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Coastal dune behaviour at different beach widths

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Along the Dutch coastline, sand dunes form a natural defence against the sea. Together with the size of the beach, dune dimensions determine whether coastal safety requirements are met. Dunes grow via onshore transport of sediment by wind and erode mainly through the impact of sea waves during storms. Previous studies show that both dune growth and erosion are influenced by beach dimensions. A wide beach (500 m) is expected to provide more sediment for onshore transport and to dissipate more wave energy than a narrow beach (50 m). Hence, all other factors being equal, dune growth is likely to be higher on wide beaches than on narrow beaches. This study quantifies the relation between dune behaviour and beach width. Results will be used to improve and test predictive modelling of shoreline development.

The combined effect of beach dimensions on dune behaviour was studied by comparing changes in dune volume at beaches of different widths. These volume changes represent the net effect of sediment accumulation and sediment loss of the dune. Yearly elevation measurements of 200 locations along the Dutch coastline were used, taken between 1960 and 2010. From these elevation measurements, beach width and yearly changes in dune volume were derived. Subsequently, measurements were grouped in beach width classes, each containing 100 paired observations of dune volume change and beach width. For these classes, the average and variability of volume changes were calculated.

The results show a clear relation between beach width and dune behaviour. Going from narrow to wide beaches, average volume changes increase to a maximum. The beach width at which maximum growth is reached, differs per study area. For extremely wide beaches, average rates are lower. These cases are associated with development of transport inhibiting beach-topography. Inverse to the trend in volume changes, the variability of dune behaviour is highest on narrow beaches and decreases for wider beach classes.

The positive relation between dune growth and beach width can be explained by both increased sediment input and reduced dune erosion at wider beaches. Further research is required to separate the effect of beach width on dune accretion from the effect on dune erosion.