



BE SAFE is now approximately halfway the project. A lot of data has been collected in the field and in the laboratory. We presented our findings so far at conferences, several MSc. students did their graduation work within the project, and the first journal articles on BE SAFE work have already been published. With this newsletter, we want to share some highlights of the project with the BE SAFE end-users and other people interested.

Contact the BE SAFE team for questions or more information.

Ecology

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Biogeomorphology

Pim Willemsen



Safety

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Wave damping by vegetation

In a previous newsletter, we already mentioned our measurements of wave height reduction over salt marshes in the Western Scheldt and the Wadden Sea, and in a reed field along the Nieuwe Maas. Most of these measurements have been continued for almost 2 full years now, which gives us insights in the seasonal differences in the wave height reduction between summer state (left photo, July) and winter state (right photo, same vegetation species in November) of the vegetation.



In some countries, like in the US, the hurricane season corresponds more or less with the summer state of the vegetation, whereas in the Dutch situation, the winter state is of main importance for the reduction of wave loads on the dikes. However, Vincent Vuik has shown in a [publication in Coastal Engineering](#) that also the presence of winter state vegetation can lead to a significant reduction of wave loads on coastal dikes under design conditions.



Stability of vegetation

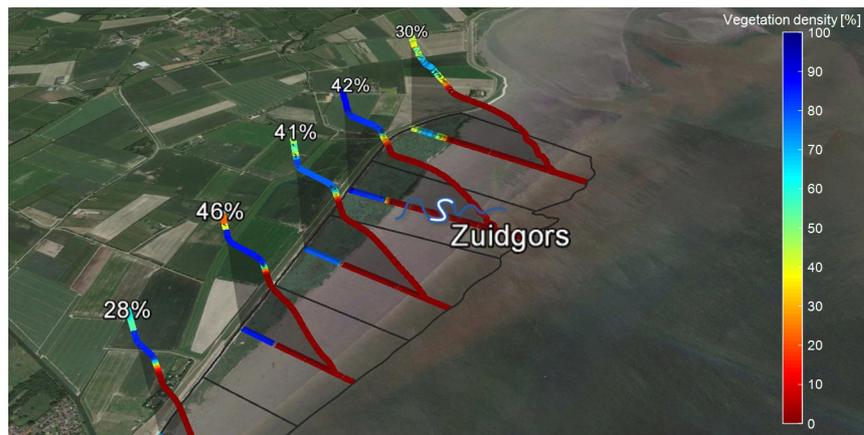
An important question is how much vegetation will remain when even more severe storms than observed will occur. Assuming that all vegetation will withstand the wave forces will lead to a very optimistic representation of the effect of vegetation, whereas neglecting the role of vegetation will probably result in a too conservative estimate of the wave loads on the dikes. Hannah Suh Heo recently defended her [MSc thesis](#) at the TU Delft on this topic, supervised by Vincent Vuik and Bas Jonkman. She has developed a method to estimate the wave forces that plants can withstand before they break or fold. The method makes use of measurements of the strength of plant stems, which were carried out at NIOZ. In the past weeks, we have deployed cameras in the field for continuous monitoring of the stem breakage process. With the images, we will try to fine-tune the stem breakage model.

Long-term dynamics

While stem breakage imposes short-term uncertainty on the effectiveness of nature-based flood defenses, an important source of long-term uncertainty is that coastal wetlands can be highly dynamic. For instance, the seaward boundaries of salt marshes are known to have cyclic alternations between expanding and eroding phases at decadal time scale. BE SAFE team member Tjeerd Bouma and his co-authors recently published a [paper in Limnology and Oceanography](#), showing that the switch between expansion and erosion of the seaward marsh boundary in the long run can be driven by daily or seasonal height change of the adjacent tidal flats. When passing a threshold, the height difference between the marsh and the neighboring tidal flats can trigger the erosion of the marsh edge (left photo below). Rapid and frequent height changes impose difficulties for vegetation regrowth via seedling establishment (right photo below).



Pim Willemsen has investigated this long-term variability, by mapping the geometry of different real world coastal wetlands over a period of 50 years. He developed a promising method to cut wetlands in multiple pieces and assess the geometry of those pieces (see below for a visualization). The wave attenuating capacity (under design conditions) of those different pieces is studied using a wave model. Preliminary results for different marshes in the Western Scheldt over the past decade show a high spatial variability of the geometry and wave attenuating capacity, while the temporal variability is relatively low. In September, Pim has presented his results on the Conference of Estuarine Coastal Sciences Association (ECSA) in Bremen (Germany).



Seedling establishment

For the restoration or creation of coastal wetlands, an important problem that needs to be solved is to find out the key to the (re)growth of vegetation from seedlings, as this is often difficult due to tough environmental conditions. According to the recently developed 'window of opportunity' (WoO) concept, successful seedling establishment demands a period with low disturbance, to improve the survival chance of seedlings. Stef Driessen and Annick van der Laan from Utrecht University have recently finished their Master projects on this topic in NIOZ-Yerseke, supervised by Tjeerd Bouma and Zhenchang Zhu. They found that growth condition like salinity decides the length of the opportunity window needed for seedling survival, by regulating the growth rate. Sediment type did not affect seedling growth, but still matters, as it determines how easy the sediment can be eroded and thus how stable the seedlings will be.

Implementation of vegetated foreshores

Vegetated foreshores and other nature-based flood defense (Nbfd) solutions serve multiple functions. In addition, the inclusion of ecosystems as part of the flood defense introduces new uncertainties into flood risk management. These two specific Nbfd characteristics imply involvement of different actors and actor interactions into decision-making and require alternative governance arrangements to enable implementation.

In the governance project, Stephanie Janssen and colleagues have performed a study to three Dutch case studies to analyze actor interactions and the games these actors play in Nbfd projects. For this purpose, insights are used from Game Theory and Institutional Rational Choice Theory. The case analyzed so far are the Sand Engine, the Markermeer dikes and the Afsluitdijk. From our analysis we were able to structure specific Nbfd games. In the case studies, we found that games can be altered at higher-level decision-making. For example, a Nbfd game will change drastically once the project objective turns from flood protection only into a multi-objective project including nature. It will directly affect the possible outcomes (i.e. project designs) and more importantly: the valuation of outcomes. In addition, our analyses show that the valuation of game outcomes is directly influenced by the perception and knowledge of specific players. These features in the game can change during a project, which possibly enables nature-based outcomes in flood defense projects.

The first results of this research were presented at the Adaptation Futures conference last May in Rotterdam, and discussed in a workshop. In the coming period we will write down the results of our analysis and submit it for publication. In addition we are working on supplementary case studies, in order to come up with more general recommendations for playing Nbfd games.

Implementation case study

In the coming year, the complete research team will work on an implementation case study, where we apply the new knowledge, models and tools to an actual dike reinforcement project in the Netherlands. After an exploration of promising projects and a discussion with our end users, we have decided to investigate how salt marshes can be taken into account for the reinforcement of two Wadden Sea dikes along the coast of Friesland.



According to the last safety assessment, the revetments of these dikes do not meet the safety requirements. Vegetated foreshores help in reducing the wave loads on the revetments, which could potentially lead to a decrease in the length over which the dike should be improved or in the required strength of the new revetments. The BE SAFE team will reflect on dike safety, morphological development and ecological functioning of the salt marshes and stakeholder involvement. The BE SAFE users and several actors such as the water board Wetterskip Fryslân and the local nature conservancy It Fryske Gea will be actively involved in the case study.

Events

In the coming months, NCK on behalf of NWO is planning to organize a Building with Nature (BwN) symposium for all NWO-BwN projects and others who are interested. BE SAFE will participate in this event, and the users of BE SAFE will be warmly welcome to attend. A date will be announced shortly.

May 2016	Adaptation Futures, Rotterdam	Stephanie	Oct 2016	Flood Risk, Lyon	Vincent
Jun 2016	SKLEC workshop, Shanghai	Zhenchang	Nov 2016	Visit water institute, Louisiana	Stephanie
Jun 2016	CEIMAR Summerschool, Granada	Pim	Nov 2016	Kick off implementation case	BE SAFE
Sep 2016	ECSA conference, Bremen	Pim	Jan 2017	BwN event	NWO/NCK
Oct 2016	BE SAFE project meeting, Delft	BE SAFE	Mar 2017	Visiting Nepf lab MIT, Boston	Pim
Oct 2016	PECS conference, Scheveningen	Vincent	Jun 2017	ECCA 2017, Glasgow	Stephanie