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# Science: Global Warming May Increase Frequency of U.S. Lightning Strikes

More lightning strikes could trigger wildfires and change the chemistry of our atmosphere.

13 November 2014 Meagan Phelan

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As the world gets hotter, lightning strikes will increase by about 12% for every 1 degree Celsius rise in global average air temperature, a new study (<http://www.sciencemag.org/lookup/doi/10.1126/science.1259100>) published in the 14 November issue of *Science* reports.

Because lightning is a primary trigger for wildfires and also generates nitrogen oxides that influence greenhouse gas composition, this finding has important implications for understanding future changes to wildfire frequency and atmospheric chemistry.

Observations have shown that lightning occurs more frequently when it is hotter than when it is colder, but it is difficult to know how much more lightning to expect as global temperatures continue to rise. Previous estimates have predicted lightning strikes could increase anywhere between 5 and 100% for every 1 degree Celsius climb in global average air temperature.

But these estimates have relied on proxies for lightning strikes, such as cloud height calculations, that in some cases have "no obvious connection to the underlying physics," said lead author David Romps, assistant professor of earth and planetary science at the University of California, Berkeley. In other cases, he said, scientists have used techniques that weren't very sensitive to physical factors like precipitation rate.

Now, a team led by Romps has constructed a new proxy measurement to stand in for the frequency of lightning strikes. It focuses on the continental United States, where lightning strikes frequently and is well-recorded by numerous instruments.

Critically, the team's new measurement is based on two physical characteristics: precipitation rates and the energy available to clouds in the sky, which is also called CAPE, for convective available potential energy. "Higher CAPE implies more energetic thunderstorms," Romps explained.

"To make lightning," Romps said, "a cloud needs to generate an electric field, which it does using water...The more water a cloud processes, the more lightning we should expect. And the more energy available to a cloud, the faster it rises and longer it can keep water drops and ice particles suspended, so, again, the more lightning we should see."

The researchers tested how well their model for lightning strike occurrence captured real lightning strike observations from the continental U.S. during the year 2011. The proxy closely predicted both the number and magnitude of strikes during that time period, as well as the variance in strike rate observed within a season. There was much more lightning in July, August, and September, for example, than in October, November, and December.

The study suggests that U.S. lightning strikes will increase by about 12% (from the current annual number of around 25 million) for every 1 degree Celsius rise in global average air temperature.

They then applied their proxy in 11 global climate models to predict future increases in lightning strikes across the U.S. Their results suggest lightning strikes will increase by about 12% (from the current annual number of around 25 million) for every 1 degree Celsius rise in global average air temperature.

"Half of the wildfires in the U.S. are triggered by lightning," Romps explained. "Those wildfires are often the most difficult to fight since they can be triggered far from the nearest fire station. The fear is that a higher rate of lightning strikes will lead to a higher incidence of wildfires."

"One of our next steps," he continued, "is to look at the spatial distribution of future increases in lightning strikes." That type of information will be useful for assessing changes to wildfire frequency and initiation point.

Because lightning generates nitrogen oxides that impact atmospheric content, the new proxy will also be important for understanding future changes to the chemistry of our atmosphere.

"Lightning is the dominant source of nitrogen oxides in the middle and upper troposphere," Romps explained. Through its control on nitrogen oxides, lightning indirectly regulates levels of ozone, increasing the presence of this greenhouse gas, and it also regulates levels of the hydroxyl radical OH, a highly active atmospheric ion which plays an important role in eliminating methane, a powerful greenhouse gas.

The method developed by Romps' team could be used outside the U.S. to assess future changes in lightning rates in other parts of the world.

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