European Geosciences Union
General Assembly 2016
Vienna | Austria | 17–22 April 2016

Acknowledgements
We acknowledge the support of VLIZ (Flanders Marine Institute) for the purchase of research infrastructure for measuring and monitoring of Aeolian transport in beach-foredune and beach-dike systems at the Belgian coast.

KU LEUVEN

Agglomeration of a comprehensive model for the **wind-driven sand transport** at the **Belgian Coast**

Glenn Strypsteen and Pieter Rauwoens

KU Leuven, Department of Civil Engineering, Technology Cluster Construction, Coastal Engineering, Technology Campus Ostend

Background
Because of climate change, there is a continuously increasing threat of rising sea levels and stronger storms. Coastal protection against flooding has historically been dealt with the use of hard structures, such as dikes and storm walls. Although effective, those measures are not suited to deal with a rising sea level. Instead, they are designed to protect the hinterland from flooding for the present situation and have no possibility to adapt to changing circumstances. In the last decades, soft coastal protection measures (beach and foreshore nourishment, dunes) get more in the picture, because of their ability to grow with the sea. Beaches and dunes form a dynamic system, with changing morphology because of the meteorological forces acting on them. Below sea level, waves are responsible for the transport of sand onshore. At the beach itself, the wind takes over, moving the sand up in the dunes, if present.

Research Problem
Aeolian transport is the wind-driven transport of sand at the beach and dunes. This transport is crucial for the restoration of dunes in between storms. Up to date, no accurate quantitative data on the amount of Aeolian sand flux is available at the Belgian coast. In order to assess the impact of Aeolian transport in the overall sediment budget and to derive quantitative relations between the amount of sand transported by wind and parameters describing the hydro-meteorological state, a series of field campaigns are scheduled.

Study Sites (Fig. 1)
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:

- Mariakerke (A): Mariakerke is a weak link in the coastal protection of the Belgian coastline. To protect this site against the impact of a 1000 year storm event a combination of hard (heightening of the dike) and soft measures (nourishments of the beach and shoreface) are being implemented.
- Koksijde (B): This zone has more or less a natural ecosystem (beach and dune).

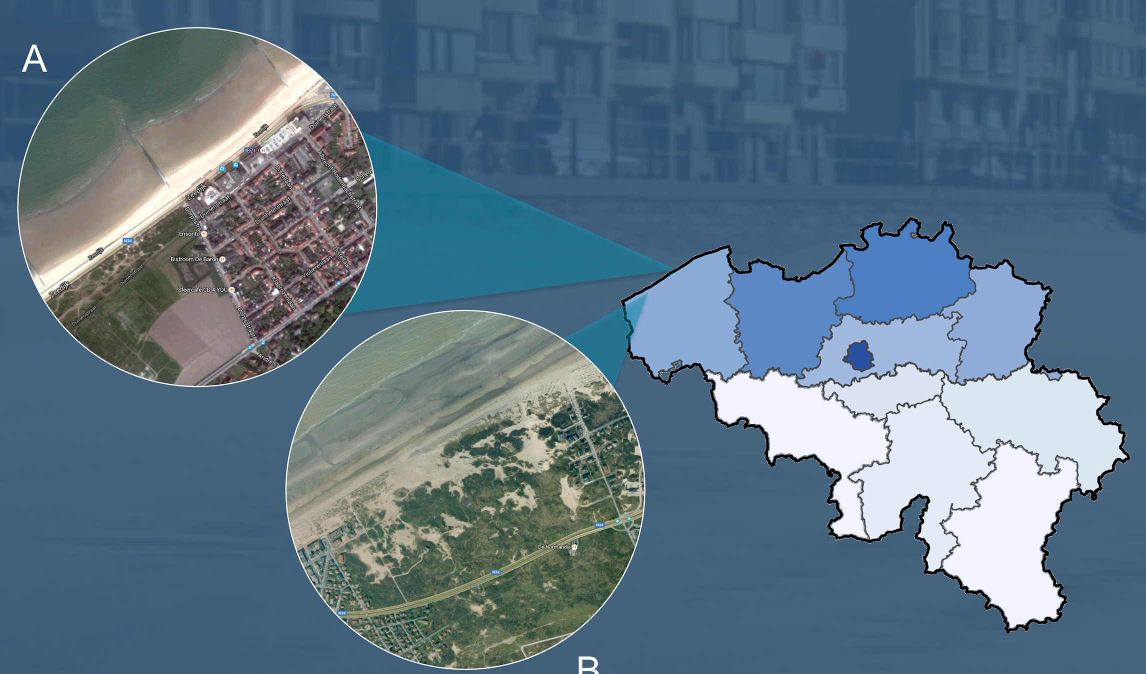

Fig. 1 – The two study sites, where the interaction between beach-dike (A) and beach-dune (B) is investigated.

Methods
To gain a better understanding of the Aeolian processes governing the beach and dune formation, a research route consists of measurement campaigns (Fig. 2) at the beach and physical modelling (Fig. 3) at lab scale, both on event scale and decadal time scale.

1) Measurement campaigns (Fig. 2)
Measurements will be performed over a number of fixed measurement stations aligned, along, and across the intertidal zone, aerial beach and embrio and foredune. They will provide accurate data of meteo-marine conditions, morphology, and wind-driven sand transport events. Aeolian sand transport and wind flow measurements (wind speed and wind direction) will be undertaken:

- at regular interval (one campaign per month and a campaign with consecutive days every 3 months)
- event related (e.g. before, during and after storm events).

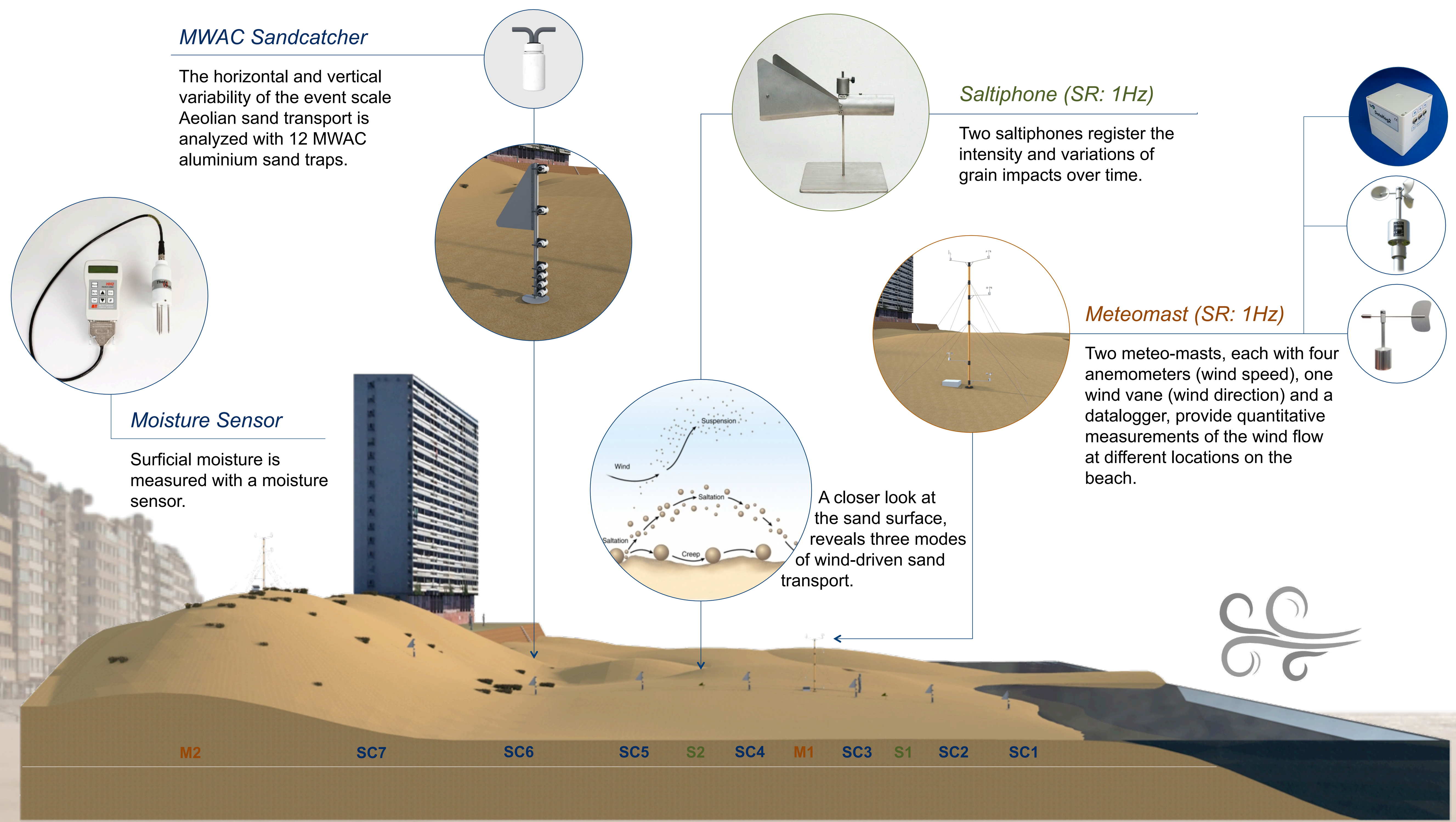

Fig. 2 – Investigating the Aeolian interaction between beach-dune and beach-dike environments with a series of measuring instruments.

2) Physical Scale Modelling (Fig. 3)
In order to eliminate the random and the chaotic behavior of the variables in the field campaigns (for example, wind speed and direction), small-scale wind tunnel experiments will be carried out.
Therefore, an Aeolian wind tunnel is designed and currently made at the university. The wind tunnel is constructed in modules and has a cross-section of 1x1.4m and a working length of 7.5m. Nine radial fans, in a square matrix, provide a suction flow through the tunnel.

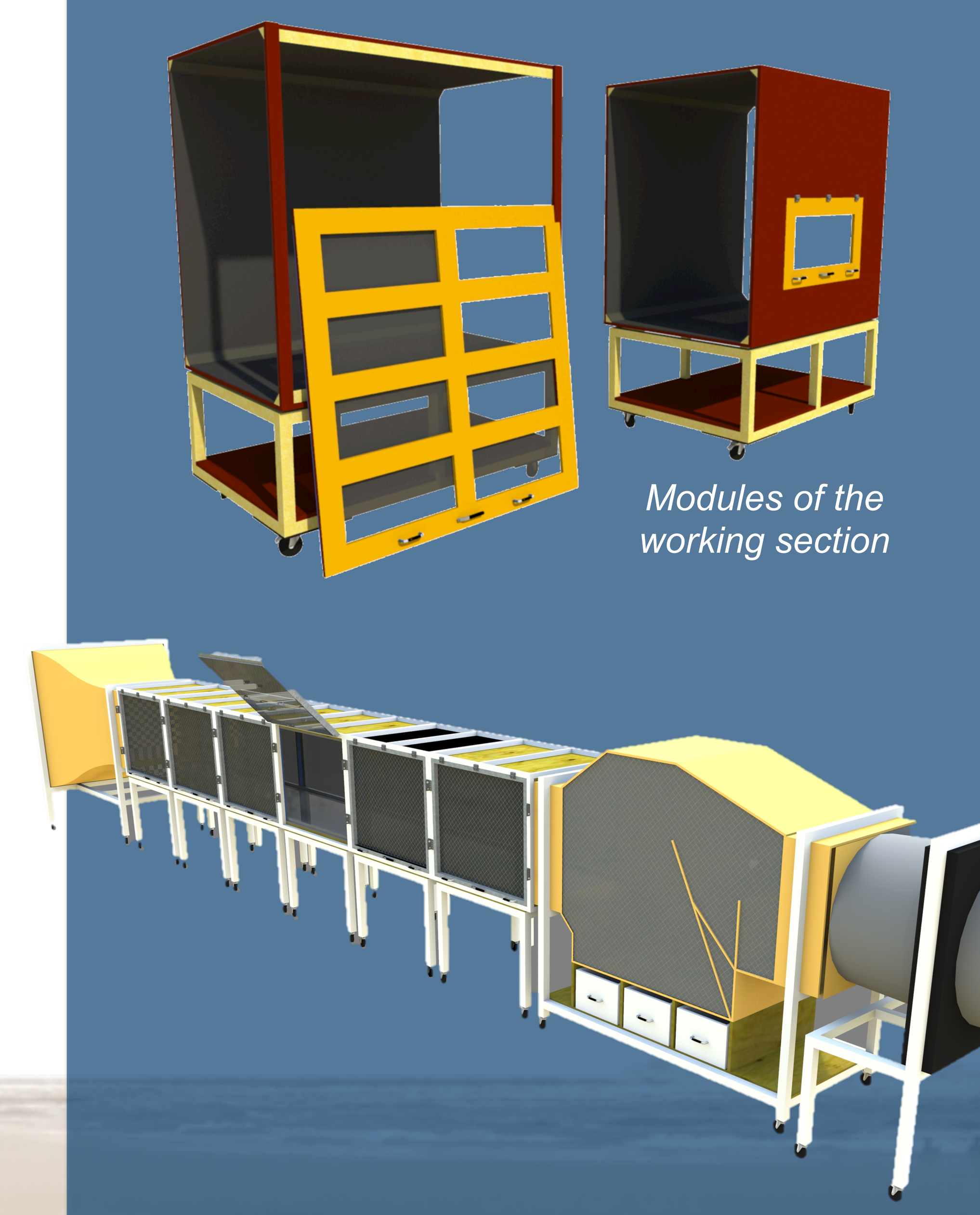

Fig. 3 – Aeolian wind tunnel used for physical scale modelling of the wind-driven sand transport at the Belgian Coast.

Concluding Remarks
For the first time, the interaction between beach-dune and beach-dike dynamics is studied so intensively at the Belgian coast. A model will be developed which relates the wind-driven sand transport, q, with physical parameters such as the wind speed, fetch distances, surficial moisture content, grain size of the sand, and the slope of beach and dune surface.

$$q = f(d, g, U, F, w, \alpha)$$

MORE ONLINE
CRESTPROJECT.BE

References
[1] M. Bagnold, The physics of blown sand and desert dunes., London: Methuen, 1941.
[2] S. Hotta, „Sand transport by wind," Nearshore dynamics and coastal processes, 1988, pp. 518-538.
[3] D. Sherman, „A method for measuring Aeolian sediment transport rates," Can. symp. Coastal sand dunes, Ottawa, National Research Council, Canada, 1990a, pp. 37-47.
[4] I. Delgado-Fernandez en R. Davidson-Arnott, „Meso-scale aeolian sediment input to coastal dunes: The nature of aeolian transport events.," in *Geomorphology 126*, 2011, pp. 217-232.
[5] A. Poortinga, J. Keijsers, S. Visser, M. Riksen en A. Baas, „Temporal and spatial variability in event scale aeolian sand transport on Ameland.," The Netherlands, GeoResJ 5, 2015, pp. 23-35.

contact

Glenn Strypsteen, PhD Researcher
KU Leuven | Technology Campus Ostend – Zeedijk 101, B-8400 Ostend, Belgium
glenn.strypsteen@kuleuven.be