Coastal adaptation under Sea Level Rise using soft engineering

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Context

Global Mean Sea Level (GMSLR) is rising at increasing rate. The most optimistic prediction for 2100 is a rise of 0.40m (see Figure 1) [1].

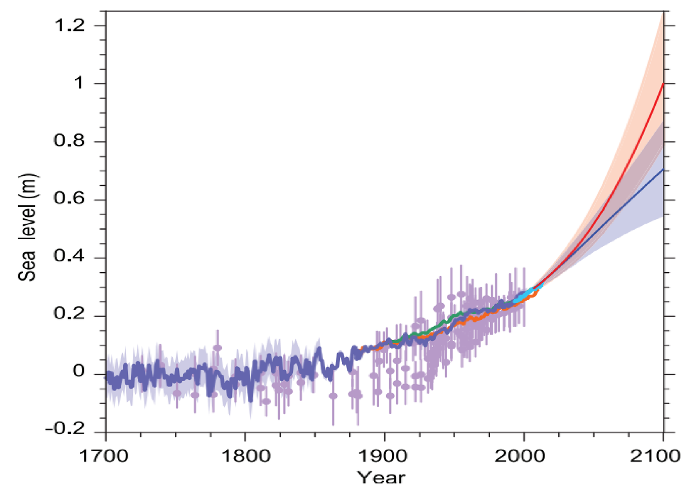


Figure 1: Global mean sea level rise prediction-RCP2.6 (blue)-RCP8.5 (red). *IPCC (2013)*.

Consequence →

Existing hard engineering coastal defence structures are not designed for such a rise, and therefore are subject to overtopping and breaching (see figure 2) [2].

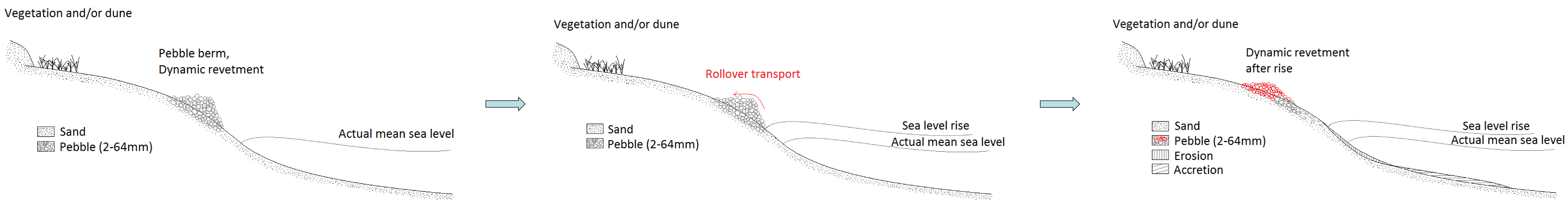
Figure 2: Seawall overtopped. [3]

Potential Solution →

UK government could save up to £380 million by 2030, if alternative soft engineering structure would be used in the future (Figure 3) [2].

Figure 3: Dynamic revetment (cobble berm) completed in Oregon [4].

Dynamic revetment concept



- Dynamic revetment installed on the beach, usually receiving storm waves and surges.
- The part of the beach underneath the revetment as well as the hinterland behind it are protected against erosion as the wave energy is absorbed by the structure.
- Like many natural composite beaches, this kind of protected beach stays attractive.

- With the sea level rising, the pebble berm is more frequently under wave attack from regular wave and surge.
- Therefore, like natural gravel beach or barrier island, the pebble berm rolls over (backward) and maintains his relative crest elevation with the SLR (upward relative to original profile). [5]

- As long as accommodation space is available, it keeps pace with SLR while protecting the hinterland and underneath beach against erosion.
- Eventually, if it reaches the vegetation or dune, those ones will help protecting the beach by stabilising it or bringing more sand in the beach stock, respectively.

Methodology

Test Details	Profile Formed	Water Level (m)	Test Length (hrs)	Beach Profile Formed by Test
Plane profile (1:15) shaped manually	P1.0			
P1.0 modified under erosive waves, SLR=0 m	P1.1	4.5	30	
Construct dynamic revetment on profile P1.1, SLR=0 m	P2.1	4.5	8	
P2.1 modified under erosive waves, SLR=0 m	P2.2	4.5	30	
P2.2 modified under erosive waves, SLR=0.2 m	P2.3	4.7	10	
P2.3 modified under erosive waves, SLR=0.4 m	P2.4	4.9	20	
Resilience testing, SLR=0.5 m		4.9	15	

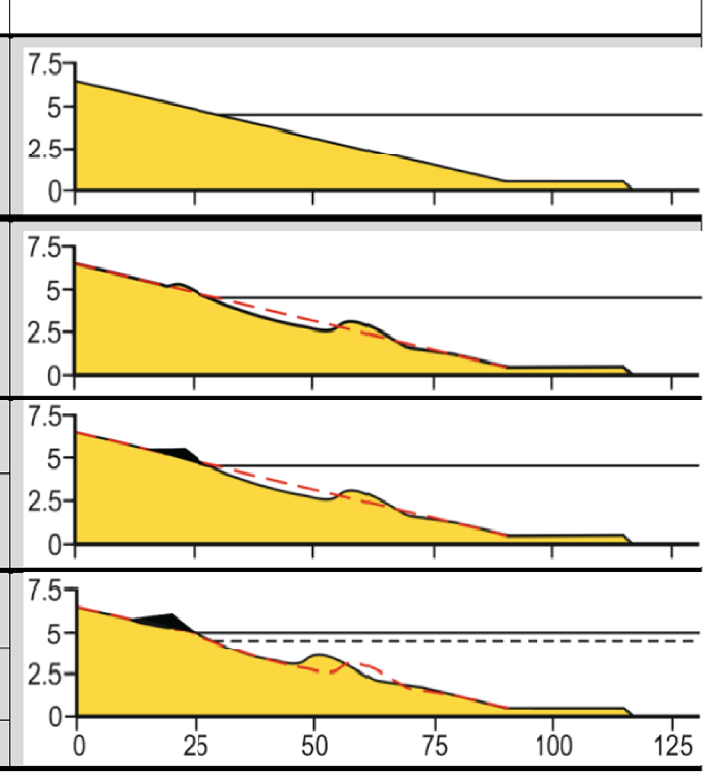


Table 1: Insight of the experimental procedure. The red dashed line represents the previous profile. The black dashed line represents the previous water level. The revetment is colored in dark. [6]

This experiment will assess whether the revetment behaves as hypothesised above. Moreover, this test will provide new data on beach profile evolution under SLR, and show the differential erosion between a protected and non protected beach profile.

The experiment ever undertaken on SLR will take place at the GWK Hydralab+ facility (Figure 4).

Figure 4: Photo of an instrumented beach in the GWK flume. [7]

References

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