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Optical and chemical properties of wildland biomass burning particles measured downwind during the BBOP study

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Rapid physical, chemical and optical changes in biomass burning particles were measured downwind (< 3 hours temporally) from wildland fires. The Biomass Burning Observation Project (BBOP), sponsored by the U.S. Department of Energy (DOE), involved the measurement of emissions from wildland fires in the Pacific Northwest and agricultural burns in the Central Southeastern United States observed from the DOE Gulfstream-1 airborne platform over a four month period in 2013. Optical instrumentation included a CAPS PMex particle extinction monitor operating at 630 nm (Aerodyne Research), a photothermal interferometer (Brookhaven National Laboratory) measuring particle absorption at 632 nm and a 3 wavelength nephelometer (TSI). Information about the chemical evolution of the plumes was obtained primarily using a SP-AMS (Aerodyne Research) and a Single Particle Soot Photometer (SP2, Droplet Measurements).
The chemical composition of the particulate emissions were characterized in the context of the fire location, combustion conditions, and optical property measurements, including extinction and single scattering albedos. The chemical composition of organic aerosol was found to be rapidly changing as a function of downwind location, with oxygen to carbon ratios increasing as a results of atmospheric aging processes (e.g., dilution, photochemistry). The single scattering albedo, (SSA) of plume aerosols increases downwind as the ratio of total particle extinction to carbon monoxide concentration (a marker for the plume dilution) increases, a finding that is related to changes in organic aerosol chemistry.