



Using Real-Time Data: Temperature's Impact on Sea Level Rise

Grade Level: 5-8

Time: 1-2 class periods

National Benchmarks: Benchmarks 1A: The Scientific Worldview; 1B: Scientific Inquiry; 3A: Technology and Science; 4B: The Earth; 4C: Processes that Shape the Earth; 4D: The Structure of Matter; 4E: Energy Transformations; 5D: Interdependence of Life; 9B: Symbolic Relationships; 9D: Uncertainty; 12B: Computation and Estimation; 12D: Communication Skills; 12E: Critical-Response Skills.

National Science Content Standards: *Science as Inquiry: A; Physical Science: B:* Properties and changes of properties in matter; Transfer of energy; *Earth and Space Science: D:* Structure of the earth system; *Science and Technology: E:* Abilities of technological design; Understandings about science and technology; *Science in Personal and Social Perspectives: F:* Populations, resources, and environments; Natural hazards

New York State Standards: 1, 2, 4, 5, 6, 7

Objective: Students will know how to retrieve data from a real-time data website and be able to explain and pose questions about the relationship between global warming and water level rise in the Hudson River Estuary.

Lesson Outline:

1. Students retrieve data from the HRECOS website according to the worksheet instructions
2. Students use the data to discuss the relationship between ocean and Hudson River Estuary water levels.
3. Students use the data to discuss the relationship between seasonal temperatures and water levels.
4. Students use the data to discuss the potential impact of global warming on water level in the Hudson River Estuary.

Materials: Computers with internet access (either at home or at school).

Engagement: Are we vulnerable to sea level rise in the Hudson River? Since small, gradual changes like sea level rise are difficult to observe, ask students to think about short term events. Are we vulnerable to tidal changes? Are we vulnerable to storm surges? These short term events are indications that we in the Hudson River Estuary are vulnerable to changes in the ocean's water level including the gradual change of sea level rise.

Explore: During the lesson, students will become familiar with HRECOS data. Students should all receive a copy of the "Temperature's Impact on Sea Level Rise" worksheet which guides them through the investigation.

Explain: According to some estimates, the Hudson River has risen 4-6" since 1960. HRECOS has only been in operation since 2008, however, so we are unable to detect the impact of sea level rise in the HRECOS data set. We can, however, observe the impact of changing water temperatures.

Like most other substances, water expands as it is heated, over most temperature ranges. Between spring and fall, water on the ocean's surface heats sufficient to cause a noticeable sea level rise. Rising ocean waters force waters in the Hudson River Estuary to rise as well. The result is an annual cycle of low to high to low water levels again from the spring to fall to winter.

This cycle is often difficult to observe with the raw HRECOS data set. This is because tidal fluctuations, rain events, and storm surges cause short term fluctuations that confuse the longer term, annual cycle. To reduce this noise, we plot the data as monthly averages. This, in fact, is the same technique used by the National Water Level Program at the National Oceanic and Atmospheric Administration (NOAA) for tracking changes in sea level across coastal U.S. waters.

Extend: Visual Demonstration

Materials:

- Flask or clear plastic drink bottle
- Glass tube
- Stopper
- Lamp or strong sunlight

Instructions:

- Fill the flask almost to the brim with water.
- Insert the glass tube through the rubber stopper and insert this in the top of the flask.
- Water should rise slightly up the tube. Use a marker to mark the starting water level.
- Place the flask next to a desk lamp or in strong sunlight for at least 10 minutes.

The water will expand by a factor of 0.021% for every degree in temperature rise. This is the same process that causes water levels in the ocean and in the Hudson River Estuary to rise in the spring and summer.

Evaluate: Collect Student Worksheets.