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**GRAY MATTER**

# Weather and Violence

By Marshall Burke, Solomon Hsiang and Edward Miguel

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As temperatures rise, tempers flare. Anyone who has experienced the hostility of a swelteringly hot summer day in the city can attest to that.

But researchers are now quantifying the causal relationship between extreme climate and human conflict. Whether their focus is on small-scale interpersonal aggression or large-scale political instability, low-income or high-income societies, the year 10,000 B.C. or the present day, the overall conclusion is the same: episodes of extreme climate make people more violent toward one another.

In a paper published this month in the journal *Science*, we assembled 60 of the best studies on this topic from fields as diverse as archaeology, criminology, economics, geography, history, political science and psychology. Typically, these were studies that compared, in a given population, levels of violence during periods of normal climate with levels of violence during periods of extreme climate. We then combined the results from those studies that concerned modern data in a “meta-analysis,” a powerful statistical procedure that allowed us to compare and aggregate findings across the individual studies.

We found that higher temperatures and extreme rainfall led to large increases in conflict: for each one standard deviation change in climate toward warmer temperatures or more extreme rainfall, the median effect was a 14 percent increase in conflict between groups, and a 4 percent increase in conflict between individuals.

The studies in our analysis covered all major regions of the world and showed remarkably similar patterns across a wide range of settings. For example, they documented that spikes in temperature increased violent crime in the United States and Australia, that years of low rainfall increased domestic violence and ethnic conflict in South Asia, that extreme rainfall events increased land invasions in Brazil and that warmer temperatures increased civil conflict throughout the tropics. These studies also documented the role that climate played in the collapse of many of human history’s iconic civilizations: the Akkadian empire in Syria around 2000 B.C., the Maya in Mexico in the ninth century A.D. and Angkor Wat in the 1400s.



Olimpia Zagnoli

Our findings held at very high levels of statistical confidence. To illustrate the consistency of the results: of the 27 quantitative studies we looked at that examined a link between temperatures and modern conflict, all of them found that higher temperatures were associated with more violence. This sort of pattern in the results was extremely unlikely to happen by chance. (Imagine trying to get 27 “heads” in a row when flipping a coin.)

What explains the strong link between climate and conflict? Different mechanisms are most likely operating in different settings, but the two most important factors appear to be aggression and scarcity. The aggression factor is intuitively easy to understand (again, recall summer in the city), and it probably underlies the finding that anomalously hot months have significantly higher crime rates in cities in the United States. As for scarcity, the logic is only slightly more complex. In low-income countries largely dependent on agriculture — like those in much of sub-Saharan Africa and parts of Asia and Latin America — when the rains fail and temperatures scorch, crops wilt and die. This leaves many people dangerously close to the edge of survival, which can lead to social strife and even civil war.

Our findings help us better understand both the past and the present, but they are particularly important for what they imply about the future. Many global climate models project global temperature increases of at least 3.6 degrees Fahrenheit (2 degrees Celsius) over the next half century. Our results imply that if nothing changes, this rise in temperature could amplify the rate of group conflicts like civil wars by an astonishing 50 percent in many parts of the world — a frightening possibility for a planet already awash in conflict.

As the United Nations Intergovernmental Panel on Climate Change finalizes its long-awaited assessment report, due next year, these possibilities should loom large. The report, a draft of which was recently leaked to the press, will inform the public and our leaders about current and future changes in our climate. In the discussion that follows, our leaders must consider how they will guide the world through its hotter, stickier future.

Decision makers must show an understanding that climate can fundamentally shape social interactions, that these effects are already observable in today's world and that climate's effects on violence are likely to grow in the absence of concerted action. Our leadership must call for new and creative policy reforms designed to tackle the challenge of adapting to the sorts of climate conditions that breed conflict — for instance, through the development of more drought- and heat-resistant agricultural technologies.

In the absence of such efforts, our results suggest that our children and grandchildren could face an increasingly hot and angry planet.

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