

# IMPLICATIONS OF SPATIAL GRAIN SIZE VARIABILITY FOR AEOLIAN TRANSPORT

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## INTRODUCTION

Coastal dunes are crucial for coastal protection, habitat development and recreation. In recent years, their strength as a long-term building with nature approach has been explored in engineering projects. To improve implementation strategies, prediction of the development of the dune system is necessary. Aeolian sediment transport models may aid in informed design and decision-making. However, many aspects of aeolian sediment transport models need a thorough understanding to give reliable predictions. This research particularly focuses on grain size and assesses its effects on aeolian sediment transport at varying spatial and temporal scales. The aim is to provide recommendations on the relevance of spatial grain size variations in aeolian sediment transport modelling for coastal maintenance applications. For this purpose, we apply the aeolian sediment transport model AeoliS, which allows for multi-fraction transport simulations (Hoonhout, 2017).

## AEOLIAN SEDIMENT TRANSPORT MODEL

As a process-based model, AeoliS can be used to study physical processes and simulate aeolian sediment transport on the scale of engineering applications. The model was developed to reproduce aeolian sediment transport in supply-limited situations due to, for instance, soil moisture content and sediment sorting. Its multi-fraction approach makes it suitable to study the effect of grain size variations on aeolian transport. The transport equations used in AeoliS are dependent on the grain size because of the relation between grain size and the transport rate, threshold velocity, and bed roughness.

## SPATIAL GRAIN SIZE VARIATIONS

Field measurements have shown that considerable variations in grain size can be present on sandy beaches. Longshore variations can occur where adjacent stretches of coast show significant variations in grain size (Hallin, 2019). In some cases, cross-shore variations have been measured that show a fining gradient towards the dunes. Vertical variability in the grain size distribution at the bed has also been observed in the field (van IJzendoorn et al., 2022). Due to the range of spatial scales at which these grain size variations occur (mm - m - km), it is expected that their relevance may vary with the temporal scale considered (seconds - hours - years).

## METHOD AND PRELIMINARY RESULTS

In this study, the AeoliS model is used to simulate the effect of spatial grain size variations on the aeolian transport rates at varying temporal scales. For each type of spatial variation (i.e., cross-shore, alongshore and vertical), scenarios are created that include a range in grain size distribution that has been measured in the field. Subsequently, these scenarios are executed for different wind speeds and extended from short (seconds-minutes)

to long (months-years) time scales. Based on the effect on the sediment flux, the relevance of each type of spatial grain size variation is analyzed. For example, Figure 1 presents results of simulations in which it is shown that vertical grain size layering in the bed affects the sediment flux on a minute-scale. However, the relatively small difference between the two scenarios may be negligible at longer time scales. Thus, results are presented from these scenarios at longer time scales, in combination with scenarios that include longshore and cross-shore grain size variations.

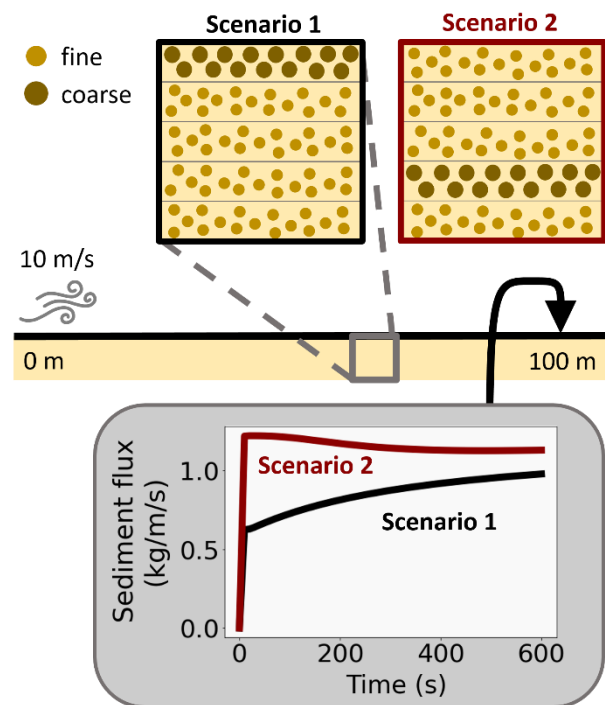


Figure 1 - Effect of vertical grain size layering on the sediment flux at minute-scale measured at the end of the domain with a wind speed of 10 m/s.

## REFERENCES

- Hallin et al. (2019): Longshore transport variability of beach face grain size: Implications for dune evolution, *Journal of coastal research*, 35(4), 751-764.
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