State of the art of aeolian and dune research on the Dutch and Belgian coast, 2017

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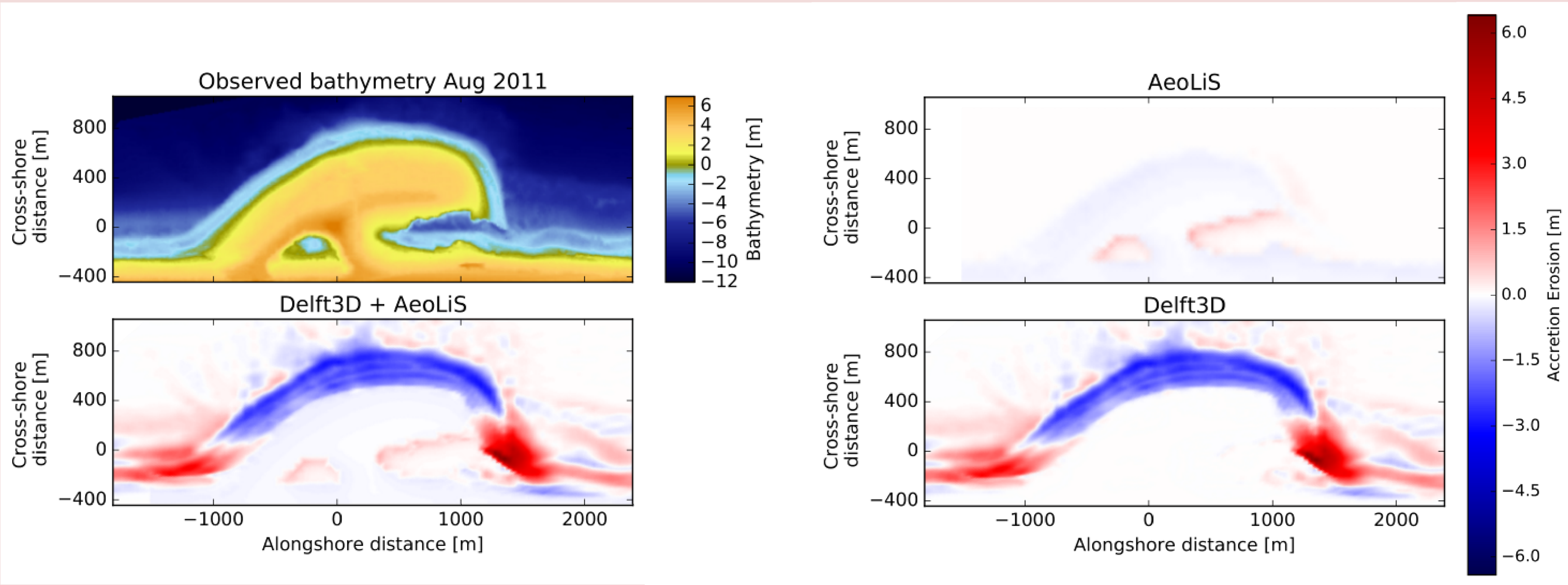
Introduction

Five years ago, at the previous anniversary of the NCK days, an overview was presented of the state of the art of "Measuring and modelling coastal dune development in the Netherlands" (De Groot et al., 2012). At that moment, new coastal-dune research had sprung up in the Netherlands after a relatively quiet period of about two decades, and the individual research projects were just starting to interconnect. Since then, research has blossomed. An overview is presented here.

Coupling Marine and Aeolian sediment transport processes and models (Delft University of Technology)



The aeolian (dry) and marine (wet) coastal domain are both part of the same sediment sharing system of the coastal zone. In existing modelling suites like Delft3D and AeoLis however, these domains are considered separately and an integrated representation of the coastal zone lacks. To provide this integrated numerical representation, our study has explored the numerical on-line coupling of Delft3D and AeoLiS. In this Figure, early results of the coupled models show a successful representation of the sedimentation and erosion patterns by both marine and aeolian processes. This coupled model setup provides opportunities for new studies regarding sediment transport due to marine and aeolian processes over the land water interface of the coastal zone.

Monitoring at the Hondsbossche and Pettemer Dunes (W+B)

In 2015 a mega sand nourishment (35-40Mm3) was completed to reinforce the sea defense at Petten incorporating a coastal dune area now called the Hondsbossche and Pettemer Dunes (HPD). Currently the morphological and ecological development of the dry area of the HPD is being monitored by an Ecoshape consortium by means of frequent (4/yr) LiDAR elevation measurements and vegetation monitoring. The aim is to improve the understanding of aeolian transport of sand and the interaction with dune and vegetation dynamics and measures in the design such as dune profile shape, artificial relief features and brushwood screens.

Improving long-term predictions of aeolian dune growth at narrow wave dominated beaches (UU)

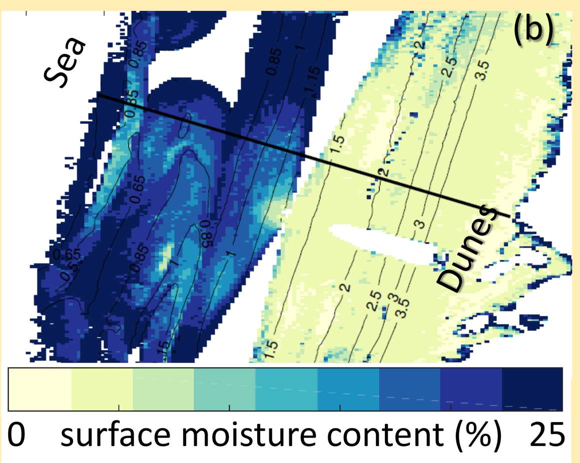
Improve aeolian transport and wind parametrizations
Sand behavior during transport is studied with our newly developed Saldec system (a). Sonic anemometers link results to wind characteristics. The effects of beach-dune topography on wind fields are studied using wind measurements and CFD modelling (d).

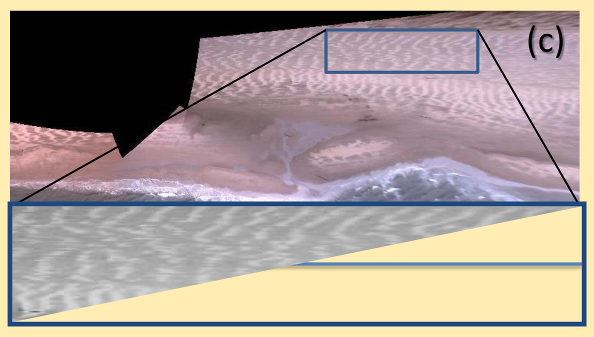
Model surface moisture content
High surface moisture content limits aeolian transport. A newly developed method allows us to create regular (every 15 minutes) maps of surface moisture content on the beach using a terrestrial laser scanner (b). Ground water, sea level and meteorological observations link surface moisture dynamics to ground/surface water dynamics and evaporation/precipitation.

Determine aeolian transport occurrence and intensity to qualitatively check aeolian transport predictions
The Argus video system reveals sand strips during aeolian transport (c). Sand strip occurrence, wave length and migration speed is linked to water levels, wind speed and -direction. This enables us to create a long term (>15yr) record of aeolian transport.

Monitor dune volume change to quantitatively check aeolian transport predictions
Beach and lower foredune topography is monitored using mobile laser scanning. Aerial (UAV) monitoring is used to study the upper parts of the foredune and the hinterland (d). Similarly, morphologic changes of man-made trenches at the Kennemerduinen are monitored.

Final goal: Combine results to create a new model for aeolian transport through the beach-dune interface.





Field Campaigns in Koksijde and Mariakerke, Belgium (KUL, VUB)

As part of the CREST-project, coastal resilience is quantitatively investigated. Recovery of the beach profile after storm is partly attributed to Aeolian transport, hence several field campaigns are scheduled:

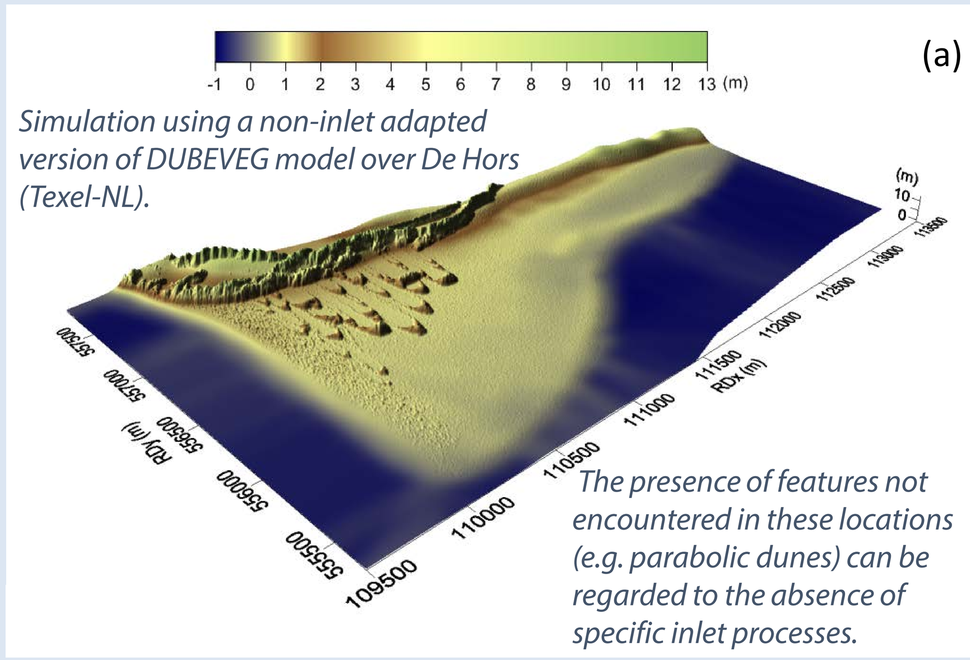
- Frequent short-term campaigns, to get variation in wind speed and direction, beach profile and meteorology
- Long-term campaigns, typically ten days, measuring simultaneously sediment transport by waves, currents and wind

Instrumentation involves meteo-masts, topographic equipment and various sandcatchers (see figure)

Coupling inlet processes on Cellular Automaton (CA) models (UT)

Current models are not capable of simulating dune development on systems close to inlets.

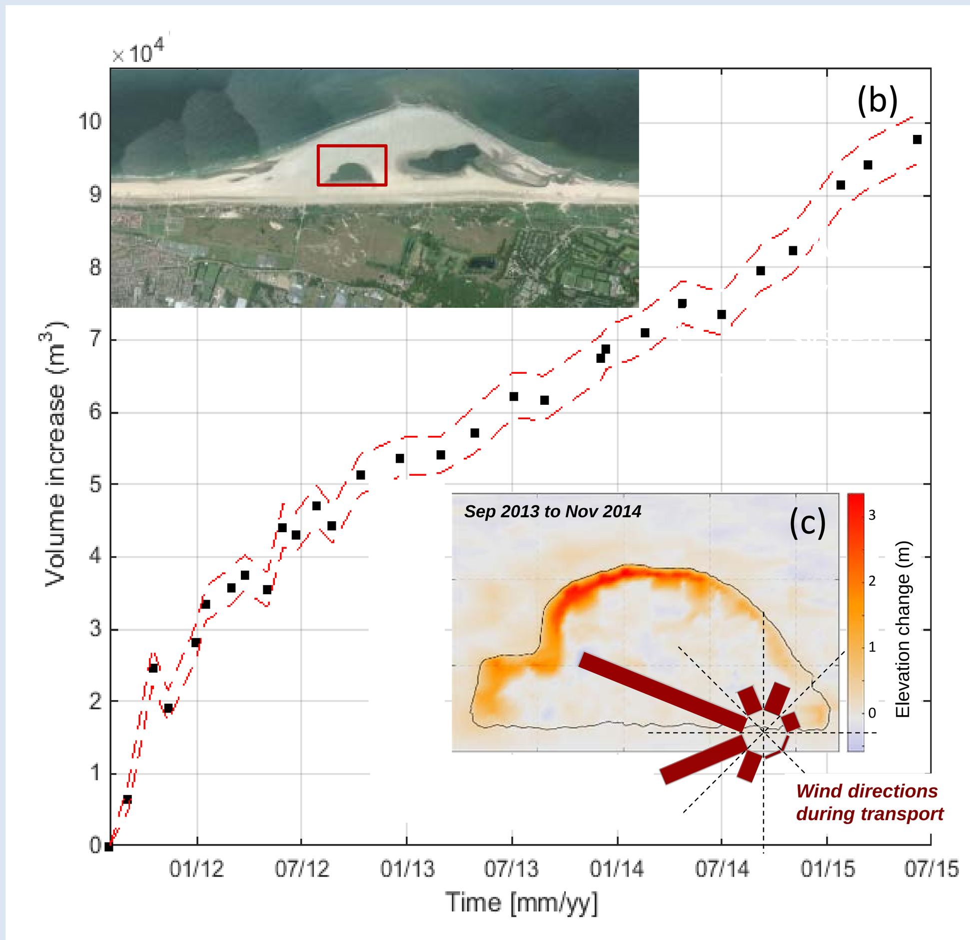
Adaptation of the CA model DUBEVEG (Keijsers et. al, 2016) is currently under development in order to properly understand and simulate dune development on these complex systems (a).

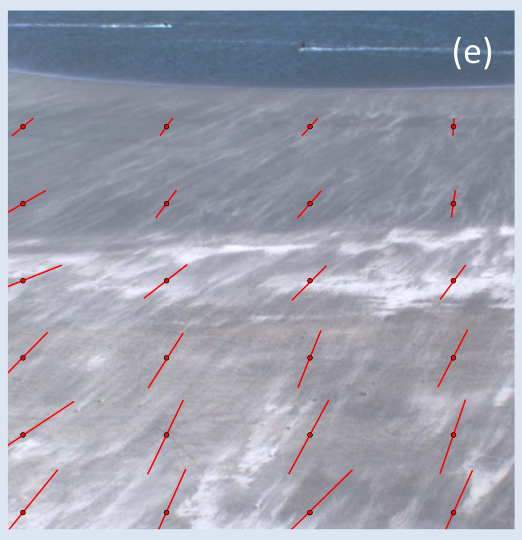


Understanding aeolian processes on mega-nourishments (UT)

Aeolian sedimentation in lake since August 2011 from topographic surveys (b).

Sedimentation pattern in lake with frequency distribution of wind directions during aeolian transport occurrence in same period (c). Transport occurrence was identified from Argus video imagery (d).

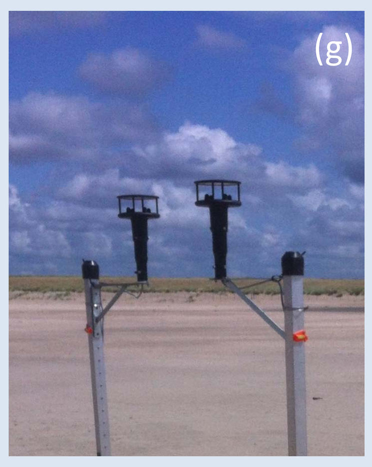




Identify and measure aeolian sand transport (UT)

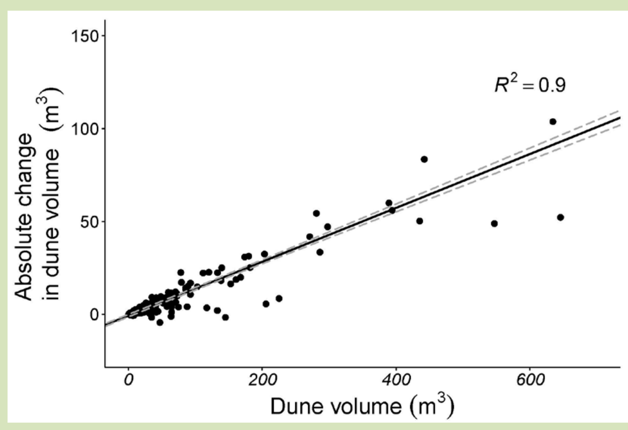
Using images to identify transport events (e).

Developing methodologies for quantifying aeolian transport in the field. Using laboratory and field experiments (f, g).



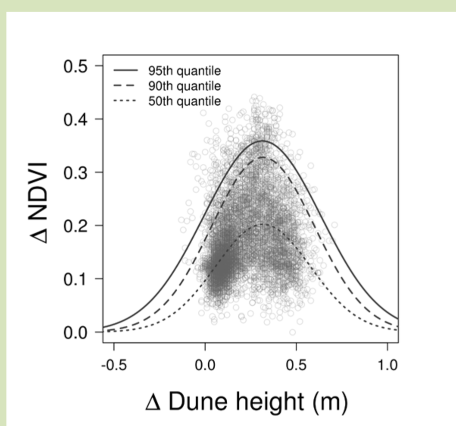
Mapping dune development and vegetation characteristics with an UAV (WUR)

1. Dune volume determines dune growth

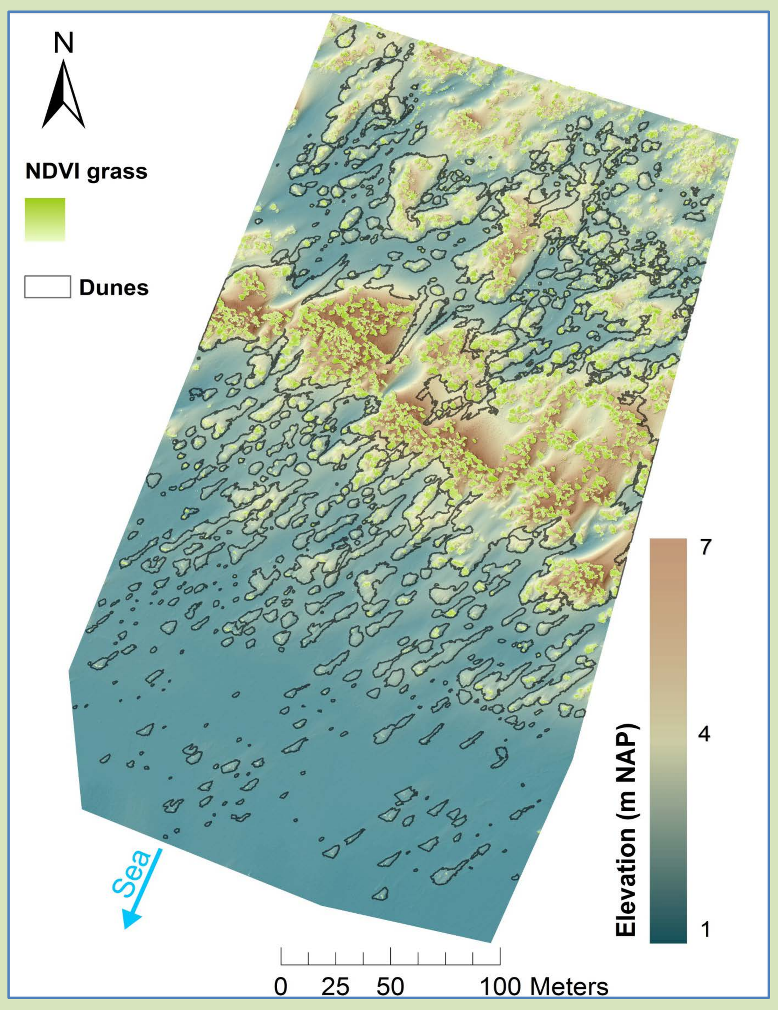


Highly dynamic embryo dune field at the Hors, Texel (NL). Coastal grasses are mapped in NDVI

2. Dune growth determines plant growth



Marram grass requires regular burial in wind-blown sand.



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