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The Untold Story of Pyrocumulonimbus

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Wildfire is becoming the focus of increasing attention with heightened concerns related to climate change, global warming, and safety in the urban-wildland interface. One aspect of wildfire behavior has been totally overlooked until recently—the role of pyrocumulonimbus (pyroCb for short) in both firestorm dynamics and atmospheric impact. PyroCb are fire-started or –augmented thunderstorms that in their most extreme manifestation inject huge abundances of smoke and other biomass burning emissions into the lower stratosphere. The observed hemispheric spread of smoke and other biomass burning emissions could have important climate consequences. Such an extreme injection by thunderstorms was previously judged to be impossible because the extratopical tropopause is considered to be an effective lid on convection.

At least two recurring themes have developed as pyroCb research unfolds. First, some "mystery layer" events—puzzling stratospheric aerosol layer observations— and layers reported as volcanic aerosol can now be explained in terms of pyroconvection as the "smoking gun." Secondly, pyroCb events occur with surprising frequency, and they are likely a relevant aspect of several historic wildfires. Here we will show that pyroCbs offer an alternative explanation for previously assumed volcanic aerosols in 1989-1991. In addition, we survey the Canada/USA fire season of 2002 and identify 17 pyroCbs, some of which are associated with newsworthy fires such as Hayman, Rodeo/Chediski, and Biscuit fires. Several of these pyroCbs injected smoke into the lowermost stratosphere.