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1. SOCIETY:

Researchers find warming climate can cause more violent behavior

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From road rage to riots, scientists say they now have clear evidence that rising temperatures lead to spikes in violence.

In a study published yesterday in the journal *Science*, researchers crunched reams of data on conflict and climate from all over the world, dating from 10,000 B.C. to the present. They found "remarkably similar" behavioral changes showing that whether the subject is domestic violence in Australia, peasant rebellion in China or property crimes in the United States, blood seems to boil when shifts occur in normal rainfall and temperature levels.

Advice often ignored hangs over a Canadian freeway. Photograph courtesy of **Flickr**.

"Past climatic events have exerted significant influence on human conflict," the authors wrote. "If future populations respond similarly to past populations, then anthropogenic climate change has the potential to substantially increase conflict around the world, relative to a world without climate change."

To do the work, researchers collected and reanalyzed 60 existing studies and 45 data sets. They then standardized the data by converting the climate changes into location-specific units known as standard deviations. One unit of standard deviation would be roughly equivalent to seeing temperatures in a U.S. county rise 5 degrees Fahrenheit in a given month.

The study does not explain what precisely about rising temperatures heightens violent tendencies. But lead author Solomon Hsiang likened it to early studies identifying a link between tobacco and lung cancer long before scientists were able to pinpoint how and why various chemicals in cigarettes interact with the human body. He said the conflict findings could help draw a clearer line between rising global temperatures and civil unrest, and help clarify how climate change is altering societies.

"This helps us better imagine a world where we experience anthropogenic climate change," said Hsiang, an assistant professor of public policy at the University of California, Berkeley. "We don't often think about how these changes touch down in our everyday lives."

Predicted rise in global conflicts

And on a very personal level -- cases of assault, domestic violence, rape, murder -- the study finds individual acts of aggression rise dramatically with the temperature. For every standard deviation of base-line average temperature, the authors found a 4 percent rise in acts of violence among individuals. If that doesn't sound like much, Hsiang noted that the United States alone already sees about 2 million violent crimes annually -- meaning crime rates could go up exponentially.

Even more troubling, he said, are levels of intergroup conflicts like riots and civil wars. Those episodes rise 14 percent per standard deviation. And since climate models predict an average of two to four standard deviation shifts in global climate conditions by midcentury, the authors note, global conflicts could increase as much as 50 percent.

Marc Levy, deputy director of Columbia University's Earth Institute, whose work focuses on climate change and human security, praised the study and said what makes it unique is the use of statistical techniques to discover what a growing

body of research on global warming and conflict leads up to.

"They get a very, very clear signal. The conclusion is inescapable that humans are sensitive to climate stress," said Levy. "Being able to definitively make that claim is brand-new. It's always been contingent or filled with caveats."

Hsiang said the paper stemmed from a growing interest among social scientists in understanding the links between rising temperatures, rainfall pattern changes, and impacts like conflict and migration. Yet while the field of study has exploded over the past five to eight years, he and UC Berkeley co-authors Marshall Burke and Edward Miguel sought to look at a broad set of literature and set a standard for what consists of a methodological approach.

They ruled out studies that compared events in different countries -- because after all, they noted, examining conflicts in Norway and Nigeria can't possibly take into account differences in politics, geography and other variables that come into play. Instead they looked only at scientific experiments that follow a single community over time.

"We didn't want apples and oranges, just apples and apples over time. And that's when things started to look much more in agreement," Hsiang said. While the scales and duration of various conflicts differed, he said, the team found that when it comes to personal violence, political instability or institutional breakdowns, conflict responds to temperature.

Should policymakers wait for the details?

Halvard Buhaug, research director at the Peace Research Institute Oslo, who authored a study in 2010 finding that climate change had no impact on civil wars in Africa, called the attempt to do a meta-analysis of climate and conflict data "a good idea." But he argued that as far as the results on civil conflict go, the results are problematic.

"In my mind, the study fails to achieve its objective. I think that they overemphasize the statistical findings that they report," he said. Specifically, he said, many of the studies reanalyzed indicate an "insignificant" effect of climate. And where the effect is significant, the nature of the weather events differs. Buhaug argued that exactly how climate changes differed from the norm also needs to be understood and taken into account.

The study's authors, for their part, dismiss findings that temperature and rainfall events have a limited impact on civil war in Africa, saying "the confidence intervals around these estimates are sufficiently wide that they do not reject a relatively large effect of climate on conflict that is consistent with 35 other studies of modern data and 28 other studies of inter-group conflict."

Hsiang said he believes the study shows strong statistical evidence implicating climate as a cause of conflict. He argued that even though researchers still don't understand why temperatures make communities hot and bothered, enough research exists for action to reduce greenhouse gas emissions.

"We don't want policymakers to sit and wait around for all the details. We know these things are linked, and we can make some policy decisions based on them," he said.

Levy, who is helping to write the Intergovernmental Panel on Climate Change fifth assessment report's chapter on human security, said the study underscores a change in how researchers are starting to think about the broad impacts of climate change. Looking systematically at the risks posed by rising temperatures, he said, "it's adding up to a fairly alarming portrayal."