An Investigation of the Summer 2017 North American Wildfires and Their Influence on the Upper Troposphere and Lower Stratosphere

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During the summer months of 2017 dozens of wildfires burned across the western United States and Canada. Smoke from these fires was carried long distances from the source regions, impacting surface air quality in distant regions and attenuating incident solar radiation. The fires occurring in early to mid-August 2017 in British Columbia coincided with favorable meteorological conditions so that smoke was injected into the lower stratosphere. In cases such as these so-called "pryocumulus" events there is the potential for the smoke plume to travel around the globe and reside for long periods of time at high altitudes. The smoke from the August fires in British Columbia was clearly observed both in nadir viewing and limb scattering instruments that are part of the Ozone Mapping Profiler Suite (OMPS) and its limb profiler (OMPS LP) onboard the Suomi NPP satellite. These observations revealed unprecedentedly high aerosol index values (a semi-quantitative measure of aerosol loading), as well as very high extinction values reaching altitudes of nearly 20 km, with the smoke circumnavigating the globe at high northern latitudes. We investigate the capabilities of current state-of-the-art aerosol transport models to simulate these events. First, we focus on the near-real time (NRT) predictions of aerosol transport from the NASA Goddard Earth Observing System (GEOS) model, which assimilates aerosol optical depth data from satellite observations but lacks proper constraints on aerosol injection altitudes suitable for capturing these sorts of events. Then we perform sensitivity studies with an enhanced version of the GEOS system that accounts for background stratospheric aerosols and in which we can prescribe the injection profile from the smoke events. We make an estimate of direct radiative impact of the resulting aerosols, including the impact of the aerosols on the stratospheric background aerosol loading and circulation.

Key words: aerosols, radiative forcing, UTLS composition