

Wind-blown sand in beach-foredune and beach-dike environments at the Belgian Coast

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At many places, coastal dunes operate as a natural safety barrier against the destructive forces of the sea, protecting the hinterland from flooding. Shifting of sand dunes is essential to let the growth of the dunes keep pace with sea-level rise, and at the same time create an attractive and dynamic dune landscape. Opposed to sea dikes, wind-blown sand allows dunes to grow naturally and vertically with the rising sea-level, and therefore ensuring a long-term coastal safety.

Although, a lot of research has been done in the area of Aeolian transport, it is only during the recent years Aeolian transport in coastal areas becomes significantly more important. In these areas, the physical processes are more complex, due to a large number of supply limiting parameters. In this research, a model will be developed which relates the wind-driven sand transport at the Belgian coast with physical parameters such as the wind speed, humidity and grain size of the sand, and the slope of beach and dune surface. For the first time, the physics of wind-blown sand and coastal dunes is studied at the Belgian coast. The 67km long Belgian coastline is highly urbanized and therefore subjected to coastal protection and safety. The coast mostly consists of sandy beaches and dikes. Although, still 33km of dunes exist, whose dynamics are far less understood. The overall research approach consists of three pathways: (i) field measurements, (ii) physical model tests, and (iii) numerical simulations. First and most importantly, several field campaigns will provide accurate data of meteo-marine conditions, morphology, and sand transport events, on a wide beach at the Belgian Coastline. The experimental set-up consists of a monitoring station, which will provide time series of vegetation cover, shoreline position, fetch distances, surficial moisture content, wind speed and direction and transport processes. The horizontal and vertical variability of the event scale Aeolian sand transport are analyzed with 12 MWAC sand traps. Two saltiphones register the intensity and variations of grain impacts over time. Two meteo-masts, each with four anemometers and one wind vane, provide quantitative measurements of the wind flow at different locations on the beach. Surficial moisture is measured with a moisture sensor. The topography measurements are typically done with laser techniques. To start, two sites are selected for measurement campaigns: one consists of the typical beach - dike system, a second site involves the coastal foredunes. Next to the field measurements, physical model tests are used to provide data that is difficult to measure in the field. They will be used to determine the shear velocity and critical shear velocity, in which sand particles initiate motion, in function of the transport flux. The effect of surficial moisture, vegetation and morphologic landforms will also be investigated in the model tests. Numerical simulations will gain a better insight in the physical processes of the Aeolian events and will be validated with the experimental results from the field campaigns and the physical model tests.

The ultimate objective of the research is to obtain a sand transport model for the Belgian Coast, which can be used to assess the stability of nourishments in a quantitative matter. But at the same time, it also will gain a better insight in the beach-dune and beach-dike interactions with the changing climate.

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Keywords: Coastal Aeolian geomorphology; field measurements; physical model tests; numerical simulations; Belgian Coast