Climate Extremes and Global Health

New Ways to Make Progress

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The last few years have brought a string of terrible news about the global climate. Politically, the 2015 Paris agreement on climate change is stalling. The United States has announced that it will abandon the pact, and no other country has stepped up to fill the vacuum. Emissions rose 1.4 percent last year and no major industrialized country is on track to meet the emission control pledges it made in Paris, which means that the world is way off track to meeting the target of limiting warming to two degrees Celsius above preindustrial temperatures. Scientifically, the news is even grimmer. New research in climate science indicates that extreme events, such as heat waves, the collapse of major ice sheets, and mass extinctions, are becoming dramatically more probable. And

the evidence is mounting that climate change will have an extreme impact on human health into the near future.

These two strands of bad news offer a road map for doing better: the new scientific research on climate change, with its terrifying insights into what humans are doing to the environment, could help activists and political leaders build the political momentum for deep and costly cuts in emissions. Until now, most of the research about the impact of climate change has confirmed the maxim that the political scientist Aaron Wildavsky outlined decades ago: “richer is safer.” Scientists believed that because wealthier societies had the resources to adapt to a warmer world, poor countries would suffer more. This presented a political problem because most emissions come from rich or emerging economies. In fact, the wealthiest one billion people around the world (living in both rich and poor nations) are responsible for more than 50 percent of the emissions of carbon dioxide and other greenhouse gases.

But new studies show that the rich are far more exposed than anyone realized—especially to deadly heat. In the past, efforts to build political support to combat climate change centered on abstract arguments about the slow buildup of carbon dioxide in the atmosphere. These concerns rarely had much political impact because most societies put a heavier weight on tangible near-term priorities than cumulative effects whose consequences will be felt mostly in other countries. But today there is an opportunity to shift the politics around climate change because scientists can now make a strong case that no one is exempt from the extreme and immediate risks posed by a warming world.

THE NEW SCIENCE OF DISASTER

For decades, most of the scientific research around global climate change has focused on showing that humans are to blame. Scientifically, that mission was achieved long ago, but politically, those facts haven't yet had much of an impact.

The concentration of carbon dioxide in the atmosphere is rising by about three parts per million (ppm) almost every year. During much of the early political debate around climate change in the 1990s, many scientists thought that about 350 ppm or perhaps 400 ppm was a red line that shouldn't be crossed. Today the concentration of carbon dioxide stands at 410 ppm, and it is only increasing. With higher concentrations have come higher temperatures. Since the 1900s the planet has warmed a bit more than one degree Celsius; most of that warming has occurred since 1980. The last decade of measurement—2007 to 2017—has been the hottest. The oceans are heating up as well—a fact that is now well documented thanks to thousands of autonomous submarine robots that cruise the planet's oceans taking measurements. In 2016, the scientifically cautious American Meteorological Association (AMS) declared that "we're experiencing new weather, because we've made a new climate."

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The old science of global climate change generated good talking points for the convinced. But only a small fraction of global emissions comes from places where the public is already mobilized, such as western Europe and the blue coastal and urban communities in the United States.

Convincing the convinced won't fix a global problem. That's where the new science comes in.

Unlike in the past, scientists today have massive data sets that allow them to more conclusively assess the rising risk of extreme events that will have major consequences for human welfare. Despite attempts to turn the tide, such as with the Paris agreement, emissions are still increasing, which means that warming is on track to rise at least four degrees over the coming century. A warmer planet will be a more extreme planet. Beyond 2050, as much as 44 percent of the planet's land areas will be exposed to drying. This will lead to severe drought conditions throughout southern Europe, North America (mainly the eastern and southwestern United States and Mexico), much of southeast Asia, and most of the Amazon—affecting about 1.4 billion people. In the latitude bands between 30 degrees N and 30 degrees S the probability of multi-decadal drought will rise to 80 percent. There is also a heightened risk of more extreme rainfall, which, coupled with population growth, will expose an additional two billion people to floods.

WARMING IS BAD FOR YOUR HEALTH

Although these scenarios, which are still decades in the future, haven't inspired much serious policy action, scientists are also focusing on a more politically salient dimension of climate change: the immediate risk to human health. For a long time, scientists have known that health and climate change are linked because many of the pollutants that contribute to warming also damage human health. At the top of that list are fine particulates that emanate from burning fossil fuels (diesel fuel and coal) and biomass. Soot is a major cause of warming—a ton of diesel soot has the same warming effect as 2000 tons of carbon dioxide. Methane is another

superpollutant that is also laden with health hazards: it causes warming directly while also increasing the amount of ozone near the planet's surface where humans breathe and crops grow. Soot and ozone, along with sulfate and nitrate particles from fossil fuel combustion, are among the leading causes of ambient and indoor air pollution, which is today's number one air pollution problem globally. According to the World Health Organization, seven million people every year die as a result of this kind of pollution, which causes lower respiratory infections, lung cancer, heart disease, strokes, and chronic obstructive pulmonary disease. (By comparison, AIDS, malaria, and tuberculosis kill less than half that number and car accidents are responsible for fewer than 1.5 million deaths per year.)

Awareness of these facts has already animated politicians from China to California to regulate soot and pollutants that are precursors to ozone. The more they learn, the more they do. What's new today is that efforts to control climate pollutants are no longer just piggybacking on concerns about human health. By linking together different disciplines and deploying large data sets, scientists have been able to show how climate change directly undermines human health. For example, experts have attributed to climate change catastrophes such as the 2003 heat wave in France that killed more than 10,000 people and the 2010 heat wave in Russia that killed an estimated 15,000, along with other major storms and droughts such as the parching that is devastating rural areas in Australia. The combination of heat and humidity is particularly lethal, and with warming both are expected to rise. The probability of extreme weather rose by a factor of ten or more between 2011 and 2015, the hottest five-year period on record. To make matters worse, diseases borne on insect vectors, such as chikungunya and dengue fever,

seem likely to proliferate as the habitats of mosquitoes expand.

Those same models that scientists are using to find the fingerprints of climate change on human health suggest that the worst is yet to come. Beyond 2050, there is a 50 percent probability that about half of the world's population will be subject to mean temperatures in the summer that are hotter than the hottest summer on record unless the world takes immediate and large-scale action. In the most highly populated regions of the world, by the end of the century, there are 10 to 30 percent chances of heat waves greater than 130 degrees Fahrenheit. Moreover, heat and droughts threaten regions that produce much of the world's food. Food prices are expected to raise 23 percent by 2030, making food markets more volatile, and under heat stress the nutritious content of food crops is declining. Extreme weather disasters also have negative impacts on mental health. When hot is over 130 degrees, whole societies can come unglued. Richer countries are not exempt from these effects.

Statistical science isn't a crystal ball, and the fact that predictions about climate change are probabilistic rather than precise has long been used as an excuse for delaying action until all the facts are in. But the new research on catastrophic events suggests that policy should follow exactly the opposite logic. There is some chance (around five percent) that warming over the coming century will be more than six degrees on average globally. Practically, this means that outcomes that were previously assumed to be unlikely worst-case scenarios could arrive more quickly than people think. Those risks are no longer distant and abstract—in part because climate impacts are mounting quickly and in part because it takes time to alter the trajectories of emissions that

cause warming. Efforts to prevent this future must begin today. It is impossible to know for at least a couple of decades which warming track the planet is on—either the bad or the really bad. By the time things become clear, most of the warming will already be loaded into the system and much more difficult to reverse.

CHANGING THE GAME

Every time there is a major research breakthrough, the scientific community thinks that society will listen and take action. So far, that has not been the case because political behavior doesn't simply dance to the beat of scientific progress. This time can be different, but scientists and activists will need to think and work in different ways. New research presents an opportunity for scientists to make the case for deep emissions cuts in a manner that is both politically persuasive and grounded in robust science. For decades, climate change has been framed as a problem of justice—a crisis created by the rich that disproportionately harms the poor. That argument is not wrong, but the rich are hurting themselves, too. Massive fires in Sonoma and Napa, the richest wine-growing areas in the United States, may have a larger political impact than distant crises—just as heat waves in Japan and superfires in Europe are having a political impact there. To communicate these new findings, scientists also need to think about how they influence society. In particular, they should build new partnerships with groups that shape how societies frame justice and morality, including religious institutions. Indeed, this essay emerges from efforts to rethink how a changing climate will affect human welfare

and humanity's relationship to creation that were spearheaded by Pope Francis in his Encyclical *Laudato si'*.

The ultimate goal of climate change scientists remains unchanged: deep cuts in emissions. This will require testing and deploying new technologies—for example, schemes to capture and store greenhouse gas pollution and systems for massively integrating renewable power into the electric grid. Nuclear power may also have a fresh role to play in making energy systems cleaner but it must first overcome adverse public and political opinion in many countries. Still, new research suggests that even cutting emissions to zero won't be enough. It will also be necessary to remove the roughly one trillion tons of carbon dioxide that are already in the atmosphere. Avoiding emissions would help reduce warming in the distant future; removing emissions that have already accumulated would have a more immediate effect. Promising new ideas are emerging. But it is one thing to plug imaginary code into climate models that show that the problem can be solved; it is another to test and build these technologies at an industrial scale.

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In the long haul, deep decarbonization—the reduction of emissions of carbon dioxide and other warming gases nearly to zero—will be needed. But this will take decades. A crash program might get to net zero emissions around 2050, and even that would be exceptionally difficult. Technologies to remove hundreds of billions of tons of carbon dioxide from

the atmosphere, combined with aggressive programs to cut shorter-lived pollutants—such as soot, methane, and industrial gases—can succeed in preventing catastrophic changes.

If the planet proves to be highly sensitive to even small fluctuations in the climate, which new research suggests is more probable than previously thought, then it may be necessary to alter the energy balance of the climate directly. These schemes that involve manipulating the amount of sunlight that reaches and warms the planet, also known as geoengineering, could have unintended consequences such as droughts in the tropics or the neglect of ocean acidification that occurs when carbon dioxide builds in the atmosphere. It also poses a near-impossible governance challenge: who should be in charge of the planetary thermostat? For most climate scientists, those problems have been reason enough to treat geoengineering as taboo. But the scientific community needs to start taking this option seriously. The American Geophysical Union, the world's largest professional body of geoscientists, has recently endorsed that position, although their blessing has not yet unlocked the necessary funding for research.

Finally, societies must start preparing for more frequent and more extreme weather events. This means hardening or abandoning coastal areas, developing crops that are resistant to droughts and extreme heat, building systems that can help farmers predict extreme weather, and finding new ways to conserve and reuse water. Much more work will also be needed to address the health consequences of extreme heat—some of which will require strengthening public health systems while also reorienting medical training and interventions.

Adaptation is rapidly becoming central to the reality of climate change. In a transformed climate, more than half of the population may be exposed to extreme heat waves and perhaps one-third to vector-borne diseases. Seeking alliance with faith leaders, health-care providers and other community leaders should be an integral part of the strategy on climate change. In particular, even when they do not share the same notion of God, faith leaders should act both together and separately in their own communities to preserve human dignity and our common home. It's too late to quickly stop the consequences of the gases that are already building up. Many necessary steps are already long overdue. The silver lining in all of this, if there is one, is that a recognition of the nasty and brutish new normal may yet mobilize the political support needed to make a dent in global emissions.