Projecting and Mapping Sea Level Rise

Lesson Overview

Grade Level: 6th
Subject Area: MS-ESS3 Earth and Human Activity: Climate Change
Next Generation Standards: ESS3.C Human Impacts on Earth Systems
Inquiry Question: How will sea level rise affect Humboldt Bay in the future?
Overview: In this lesson students will be introduced to the concept of climate change impact projections. Students will learn what a projection is and develop an understanding as to how human behavior can influence projections. Students will be able to connect sea level rise projections to their own lives by doing a measuring and mathematics exercise. They will also do a mapping exercise looking at areas at risk from sea level rise around the Humboldt Bay.
Preparation: Print out enough Humboldt Bay inundation maps for each student. Provide measuring tapes for every other student.

Prior Knowledge
Students should be familiar with the greenhouse gas effect, and have a basic understanding of how some human activities create greenhouse gases. Students should have a basic understanding of climate change

Student Objectives
Students will be able to convey how present and future human activity will effect projections.

Students will understand that they will see sea level rise impacts in their lifetime on Humboldt Bay.

Materials
Provided:
Humboldt Bay Inundation Map

Needed:
Tape measures

Time Needed
1 Class Period

Teacher Background

It is hard to make climate change impact projections since there are many variables. The three unknowns that need to be taken into account when making projections are as follows:

1. Uncertainty of future greenhouse gas emissions into the atmosphere in the future.
2. Uncertainty in how components of the climate like temperature, precipitation, and sea level, will react towards the quantity of green house gas emitted.
3. Uncertainty of how natural factors will influence climate in the future, such as volcanic activity intensity of the sun, and natural processes such as ocean circulation currents.

Scientists recognize that there is a lot of variability that goes into climate change projections. Scientists try to account for this variability by creating predictions that include many different factors such as possible future economic, social, technological, and environmental conditions.

Climate change scientists use climate models to make projections. Climate models use complex mathematical representations to demonstrate the interaction between different climate features, such as the ocean, land, ice and atmosphere. Since climate models are mapping very complex interactions

supercomputers are used. Despite the use of advanced technology, due to the complexity and numerous unknowns influencing climate change impacts, no climate models are perfect.

Even if there is a complete halt in greenhouse gas emissions worldwide, climate change impacts are still projected. This is due to the fact that many greenhouse gases stay in the atmosphere for hundreds of years. Another reason is that the ocean, which is one of the largest storages of heat, has a delay in responding to greenhouse gas concentrations. Even without the continued emission of greenhouse gases in the atmosphere the ocean will continue to respond to increased temperatures and greenhouse gas concentrations for up to hundreds of years.
(http://www.epa.gov/climatechange/science/future.html#)

The sea level rise projection map of Humboldt Bay used in this lesson was modeled as if the sea level raised two meters and the dikes protecting the Humboldt Bay breached. The area shown as inundated is if there was no infrastructure in place to protect the land from flooding.

Procedures

ENGAGE	Grouping: Class	Timing 5 minutes

- Ask students if they think there will be any impacts of climate change in Humboldt. If yes, how?
- Ask students if they think that sea level rise will affect Humboldt Bay.

EXPLAIN	Grouping: Class	Timing 15 minutes

- Explain that you are going to do an activity exploring sea level rise projections.
- Write the definition of projection on the board
  - "Projection: an estimate of what might happen in the future based on what is happening now" (Dictionary.com)
- Explain that climate projections are statements that climate scientists make about the possibility of a climate change impact happening in the future depending on present and future influencing conditions.
- Explain that projections often give several future possibilities depending on decisions people and politicians make now.
- Explain that there are many unknowns in projections
  - Amount greenhouse gases that will continue to be emitted
  - How climate responds to greenhouse gas concentrations
  - Natural Influences
- Tell students that sea level rise projections for Humboldt Bay for year 2100 are between 2.0 and 5.2 feet. Write these two projections on the board.
- Ask students why they think there is such a huge difference between the two projections.
- Explain to students that the two projections are largely dependent on human activity.
  - Explain that the higher projection of 5.2 feet is if we continue to use the same amount of fossil fuels as we use now and make no changes.
  - Explain that the lower projection of 2 feet is if we drastically reduce the number of emissions we're producing.
  - Ask students to think of examples of how we can reduce greenhouse gas emissions
    - Example Answers: burning less fossil fuels (driving less, driving electric vehicles, biking less, using clean or alternative energy, flying and traveling less), using cleaner energy technology (solar power, wind energy), protecting forests (carbon sequestration), reducing waste, supporting businesses that use cleaner energy, eating less meat.

EXPLORE	Grouping: Pairs	Timing: 25 minutes

- Hand out a measuring tape to pairs of students.
- Tell students to write down how old they are now in 2015 in their notebook. Ask students to figure out how old they will be in 2100
- Tell students to measure themselves and mark down in their notebook how tall they are.
- Ask students to now measure 2 feet on themselves and then measure 5.3 feet.
  - Explain to students that these are the projections for how high the sea level will rise above what it is already at by year 2100.
- Ask students if they think this amount of sea level rise will affect homes, land, and businesses in Humboldt.
- Hand out an inundation map to each student.
- Ask students to locate three places on the map that they recognize.
- Ask students to locate three areas at risk from sea level rise.

ELABORATE	Grouping: Small Groups	Timing: 5 minutes

- Tell students that climate change is not an issue that just affects polar bears but affects people as well.
- Explain that sea level rise will affect a lot of different areas and people who live around the Bay so it is important to work together as a community to prepare to climate changes.

EVALUATE	Grouping: Individual	Timing: 2 minutes

- Follow assessment options below

Assessment:

Option 1: Do students understand that human activity can affect sea level rise projections?

- Ask students to answer the question in their journal: "How might present and future human activity affect sea level rise projections?"

Option 2: Do students understand that there will be climate change impacts on Humboldt Bay in the next 100 years?

- Ask students to write down Yes or No to the following question "According to climate change projections will sea level be higher than it is now in 100 years?"

Extensions: If you have more time or want to create a homework assignment,
have students write a page to answer assessment option 1 question in more detail.

Resources: http://www.epa.gov/climatechange/science/future.html
http://www.epa.gov/climatechange/science/future.html#

Vocabulary

Projection: the act of visualizing and regarding an idea or the like as an objective reality

Climate Models: use quantitative methods to stimulate the interactions of the atmosphere, oceans, land surface, and ice. They are used…(to make) projections of future climate. (www.wikipedia.com)

Fossil Fuels: any combustible (burnable) organic material, as oil, coal, or natural gas, derived from the remains of former life.

Climate: the generally prevailing weather conditions of a region, as temperature, air pressure, humidity, precipitation, sunshine, cloudiness, and winds throughout the year, averaged over a series of years.

Greenhouse Gases: any of the gases whose absorption of solar radiation is responsible for the greenhouse effect, including carbon dioxide, methane, ozone, and the fluorocarbons.

Atmosphere: the gaseous envelope surrounding the earth; the air.

Emissions: the act of emitting or sending forth

Concentration: the amount of a particular substance in a given amount of another substance, especially a solution or mixture.

Definitions taken from Dictionary.com unless noted otherwise.

Two Meter Inundation Map