Building safety with nature
Symposium March 27, Delft
Global background

- Increasing coastal flood risks:
  - Rapid development
  - Sea level rise and subsidence
- Frequent floods in developed and developing countries
- From Building with Nature to Nature-based flood risk reduction

Mekong, Bac Lieu, protective forest

R. Waterman
Flood risk reduction concepts

USACE, 2015

Temmerman et al. 2013
Background: Netherlands

- Dike reinforcements (HWBP)
- New safety standards as of 2017
Remaining challenges

- Flood risk reduction through BwN solutions
  - Effects on waves, failure mechanisms, breaches
- Hybrid solutions
- In various environments, e.g. mangrove
- Proven technology? Dealing with dynamics and uncertainties
- Organizational and management aspects
13:00-13:30  Welcome and coffee
13:30-13:45  Introduction by Bas Jonkman, Professor of Integral Hydraulic Engineering, TU Delft
13:45-14:15  ‘How managed realignment affects flood levels in the Scheldt estuary’ by Stijn Temmerman, Professor of Ecosystem Management, University of Antwerp
14:15-14:45  ‘Ecosystem services and livelihoods in coastal Bangladesh’ by Robert Nicholls, Professor of Coastal Engineering, University of Southampton
14:45-15:15  Coffee break
• 15:15-16:00  Panel discussion: 'Advancing application of nature-based solutions for flood risk reduction’, chaired by Vincent Vuik, TU Delft & HKV Consultants
Panel members:
- Stefan Aarninkhof, Professor of Coastal Engineering, TU Delft
- Niels Roode, Project Manager of POV Voorlanden
- Bas Roels, Senior advisor freshwater, WWF Netherlands
  *(Panel discussion will be in Dutch)*
• 16:00-16:30  Closure and drinks
Hallegate; Nicholls et al (2013)
• Develop new methods to assess how (much) vegetated foreshores contribute to flood risk reduction
• Enable design and implementation
• *Dynamics and uncertainties*
Towards implementation?

- Foreshore length

- Wave height at the dike

- Foreshore length
Towards implementation?

Foreshore length

Wave height at the dike

Sensitivity to changing foreshore length + vegetation

How to proceed to implementation?
Implementation case: Koehool

- HWBP project, in exploration phase
- Vegetated foreshores are in front of the dike and on the agenda
- Wetterskip Fryslan, nature organizations and Rijkswaterstaat involved
- Project is part of the POV Waddenzeedijken
- Potential link with mudmotor (to be explored)
Implementation case

BE SAFE investigations (Jan-Dec 2017):
- Role of foreshores in safety assessment and dike design
- Additional benefits of vegetation
- Goals for ecology (biodiversity) vs safety (wave attenuation)
- Stakeholder interactions: dike managers, foreshore owner, nature conservancy, ... (apply game theory)
A bit more on the sub-projects
Focus: *Long-term marsh dynamics* & *compatibility of ecosystem services*

Lateral erosion  &  Lateral expansion

Root biomass can greatly decrease erosion resistance of the marsh edge (Zhu et al., prep.)
Biogeomorphology

1. Historical data analysis: wave attenuating capacity
2. Fieldwork: morphodynamics
3. Vegetation edge

Modelling: equilibrium and complex
Safety

Approach
- Field measurements (waves, vegetation)
- Numerical modelling
- Uncertainty quantification

Insights:
- Effect of foreshore + vegetation on:
  - Wave run-up
  - Failure probability of the dike system
  - Dominating uncertainties

Reduction of significant wave height on veg. foreshore
Focus on actor-interactions needed to enable implementation:

- Find ‘typical’ BwN interactions
- Indicate chances for cooperation
- Use of game theory
- Develop a decision-support tool

Game tree, NBFD case study

Adaptive co-management
Closure

- Promising alternative as part of dike reinforcements
- Veg. foreshores $\rightarrow$ significant wave run-up reduction
- Several uncertainties
- BE SAFE: Understanding of morphological, hydraulic and ecological functioning and actor interactions

Outlook:
- Implementation case
- International exchange (e.g. Louisiana, NJ)