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Determination of the broadband optical properties of biomass burning aerosol

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The direct and semi-direct effects of atmospheric aerosol on the Earth's energy balance are still the two of the largest uncertainties in our understanding of anthropogenic radiative forcing. In this study we developed a new approach for determining high sensitivity broadband UV-Vis spectrum (300-650 nm) of extinction, scattering and absorption coefficients, single scattering albedo and the complex refractive index for continuous, spectral and time dependent, monitoring of polydisperse aerosols population. This new approach was applied in a study of biomass burning aerosol. Extinction, scattering and absorption coefficients (αext, αsca, αabs, respectively) were continually monitored using photoacoustic spectrometer coupled to a cavity ring down spectrometer (PA-CRD-AS) at 404 nm, a dual-channel Broadband cavity-enhanced spectrometer (BBCES) at 315-345 nm and 390-420 nm and a three channel integrating nephelometer (IN) centered at 457, 525 and 637 nm. During the biomass burning event, the measured aerosol number concentration increased by more than an order of magnitude relative to other week nights and the mode of the aerosols size distribution increased from 40-50 nm to 110nm diameter. αext and αsca increased by a factor of about 5.5 and 4.5, respectively. The αabs increased by a factor over 20, indicating a significant change in the aerosol overall chemical composition. The imaginary part of the complex RI at 404nm increased from its background level at about 0.02 to a peak of about 0.08 and the SSA decreased from 0.9 to about 0.6. Significant change of the absorption spectral dependence indicates formation of visible-light absorbing compounds. The mass absorption cross section of the water soluble organic aerosol (MACWSOA) reached up to about 12% of the corresponding value for black carbon (BC) at 450 nm and up to 30% at 300 nm. These results demonstrate the importance of biomass burning in understanding global and regional radiative forcing.