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Size-resolved composition of laboratory generated source dust aerosols

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The considerable interest in studying mineral dust aerosols is motivated by the importance of their large presence in Earth troposphere and their implication in various environmental processes, in particular direct and indirect radiative forcing or biogeochemical cycles. A number of recent field campaigns such as AMMA or SAMUM have been dedicated at least in part to the characterisation of mineral dust properties and have confirmed both the complexity and the variability of these atmospheric components. Beside particle size and shape, mineralogical composition is a key parameter for the quantification of the various effects of dust. This composition is known to depend on 1) the source of the aerosol and, 2) particle size for a given aerosol. Therefore, the modelling of dust aerosol properties requires the assessment of their size-resolved composition at regional scale.

For contributing to the better knowledge of dust emission processes, our study aims at assessing the size-resolved mineralogical description of aerosols produced from different sources. For this, we analyse the mineralogical composition through the elemental composition (Na, Mg, Al, Si, P, S, K, Ca, Ti, Fe) of dust collected on cascade impactor (DEKATI) stages. In general, this kind of measurement is used to describe mass distribution or, sometimes, the mixing state of dust and other aerosol species but only few papers report on size-resolved elemental composition concerning specifically mineral elements. In particular, we focus our efforts on the quantification of iron oxides because these mineralogical species are involved in the absorption of solar radiation by dust and also because dust is a major provider of iron for ocean biogeochemistry. We performed the quantification of iron oxides content using the method adapted for aerosol samples of Lafon et al. (2004).

The aerosol from various source regions are generated in laboratory using natural soils collected in actual source regions. The large bank of soil sample available at the LISA covers the major desert zones of Africa (especially various Saharan soil samples) and Asia. The aerosol generation is performed with a new system designed specially to simulate the interparticle shocks, and their sandblasting, as they occur in natural conditions.

We present examples of size-resolved elemental composition obtained by X-ray fluorescence analysis applied to the content of the various stages of a cascade impactor. We also compare the size-resolved composition to the bulk one and discuss its regional specifics and variability. The mass size distribution of various element and iron oxides is also discussed taking into account regional variability in order to better describe fine and coarse modes of dust aerosol. Finally, we propose a new composition model including the studied parameters.