

THE HUMAN ELEMENT

EARTH

AIR

FIRE



“*When I walk on the beach, it’s like I’m taking a trip in my past. But I’m also walking into my grandchildren’s future. Beause we’re one storm away from becoming a part of history.*”

—Carol Pruitt in *The Human Element*, speaking of living on Tangier Island in Chesapeake Bay, VA

WATER



WATER LESSON OBJECTIVES

At the end of this lesson, students will be able to:

- ▶ Explain the causes and mechanisms of glacial melt and rising sea levels.
- ▶ Articulate how rising sea levels impact humans living in coastal areas using visual evidence and scientific data.
- ▶ Discuss how human behavior is changing water on Earth, how those changes are affecting humans, and how human efforts might help or ameliorate those changes.

MATERIALS

- ▶ You can find the Water Chapter here: <https://vimeo.com/328529341>. The password is: **THEdu**.
- ▶ Projection equipment to screen the Water Chapter of *The Human Element*
- ▶ Printed copies of [Handout One—Water Note Catcher](#)
- ▶ Printed copies of [Handout Three—Artist Statement](#)
- ▶ Student access to the internet or copies of [Research Appendix One](#)

DURATION

Two 50-minute class periods

OPENING EXERCISE: CLIMATE CHANGEMAKER

Read aloud the following quote from [ExtremelceSurvey.org](https://www.extremelicesurvey.org/):

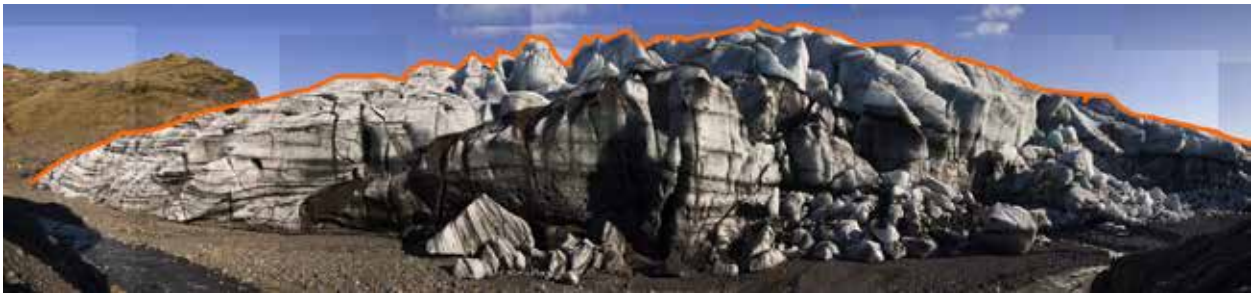
“*Founded in 2007 by James Balog, the Extreme Ice Survey (EIS) is an innovative, long-term photography program that integrates art and science to give a ‘visual voice’ to the planet’s changing ecosystems. We believe that the creative integration of art and science can shape public perception and inspire action more effectively than either art or science can do alone.*”

Ask students to briefly discuss:

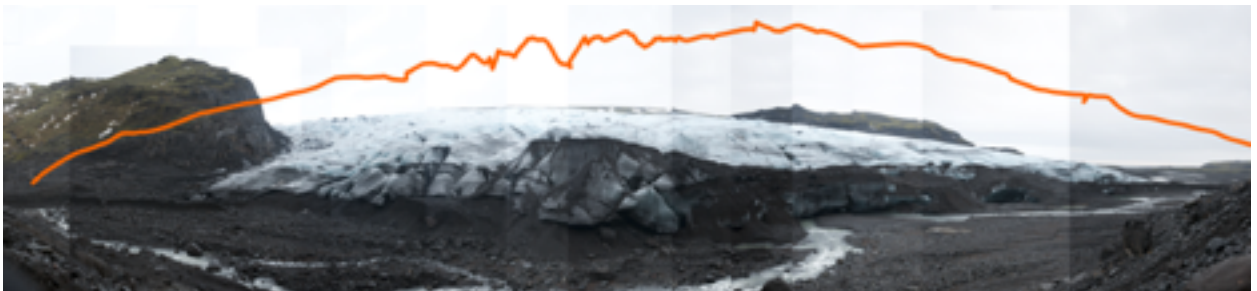
According to this statement, what is the role of the Extreme Ice Survey’s photography in relation to science? Do you agree? Why or why not?

Project or distribute the following images:

The Extreme Ice Survey uses time-lapse photos to record images of receding glaciers around the world like these:



April 2006



October 2006

* Photos: <https://chasingice.com/thescience/>

If you have access to the internet, consider showing these time-lapse videos:
<https://www.youtube.com/channel/UCrbOu1VKjJinDig-0p2dZAw>

As a class, discuss:

- ▶ What do these images from the Extreme Ice Survey tell you about receding glaciers?
- ▶ How is seeing these images different from reading about melting ice?
- ▶ What is the role of visual evidence like this in understanding science?
- ▶ The receding glacier images from 2006 on the previous page were taken six months apart. The first is from the end of winter when one might expect ice levels would be high, and the second is at the end of summer when ice would be expected to be lower. How might you go about learning whether the change represented here is normal for season change, or not?

Watch the Film Chapter “Water” (run time, 17:13)

Pass out [Handout One—Note Catcher](#) for students to take notes as they watch the clip.

Discuss: After watching the clip, how do you think the visual evidence provided by the Extreme Ice Survey changed our understanding of climate change across the globe?



EXPLORE THE HUMAN CAUSES OF SEA LEVEL RISE

Increasing global air temperatures are melting glaciers and ice sheets. When ice melts, the water eventually runs off into the oceans, causing sea levels to rise.

The oceans also absorb much of the heat from a warming atmosphere. This heating causes the water volume to expand, and is currently contributing another 40 percent to sea level rise.

Average sea level around the world is rising three millimeters per year. At the rate the ice is melting today, and at the current rate of atmospheric warming, that translates into 30 millimeters in a decade, and 240 millimeters – three-quarters of a foot – in an average American's lifetime.¹ But steadily increasing air temperatures from the greenhouse effect and newly observed ice sheet breakdown in Antarctica means that the rate of future sea level rise will be even greater than the rate we see today.

Ask students to examine the graphs in [Handout Two: Rising Carbon, Heat and Sea Levels](#) and answer the following discussion questions:

- ▶ What is the story these three charts tell about the relationship between rising levels of carbon dioxide, global temperatures and sea level?
- ▶ What do these three charts suggest about how to act to slow or mitigate rising sea levels?
- ▶ What further questions do you have as you study these graphs together?
- ▶ Though this section of the film focuses on rising sea levels, what other effects might rising ocean temperatures have on sea life, sea chemistry, or other aspects of sea life?



THE COSTS OF RISING SEA LEVEL

“As the oceans rise, every community on the coast will be affected. And some of them much sooner than others.”

—James Balog, *The Human Element*

“We’ll have to decide how we’re going to handle the situation, because we as a society do not have the resources to protect everything.”

—Dave Schulte, U.S. Army Corps of Engineers, in *The Human Element*

As a class, discuss: What did you see in the “Water” film clip that represented the effects of rising sea levels?

As nations, communities and individuals around the world explore how to protect themselves against rising seas, cost is a critical factor. Difficult decisions must be made.

For example, the film identifies the following communities as at-risk. Below are the estimated costs for cities to adapt to ocean flooding with protective structures, or relocate.

Isle De Jean Charles, Louisiana

Population: 85

Relocation Cost: \$50 Million

Norfolk, Virginia

Population: 245,000

Adaptation Cost: \$1 Billion

Miami, Florida

Population: 450,000

Adaptation Cost: \$413 Billion

New York City, New York

Population: 8.5 Million

Adaptation Cost: \$120 Billion

Tangier Island, Virginia

Population: 782

Adaptation Cost: \$100 Million

EARTH

AIR

FIRE

WATER

If you live in a coastal community, consider using one of these tools to visualize how rising sea levels may impact your area:

- ▶ <https://coast.noaa.gov/slr/>
- ▶ <http://sealevel.climatecentral.org/maps>

Split the class into groups to develop answers to the following questions. Ask them to prepare to present and defend their answers using evidence from the film, recent events, or original research:

1. What factors should be considered when deciding whether a community threatened by rising sea levels should be abandoned or protected?
2. What are the different considerations for heavily-populated urban areas versus rural areas?
3. How would you weigh the moral, ethical and economic costs of protecting a particular city or town against the human cost of abandoning it?
4. What policies would you recommend to guide decisions on how money is allocated to threatened communities?



EXTENSION ACTIVITY:

Have students read “[A Subtle Effect of Climate Change: Uneven Sea Level Rise](#)” (full text in [Research Appendix One](#)).

Discussion question or writing exercise:

1. How might the information in this article influence policy decisions about where and how to invest in saving coastal communities?

EFFECTS: VISUAL EVIDENCE

“When the children in the water get to be people in their 60s, and 70s, and 80s, the water level is going to be really different than it is now. The world is changing, and the world that they will know in the near future will be a profoundly different world than the world you and I know right now.”

—James Balog, *The Human Element*

In the final part of the lesson, distribute or share the below images from *The Human Element* (<https://thehumanelementmovie.com/water/>).



Discuss:

- ▶ What do these images tell you about the meaning of rising sea levels?
- ▶ How is seeing these images different from reading about rising sea levels?
- ▶ Does seeing images that contain people and everyday life feel different to you than seeing images of the receding glaciers? Why or why not? Which resonates more with you?

THE HUMAN ELEMENT OF CHANGE

This lesson culminates with a project to help students synthesize their learning. The below projects can be completed during class time or assigned as homework. If you are planning to complete all four of *The Human Element* lessons, this portion of the lesson can contribute to the final culminating lesson.

Suggested project ideas:

1. If you live in a coastal community, research a recent event such as a major storm or sea surge. Interview a local or state official to learn about how climate change is acknowledged, or not, in the way your community is thinking about rising sea levels. What is happening in your community to address those concerns?
2. If you live in an inland community, explore where your community gets its drinking water, and what, if any, concerns exist about how climate change is going to affect the water supply in your area.
3. Using art, photography, found objects or other creative mediums, create two art pieces that represent the different ways rising sea levels may affect your community. If you are inland, focus on how climate change affects water availability in your area. See [Handout Three—Artist Statement](#) for a statement prompt and peer review suggestions.

E
A
R
T
H

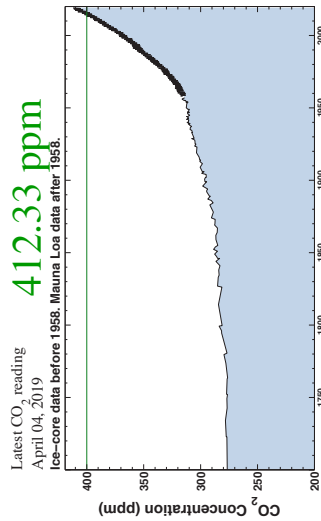
A
I
R

F
I
R
E

W
A
T
E
R

Rising Carbon Dioxide in the Atmosphere

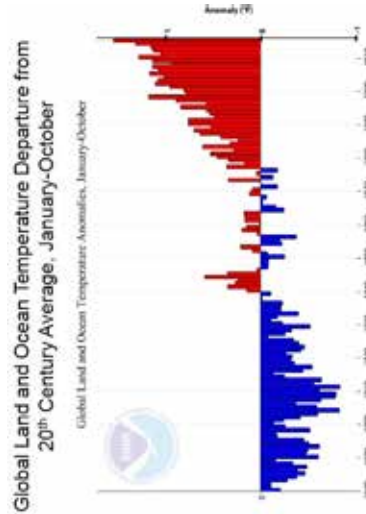
When carbon dioxide is released into the atmosphere, it traps heat to the earth. carbon dioxide is a byproduct of burning fossil fuels, a problem worsened by deforestation, which prevents the gas from being absorbed or converted.



https://scripps.ucsd.edu/programs/keelingcurve/wp-content/plugins/sio-bluemoon/graphs/co2_800k_zoom.pdf

Global Temperature is Rising

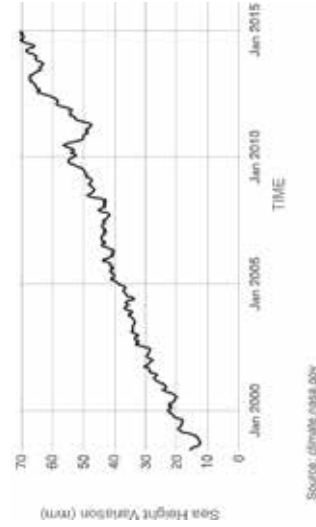
As a result of rising carbon dioxide and other gasses that trap heat in Earth's atmosphere, temperatures are rising globally at a rate that cannot be attributed to natural warming cycles.



https://www.ucsusa.org/sites/default/files/styles/embedded_original/public/images/2016/11/gw-global-land-ocean-temperatures-departure-from-20th-century-average.jpg?itok=FWgfn5uY

Rising Sea Levels

As global temperatures rise, glaciers melt into the ocean and increase the sea level.



<https://climate.nasa.gov/vital-signs/sea-level/>

EARTH

AIR

FIRE

WATER



HANDOUT THREE

EARTH

AIR

FIRE

WATER

ARTIST STATEMENT

Artist Statement:

Write a paragraph about your artwork and how it relates to the ways climate change and human behavior have affected rising sea levels, or how your community's relationship to water has changed. Be sure to clearly state your message.

Peer Review Questions:

What message do you gain from the artwork and the artist's statement above?

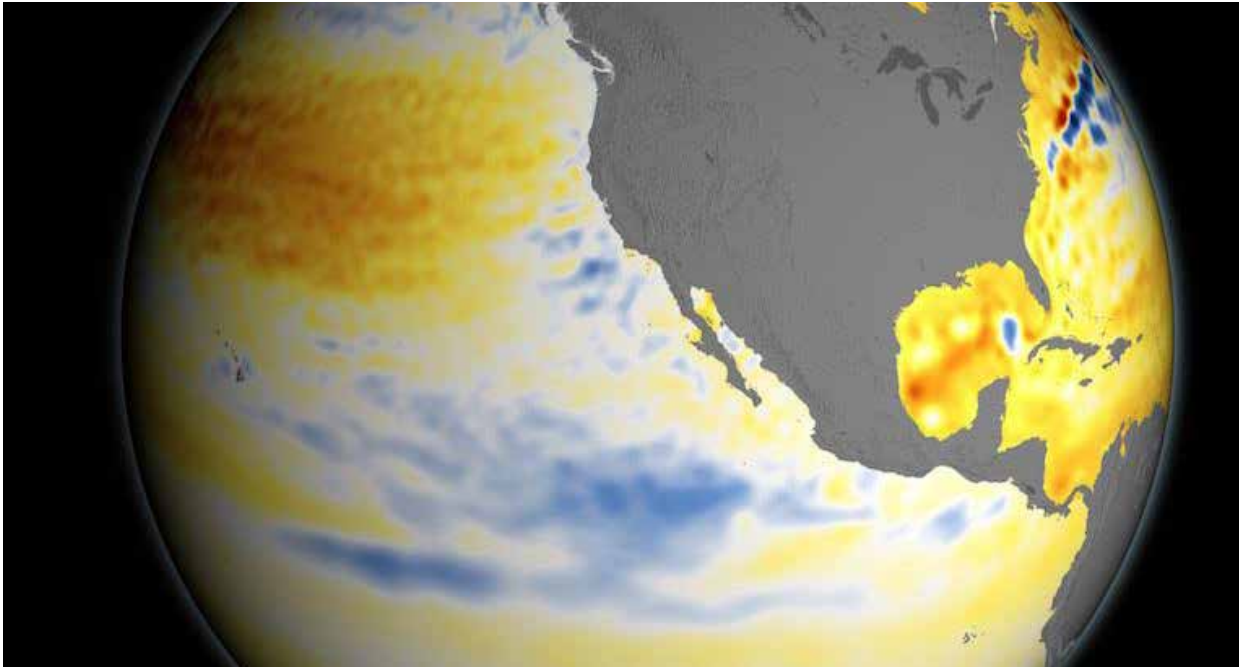
What questions arose for you, and what would you like to know more about?

What did you like about this work?

What opportunities for growth do you see?

UNEVEN SEA LEVEL RISE

*Adapted from “[A Subtle Effect of Climate Change: Uneven Sea Level Rise](#),” by Laura Snider, December 13, 2008 in *Sea Level News at NASA.gov**



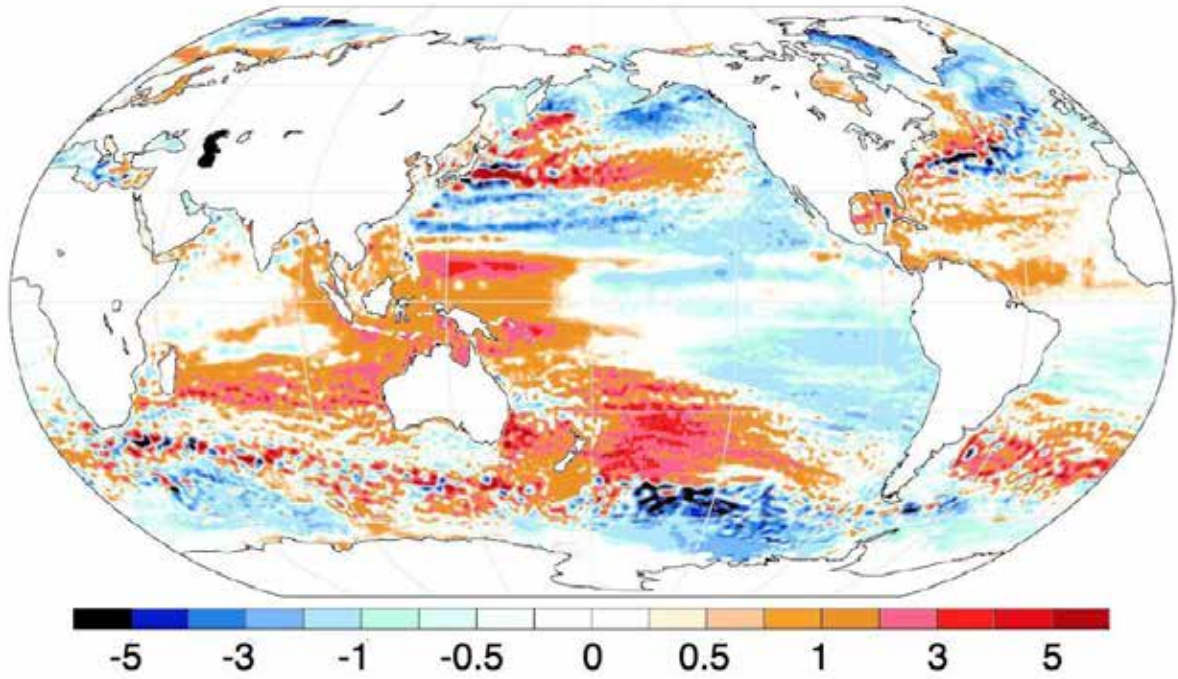
A visualization of sea level rise between 1992 and 2015, based on satellite data. Orange and red indicate higher sea levels; blue lower, or unchanged. Credit: NASA's Scientific Visualization Studio, Goddard Space Flight Center.

Regional differences in sea level rise are influenced by where heat is stored in the ocean (since warm water expands to fill more space than cold water) and how that heat is transported around the globe by currents and wind. Uneven sea level rise is also influenced by ice sheets, which lose mass as they melt and shift the gravitational forces affecting regional sea surface height.

Natural shifts in ocean cycles—including the Pacific Decadal Oscillation, a pattern of sea surface temperatures similar to El Niño but longer lasting—are therefore known to affect sea levels. So scientists were not surprised to find that as the ocean rises, it rises unevenly. But it's been difficult to say whether these natural cycles were the dominant influence on regional differences.

The findings suggest that regions of the world where seas have risen at higher than average rates—including the Eastern Seaboard of the United States and the Gulf of Mexico—can expect the trend to continue as the climate warms.

“By knowing that climate change is playing a role in creating these regional patterns, we can be more confident that these same patterns may linger or even intensify in the future if climate change continues unabated,” one of the scientists, John Fasullo, said. “With sea levels projected to rise a couple of feet or more this century on average, information about expected regional differences could be critical for coastal communities as they prepare.”



Regional sea level trends in millimeters per year from 1993 through mid-2018 with the global average rate removed. Red colors indicate that the local rate of sea level rise was greater than average, and blue colors indicate the opposite. **Credit: PNAS.**

Improving forecasts

The research findings have implications for local officials, who are interested in improved forecasts of sea level rise for the areas they oversee. In the past, forecasters have had to rely on the average global rate of change of sea level rise—about 3 millimeters a year and accelerating—and knowledge of the uneven regional impacts associated with continued melting of the ice sheets covering Greenland and Antarctica.

The findings add the possibility that the regional patterns of sea level rise tied to climate change can also be included, because the models predict that the regional patterns observed in the satellite measurements will continue into the future.

ENDNOTES

- 1 <https://oceanservice.noaa.gov/facts/sealevel.html>