First Comparison of Asian and African transported atmospheric particles during desert dust events.

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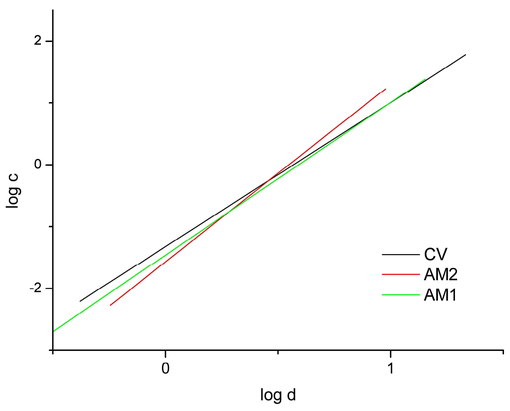
Introduction

The African and Asian desert regions are the greatest production source for mineral dust from soil erosion, which has a significant impact on the atmospheric radition field. Many investigations are done on both, but lacking a common basis for comparison and far away from an experimental closure. Analysed SEM/EDX samples originating from the SAMUM II field campaign, conducted 2008 on Cape Verde Islands and from a series of measurement from Amakusa, Japan, 2010, were classified the same way in order to compare their elemental composition and mixing state. When calculating the two different datasets, great difficulties appeard. The following is a description of the attempt to compare two sets of samples with similar history.

Locations

Both sampling sites are located off-coast in the range of long transported desert dust. It must be taken into account that the source regions, the saharan desert for Cape Verde Islands and the Chinese deserts for Amakusa, are slightly different. However, the uplift, transportation and processing of particles during transport over continents and oceans might be assimilable.



Kandler et al. (2007) proofed the existence of a sulfate coating on mineral dust paricles for samples taken near Izaña, Teneriffe by showing the behavior of the elemental ratio with increasing size. Elements that occur within surface coatings and elements that are contained in the complete particle volume, show different behaviour of the element index or volume ratio, assuming that a coating thickness is independent of particle size. Here, d log c was plotted to determine the gradient of the three samples considered. The plot shows, that in the second Amakusa Sample, more particles are likely to have a sulfate coating (average gradient is 2.86) than in the first Amakusa sample (2.46) and on the Cape Verde sample (2.32).
Sulfate containing particle classes were not regarded. High values of SO2 are discribed previously by Zhang et al.. A coating on particles therefore is very likely.

Results and discussion

As shown in figures 1 to 3, the size resolved chemical composition shows a high dominance of aluminiumsilicate-particles, most of them iron containing. Another important particle group detected on Cape Verde samples are the sulfat-silicate mixtures (lilac, fig.1). The amount of sea salt (green) and aged sea salt is remarkably low during a dust event. Also, no mixtures of sea salt and dust particles where found, indicating that there is no mixing of dust and sea salt during long range transport, but maybe short before deposition.
For samples from Amakusa Island (fig.2 and 3) the relative number abundance of sea salt is much higher. During two days of a dust period, the amount of seasalt is pushed back and replaced by sulfates (purple, fig. 3), whereby the relative number abundance of silicate particles, which mark the dust event, is not decreasing. Sulfate-silicate mixtures are found rarely on Amakusa, whereby mixtures of silicate with sea salt are occuring frequently. This indicates that there is a strong up and down ward mixing during transport.
Sulfate silicate mixtures where plotted in Si-Al-Na ternary plots. It appears for all investigated samples from Amakusa, that the content of Na in particles is high compared to Cape Verde samples (see figs. 3 and 4).

References
Kandler et al. 2007: Chemical composition and complex refractive index of saharan mineral dust at Izana, Tenerife (Spain) derived by electron microscopy Atmospheric Environment.
Zhang et al. 2008: Influences of sulfate and nitrate on the hygroscopc behaviour of coarse dust particles Atmospheric Environment.

Methods

All sampels regarded in this study were collected with a miniature impactor system. For the sampling of probes for single particle analysis carbon caoted nickel discs and foils of polyvinylformal with carbon coating on nickel grids were used. On Cape Verde Islands, the sampling equipment was installed 4 m above ground (109 m above sealevel). On Amakusa, Japan, the sampling site was located on a sightseeing platform of Mt. Arao-Dake, 342 m above sealevel.
The size resolved particle aspect ratio and the chemical composition is derived by means of electron-microcopical single particle analysis and energy dispersive X-ray analysis with an Environmental Scanning Electron Microscope FEI, Quanta 200 FEG at Institute of Applied Geosience, Technische Universität Darmstadt.

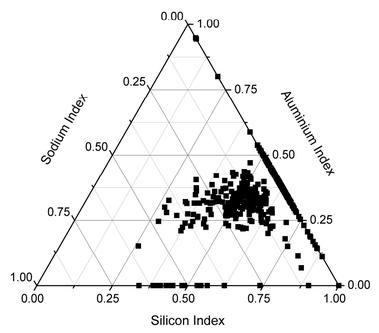


Fig. 3. Ternary plot of silicon, aluminium and sodium index for sulfate-silicate mixtures of Cape Verde sample

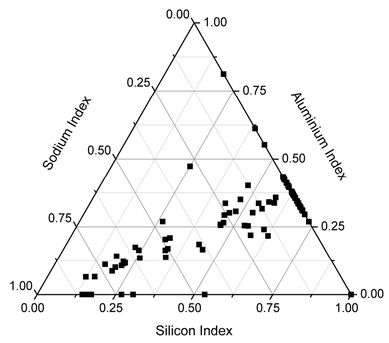


Fig. 4. Ternary plot of silicon, aluminium and sodium index for sulfate-silicate mixtures of Amakusa samples

Future questions:

We are meeting a different meteorological situation. How does local meteorology influence the particle distribution and mixing state?
We are gaining particles from different source regions. Can we compare the geo-chemical composition of the source region and therefore of the transported particles?
Which role does mixing with sea salt, biomass burning and urban polution aerosols play?
How does the composition change within time?

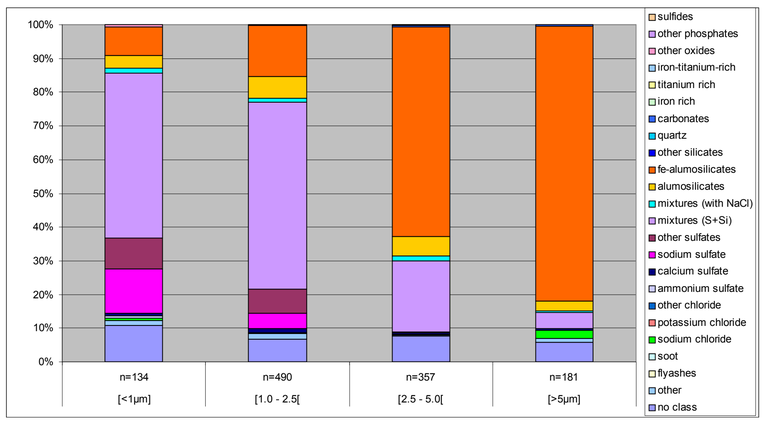
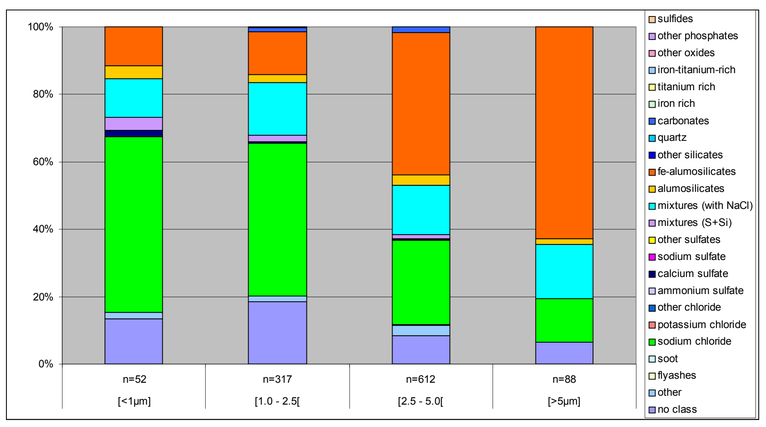


Fig. 1. Size-resolved relative number abundance of the different particle groups averaged for Cape Verde samples of Jan. 25th. 2008.
„n“ is the counted number of particles.



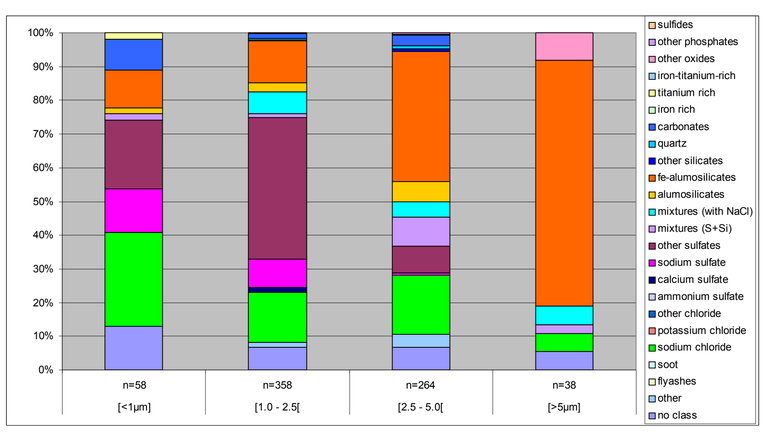


Fig. 2. Size-resolved relative number abundance of the different particle groups for Amakusa Samples of 16th and 17th March 2010.
„n“ is the counted number of particles.

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