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Observing the climate impact of large wildfires on stratospheric temperature

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In the future, large wildfires are expected to become more frequent and intense. Not only do they pose a serious threat to people and ecosystems, but they also affect the Earth's atmosphere. Aerosols from large wildfires can even reach the stratosphere where they can linger for months to years. However, little is known about their impact on climate. In particular, the potential of large wildfires to cause temperature changes in the stratosphere has hardly been studied.

In our study, we analyze two extreme wildfire events, those in 2017 in North America and those in 2019/20 in Australia, using new satellite observational data. We find strong effects of the fires on the atmospheric temperature structure and short-term climate in the stratosphere. The results show significant warming of the lower stratosphere by up to 10 K within the aerosol clouds emitted by the wildfires immediately after their formation. The climate signal in the lower stratosphere persists for several months, reaching 1 K for the 2017 North American wildfires and a remarkable 3.5 K for the 2019/20 Australian wildfires. This is stronger than any signal from volcanic eruptions in the past two decades. Such extreme events potentially influence the atmospheric composition and stratospheric temperature trends, underscoring their importance for future climate.

Improved knowledge of the temperature signals from extreme wildfires is particularly important for trend analysis. Our ongoing research on this topic aims to further improve the separation of natural variability from anthropogenic influences in climate trend detection, especially in the stratosphere.