WATER INFORMATICS SCIENCE & ENGINEERING
EPSRC CENTRE FOR DOCTORAL TRAINING

UNIVERSITY OF BATH

Coastal Adaptation Under Sea Level Rises: Prototype Scale Measurement Of A Dynamic Revetment

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&

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Logo slide

hydralab+

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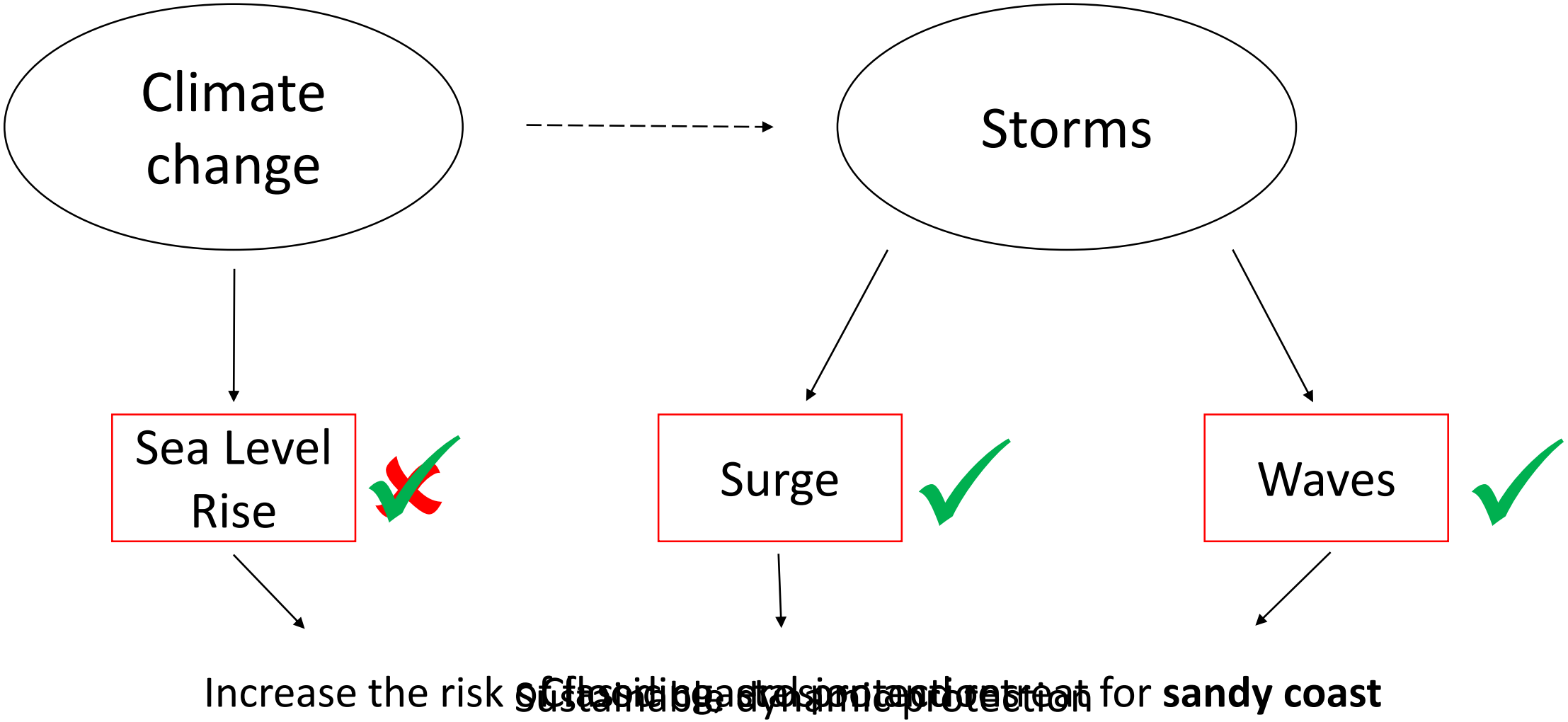
Context


Climate change
Storms
Sea Level Rise
Surge
Waves
Increase the risk of flooding and coastal erosion
Sustainable dynamic protection
for sandy coast

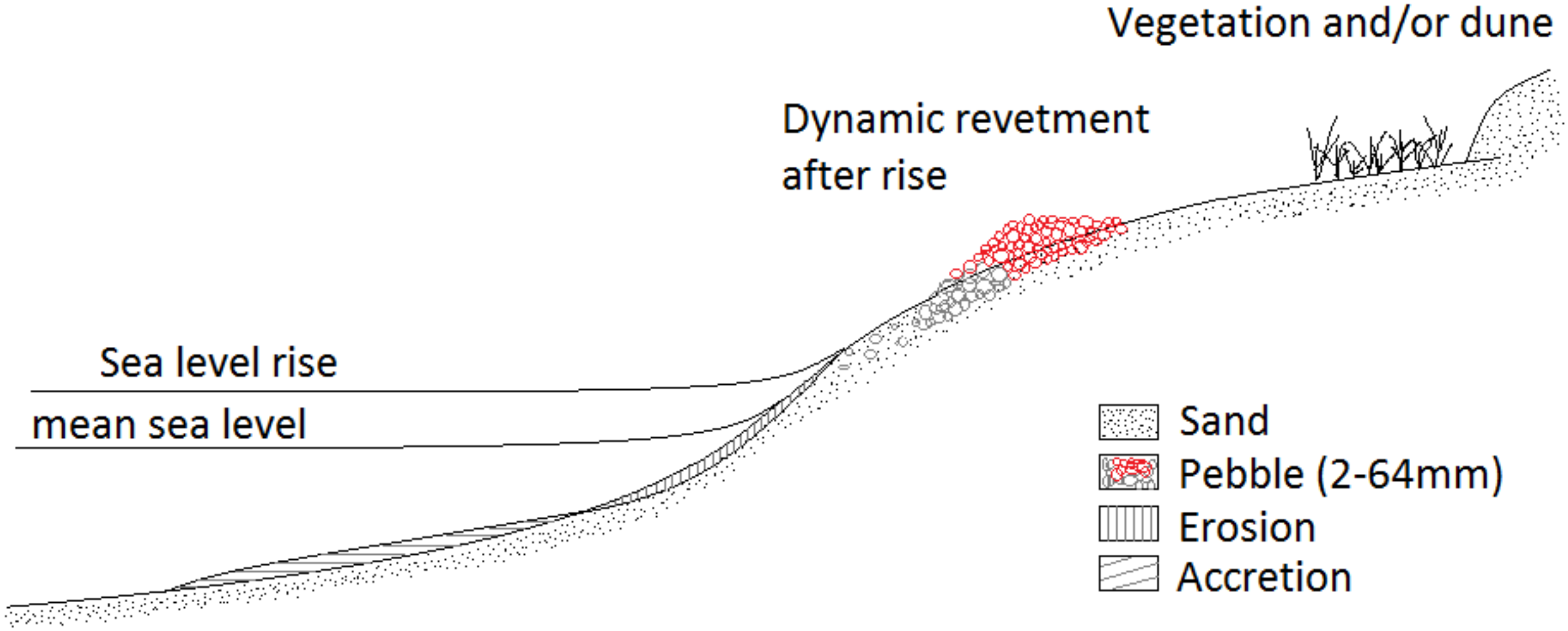
Objectives

1. Design a sustainable protection structure for a sandy beach accounting for Sea Level Rise

2. Test a prototype structure in a large scale laboratory flume

3. Behaviour and performance of the dynamic revetment

1. Design a sustainable protection for sandy beach



Objectives

1. Design a sustainable protection structure for a sandy beach counting for Sea Level Rise

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2. Prototype scale measurement: DynaRev

a. The facility

Großer Wellenkanal (GWK), Large Scale Flume, Hannover, Germany

309 metres long

7 metres deep

5 meters wide

2. Prototype scale measurement: DynaRev

a. The facility

http://hydralab.eu/assets/images/Wellenkanal-HDRneus.jpg

Active wave absorption

Maximum stroke: 4.2 m

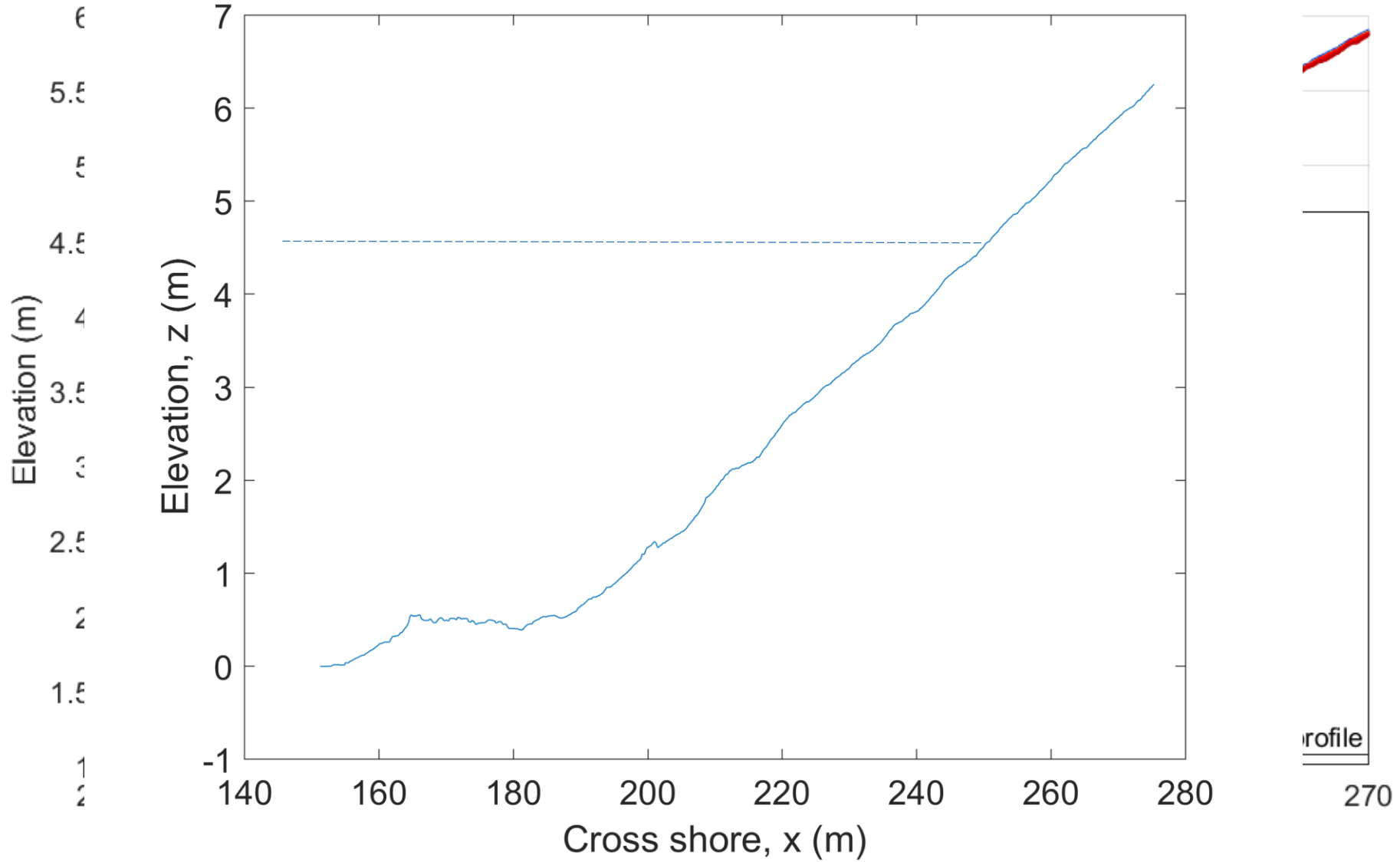
Maximum significant wave height: 1.3 m

Period: 3 – 20 s

2. Prototype scale measurement: DynaRev

b. Survey equipment

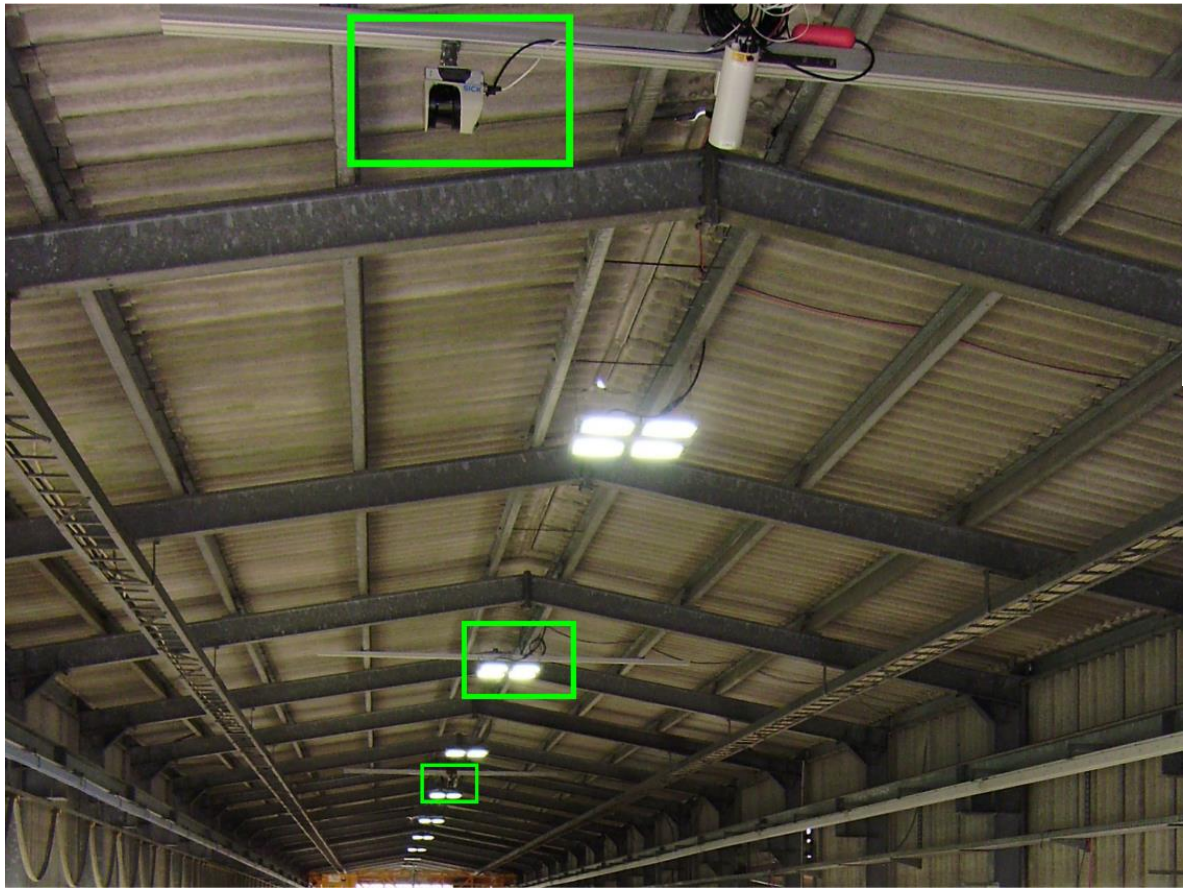
Overhea

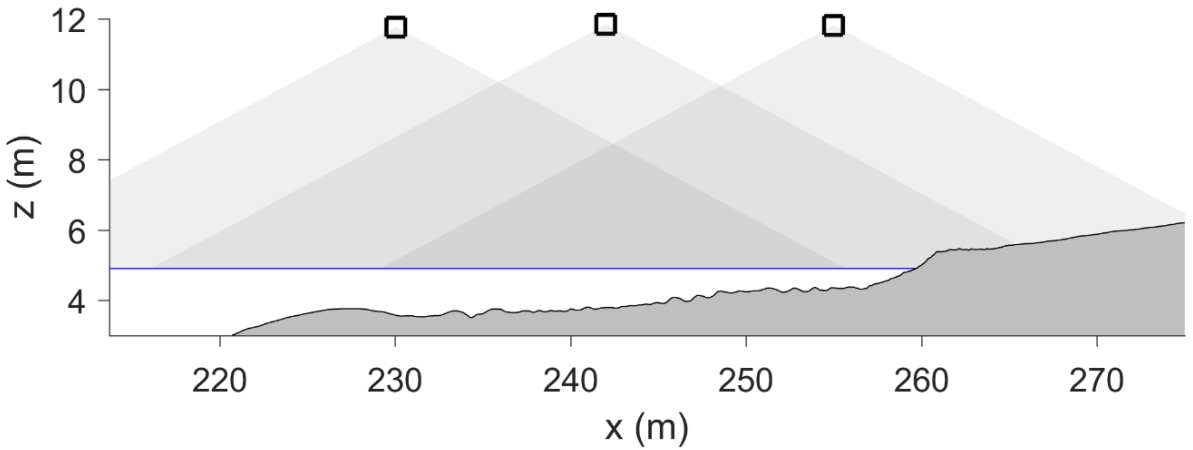


2. Prototype scale measurement: DynaRev

b. Survey equipment

3 Overhead Lidars (Light Detection and Ranging)



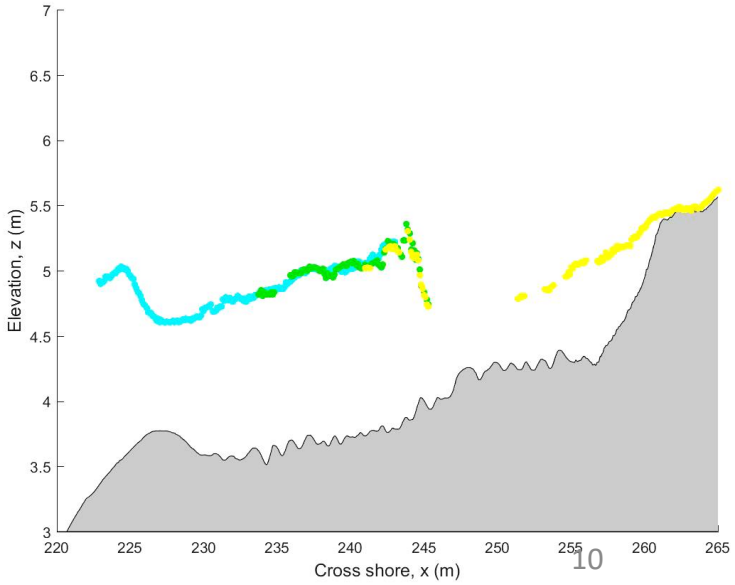


$z = 11.80$ m

$x_{land} = 255$ m

$x_{mid} = 242$ m

$x_{sea} = 230$ m



2. Prototype scale measurement: DynaRev

b. Survey equipment

Instruments for hydrodynamics
Wave gauges
Acoustic Doppler Velocimeters (ADV)
Pressure Transducers (PT)
Cameras
Multibeam Sonar
Electromagnetic Current Meters (EMCM)

Instruments for morphodynamics
Acoustic Backscatter Sensors (ABS)
Optical Backscatter Sensors (OBS)
Ripple Profiler
Sector Scanning Sonar
RFID Pebbles
Multibeam Sonar
RFID Pebbles

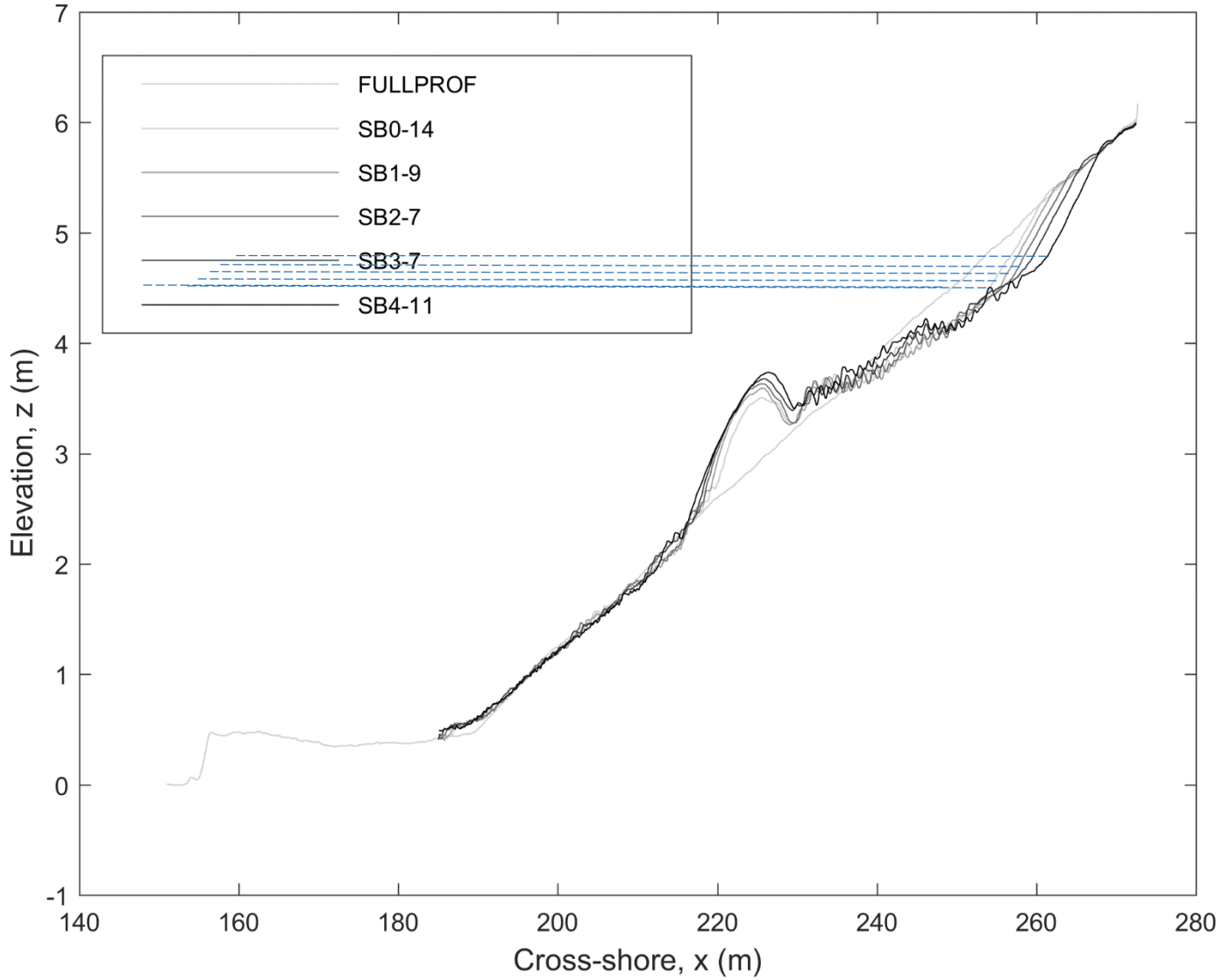
2. Prototype scale measurement: DynaRev

c. Experimental plan

Approach equilibrium

4.5 m

20 hours



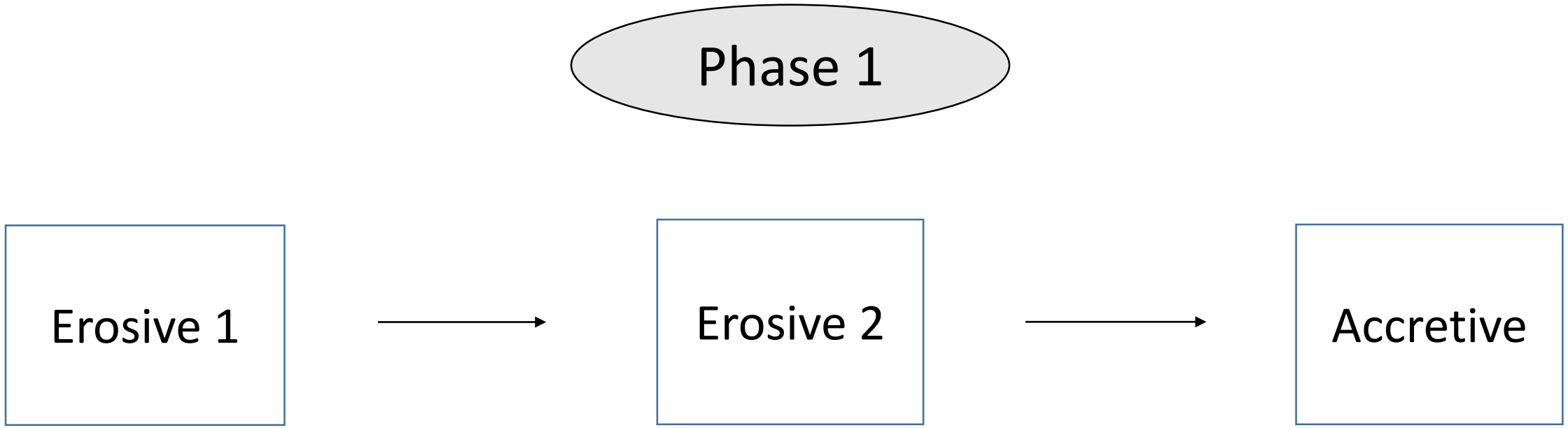
→ SLR 4

4.9 m

17 hours

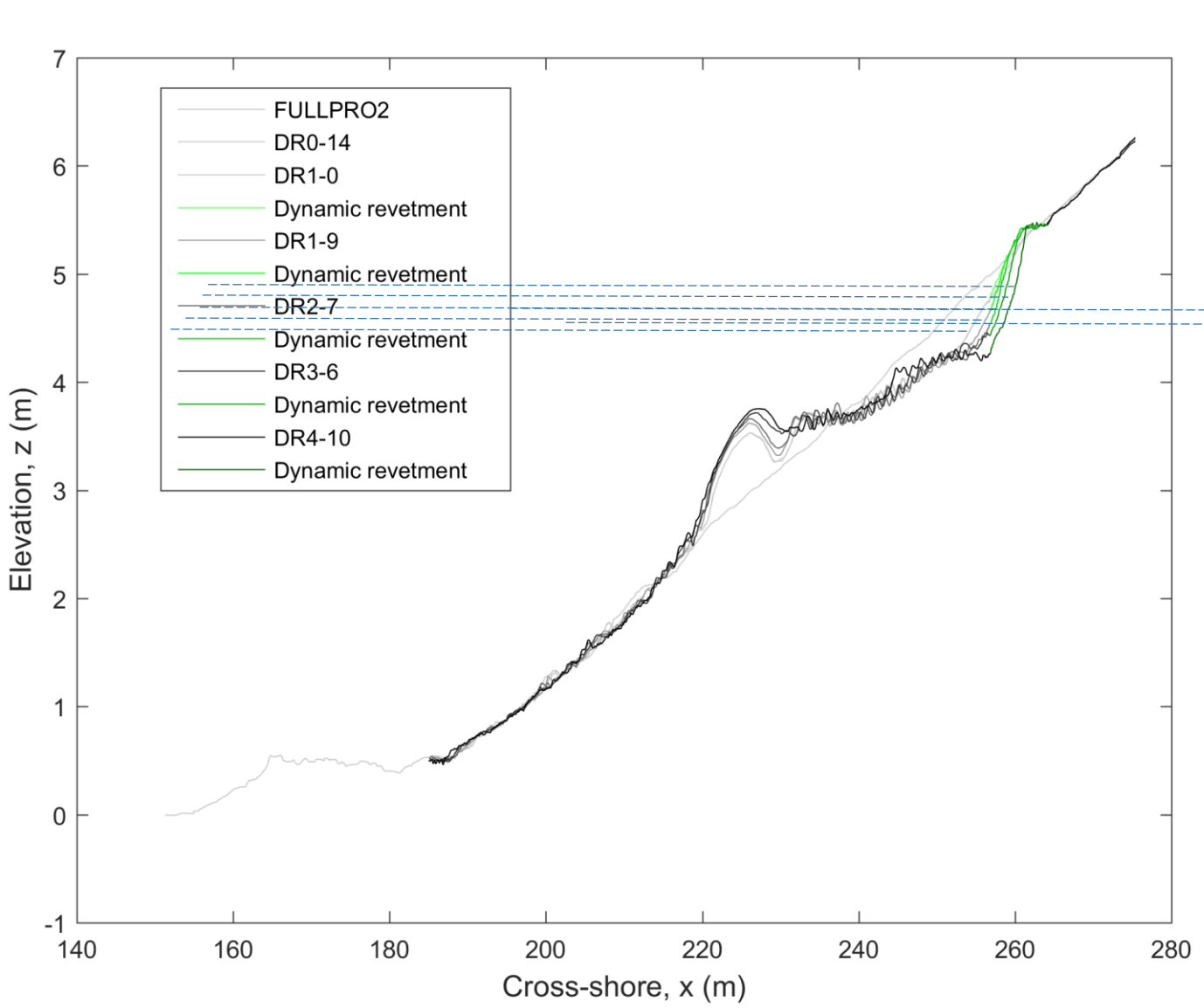
2. Prototype scale measurement: DynaRev

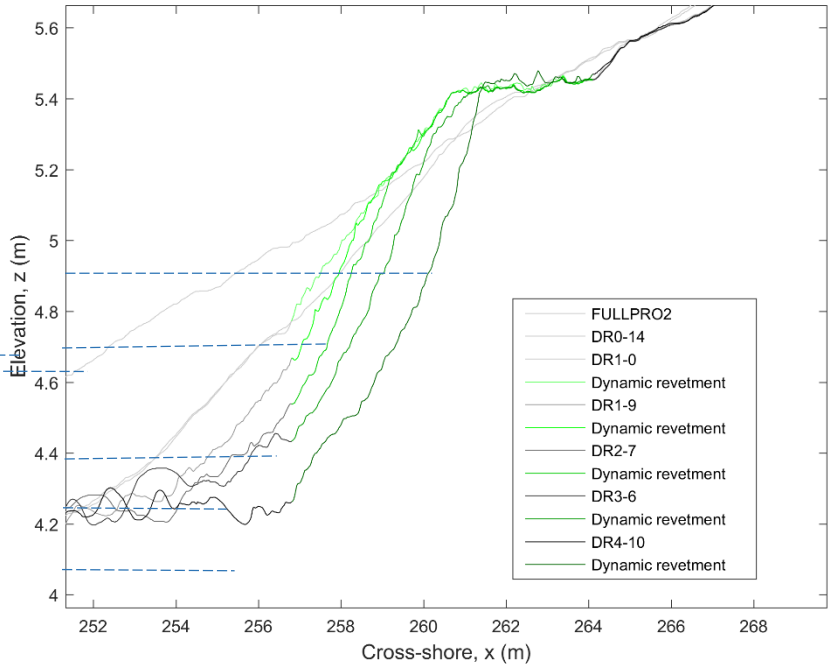
c. Experimental plan



2. Prototype scale measurement: DynaRev

c. Experimental plan





ı: 7.3 m

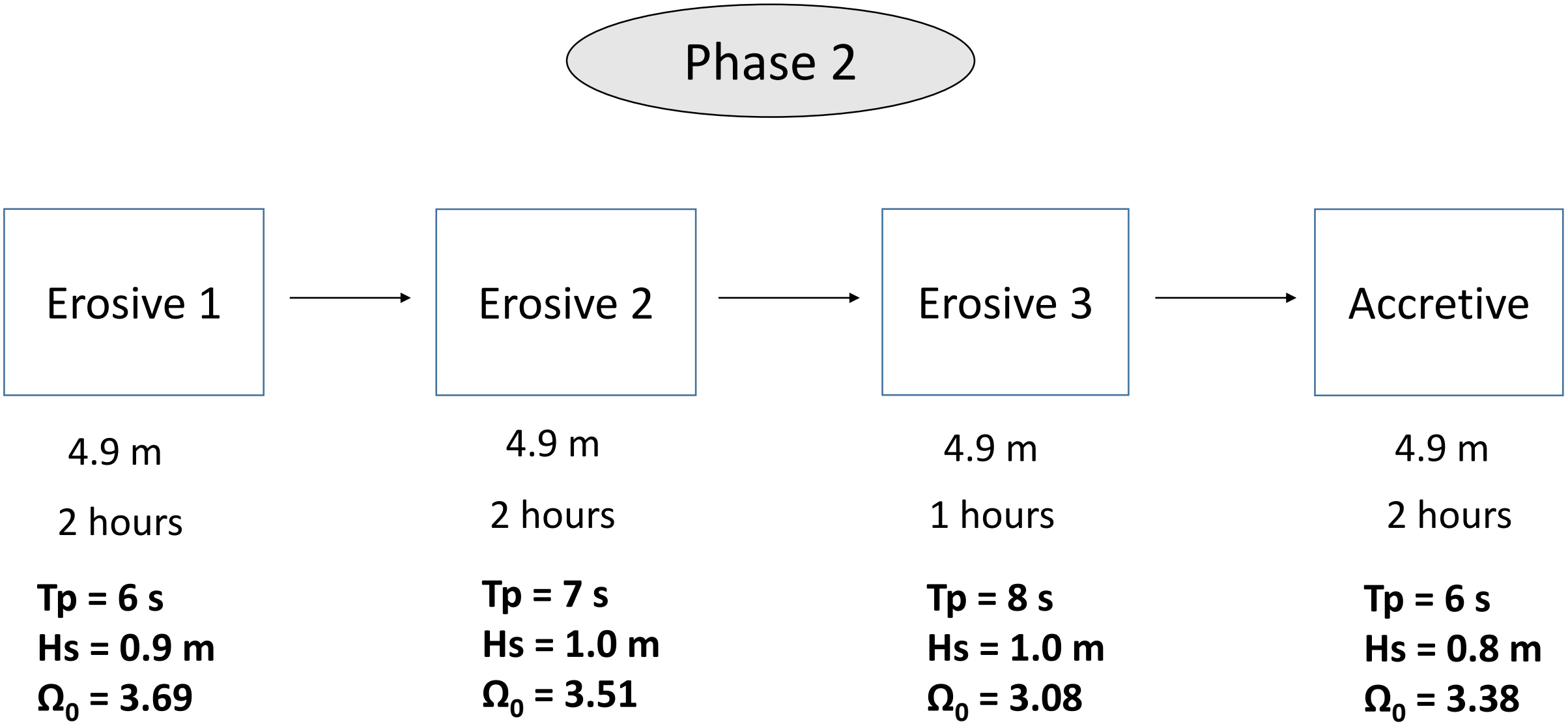
e: 9.38 m³

4.9 m

17 hours

2. Prototype scale measurement: DynaRev

c. Experimental plan



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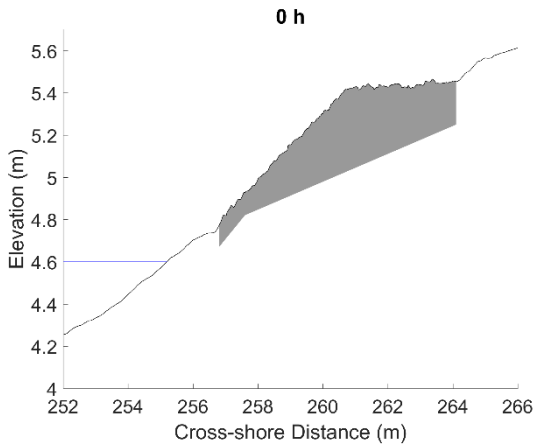

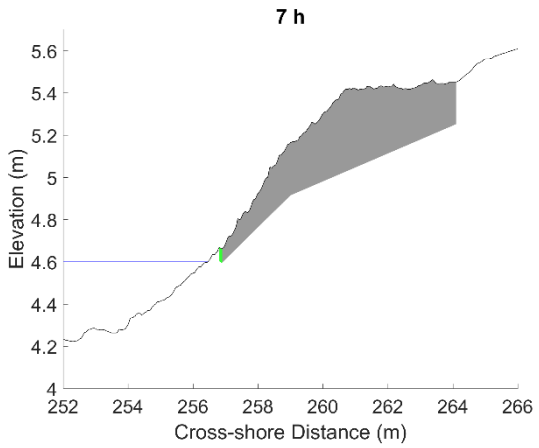

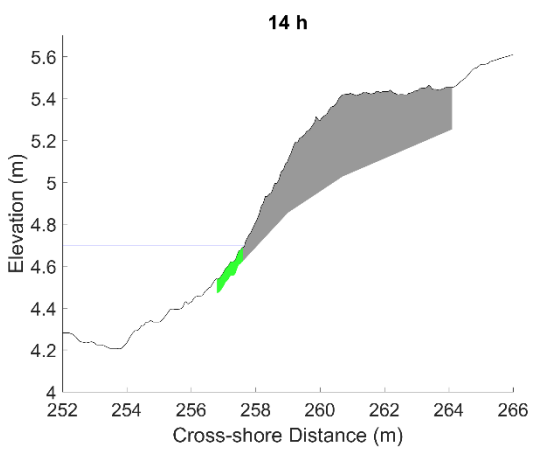

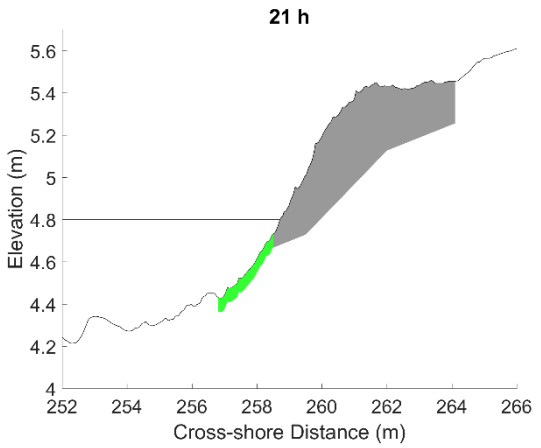

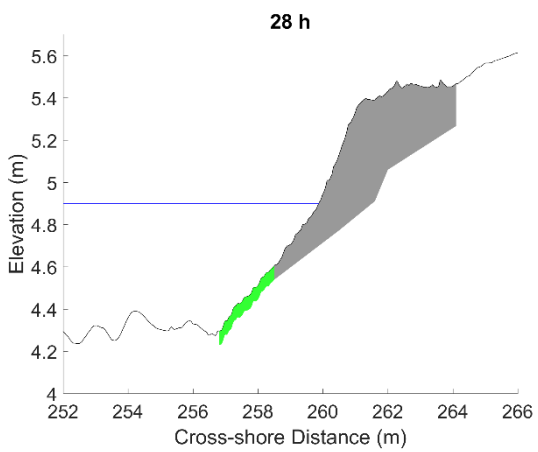

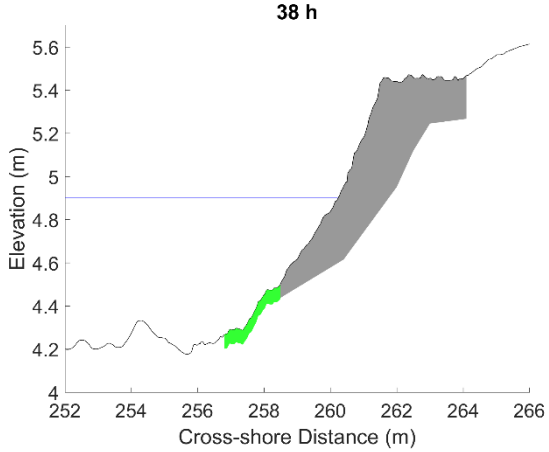

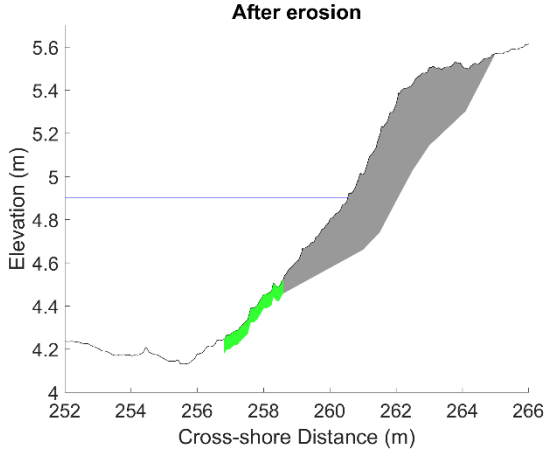

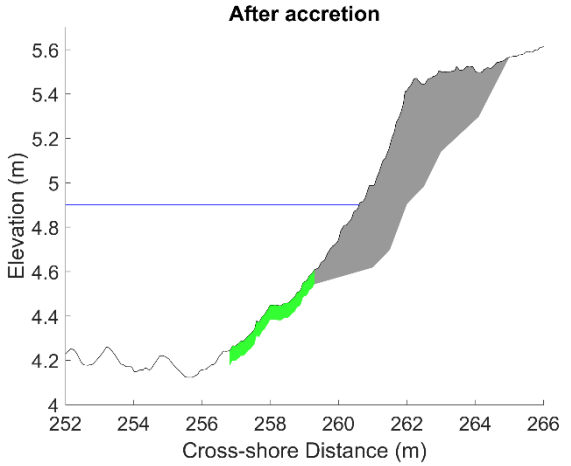

Conclusion

- We identified a need to develop a new kind of dynamic protection accounting for sea level rise
- We designed a dynamic revetment and tested it an a laboratory flume to investigate its response with a rising sea level
- We obtained a comprehensive dataset of hydro and morphodynamics under controlled conditions
- The revetment demonstrated an inherent stability with both a rising sea level and storms
- Seaward movement of sand from under the revetment kept pace with the crest growth leading to no significant overall height gain.
- Cobble transport was predominantly landward onto the revetment crest
- We identified potential design improvements for future implementation

Future Work and Publication

- Wave breaking bubble plume and splash (submitted)

DynaRev

- Experimental reproducibility (in preparation)
- Performance of the dynamic revetment (in preparation)
- Sand bar formation and migration (in preparation)

- Beach profile evolution under sea level rise (future)
- Influence of bar morphology on wave height and runup (future)
- Bathymetry inversion (future)
- Numerical modelling of composite beach using X-beach (future)
- Investigation of roller geometries and associated energy dissipation (future)

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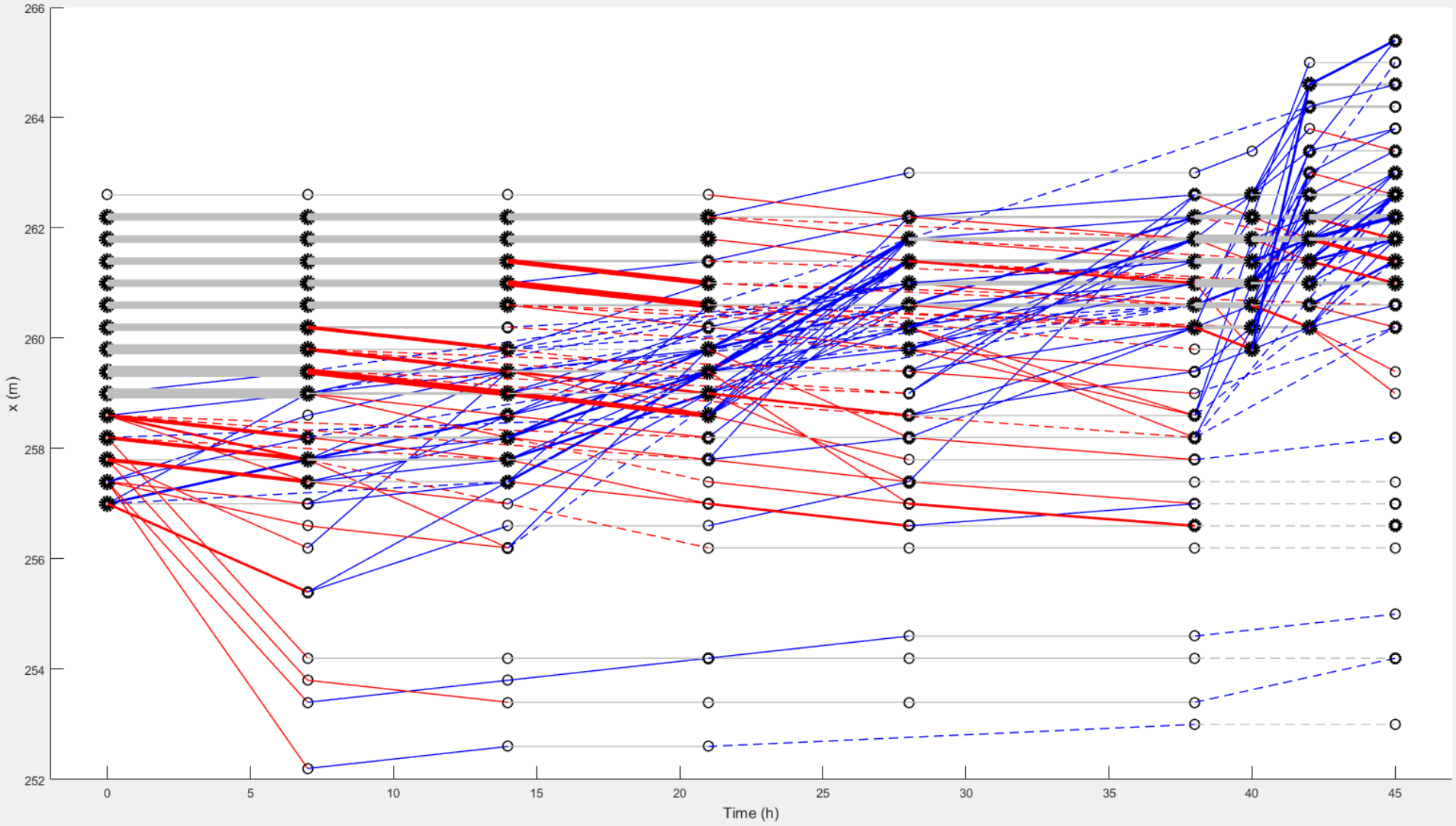
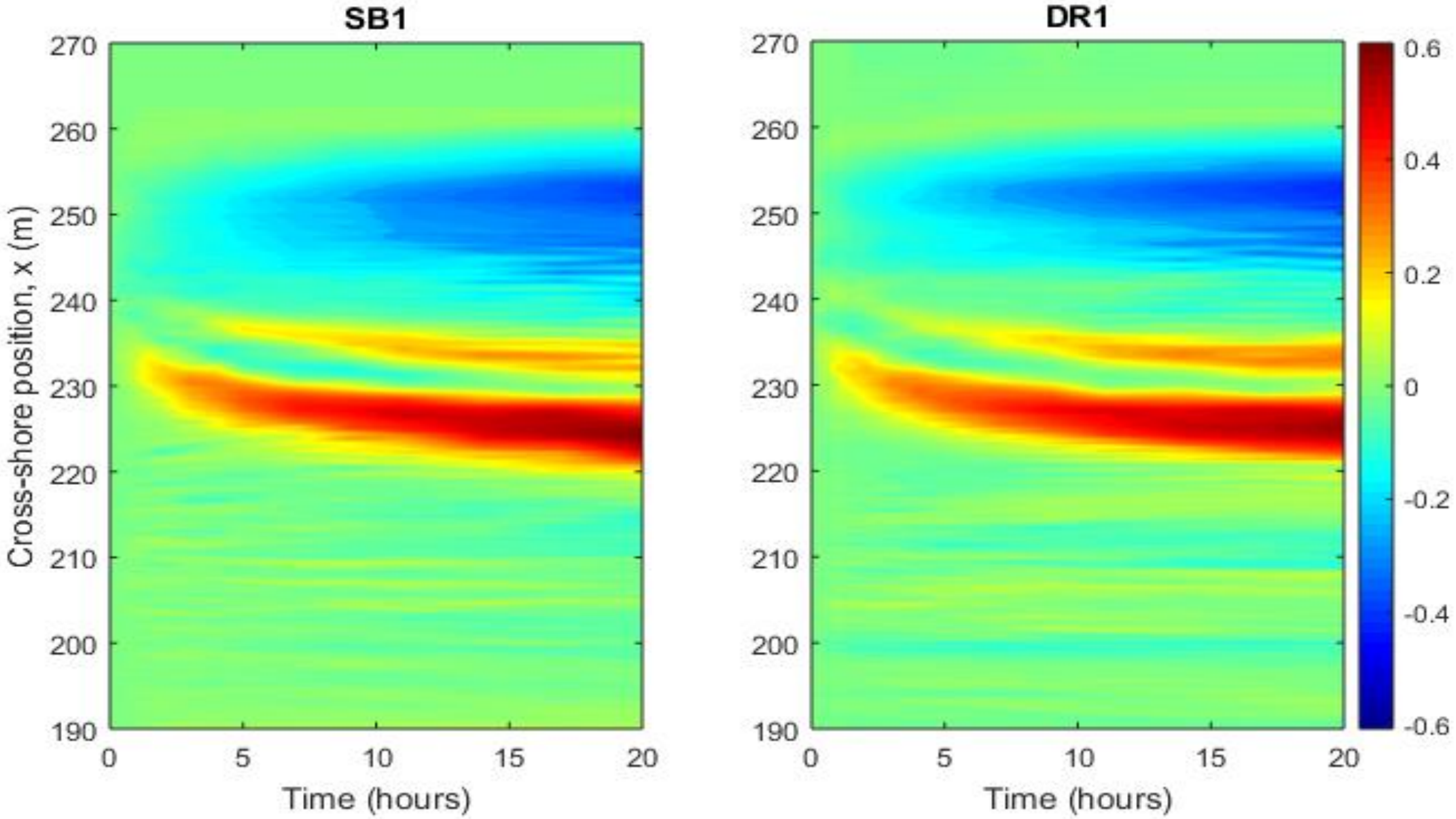
3. Behaviour and performance of the dynamic revetment




SB1
DR1
Cross-shore position, x (m)
270
260
250
240
230
220
210
200
190
0
5
10
15
20
Time (hours)
0.6
0.4
0.2
0
-0.2
-0.4
-0.6