
Coexistence of two dune growth mechanisms

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Résumé

An increasing body of evidence indicates that sand availability does not control only dune shape but also the dune growth mechanism. As a consequence, the same flow condition can produce different dune orientations (Fig.). Here, we use field measurements, subaqueous laboratory experiments and numerical simulations to document dune shape and alignment under multidirectional flow conditions. In zones of infinite sand supply, we show that dune patterns take the orientation for which the sand flux perpendicular to the crest is maximum. In zones of low sand availability, dunes tend to align with the direction of the resultant sand flux at the crest. In the first case, periodic dunes grow in height from the available sedimentary resource in the inter-dune area. In the second case, dunes elongate by developing a finger-like structure on the non-erodible ground. These two dune growth mechanisms are modeled and quantified from the dynamic interactions between topography, flow and sediment transport to predict dune orientation, wavelength, migration speed and growth rate. Then, exploring the parameter space of flow conditions (i.e., the angles between the flow directions and the transport ratios), we can estimate the magnitude of the positive feedback between shear velocity and topography (i.e., the speed-up) for which observations and predictions agree. All these results can provide new information about flow conditions and sediment properties in all remote places where dunes exhibit different orientations, especially in marine environments.

Mots-Clés: Dune growth mechanisms, dune shape and orientation, sand flux, speed up

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