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Simulating dune dynamics at the coast: morphological feedback in a supply limited Aeolian transport model

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In order to simulate coastal dune dynamics and to be able to explain morphological features at the dry beach, it is important to include limitations in sediment supply as well as feedback between sediment transport processes and morphological changes. For this purpose we extend the process based model for supply limited sediment transport at the coastal zone AeoLiS (Hoonhout & de Vries, 2016) with a spatially varying wind field
The original intention of the AeoLiS transport model was to be able to simulate the influx of Aeolian sand into the dune area. It is shown that the limitations of sediment supply on the beach (e.g. surface moisture, armouring) are more important than the Aeolian transport capacity. At present, intending to use AeoLiS as a hindcast tool for dune morphology, an adequate prediction of the wind field is needed. Even more so, the feedback mechanism between wind field perturbation and topographical changes is crucial.
We chose to extend the model with the shear stress perturbation theory in the boundary layer by Weng et al. (1991). Here, we validate the model formulation on the growing rate and migration velocity of a 1D (linear dunes) or 2D (Barchan dunes) initial heap of sand. Migration velocity is known to scale with wind speed and dune height. The growing rate is known to depend on the level of saturation of Aeolian transport upwind of the profile and the initial shape of the profile. Given the framework of AeoLiS as a model for supply-limited transport, we are able to relate the saturation level to coastal indicators such as beach width.
Results indeed show growing or shrinking dunes, that migrate downwind. Furthermore, it is numerically confirmed that larger beach widths give rise to faster growing dunes.