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Measuring the alongshore variability in the wave field over an inundated beach

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Along wave-dominated coasts, sandy dunes can erode severely during extreme storms. The volume of eroded dune sand has been observed to vary strongly alongshore. Recent observations show that this alongshore variation in dune erosion may relate to alongshore depth variations of nearshore crescentic sandbars, where shallower areas supposedly reduce the wave attack on the dune. On the other hand, other observations suggest that the pre-storm dune morphology (e.g. foredune slope, embryo dune presence) may provide an alongshore variable sand buffer against wave attack, leading to alongshore-variable dune erosion. The latter suggests that alongshore-variable dune erosion does not require alongshore variability in wave attack. Despite observations of alongshore-variable dune erosion and morphological coupling within the sandbar-beach-dune system, concurrent measurements of the nearshore wave field are lacking. With our research, we aim to quantify the alongshore variability in the wave field reaching the dunes during storms.

During the winters of 2017/2018 and 2018/2019 we deployed 7 pressure sensors spaced 250 m apart, along a 1.5-km stretch of beach on the Dutch coast (Egmond aan Zee). All sensors were located above the high tide water level, each at different elevation levels (maximum 1 m difference). We monitored marine forecasts for approaching storms, and deployed 7 additional pressure sensors 40 m seaward of each initial presure sensor before the storm surge arrived. During the study period the sensors were submerged several times during storm surges of 1-2 m. Full bathymetric (sonar) and topographic (mobile laser scanner) surveys were done before and after the storms. As the sensor heights, bed levels and thus water depths varied alongshore, we had to correct for observed wave properties before comparing between the measurement locations for a given moment in time. To do so, we compared wave properties at a specific water depth during a tidal cycle. Using this approach during low-moderate conditions, we found Hs to be up to 1.8 times larger at locations fronted by a deeper subtidal bar crest, compared to locations fronted by shallower areas in the subtidal bar. This agrees with the expected modulation in Hs driven by the alongshore depth variability in the subtidal bar. At the conference we will present our results obtained during storm surges and aim to discuss our measurement strategy.