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2 Seas Mers Zeeën
Polder2C's
European Regional Development Fund

Polder2C's: a unique opportunity for full-scale experiments

www.polder2cs.eu

This project has received funding from the Interreg 2 Seas programme 2014-2020 co-funded by the European Regional Development Fund under subsidy contract No [2S07-023]

The Polder2C's project

- Main focus
  Protection against, and adaptation to the consequences of climate change in coastal regions

- Depoldering Hedwige-Prosperpolder:
  450 ha turned into tidal nature area

- Living lab Hedwige-Prosperpolder:
  3 km of levee for testing

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Living Lab HPP

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Polder2C's project partners

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stowa

Vlaanderen
is mobiliteit &
openbare werken

De Vlaamse
Waterweg nv

Environment
Agency

KU LEUVEN

Cerema

Ministerie van Defensie

South West
Water

Rijkswaterstaat
Ministerie van Infrastructuur en Waterstaat

Provincie
Zeeland

Université
de Lille

ISL
Ingénierie

TU Delft

UNIVERSITY
OF APPLIED SCIENCES

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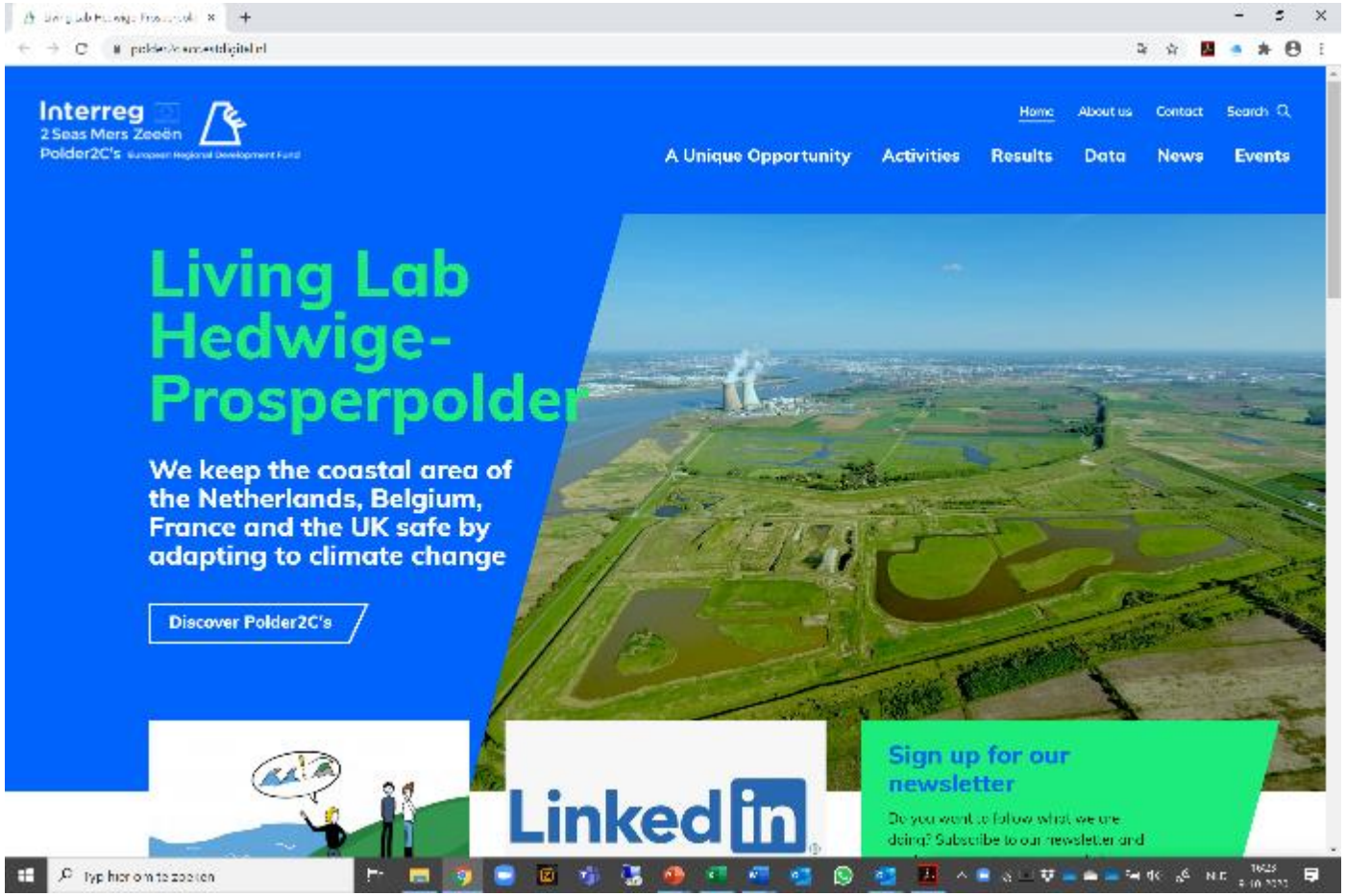

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The Polder2C's project

Focus areas

- Flood Defences (WP1)
  - Destructive full-scale tests: Continuous overflow, wave overtopping, wave impact, levee breach growth;
- Emergency Response (WP2)
  - Inspection, emergency measures, damage repair, breach initiation & closure;
- Knowledge Infrastructure (WP3)
  - Educating the next generation, sharing knowledge, student involvement;

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Full scale testing of flood defences

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Goal

Improve our understanding of how levees behave under varying loading conditions

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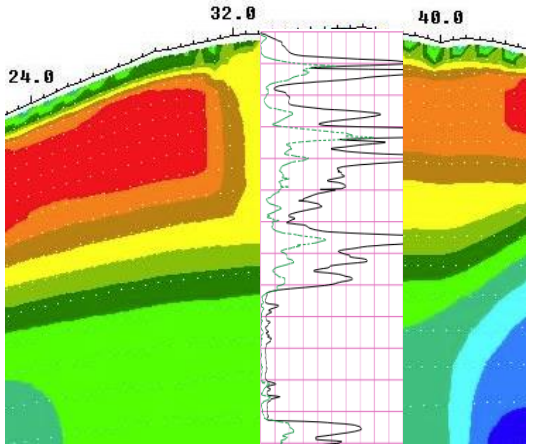
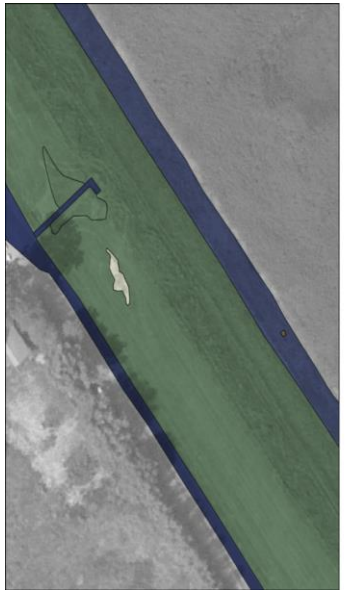
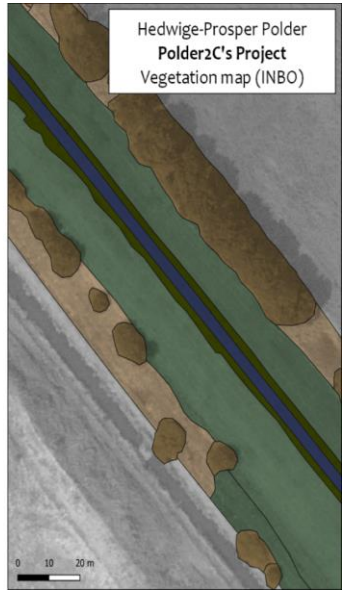
Survey

- Soil characterization
- Topo
- ERT
- Vegetation map
- JET, EFA, firehose erosion test
- Grass sod pull test
- Water pressure
- …







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Overflow generator

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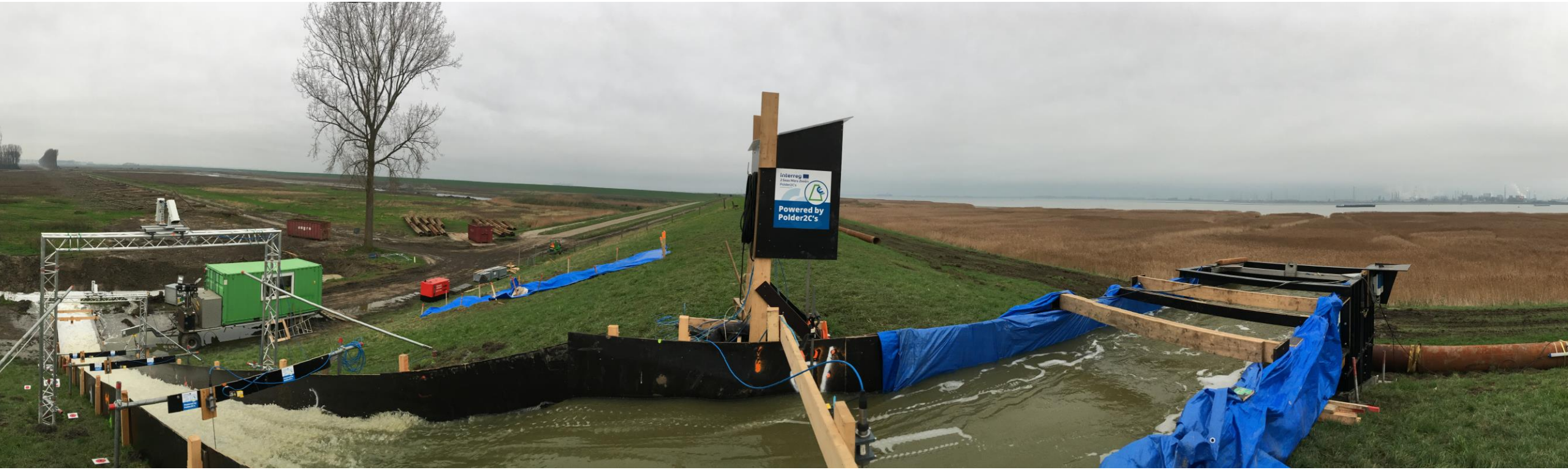
Overflow generator



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Monitoring

- Default: discharge (pump), velocity (EM) and water level (accoustic) at 3 locations along the slope

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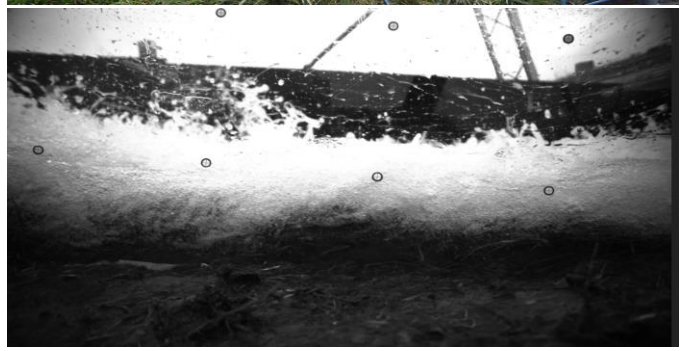
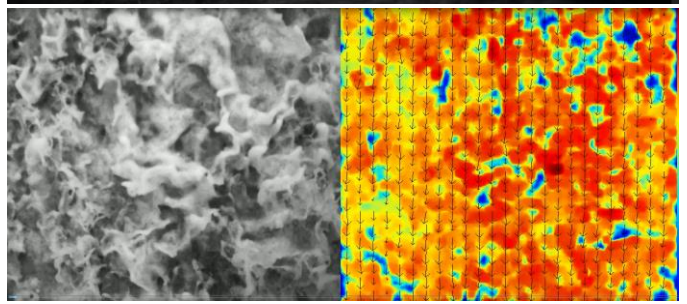
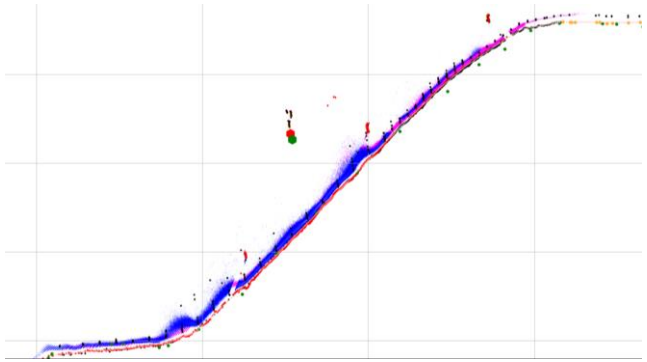
Monitoring

- At selected test sections
  - Water surface profile with 2D-LIDAR
  - Particle velocity along the slope (PTV of a floating particle)
  - Surface velocities (LSPIV)
  - Bubble image velocimetry over water depth







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Monitoring

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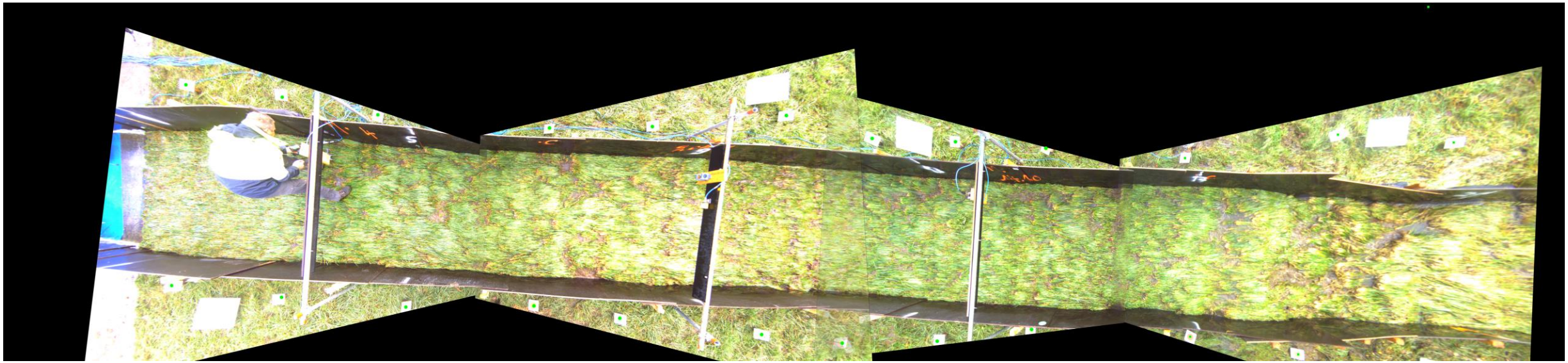
- Damage patterns/Erosion
  - *Georeferenced images*
  - *Counting evolution bare spots*
  - *Photogrammetry*
  - *3DLS*



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Monitoring

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Proeven

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Continuous overflow tests

- Width of 2 m breed (sometimes 1 m)
- River levels ~20 cm up to (almost) 50 cm above the crest
- Failure ranging from 10 minutes to (more than) 33 hours

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Continuous overflow tests

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Scenarios

- Reference
- NL/Be
- Varying grass heights
- Anomalies
  - Animal/artificial burrows
  - Tree
  - Cliff
  - Wet spot: reed
- Emergency repair measures





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Continuous overflow tests

Emergency repair measures

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Cocos mat ✓✓

Tyvek ✓

EPDM ✓✓

RTM ?

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Damage patterns

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Cliff formation

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Animal burrows

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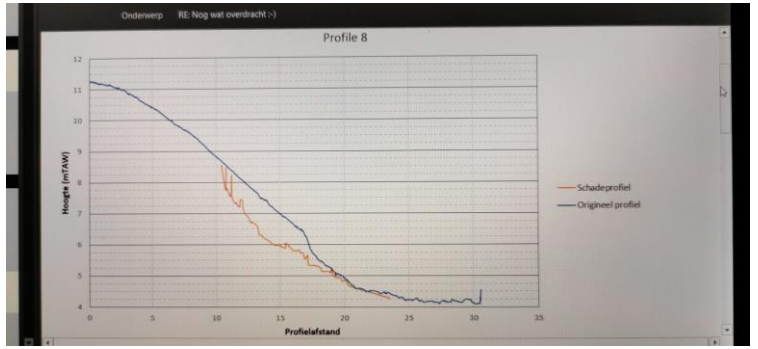
Continuous overflow tests

- Lessons learned
  - Slowly bare spots arise, cliff formation on levee slope
  - Sudden failure of the cover
    - Undermining by erosion of core
    - Headcut migration ones sandy core is reached

- Connection with sandy core!
- Thickness of cover!
- Animal activity!
- Wet spots!



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Erosion resistance tidal marshes

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- Icw. NWO HPP (TUDelft & UAntwerpen)
- In situ & in lab

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Wave overtopping simulator

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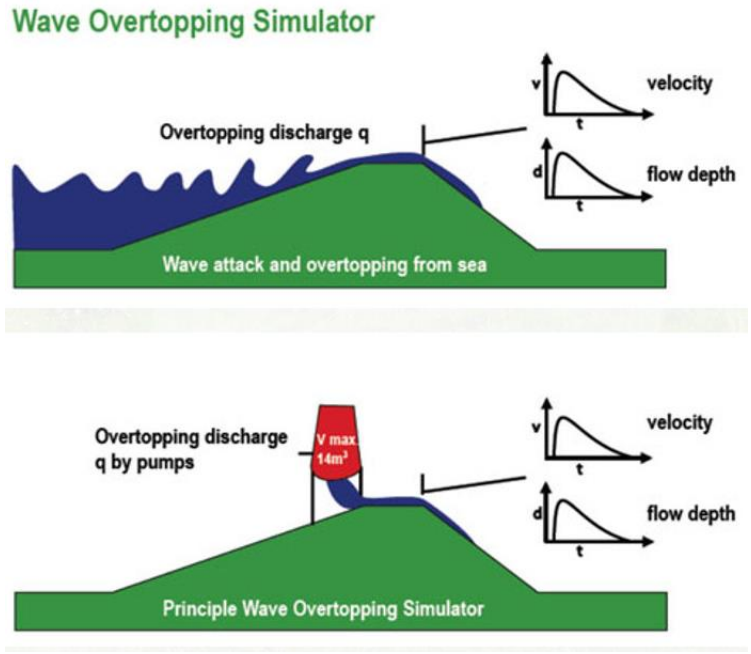

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Wave overtopping tests

- Width of 4 m breed
- River levels ~crest and Hs = 0,5 – 1 (– 2) m
- No failure before 4-6 hours if anomaly present…

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Wave overtopping tests

Scenarios

- Reference
- Anomalies
  - Artificial burrows
  - Wet spot
- Lime treatment & transitions (in collaboration with HWBP)

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Cliff formation

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Animal burrows

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Wave overtopping tests

- Lessons learned
  - Slowly bare spots arise, cliff formation on levee slope
  - Sudden failure of the cover
    - Undermining by erosion of core
    - Headcut migration ones sandy core is reached

- Connection with sandy core!
- Erosion of bare clay!
- Animal activity!

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Wave overtopping tests

Extra’s

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Wave overtopping tests

icw. HWBP (NL) & Lhoist

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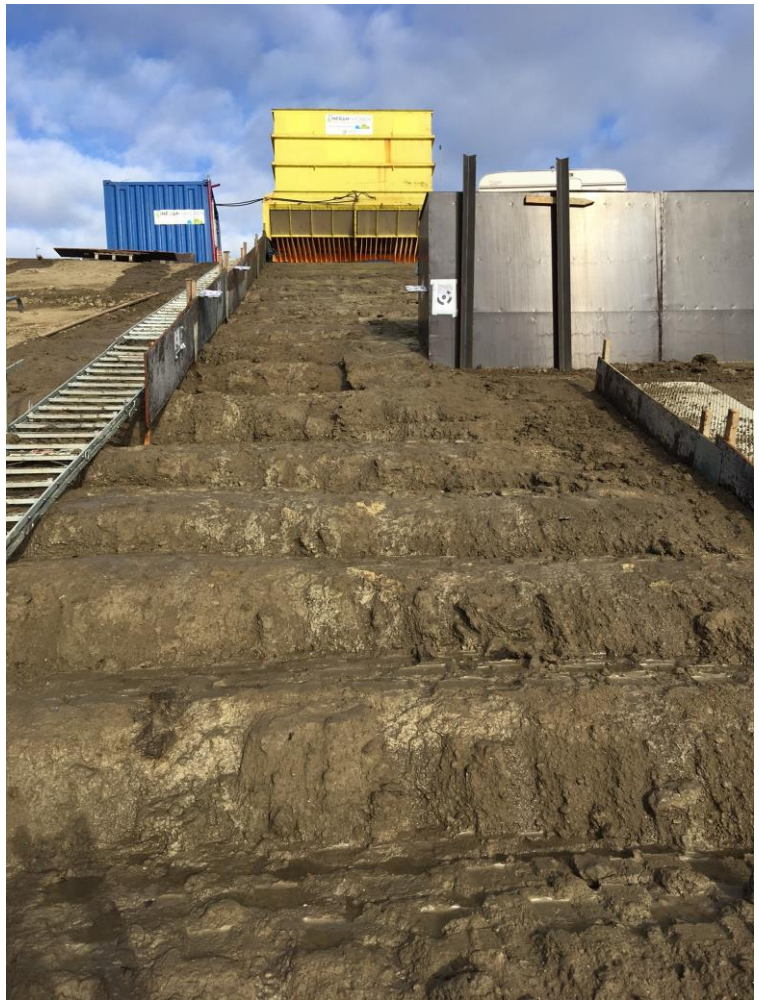

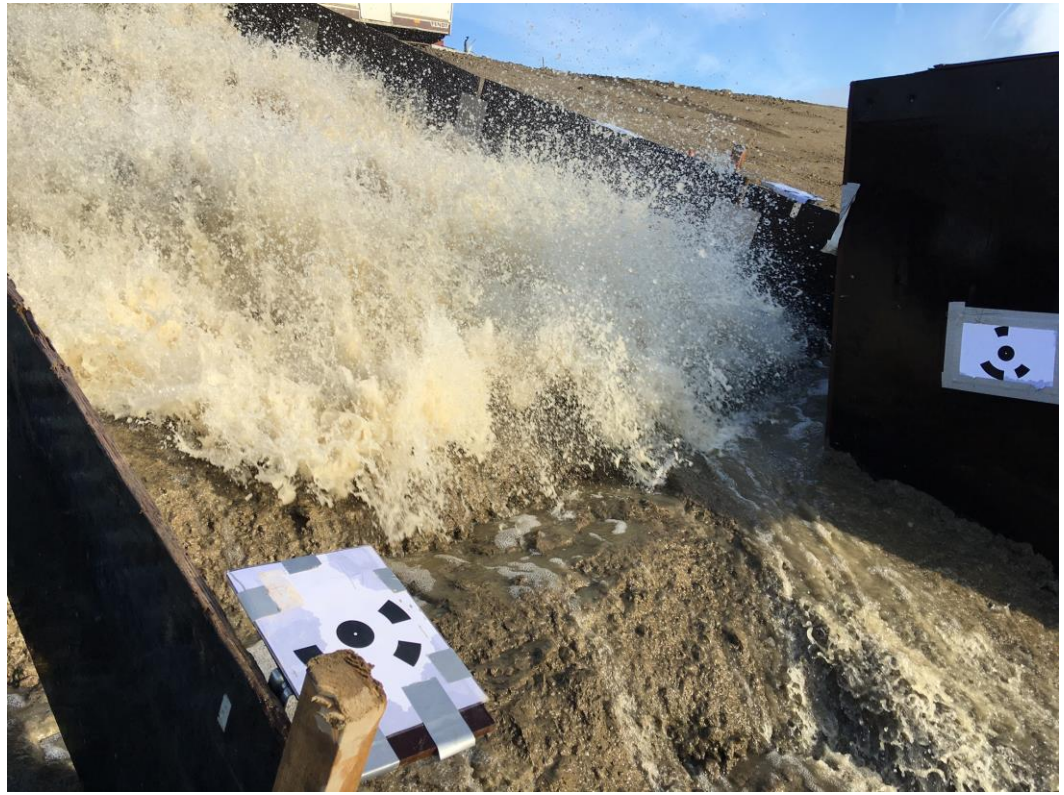

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Wave impact

Scenarios

- Reference
- Levee repair/strengthening with grass sods
  (in collaboration with NWO HPP, WageningenUR)

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Effect of tidal marsh on breach growth

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(Zhu et al., 2020)

Assess the effects of the presence of tidal marsh on breach growth:

- Breach experiment WITH tidal marsh
- Breach experiment WITHOUT tidal marsh

In collaboration with the Dutch Research Council (NWO HPP, TUDelft)

Animal burrow detection

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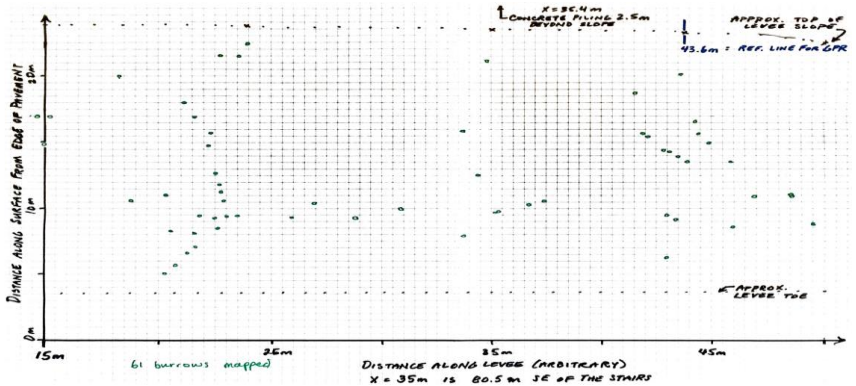
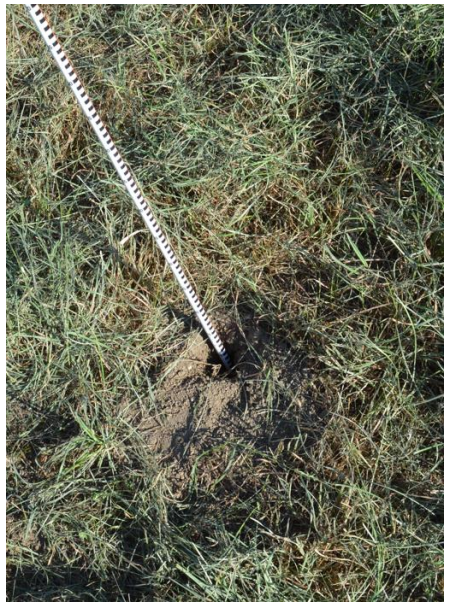
- Non-destructive detection techniques
  - Visual, Smoke test, GPR, ERT
- Destructive detection techniques
  - Grouting and excavating





Possibilities for collaboration

- Modelling of hydrodynamics and erosion
- Twin sites
- Testing innovative tools/services/products
- Late Summer School Sep’22
- Large Scale Crisis Exercise Sep’22

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Questions, suggestion, …

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