ESS DTP: Project Proposal for REPs 2019

Project Title: Analysing wave-vegetation-soil interactions in coastal wetlands

Lead Supervisor Details: Dr Ben Evans, Post-doctoral Researcher, Department of Geography

Co-supervisor Details (if applicable): Dr Iris Möller, Lecturer, Department of Geography

Project Description (max 500 words please):

Background: Vegetation growing in the intertidal zone (between tidal low and high water) is increasingly valued for its role in reducing the impact of waves and erosion on shorelines and engineered coastal defences. The role of vegetation in binding sediment together, however, and the potential erosion around vegetation elements during extreme storms due to scour or mechanical action (see Figure 1 below) is complex and currently not well understood. The response of muddy sediment to wave forces is considerably more complex than that of sandy shores. Such sediment is commonly present where salt marsh vegetation grows. In addition to the presence of (partially mobile) biological 'structures' (plants and other organisms) within and on the surface, the complex response is also due to the large silt/clay fractions present and thus the cohesive nature of the sediment involved. Little is known about the types of hydrodynamic conditions that lead to erosion of these coastal features and of the damage salt marsh plants sustain under wave forcing. However, until we have such knowledge, it will not be possible to predict the future of such vegetated shorelines and thus the degree of natural coastal protection that they will provide as sea level rises and the climate changes. These issues are particularly critical in the early stages of establishment and growth of such intertidal plant communities, when a connected plant canopy has not yet formed and the sediment between plants is more exposed.

Figure 1: Examples of intertidal vegetation (at low-densities, plants can cause scour patterns around individual stems) (photos: I Möller)

The Student's Task: A large dataset of wave measurements, digital images of soil surfaces around plant arrangements, and sediment samples was collected during the summer of 2018. This yielded high-quality digital images 'before' and 'after' exposure of the soil around various different plant species and arrangements in a large wave flume experiment (see Figure 2) for separate wave conditions of increasing magnitude, as well as data from the field in the UK.

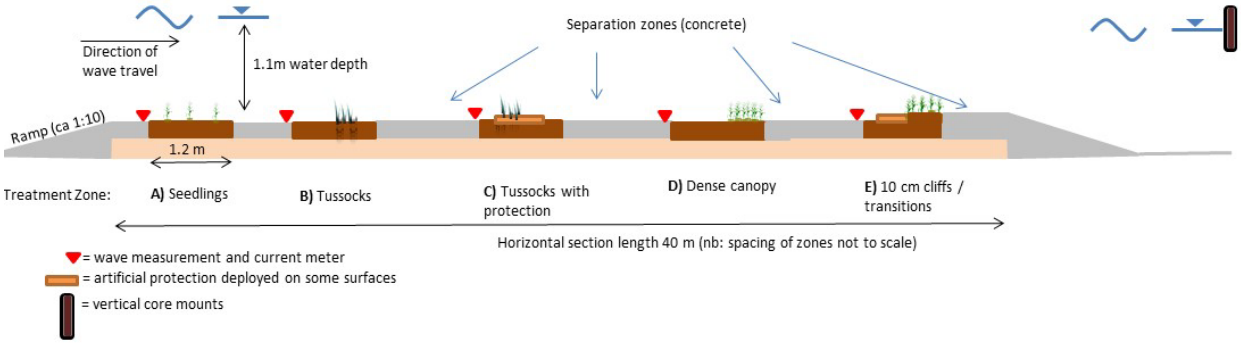

Figure 2: General setup of five experimental test sections and vertical core mount locations on cross-flume steel bar (nb: not to scale; zones A/B and C/D were swapped between wave runs 8 and 9)

Soil surface images were processed into 3D digital surface models using structure-from-motion (SFM) techniques (see Figure 3 and supoprting information below).

Depending on the student's background and interest, s/he will be working with this unique dataset under the close supervision of the project Postgraduate Researcher, Dr Ben Evans, to conduct analysis of wave records and/or produce a series of quantitative measures of erosion and accretion patterns extracted from the SFM-based digital surface change detection to inform the project's question of how (and to what extent) erosion processes taking place. There is also the possibility to assist with fieldwork and laboratory analysis.

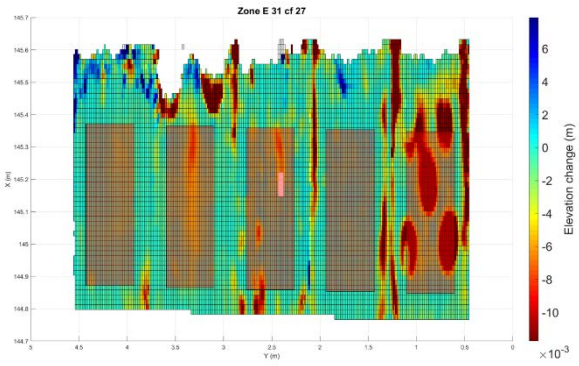

Figure 3: Example of changes in surface elevation within five adjacent experimental soil surfaces in which different plant species were present at the time of exposure to wave conditions (left-right: across-flume; bottom-top: direction of wave travel along the flume; colour key indicates patterns of erosion (red) to accretion (blue))

Project Restrictions (please note any restrictions here):
Programming skills in Matlab (preferable), Python or 'R', and a good understanding of multi-variate statistics, as well as a working knowledge of standard spreadsheet and word processing software are essential. The internship would need to start on or after 24th July and end round 18th September.

Students must meet all of the following criteria. The student must:

- Be studying for a degree in a quantitative discipline outside of NERC's scientific remit (e.g. mathematics, statistics, computing, engineering, physics)
- ***Be applying for a placement in a different department to their undergraduate degree***
- Be undertaking their first degree studies (or integrated Masters)
- Be expected to obtain a first or upper second class UK honours degree or equivalent
- ***Be eligible for subsequent NERC PhD funding (UK, EU or right to remain in the UK)***

Links to relevant supporting information:

The experiment during which the data for this project was collected is outlined here:

www.thesaltmarshexperiment.org

www.nerc-resist.uk

Funding

The REPs programme is funded by the Natural Environment Research Council. **The REP will be a 6-8 week placement at minimum wage and REPs recipients will be paid as employees, with the level of remuneration being equal to the National Living Wage.**

Ideally the candidate would undertake the placement from 24 July – 18 September. If the candidate starts before 8 July 2019 there would be a break from 8-23 July during which the supervisors are unavailable.

To apply please send a CV to the lead supervisor (Dr Ben Evans, bre24@cam.ac.uk) as soon as possible.