Aircraft measurements of biomass burning aerosol particles

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Biomass burning from forest fire or agricultural burning emits a huge amount of aerosol particles and gases in a global scale. Thus, its influence on the climate and regional pollution are significant. Especially, biomass burning is one of the major sources of light absorbing aerosol particles such as black and brown carbon, and the understanding of their contributions to global climate is critical.

Aerosol particles from biomass burning depend on types of fire, i.e., smoldering or flaming, fuel sources, and evolution after emission. The evolution of biomass burning aerosol after emission is relatively rapid (~hours), and it changes its chemical, physical, and optical properties within smoke through, for example, dilution, condensation, coagulation, cooling, oxidation, and photochemical processes. To understand the effects of biomass burning influences on the atmospheric phenomenon, it is necessary to accurately observe the evolution (or aging) process within smoke. In this study, we measured and collected biomass burning smoke from wild fires in North America during the Biomass Burning Observation Project (BBOP) 2013 aircraft campaign. The BBOP campaign was the aircraft-based field campaign to study the near-field evolution of particulate emissions from biomass burning from July to October 2013.

This study mainly focuses on the measurements using transmission electron microscopy to analyze the physical and chemical changes within biomass burning smoke. This study found tar balls, which are spherical organic particles and were abundant in relatively aged smoke (>several hours from emission). The number fraction of tar balls increased as the biomass-burning plume aged and reached more than half of all aerosol particles with aerodynamic diameter between 100 and 700 nm. Aircraft-base measurement is powerful and almost the only method to measure such rapid processes occurred in high altitude and will be important observation technique in the atmospheric sciences.

Keywords: Transmission electron microscope, Tar ball, Biomass burning

