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Methodological aspects of mineral dust deposition measurement in a dust transport region (Tenerife): results from single-particle characterization

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Mineral dust is dominated by particles in the supermicron range and consists to a great extent of particles larger than 10μm. Therefore, assessment of its properties can't rely on standard PM10 instrumentation. Frequently, deposition or other passive measurement techniques are used to sample mineral dust from the atmosphere. However, there exists a multitude of different collection instruments with different, usually not well-characterized sampling efficiencies, so the resulting data might be considerably biased with respect to their size representatively. In this study, individual particle analysis by automated scanning electron microscopy (SEM) coupled with energy-dispersive X-ray (EDX) was used to characterize different, commonly used passive samplers (Big Spring Number Eight, Modified Wilson and Cooke, funnel, Sigma-2 and flat-plate geometries) with respect to their size-resolved deposition flux and mass concentration. Samples were therefore collected on pure carbon adhesive substrate inside the different passive samplers. In addition, computational fluid dynamics modeling was used in parallel to achieve deposition velocities from a theoretical point of view.
Approximately 150,000 particles from 90 samples were analyzed. Results show that flux measurements made using different passive samplers and measure differently, indicating that there is no agreement on the values among samplers (no unified result). The results also show that the measured flux distributions is dominated by coarse particles, maybe, contributing more than 90% of the total mass flux. Furthermore, different classical deposition velocity models were assessed to calculate concentration from particle mass flux. Nevertheless, the estimation of an appropriate deposition velocity from different models was one of the main challenge of the work. To sum up, the results indicate that passive sampling method accompanied by an automated single particle analysis is a good option to investigate the special and temporal distribution of mass flux and mass concentration of atmospheric dust aerosol and particularly useful to get size resolved information on single particle level.