

# Marine Evidence Conference 2024

## Selecting sites for coastal restoration using the 'Mini Buoy'

Dr Cai Ladd | [c.j.t.ladd@swansea.ac.uk](mailto:c.j.t.ladd@swansea.ac.uk)  
Bangor, 28<sup>th</sup> March 2024



University  
of Glasgow



Swansea University  
Prifysgol Abertawe

# Challenge

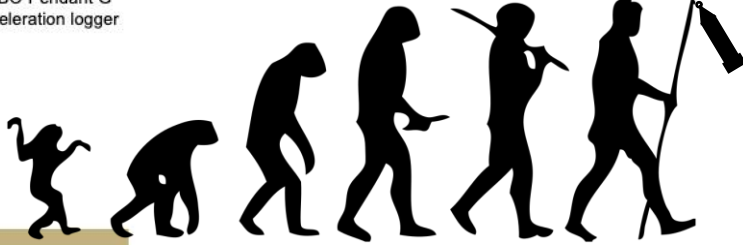
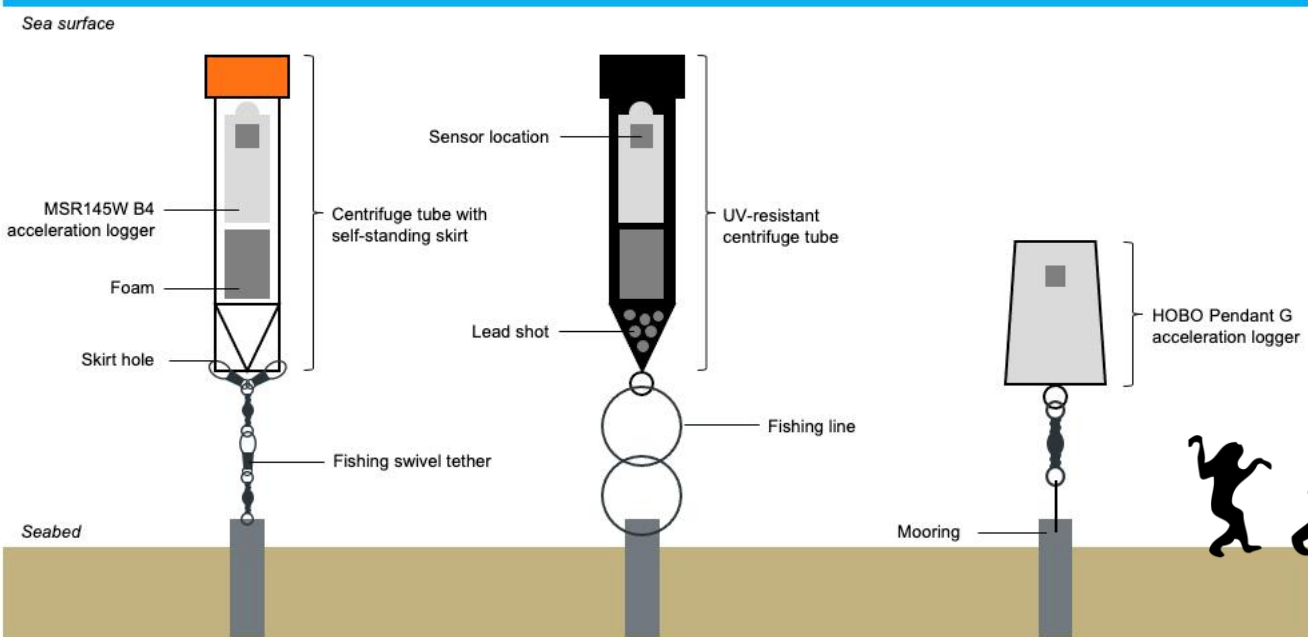
establishing on the intertidal



The  
wrong  
location

The  
wrong  
species

# Concept the B4, B4+, and Pendant Mini Buoys



B4



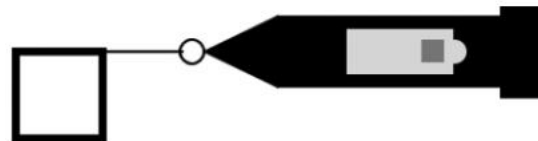
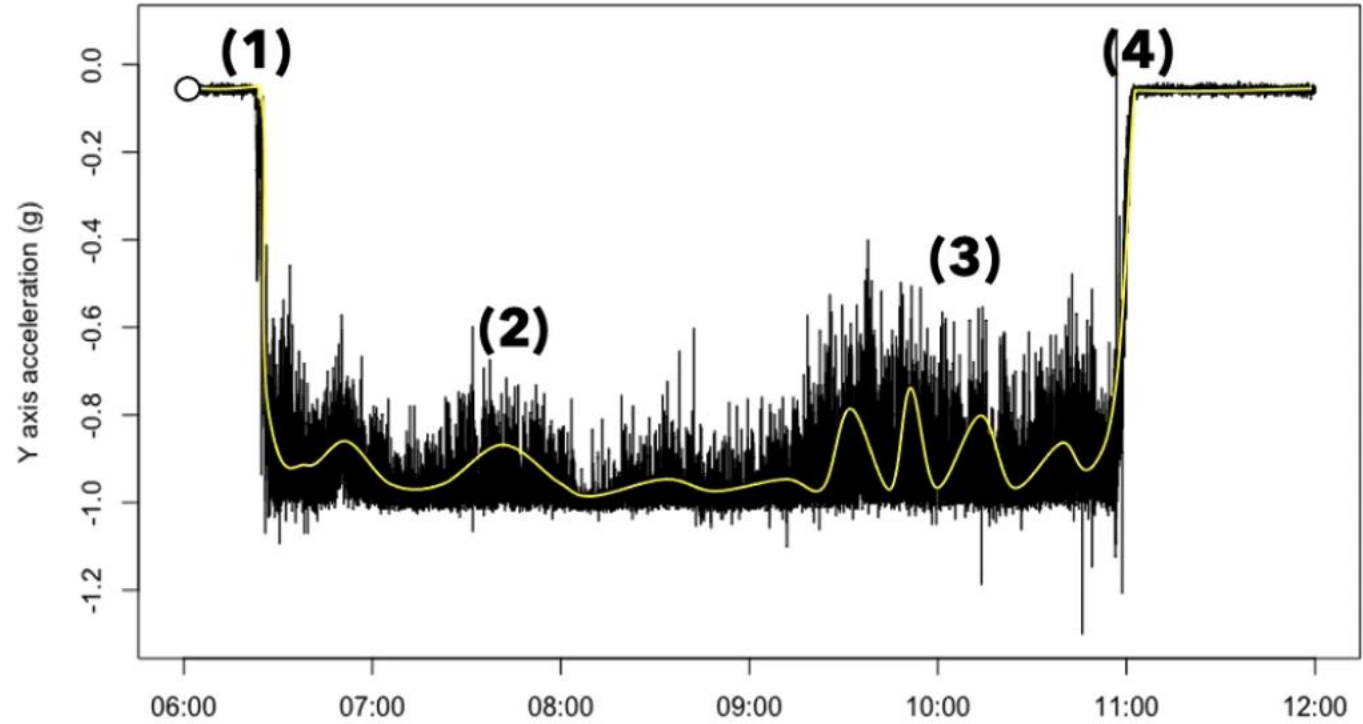
B4+



Pendant

# Concept

- A plastic float, pinned to the ground contains an accelerometer data logger
- Acceleration along the y-axis can be used to interpret the start (1) and end (4) of an **inundation event**
- Persistent dip in acceleration indicates a **current**. The stronger the current, the greater the dip (2)
- Swaying back-and-forth in acceleration indicates a passing **wave**. The greater the variation, the larger the wave (3)

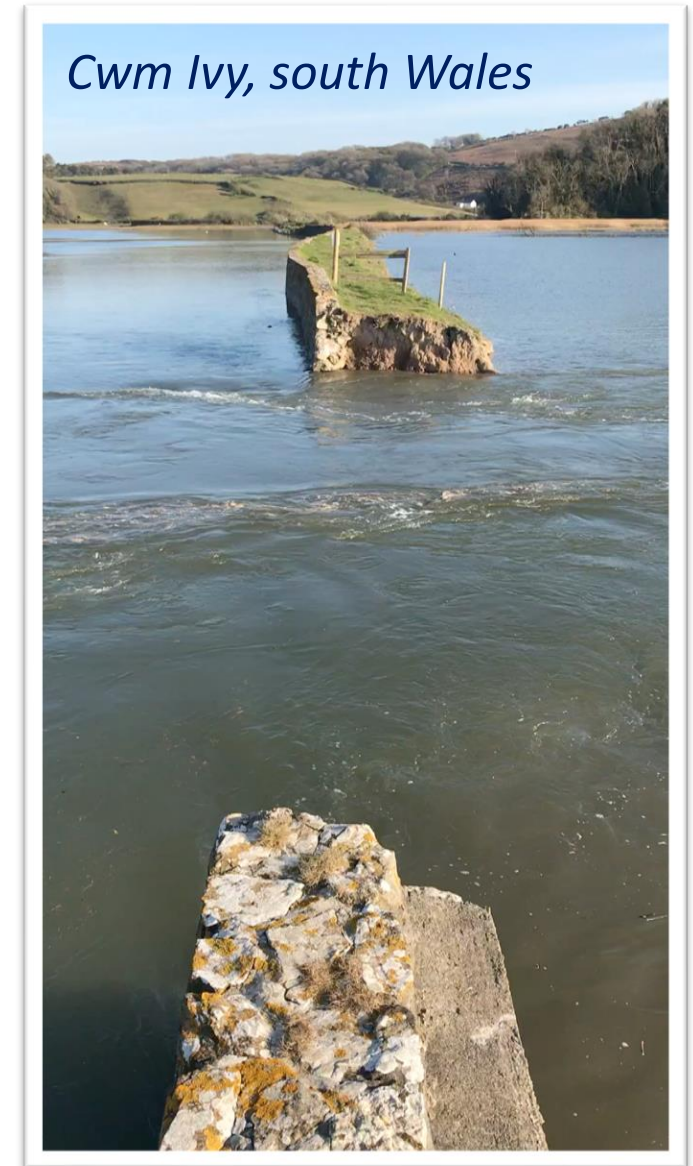
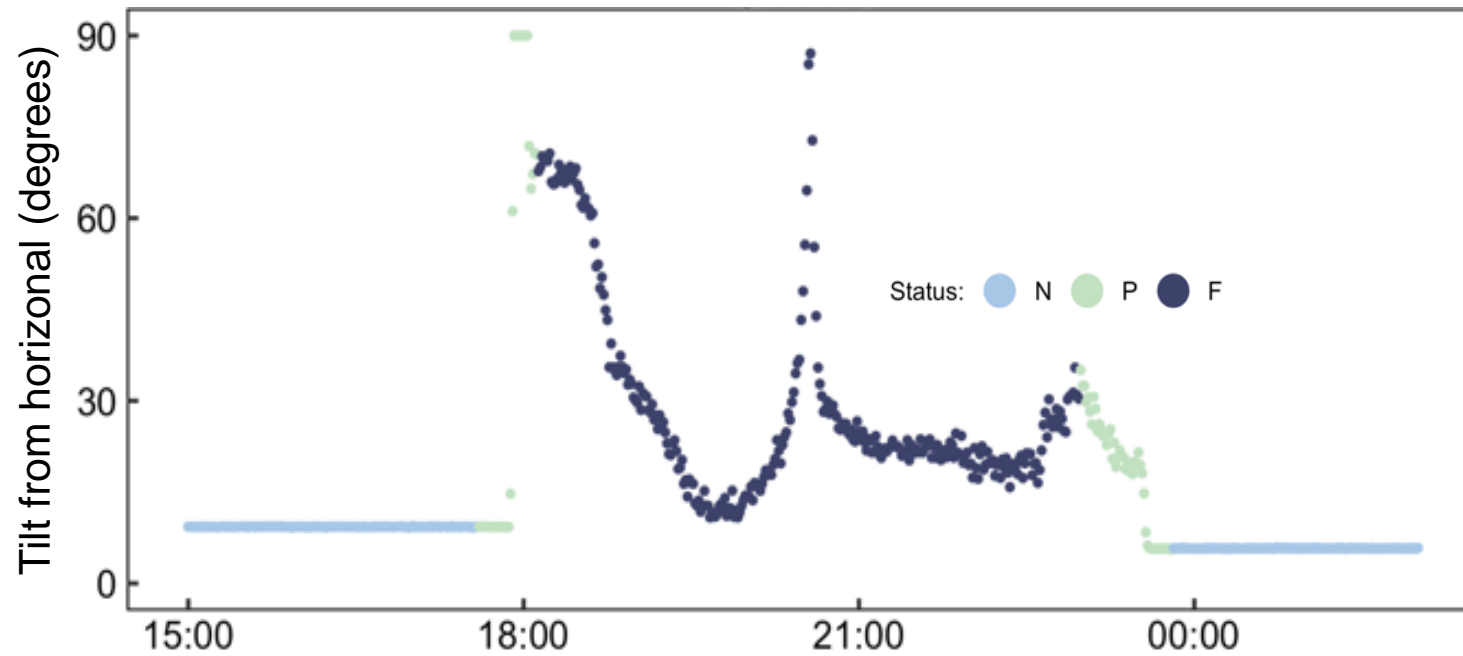




# Calibration

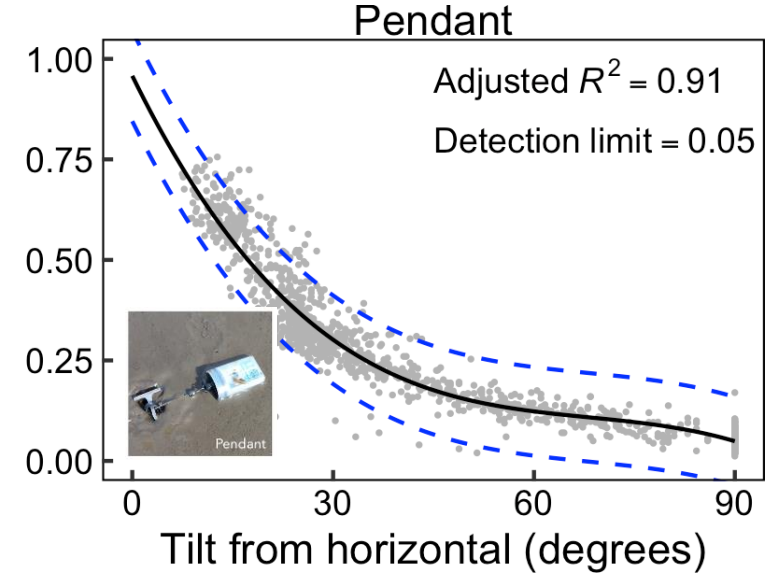
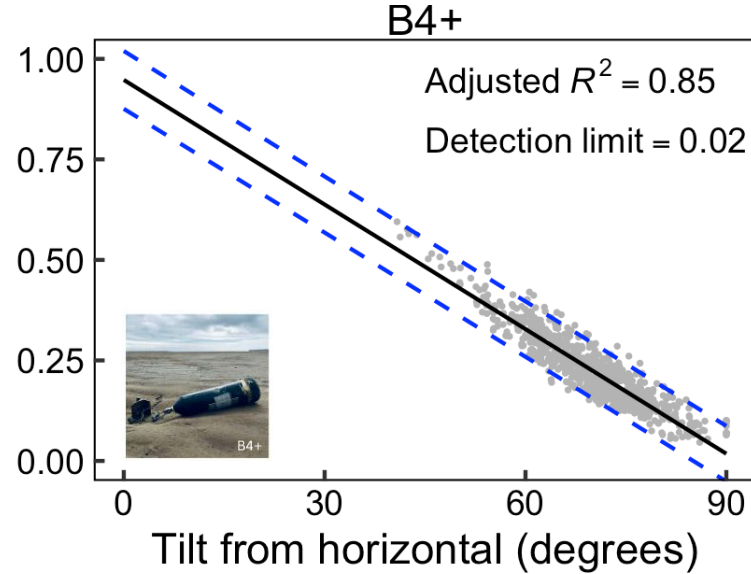
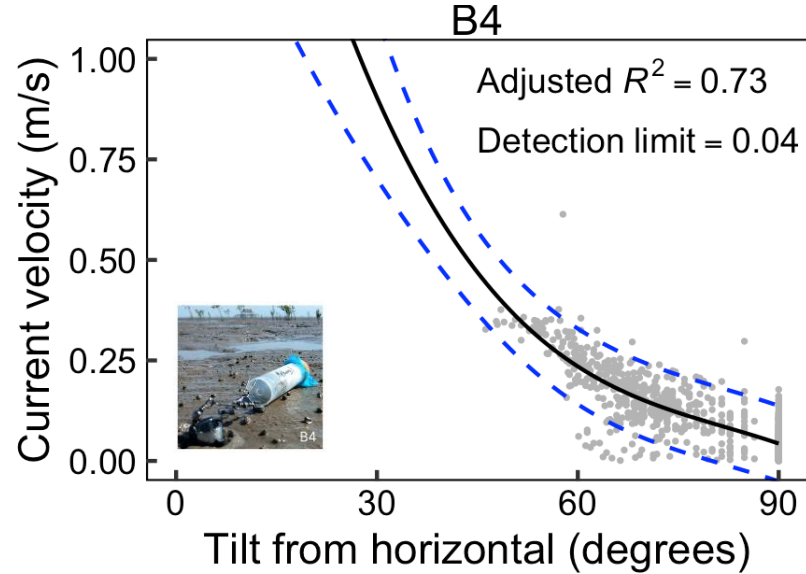
inundation status

- Search for abrupt shifts at start and end of inundation events and classify as **partial** inundation



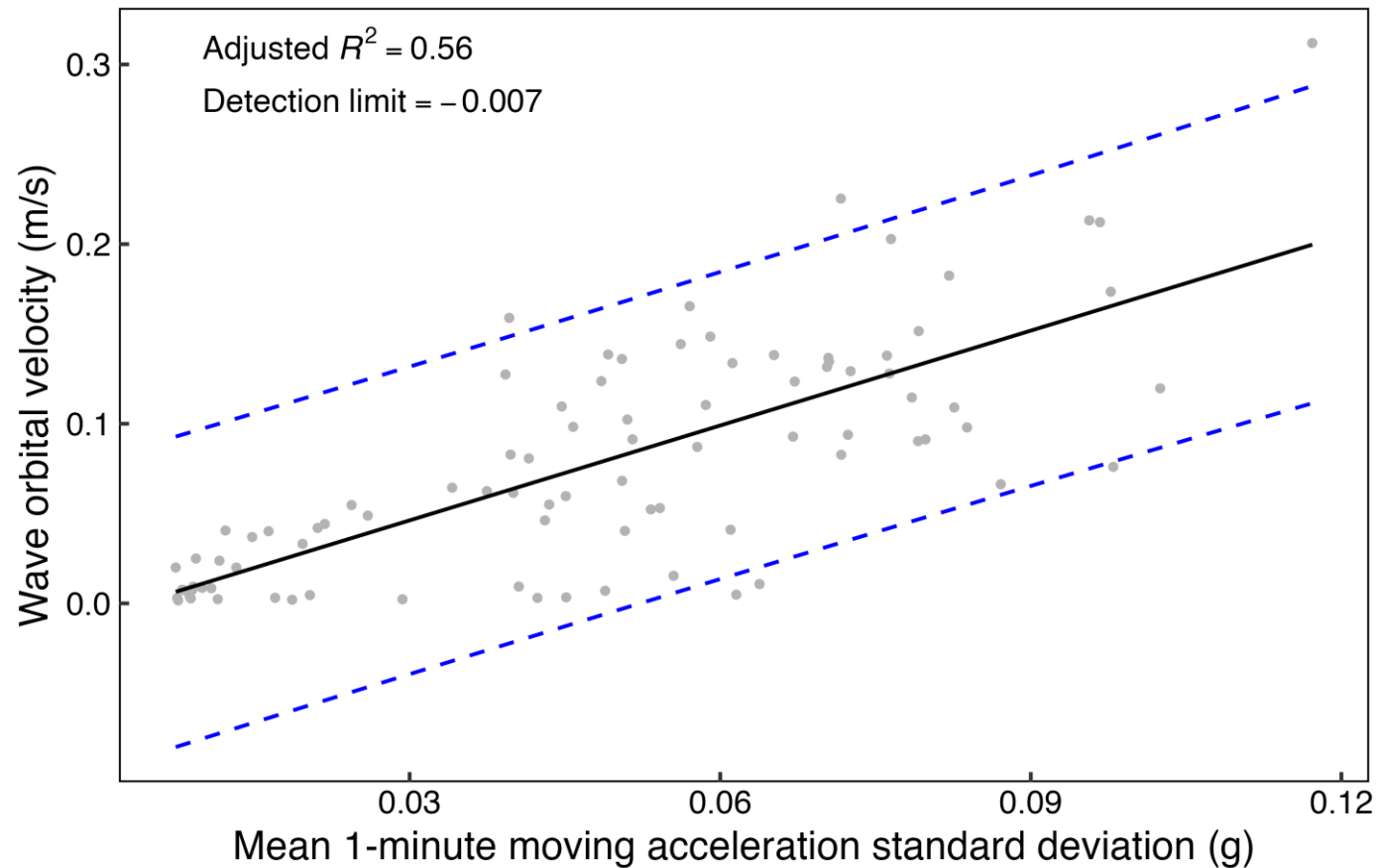
# Calibration current velocity

- Mean **current velocity** against mean y-axis tilt over 1-minute windows



# Calibration wave orbital velocity and significant wave height

- Mean **wave orbital velocity** and **significant wave height** from Wave Directional Spectra analysis of ADV data, and correlated against 1-minute rolling standard deviation of acceleration in 10-minute windows



# Analysis The Mini Buoy App 2.0

The Mini Buoy App

Project: Downloads | Target: Default\_Target | Reference: Default\_Reference

### The Mini Buoy

Mini Buoys are self-assembled research tools for measuring hydrodynamics along shallow coastal settings using drag-tilt technology and globally available materials. Refer to the Mini Buoy Handbook for information on Mini Buoy assembly, deployment, and data analysis.

[Open handbook](#)

This App allows users to analyse Mini Buoy data for comparing inundation duration, current velocity, and wave orbital velocity (the 'B4+' Mini Buoy only) statistics between reference (e.g., established vegetation) and target (e.g., potential restoration area) locations.

#### Inundation duration

#### Current velocity

#### Wave orbital velocity

### Designs

There are three Mini Buoy designs to choose from.

Select a Mini Buoy design to view attributes

B4

The original Mini Buoy design featured in Balke et al. (2021) that contains an MSR145 B4 acceleration data logger inside a self-standing centrifuge tube attached to an anchor via a fishing swivel. The B4 measures inundation duration and current velocity only.

float (3 cm)

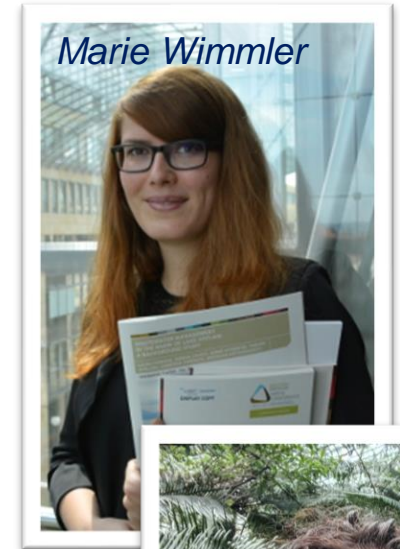
floral foam (3 cm)

skirt hole (0.5 cm)

ground to sensor (15.5 cm)

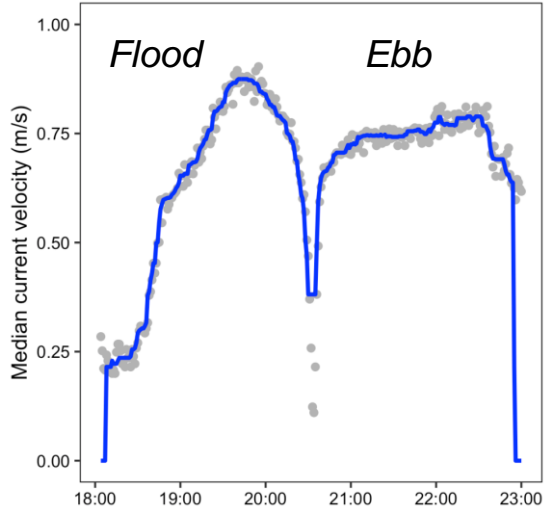
float (13 cm)

tether (5.5 cm)

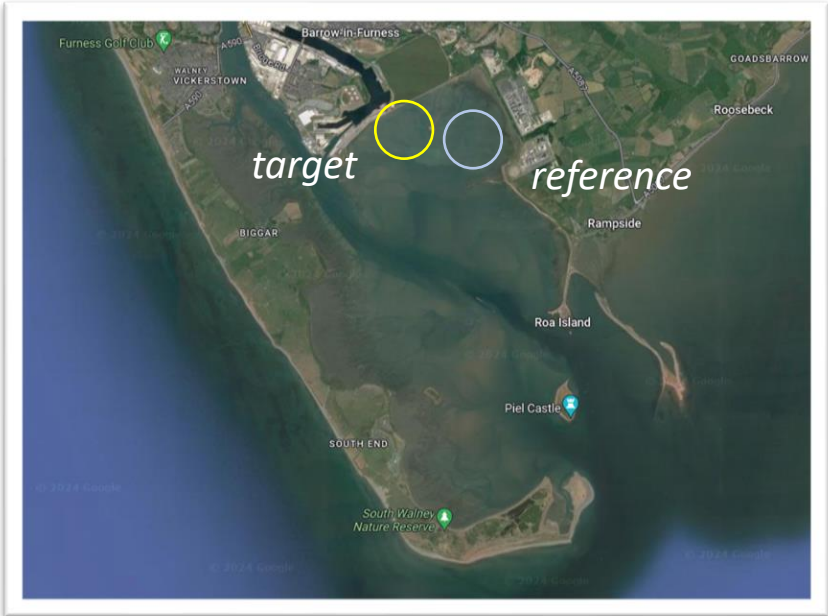




# Application current projects



*Sediment flux to an unmanaged realignment site  
Heidi Burgess + Jonathan Dale*



*Z. Noltii restoration, Barrow-in-Furness  
Cumbria Wildlife Trust*



*Viability of poldering to  
create saltmarsh in the UK  
NRW + Jonathan Dale*

*Geomorphic health of  
Solway Coast habitats  
CLEARcoasts*



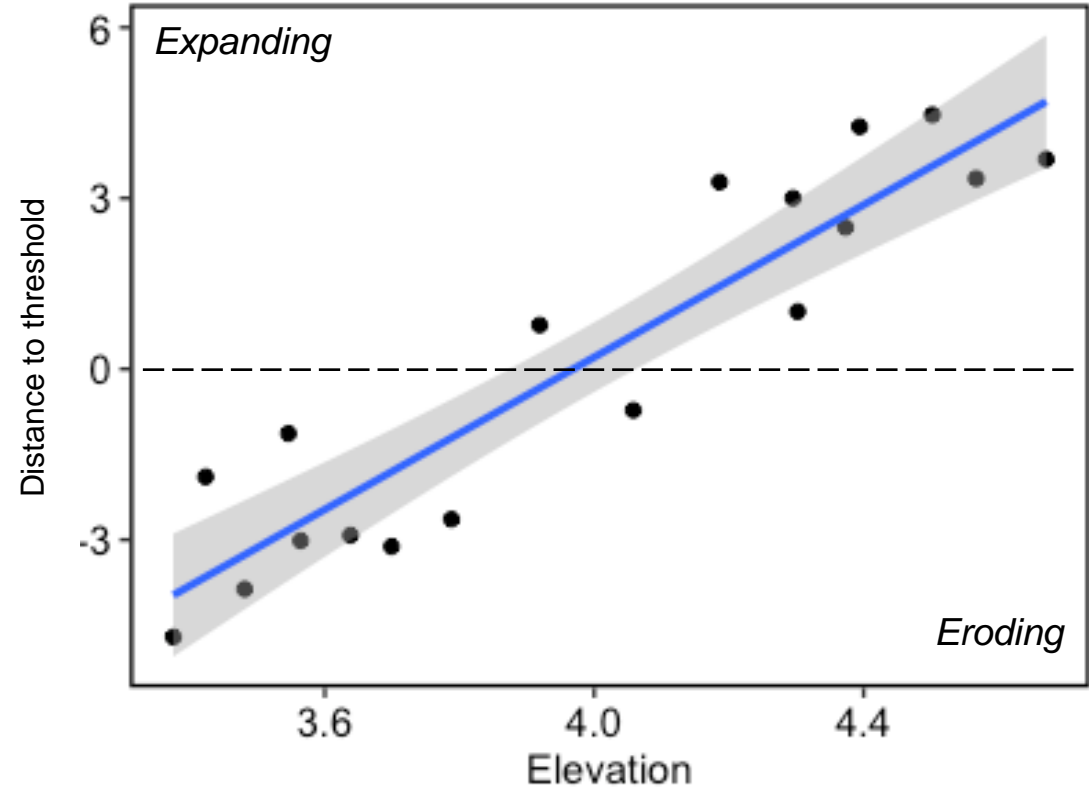
# Application detecting saltmarsh tipping points



# Application

detecting saltmarsh tipping points

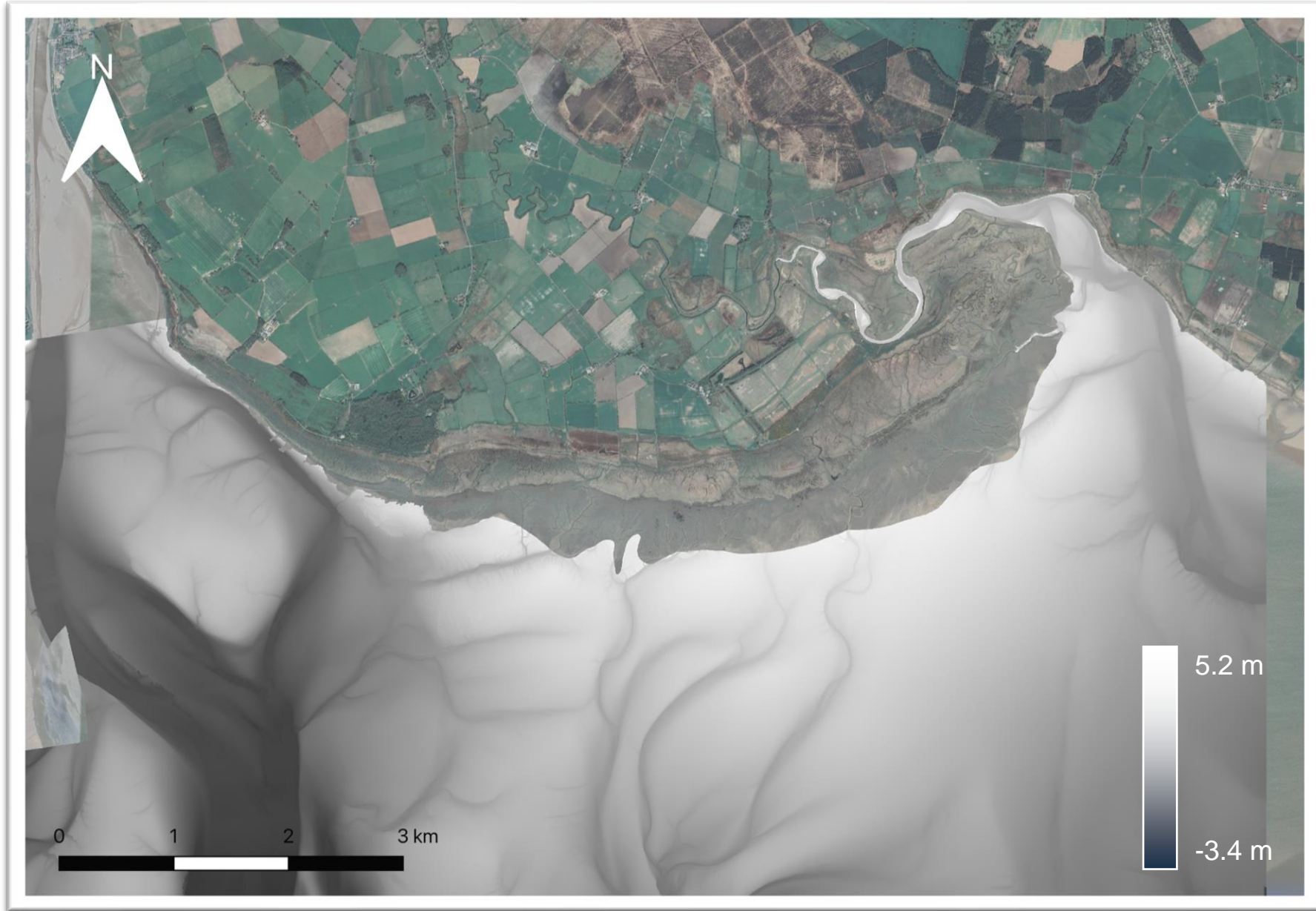
- Distance to the threshold plane positively correlated with **elevation**
- Straight line equation can be used to transform a **Digital Elevation Model** of the tidal flat into D2T values





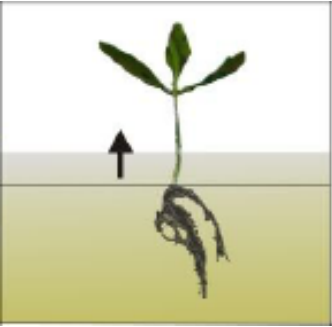
# Application

detecting saltmarsh tipping points

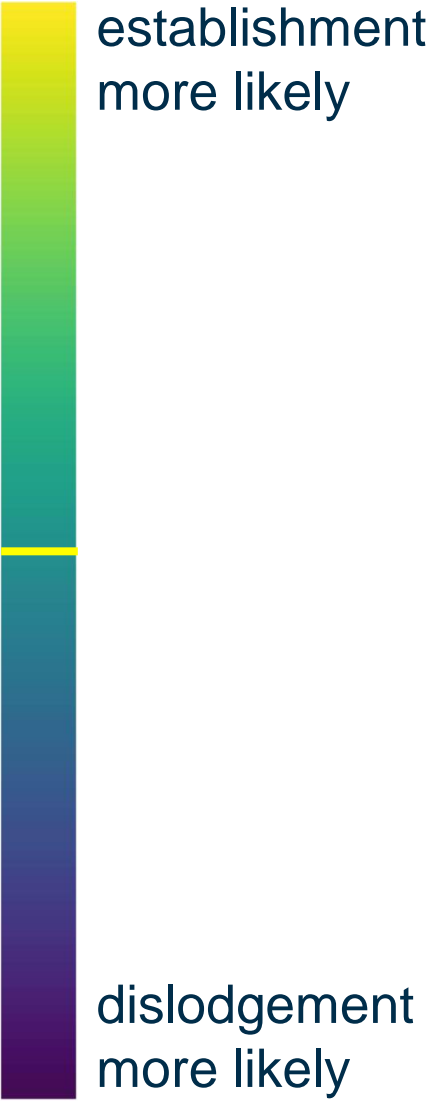
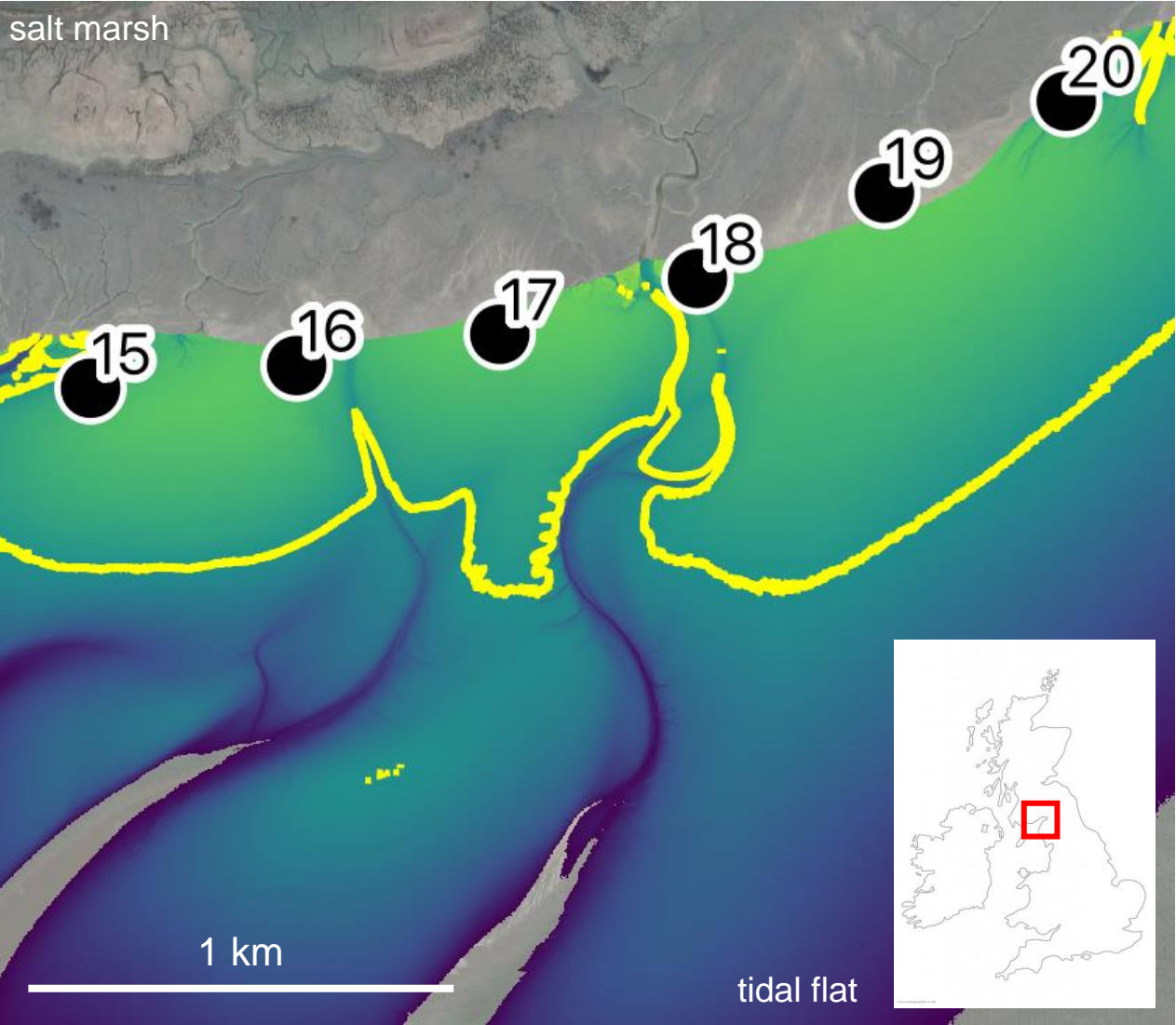
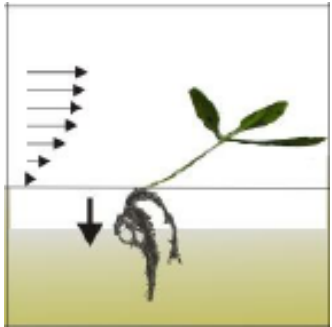




# Application detecting saltmarsh tipping points



tipping point



# Summary

- Mini Buoys are a low-cost and open-source alternative to conventional hydrographic sensors
- Data can be used to predict the likelihood of coastal wetland establishment or erosion
- A valuable tool for community engagement in shaping coastal management planning

*Diolch yn fawr.*

