AEOLIAN SAND TRANSPORT ACROSS A SHELL-FRAGMENTED BEACH

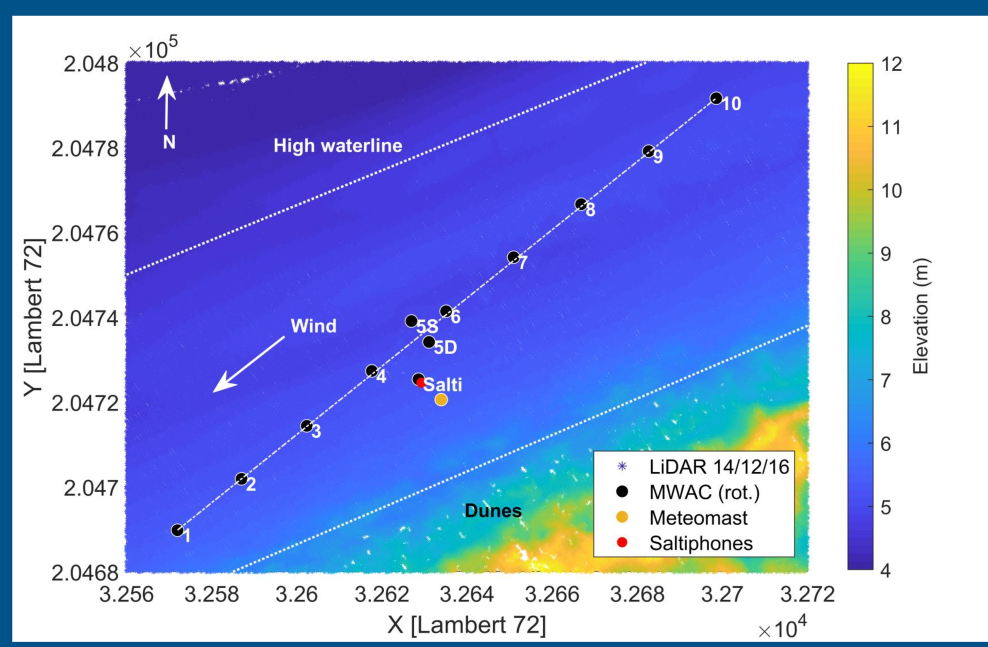
A FIELD STUDY

STRYPSTEEN G. & RAUWOENS P.

glenn.strypsteen@kuleuven.be

INTRODUCTION & METHODOLOGY

When studying aeolian sediment transport in coastal zones, often a location is chosen where the number of supply-limiting factors is minimal (e.g. moisture, shells, vegetation), to ensure better comparison between predicted and observed values. However, as is often the case in a natural coastal environment, the beach contains bed irregularities caused by wind action, patches of pebbles, beach wrack, shells and shell-fragments, vegetation and beach litter. The effect of these small-scale bed features is frequently disregarded when conducting field experiments, even sometimes called insignificant. This study presents detailed measurements of aeolian sand transport rates, wind conditions, and grain size distributions during a two-day measurement campaign in the winter of 2016 on the natural upper beach of Koksijde, Belgium. The experiment was designed to study the influence of shell pavement (various types of shells) on sand transport rates during strong and highly oblique onshore wind. Understanding local aeolian transport processes ultimately helps improving predictions of aeolian sediment transport in coastal areas over short to long-term timescales.



TRANSPORT RATE

TRANSPORT INTENSITY

WIND MEASUREMENTS

TOPOGRAPHICAL MEASURMENTS

Figure 1. Plan view of the study site with the location of the equipment.

- **ENVIRONMENTAL CONDITIONS**

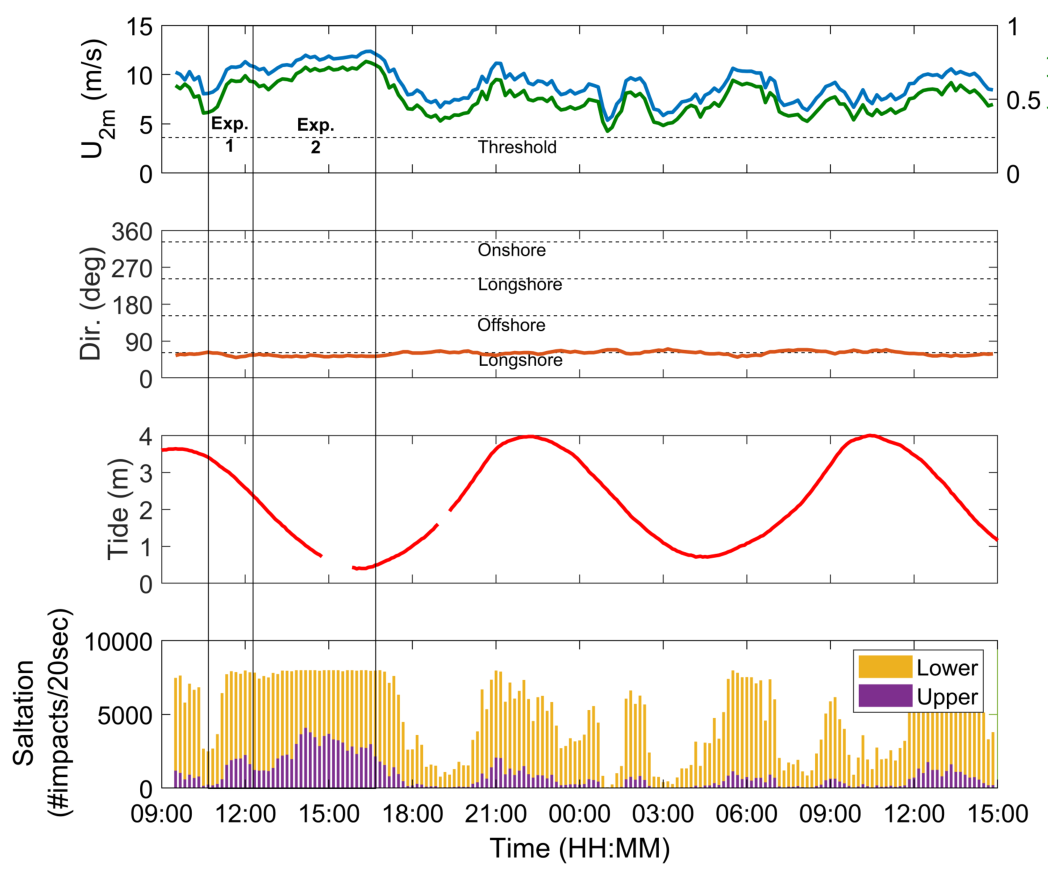


Figure 2. 10-minute time series of wind speed, shear velocity, wind direction, tide and saltation impacts over the entire field experiment.

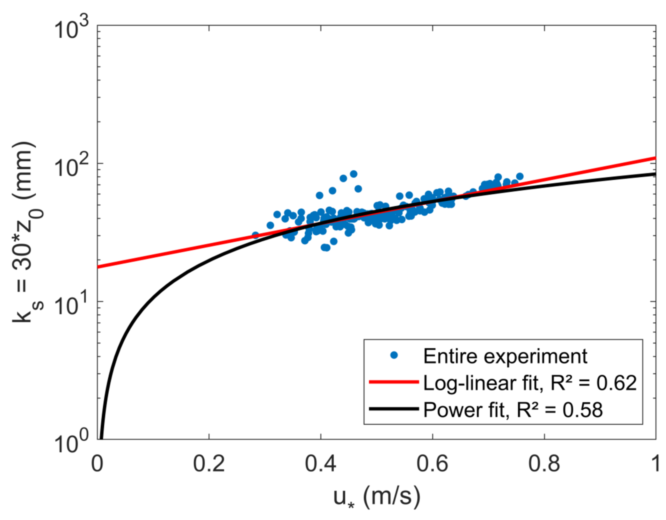


Figure 3. Bed roughness for different shear velocities during the entire experiment (range = 20-90 mm).

- **RELATION BETWEEN SEDIMENT TRANSPORT AND WIND SPEED**

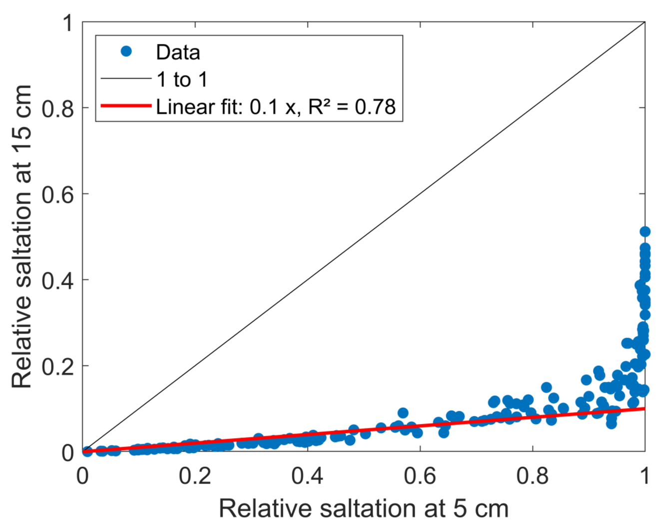


Figure 4. Comparison between the registrations of the two saltiphones.

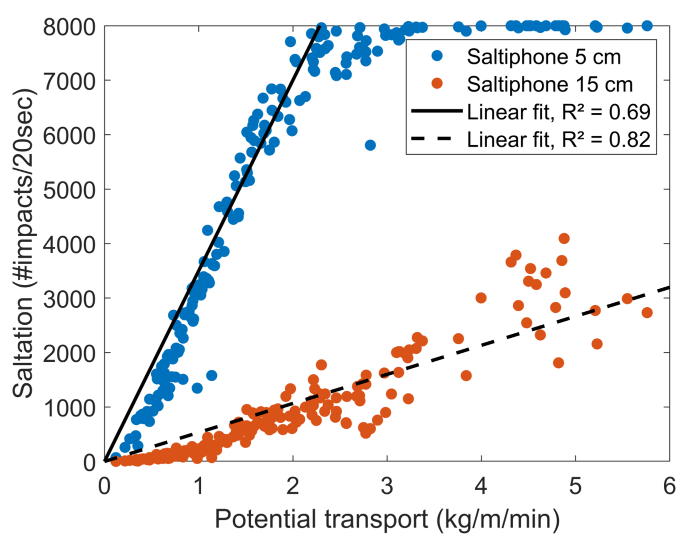


Figure 5. Relation between overall particle count and potential transport based on a modified Bagnold model.

- **SPATIAL GRADIENTS IN SEDIMENT TRANSPORT**

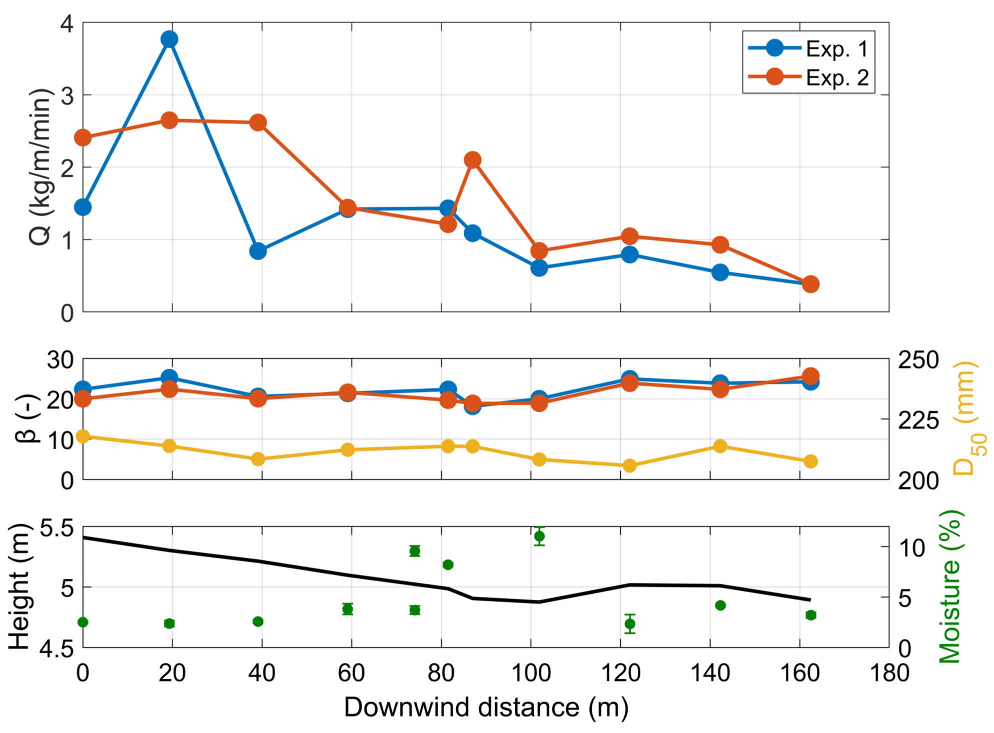


Figure 6. Upper graph shows the measured mass fluxes downwind during Experiment 1 and 2. Left to right is MWAC 10 to MWAC 1. Middle graph shows the calculated exponential decay coefficient β from the mass flux profiles and mean grain size. Lower graph shows the beach profile at the beginning of the field campaign together with the variation of surface moisture.

- **SEDIMENT DEPOSITION**

Figure 7. Deposition of sand on the upper beach in the form of mobile large rippled sand strips visible on top of the shell pavement.

CONCLUSIONS

1. During the two experiments, spatial variations in aeolian sand transport indicate that there is a consistent decrease in transport with distance downwind. Within 162 m, aeolian sand transport decreases by factor 10 in the direction of the dunes.
2. The decrease in mass flux causes for a local deposition of sand on the upper beach in the form of large rippled sand strips. The sand strips are not entering the dunes directly, but slowly move across the surface downwind.
3. This accumulation of sand acts as a new source area for aeolian transport to the dunes when the intertidal beach is inundated. However, this region is also very sensitive to wave uprush, whereas the accumulated sand may be removed again from the upper beach.
4. Aeolian sand transport across the roughness elements does not influence the vertical distribution of sand particles as the decay rate of the vertical flux profiles remains constant. Consequently, the mean particle size above the surface remains constant along the transect.

KU LEUVEN

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