DOWNWIND EVOLUTION OF AEOLIAN SALTATION

ACROSS AN ARTIFICIALLY CONSTRUCTED BERM

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INTRODUCTION & METHODOLOGY

This study reports on a field experiment designed to carry out simultaneous measurements of wind and sediment transport across a human-constructed high berm with a steep seaward cliff that is backed by a dyke. In front of the dyke, a trench is excavated to prevent aeolian sand being blown to the hinterland. Two sets of measurements were carried out, one with oblique onshore and one with winds directly onshore. The objective of this study is to examine the fetch effect and saltation evolution. Three research goals are set:

1. To quantitatively study the flux profile of aeolian sand transport blowing over a flat beach with increasing fetch length;
2. To define a relationship between the vertical decay coefficient β of the flux profile and the fetch length;
3. To relate aeolian sediment flux to topographical volume changes.

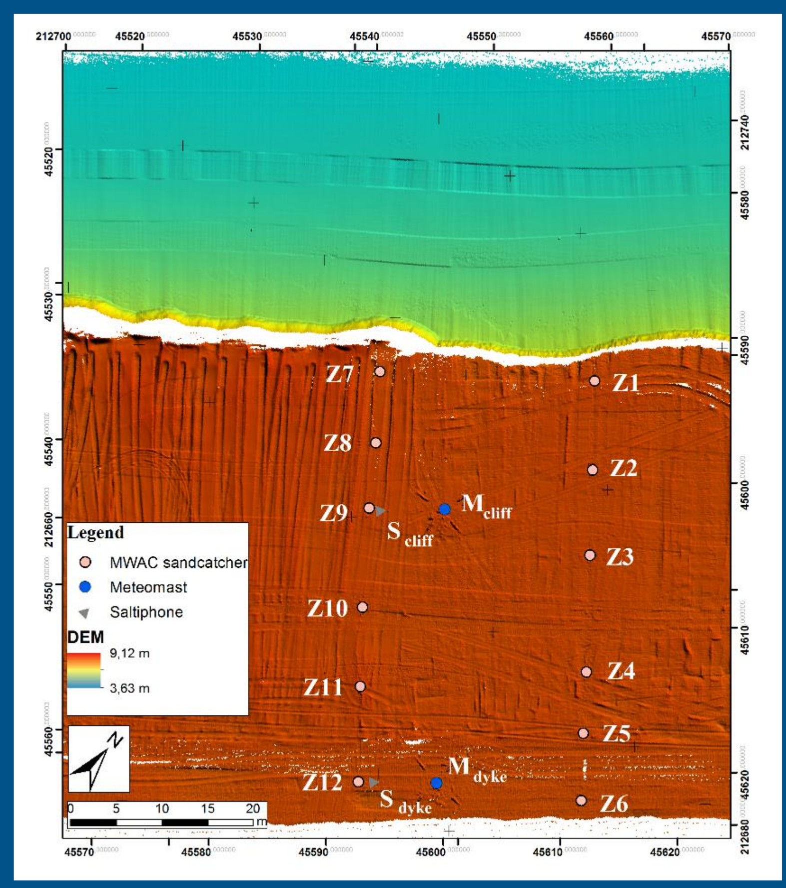

Figure 1. Plan view of the study site with the location of the equipment.

- **AEOLIAN SAND TRANSPORT EVENTS**

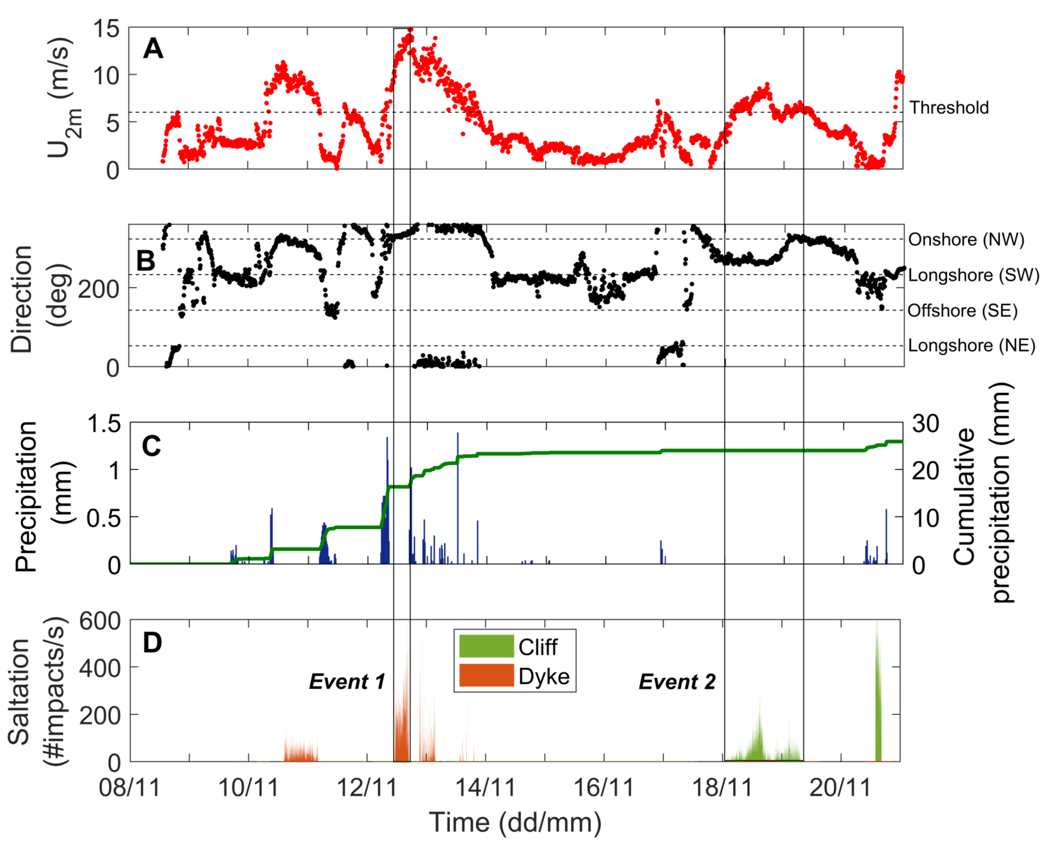

Figure 2.
A. 10-min average records of wind speed at 2 m. The dashed line represents the threshold of movement (6 m/s).
B. 10-min average records of wind direction. Offshore winds occur when wind direction is between 53 and 233 degrees. Wind speed and direction refers to the data obtained from Mcliff.
C. Precipitation and cumulative precipitation.
D. Saltation intensity at Mdyke and Mcliff, 10 cm above the surface, recorded once every 20 seconds. Two aeolian transport events were measured with the MWAC sand traps (Event 1 and Event 2).

- **WIND FLOW ACROSS AN ARTIFICIALLY CONSTRUCTED COASTAL BERM**

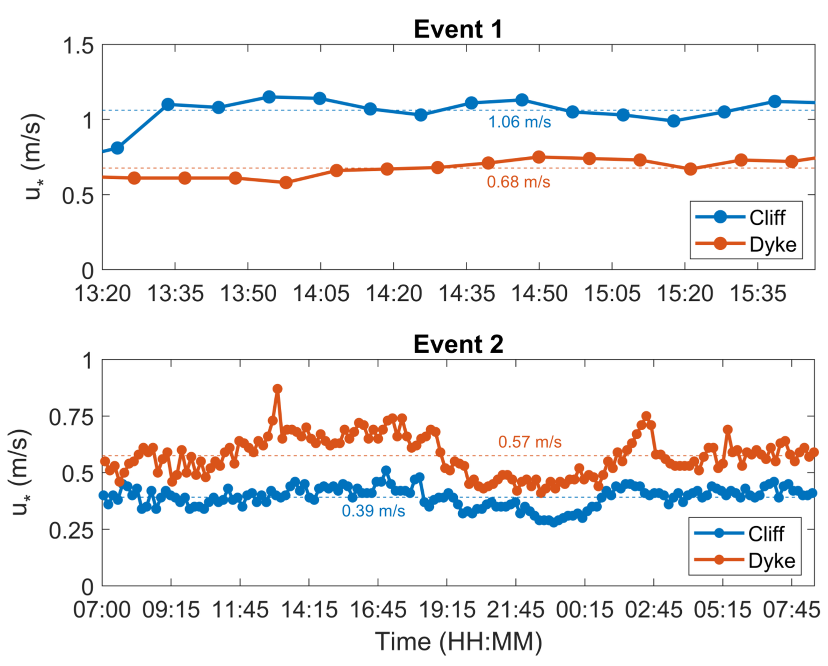

Figure 3. Shear velocities during Event 1 and 2 using the regression procedure of the logarithmic law.

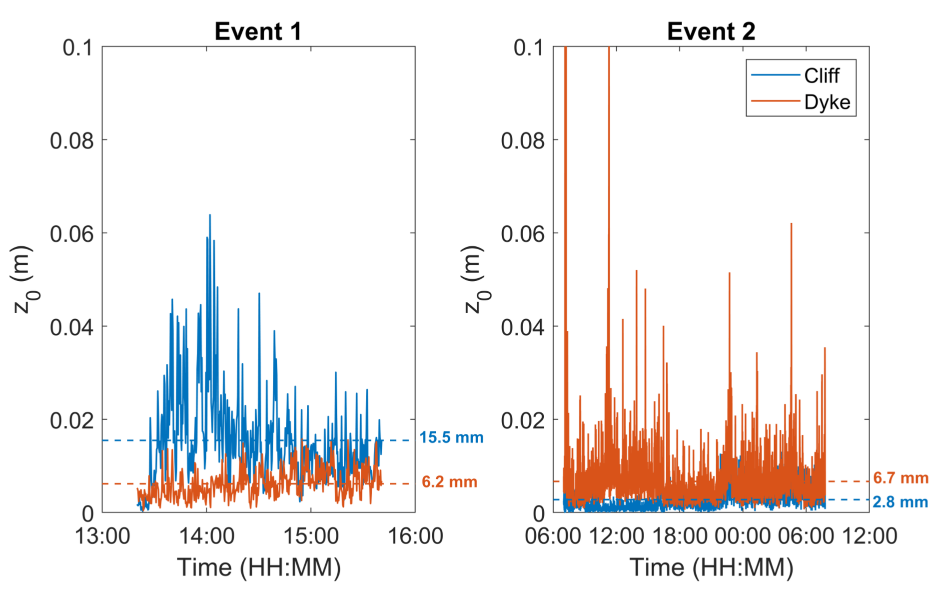

Figure 4. Temporal fluctuation of the aerodynamic surface roughness length z0 during Event 1 and 2.

- **FETCH EFFECT**

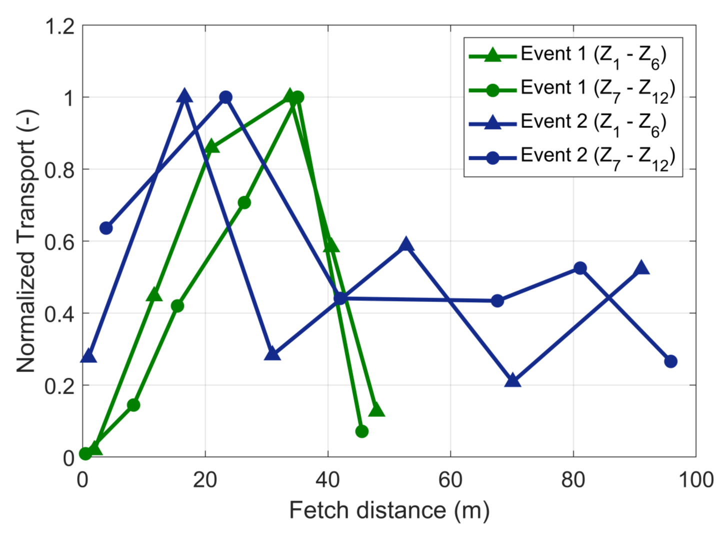

Figure 5. Evolution of sand transport downwind from the lip of the berm for Event 1 and Event 2.

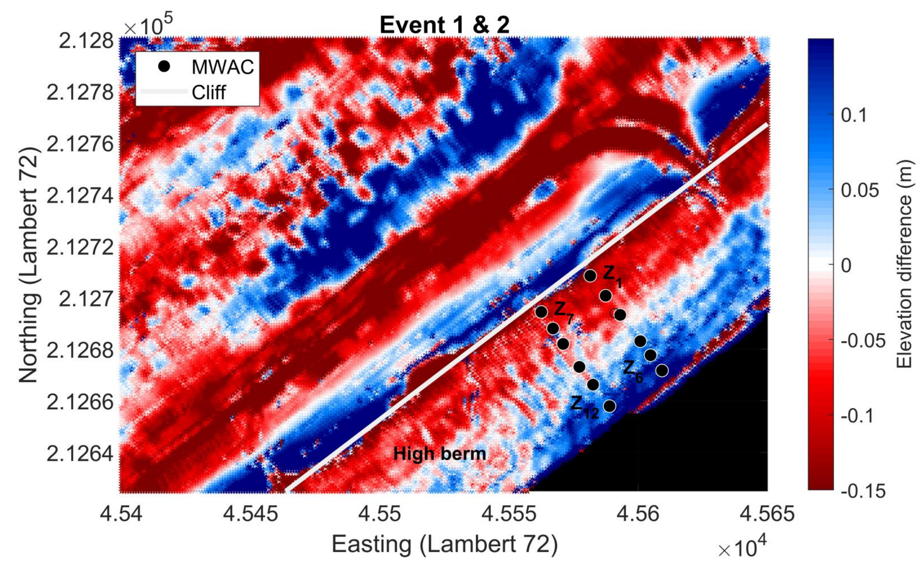

Figure 6. Topographic elevation changes caused by transport Event 1 and Event 2. Red color indicates erosion, while blue color indicates deposition.

- **DOWNWIND EVOLUTION OF VERTICAL FLUX PROFILES**

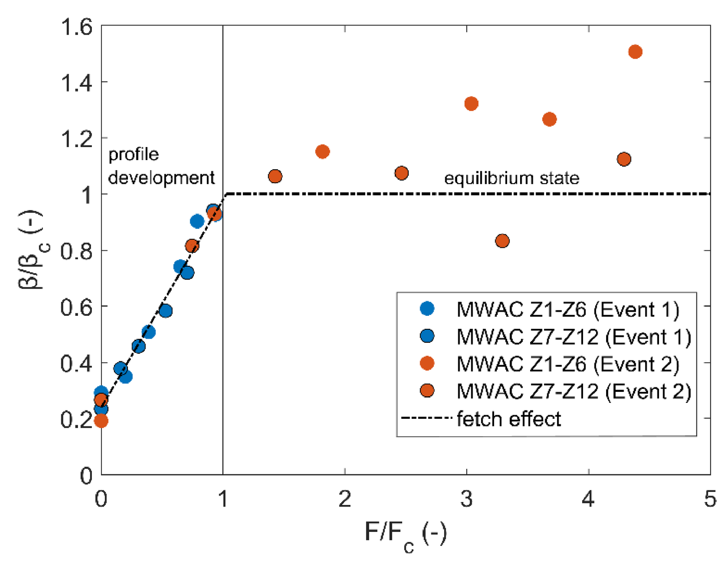

Figure 7. The increase of decay rate as a function of increasing fetch length.

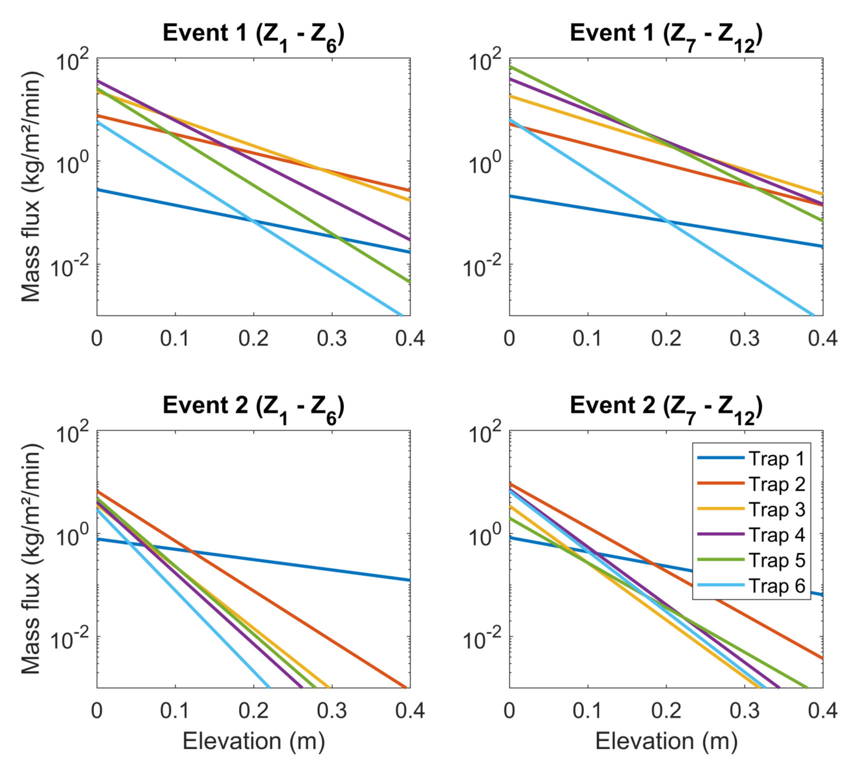

Figure 8. Vertical flux profile development for Event 1 and Event 2 in the transect Z1 – Z6 and Z7 – Z12. Trap 1 corresponds with the most upwind sand trap, while Trap 6 corresponds with the most downwind sand trap.

CONCLUSIONS

1. The fetch effect has been measured across the flat berm where maximum transport was achieved at a distance of 20 to 35 m of the berm lip.
2. The overshoot effect is observed during the oblique onshore wind event where the available fetch length was much larger. The equilibrium mass flux was approximately half of the maximum mass flux obtained at the critical fetch distance.
3. The evolution of the vertical mass flux profiles downwind causes the exponential decay rate β increase almost linear with increasing fetch length further away from the berm lip, until an equilibrium decay rate is achieved. Traditional transport equations may be used in the equilibrium state, where saltation is fully developed with sand particles having a relatively stable distribution.
4. Based on this study, the steep cliff in front of the human-constructed coastal berm is very sensitive to erosion. Sand being eroded from the berm lip is deposited in front of the dyke and in the trench.

KU LEUVEN

AGENTSCHAP INNOVEREN & ONDERNEMEN

Vlaanderen is ondernemen

CREST CLIMATE RESILIENT COAST