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Raising the (subtidal) bar for embryonic dune growth and survival

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Along sandy coasts, the development of new dunes is governed both by physical and ecological processes. Vegetation is crucial for the initiation of embryonic dunes and the subsequent increase in dune height and volume when sediment supply is sufficient. Here, plants pose localised barriers to the wind flow, reducing the wind velocity and allowing sand to accumulate. During severe storms, wave-induced processes can dramatically erode embryo dunes. In this case, the plants' tolerance to and recovery from hydrodynamic disturbances, such as exposure to saline water during high water levels and their (partial) removal during storms, is vital to the long-term resilience of the dune building process. Accordingly, areas with high embryo dune abundance have been correlated to wider beaches, attributed both to increased wind-driven sediment supply and increased wave attenuation during storms. Recent observations have shown that alongshore variations in subtidal sandbar morphology may also lead to variations in wave attenuation and foredune erosion. It remains unclear, however, whether subtidal bar characteristics play a role in long-term (months to years) embryo dune development. We hypothesize that beaches with shallow sandbars, located further onshore, experience less embryo dune erosion during storms than beaches with deeper, further offshore located bars. To test this hypothesis, we analysed a data set of annual bathymetric (profiles with 250 m alongshore spacing) and topographic (airborne Lidar) measurements in addition to observations of embryo dune presence derived from aerial photographs, spanning 50 km along the Dutch coast from 2010 to 2016. Embryo dune area extraction was done by supervised classification of vegetation pixels on the beach. Using a linear regression model, we found that profiles with higher percentages of depths < 4 m significantly correlated to larger embryo dune areas. This suggests that sandbar morphology plays a significant role in the development of alongshore-variable embryo dune development through variations in wave attenuation during storms. At the conference, we will further explain the observed spatial and temporal (storm-driven) variability in embryo dune development.