Observations of the REDUCTION of aerosol light absorption and INCREASE of biomass burning aerosol light scattering for increasing relative humidity

W. Patrick Arnott, Kristin Lewis, and Guadalupe Paredes-Miranda
Physics Department, University of Nevada Reno
Reno NV USA

Derek Day
National Park Service
Fort Collins CO USA

Rajan K. Chakrabarty and Hans Moosmüller
Desert Research Institute
Reno NV USA

Jose-Luis Jimenez, Ingrid Ulbrich, and Alex Huffman
University of Colorado
Boulder, CO USA

Timothy Onasch and Achim Trimborn
Aerodyne Research Inc
Boston MA USA

Sonia Kreidenweis and Christian Carrico
Department of Atmospheric Sciences
Colorado State University
Fort Collins CO USA

Cyle Wold, Emily N. Lincoln, Patrick Freeborn, and Wei-Min Hao
Fire Sciences Laboratory
Missoula, MT USA

A very interesting case of smoke aerosol with very low single scattering albedo, yet very large hygroscopic growth for scattering is presented. Several samples of chamise (Adenostoma fasciculatum), a common and often dominant species in California chaparral, were recently burned at the USFS Fire Science Laboratory in Missoula Montana, and aerosol optics and chemistry were observed, along with humidity-dependent light scattering, absorption, and particle morphology. Photoacoustic measurements of light absorption by two instruments at 870 nm, one on the dry channel, one on the humidified channel, showed strong reduction of aerosol light absorption with RH above 65 percent, and yet a strong increase in light scattering was observed both at 870 nm and 550 nm with nephelometers. Multispectral measurements of aerosol light absorption indicated an Angstrom coefficient for absorption near unity for the aerosols from chamise combustion. It is argued that the hygroscopic growth of scattering is due to uptake of water by the sulfur bearing aerosol. Furthermore, the reduction of aerosol light absorption is argued to be due to the collapse of chain aggregate aerosol as the RH

increases wherein the interior of aerosol does no longer contribute to absorption. Implications for biomass burning in general are that humidity processing of aerosols from this source and others like it tends to substantially increase its single scattering albedo, probably in a non-reversible manner. The chemical pathway to hygroscopicity will be addressed.