OPTICAL PROPERTIES OF AEROSOL EMISSIONS FROM LABORATORY PEAT COMBUSTION

M. Gyawali, R. L. N. Yatavelli, A. C. Watts, V. Samburova, R. K. Chakrabarty, J. D. Knue, L.–W. A. Chen, I. Arnold, X. Wang, A. Y. Khlystov, J. C. Chow, B. K. Zielinska, J. G. Watson, and H. Moosmüller

Division of Atmospheric Sciences, Desert Research Institute, Reno, NV 89512, USA

Globally, organic soils and peats may store as much as 600 Gt of terrestrial carbon, representing 20 – 30% of the planet's terrestrial organic carbon mass. This is approximately the same carbon mass as that contained in Earth's atmosphere, despite peatlands occupying only 3% of its surface. Effects of increasing fire frequency and size in these ecosystems are of global concern due to the potential for enormous carbon release into the atmosphere with significant implications for the global carbon cycle and radiative forcing. Combustion of peat mostly takes place in the low temperature, smoldering phase of a fire. It consumes carbon that may have accumulated over a period of hundreds to thousands of years. In comparison, combustion of aboveground biomass fuels releases carbon that has accumulated much more recently, generally over a period of years or decades.

Here, we present the aerosol optical properties from the controlled laboratory combustion of peat soil samples from three regions, Siberia (Russia) and Alaska and Florida (USA). Aerosol absorption and scattering coefficients measured using a three-wavelengths photoacoustic instrument were analyzed for single scattering albedo (SSA) and absorption Ångström coefficient (AAC) and compared with previously reported values for other common wildland fuels. The mean organic mass-normalized absorption cross-section (MAC) of peat samples was found to be quite low, ranging from as low as 0.001 m^2g^{-1} at 781 nm to as high as 0.32 at 405 nm; however, combustion emissions from all peat samples depicted large AAC. While SSA values (0.9-1.0 at 405 nm) were similar to those from other wildland fuels, AAC values, (4.5-7.2 range at 405-870 nm) were substantially higher for emissions from peat combustion. These results have important implications for radiative forcing, actinic fluxes driving photochemistry, and optical source apportionment. Three fuel moisture levels were used in this work to enable us to determine whether peat sources or fuel moisture content were more important for the optical characteristics of combustion emissions. Results showed that SSA and AAC vary with moisture content—higher moisture content results in higher SSA values and lower spectral dependence of AAC. Florida lake peat (at 10% moisture level) exhibited the highest AAC value (~7.2).