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Estimating the radiative effects of a massive smoke plume

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In mid-August 2017, a massive smoke plume originating over northern Canada was tracked during its transport to Europe, over the North Pole, and around the world. The impact of this smoke on the aerosol load of the lower stratosphere has recently been compared to that of a moderate volcanic eruption. We conducted simulations of the smoke plume using the NASA GISS ModelE coupled chemistry climate model to understand the chemical evolution and radiative impacts of the smoke at the surface, using the event as a natural experiment with which to better understand direct aerosol effects. Above boundary-layer smoke injection and emissions with daily temporal resolution were required to deliver smoke to high altitudes and to capture its synoptic transport relative to satellite retrievals of trace gases and aerosols. By comparing experiments with and without the extreme fire emissions, we estimated daytime cooling at the surface of 5-10 °C under the thickest parts of the plume for several days. This surface cooling was consistent with discrepancies between operational weather forecasts and observed surface temperature.