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The response of thunderstorms and lightning to smoke from Amazonian fires

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The effects of man-made aerosols on clouds are long believed to be a key component for model predictions of climate change, yet are one of the least understood. High aerosol concentrations can change the convection intensity and hence the electrical activity of thunderclouds. Focusing on the Amazon dry season in Brazil, where thousands of man-made forest fires inject smoke into the atmosphere, we studied the aerosol effects on thunderclouds and lightning. We used the ground-based World-Wide Lightning Location Network (WWLLN) measurements together with Aqua-MODIS remotely-sensed aerosol and cloud data to study the relationship between aerosol loading and lightning flash occurrence. We present evidence for the transition between two regimes, representing opposing effects of aerosols on clouds. The first is the microphysical effect which is manifested in an increase in convective intensity (and therefore in electrical activity), followed by the radiative effect that becomes dominant with the increase in aerosol loading leading to a decrease in convective intensity, manifested in lower lightning activity.