidence that human behavior has changed in response to policy/virus.

Behavior change = decreased consumption or a proxy for decreased human population

If human behavior has changed? Where else might we look for impacts?

Use the internet to explore how the Earth system might change if there was a decrease in per capita consumption or human population.