

The underestimated cooling effect on the planet from historic fires

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Historic levels of particles in the atmosphere released from pre-industrial era fires, and their cooling effect on the planet, may have been significantly underestimated according to a new study.

Fires cause large amounts of tiny particles, known as aerosols, to be released into the atmosphere. These aerosols, such as the soot in smoke or chemicals released by burning trees, can cool the planet by reflecting sunlight back into space and increasing cloud brightness.

Until now, researchers believed that there were fewer wildfires before 1750—prior to the first Industrial Revolution. Additionally, fires from agricultural burning practices in the pre-industrial era have been largely negated or underestimated in datasets of [fire](#) emissions. Therefore, it was thought there were lower levels of aerosols in the atmosphere, reducing their effect on the climate.

Research led by scientists at the University of Leeds has shown fires may have been as common before 1750 as in modern times and possibly even more so. This implies that the cooling effect of present-day man-made [aerosol](#) pollution, such as the tiny particles in car emissions and power plant stacks, may have been overestimated.

Study lead author Dr. Douglas Hamilton carried out this research while at the School of Earth and Environment at Leeds; he is now at Cornell University in Ithaca, New York. He said: "We know aerosols in the atmosphere have always had a significant impact on climate, but until now, the influence they had historically has been underestimated.

"It has been a case of not having the correct tools for the job as global fire models have mostly been designed to simulate present-day fires and long-term observational records of fire activity are sparse.

"Our findings show there may be a significant gap between previous estimations and what was actually taking place in the pre-industrial atmosphere. This suggests the high possibility of a much smaller difference in aerosol cooling between pre-industrial and present-day than we have previously thought. The implication is that the cooling effect of

additional present-day man-made aerosol pollution may have been overestimated.

"Scientists around the world use models to predict atmospheric conditions in the past. We believe these models need to be updated to take into account our new evidence. To continue to study the history of the planet's environment accurately, as well as more accurately predict how human activity impacts the Earth system, we now need to reassess our understanding of how much fires contributed in the pre-industrial era."

Analyses of ice core records, charcoal measured in lake and marine sediments, and tree rings suggests that fire activity varied considerably over the last 500 years but that generally fires peaked around 1850 before declining to present day levels.

The study published in *Nature Communications*, suggests there has possibly been a reduction of fire emissions of between 45 to 70 per cent globally since the Industrial Revolution.

Using fire models that incorporate a more robust understanding of how humans influence global fire activity, the team was able to re-assess pre-industrial fire occurrence and estimate what the levels of subsequent aerosol emission were in 1750.

When incorporated into a global aerosol model, the fire models showed a substantial difference in atmospheric composition that has not been accounted for in climate models.

Study co-author Ken Carslaw, Professor of Atmospheric Science at Leeds, said: "Satellite measurements give us a much clearer understanding of present-day wildfire patterns and the amount of aerosols they release into the atmosphere. It has been widely assumed in

global climate models that aerosol emissions from fires in the pre-industrial era were lower than today, but this is based on a misconception that wildfires have increased with human population density.

"However, the recent analysis of wildfire occurrence shows that at a global scale burned area actually declines as population density increases. This is due in large part to advances in firefighting and fire suppression as well as changes in land use—burnable material, such as forests and grasslands, has been cleared away for houses and roads.

"While climate change and rising global temperatures could lead to an increase in wildfires in the future, it becomes harder to predict the impact on atmospheric conditions without an accurate understanding the role fire emissions played in the past."

Study co-author Dr. Catherine Scott from the Institute for Climate and Atmospheric Science at Leeds said: "It's impossible to evaluate how present-day society's impact on climate has changed over the years without a firm understanding of what the atmosphere was like historically and how it has evolved.

"Our study suggests that the level of particles in the pre-industrial atmosphere might have been more similar to the level we have today than we thought.

"Additionally, whilst this study focused on improving understanding of aerosol emissions from pre-industrial fires we also have to remember that historic and present-day fires have many other effects on the [atmosphere](#), such as the carbon dioxide emitted during burning, and the impact of the fire on the capacity of the remaining forests to take up and store carbon.

"These factors play an important role in the overall impact of fires on

the climate and we need to develop a much deeper understanding of how fires evolved over the pre-industrial era and into present day to appreciate how these impacts fit together."

More information: D. S. Hamilton et al, Reassessment of pre-industrial fire emissions strongly affects anthropogenic aerosol forcing, *Nature Communications* (2018). DOI: [10.1038/s41467-018-05592-9](https://doi.org/10.1038/s41467-018-05592-9)

Provided by University of Leeds

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