A Conversation with Katharine Hayhoe

Texas Offers Perfect Setting to Study Impacts, Costs of Climate Change

Katharine Hayhoe is an atmospheric scientist and professor at Texas Tech University in Lubbock, where she directs the Climate Science Center. She was a lead author of the Fourth National Climate Assessment, *released in November 2018, which documents the extent of climate change. She also hosts* Global Weirding, *a video series produced by Lubbock's PBS affiliate, KTTZ.*

Q. How do scientists differentiate between extreme weather and climate change?

Climate is the statistics of weather over at least 20 to 30 years. When we look at our extreme weather, we see that the statistics of that weather are changing. In Texas, our heat waves are getting more intense, and stronger and more frequent. Our heavy rainfalls that especially occur in the eastern half of the state are becoming more frequent. We're seeing that hurricanes are not more frequent, but there's a lot more rainfall associated with them today than there would've been 50 or 100 years ago.

It's estimated that almost 40 percent of the rain that fell during Hurricane Harvey would not have fallen if the same storm had occurred 100 years ago. In West Texas, our own work has shown that as the world gets warmer, we expect our droughts—which are, of course, a natural part of our weather here—to become more frequent and more severe.

So, we know that here in Texas, we see all kinds of extreme weather naturally, but as the climate changes, as the world warms, we are seeing a lot of this extreme weather become intensified—some more frequent, some more intense, some stronger, some longer, and some all of the above.

Q. How did you get into studying climate change and what makes Texas Tech a good base for the work that you do?

Well, I was planning on becoming an astrophysicist, and I was almost finished with my undergraduate degree in physics. I needed an extra course and saw this interesting course on climate science over in the geography department, and I thought, "Well, I'll take that." I was absolutely shocked to find out that climate science was all physics—in fact, some of the very same physics that I had been learning in my astronomy classes.

I ended up at Texas Tech University because they were recruiting my husband. My husband is a linguist, and I wasn't really too sure about moving to Texas and doing climate science. But now that I've been here for over 12 years, I realize that this is the perfect place to study climate change.

Q. What makes Texas such a good place for climate change study?

Texas already naturally gets more extreme climate [events] than any other state in the country. Since 1980, we have experienced 106 events that have caused at least $1 billion worth of damage. And one of the ways that climate change is affecting us is by increasing the frequency or the risk associated with extreme weather and climate events. So, Texas is really on the forefront of being vulnerable to the impacts of a changing climate.

Then, what's the solution to the changing climate?

Digging up and burning coal and gas and oil is the No. 1 reason why the planet is warming. Texas, of course, is a huge producer of fossil fuels. We have the highest carbon emissions of any state in the country, but Texas is also the leading producer of wind energy. We are simultaneously the state that currently contributes the most to the problem but, together with California, we are arguably the state that has the most to contribute to fixing the problem.

Texas is also the perfect place to be because there are so many people here who aren't really on board with the idea that the climate is changing. The impacts matter to us here in the places where we live today, and we need to fix the problem.

Almost every day, I run into somebody—whether it's at church, a neighbor, at the university or a student who has questions—who says, "How do we know that this is real?"

And when they find somebody who lives here in Texas, who studies this full time, they have a lot of questions.

A lot of people are just really confused. It's the perfect place to be to talk about climate change to help people understand it, to encourage our investment and solutions, and to help people understand how we are vulnerable to the impacts of a changing climate and what we need to do to prepare.

Q. In a normal weather cycle, what should be going on in Texas?

What many people don't realize is that climate scientists study past climate, too. We study all of the natural factors that cause the climate to change. In fact, as a group, we scientists actually spend more time studying natural causes of climate change and natural variability and past climate than we do studying how humans are affecting climate.

Photo credit: Texas Tech University

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We've learned that the earth has been warmer and cooler before in the past. When we study the causes, we find that there are a couple of really important factors at play affecting our climate. One is the amount of energy we get from the sun, which goes up and down over time. Another is the configuration of the earth's orbit around the sun. That's actually responsible for the ice ages and the warm periods in between like we're in right now.

We know that large sustained volcanic eruptions can temporarily cool the earth, and we also know that there are natural cycles like El Niño—which, of course, everybody in Texas has heard of—that exchange heat between the ocean and the atmosphere. When we have an El Niño, our air temperature tends to be a bit warmer than average because heat is going into the ocean, and when we have a La Niña, our air temperature tends to be a bit cooler than average because heat is coming out of the ocean.

So, when we see the climate changing as we see it today, we don't automatically jump on the bandwagon and say, "Oh, it has to be humans."

We look at all the natural factors that caused climate change in the past to see if they could be responsible. When we look at the sun, we find that the sun's energy has actually been going down since the 1970s, not up. So, if our temperature were being controlled primarily by the sun right now, we'd be getting cooler, not warmer.

We find that, according to orbital cycles, we should be gradually cooling heading into the next ice age sometime in the next 1,500 years—which we don't want to do because the last time we had an ice age, most of North America was covered with a mile of ice.

Q. What changed the natural cycle?

Large-scale agriculture and deforestation and heat-trapping gas emissions that resulted from these activities [changed the cycle]. The more land area we cultivate [and] the more forest we cut down, the greater the impact we have on climate.

So, by the time we got to the Industrial Revolution, when people were already spreading across North America, cutting down forests here [and] turning them into farmlands, we had just about perfectly stabilized the climate.

We had counteracted the effect of orbital cycles on our climate, which is actually what we want. We like a nice stable climate: Just like Goldilocks, we don't want it too cold, we don't want it too hot, we want it just right.

Then, all of a sudden, along came the Industrial Revolution. We started digging up massive amounts of coal and gas and oil [and] burning it, and our temperature started to increase really quickly.

Q. How is our regional economy affected by climate change, and are certain industries more impacted than others?

A fundamental assumption that underlies our society—one that we don't think about very often—is that the climate is relatively stable. That assumption has been valid not just over the past 100 or 200 years but really over the course of human civilization on this planet. We have not seen any significant change in our average climate on the order of what we have experienced over the last two decades.

In the past, when we designed our building codes, when we set our flood zones, when we built our cities and a lot of very expensive infrastructure—ports, transportation, industrial facilities—along the coastline, we assumed that where sea level was in the past was an accurate predictor where sea level would be in the future.

We've built our industry and a large part of our economy around the unstated and unvoiced assumption that the climate is relatively stable, that conditions of the past are an accurate predictor for conditions of the future.

But today, that isn't valid anymore. So, where and how we grow our crops is already starting to change. Just because your family has always grown cotton in the same place in Texas does not necessarily mean that the next generation will be able to grow the same crop in the same place.

As conditions change, we find that our infrastructure is unprepared [for] and vulnerable to the more frequent or more severe extreme weather events that we are already experiencing in many places—let alone that we'll experience in the future.

The implication of all of these is that it will cost a lot to adapt to the changes.

Q. What other economic effects can Texas expect?

In Houston, Harvey was not the first extreme flood that they have had. They actually had, in some places, three 500-year flood events in three years. Harvey was the third one. That's not a 500-year flood event when you have three of

them in three years. The majority of the emergency calls and the majority of the flooding that occurred during those events, especially during Harvey, were outside the flood zone. That meant that many affected homes and buildings did not have flood insurance.

The insurance industry is one of the industries that is most aware. They've had their finger on the pulse of changing weather statistics over the last few decades because they are the ones who make the payments when disasters happen. And they are increasingly concerned about [whether] some types of insurance are even viable in a changing climate.

South Miami is raising the level of its streets by two feet and installing pumps. As sea level rises, they're already experiencing sunny-day flooding today—flooding when there's no storm, just a king tide.

A few months ago, there was a headline that the oil and gas industry—which is one of the industries most responsible for a changing climate—asked for protection from rising seas for some of their facilities on the Gulf Coast.

Well, who's going to pay for that protection? Really, it comes down fundamentally to economics. The costs of Harvey were estimated at around $125 billion. Other estimates have shown that if you actually factor in not just the direct damages, but also lost productivity, the human migration, the loss of wages, the impact of any severe event lasts for decades beyond that event. And the assessed cost of the direct damages tends to be on the order of about 10 percent of the actual cost.

Q. How long lasting are the economic impacts of events arising from the changes in climate and extreme weather?

There are some counties in Oklahoma and Texas where you can still see the signal of the Dust Bowl in their revenues today.

Of course, the dust bowl was a natural event, but it was a natural event that was exacerbated by human behavior. In that case, it wasn't climate change at the global scale, but it was the agricultural techniques that people were using that contributed to the dust bowl, making it more severe than it would have been and longer than it would have been without human interference.

So, we already have cautionary tales from the past of how naturally occuring weather extremes have been exacerbated by human choices, human activities and human behavior that have been economically devastating for certain regions in the United States.

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Q. What can we do in the near term to prepare for climate change?

That is the trillion-dollar question. For many Texas cities, water is a big problem. I've worked with cities such as Austin and with the North Texas Municipal Water District, just north of Dallas. The goal is to incorporate climate projections into their long-term water planning so they actually have realistic estimates of what their supply and their demand will look like in the future in a changing climate.

For other cities—Washington, D.C., Chicago and others—we look at specific thresholds that have to do with how much energy they will need in the future. How will energy demand shift change between heating in the winter and cooling in the summer so they can start to prepare for less oil and gas in the winter, but more air conditioning in the summer?

Here in Texas, one of the things that people are doing is transitioning from big pivot irrigation systems, where they spray water on the ground and a lot of the water evaporates before it actually hits the ground, to in-ground direct irrigation that uses a lot less water.

Individually, I think it's important to be aware of the way that climate change can affect us. I've had calls from some farmers and producers and ranchers asking, "Should I sell my land? Should I be moving further north? If I still want to grow the same types of crops, what types of places are going to be conducive to growing those crops in the future?"

The other half of the picture is that we need to reduce and eventually eliminate our carbon emissions. We have to transition to new, clean ways of getting energy. And again, Texas is leading the way in that, but it is not a global leader. China is. A lot of people don't realize that China has more wind and solar energy than any other country in the world.

We are in serious jeopardy of being left behind in the new clean-energy economy because around the world last year, 70 percent of new installed energy was renewable. It's being installed in India, in China and in developing countries around the world, and that's what we have to do to move forward into the future.

Individually here in West Texas, a lot of farmers and producers are opening up their land to wind turbines because the check arrives in the mail and you can still farm around the turbine.

There are a lot of things we can do. We might say, "Well, I don't own land. I can't put wind turbines on my land."

A lot of our choices relate to our food—reducing food waste and eating lower down the food chain and reducing the amount of beef that we eat, focusing more on fish and on plant-based food. That's where there are important things that we can do to reduce our own carbon footprint.

But the most important thing we can do is talk about it, because if we don't talk about it, why would we care? And if we don't care, why would we act?

For audio excerpts of our interview with Katharine Hayhoe, go to dallasfed.org/research/swe/2019/swe1903e.