Variations in the size distribution of non-sea-salt sulfate aerosol in the marine boundary layer at Barbados: Impact of African dust

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Abstract. Four African mineral dust episodes occurred during a program of daily aerosol measurements at Barbados (13°15'N, 59°30'W) in April 1994. Non-sea-salt sulfate (nss SO$_4^{2-}$) and dust were highly correlated ($r^2 = 0.93$) and ranged from 0.5 to 4.2 µg m$^{-3}$ and 0.9 to 257 µg m$^{-3}$, respectively. Day-to-day variations in the size distributions of mineral dust and sea salt were relatively small. However, the coarse-particle (aerodynamic diameter $> 1 \mu$m) fraction (CPF) of nss SO$_4^{2-}$ varied substantially, from 21% to 73%. The highest CPF SO$_4^{2-}$ values were associated with dust events; the lowest CPF was associated with the air mass from the central North Atlantic when the dust concentration was lowest, 0.9 µg m$^{-3}$. We suggest that large CPF SO$_4^{2-}$ values are a consequence of SO$_2$ in European pollutants that heterogeneously react with the suspended dust over North Africa. Nonetheless, the association of pollutants and dust does not always result in a large CPF; low CPF values suggest that SO$_2$ may have been oxidized to SO$_4^{2-}$ prior to mixing with dust-laden air. On those days when dust and pollution concentrations were low, the dominant source of nss SO$_4^{2-}$ was ascribed to oceanic dimethylsulfide (OMS) and the CPF remained close to 20%. Because such large variations can occur in the particle size distribution of nss SO$_4^{2-}$ in association with dust events, the role of mineral dust on nss SO$_4^{2-}$ size must be taken into account when estimating the impact of nss SO$_4^{2-}$ on radiation transfer in the atmosphere.

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