

# Climate change is more extensive and worse than once thought

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In this June 20, 2017 file photo, a local temperature sign reads 120-degrees Fahrenheit as temperatures climb to near-record highs in Phoenix. Scientists say climate change is faster, more extensive and worse than they thought a quarter century ago. (AP Photo/Ross D. Franklin, File)

Climate scientists missed a lot about a quarter century ago when they predicted how bad global warming would be.

They missed how bad wildfires, droughts, downpours and hurricanes would get. They missed how much ice sheets in West Antarctica and

Greenland would melt and contribute to sea level rise. They missed much of the myriad public health problems and global security issues.

Global warming is faster, more extensive and just plain worse than they once thought it would be, scientists say now.

International negotiators meet next week in Poland to discuss how to ratchet up the fight against [climate change](#) in what's called the Conference of Parties . The world's understanding of global warming has changed dramatically since the first conference in March 1995. Since then the globe on average has warmed nearly three-quarters of a degree (0.41 degrees Celsius) but that's not even half the story.

That global annual temperature increase is slightly lower than some early 1990s forecasts. Yet more than a dozen [climate scientists](#) told The Associated Press that without the data currently available and today's improved understanding of the climate, researchers decades ago were too conservative and couldn't come close to realizing how global warming would affect daily lives.



In this April 14, 2010 file photo, a shepherd walks with a herd of sheep as he crosses a dried water bed in the outskirts of Hyderabad, India. Studies have shown climate change has worsened droughts, downpours and heat waves that have killed thousands of people. (AP Photo/Mahesh Kumar A., File)

One scientific study this month counted up the ways—both direct and indirect—that warming has already changed Earth and society. The total was 467 .

"I don't think any of us imagined that it would be as bad as it's already gotten," said University of Illinois climate scientist Donald Wuebbles, a co-author of the recent U.S. National Climate Assessment . "For example, the intensity of severe weather. We didn't know any of that back then. And those things are pretty scary."

In the 1990s, when scientists talked about warming they focused on the average annual global temperature and sea level rise. The problem is that people don't live all over the globe and they don't feel average temperatures. They feel extremes—heat, rain and drought—that hit them at home on a given day or week, said Pennsylvania State University climate scientist Richard Alley.

"The younger generations are growing up where there is no normal," University of Washington public health and climate scientist Kristie Ebi said, pointing out that there have been 406 consecutive months when the world was warmer than the 20th century average.

More recently economists have joined scientists in forecasting a costly future. Yale economist William Nordhaus, who won the 2018 Nobel prize for economics for his work on climate change and other

environmental issues, told the Associated Press that his calculations show climate change would cost the United States \$4 trillion a year at the end of the century with a reasonable projection of warming.



In this July 29, 2010 file photo, Moscow's St. Basil's cathedral, background, is seen through the smog covering Moscow during a heat wave. Scientists say climate change is faster, more extensive and worse than they thought a quarter century ago. Studies have shown climate change has worsened droughts, downpours and heat waves, such as the Russian one in 2010, that have killed thousands of people. (AP Photo/Misha Japaridze, File)

The way science has looked at global warming has changed over the last quarter century because of better knowledge, better computers, better observations, more data—and in large part because researchers are looking more closely at what affects people most. Add to that what many

scientists see as an acceleration of climate change and the picture is much bleaker than in the 1990s.

Back then, Michael Mann was a graduate student exploring [global warming](#).

"I honestly didn't think that in my mid-career we would be watching the impacts of climate change play out on my television" nor that they would be so strong, said Mann, now a prominent climate scientist at Pennsylvania State University. It is playing out with wildfires, rain-soaked hurricanes, flooding, drought, heat waves and other extreme weather, he said.

Scientists now better understand how changes in currents in the air—such as the Jetstream—and the rain cycle can cause more extreme weather. And recent research shows how climate change is altering those natural factors.

The biggest change in the science in the last quarter century is "we can now attribute changes in global temperatures and even some extreme events to human activity," said Sir Robert Watson, a former top NASA and British climate scientist who chaired the United Nations' Intergovernmental Panel on Climate Change from 1997 to 2002.





In this Aug. 28, 2017, file photo, rescue boats float on a flooded street as people are evacuated from rising floodwaters brought on by Tropical Storm Harvey in Houston. Scientists say climate change is faster, more extensive and worse than they thought a quarter century ago. They've concluded climate change has caused more rain in hurricanes Harvey, Maria, Katrina and others. (AP Photo/David J. Phillip, File)

With improved knowledge and tools, scientists can better understand extreme weather such as hurricanes and droughts, and they can run complex computer simulations that attribute extremes to human-caused warming from the burning of coal, oil and natural gas, Watson said.

Scientists attribute extreme events to human-caused warming by comparing what happened in real life to simulations without heat-trapping gases from fossil fuels. They've concluded climate change has caused more rain in hurricanes Harvey , Maria , Katrina and others .

Studies have shown climate change has worsened droughts, downpours and heat waves, such as the Russian one in 2010, that have killed

thousands of people. And they have linked climate change to the growing amount of land in the western United States burned by wildfire, which wasn't considered a big climate issue a couple decades ago, said University of Utah fire scientist Phil Dennison.

From air pollution triggered by wildfires that caused people in Northern California to don breathing masks to increased asthma attacks that send children to the hospital, [medical experts](#) said climate change is hurting people's bodies.

"We're seeing surprises," public health professor Ebi said. "We're projecting changes and we're seeing them sooner than we expected."



In this July 26, 2011 photo, a melting iceberg floats along a fjord leading away from the edge of the Greenland ice sheet near Nuuk, Greenland. Massive ice sheets in western Antarctica and Greenland are melting much faster than scientists figured a quarter century ago. Greenland has lost more than 5 trillion tons since 1992. International talks to fight global warming are set to start in

Poland next week. (AP Photo/Brennan Linsley, File)

That includes once-tropical disease carrying mosquitoes in Canada and warm water shellfish bacteria showing up in Alaska , she said.

Massachusetts General Hospital emergency room physician Dr. Renee Salas, who wrote a chapter in the medical journal Lancet's annual climate health effects reports, said these aren't abstract statistics, but real patients.

"When I had to tell a tearful mother that I needed to admit her 4-year-old daughter for an asthma attack, her fourth visit in a week, climate change was truly top of my mind because I knew her disease was due to rising pollen levels," Salas said.

Massive ice sheets in western Antarctica and Greenland are melting much faster than scientists figured a quarter century ago.

Antarctica has lost nearly 3 trillion tons of ice since 1992, enough to cover Texas nearly 13 feet (4 meters) deep, scientists reported in June. Greenland has lost more than 5 trillion tons in the same period.





In this Nov. 16, 2018 file photo, a couple wears masks while walking at Fisherman's Wharf through smoke and haze from wildfires in San Francisco. From air pollution triggered by wildfires that caused people in Northern California to don breathing masks to increased asthma attacks that send children to the hospital, medical experts said climate change is hurting people's bodies. (AP Photo/Eric Risberg, File)

Melting in Antarctica and Greenland in the last few years "literally doubled our projections of the sea level rise at the end of this century," said Mann of Penn State.

Non-experts who reject mainstream science often call scientists "alarmists," yet most researchers said they tend to shy away from worst case scenarios. By nature, scientists said they are overly conservative.

In nearly every case, when scientists were off the mark on something, it

was by underestimating a problem not overestimating, said Watson, the British climate scientist.

But there are ultimate worst cases. These are called tipping points, after which change accelerates and you can't go back. Ice sheet collapses. Massive changes in ocean circulation. Extinctions around the world.

"In the early 1990s we only had hints that we could drive the [climate](#) system over tipping points," said Jonathan Overpeck, environment dean at University of Michigan. "We now know we might actually be witnessing the start of a mass extinction that could lead to our wiping out as much as half the species on Earth."

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