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Abundance of giant mineral dust particles: Insights from measured emitted dust size distributions during the J-WADI campaign

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Gaining a precise understanding of the particle size distribution (PSD) of mineral dust at emission is critical to assess its climate impacts. Despite its importance, comprehensive measurements at dust sources remain scarce and usually neglect part of the super-coarse (particle diameter d between 10 and 62.5 µm) and the entire giant (d > 62.5 µm) particle size ranges. Measurements in those size ranges are particularly challenging due to expected relatively low number concentrations and low sampling efficiencies of instrument inlets.

This study aims to better constrain the abundance of super-coarse and giant dust at emission as part of the Jordan Wind erosion And Dust Investigation (J-WADI, https://www.imk-tro.kit.edu/11800.php) field campaign conducted north of Wadi Rum in Jordan in September 2022. The goal of J-WADI is to improve our fundamental understanding of the emission of desert dust, in particular its full-range size distribution and mineralogical composition.

To capture the dust PSD across the entire size spectrum, we deployed multiple aerosol spectrometers, including active, passive, and open-path devices, such that in combination, a size range from approximately 0.4 to 200 µm was covered. Here we investigate the variability of the PSD in the super-coarse and giant ranges from observed dust events, address instrumental uncertainties and the impact of different inlets on the resulting PSDs. Our preliminary results reveal a mass concentration peak at around 30 µm, potentially limited toward larger sizes by substantially reduced inlet efficiencies. Giant dust particles were generally detected during active dust emission starting from friction velocities larger than around 0.2 m s^{-1}.

Based on our results, we will investigate the mechanisms facilitating super-coarse and giant dust particle emission and transport. Quantifying the conditions for and the amount of super-coarse and giant dust at emission will lay the foundation to incorporate its impacts in weather and climate models.