Saltmarsh restoration through construction of sedimentation fields: controls on sediment delivery and hydrodynamics

Jonathan Dale[1], Gabriela Ciappara[1], Michelle Farrell[2], Michael Kennedy[2], Cai Ladd[3]

[1] Department of Geography and Environmental Science, University of Reading
[2] Centre for Agroecology, Water and Resilience, Coventry University
[3] Department of Geography, Swansea University

1. Introduction

Sedimentation fields are constructed to encourage saltmarsh growth by decreasing current velocities and wave heights, therefore increasing sedimentation rates.

Little is known about the influence variations in hydrodynamics have on sediment delivery and accumulation.

This is particularly the case for relatively exposed sites with large tidal ranges.

2. Study site

Rumney Great Wharf has a long history of anthropogenic activity including reclamation[1]. Sedimentation fields were constructed using brushwood between 1999 and 2005, creating five polders numbered 1 to 5 (west to east)[2]. Fencing was not maintained or routinely monitored following construction but will be reimplemented in the summer of 2024.

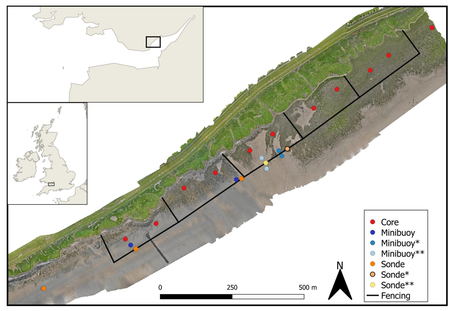

Figure 1: Location of Rumney Great Wharf and equipment deployed during two field campaigns (*summer deployment only, **winter deployment only).

3. Methods

Hydrodynamic measurements

EXO3 Sondes (water depth and suspended particulate matter) and mini buoys[3] (current and wave orbital velocity) were deployed during a summer (15/5/23 to 30/6/23) and winter (31/10/23 to 15/12/23) deployment period.

Marsh platform measurements

Sediment traps were deployed during the summer and winter deployment periods. Sediment cores were collected, and the upper 50 cm analysed for moisture content, organic content, clastic content and bulk density.

Topographic change

Site surveyed using a DJI Mavic 3e sUAS for topographic reconstruction using Structure-from-Motion.

5. Future work

Assessment of topographic change through a second sUAS survey.

Evaluate differences between the saltmarsh properties inside and outside of the polders.

Examine change in hydrodynamics and sediment delivery following reimplementation of the fencing.

4. Results

Sediment availability was greater and less variable between sites during the winter deployment, although accumulation rates were lower. Sediment properties differed between vegetated and unvegetated sites.

Site hydrodynamics

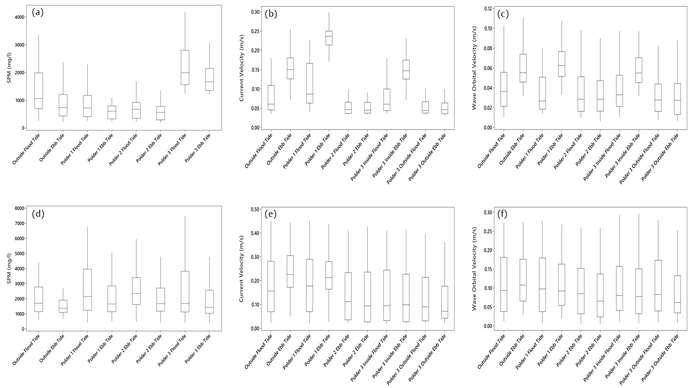

Figure 2: Variation in flood and ebb tide average (left) SPM, (middle) current velocity, and (right) wave orbital velocity from 18/5/23 to 30/6/23 (a-c, top row) and 31/10/23 to 15/12/23 (d-f, bottom row).

Storm Debi – 13/11/2023

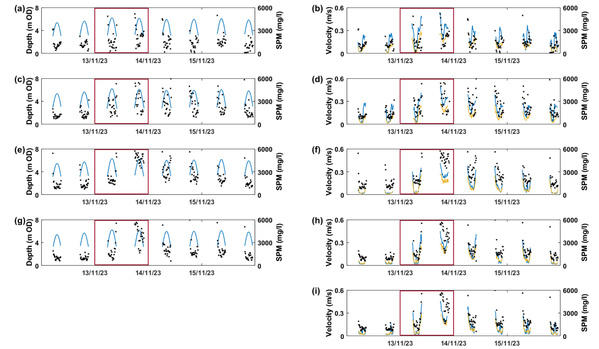

Figure 3: SPM variations in comparison to (left) depth and (right) current velocity (blue line) and wave orbital velocity (yellow line) at (a-b) Outside, (c-d) Polder 1, (e-f) Polder 2, (g-i) Polder 3 during Storm Debi (indicated by the red box).

Sediment accumulation

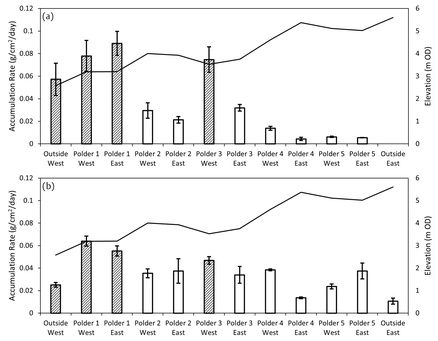

Figure 4: Sediment accumulation rates (n = 5) during the (a) summer and (b) winter deployments at each coring site. Filled bars represent unvegetated mudflat sites, unfilled bars represent vegetated marsh platform sites. Elevation (m OD) of each site is also indicated.

Sediment properties

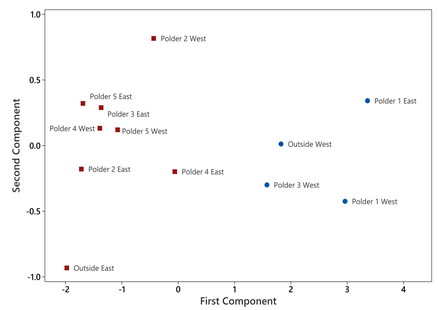

Figure 5: Principal component analysis of difference in sediment properties between each site. Blue circles represent unvegetated mudflat sites, red squares represent vegetated marsh platform sites. The first component explained 92% of the variability (eigenvalue = 3.7), the second component explained 5% of the variability (eigenvalue = 0.2).

Contact information

Jonathan Dale

j.j.dale@reading.ac.uk

Funding

Research was funded by Natural Resources Wales.

References

[1]Allen, J.R.L. and Fulford, M.G., 1986. The Wentlooge level: a Romano-British saltmarsh reclamation in southeast Wales. Britannia, 17, pp.91-117

[2]Armstrong, S., et al., 2021. Rumney Great Wharf Saltmarsh Restoration / Enhancement Feasibility and Preferred Option Studies. Produced by ABPmer for NRW. NRW Evidence Report No: 528, 96pp, NRW, Cardiff

[3]Ladd, C., et al., 2021. The Mini Buoy: a novel hydrodynamics sensor for long-term deployments in coastal wetlands. EGU General Assembly 2021, EGU21-7208.

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