Abstract

Asian aerosols are among the most complex yet widely studied components of the atmosphere not only due to their seasonal variability but also their effects on climate change. Four Aerosol Robotic Network (AERONET) sites have been selected to represent aerosol properties dominated by pollution (Taihu), mixed complex particle types (Xianghe), desert-urban (SACOL), and biomass (Mukdahan) in East Asia during the 2001-2010 period. The volume size distribution, aerosol optical depth (τ and τ_{abs}), Ångström exponent (α and α_{abs}), and the single scattering co-albedo (ω_{oabs}) parameters over the four selected sites have been used to (a) illustrate seasonal changes in aerosol size and composition and (b) discern the absorptive characteristics of black carbon (BC), organic carbon (OC), mineral dust particles, and mixtures. A strongly absorbing mineral dust influence is seen at the Xianghe, Taihu, and SACOL sites during the spring months (MAM) as given by coarse mode dominance, mean $\alpha_{440\text{-}870} < 1$, and mean $\alpha_{abs440\text{-}870} > 1.5$. There is a shift towards weakly absorbing pollution (sulfate) and biomass (OC) aerosol dominance in the summer (JJA) and autumn (SON) months as given by a strong fine mode influence, $\alpha_{440\text{-}870} > 1$, and $\alpha_{abs440\text{-}870} < 1.5$. A winter season (DJF) shift toward strongly fine mode, absorbing particles (BC and OC) is observed at Xianghe and Taihu ($\alpha_{440\text{-}870} > 1$ and $\alpha_{abs440\text{-}870} > 1.5$). At Mukdahan, a strong fine mode influence is evident year round with weakly and strongly absorbing biomass particles dominant in the autumn and winter months, respectively, while particles exhibit variable absorption during the spring season (mixtures of BC and OC). A clustering method using $\alpha_{440\text{-}870}$ and $\omega_{oabs440}$ further demonstrates the seasonal and regional dependences of aerosol absorptive properties and should be implemented over other AERONET sites in the future.