Geophysical Research Abstracts
Vol. 21, EGU2019-14487-1, 2019
EGU General Assembly 2019

Dust generation from active sand under saltation

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Aeolian (wind-driven) dust emission has a major impact on many environmental and socioeconomic issues such as climate change, soil ecology and fertility, air pollution and thus on human health. The emission of the mineral dust to the atmosphere is a major process in determining the global dust cycle. Comparisons of global dust emission model results against dust measurements still show large discrepancies due to a number of major uncertainties in our understanding of dust emission processes. Active (dune) sands have been identified, by remote sensing studies, as dust sources in northern Africa, China, and elsewhere. However, there is only limited empirical information on dust generation from sands under natural aeolian conditions of saltation. This study integrates wind tunnel experiments and high resolution laboratory sand analyses to explore dust emission from active sands with a focus on the dust emission mechanisms. Four sand samples were used to represent different sand compositions of grain size, dust content, morphology, and mineralogy. No dust emission was recorded for shear velocities below the saltation threshold. PM10 concentrations were increased with the initial content of dust-sized particles in the sand. The experiments identify clay coatings removal as the dominant mechanism in with an addition of re-emission of existing dust-sized particles in the sand. The results also suggest that aeolian abrasion play only a minor role in PM10 dust generation from sands.