Chemical composition of near-source windblown dust aerosols in the United States

Mo Dan[1,2], Daniel Tong[1,3] and Tong Wang[2]

1. National Oceanic and Atmospheric Administration, Air Resources Laboratory, College Park, Maryland, 20740 USA
2. Now at Beijing Municipal Institute of Labor Protection, Beijing, China
3. George Mason University, Center for Spatial Information Science and Systems, Fairfax, VA, 22030 USA

Abstract:

Windblown dust aerosols affect the Earth's climate, ocean fertility, atmospheric chemistry, and human health. The extent to which dust affects the environment is determined by the chemical and physical characteristics of dust particles. Here we analyze the chemical composition of near-source dust aerosols based on newly reconstructed long-term dust climatology from the Interagency Monitoring of Protected Visual Environment (IMPROVE) ground network. Dust samples were collected from 30 remote monitoring sites from Colorado Plateau and four North America deserts (Chihuahua, Sonoran, Great Basin and Mojave) from 2000 to 2007. Fine soil, calculated from five crustal elements and their common oxides, is by far the largest component of fine particles during dust storms, contributing on average 58% to total $PM_{2.5}$ (particulate matter less than 2.5 micrometer in diameter) during dust events. Regardless of large spatial and temporal variability, the fraction of fine soil shows similarity in seasonal and spatial distribution across the western US except over the Mojave Desert, which is a relatively small dust source. Hence it is reasonable to treat the western US dust sources as a whole when modeling the chemical composition of local dust storms. Organic matter, sulfate, and nitrate rank the second and third in abundance, contributing an average of 12%, 10% and 4% to $PM_{2.5}$ mass concentration, respectively. The EC fraction is significantly lower during dusty days (0.75% of $PM_{2.5}$), compared to that on non-dusty days (>6%). The ratios of K/Al and Ca/Al are much lower in US local dust than that from Asia or Africa, suggesting potential useful indicators to dust origins.