Geophysical Research Abstracts,
Vol. 11, EGU2009-12084, 2009
EGU General Assembly 2009

Recent progress in understanding the regional characteristics of mineral dust composition and identification of source regions

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The environmental and climatic impacts of mineral dust particles issued from arid and semi-arid regions of the globe strongly depend on their physico-chemical properties, that is, composition, size distribution, and shape.
Mineral dust particles are mainly aggregates of silicates (quartz, clay minerals, feldspars) and carbonates (calcite, dolomite, gypsum) with diameters up to tenths of microns. Surface and bulk chemical compositions determine their optical properties regarding scattering and absorption of solar and terrestrial radiation, but also their role in supplying nutrient to the ocean water. The surface chemistry (hygroscopicity, coatings, etc) also determine their ability to act as cloud condensation- and ice nuclei, and thus affect cloud and precipitation formation. Finally, they offer reaction and adsorption surface for numerous organic and inorganic reactions of particulate matter and trace gases; therefore, playing an important role in the removal of atmospheric trace and pollution constituents.
In this presentation we will focus on the regional variability of the elemental bulk composition of mineral dust which is needed to predict the variability of its impacts at the regional and continental scales. The current state of knowledge is mainly determined by numerous investigations from the Sahara and from the Chinese deserts. Many conclusions are based on measurements performed in surface air or in the lower boundary layer over the deserts and adjacent oceans.
Compositional differences (elemental, mineral and isotopic) of desert aerosol are strong indicators for distinct major regions. Source apportionment seems to be possible using compositional data for a local and regional type of transport. During long-range transport, source characteristics can get lost when large scale mixing is taking place. Any final conclusion regarding the actual source requires additional application of tools like 3-D air mass trajectory analysis, use of satellite imagery etc. Pinpointing of single sources or hot spots seems to be questionable because dust aerosol undergoes vigorous convective mixing especially over strongly heated desert surfaces. Additional horizontal mixing with different air masses tends to smear out the primary characteristics of its origin.
However the investigation of the bulk composition remains a necessary task to derive other aerosol properties regarding direct and indirect aerosol effects like refractive index, absorption, hygroscopicity, state of mixing. In addition, source apportionment based on dust composition is an important tool for paleoclimatalogy.
New data on minor species like iron oxides will be presented and used to estimate the refractive index of mineral dust across the visible spectrum.