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How Barchan Dunes distribute over Deserts

O. Duran, V. Schwaemmle, P. Lind and H. Herrmann
Institute for Computational Physics, Stuttgart University (duran@icp.uni-stuttgart.de)

Due to their high mobility, barchan dune fields play an important role in the propagation of desert. Although the models of isolated barchan dunes predict an intrinsic instability that should merge a whole dune field into a single dune, in real conditions they are quite stables. Here we show that the size of barchan dunes in a dune field is log-normal distributed, and thus, the dynamics of dune field evolution is determined by an underlying multiplicative process, and that they are uniformly distributed across the field. We derive a simple relation between the fundamental macroscopic properties characterizing a dune field, namely, the inter-dune spacing and the first and second moments of the dune size distribution. This relation is obtained from a mean-field approach and is fulfilled in both, simulations and real conditions. Moreover, we show how these properties only depend on boundary conditions, closing a theoretical picture for the structure of an entire dune field.