



**Deltares**

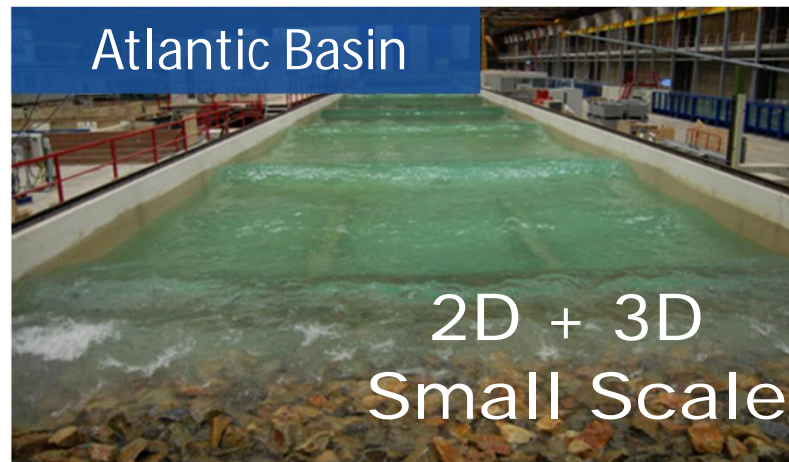
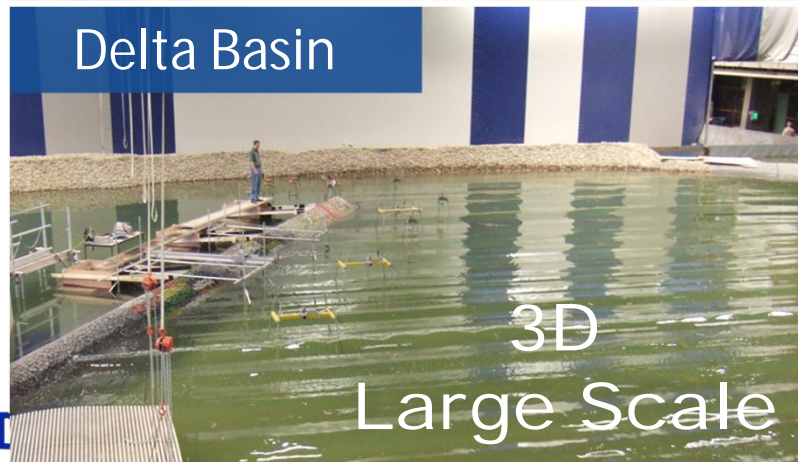
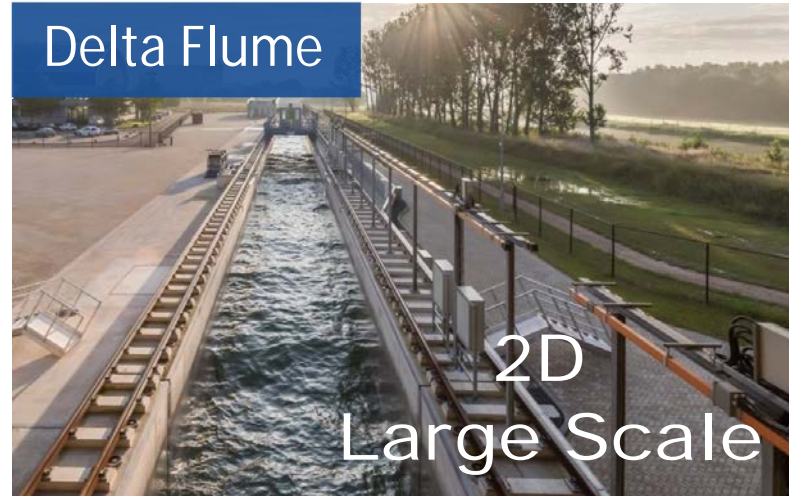
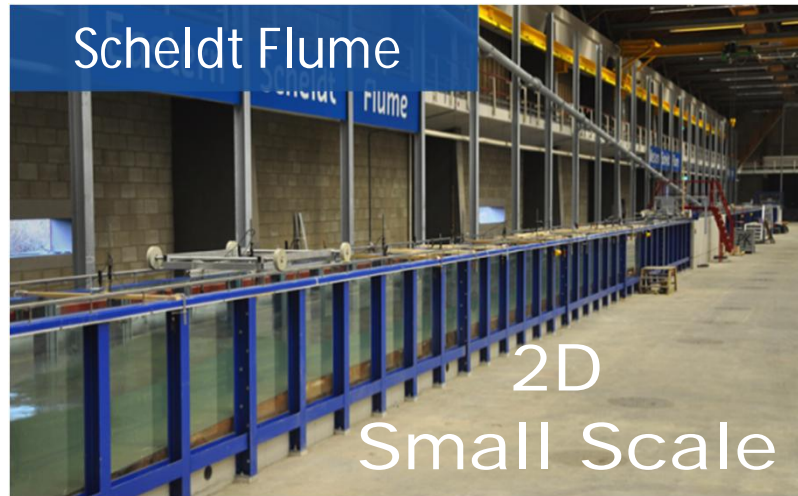
# **Experimental facilities**

# **Implications for Advanced Flood Research**

Dirk-Jan Walstra  
(with help of many colleagues)



# Physical model testing for Coastal Structures

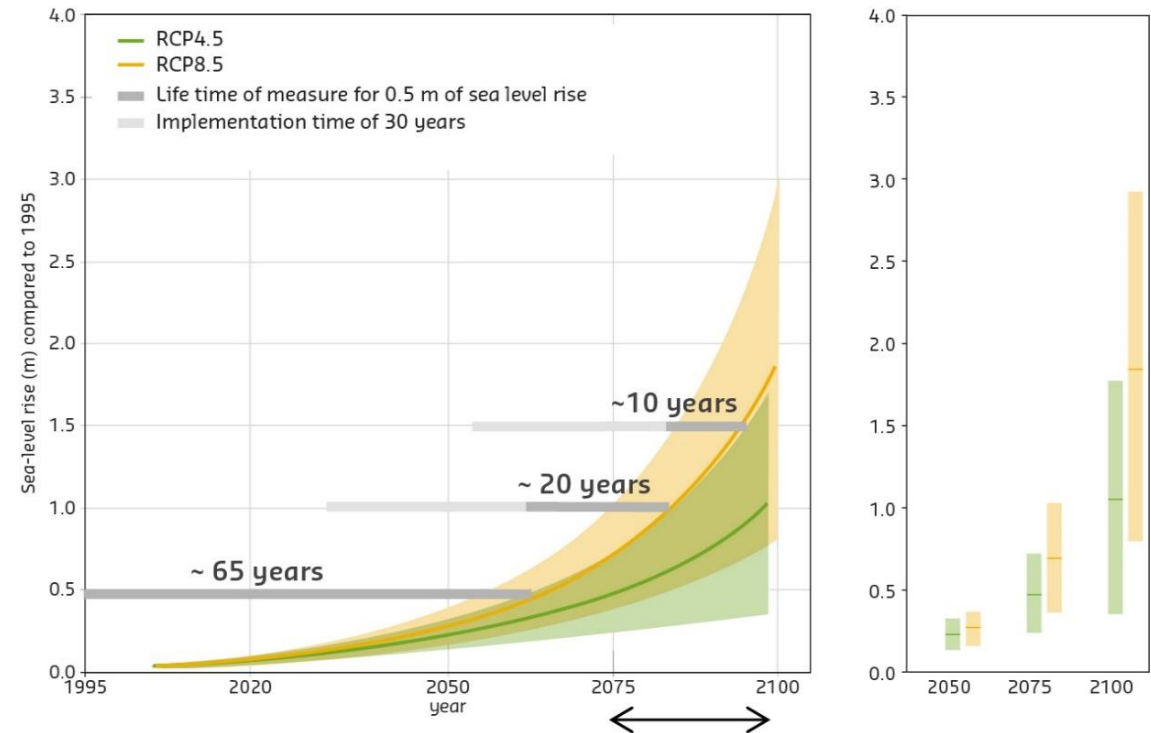




geo-containers

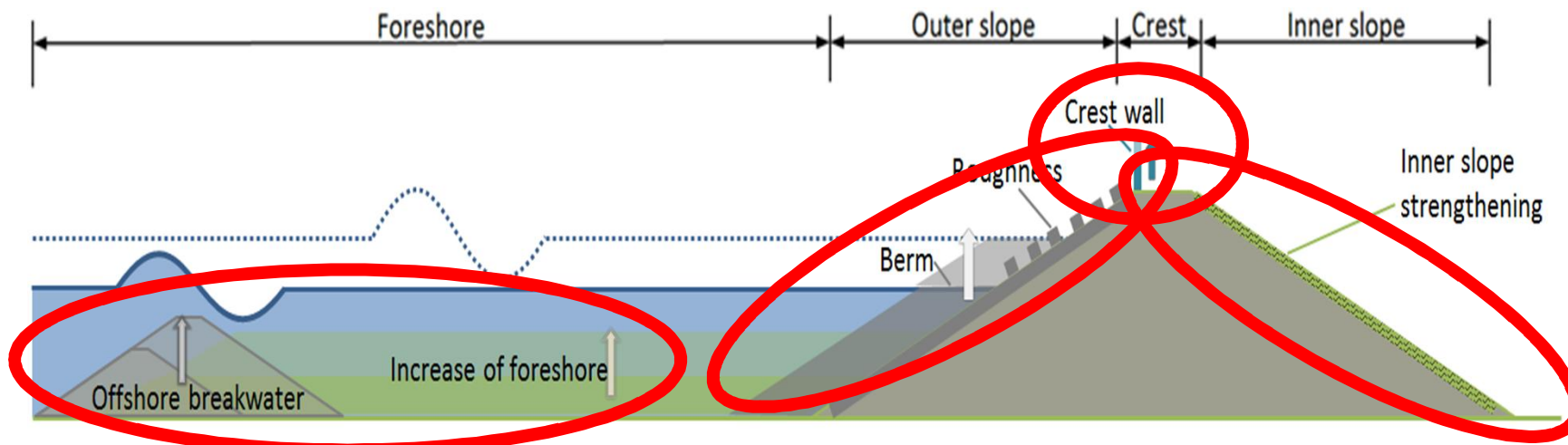
# Need for adaptive approaches in coastal protection

- The functioning/efficacy of a coastal protection measure is negatively impacted during its life time
- Highly uncertain projections of sea level rise
- Focusing of worst-case scenario may be unnecessarily costly
- Postponing potential investments is likely to be an attractive alternative to worst-case scenario designs
- Costs of postponed investments can be reduced by taking potential future adaptation measures into account in designs



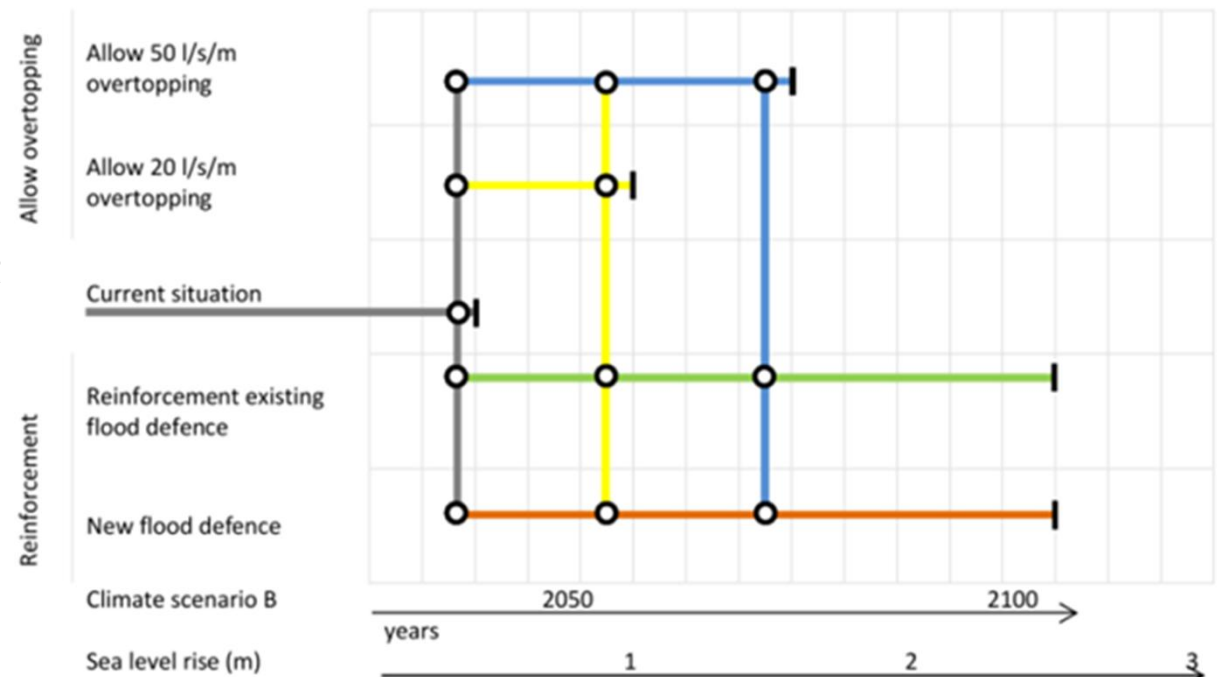
# Adaptive Design Approach – Step 1: identification of design options

- Adaptation measures (without increasing crest level):
  - Reduce hydraulic loading before toe of structure (e.g. offshore breakwater or foreshore).
  - Increase dissipation on seaward slope (e.g. berm or roughness elements).
  - Add element on crest (earthen part remains the same) (e.g. glass wall).
  - Strengthen inner slope to allow larger overtopping discharges



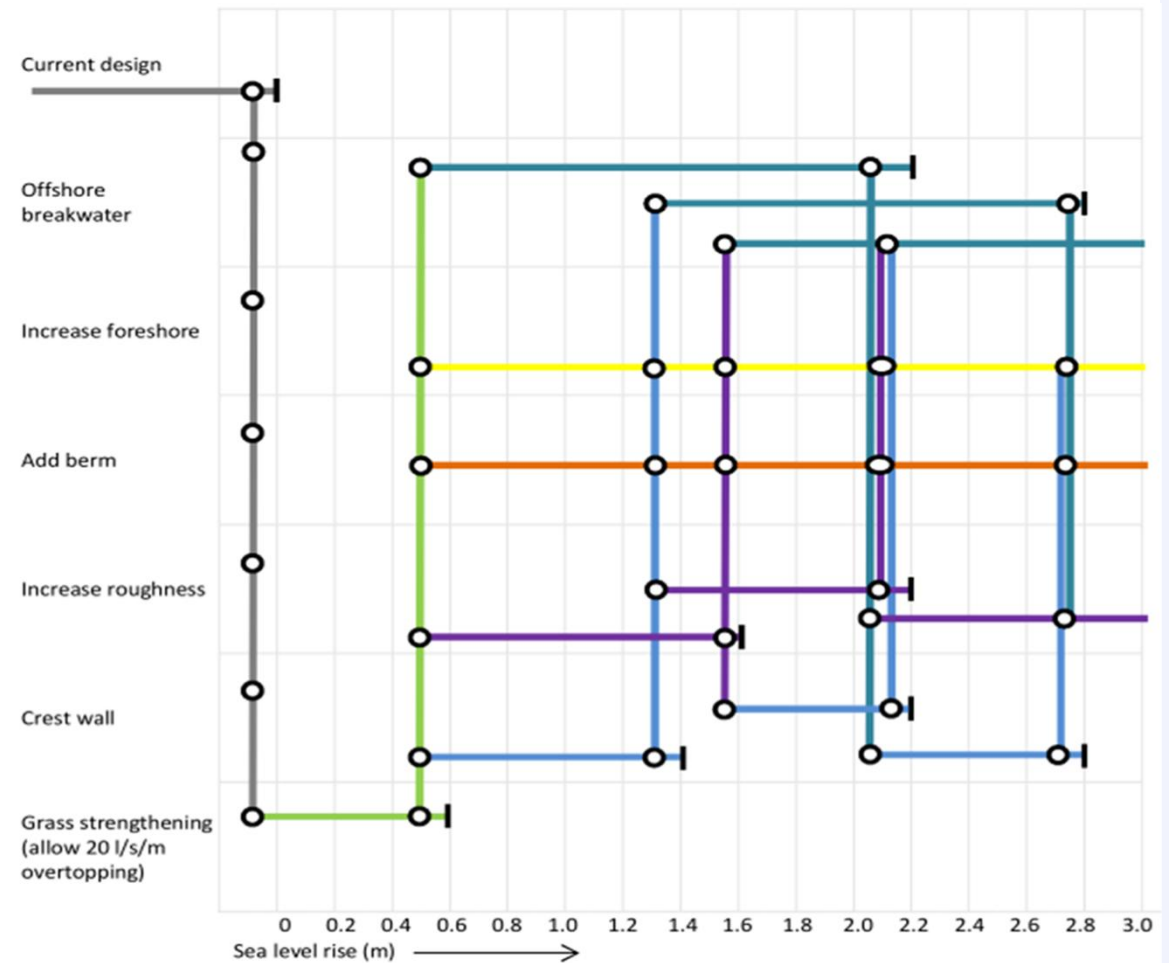
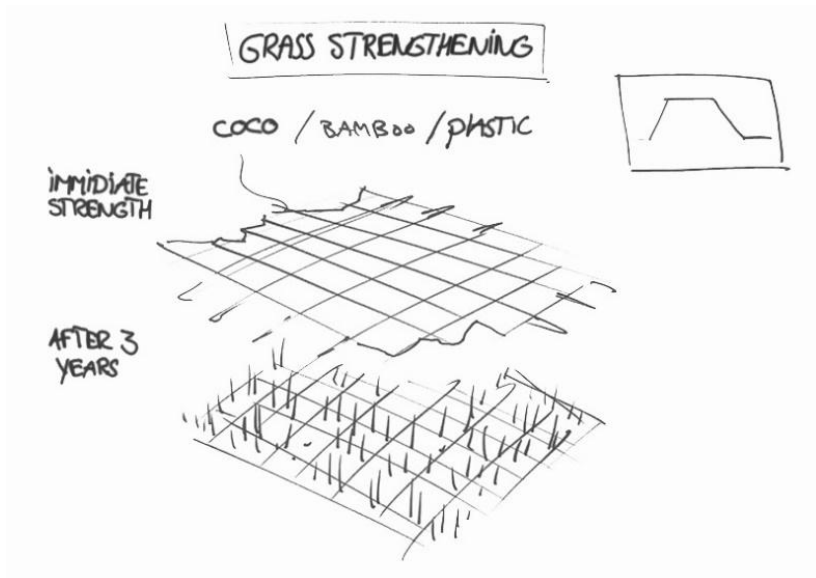
# Working out the options – Step 2: Adaptive Pathways

- Select feasible solutions for adapting coastal structure
- Quantify how much SLR can be accommodated by each measure
- Defining tipping point: Solutions have a limit to amount of SLR
- Analyze feasibility of combination of measures



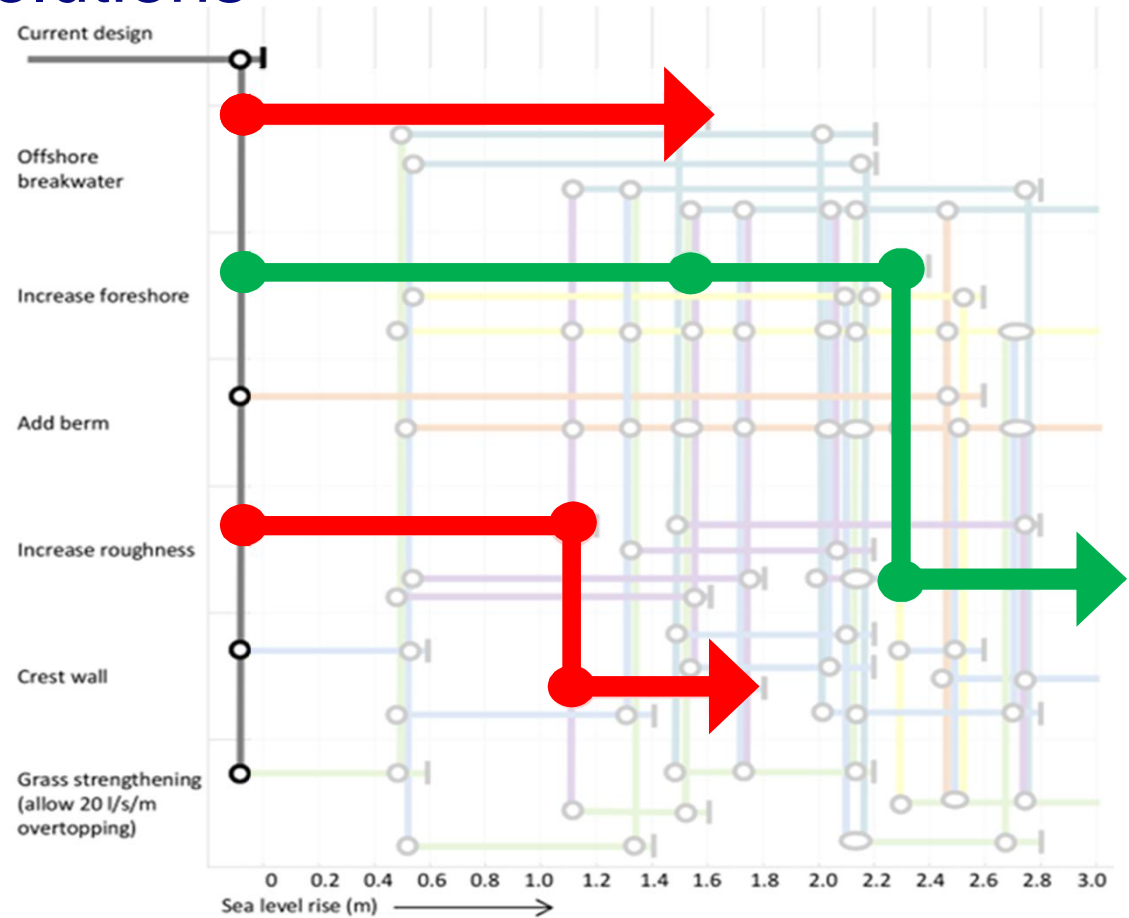
# Exploring different combinations of reinforcements

- Tipping point: Crest wall of glass has limited height (1.5m) due to limited strength of glass and acceptability of public.
- Or: start with grass strengthening....

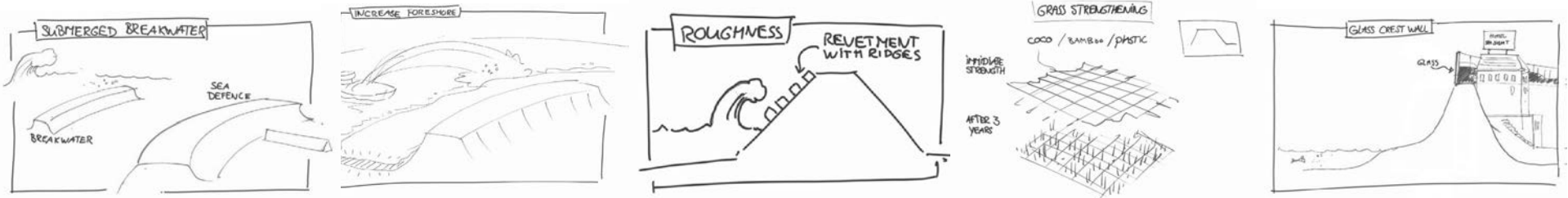


# Adaptation pathways of all solutions

- Insight into most realistic and economic adaptation measures.
- Combination of more than 1 adaptation measure required in case of high SLR.
- Postponing investments for adaptation to uncertain high SLR is attractive.
- Pathway selection taking future potential SLR into account may lead to another initial solution.



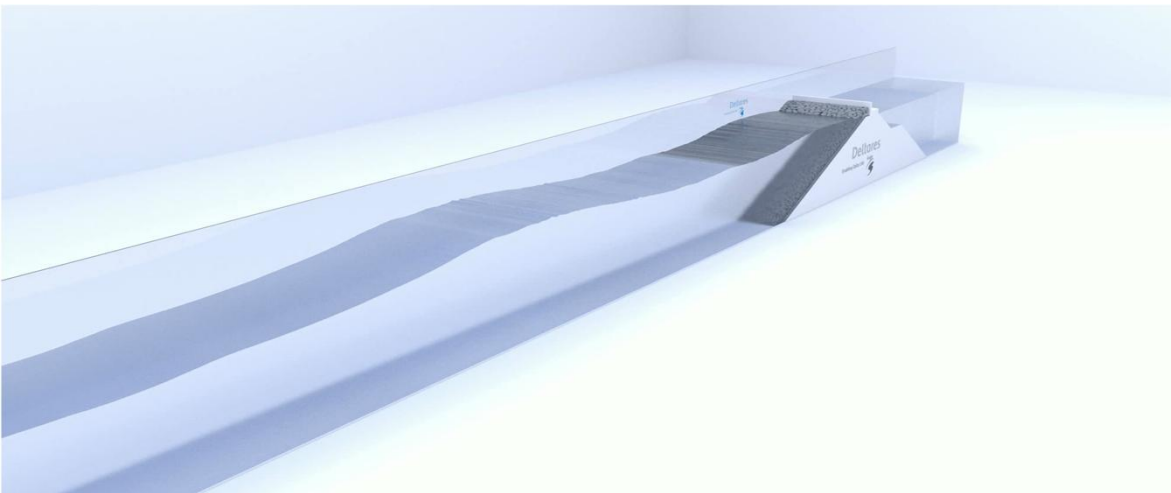
Del





# Knowledge Gaps & Role of experimental facilities

- Design rules are often a mix of physical and empirical relations addressing a single design solution and/or simplified forcing
- Taking climate adaptation measures require combinations of solutions for which no design rules are available
  - Shallow foreshore in combination with roughness and/or a crest wall.
  - Roughness in combination with berm and/or oblique waves.
- The mix of numerical models, data analysis (e.g. machine learning) *and experimental facilities* is imperative to develop resilient, robust and cost efficient coastal protection solutions



# Contact

✉ [dirkjan.walstra@deltares.nl](mailto:dirkjan.walstra@deltares.nl)

🏠 [www.deltares.nl](http://www.deltares.nl)

🐦 [@deltares](https://twitter.com/deltares)

🌐 [linkedin.com/company/deltares](https://www.linkedin.com/company/deltares)

✉ [info@deltares.nl](mailto:info@deltares.nl)

📷 [@deltares](https://www.instagram.com/deltares)

📘 [facebook.com/deltaresNL](https://www.facebook.com/deltaresNL)

