

# Lesson 9

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## New York Explores Sea Level Rise: A Field Based Activity



## New York Explores Sea Level Rise

### New York State Intermediate Level Science

#### Standard 1: Analysis, Inquiry and Design/Scientific Inquiry

- S1.2c differentiate among observations, inferences, predictions, and explanations
- S2.1d use appropriate tools and conventional techniques to solve problems about the natural world, including: measuring, observing, describing, classifying, sequencing
- S2.3b conduct a scientific investigation
- S2.3c collect quantitative and qualitative data
- S3.1a organize results, using appropriate graphs, charts, and data tables
- S3.2d formulate and defend explanations and conclusions as they relate to scientific phenomena
- S3.2h use and interpret graphs and data tables

#### Standard 6: Interconnectedness

- 5.2 Observe patterns of change in trends or cycles and make predictions on what might happen in the future.

#### Standard 4: The Physical Setting

- 2.2i Weather describes the conditions of the atmosphere at a given location for a short period of time.
- 2.2j Climate is the characteristic weather that prevails from season to season and year to year.
- 2.2r Substances enter the atmosphere naturally and from human activity. Some of these include greenhouse gases such as carbon dioxide, methane, and water vapor. These substances can affect weather, climate, and living things.
- 7.2d Since the Industrial Revolution, human activities have resulted in major pollution of air, water, and soil. Pollution has cumulative ecological effects such as acid rain, global warming, or ozone depletion. The survival of living things on our planet depends on the conservation and protection of Earth's resources.

### Next Generation Science Standards

#### Science and Engineering Practices:

- 2. Developing and using models
- 4. Analyzing and interpreting data
- 5. Using mathematics and computational thinking
- 6. Constructing explanations
- 7. Engaging in argument from evidence
- 8. Obtaining, evaluating, and communicating information

#### Grade 7

- LS2-4. Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.



## Common Core State Standards - ELA in the Content Areas - Grades 6-8

### **CCSS.ELA-Literacy. RST.6-8.7**

Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).

### **CCSS.ELA-LITERACY. WHST.6-8.2**

Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.

### **Standards for Mathematical Practice**

#### **CCSS.Math. Practice.MP2**

Reason abstractly and quantitatively.

#### **CCSS.Math.Practice.MP4**

#### **Model with mathematics.**

Grade 6: CCSS.Math.

Content.6.NS.C.8

Solve real world and mathematical problems by graphing points in all four quadrants of the coordinate plane. Include use of coordinates and absolute value to find distances between points with the same first coordinate or the same second coordinate.

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# New York Explores Rising Sea Level: A Field-Based Introduction

*Adapted from: "Climate Change and Sea Level Rise Data Collection," by Margie Turrin, Education Coordinator, Lamont-Doherty Earth Observatory, Columbia University Earth Institute. Additionally, Steve Stanne, Estuary Education Coordinator, NYSDEC Hudson Estuary Program/NYS Water Resources Institute and Meghan Marrero, Ed.D edited the activity.<sup>1</sup>*

## Introduction

In this activity, students will use the science community's current predictions for sea level rise to map the slope of their field area. They will mark how far inland water is predicted to reach as sea level rises, and assess how that flooding might impact habitat, vegetation, and structures made by people.

The first part of the activity may take place in the classroom, the second part outside on the shoreline of a tidal water body. Students can then wrap up in the classroom.

## Background Information

### What Is Climate Change?

Climate refers to long-term changes in patterns of temperature, precipitation, humidity, wind, and seasons. Climate varies by region but overall the earth's climate has been warming. Global temperatures over both land and ocean surfaces have risen  $\sim 0.85^{\circ}\text{C}$  ( $1.5^{\circ}\text{F}$ ) since 1880.<sup>2</sup> The U.S. is warming at  $\sim 0.72^{\circ}\text{C}$  ( $1.3^{\circ}\text{F}$ ) per century<sup>3</sup>.

### Is Global Sea Level Rising?

According to the International Panel on Climate Change (IPCC), the scientific body set up to look into this, during the 20th century global sea level has risen about 1.7 mm/year (0.07 inches). A newer data set with more accurate sea level measurements made from satellites shows that since 1993, global sea level has been rising at a rate of  $\sim 3$  mm/yr (0.12 inches) – nearly double the previous half century. Coastal tide gauge measurements confirm this conclusion.

Global rates are important for assessing overall trends in sea level change. However, climate models predict that sea level will not rise uniformly around the world, and satellite data and local tide gauge measurements show that this is true. In some places, like the Chesapeake Bay, rates are up to several times the global mean rise. In other regions, like areas of Alaska, sea level is falling. This variability is in large part due to local circumstances of geology, ice history, temperature, salinity, and ocean currents.<sup>4</sup>

<sup>1</sup> This activity is adapted from: "Climate Change and Sea Level Rise Data Collection" by A. Baldwin and C. Samis at Assateague State Park, further edited in 2013 by Amanda Sullivan, Maryland Department of Natural Resources.

<sup>2</sup> Sources: IPCC, 2013: "Climate Change 2013: The Physical Science Basis. Summary for Policymakers: Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change" [Stocker, T., D. Qin, G-K. Plattner, M. Tignor, S. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex, P. Midgley (eds.)]. IPCC, Switzerland. [http://www.climatechange2013.org/images/report/WG1AR5\\_SPM\\_FINAL.pdf](http://www.climatechange2013.org/images/report/WG1AR5_SPM_FINAL.pdf)

<sup>3</sup> NOAA's National Climate Data Center

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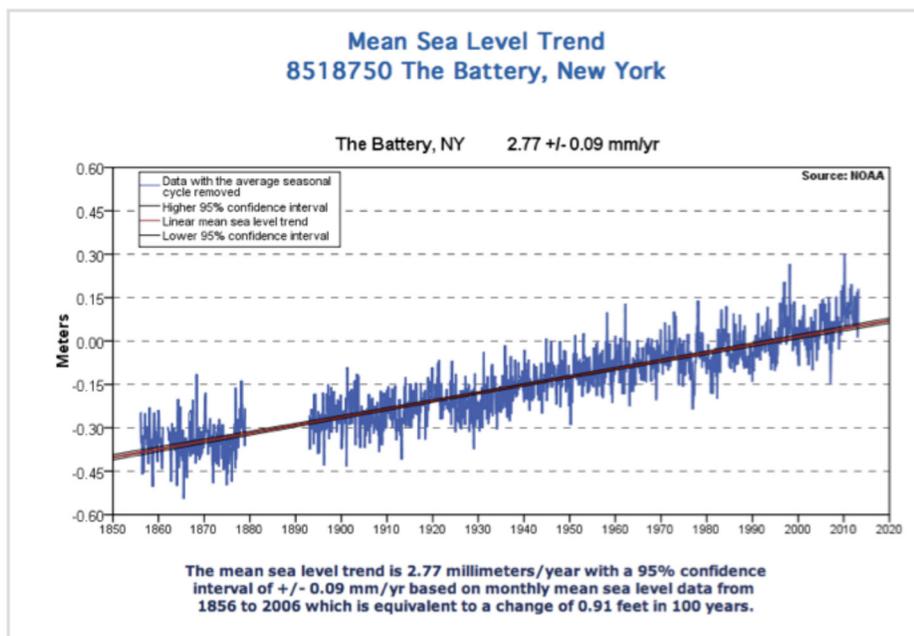
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## Why Is The Sea Level Rising?

- There are two major causes of global sea level rise: (1) thermal expansion of ocean water and (2) melting of land-based ice. The ocean is absorbing much of the additional heat trapped by greenhouse gases in our atmosphere. As it warms, ocean water expands, causing sea level to rise. Approximately 50% of the rise in sea level is due to this expansion. At the same time, warmer temperatures across the globe are causing land glaciers and sections of the Greenland and Antarctic Ice Sheets to melt. No longer locked up in ice, this meltwater eventually reaches the oceans and also causes sea level to rise.

## What About New York?

A tide gauge at the Battery in New York City measures local or 'relative' sea level, and provides evidence that sea level has risen close to 2.77 mm/year over the last 150 years. For the last 100 years this amounts to a rise of 27.7 cm (~ 11 inches)<sup>5</sup>.



## What Does This Mean For Our Future?

In 2013 and 2014 reports, the IPCC suggests that sea level rise will continue to accelerate over the next ~100 years. How much sea level rises will depend on how well carbon dioxide emissions are controlled. If emissions are greatly reduced, sea level rise is predicted to be 28-61 cms (11-24 inches). If carbon dioxide emissions are not well-controlled, sea level rise may be closer to 52-98 cms (20-39 inches).<sup>6</sup> What will this mean on your local waterfront? Let's get outside and see!

<sup>4</sup> IPCC, 2013: "Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change: Chapter 13, Sea Level Rise", Coordinating Lead Authors Church, J.A. and P. U. Clark. IPCC, Switzerland. [http://www.ipcc.ch/pdf/assessment-report/ar5/wg1/WG1AR5\\_Chapter13\\_FINAL.pdf](http://www.ipcc.ch/pdf/assessment-report/ar5/wg1/WG1AR5_Chapter13_FINAL.pdf)

<sup>5</sup> <http://tidesandcurrents.noaa.gov/sltrends/>

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## Major Concepts

- Our warming climate is causing sea level to rise.
- We measure this change globally with satellites and locally with tide gauges.

## OBJECTIVES

Students will be able to

- Analyze the IPCC's predictions for global sea level rise, and compare these to local sea level changes over the past 100 years.
- Apply IPCC report predictions for global sea level rise to the physical coastline at their field site, using rudimentary tools.
- Use real time, remotely sensed water level data to examine sea level impacts throughout a tidal cycle.

## Materials Required

- Dry erase board or flip chart paper
- Footwear, clothing, and sun protection suitable for fieldwork, including water shoes or boots for students on the water's edge

Supplies for each group of 4-5 students:

- Pole approximately 1.5 meters long (can use a tide stick)
- 'Line level' (or string level) ~3 inches in length. Often come two in a kit and may come with surveyors' string. Found in hardware stores.\*Note that there is a level app for cell phones and tablets, which students may enjoy using instead of a traditional level. They will need to hold the phone or tablet under the string.
- Surveyor's string or line – allow for plenty of length at your site
- Tape (colored painter's or electrical tape) to mark off elevation on the 1.5 meter pole
- A meter tape measure
- 3 stakes (if the ground is soft) or colored chalk, cones or other types of physical markers that can be used to mark locations for three different sea level scenarios
- A field copy of the graph sheet (attached) on a clipboard
- 3 pens/pencils of different colors
- Times for High Tide / Low Tide at your site (available from NOAA tides & currents page: [http://tidesandcurrents.noaa.gov/tide\\_predictions.html?gid=62#listing](http://tidesandcurrents.noaa.gov/tide_predictions.html?gid=62#listing))

## Engage

### Pre-Activity

Prior to reviewing the background information and starting the field activity, pose two sets of questions on a dry erase board or a flip-chart that you can use in the field. Have the students vote, and record the results using a tally mark for each possible answer in the following sets of questions.

*(Note: For each of the questions provide a range of answers to help guide the responses. Without any guide student responses have a tendency to be extreme, wide-ranging and often unrealistic.)*

6 IPCC, 2013: *Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 1535 pp.

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- 1) Question Set #1: How much do you think sea level has risen in NYC over the last 100 years?  
[Suggested response categories could include: 1) 0-9 cm (0-3.5 inches); 2) 10-19 cm (4-6 inches); 3) 20-29cm (8-11 inches); 4) 30-45cm (12-17.5 inches).]
- 2) Question Set #2: How much do you think sea level will rise in the next 100 years? 1) Less than it has in the last 100 years; 2) As much as it has in last 100 years ; 3) Double the rate of the last 100 years; 4) Triple the rate of the last 100 years.

Place these answers where the students can see them and move on with the activity. You will discuss them during the background and field activities.

Next, have students review the background information (see student worksheet), either as a class or in small groups. Consider using a reading strategy to assist students in unpacking the text.

As you read the final two background sections, review the students' responses to the first pre-activity question re: projected change in the last 100 years. Discuss what they had relied on when they answered this question i.e., other students' answers; news coverage they had heard; strictly a 'guess'; other?

## Explore

### Field Activity

Start by asking: *How will climate change affect this shoreline?*

Allow students to share some of their predictions, and point out particular shoreline features or landmarks that may be affected by rising sea levels. Discuss where the shoreline will be as sea level rises.

Tell students they are going to work in teams of 4-5 students. Each team will make measurements allowing them to predict what the shoreline will look like as sea level rises. Explain that they are going to look at what would happen based on three IPCC projected levels of sea level rise (see student worksheet):

- a) 28 cm (11 inches) anticipated with aggressive emission reductions
- b) 52 cm (20.5 inches) anticipated with reductions at a lesser scale
- c) 98 cm (39 inches) anticipated with 'business as usual' – few reductions.

Begin the activity.

1. Divide the class into groups of 4-5 students.
2. Give each group their set of field supplies. Spread the groups out along the waterfront, not too far apart as they will need to plot their locations together with those of the other groups. For younger students, you may wish to assign a spot, e.g., every 5 meters along the water's edge. Alternatively, have the groups choose their own locations.

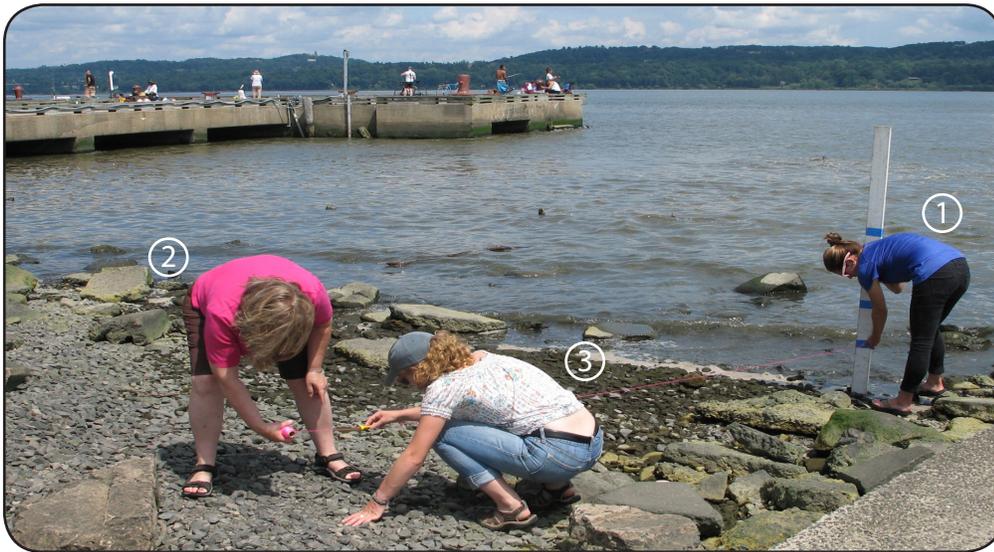
*Note: This activity will work best at sites with a fairly straight shoreline, lacking irregular coves and points. The groups can then be spread out more or less evenly along the shore, and their transects – run perpendicular to the shoreline – will not overlap.*

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3. Model for students how they will mark the three different IPCC measures on their poles with color tape. Then have them mark their poles.
4. Student #1 for each group holds the measuring pole vertically at the water's edge with his/her back to the water (may require water footwear). This is the starting point for their transect.  
*Note that they are measuring change added to the tide height at this time; it doesn't matter how high the tide is when you start the activity. They will discuss how tides may influence what happens later, back in the classroom.*
5. Tie the survey line around the pole where it is marked for 28 cm (11 inches) elevation. Student #2 walks straight away from the water with the survey line, trying to hold it level to where it is tied on the pole.



Student #1 is holding the pole.  
Student #2 is holding the line.  
Student #3 is hanging the level.



Student groups are spaced along the shoreline.

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6. Student #3 will hang the level on the survey line and direct student #2, helping them to keep the bubble in the line level evenly positioned as the string is extended until it intersects with the shore (in other words, it hits ground). Student #4 marks this location 'A' with a stake or other marker. (See photographs of this activity on the previous page.)
7. Move the survey line up the pole to the second mark at 52 cm (20.5 inches). Extend the string until it is level and touching the ground. Mark with stake 'B'.
8. Move the survey line up to the third mark on the pole (98 cm or 39 inches). Extend and level the string. Mark where it meets the ground with stake 'C'.
9. Have student #4 use the tape to measure and record on the bottom of the grid sheet how far the water would extend inland from its present edge under each of the three scenarios.
10. Have a couple of students measure and record the distances between Student #1 in each team, starting at one end of the field site and working to the other. They should base their measurements on where Student #1 was standing. These distances will determine the start point for charting each group's transect on the grid sheet.
11. Each group should enter the information requested at the bottom of their sheet.

If time allows, have the groups share their data and plot the results on their grid sheets while in the field, as directed below. Then move on to the Explain section.

If time is short, bring the class back together after students have placed the markers showing where shorelines will be with higher predicted sea levels. Briefly discuss the new sea level 'contours' before leaving. Set aside time for students to plot the data and discuss their observations more intensively back at school.

### Plot The Data

(May be done at the site or back in the classroom)

Have each group share its data with the others to complete their grid sheets. Each team should have a complete set of all teams' data-points and the measurements of the distances between the transects.

Have students determine the range of each data set. How far inland will the new shorelines be? How far apart are the two outermost transects? They then choose suitable scales for each grid axis and label each one with appropriate numbers. On the vertical axis, the scale must extend beyond the greatest distance measured from the existing water's edge to a new shoreline. On the horizontal axis, the scale must cover the distance between the transects at either end of the field site's shoreline.

Student should locate each transect at its proper point along the X axis and then – above that point – plot the three sea level data points for that transect. Then have them draw a line connecting across all the points 'A', another connecting all points 'B', and a third connecting points 'C'. Use a different color for each line. This will create a diagram of sea level change 'contours'. Students can add labels for each contour, corresponding to the three scenarios on which they are based.

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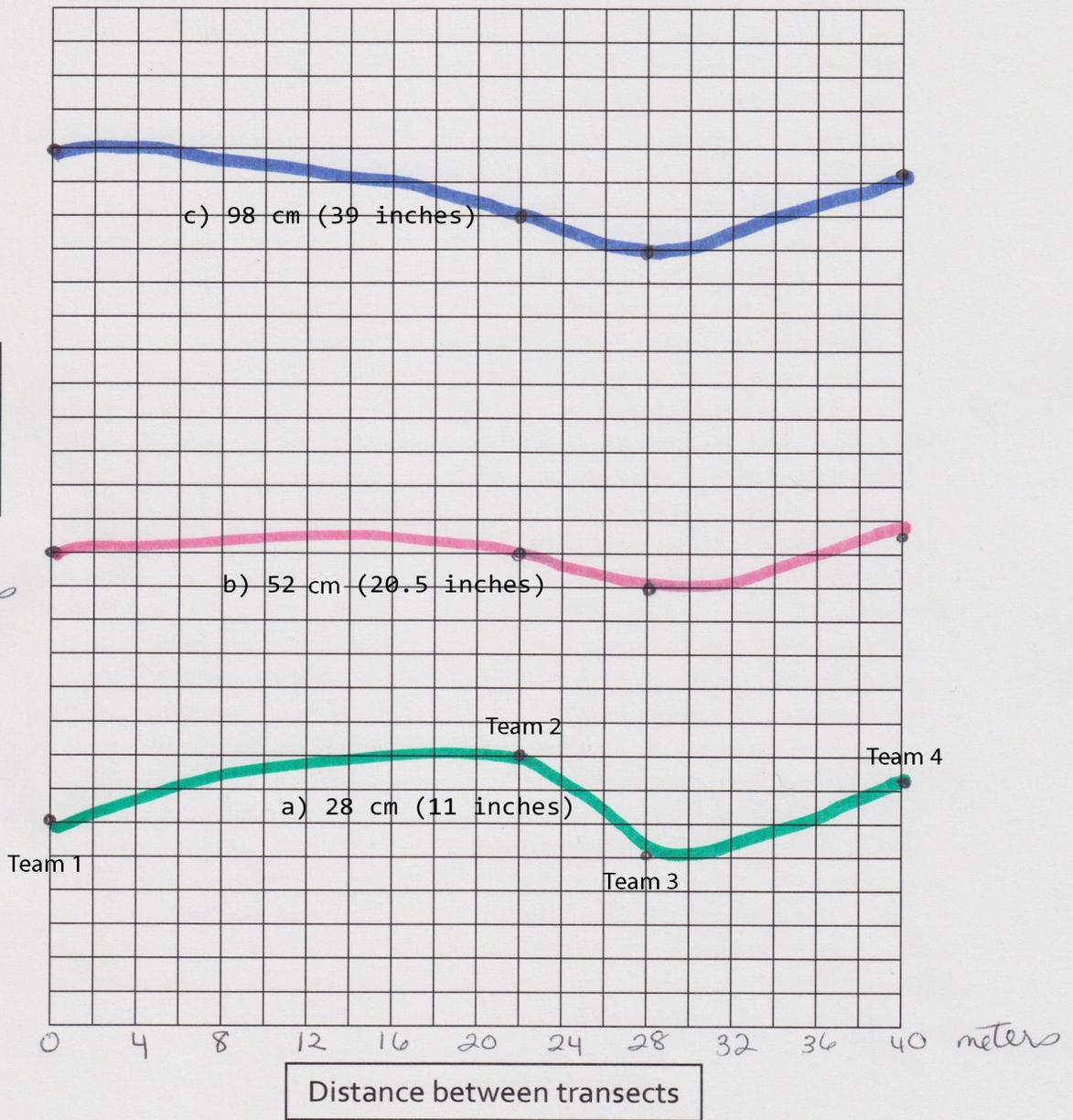
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### Waterfront Profile

Draw 3 different shoreline profiles using 3 colors, one for each of the 3 scenarios (A,B,C).

Distance from the water's edge

*0.5 meter squares*



DATE OF DATA COLLECTION 8/4/14 TIME OF COLLECTION 1:30 PM  
 LOW TIDE TIME 10:21 AM HIGH TIDE TIME 4:23 PM TIDAL RANGE FOR AREA ~3ft  
 TEAM NAME TEAM #1 @ zero marker  
 FOR YOUR TEAM: Measurement to Point A 3m Point B 7m Point C 13m

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## Explain

(May be done at the site or back in the classroom)

Discuss with the students what the effect of sea level rise will be on this shoreline region. What sorts of structures and land areas – including plants, animals and habitats – will be impacted by this projected sea level rise? If this is done back in the classroom, teachers and/or students may wish to snap a picture of the site to help in the discussion of impacts.

Remind students that we looked at a range of IPCC estimates based on data from the last 100 years and adding in the effects of our warming environment and changes in glaciers. Point out that the IPCC projections are not a guess; they are based on carefully made actual measurements. Entered into computer models, these data allow scientists to make realistic predictions for the future.

Ask the students where the tide was when their measurements were made. High? Low? Somewhere in between? What is the tidal range in this area? What will happen as the water level changes through the daily tidal cycle? If students have studied spring and neap tides discuss how these would affect water levels at their site<sup>7</sup>.

As sea level rises it magnifies the effects of storm surge. During superstorm Sandy, storm surge – the rise in water level as Sandy approached and passed over the area – was added to high tide, resulting in 10-14 foot high storm tides. What might that look like at your site? If sea level continues to rise, future storms won't need to be as severe as Sandy to have the same impacts.

## Discuss

Is there anything we can do to slow the rate of sea level rise?

*Suggested Answer: The IPCC discusses reducing greenhouse gas emissions by reducing our burning of fossil fuels and our carbon footprint to slow the build-up of greenhouse gases in the atmosphere and therefore trap less heat. Challenge your students to think of personal changes they can make.*

Are there ways to develop land differently when it is at or near a coastline?

*Ideas: Build back from the shoreline and above the projected sea level rise marks. Discuss the benefits of keeping our shorelines as natural as possible to allow them to respond to changes in sea level. Incorporate designs that can flood and recover.*

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<sup>7</sup> <http://oceanservice.noaa.gov/facts/springtide.html>

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## Elaborate

As a class, use the Hudson River Environmental Conditions Observing System [HRECOS] to look at the effects of sea level change over a tidal cycle:

1. Go to <http://www.hrecos.org>, then to 'Current Conditions'.
2. You can click on the top of the control panel to list the stations from North to South so you can locate the stations geographically.
3. Choose the site closest to your sample site and select 'Depth' or 'Elevation' to show the tidal cycle at this location.
4. Select the date on which you made your measurements.
5. Measure the tidal range for this site. In each 24 hour period there are two cycles of high and low tides. Select the cycle with the greatest difference between high and low points, and measure the difference between those two water levels – the tidal range. You can do this visually using the graph or you can download the actual measurements in Excel to your computer.
6. Refer back to your field data. During what part of the tidal cycle did your team collect data? Was the tide high, low, in between? How much would you predict you might have to adjust the sea level contours on your grid if you did not measure at the highest part of the tidal cycle? Use a pencil to sketch it on your grid.

For accelerated students, use Google Maps to create an image of your field site. Be sure the image includes a scale bar. Have the students transfer their data to the map image using the measurements on the map and on their graphs.

## Evaluate

Assign the short writing activity (see student worksheet) for homework. By reviewing students' responses, you can assess whether they understood what they were doing in the field and the larger picture of climate change and sea level rise.

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## Student Worksheet New York Explores Sea Level Rise

Name \_\_\_\_\_

### WHAT IS CLIMATE CHANGE?

Climate refers to long-term changes in patterns of temperature, precipitation, humidity, wind, and seasons. Climate varies by region but overall the earth's climate has been warming. Global temperatures over both land and ocean surfaces have risen  $\sim 0.85^{\circ}\text{C}$  ( $1.5^{\circ}\text{F}$ ) since 1880. The U.S. is warming at  $\sim 0.72^{\circ}\text{C}$  ( $1.3^{\circ}\text{F}$ ) per century.

### IS GLOBAL SEA LEVEL RISING?

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Global rates are important for assessing overall trends in sea level change. However, climate models predict that sea level will not rise uniformly around the world and satellite data and local tide gauge measurements show that this is true. In some places like in the Chesapeake Bay, rates are up to several times the global mean rise. In other regions, like areas of Alaska, sea level is falling. This variability is in large part due to local circumstances of geology, ice history, temperature, salinity and ocean currents.

### WHY IS THE SEA LEVEL RISING?

There are two major causes of global sea level rise: (1) thermal expansion of ocean water and (2) melting of land-based ice. The ocean is absorbing much of the additional heat trapped by greenhouse gasses in our atmosphere. As it warms, ocean water expands, causing sea level to rise. Approximately 50% of the rise in sea level is due to this expansion. At the same time, warmer temperatures across the globe are causing land glaciers and sections of the Greenland and Antarctic Ice Sheets to melt. No longer locked up in ice, this melt-water eventually reaches the oceans and also causes sea level to rise.

### WHAT ABOUT NEW YORK?

A tide gauge at the Battery in New York City measures local or 'relative' sea level, and provides evidence that sea level has risen close to 2.77 mm/year over the last 150 years. For the last 100 years this amounts to a rise of 27.7 cm ( $\sim 11$  inches) (see graph on next page).

### WHAT DOES THIS MEAN FOR OUR FUTURE?

In 2013 and 2014 reports, the IPCC suggests that sea level rise will continue to accelerate over the next  $\sim 100$  years. How much sea level rises will depend on how well carbon dioxide emissions are controlled. If emissions are greatly reduced, sea level rise is predicted to be 28-61 cms (11-24 inches). If carbon dioxide emissions are not well controlled, sea level rise may be closer to 52-98 cms (20-39 inches). What will this mean on your local waterfront? Let's get outside and see!

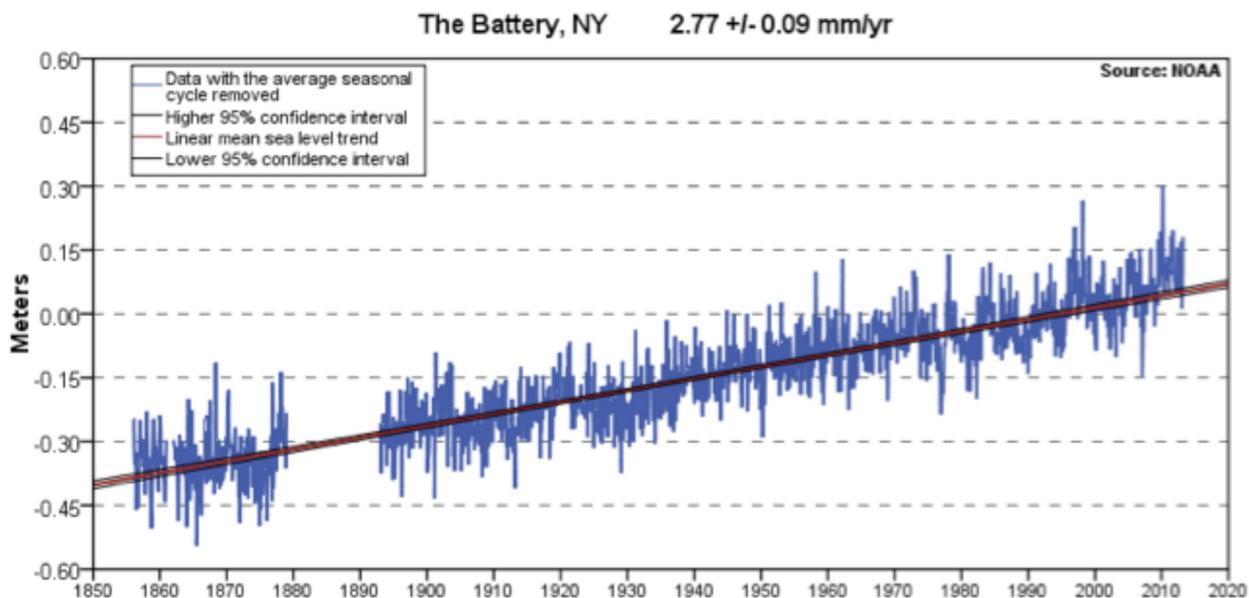
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## Student Worksheet New York Explores Sea Level Rise

### Mean Sea Level Trend 8518750 The Battery, New York



The mean sea level trend is 2.77 millimeters/year with a 95% confidence interval of +/- 0.09 mm/yr based on monthly mean sea level data from 1856 to 2006 which is equivalent to a change of 0.91 feet in 100 years.

### FIELD ACTIVITY

- Your class will work in teams of 4-5 students. Each team will make measurements allowing you to make an accurate prediction of what the shoreline will look like as sea level rises. You are going to look at what would happen based on three IPCC projected levels of sea level rise:
  - 28 cm (11 inches) anticipated with aggressive emission reductions
  - 52 cm (20.5 inches) anticipated with reductions at a lesser scale
  - 98 cm (39 inches) anticipated with 'business as usual' – few reductions
- Your teacher will give each group a set of field supplies. Once you have these, spread out along the waterfront, not too far apart as you will end by combining your information with the other groups to plot the larger waterfront location.
- Mark the three different IPCC measures on your pole with the marking tape.
- Student #1 for each group holds the measuring pole vertically at the water's edge with his/her back to the water (may require water footwear). This is the starting point for your sea level rise transect, which will extend inland from the water's edge.

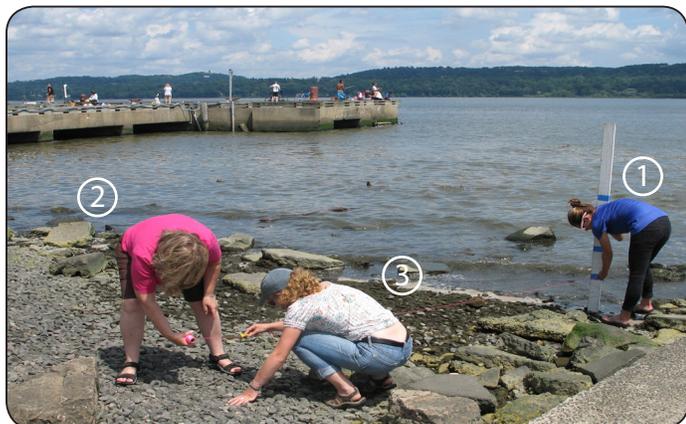
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## Student Worksheet New York Explores Sea Level Rise

- Tie the survey line around the pole where it is marked for 28 cm (11 inches) elevation. Student #2 walks straight away from the water with the survey line, trying to hold it level to where it is tied on the pole.



Student #1 is holding the pole. Student#2 is holding the line.  
Student#3 is hanging the level.



Student groups are spaced along the shoreline.

- Student #3 will hang the level on the survey line and direct student #2, helping them to keep the bubble in the line level evenly positioned as the string is extended until it intersects with the shore (in other words, it hits ground). Student #4 marks this location 'A' with a stake or other marker
- Move the survey line up the pole to the second mark at 52 cm (20.5 inches). Extend the string until it is level and touching the ground. Mark with stake 'B'.
- Move the survey line up to the third mark on the pole (98 cm or 39 inches). Extend and level the string. Mark where it meets the ground with stake 'C'.
- Have student #4 use the tape to measure and record on the bottom of the grid sheet how far the water would extend inland from its present edge under each of the three scenarios.
- Your teacher will select a couple of students to measure and record the distances between Student #1 from each team, starting at one end of the field site and working to the other. They should base their measurements on where Student #1 was standing. These distances will determine where each group's transect is charted on the grid sheet.
- Enter the information requested at the bottom of your group's grid sheet.

If time allows, all the groups will share their data and plot the results on their grid sheets while in the field, as directed below. If time is short, the class will return and complete this grid in school. Before heading back, take a look at the placement of the markers showing where shorelines will be with higher predicted sea levels. What will these new sea level 'contours' mean for this waterfront and its structures, plants, animals and habitats?

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## Student Worksheet New York Explores Sea Level Rise

### PLOT THE DATA

(May be done at the site or back in the classroom)

Your group should share its data with the others to complete the grid sheets. Each team should have a complete set of all teams' data-points and the measurements of the distances between the transects.

What is the range of each data set? How far inland will the new shorelines be? How far apart are the two outermost transects? Choose suitable scales for each grid axis and label each one with appropriate numbers. On the vertical axis, the scale must extend beyond the greatest distance measured from the existing water's edge to a new shoreline. On the horizontal axis, the scale must cover the distance between the transects at either end of the field site's shoreline.

Locate each transect at its proper point along the X axis and then – above that point – plot the three sea level data points for that transect. Draw a line connecting across all the points 'A', another connecting all points 'B', and a third connecting points 'C'. Use a different color for each line. This will create a diagram of sea level change 'contours'. Add labels for each contour, corresponding to the three scenarios on which they are based and be ready to discuss your chart.

### WHAT ABOUT THE TIDES?

In your group explore the following:

1. Where was the tide when your measurements were made? High? Low? Somewhere in between? What is the tidal range in this area? What will happen as the water level changes through the daily tidal cycle?
2. As sea level rises it magnifies the effects of storm surge. During superstorm Sandy, storm surge – the rise in water level as Sandy approached and passed over the area – was added to high tide, resulting in 10-14 foot high storm tides. What might that look like at your site? If sea level continues to rise, future storms won't need to be as severe as Sandy to have the same impacts.

### EVALUATION

In 1-2 paragraphs, describe the field activity you conducted with your classmates. Be sure to include:

- The reasons for conducting the activity
- The procedures your team followed
- What you learned from the experience and why it is important

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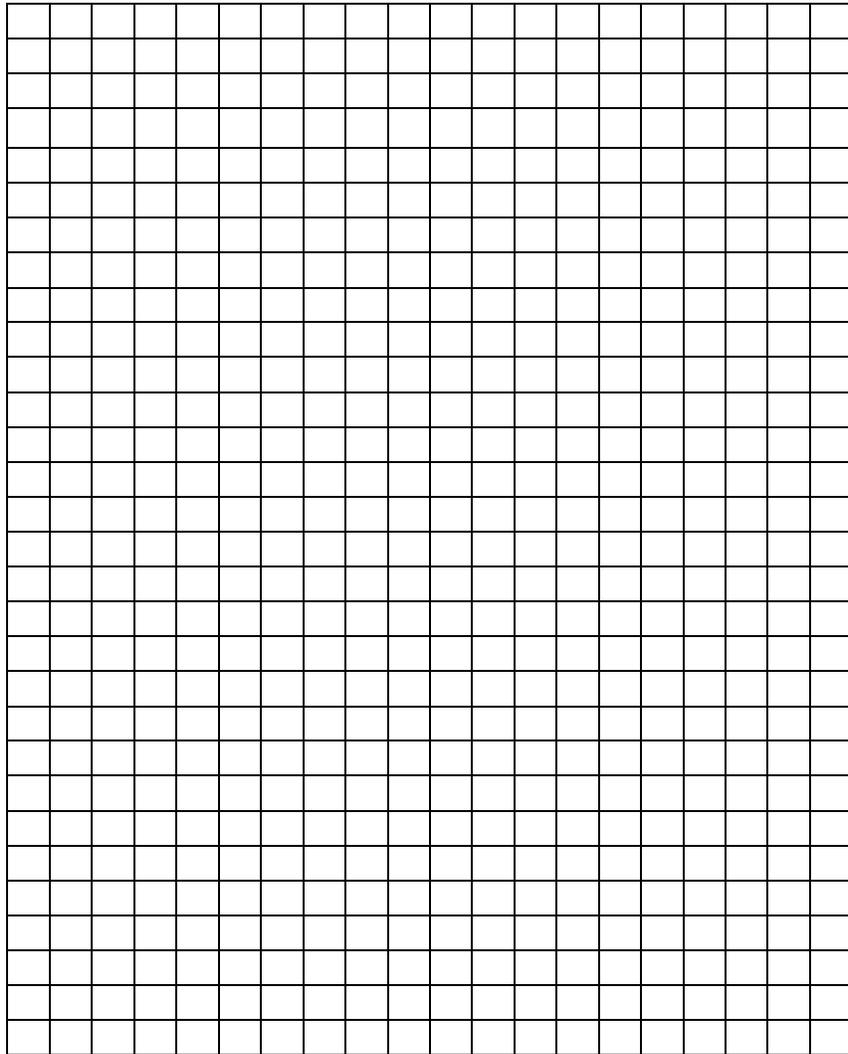
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## Student Worksheet New York Explores Sea Level Rise

### Waterfront Profile

Draw 3 different shoreline profiles using 3 colors, one for each of the 3 scenarios (A,B,C).

Distance from the water's edge



Distance between transects

DATE OF DATA COLLECTION \_\_\_\_\_ TIME OF COLLECTION \_\_\_\_\_  
 LOW TIDE TIME \_\_\_\_\_ HIGH TIDE TIME \_\_\_\_\_ TIDAL RANGE FOR AREA \_\_\_\_\_  
 TEAM NAME \_\_\_\_\_  
 FOR YOUR TEAM: Measurement to Point A \_\_\_\_\_ Point B \_\_\_\_\_ Point C \_\_\_\_\_

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# Hudson River Estuary Climate Change Lesson Project

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[www.nyseagrant.org](http://www.nyseagrant.org)  
<http://www.dec.ny.gov/lands/>



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