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Simulation of self-lofting of smoke in the stratosphere from the "mother of all pyroCb" British Columbia injection on August 12, 2017

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On August 12, 2017, at least three large pyroCb in British Columbia, Canada at about 53°N, 123°W injected smoke at about 14 km in the lower stratosphere, 2 km about the tropopause. The smoke mass was estimated as "about half a Kasotochi," in terms of sulfate aerosols. The Kasatochi volcanic eruption in 2008 put 1.5 Tg SO_2 into the stratosphere, which is about 2.3 Tg sulfate, which means the pyroCb put a little more than 1 Tg smoke into the stratosphere. Subsequent observations from the OMPS and other satellites show that over the subsequent weeks parts of the cloud rose to above 20 km as it circled the Northern Hemisphere. Previous climate model simulations of the climate impacts of smoke from fires that would be generated by nuclear war from both the NASA GISS ModelE and NCAR WACCM models showed similar self-lofting as the smoke absorbed solar radiation, prolonging its lifetime by several years, much longer than the observed lifetime of sulfate aerosols from volcanic eruptions. Now, with the largest smoke injection into the stratosphere in the modern era, we have the chance to test this lofting mechanism in our models. Using the WACCM model run at 1.9°x2.5° latitude-longitude horizontal resolution, 66 vertical levels (140 km top), coupled ocean and sea ice, full stratospheric chemistry, and CARMA (Community Aerosol and Radiation Model for Atmospheres) for modeling the microphysical evolution of the aerosols, we simulate this smoke injection, and compare the resulting distribution and optical properties to multiple independent observations. We also evaluate the dependence of these results on initial conditions and model assumptions.