

Tar ball particles from biomass burning smoke

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Tar ball is a spherical organic particle emitted from biomass burning and is brown carbon that influences climate. Tar ball is abundant in ambient atmosphere and sometime dominates in aged biomass burning smoke. However, its effect on climate remains uncertain because both its composition and shape, which can be determined using microscopic technique, are necessary to identify tar ball. This study uses a transmission electron microscope with an energy-dispersive X-ray spectrometer (TEM-EDS) to analyze tar balls and aims to reveal its abundance in wild biomass-burning smoke and its micro-physical properties.

The samples were collected from wild fires in North America during Biomass Burning Observation Project (BBOP) 2013 aircraft campaign. BBOP campaign is an aircraft-based field campaign to study the near-field evolution of particulate emissions from biomass burning from July to October 2013. Aerosol particles from wildfires in the Western US (Idaho, Oregon, and Washington) and from agricultural burns in the Mississippi Embayment (Arkansas) were sampled. From these samples, number fractions of tar ball were measured from TEM images.

Tar balls primarily originated from wildfires and were lack in agricultural-burning smoke. They were abundant in relatively aged smoke (>several hours from emission), and the number fractions could reach more than half of all aerosol particles with aerodynamic diameter between 100 and 700 nm. Samples with relatively high tar ball fractions were focused, and the bulk optical and chemical compositions within the smoke with many tar balls will be discussed. Abundances and optical properties of tar balls shown in this study are useful to evaluate their effects on the global climate.

Keywords: aerosol, Transmission electron microscope, climate, tar ball, biomass burning