Biomass Burning Aerosols Optical Properties Constrained by Observations of their Chemico-Physical Properties.

B.V. Scarnato[1], S. China[2] and C. Mazzoleni[2]

[1]Department of Meteorology, Naval Postgraduate School, Monterey, CA, USA
[2]Department of Physics and Atmospheric Sciences Program, Michigan Technological University, Houghton, MI, 49931, USA
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Presenting author email: bvscarna@nps.edu

Biomass burning (BB) aerosols are a product of natural fires and human-induced burning, and they contain nitrate, ammonium, sulfur, organic components and back carbon (BC).

BB contributes significantly to regional air quality, visibility, cloud processes, human health, global carbon cycle, and further global and regional climate.

Direct radiative forcing (DRF) of BB aerosols can be positive or negative. One source of DRF uncertainty is the variability of BB optical properties, which are a function of aerosols composition, morphology and mixing state with other aerosol compounds.

BC particles are one of the major light absorbing constituents in BB smoke. BC particles are aggregates of smaller spherical carbonaceous monomers and are typically observed as internally mixed with other materials. Recent modeling studies show the strong dependence of BC optical properties on chemico-physical characteristics, such as monomer size and number, aggregate shape and compactness and its configuration of mixing with other compounds (i.e., Scarnato et al., 2013, 2014, China et al. 2015).

In this study, we provide a characterization of a variety of biomass aerosols generated at the US Forest Service Fire Sciences Laboratory in Missoula, Montana. The particle emissions were characterized by an extensive suite of instrumentation that measured aerosol chemistry, size distribution, optical properties, and cloud-nucleating properties.

Individual particles containing BC were analyzed with electron microscopy, and were categorized and characterized by their morphology, aggregation and mixing state. Based on the statistical significant characterization of chemico-physical properties, synthetic BC particles were modeled and optical properties were numerically simulated accordingly, using the discrete dipole approximation model.

The aim of this study is to enhance the understanding of the effects of morphology and mixing on light interactions with biomass particles containing BC and brown carbon aerosols.

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