Brown carbon in tar balls from smoldering biomass combustion

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We report the direct observation of laboratory production of spherical, carbonaceous particles – "tar balls" – from smoldering combustion of two commonly occurring dry mid-latitude fuels. Real-time measurements of spectrally varying absorption Ångström coefficients (AAC) indicate that a class of light absorbing organic carbon (OC) with wavelength dependent imaginary part of its refractive index – optically defined as "brown carbon" – is an important component of tar balls. The spectrum of the imaginary parts of their complex refractive indices can be described with a Lorentzian-like model with an effective resonance wavelength in the ultraviolet (UV) spectral region. Sensitivity calculations for aerosols containing traditional OC (no absorption at visible and UV wavelengths) and brown carbon suggest that accounting for near-UV absorption by brown carbon leads to an increase in aerosol radiative forcing efficiency and increased light absorption. Since particles from smoldering combustion account for nearly three-fourths of the total carbonaceous aerosol mass emitted globally, inclusion of the optical properties of tar balls into radiative forcing models has significance for the Earth's radiation budget, optical remote sensing, and understanding of anomalous UV absorption in the troposphere.

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