

TOPIC: Tornadoes are among the most dangerous weather phenomena. When a tornado devastated Oklahoma on May 20, 2013, many reported that it was the strongest such storm in more than a decade. Can such storms be attributed to climate change? What is the effect of climate change on the frequency and intensity of storms of all types? In a well-researched paper of five pages, explain the role of climate change in the occurrence of extreme weather. (4 sources, APA style).

### Climate Change as the Cause of Severe Tornadoes and Extreme Weather: Too Early to Tell

Tornadoes are among the most severe and dangerous weather phenomena. When a tornado devastated Oklahoma on May 20, 2013, many reported that it was the strongest such storm in more than a decade. Just days after the tornado, California, Democratic Senator, Barbara Boxer, also used part of her floor speech to connect the Oklahoma tornadoes to climate change. "This is climate change," she said. "You're going to have terrible storms. You're going to have tornadoes" (Perry, 2013). While politicians like Senator Boxer and many media pundits are ready to attribute such storms and extreme weather to climate change, the scientific consensus holds that it is too early to tell.

It is no mystery to scientists and climatologists that human caused (a.k.a., anthropogenic) climate change and global warming are a reality. In fact, more than 97% of scientists working in the disciplines contributing to studies of the Earth's climate accept that climate change is not only happening, but it is almost certainly being caused by human activities such as the burning of fossil fuels, industrial

processes, deforestation, and so forth (EPA, 2013a). The scientific consensus is supported by data which shows that the Earth's average temperature has risen by  $1.4^{\circ}\text{F}$  over the past century with many regions in the world experiencing drastic changes in rainfall, floods, droughts, severe heat waves, and more (EPA, 2013a). In simple and straight forward terms, anthropogenic climate change is an unavoidable and disturbing fact of the 21st century.

Although scientific consensus has been achieved with respect to the climate change phenomenon, caution is well advised in attributing events like the May 20, 2013, Oklahoma tornado to climate change. When it comes to sound science, the validity of a theory is best attested to by its predictive capability. Einstein's well-established theory of relativity, for instance, has been the subject of scores of predictions that have been tested and proven correct, time after time, over the past century. The predictive power of climate change theory is, however, far from robust or even satisfactory by even the most lenient of scientific standards. Princeton University climate change expert, Michael Oppenheimer, explains, for example, that while he and other experts agree that one key ingredient - namely, the energy-building mix of heat and humidity - will become more common as the climate warms, the factors that

contribute to tornado formation are extremely complicated (Peeples, 2013). In so many words, Oppenheimer's point can be translated as meaning that it is one thing to talk about the probabilities that climate change will lead to more extreme weather and another thing to blame the Oklahoma tornado on climate change. That is why scientists and climate experts acknowledge that "ample debate remains around how climate change may affect other elements, in particular the prerequisite twisting of the wind" (Peeples, 2013). And it is also why Professor Oppenheimer says about the relationship between climate change and extreme weather events like the Oklahoma tornado that "It's a damn difficult thing to predict" (Peeples, 2013).

Despite the illuminating commentary by scientists like Princeton's Michael Oppenheimer, some may continue insisting that intuition alone is sufficient for justifying claims that climate change is the cause of extreme weather events like the Oklahoma tornado. However, recent research at the National Oceanic and Atmospheric Administration's National Severe Storms Laboratory would appear to provide a rather sobering adjustment to the debate. Harold Brooks, Senior Scientist, Forecast Research and Development Division, has suggested, for example, that lateral wind shear, which organizes storms, could actually

become less favorable for tornadoes as a result of global warming (Peeples, 2013). Moreover, data collected by Brooks and others over the past two decades appear to support the prediction that tornadoes will become less frequent as global temperatures continue to rise. In fact, when the National Severe Storms Laboratory data are adjusted for changes in observational methods and frequencies, it becomes apparent that there has been no increase in stronger twisters, and maybe even a slight decrease in EF4s and EF5s (National Climatic Data Center, 2013). Even further, other researchers like Jeff Masters, climatologist and founder of Weather Underground, makes the case that the apparent increase in tornadoes and other extreme weather events is due to a number of factors that skew reports about storm intensity and frequency. These factors include: more meticulous tracking practices and methods, changes in how tornadoes are categorized, heightened public awareness, better detection rates, and population growth in tornado alleys (Peeples, 2013). Although the data would appear to run counter to the intuitive conclusion that climate change is causing increases in the frequency and intensity of tornadoes, scientists like Brooks and Masters remain cautious in making any definite predictions. Masters suggests, more specifically, that it is unlikely that

scientists will understand any time soon how tornadoes will change with the climate (Peeples, 2013).

The question yet remains, of course, as to the relationship between climate change and the frequency and intensity of storms of all types. Theory holds that global warming can make hurricanes and storms more destructive in several ways:

- 1) Warming-driven sea level rise makes storm surges more destructive
- 2) Owing to higher sea surface temperatures from human activities, the increased water vapor in the atmosphere leads to 5 to 10% more rainfall and increases the risk of flooding
- 3) Water vapor and higher ocean temperatures help fuel the storm (Romm, 2012)

Scientific studies also indicate that extreme weather events such as storms, floods, and hurricanes are likely to become more intense as a result of climate change and global warming. However, because these extremes already vary naturally, it may be difficult over short time periods to distinguish whether changes in their intensity and frequency can be attributed to larger climate trends caused by human influences (EPA, 2013b).

Michael Mann, a climatologist who directs the Earth System Science Center at Pennsylvania State University, appears to

agree that it is still too early to fully understand the relationship between climate change and storm intensity and frequency. Despite this fact, Mann has made some interesting comments that demonstrate why the debate remains murky and unresolved. He says, for instance, that "If one factor is likely to be favorable and the other is a wild card, it's still more likely that the product of the two factors will be favorable" (Peeples, 2013). Mann's safe advice on the subject is expressed in terms of a wager. As a result of climate change, he says that "if you're a betting person - or the insurance or reinsurance industry, for that matter - you'd probably go with a prediction of greater frequency and intensity of storms" (Peeples, 2013).

As almost everyone in contemporary society already knows, it is commonplace for policy makers, media pundits, and others to make claims that storms like the Oklahoma tornado on May 20, 2013, should be attributed to climate change. Theoretically, climate change may, in fact, result in increases in the frequency and intensity of hurricanes and other types of storms. But the verdict is yet out on the subject. And further, when it comes to tornadoes, not only is it too early to tell, but much of the data and models suggest that climate change and global warming are likely to reduce the frequency and intensity of tornadoes, not worsen them. Thus, in light of the recent

Oklahoma tornado and all the visceral hype about climate change, it is best to maintain a more objective integrity in the discussion. In fact, the real lesson in it all "is that we ought to ignore the noise from zealots and listen to the scientists" (Guzman, 2013).

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