Geophysical Research Abstracts
Vol. 19, EGU2017-6272, 2017
EGU General Assembly 2017

An analytical model for the aeolian sand ripple instability

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Aeolian ripples, which decorate the flanks of sand dunes, belong to a distinct class of pattern. It has been recently shown by means of direct DEM simulations that the instability mechanism at the origin of their formation is related to saltating grains with 'resonant' trajectories, i.e. whose hop length are tuned to the ripple wavelength, and to the existence of an interfacial collisional layer between the static sand bed and the transport layer [1]. Drawing on these ingredients, we propose here an analytical model that is able to reproduce the growth and the propagation of ripples, with scaling laws in agreement with experimental data.

[1] O. Durán et al., PNAS 111, 15665-15668 (2014).