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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Does the size distribution of mineral dust aerosols depend on the wind speed at emission?" *by* J. F. Kok

Anonymous Referee #1

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This is a fascinating and potentially important paper providing evidence from a number of datasets that the author's theory relating eolian dust production to brittle fragmentation processes is consistent with observed mineral aerosol size distributions (for steady-state, transport-capacity-limited saltation generating dust). These results have the potential to simplify the parameterization of dust emission in atmospheric circulation models, and improve understanding of dust transport distances and pathways (but require a re-consideration of many studies using grain size as a proxy of wind strength)in paleo-dust deposits preserved in the geological record.

It is pointed out that the evidence is contradictory from field and laboratory studies as to whether dust particle size decreases with wind speed: this may be, I suspect, due to differences in mineral material properties for dusts of different chemical composition.

There may be some situations, with regards to weathered sediments with clay or iron coatings, for example, in which the brittle fragmentation mechanism falls short of the complete actual dust particle formation process. Future research could, for example, perform wind tunnel tests of different pure, granulated minerals in different weathering states to investigate if the Kok brittle-fragmentation model holds and where it may not. However, for the majority of terrestrial dust-emissive soils, the mechanism presented by Kok probably holds. Similarly, since the global dust aerosol load is most likely created through transport-capacity-limited, steady-state saltation (as opposed to supply-limited saltation), the Kok mechanism is likely well suited to potentually simplify global numerical modeling efforts aimed towards the dust cycle.

The suggestion, based on the author's findings, that "it supports the interpretation that increases in the mean dust size in these records are not related to changes in the wind speed during emission, and instead indicate either stronger transporting winds or a reduced distance to the source" is crucial: if true, countless published studies of the Quaternary loess record and other paleo-eolian dust, in which dust grain size is used as a proxy of wind strength- which is then used to tweak paleoclimatic models- are now thrown into question.

Technical comments: (A) The actual six field data sets considered should be introduced, cited, and discussed briefly in section 2 of the manuscript. The way the paper is presented now, one must access the Supplementary Data (Table 1 does not provide enough information about soil type, geographic location and thus geomorphic setting of the dust data): this should not be required of the reader.

(B) The Nickling et. al reference should be corrected from "semident" transport to "sediment" transport.

Interactive comment on Atmos. Chem. Phys. Discuss., 11, 19995, 2011.