Design of a Novel Open-Path Aerosol Extinction Cavity Ringdown Spectrometer and Data from Recent Field Deployments

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We present the key elements of a new open-path cavity ringdown spectrometer (CRDS) design as well as comparisons with a conventional closed-path CRDS and data obtained during two recent field campaigns: FRAPPE at NOAA's Boulder Atmospheric Observatory and HAGiS at NOAA's Earth System Research Laboratory. CRDS has been employed previously to quantify aerosol extinction at relative humidities <90%. At very high humidities (as found in and near clouds), however, existing CRDSs perform poorly, diverging significantly from theoretically predicted extinction values. The new open-path CRDS measures extinction as aerosol is drawn directly through the optical cavity transverse to the axis of the laser. With no inlet/tubing, particle losses due to impaction of coarse particles and condensation of highly humidified particles on transfer lines is eliminated, improving aerosol extinction measurements where such conditions exist. During FRAPPE the open-path CRDS recorded very large extinction enhancement (f(RH) > 50) due to highly humidified aerosol in low-lying rainclouds, demonstrating the instrument's utility in characterizing extinction in extremely high relative humidity conditions. During HAGiS the accuracy of aerosol hygroscopic growth parameterizations was investigated by comparing the extinction they predict to the extinction measured by the open-path CRDS.