Mesoscale modeling of aeolian sand transport

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We report on our recently developed two-species model for aeolian sand transport [1], which extends the continuum model introduced by Sauermann and coworkers [2] by discriminating between two types of trajectories that represent a low-energy reptating and a high-energy saltating grain fraction—a picture that is motivated by experiments and commonly invoked to motivate formation of aeolian sand ripples [3,4]. In particular, we show that the mean grain speed, hop length, and transport rate observed from this improved model are in remarkable agreement with various wind tunnel data. We also speculate about the reason for the success of the coarse-grained description in comparison to more detailed numerical models, despite of its allegedly unfaithful representation of some of the grain-scale details [4]. A key feature seems to be that the model captures the essential mesoscale physics, and that the unresolved complex details on smaller scales have little impact on the most salient transport characteristics. We conclude that the two-species continuum approach provides an appropriate starting point for analytical and efficient numerical modeling of the seemingly complex aeolian saltation process and the whole hierarchy of structures it creates, ranging from ripples over isolated dunes to extensive aeolian bed forms.

References

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