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# Modelling the effect of coastal foredune topography on annual aeolian sand input from the beach

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Predictions of the seasonal to annual aeolian input of beach sand into the foredune are generally too high compared to measured deposition volumes. As such predictions are generally based on wind-characteristics alone, the over-prediction is generally ascribed to transport limiting factors, such as beach moisture, that are not incorporated in the model formulations. However, also the applied wind characteristics themselves may be in error. Most predictions rely on regional wind data, thereby ignoring the potential effect of the foredune topography on the local (i.e. on the beach) wind field. Previous studies have shown that shore-oblique winds are rotated to a more shore-parallel direction. Additionally, the near-bed wind velocity just in front of the beach-dune interface is reduced. These results are based on relatively low (< 15 m) and moderate slope (> 0.33 m/m) coastal foredunes. For higher (> 20 m) and steeper (>0.44 m/m) foredunes, which are common for the Dutch coast, the effects are expected to be more pronounced. The use of local rather than regional wind characteristics is then expected to substantially reduce the potential aeolian input into the foredune. To quantify this effect, we modelled wind behavior using the open source Computational Fluid Dynamics (CFD) package OpenFOAM. The output of this model study was subsequently used to investigate the effect of local rather than regional wind characteristics on annual predictions of aeolian sand input for the Dutch coastal dune system.

Our results confirm that the Dutch high and steep foredunes have a substantial effect on wind patterns, more than found so far in field data at other sites. A typical Dutch 20-m high foredune with a 0.44 m/m slope reduces wind speeds up to 33% 5 m in front of the foredune for shore normal winds. A maximal shore parallel rotation of 22° was modeled at the dunefoot for winds approaching 35° obliquely from the shore normal. The influence of regional wind speed on the speed reduction and alongshore topographic steering is predicted to be negligible. Next, the results of the CFD study were used to convert 24 years of regional wind data to near-dunefoot wind speeds and directions. These wind speeds and directions were subsequently used to calculate potential transport using the Hsu (1974) equation while accounting for the cosine effect. Potential transport rates are predicted to be reduced by 70% using local wind speeds and direction. Results show a 48% drop in predicted aeolian input resulting from the more shore-parallel wind angle alone, while the drop in wind speed (but with the regional approach angle) reduces the input by 46%. Our next step will be to improve the aeolian transport modeling by using the modeled wind profiles in a supply limited advection model that explicitly includes sediment pick-up and deposition.