Mitigation or Adaptation: You Decide

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Following a broad overview of climate change, audience members are presented with realistic scenarios from around the world: Should we build a resort hotel in Miami Beach? How do we address air pollution in Beijing? How do we feel about longer growing seasons in Greenland? Audience members use clickers to vote on a course of action and the results give a launching point for discussion.

**iRespond clickers and Microsoft PowerPoint are required for this presentation.
**The flatscreen PowerPoint presentation that accompanies this live program is available on the SOS website.

Live Program Script:

**Note:

- Lines that begin with ">>" and bracketed text denote presenter instructions. *In this version of the script, these are also italicized.*
- "(Q?)" denotes discussion questions.

---(1) Blue Marble---

>>Welcome the audience to SOS...give basic information about NOAA and the sphere and introduce the first three clicker questions.

>>Allow enough time for the majority of audience members to respond and then move to the next slide to show the results.

You've probably already guessed that the last question has to do with climate change. Before we can discuss adapting to climate change and mitigating its effects, let's understand what is happening:

---(2) Atmospheric Chemistry: GEOS-5 Model---

Through the burning of fossil fuels, humans are releasing harmful pollutants into the atmosphere. Some of these pollutants have an immediate effect. For example, carbon is released from coal power plants and the burning of forests and it can make breathing more

difficult. Sulfate (white) comes from fossil fuel burning and volcanic eruptions. Dust (red) is carried by the wind out of deserts like the Sahara. And sea salt (blue) is lifted up and carried by wind and weather systems over the ocean. Black carbon is a big concern because it is linked to fossil fuel burning.

These particles are big enough to impact visibility, but small enough to get into your lungs. For perspective, a grain of beach sand has a diameter of 90 microns while a typical fine particle of black carbon has a diameter of only 2.5 microns.

Dataset Notes

- Dust, sulfate, and sea salt fall out of the sky after it is carried.
- Pollutants and smog can be removed from the air through rain, so aerosol pollution is a big concern during a drought.

Main takeaway: We are releasing pollutants into the atmosphere which is a present-day health concern because it makes breathing more difficult.

(Q?) How can we adapt to this?

Potential answer: Black carbon is emitted by cars, but catalytic converters have greatly reduced this type of pollution. In Asian countries with rampant air pollution, people have adapted by wearing masks to protect their lungs.

---(3) Carbon Tracker: Slide Scale - 2000 - 2010---

One pollutant gets a lot of attention-- carbon dioxide, or CO2. CO2 is different than black carbon-- black carbon refers to solid particles that are released when fossil fuels are burned. CO2 is a gas. When we breathe in oxygen, we breathe out CO2. During the spring and summer, plants undergoing photosynthesis do the reverse. They “breathe in” CO2 and release oxygen. However, when we release CO2 through the burning of fossil fuels, we add too much for plants to remove. And CO2, unlike aerosols, can stay in the atmosphere for tens, hundreds, even thousands of years depending on what things act upon it.

Dataset Notes

- The planet “breathes” through each season, but the concentration of CO2 increases.
- CO2 is measured at the Mauna Loa observatory because it is located away from sources of CO2 emission.
- To keep up with the rising CO2 concentration, notice how the scale has to continually shift upward!

Main takeaway: CO2, unlike aerosols, stays in the atmosphere and disrupts the Earth’s energy balance. Heat radiating from the surface of the Earth is absorbed and reemitted back down by

the CO_2 in the atmosphere in a process called the greenhouse effect, causing a net warming of the planet.

---(4) Global Temperature Anomalies 1880-2014---

The phrase “global warming” refers to the average temperature of the planet, which is increasing. However, not all places on Earth experience the same level of warming all the time. Some places even experience local cooling.

Dataset Notes

- This dataset plots temperatures in relation to the 20th century global average temperature.
- The twenty hottest years on record were the last twenty years. 9 of 10 of the hottest years on record occurred since 2002 (1998 is the exception).
- In 2014, the combined land and ocean surface temperature was 1.24°F (0.69°C) above the 20th century average, making the year the warmest since records began in 1880.

Main takeaway: The global average temperature has risen over the last century and is expected to rise even more. Looking at this dataset and CarbonTracker together, we can see in the data that CO_2 concentrations are linked to global average temperature.

(Q?) How can we adapt to increasing temperatures?

Potential answer: We can use more air conditioning (more energy) to adapt. But to mitigate the temperature increase, we need to use less energy or switch to carbon neutral energy sources. Sometimes adaptation and mitigation are opposing ideas!

---(5) Sea Ice Concentrations: September Only - 1987-2014---

As the global average temperature increases, ice is melting, especially at the North Pole. Sea ice is not extending as far south.

Dataset Notes

- The ice is thinning-- this is not illustrated in the dataset.
- Temperature changes are intensified at the poles.
- Global temperature change will accelerate as the amount of Earth’s white surface decreases. This is because white surfaces reflect sunlight-- it doesn’t absorb it.

---(6) Greenland Melting Trends---

Glacier melt in Greenland and Antarctica is flowing into the ocean, and it is accelerating.
>>Enable Jakobshavn Glacier Retreat layer

Located in western Greenland, the Jakobshavn (“yah-cub SHAH-vin”) glacier has lost an unprecedented amount of ice since the year 2000. Notice how the same area of ice was lost between 2002 and 2003 as was lost between 1851 and 1875.

Dataset Notes

- Blue denotes 10 days of melt per year; Red denotes 60 days per year.
- The fastest melting is occurring along Greenland’s coastlines.

Main takeaway: Sea ice melting creates a positive feedback loop that generates further warming. Ice sheets, especially on Greenland, are melting and this is one contributor to global sea level rise.

---(7) Sea Level Trends - 1993-2012---

Sea level rise is not a uniform phenomenon. Some areas are seeing fast rates of sea level rise and others are seeing little or none at all. As glacier ice melts, the water is dispersed across the oceans, but another factor is responsible for these different rates of sea level rise. Some parts of the ocean are warmer than others, so the water is less dense and takes up more space. This property of water is called thermal expansion.

Dataset Notes

- Western Pacific is seeing the fastest sea level rise. Eastern Pacific is seeing negligible/none.
- Global average sea level is rising about 2.5 mm/year since 1880.

(Q?) How can we adapt to this?

Potential answer: Bring in more land to replace land lost to erosion. Move to higher elevation. Use newly available land for agriculture, new shipping routes.

To recap: the burning of fossil fuels is polluting the air, contributing to immediate human health concerns with regards to air quality, and intensifying the greenhouse effect. The global average temperature for 2014 was the highest ever recorded. Rising temperatures are currently accelerating the rate of ice loss on Greenland and Antarctica and this, paired with thermal expansion, will be witnessed in coastal communities in the form of sea level rise.

However, scientists believe that if emissions decrease, the global average temperature will not increase as much and the consequences of climate change will be reduced. Climate scientists use models to forecast future outcomes of climate change, taking into account natural variability and human activity.

---(8) Climate Model: Temperature Change (RCP 8.5) - 2006 - 2100---

For example, this model developed by NOAA's Geophysical Fluid Dynamics Laboratory runs under the assumption that carbon emissions increase as the global population grows. The CO2 concentration reaches 936 ppm by 2100-- more than doubling today's CO2 concentration-- and the average global temperature increases on the range of 9 to 11 degrees F above the 20th century average.

But efforts are already being made to reduce carbon emissions and mitigate the effects of climate change.

---(9) Climate Model: Temperature Change (RCP 2.6) - 2006 - 2100---

This dataset shows the same model running under the assumption that green technologies and renewable energy are emphasized over the rest of this century and there is a worldwide effort to mitigate CO2 emissions. In this scenario, the CO2 concentration reaches a peak at 443 ppm around the year 2050, before gradually declining to 421 ppm in the year 2100. This shows what can happen if we work together to reduce CO2 emissions.

Climate change is happening now, and because it is such a broad problem, there is no silver bullet. There are two strategies for dealing with it and both are needed.

- Mitigation is lessening the severity of changes. If we reduce CO2 emissions, we will mitigate global average temperature rise.
- (Q?) How can we do this?
    - Use more renewable energy, reduce burning of fossil fuels, increase fuel efficiency
- Adaptation is becoming more suited to the environment. As sea level rise, severe storms, heat waves, floods, droughts, and disease threaten our communities we need to build resilient infrastructure to protect our lives and property and prepare future generations.
- (Q?) What are some examples of climate change adaptation?
    - Building dams and levees, wearing masks, moving further inland

---(10) Blue Marble with Scenario PIPs---

Climate change, especially sea level rise, is factoring into decisions that are being made today. Using the clickers, we are going to examine several real world scenarios and you'll be presented with choices. Voting is anonymous, but if you feel comfortable, I will ask for people to say what they voted for and why.

>>Each scenario is inspired by a real life news story-- these are listed at the end of the script. Feel free to pair these scenarios with other news stories, particularly local stories if your area is being similarly affected.

>>If no clickers are available, discussion may be more difficult as audience members may be more hesitant to participate. Use silence… someone will eventually break the silence and others will then feel comfortable speaking. Also try playing devil's advocate to evoke an audience response.

----Scenario 1: Island Village----

Imagine you're living in an island village in the Pacific that is currently struggling with sea level rise. Most of the food that you eat is grown on the island, but saltwater is seeping into the soil and killing crops. People don't want to leave and they also point to the fact that coral reefs are eroding and building up new sediment on the island-- in this way, they argue, the island is protected. Do you believe your population should relocate from the island or stay put?

A. Relocate.
B. Stay put.

In Tuvalu, this is what's happening. The corals are bleaching and providing new land on the island, but saltwater is still intruding. Crops are being grown in concrete enclosures to protect them from ocean water.

The Maldives, another island nation that is also struggling with rising seas, has pledged to become carbon neutral by 2019 to mitigate future sea level rise.

----Scenario 2: Greenland----

Imagine you are a native of Greenland. In recent years you've noticed that crops are growing quicker, the growing season seems to last longer, and there is more food to eat. How do you feel about these changes?

A. Sounds great!
B. This doesn't feel right...What's the catch?

The warming of the Arctic is allowing for unprecedented agricultural growth in Greenland, but this is not without its drawbacks. The natural beauty of Greenland is threatened by the warming, as is the native way of life. In addition, ice melt may put some villages in Greenland at risk of flooding.

----Scenario 3: New York City----

Imagine you're living in a coastal community outside of New York City. Your home is only 6 feet above sea level, and you are still recovering from damage to your home caused by Hurricane Sandy. Two initiatives have made headlines in your community: the first wants to design a system of levees to protect your area from floods. The second wants to purchase homes in areas that are at-risk of flooding and demolish them to revive wetlands along the coast. The

levees will provide immediate protection against the next flood, but the wetlands are a natural barrier and may be a more resilient solution in the future. Which proposal do you support?

A. Construction of levees
B. Evacuation and demolition of homes
C. Both
D. Neither
E. Other

Both of these proposals are moving forward in the New York metro area, although there seems to be a preference for solutions that do not involve demolishing homes. The US Department of Housing and Urban Development created a competition called “Rebuild by Design” in the wake of Hurricane Sandy to protect the coasts and revitalize the communities that live there.

One of the winning proposals called “Lifelines” aims to protect the Hunts Point community in the Bronx, while emphasizing the lives of the people who live there. A supporter of the proposal explained her vision of the proposal’s success: “I don’t want the Bronx to be ‘revitalized’ through gentrification. I want this community to be revitalized through the sheer spirit and legacy of resiliency that it has shown over the last forty years.”

----Scenario 4: Miami Beach Construction----

Imagine you are a real estate developer in Florida. You want to build a luxury hotel in Miami Beach. The anticipated number of tourists who will use your resort is high, but you are concerned about sea level rise. Do you still move forward with the building even if the costs to maintain and insure it are expected to skyrocket over the coming decades?

A. Yes
B. No

Part 2: You employ a lot of workers and if you don’t move forward with this project, many of them will be out of work. Do you move forward or not?

A. Yes
B. No

In spite of the very real threat of sea level rise, high rises are still being built in the most at-risk city in the United States. These buildings have short-term economic benefits, but unless serious infrastructure is installed to protect these new buildings, tidal flooding and saltwater intrusion beneath the soil will eventually make them inaccessible and unusable.

----Scenario 5: Climate Policy in China----

Imagine you are the leaders of China. Some of your largest cities are vulnerable to rising seas. There is also widespread public anger about the air quality throughout China. You have the money to address climate change but are not sure which strategies would be the best

investments. Scientists have advised you that sea level rise is intensified by climate change, particularly increased CO2. You need to address this issue from all sides, but which area should be your primary focus?

A. Mitigation-- work to reduce CO2 emissions by reducing coal-fire plants
B. Adaptation-- build coastal fortifications and evacuate people from the most at-risk areas.

In a recent agreement with the United States, China pledged that its carbon emissions would peak by 2030 and that at that time, twenty percent of their total energy would come from renewable sources. As a matter of course, this will alleviate some of the air quality concerns. So far, no significant public actions have been taken by China to confront sea level rise.

---(11) Nighttime Lights - 2012---

These are very simple scenarios. In reality, there are complex issues at play in climate policy and no decision can be made that doesn't upset at least some people.

However, work is being done to adapt to climate change and mitigate its worst effects in the public and private sectors. Car manufacturers are creating more hybrid and electric cars than ever before. Renewable energy is becoming more and more affordable and popular. Cities and towns at risk of sea level rise are designing and engineering solutions to adapt. Scientists at NOAA as well as other agencies and universities around the world are studying the impacts of climate change and informing the public so that we can prevent the worst and work for the best.

This is a global problem and we need your help to solve it-- in big and small ways. To reduce CO2 and mitigate climate change's worst effects, think about your personal energy use and how you can reduce your carbon footprint. You can study CO2 like some NOAA scientists or you can even run for public office and work to enact legislation to reduce CO2 emissions.

To adapt, we need to design solutions to new problems. Sea level rise is a real threat for today, but it also provides opportunity. Inventors, engineers, and entrepreneurs can help rework our infrastructure to protect us from the effects of climate change that we can't mitigate.

Mitigation and adaptation are vital for our future and I hope that you understand their importance and do your part, whether from it's from the mitigation angle, around adaptation, or both.

**Give your location's customary farewell.*
>>end of presentation

News Articles used for Scenarios:

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"N.J. Braces For Future Disasters By Fleeing, And Fortifying, The Coast" *NPR*. 26 Sep 2014. http://www.npr.org/2014/09/26/351737514/n-j-braces-for-future-disasters-by-fleeing-and-fortifying-the-coast

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"China's Climate Change Plan Raises Questions" *New York Times*. 12 Nov 2014. http://www.nytimes.com/2014/11/13/world/asia/climate-change-china-xi-jinping-obama-apec.html?_r=0