University of Glasgow

14th - 15th May 2019

15th UK YCSEC

Young Coastal Scientists and Engineers Conference

Conference Programme & Abstracts

ycsec2019.wordpress.com

#YCSEC2019

Sponsors

We would like to thank the following sponsors for their support towards the 15th Young Coastal Scientists and Engineers Conference:

YCSEC Steering Committee

Alistair Borthwick	(The University of Edinburgh)
Chris Blenkinsopp	(University of Bath)
Dan Conley	(University of Plymouth)
Jenny Brown	(National Oceanography Centre)
Nick Dodd	(The University of Nottingham)
Richard Simons	(UCL)
Robert Nicholls	(University of Southampton)
Suzana Ilic	(Lancaster University)


DHI IS ONE OF THE INVENTORS OF COMPUTATIONAL HYDRAULICS.
Our globally renowned MIKE software represents nearly 50 years of continuous development, offering the widest possible range of water modelling applications with unparalleled integration and performance.
mike.uk@dhigroup.com
+44 (0)2380 381961
www.mikepoweredbydhi.com
DHI are the first people you should call when you have a tough challenge to solve in a water environment.
In the world of water, our knowledge is second-to-none, and we strive to make it globally accessible to clients and partners.
So whether you need to save water, share it fairly, improve its quality, quantify its impact or manage its flow, we can help. Our knowledge, combined with our team's expertise and the power of our technology, hold the key to unlocking the right solution.
© DHI / Photo: © Mark Bailes, DHI
The expert in WATER ENVIRONMENTS
DHI

General Information

Getting to Glasgow

Airports

Glasgow International Airport is 7 miles west of the University with direct flight connections to all major European hubs, plus North America and the Middle East. First Bus service (77) connects the West End of Glasgow and the airport. The Glasgow Airport Express bus service connects the city centre and the airport. Taxi fare from the airport to the West End costs approximately £21. From the city centre to the West End costs approximately £8. Glasgow Prestwick Airport and Edinburgh International Airport are also within serviceable transport distance of the city and University.

Coaches

Buchanan Bus Station is the main terminus for long distance coaches and is close to Buchanan Street subway station. Timetables at www.travelinescotland.com

Trains

Intercity links to all major cities. There are two city-centre terminals, Glasgow Queen St and Glasgow Central (served by Buchanan St and St Enoch subway stations respectively). Frequent services to Edinburgh (50 minutes) and London (5 hours). Timetables at www.travelinescotland.com

Road

Motorway links provide access to major UK cities. Visit Google Maps for maps and directions.

Car Parking

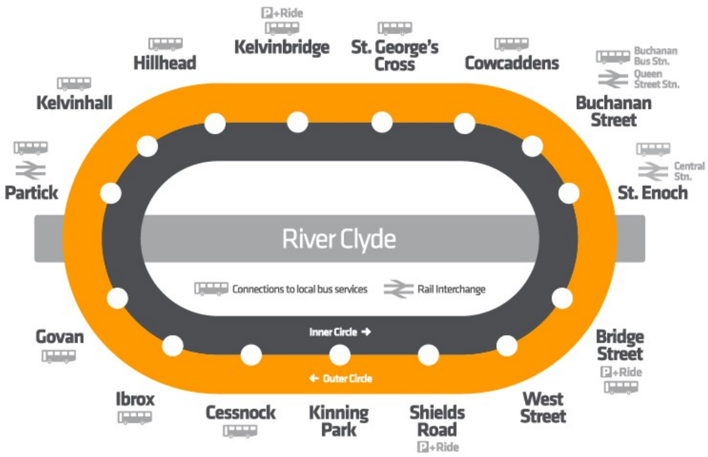
On campus parking is limited to permit holders. Car parking in the areas around the campus is extremely difficult. There are various pay & display parking spaces around the local Byres Road and Kelvin Way areas but spaces are limited. You may want to consider using the city's Subway Park & Ride scheme. This service costs around £5 and Kelvinbridge subway station has parking which is only 5 minutes walk away.

Getting Around the City

Glasgow is a very compact city and easy to get around on foot. Most delegates will be able to walk from their hotel to the University or any social events.

The city has a very efficient public transport system. The best way to get from the City Centre to the University is via the subway. The nearest stations are Kelvinbridge and Hillhead.

http://www.spt.co.uk/subway/

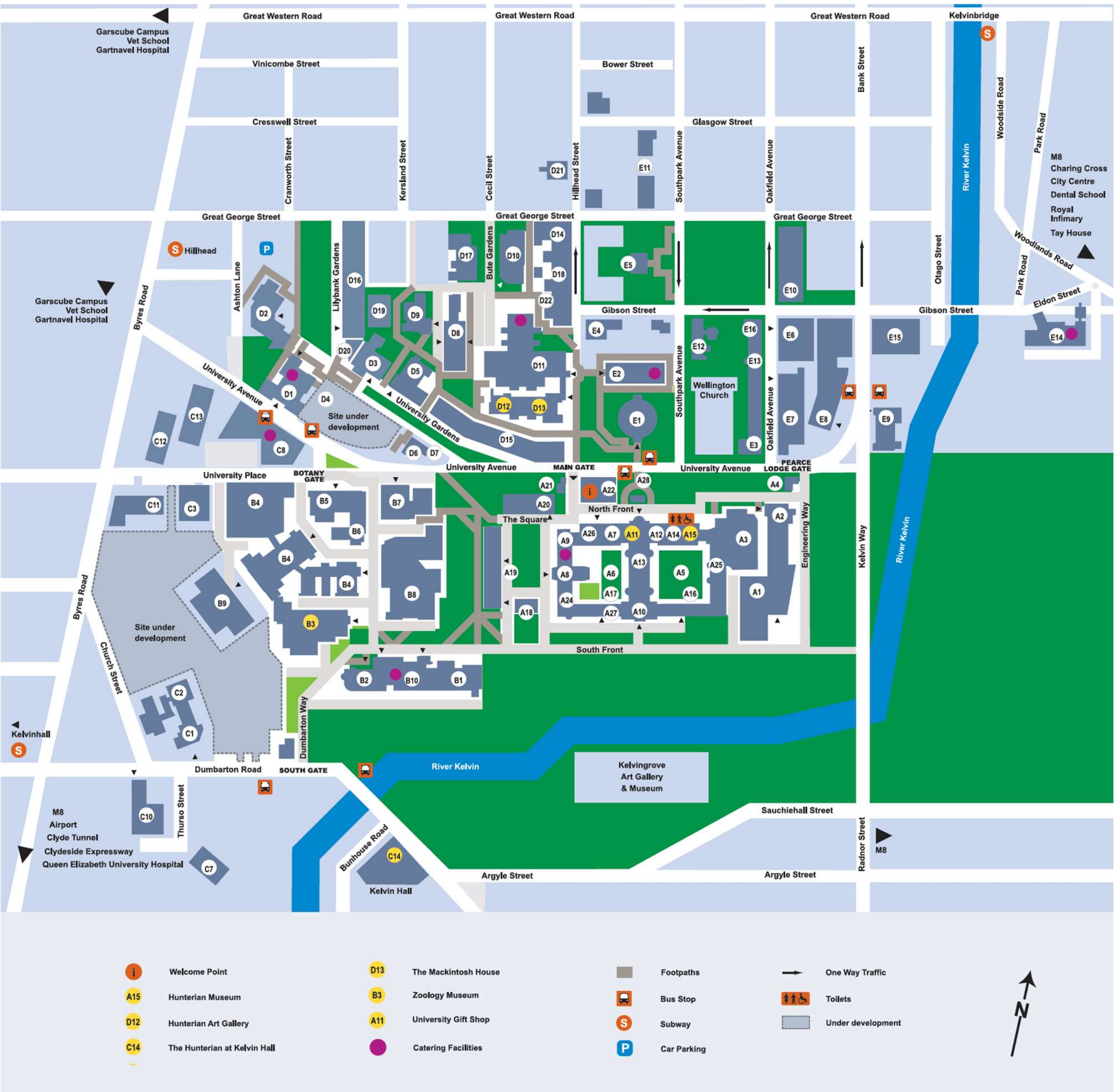


Glasgow's cycle hire scheme, Next Bikes, is a cost effective, green and healthy way for delegates to get around the city. Bikes are available to hire from various locations around the city, including the Scottish Event Campus (SEC).

Taxis in Glasgow are the most cost effective in the UK.

Gilmorehill Campus Map

The University moved from High Street to Gilmorehill in 1870. The campus was originally centred around the buildings erected on the top of the hill, designed by George Gilbert Scott. During the 20th century it spread out to the north of University Avenue where important buildings such as the MacMillan Reading Room (1940; E1 on campus map), the Modern Languages Building (1959; D10), ;Library (1968; D11) and Boyd Orr Building (1972; D1) were built amidst the Victorian terraces and town houses that have been acquired over the decades to accommodate departments and offices.



Conference activities take place in Main Building, adjacent to the East Quadrangle (A5) in the School of Geographical and Earth Sciences (A25). The reception and dinner take place in One A, The Square (A9).

Conference Information

Conference Location

The conference takes place in the School of Geographical and Earth Sciences (A25 on campus map), adjacent to the East Quadrangle (A5) of Main Building on the Gilmorehill Campus. Oral presentations take place in the East Quad Lecture Theatre next to the main entrance into the School. Poster presentations will take place in Rm 412. Sign posts for these locations will be displayed throughout the conference.

Registration Information

The conference registration desk is located in Rm 412, on the 4th floor of the East Quadrangle. The registration desk will be open from 08:30 each morning on Tuesday 14th and Wednesday 15th May. Please follow sign-posts from the entrance to the School of Geographical and Earth Sciences in the East Quad.

Oral Presentations - Please upload your presentation at the registration desk on the morning of your talk.

Poster Presentations - Posters are displayed in Rm 412 and will be displayed throughout the conference. Please mount your poster to the board allocated according to your poster number. Dedicated times have been allocated when the authors will be present at their posters for questions and discussion. We encourage all delegates to be proactive with poster presentations.

Meals and refreshments

Regular refreshment breaks will be held in Rm 412 throughout the duration of the conference and buffet lunches will also be served here.

Conference Dinner and Drinks Reception

A drinks reception, sponsored by Xylem Analytics UK, followed by dinner will take place on the evening of Tuesday 14th May at 17:30. Both events will be held at One A The Square (A9 on campus map). This will be followed by a Keynote by Dr. Larissa Naylor from the University of Glasgow back in the East Quad Lecture Theatre.

Awards

There will be prizes for best poster presentation and best oral presentation, judged by the steering committee. Awards will be presented alongside closing remarks on the final day of the conference.

Conference Schedule

Tuesday 14th May 2019

09:30 - 10:30	**Registration and Coffee**	
10:30 - 10:45	**Welcome and Housekeeping**	
Session 1 10:45 – 12:15	Boscia, D	Dynamics and transport of sand mixtures in oscillatory flows
	Karakas, K	Flow and Scour Around Round Head Vertical Wall Break-water Under Random Waves
	Chen, F	A numerical model for iceberg calving generated waves
	Mortimer, W	Experimental investigation of extreme wave run-up on a monopile coastal structure.
	Bayle, P	Scale comparison of morphological changes in laboratory flume experiment in response to increasing water level
	Poster Introductions	
12:30 – 14:00	**Lunch and Posters**	
Session 2 14:00 – 15:00	Lyddon, C	Increased coastal wave hazard generated by differential wind and wave direction in hyper-tidal estuaries
	Ma, Q	The impact of a tidal barrage on storm surge in the Severn Estuary
	Kreitmair, M	Uncertainty Quantification for Tidal Power in the Pentland Firth
	Rowett, C	The future of the Isles of Scilly: Flood risk in 2116
15:00 – 16:00	**Coffee and Posters**	
Session 3 16:00 – 17:15	Hall, A	3D Printed Artificial Reefs in the Atlantic Region (3DPARE)
	MacArthur, M	Enhancing the ecological value of coastal infrastructure
	Chirol, C	Towards science-based environmental engineering: design and evolution of creek networks in restored saltmarshes
	Argemi, M	The effect of mechanical stimulation on plant traits expres-sions: implications for ecosystem engineering capacity of biogeomorphic systems
	Neshamar, O	Hydrodynamics of large-amplitude oscillatory flows through cylinder arrays
17:30 – 19:30	**Drinks Reception and Dinner**	
19:30 – 20:30	**Keynote Lecture: Dr. Larissa Naylor, University of Glasgow**	

Conference Schedule

Wednesday 15th May 2019

08:30 – 09:00	**Welcome**	
09:00 – 09:30	**Keynote Lecture, Dr. Douglas Pender, JBA Consulting**	
Session 4 09:30 – 10:30	Gilchrist, C	Cell 1 Regional Coastal Monitoring Programme: Subtidal Sediment Microplastic Baseline
	Godfrey, S	Monitoring Coastal Morphology: The potential of action cameras for accurate 3D reconstruction
	Hart, J	CoastSnap Bournemouth: How can citizen science extract useful coastal data?
	Eichentopf, S	Equilibrium beach profile evolution from varying initial beach morphologies in large-scale experiments
10:30 – 11:00	**Coffee and Posters**	
11:00 – 11:30	**Keynote Lecture, Dr. Alistair Rennie, Scottish Natural Heritage**	
Session 5 11:30 – 12:30	Chen, C	The effect and evolution of a shoreface nourishment
	Beylard, B	Modelling of beach evolution at Norfolk coast, UK, under storm-conditions
	Coyle, J	Morphodynamic modelling of a barrier island recharge scheme: A case study in South Ford, Benbecula
	Muir, F	Prediction of coastal evolution in Scotland: Process-driven modelling driven by climate change across decadal timescales
12:30 – 13:30	**Lunch and Posters**	
Session 6 13:30 – 15:00	Seenath, A	Effects of nearshore spatial discretisation on modelling shoreline change
	Matsoukis, C	Investigating the influence of freshwater discharge on deltaic systems
	Gözlet, M	The Coastal Circulation Model of Büyük Menderes River and Adjacent Coastal Areas
	Lofthouse, E	Predicting the effects of thermal discharges in UK transitional and coastal waters – the importance of long-term hydrodynamic model simulations
	Bingol, C	Calibration of Wavewatch III under extreme conditions in eastern Mediterranean and Aegean sea
	Clee, S	2D and 3D Modelling of Offshore Sandbank Dynamics
15:00 – 15:15	**Short break and packing up**	
15:15 – 15:30	**Prize giving and Meeting Close**	

Poster Presentations

Poster	Lead Author	Title
P1	Sofia Aldabet	Quantifying spatial patterns of coastal risk in England
P2	Danielle Buchanan	Boulder transport trajectories over a winter season on an intertidal shore platform, UK.
P3	Clementine Chirol	3D visualisation of soil structure in UK saltmarshes under different sediment and vegetation types using X-Ray CT
P4	Alice Hall	Incorporating Ecological Enhancement into a new Coastal Protection Scheme: Runswick Bay, N Yorkshire
P5	Hannah Otton	Stonehaven Erosion Study
P6	Benjamin Phillips	COVE: A new vector based gravel barrier evolution model
P7	Marie Schlenker	Scoping study: The impact of climate change and coastal hazards on the Solomon Islands
P8	Jennifer Shadrick	Quantifying millennial-scale coastal erosion rates using 10Be CRN analysis and numerical models for the UK - new findings of a decelerating coastline in SW England.
P9	Olivia Shears	Investigating the role of small-scale bio-physical linkages in erosion processes at salt marsh margins

Conference Abstracts

Key Note Speakers

Dr. Larissa Naylor
Reader in the School of Geographical and Earth Sciences
University of Glasgow

**Seaside tales from rock pools to seawalls:
tips on making blue skies science relevant to societal problems**

As academic coastal scientists we are increasingly tasked with the challenge of delivering high quality academic 'blue skies' research which is world leading and that the same time, increasingly being encouraged to deliver societal impact. Fortunately for those of us at this conference coastal zone management issues are increasing rather than decreasing - and thus demand for blue skies science and science that underpins policy and practical management decisions continues to grow. Questions spring to mind: How can academic scientists successfully deliver high quality research and high quality impact? How can we make our seemingly esoteric science relevant to society? How can we use applied projects to help us answer blue skies questions? This keynote talk draws on over 20 years of experience of navigating the coastal science-policy-practice interface where my work has helped deliver changes in engineering practice on the ground, is actively shaping policies in Scotland, England and Wales and has been cited in the Intergovernmental Panel on Climate Change. I'll focus on how rock coast biogeomorphology science can help deliver improved multifunctionality of coastal assets and nature-based flood and storm alleviation and how geomorphology science is crucial to better predicting and managing the risks of climate change. More practically, I'll provide you with some tips and ideas for helping to navigate the science-policy-practice interface drawing on experience of working with concrete manufacturers, build contractors, design engineers and government agencies.

Dr. Douglas Pender
Senior Engineer in the Marine and Coastal Risk Management Group
JBA Consulting

Advances in Coastal Management

The climate is changing, research is continually advancing, but what are we as practitioners doing to make sure that these are incorporated into decision making? Over the last few years there have been significant step changes in the way that we analyse and model coastal processes within the UK. To demonstrate and discuss these recent advances, key topics and issues will be presented, providing an overview of the coastal management in the UK. Current techniques employed to solve specific problems in Modelling; Sediment Management; and Engineering will be presented. This will be followed by an outline of the potential future direction of the industry, in response to recent changes in requirements and advances in research.

Dr. Alistair Rennie
Dynamic Coast Project Manager
Scottish Government / Scottish Natural Heritage

How early career scientists are safeguarding Scotland's future:
a view from a beach near you.

Climate change is climbing up the public agenda and some may think, with the arrival of Greta Thunberg, that the influence of young people is a recent addition to the science / policy space. However, early career researchers have had a significant contribution in science and policy application for many years. The recent Dynamic Coast project is a case in point. A small research team, composed of early researchers alongside more experienced staff has revolutionised the understanding of coastal change in Scotland. It has challenged and overturned decades-old assumptions, updated scientific baselines, and supported a transformation in our ability to remain resilient at the coast: our greatest adaptational challenges are coastal. This has been possible due to modest research grants (hundreds of thousands of pounds) and a small core team, serving a wider group of policy makers and practitioners. Whilst the challenges we face are growing and increasingly focused and our scientific understanding has never been so great, the real challenge (early career or not) is to make our science applicable in as effective a way as possible. With the emergence and uptake of cloud computing, AI, EO, automated analysis, modelling and GIS (all skill sets familiar to early career researchers) the stage is set for everyone in this room to deliver the fit-for-purpose change intelligence to allow our decision-makers and politicians to move decisively toward enhanced resilience for our coast and coastal communities.

Conference Abstracts

Oral Presenters

Poster P1

Quantifying spatial patterns of coastal risk in England

Sofia Aldabet[1], Eli Lazarus[1] & Robert Nicholls[2]

[1]Environmental Dynamics Lab, School of Geography and Environmental Science, University of Southampton, Southampton, SO17 1BJ, UK
(S.AldabetMunoz@soton.ac.uk; E.D.Lazarus@soton.ac.uk)
[2]School of Engineering, University of Southampton, Southampton, SO17 1BJ, UK
(R.J.Nicholls@soton.ac.uk)

As the effects of sea-level rise and storm impacts become more severe, dependence on effective coastal protection and environmental management is intensifying. However, recent studies have suggested the emergence of a counterproductive, if unintentional, relationship between hazard defences and intensified development of housing and infrastructure that those defences are intended to protect. This phenomenon, known as the "safe development paradox", increases risk and the potential for catastrophic damage from disaster events, especially in vulnerable coastal zones. In the UK, despite its long legacy of coastal defences, flooding and coastal change have been identified as the most critical climate-driven risks in the country. In addition, sustained development behind coastal defences contributes to increasing the vulnerability to flooding and erosion, especially in a context in which the maintenance of many of these structures is economically unviable. To better understand spatial correlations between coastal hazard, development, and defences, we use Geographic Information Systems (GIS) techniques to examine publicly available national datasets and quantify spatial patterns of climate-driven coastal risks in England.

Tuesday Session 3

The effect of mechanical stimulation on plant traits expressions: implications for ecosystem engineering capacity of biogeomorphic systems

Argemi, M.[1] & Balke, T.[1]

[1]School of Geographical and Earth Sciences, University of Glasgow, G12 8QQ, UK
(m.argemi-cierco.1@research.gla.ac.uk; Thorsten.Balke@glasgow.ac.uk)

The structure and function of fluvial and coastal ecosystems (so-called “biogeomorphic ecosystems”) are driven by feedbacks between vegetation, physical disturbances and sediment dynamics. In salt marshes for example, the capacity of attenuating waves and capturing sediment depends on the specific plant morphological and mechanical properties, such as height and stiffness, which are, in turn, shaped by the physical environment. Differences in plant morphology such as a reduced size and increased stem diameter, have been observed in the field in plants exposed to hydrodynamic and wind forcing. However, most of the experimental research concerning thigmomorphogenesis (i.e. plant adaptations to mechanical stress) have been traditionally addressed from a physiological point of view using terrestrial and freshwater vegetation.

This research aims to understand how mechanical stimulation induce adaptive morphological traits on plants that, in turn, can influence their engineering properties. This has been experimentally quantified by actively bending (Fig 1a) three typical pioneer species of brackish marshes (*Bolboschoenus maritimus*), riparian floodplains (*Salix alba*) and salt marshes (*Salicornia europaea*). Additionally, brushing stimuli (Fig 1b) was also applied to *Salicornia* seedlings. Plant length and stem diameter were measured throughout the experiments and above and below-ground biomass were assessed after harvesting.

All species tested showed a significant shoot length reduction under both, bending and brushing stimuli. However, significant differences on stem diameter, above and below-ground biomass, were just observed for the species subjected to brushing stimulation.

These preliminary findings reveal the complexity of thigmomorphogenesis and the technical challenges of an experimental approach. Results also suggest that thigmomorphogenetic responses may be of general importance across biogeomorphic ecosystems and that altered trait expressions may feed back to ecosystem engineering capacity of plants, such as flow obstruction and sediment retention.

a) b)

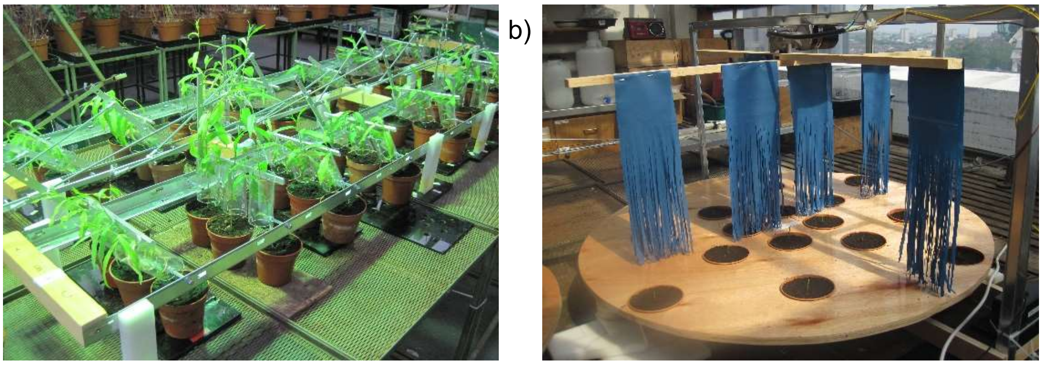


Figure 1 – Bending (a) and brushing (b) machines used to induce thigmomorphogenetic responses under controlled conditions.

Tuesday Session 1

Flow and Scour Around Round Head Vertical Wall Breakwater Under Random Waves

Cüneyt Baykal[1] & Kadir Karakaş[1]

[1]Middle East Technical University, Ankara, 06800, Turkey
(cbaykal@metu.edu.tr; karakas.kadir@metu.edu.tr)

Wave induced flow and scour around round head vertical wall breakwater are investigated via physical models. Physical model tests were performed in irregular wave flume which has 26.9m length, 6.0m width, 1.0m depth where is located in Ocean Engineering Research Centre, METU. At the beginning of the study, experiment setup was prepared in a 1.5m wide inner compartment that has glass walls at both sides. Experimental setup can be seen below in Figure 1. In order to find suitable waves to be used in the experiments, wave selection has done in the flume without the breakwater model. Appropriate waves were selected according to Keulegan-Carpenter Number and wave steepness. In order to obtain those waves, 9 wave gauges were placed through the flume and Acoustic Doppler Velocimeter were installed at the exact location where the structure will be placed. Flow investigation experiments were performed with a *B=6cm* wide and *l=9B=54cm* long round head acrylic made structure that fixed on the false bottom. The velocity distribution data were obtained by the velocity measurements taken at certain distances from tip of the structure. In scour experiments, false bottom will be removed and $d_{50}=0.2mm$ sand will filled up between inlet and outlet slopes. Morphological changes around the structure due to random waves will be measured by laser bed scanner. Hence, results will be compared with initial bed situation and after scour process. Additionally, scour formation will be recorded by the underwater camcorders.

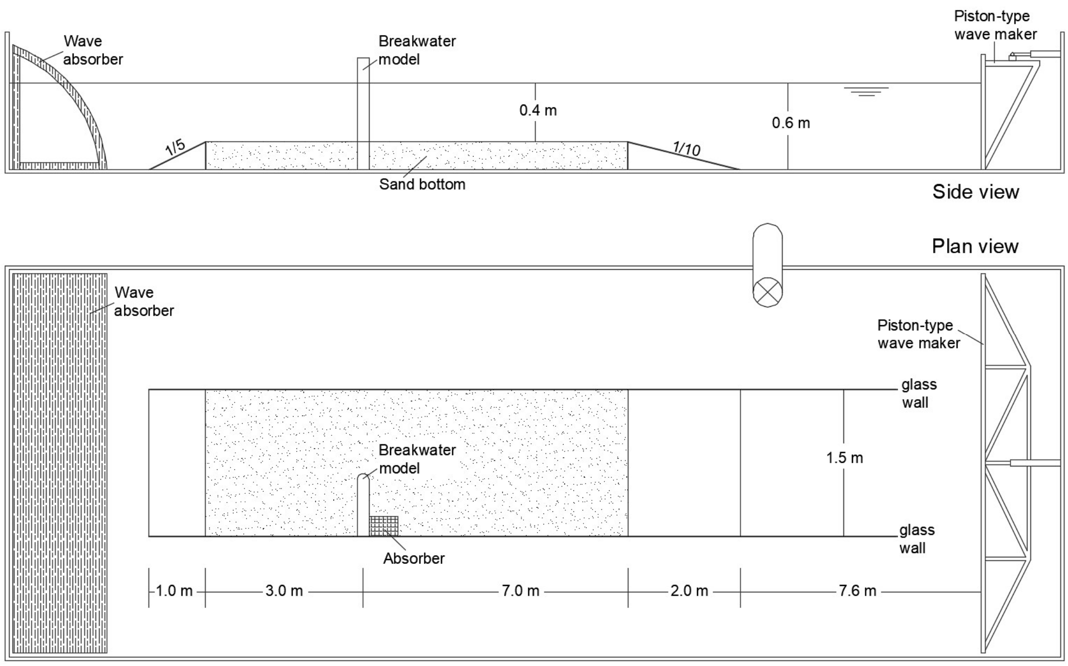


Figure 1 – Experimental Setup (not scaled)

Tuesday Session 1

Scale comparison of morphological changes in laboratory flume experiment in response to increasing water level

P.M. Bayle[1], T. Beuzen[2], C.E. Blenkinsopp[1], I.L. Turner[2], T.E. Baldock[3]

[1]University of Bath, Water Environment and Infrastructure Resilience; p.m.bayle@bath.ac.uk

[2]Water Research Laboratory, UNSW Sydney, NSW, Australia

[3]School of Civil Engineering, University of Queensland, QL, Australia

Three laboratory wave flume experiments investigating sandy beach profile development were undertaken across 3 different scales. The DynaRev (DR) large scale experiment was undertaken in GWK flume, Germany. The beach was built with a planar slope of 1/15 and was composed of sand with a D_{50} = 0.33 mm. The standard wave conditions gave a Dean's (or Gourlay) number of 3.38, and a wave steepness of 0.014. A small scale version of this experiment was run in the University of Queensland flume (UQ), using the same sand diameter, planar slope and Dean's number, but a wave steepness of 0.076. The last experiment was produced in the small scale flume of the Water Research Laboratory, at the University of New South Wales (UNSW). Although the same sand size was used, the starting slope was 1/10, the Dean's number was 3.00 and the wave steepness was 0.060. This work is to investigate methods for scaling the results of experiments investigating beach morphology under erosive conditions. Froude scaling was not satisfied between any of these experiments. All the experiments were run long enough to consider the profile to approach equilibrium. The obtained profiles at the end the respective experiment tests are compared using a novel dimensionless scaling factor given as:

$$x' = \frac{x^* \sin\beta}{R_{2\%}};\ x' = \frac{z^* \cos\beta}{R_{2\%}}$$

With $R_{2\%}$ being the elevation exceeded by 2% of runup events, β the beach slope, x and z the current experimental coordinate and x' and z' the new dimensionless coordinate. All experiments lead to erosion, similar surf zone shape (double bar system) and similar elevation of the inner and outer bar. The accreted berms differ in both their position and elevation (Fig 1a).

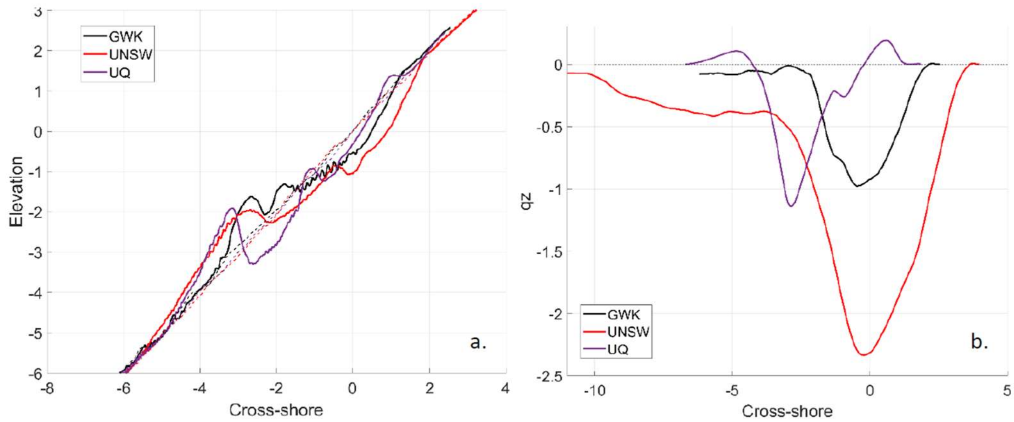


Figure 1: Comparison of the 3 different experiments, with respect to: (a) developed profile approaching equilibrium. The origin corresponds to the original shoreline for each profile; (b) cumulative sediment transport.

Experiments with the same Dean’s number shows similar magnitude of sediment transport (figure 1.b). It seems that wave steepness drives the magnitude of change, hence the position of the bars and trough relative to the shoreline.

Wednesday Session 5

Modelling of beach evolution at Norfolk coast, UK, under storm-conditions

Benjamin Beylard[1] & Shunqi Pan[1]

[1]School of Engineering, University of Cardiff, CF24 3AA, United Kingdom
(beylardb@cardiff.ac.uk)

Due to global climate change effects, extreme events are expected to become more frequent in the near future. In recent decades, beach nourishments have been increasingly used in the UK and worldwide, protecting successfully coastal populations and infrastructures against severe storm surges. Inspired by the “Zand-motor” in the Netherland, the sand-scaping project at the Bacton gas terminal along the east coast of the UK is the biggest nourishment ever implemented in the country with more than 1.5 million m^3 of sand. It has been designed to act as both feeder and permanent mega-nourishment types. Accurately predicting the impact of nourished material on beach morphology is the key for successful projects. However, the mixed sediment transport dynamics involved in the nourishment projects is yet to be fully understood and accurately modelled at the scheme scales.

This paper describes a novel engineering method to deal with mixed sediment, which is implemented in a process-based model Coast2D and its applications to the nourished beach along the Norfolk coast of the UK. The model is applied to the sandscaping project at the Bacton gas terminal (6 km by 2 km domain) under selected storm conditions. The nourished sediments used are coarser from the natives (350 μm) by a factor of 1.5 (i.e. D_{50} = 525 μm). The results show that the proposed algorithm for mixed sediment transport is capable of correctly predicting morphological changes at the site.

Wednesday Session 6

Calibration of Wavewatch III under extreme conditions in eastern Mediterranean and Aegean sea

Cem Bingol[1] & Gulizar Ozyurt Tarakcioglu[1]
[1]Middle East Technical University, Ankara, 06800, Turkey
(ccembingol@gmail.com)

Previous studies on calibration and validation for third generation wave models in Aegean Sea used buoy data from Poseidon network around Greek islands. The complex orography of Aegean Sea and existence of islands demands higher spatial resolution in modelling the region. However, even if higher resolutions are utilized (~0.05°), depth of Poseidon buoys are under 20m and it is not easily possible to obtain these depths with a spatial resolution that is applicable for calibration. However, model results at similar depths are required to make an accurate comparison to buoy data for effective calibration. For eastern Mediterranean, the available long-term buoy data is very limited.

In this study, we are introducing data from three buoys operated by Turkish General Directorate of Meteorology (MGM) since March 2015 in addition to the data from Poseidon network. Two of MGM buoys are located in Eastern Mediterranean, which gives us the chance to make calibration for eastern Mediterranean Sea. One of MGM Buoy at the Aegean Sea is located at deeper location (70m depth) which provides healthier calibration in Aegean Sea. This presentation will discuss the improvement of the performance of Wavewatch III focusing on January 2018 Storm and December 2016 Storm events.

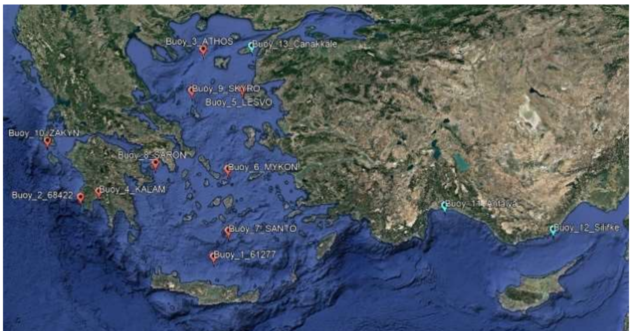


Figure 1: Buoy Locations. (Red Pin: Poseidon Buoy) (Blue Pin: New MGM Buoys)

Tuesday Session 1

Dynamics and transport of sand mixtures in oscillatory flows

Davide Boscia[1], Dominic A. van der A[1], Tom O`Donoghue[1]
School of Engineering, University of Aberdeen[1], Aberdeen, AB243FX, UK
(davide.boscia@abdn.ac.uk)

Large-scale coastal morphodynamic models used to predict seabed changes rely on parametrizations of the underlying small-scale sand transport processes driven by waves. Existing models are primarily based on experiments involving single-size sands. However, natural coasts consist of mixture of sediments, for which the single-size assumption does not necessarily hold. The overall aim of this work is to increase fundamental understanding of the transport of sediment mixtures under waves and to develop an engineering model capable of predicting wave-driven transport of sediment mixtures.

Experiments have been carried out in the Aberdeen Oscillatory Flow Tunnel (AOFT), a large laboratory facility capable of generating full-scale oscillatory flows over sand beds. The experiments involve seven sand mixtures, obtained by mixing fine ("F", d_{50}=0.17mm) and coarse ("C", d_{50}=0.61mm) sand, in the following proportions: 100%(F):0%(C), 90:10; 75:25; 50:50; 25:75; 10:90, 0:100. The flow conditions involved three velocity-skewed oscillatory flows, with flow period T=6s and peak velocity of 1.5m/s, 1.0m/s, 0.5m/s. Flow velocity was measured using LDA and bed morphology using a custom-built laser-camera system. Total and fractional net transport rates were determined from the pre– and post-test bed morphologies.

Figure 1 shows the measured bed morphology for the seven beds under the 0.5m/s flow. The bed is seen to progress from strong 2D ripples to flat-bed as the sand bed changes from 100%C to 100%F. The presentation will discuss the mixture effects on the bed morphology and the net sand transport rates, and comparison of the measurements with prediction using the SANTOSS practical sand transport model.

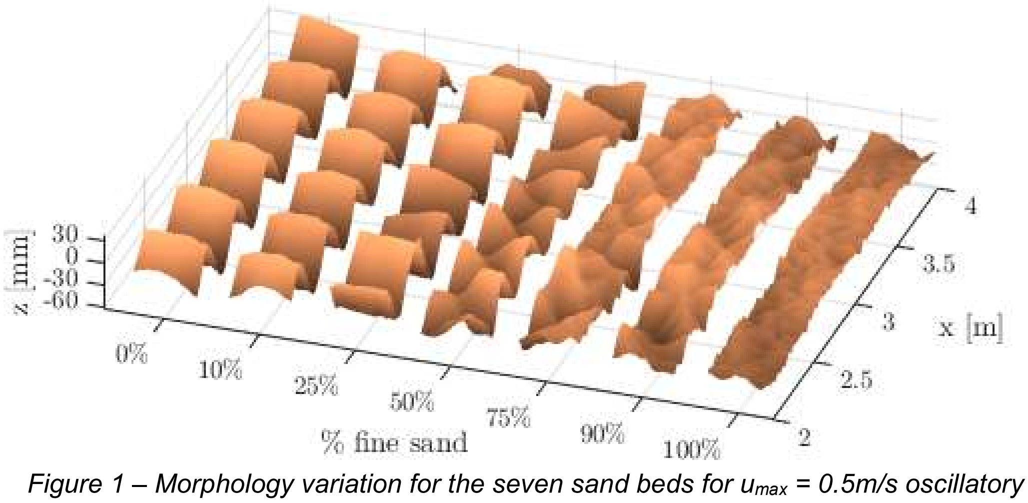


Figure 1 – Morphology variation for the seven sand beds for u_{max} = 0.5m/s oscillatory flow. x-axis correspond to the longitudinal axis of the AOFT test section.

Poster P2

Boulder transport trajectories over a winter season on an inter-tidal shore platform, UK.

Danielle H Buchanan[1], Larissa A Naylor[2], Martin D Hurst[2] & Wayne J Stephenson[3]
[1]University of Plymouth, Plymouth, PL4 8AA, England.
(Danielle.Buchanan@plymouth.ac.uk)
[2]University of Glasgow, Glasgow, G12 8QQ, Scotland.
(Larissa.Naylor@glasgow.ac.uk; Martin.Hurst@glasgow.ac.uk)
[3]University of Otago, Dunedin, 9016, New Zealand
(Wayne.Stephenson@otago.ac.nz)

Recent studies have demonstrated that on rock coasts, significant changes can take place during single storm events or storm seasons, but a detailed understanding of processes and rates of rock coast evolution remains enigmatic. Defined by the geological structure of the source, blocks are liberated from shore platforms, cliff-erosion, and off-shore sources, and are subsequently transported along the coast. Topographic variations in the surfaces of shore platforms create a geomorphic barrier, limiting boulder transport, and over time results in the accumulation of cobble to boulder-sized material. However, we have a limited understanding of boulder dynamics on platforms, due to a limited number of field studies. In this study we tracked the transport trajectories of 160 clasts over the winter season (November 2017 - March 2018) from two adjacent boulder accumulations, using a ‘tag and trace’ technique on the Glamorgan Coast. Over the winter season, 112 boulders were relocated, and of these, 93 boulders were transported primarily in an SE direction, both within and between the two boulder accumulations. Observational evidence of unmoved clasts suggested entrainment to some degree, whereby boulders were rotated, overturned, or flipped. The overall results demonstrated a complex interplay of dynamics between wave forcing and the morphological properties influencing transport, for example, the pre-transport boulder setting (e.g. micro-topographical variations, boulder orientation, and positioning). Ultimately, boulder traps are highly dynamic and complex zones on intertidal shore platforms.

Figure 1 – Boulder accumulation and monitored boulders over the winter season, Glamorgan Coast, UK.

Tuesday Session 1

A numerical model for iceberg calving generated waves

Fan Chen, Valentin Heller & Riccardo Briganti
Environmental Fluid Mechanics and Geoprocesses Research Group,
Faculty of Engineering, University of Nottingham, NG7 2RD, UK
(Fan.Chen@nottingham.ac.uk)

When icebergs calve into water, large tsunamis can be generated. This phenomenon has been highlighted in a number of recent studies as a threat for the fishing and shipping industries and coastal communities. Examples in Greenland include a tsunami generated by a capsizing iceberg in 1995 damaging a harbour and a 50 m amplitude wave recorded during an iceberg calving event at the Eqip Sermia glacier in 2014.

This work aims to numerically model the generation and propagation of such iceberg-tsunamis. This involves handling large displacements of icebergs in the computational domain which is resolved by using the Immersed Boundary Method (IBM). In the IBM the surface of the iceberg is represented by cells in a fixed Euler mesh such that the mesh remains fixed during the movement of the body. The original multiphase flow solver relying on the IBM in the open source code Foam-extend 4.0 has been modified to handle moving immersed boundaries, and it was then coupled with a motion solver to determine the iceberg motion.

This method is validated with own large-scale iceberg-tsunami tests from a HYDRALAB+ test campaign conducted in a 50 m × 50 m wave basin (Fig. 1a, b). These validation tests involve a falling (Fig. 1) and an overturning iceberg. The results show that the numerical iceberg motion and tsunamis generally agree with the laboratory observations. Further, the presented model can capture the laboratory wave heights and decay well. Future work will consider turbulence and simulate buoyancy-driven iceberg calving as well as capsizing.

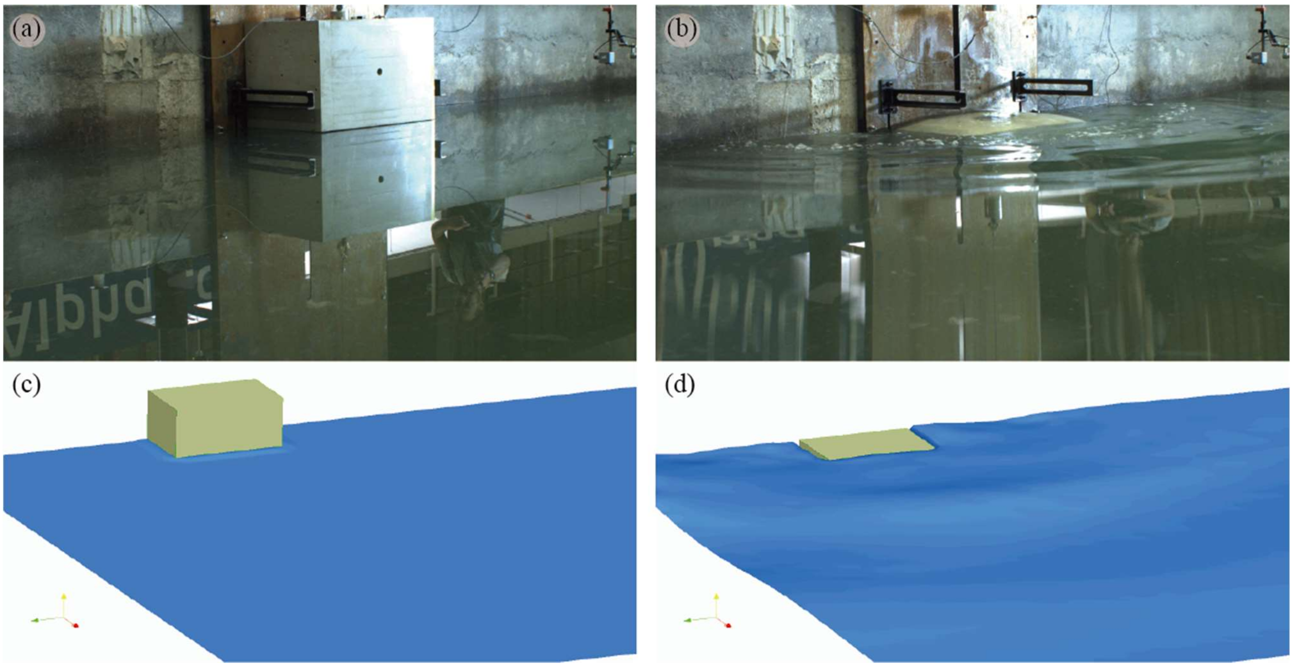


Figure 1 Evolution of the (a,b) experimental and (b,d) numerical iceberg-tsunamis generated by the gravity-dominated fall mechanism at (a,c) t = 0.00 s and (b,d) t = 4.00 s.

Wednesday Session 5

The effect and evolution of a shoreface nourishment

W.L.Chen[1] & N.Dodd[1]
Environmental Fluid Mechanics and Geoprocesses Research Group,
Faculty of Engineering, University of Nottingham, NG7 2RD, UK
(wenlong.chen@nottingham.co.uk)

Introduction

Shoreface nourishments are effective methods in protecting the coast from erosion. Therefore, its important to study the physics underlying the evolution of a shoreface nourishment. With complex numerical models that developed for practical purpose, it is difficult to isolate various physics. We thus developed an one dimensional idealised model to study the physics behind the effect and evolution of a shore nourishment.

Model

We assume that a nourishment (*b(x)*, *x* being cross-shore location) is added to an equilibrium plane beach (shoreline is at x=1500 m, and slope is 0.01). Wave of 1 m height and 6 s period is imposed at x = 0 m. The evolution of nourishment is subject to

$$\frac{\partial b}{\partial t} + \frac{1}{1-p}\frac{\partial q'}{\partial x} - \gamma\frac{\partial^2 b}{\partial x^2} = 0$$

where p=0.4 is the porosity of sediment, q' is the perturbed sediment flux resulting from the difference of sediment transport with and without nourishment. The sediment fluxes calculated are driven by wave skewness, wave asymmetry and return flow. The third term in the equation represents the diffusion of the nourishment due to gravity.

Results

Nourishments of sinusoidal shape (see thick grey line in Fig.1) are implmented at locations of x_n = 900, 1050 and 1200 m, as shown in Fig 1. A nourishment placed in the offshore diffuses and gradually move to the coast (see x_n = 900 m in Fig. 1). A nourishment placed close to the break point induces an earlier breaking. Wave energy is dissipated in this process. The magnitude of q' and hence the evolution speed of nourishment depends on the intensity of the wave break triggered by the nourishment. The nourishment either evolves into a skewed shape with its peak migrating onshore (weak break, see x_n =1050 m in Fig. 1) or splits into on- and off-shore parts (strong break, see x_n = 1200 m in Fig 1).

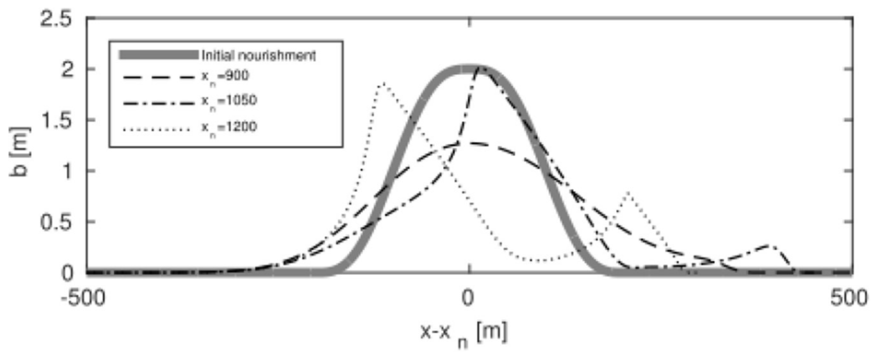


Fig. 1, Evolution of nourishment after 160 days.

Tuesday Session 3

Towards science-based environmental engineering: design and evolution of creek networks in restored saltmarshes

Chirol, C[1], Haigh, ID[2], Pontee, N[3], Gallop, S[4] & Thompson, CEL[2]
[1] Queen Mary University London, London, E1 4NS, UK
(c.chirol@qmul.ac.uk)
[2]University of Southampton, Southampton, SO14 3ZH, UK
[3]Jacobs Engineering Group, Swindon, SN4 0QD, UK
[4]Macquarie University, Sydney, NSW 2109, Australia

Coastal wetlands are being degraded at a rapid pace worldwide, resulting in the loss of critical ecological benefits including biodiversity, flood protection and carbon storage. Managed realignment (MR) schemes aim to mitigate for these losses by opening agricultural lands to tidal influence to create new coastal wetland habitats. However, the design of these schemes requires further scientific guidance, especially for complex features like creek networks, which play a crucial role in the distribution of water, sediment, nutrients and seeds through the marsh.

This research explores whether creek networks in MR schemes evolve to adopt similar morphologies to those found in natural, mature coastal wetlands, and infers which design choices encourage or impede this evolution. Using lidar elevation maps and newly-developed creek mapping algorithms, we compare creek evolution within 10 MR schemes in the UK with the natural range of creek characteristics found in 13 natural mature coastal wetlands.

The MR creek systems considered grew in length, area and volume over 5 to 20 years after implementation. However, the newly formed creeks tended to concentrate around the breaches, leaving entire areas empty of creeks and poorly drained (Figure 1). MR creeks also have a lower sinuosity due to inherited drainage ditches, and a flatter substrate. Soil properties are an underestimated factor of MR success, as the overcompacted, flat soil inherited from the previous agricultural land use may hinder creek development and negatively impact the health of the restored coastal wetlands.

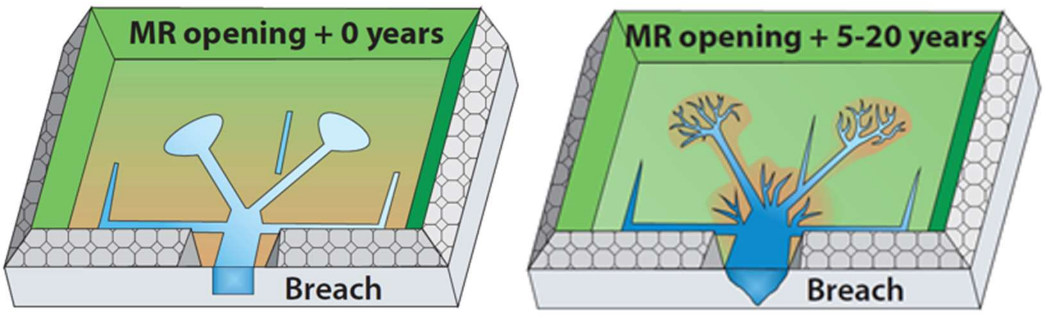


Figure 1 – Conceptual model of creek evolution in managed realignment schemes

Poster P3

3D visualisation of soil structure in UK saltmarshes under different sediment and vegetation types using X-Ray CT

Chirol, C[1]; Spencer, KL[1]; Moeller, I[2]; Carr, S[3] & Evans, B[2]
[1]Queen Mary University London, London, E1 4NS, UK
(c.chirol@qmul.ac.uk)
[2]University of Cambridge, Cambridge, CB2 1TN, UK
[3]University of Cumbria, Ambleside, LA22 9BB, UK

Saltmarshes are being degraded as a result of human activity and tidal forcings exacerbated by sea level rise, resulting in the loss of critical ecosystem services (wild species diversity, water quality regulation and flood regulation). Better understanding of what makes a marsh resistant is needed to predict the vulnerability of natural and restored marshes, and to improve conservation efforts. In particular, how do the soil properties, the plant communities and the distribution of voids and roots within the soil influence marsh resistance to eroding forces?

As part of the NERC-funded project RESIST-UK (Response of Ecologically-mediated Shallow Intertidal Shores and their Transitions to extreme hydrodynamic forcing), a collaboration between Cambridge University, Queen Mary University London and the British Geological Survey, this research analyses the 3D structure of complex, heterogenous saltmarsh soils. Undisturbed sediment cores 15 cm deep were collected at one muddy (Tillingham) and one sandy (Warton Sands) marshes in the UK, under different vegetation communities: *Spartina*, *Salicornia*, *Puccinellia* and bare ground. The cores were then scanned using X-Ray Computed Tomography at 62.5 micron resolution, and segmented between inorganics, organics and voids based on their density values (Figure 1). At the resolution considered, we observe significant differences in the spatial arrangement of roots and voids depending on sediment type and aboveground vegetation. This research provides new insight into the biological and physical factors of stability in saltmarsh soils.

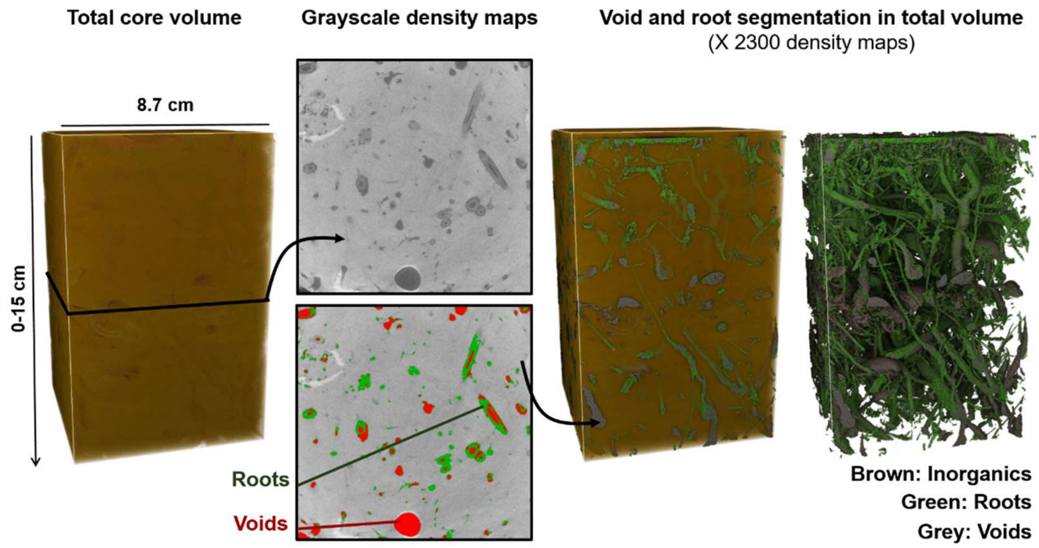


Figure 1 – Segmentation and visualisation of voids and Spartina root systems within a saltmarsh sediment core, Tillingham, UK, using X-Ray Computed Tomography

Wednesday Session 6

2D and 3D Modelling of Offshore Sandbank Dynamics

Stephen Clee[1] & Shunqi Pan[1]

1Cardiff University, Cardiff, CF24 3AA, Wales
(cleesa@cardiff.ac.uk)

The coastal zone is an important resource both socially and economically. Globally, coastal zones are under increasing threat from the effects of climate change, erosion and flooding. Understanding the mechanisms of coastal processes is key to the long term management and protection of the coastal zone and its resources.

Sandbanks are the largest of the bedform features encountered in many tidal seas and continental shelves. They are typically up to 60 km in length, 6 km in width and several metres in height. They are located in regions where there is an abundant supply of sediments with sufficiently strong tidal currents to move them. Sandbanks play an important role in coastal zone management and engineering. Primarily they act as a natural method of coastal defence, protecting the adjacent shorelines from the effects of coastal erosion. They are also important when considering navigational channels, natural habitats, sand mining and offshore construction projects.

This research aims to model the hydrodynamics and morphodynamics of the sandbanks in the southern bight of the North Sea, UK. The main objective is to determine the effects of 3D hydrodynamics on sediment transport processes.

The study site for this research is the southern bight of the North Sea. This software used is TELEMAC2D and TELEMAC3D for hydrodynamics and SISYPHE morphodynamics. This paper presents the details of model setup, calibration process and both the 2D and 3D hydrodynamic results focussed on an area of sandbanks in the domain.

Wednesday Session 5

Morphodynamic modelling of a barrier island recharge scheme: A case study in South Ford, Benbecula

J. Coyle[1] & D. Pender[1]
[1]JBA Consulting, Edinburgh, EH14 4AP, UK
(johnny.coyle@jbaconsulting.com)

South Ford is an exposed Atlantic tidal basin on the Outer Hebrides, between the islands of South Uist and Benbecula. The basin is spanned by a causeway to allow for travel between the islands, with Gualan Island providing shelter from storms generated in the Atlantic Ocean.

Direct exposure to north Atlantic makes Gualan an extremely dynamic dune system which has exhibited annual overwash and general rollback in recent years. In 2005 an extreme storm event produced a large surge in water levels, resulting in significant overwash of the Island and inundation of the South Ford hinterland, causing five fatalities at Iochdar. In response to the threat of breaching, Comhairle have developed a nourishment scheme to increase barrier volume, with the aim of reducing risk to the communities around South Ford and mitigate future erosion (Figure 1).

JBA were commissioned by Comharile to undertake detailed sediment transport and erosion modelling to better understand the morphodynamic response of the scheme. The modelling was undertaken using XBeach in 1D and 2D, with additional analysis to identify the causal factors in barrier retreat; be it high energy storms or longer-term ambient sediment mobilisation.

Results from the study were used to provide a clearer understanding of the scheme performance and will be used to support longer-term decisions for sediment and dune management within South Ford.

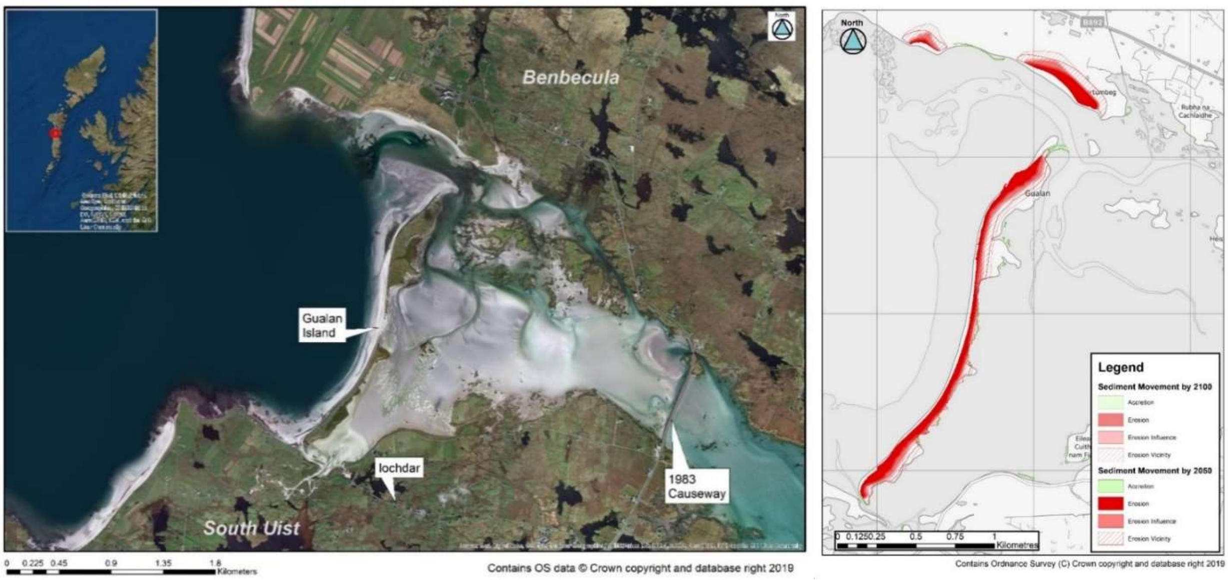


Figure 1 – Overview of South Ford and Gualan Island (left) and projected sediment erosion (right)

Wednesday Session 4

Equilibrium beach profile evolution from varying initial beach morphologies in large-scale experiments

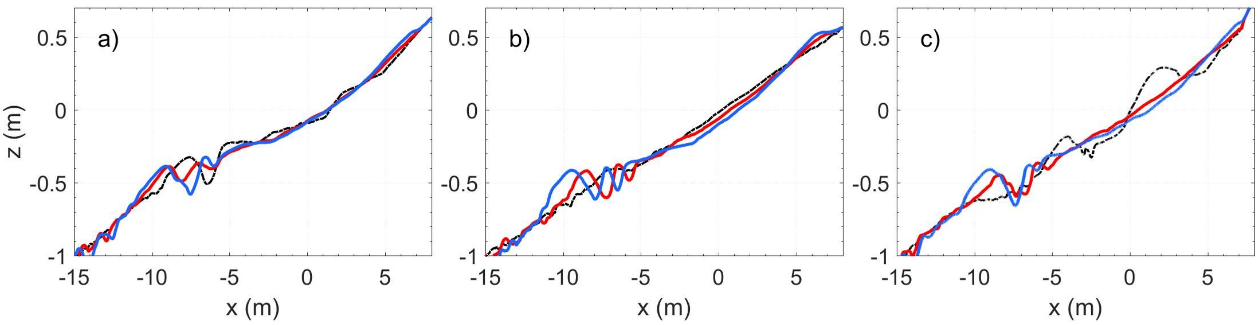
Sonja Eichentopf[1], Joep van der Zanden[2] , Marios Christou[1] & José M. Alsina[3]

[1]Imperial College London, London, SW7 2AZ, United Kingdom (sonja.eichentopf16@imperial.ac.uk, marios.christou@imperial.ac.uk)
[2]University of Twente, 7522 NB Enschede, Netherlands (j.vanderzanden@utwente.nl)
[3]Universitat Politècnica de Catalunya, Barcelona, 08034, Spain (jose.alsina@upc.edu)

It is generally admitted that the beach profile evolves towards an equilibrium configuration that is specific for a given wave climate and the beach properties. However, the process of evolving towards equilibrium and the influence of the initial beach configuration are not well understood. This knowledge is highly important to understand potentially different beach changes generated by the same wave conditions.

In this study, large-scale experimental data on beach profile evolution under sequences of varying wave conditions will be presented. Three sequences of alternating high and subsequent low energy conditions were performed as different combinations of five wave conditions. As a result, the same wave conditions were performed from different initial beach configurations allowing the investigation of the effect of the initial beach profile on the evolution of the beach and its final configuration.

The results show that in the present experiments the beach profile evolves towards an equilibrium configuration which is specific for the performed wave condition despite departing from different initial profiles (see figure 1). Due to the evolution of the beach towards equilibrium, the change rate of the beach varies depending on the initial beach profile. Consequently, the same wave condition can generate either bulk onshore or offshore sediment transport.
Details of the beach profile evolution towards equilibrium in terms of the bar and shoreline dynamics will be discussed in the final presentation along with a discussion on the influence of the initial configuration and the prevalent wave condition.



Figures 1 – Profile evolution towards equilibrium from different initial beach configurations for the same wave condition. Initial profile (---), profile after 30 min (—), profile after 120 min (—).
(a) Sequence 1; (b) Sequence 2; (c) Sequence 3.

Cell 1 Regional Coastal Monitoring Programme: Subtidal Sediment Microplastic Baseline

Claire Gilchrist[1] & Morwenna See[1]

[1]Royal HaskoningDHV, Newcastle Upon Tyne, NE1 4EE, UK
(claire.gilchrist@rhdhv.com)

The issue of microplastic pollution has seen an increasing focus over the last decade, both as a research and media topic, plastic is an unavoidable material and its impact on the marine environment has been identified on a global scale. As a relatively new field of research, many studies target areas expected to have high concentrations of microplastics, the present study represents a microplastic baseline in subtidal sediments for a large area of UK coastline. As part of the Cell 1 Regional Coastal Monitoring Programme, 24 subtidal sediment samples were taken between south Sunderland and Redcar and have been analysed for microplastic concentration and type. All samples analysed contained microplastics, the most common type being microfibres. The number of microplastic particles (per kg sediment) found in a single sample ranged from 6 to 532 particles.

Local sources are likely to include riverine input from the River Tees, run-off from urban areas Hartlepool and Seaham, waste water treatment plants along the coast and fishing activities within the area. No clear spatial pattern to concentration and microplastic type is immediately apparent, likely due to the multiple factors that influence microplastic spatial distribution (see Figure 1). Further research is required to be able to gain a wider understanding of the movements of microplastics within the study area. However, this presents a first baseline assessment for the area and the nature of sampling contributes a more complete picture of microplastic pollution in the UK.

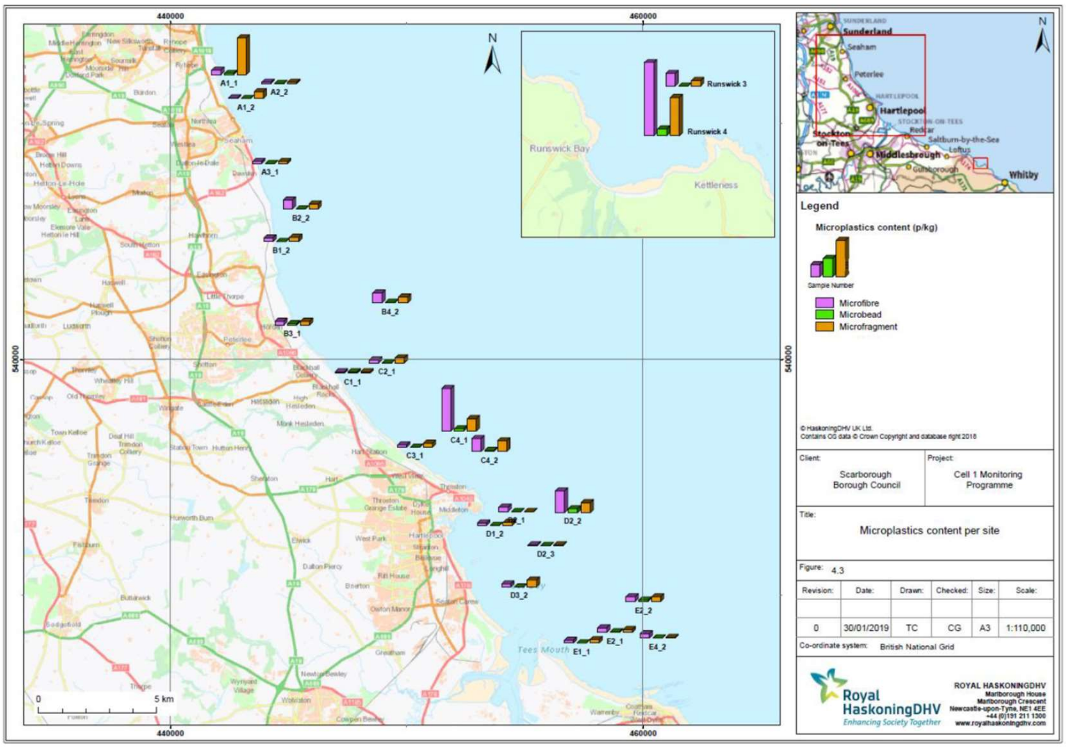


Figure 1: Microplastics content per site (particles per kg)

Monitoring Coastal Morphology: The potential of action cameras for accurate 3D reconstruction

Samantha Godfrey[1], Prof. Andrew Plater[1], Dr James Cooper[1] & Dr Frederic Bezombes[2]
[1]University of Liverpool, School of Environmental Sciences, Liverpool, L69 7TZ (sgsgodfr@liverpool.ac.uk)
[2]Liverpool John Moores University, School of General Engineering, Liverpool, L3 3AF

The combination of Structure-from-Motion with Multi-View Stereo (SfM-MVS) photogrammetry has become an increasingly popular method for the monitoring and 3D reconstruction of coastal environments. Climate change is driving the potential for increased coastal recession, meaning geomorphological monitoring using methods such as SfM-MVS have become essential for tracking impacts. SfM-MVS has been well-researched with a variety of platforms and spatial and temporal resolutions using mainly rectilinear digital cameras in coastal settings. Previously considered unsuitable for accurate 3D reconstructions, fish-eye lenses are being used more regularly in photogrammetry research. Optical correction functionality has become a standard inclusion in commercial SfM-MVS software showing increased demand and understanding of distorted images.

In this study, a camera with fish-eye lens is used with an innovative method of systematic image acquisition at a small-scale site of coastal recession with the aim of understanding image interaction and its effect on the resultant dense point cloud. Positional parameters are examined and quantitively compared to the equivalent Terrestrial Laser Scanner results which represents the assumed ground truth. Results show SfM-MVS using a fish-eye lens produced dense point clouds with millimetre accuracy when compared to the TLS. Equivalent point cloud accuracy can be achieved with a small number of images stationed in appropriate positions. Initial results show as few as five well-positioned images can provide high levels of accuracy. These findings illustrate the potential for cameras with fish-eye lenses to be used to provide a low-cost method of coastal monitoring.

Wednesday Session 6

The Coastal Circulation Model of Büyük Menderes River and Adjacent Coastal Areas

Mehmet Sedat Gözlet[1] & Gulizar Ozyurt Tarakcioglu[2]
[1]Middle East Technical University, Ankara, 06800, Turkey
(gozletsedat@gmail.com)
[2]Middle East Technical University, Ankara, 06800, Turkey
(gulizar@metu.edu.tr)

In this study, circulation model of Büyük Menderes River and the adjacent coastal areas will be presented. Büyük Menderes runs through the second biggest alluvial plains in Turkey and discharges into the Aegean Sea where fishing and tourism are main income for the region. Therefore, an accurate representation of water circulation is important both for the water quality in the bay and the morphodynamics at the coast of Büyük Menderes Delta.

Finite Volume Coastal Ocean Model (FVCOM) is used for the circulation modelling mainly because use of unstructured grid mesh enables modeling of a larger coastal water body with higher resolution at river discharge region, efficiently. The model is set-up to assess the patterns under the forcing of Coriolis, tide, wind, wave (SWAN integration) and river.

Results of model runs for March (rainy season) and October (dry season) 2017 will be presented with comparisons to in situ data (Figure 1). In situ data used in the model includes salinity and temperature of sea water and river, river discharge, wind characteristics, water levels and current measurements at three locations, which was collected as part of a research project campaign funded by The Scientific and Technological Research Council of Turkey (TUBITAK).

These results are going to be used for calibration of the model and it is the first step of developing regional circulation model for long term scenarios and future changes.

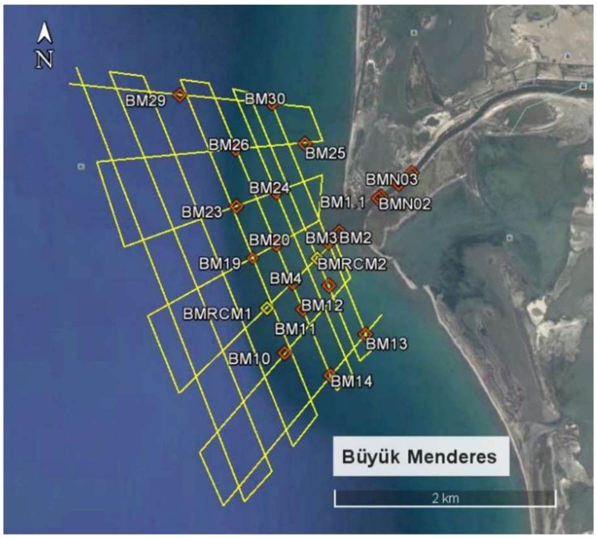


Figure 1 - Measurement Tracks and Gauge Locations (Kisacik et.al, 2018)

Reference: Kisacik et al. (2018), *Evaluation of Short Term Bedforms at River-Sea Interaction Areas: Gediz and B. Menderes Cases*, Ankara, Final Report, TUBITAK Project No: 115Y722

Tuesday Session 3

3D Printed Artificial Reefs in the Atlantic Region (3DPARE)

Alice E Hall[1], Roger JH Herbert, [1], Rick Stafford[1], João N. Franco[2], Isabel Sousa Pinto[2], Bianca Reis[2], Matthieu Dufeu[3], Mariane Audo[3], Mohamed Boutouil[3], Nassim Sebaibi[3], Valentin Georges[3], Miriam Tuaty-Guerra[4], Jorge Lobo[4], Elena Blanco Fernandez[5], Daniel Castro Fresno[5]

[1]Bournemouth University, Poole, BH12 5BB, UK
(ahall@bournemouth.ac.uk)
[2]University of Porto, Porto, Portugal (joaonunofranco@gmail.com)
[3] ESITC Caen, France ESITC CAEN (matthieu.dufeu@esitc-caen.fr)
[4]IPMA, Lisbon, Portugal (mguerra@ipma.pt)
[5]University of Cantabria, Santander, Spain (elena.blanco@unican.es)

Given the multiple stressors facing the marine environment, and shallow reef systems especially, work to protect biodiversity of the oceans is crucial. Artificial reefs (AR) have been deployed around the world for decades for many purposes including habitat restoration, coastal protection, fisheries enhancement and recreation.

The 3DPARE project (www.3dpare.eu) aims to 3D print concrete artificial reef blocks to maximise marine biodiversity, however, little is known of the key features needed to maximise the benefits of artificial reefs. We conducted surveys of natural reefs and artificial structures in Poole Bay to determine key characteristics to include in these reef blocks, using SCUBA, photogrammetry and BRUV surveys.

The 2018 results from the UK showed similar patterns in species richness and abundance across the natural and artificial sites. However, community structure differed significantly with both depth and between natural and artificial structures, and while not perfectly correlated, mobile fauna varied more with depth, and benthic flora and fauna varied more with substrate type (artificial vs. natural).

The 3D printed AR units will include various habitats including holes, tunnels and overhangs of varying size and depth. Monitoring will focus on the specific AR unit features and how they attract marine life, and help maximise native flora and fauna assemblages.

Poster P4

Incorporating Ecological Enhancement into a new Coastal Protection Scheme: Runswick Bay, N Yorkshire

Alice H Hall[1], Susan Hull[2], Robin Siddle[3], Roger JH Herbert[1]
[1]Bournemouth University, Poole, BH12 5BB,UK
(ahall@bournemouth.ac.uk)
[2]University of Hull, Hull, HU6 7RX, UK (s.hull@hull.ac.uk)
[3]Scarborough Borough Council, Scarborough, YO11 2HG, UK

Runswick Bay is located on the north Yorkshire coast and was designated a Marine Conservation Zone (MCZ) in January 2016. The Coastal Protection Scheme consisted of repairs to the existing seawall and the placement of ~9,500 tonnes of granite rock armour to form a new 250m revetment. To mitigate any environmental impacts from the works, various measures were implemented in agreement with Natural England and the Marine Management Organisation. These included limited movement of machinery, preventing damage to existing colonised boulders, informed positioning of boulders to retain water and the creation of artificial rockpools and grooves in the granite rock armour.

Seventy artificial rock pools were created using an innovate method utilising a circular saw and breaker. Rock pool diameter ranged between 36 cm and 56 cm and water depth ranged from 5 cm to 19 cm. An additional 20+ pools were generated through the informed placing of granite boulders. The monitoring to date has shown that the rock pools have increased the species richness, species diversity and total abundance of the granite boulders compared to an un-manipulated control area. A total of thirteen species were recorded within the artificial rock pools and only three species were recorded on the adjacent control rock faces. Nine of the additional species present within the rock pools were mobile species, including intertidal fish, crabs and snails.

The ecological enhancement aspects of the scheme represents leading-edge coastal engineering practice which will be monitored through links between public and private sectors and academia.

Wednesday Session 4

CoastSnap Bournemouth: How can citizen science extract useful coastal data?

J Hart[1] & C Blenkinsopp[1]

[1] University of Bath, Claverton Down, Bath, BA2 7AY, United Kingdom
(j.hart@bath.ac.uk)

CoastSnap Bournemouth is a citizen science project which gets members of the public to share images of Bournemouth beach. A camera cradle with an elevated position is used (see Figure 1a) which ensures features within the image can be easily seen and the same region is covered in each image. Participants are encouraged to submit the time and date of when the image was taken. By using known points in the environment which are fixed as Ground Control Points (GCPs), images can be rectified and converted to a local x, y coordinate system using the camera cradle as the point of origin. By comparing images, the evolution of aspects of beach morphology can be monitored over time.

Results will be presented which show how the shoreline and beach profile (against the groyne) changes seasonally and in response to storms, while a brief outline of how CoastSnap Bournemouth was set up will be provided. The work presented here shows how low cost, simple set up approaches can be utilised to provide useful coastal data which can be used and applied for coastal management purposes. Engaging community participation in the data collection phase can only be seen as a positive and projects like this encourage dialogue and thinking about coastal environments, this can empower people to care/think more about their local beach. Although limitations do exist, projects like this has vast potential in providing useful data for coastal monitoring purposes, while engaging with local communities about significant coastal issues.

A

B

Figure 1: a. the CoastSnap Bournemouth camera cradle, b. an example sand profile against the groyne.

Tuesday Session 1

Flow and Scour Around Round Head Vertical Wall Breakwater Under Random Waves

Kadir Karakaş[1] & Cüneyt Baykal[2]

[1]Middle East Technical University, Ankara, 06800, Turkey
(cbaykal@metu.edu.tr)
[2]Middle East Technical University, Ankara, 06800, Turkey
(karakas.kadir@metu.edu.tr)

In this study, wave induced flow and scour around round head vertical wall breakwater are investigated via physical model experiments. Physical model tests are performed in the irregular wave flume of Coastal and Ocean Engineering Laboratory, Department of Civil Engineering, METU. The flume is 26.9m in length, 6.0m in width and 1.0m in depth. The experiments are held in an inner channel of 1.5 m in width. The setup has a 1/10 inlet slope, and 10.0m long 0.2m deep false bottom. As a first step in the experiments, random wave series of various Keulegan-Carpenter numbers (1.5, 3.6 and 5.4) and wave steepness's (H/L = 0.01, 0.02, 0.03 and 0.04 for KC = 5.3) are determined. The wave conditions in case of no structure are measured via 9 wave gauges placed at various locations in the flume and an Acoustic Doppler Velocimeter located at 5 cm above the bed at the location of the structure. After the wave conditions are determined, flow investigation experiments are performed with a *B=6cm* wide and *l=9B=54cm* long round head acrylic made structure that fixed on the false bottom and to one side of the flume. To investigate the blockage effect, velocity distributions between the head and the inner flume wall are obtained (Figure 1). In scour experiments, false bottom will be removed and $d_{50}=0.2mm$ sand will filled up between inlet and outlet slopes. Morphological changes around the structure due to random waves will be measured by a laser bed scanner. The equilibrium scour depths around the structure will be obtained. The evolution of these depths against number of waves will be obtained by the underwater camcorders.

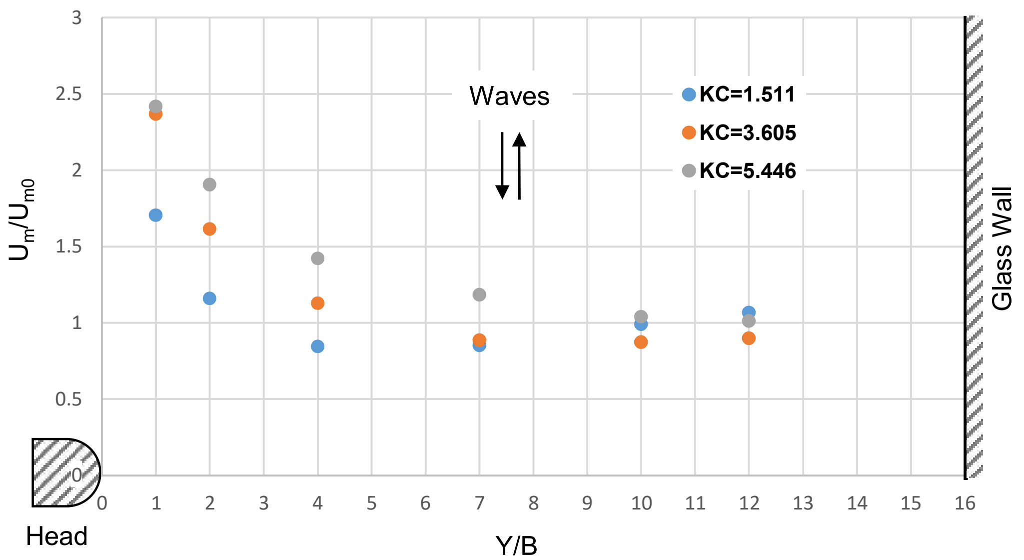


Figure 1 – Velocity distribution

Tuesday Session 2

Uncertainty Quantification for Tidal Power in the Pentland Firth

Monika Kreitmair[1], Alistair Borthwick[1], Thomas Adcock[2] & Ton van den Bremer[2]

[1]School of Engineering, University of Edinburgh, Edinburgh, EH9 3JL, UK
(m.kreitmair@ed.ac.uk and alistair.borthwick@ed.ac.uk)
[2]Department of Engineering Science, University of Oxford, Oxford, OX1 3PJ, UK
(thomas.adcock@eng.ac.uk and ton.vandenbremer@eng.ox.ac.uk)

This presentation will consider the effect of uncertainty in bed roughness coefficient on tidal stream power estimates for tidal fences situated in the Pentland Firth, Scotland. Uncertainty is expressed here through the variance of a probability density function. We propose a numerical technique (Kreitmair 2018) that permits relatively straightforward assessment of uncertainty propagation through a typical tidal flow model from bed friction to removable power. We use an open source continuous Galerkin finite element solver of the nonlinear shallow water equations to predict tide-driven hydrodynamics over an unstructured mesh fitted to the Pentland Firth region, and extending as far as the edge of the continental shelf (following Adcock *et al.* 2013). The turbines are represented by a local increase in bed roughness coefficient over three strips, one traversing the Firth but intersecting with the Islands of Swona and Stroma (denoted BCD), the second joining the mainland to the first island (B), and the third in the middle channel (C). The power is determined by integrating the product of water density, bed friction coefficient, and depth-averaged velocity cubed over the area of enhanced roughness. The averaged power is then determined using the mean value theorem. The model was run systematically over a range of bed roughness and turbine drag coefficient values, and a response surface produced of tidal stream power removed. Bicubic splines are applied to enhance resolution. Three truncated normal distributions are considered, with mean values of bed friction coefficient equal to 0.0025, 0.005, and 0.016, and standard deviation prior to truncation equal to 0.41 times the mean value. Figure 1 shows the expected power and standard deviation in power as a percentage of the deterministic power as a function of the turbine drag coefficient scaled by mean bed friction coefficient, with the mean bed friction coefficient equal to 0.005. The results show that expected power increases with bed roughness uncertainty, and this is more pronounced when the turbine drag coefficient is small.

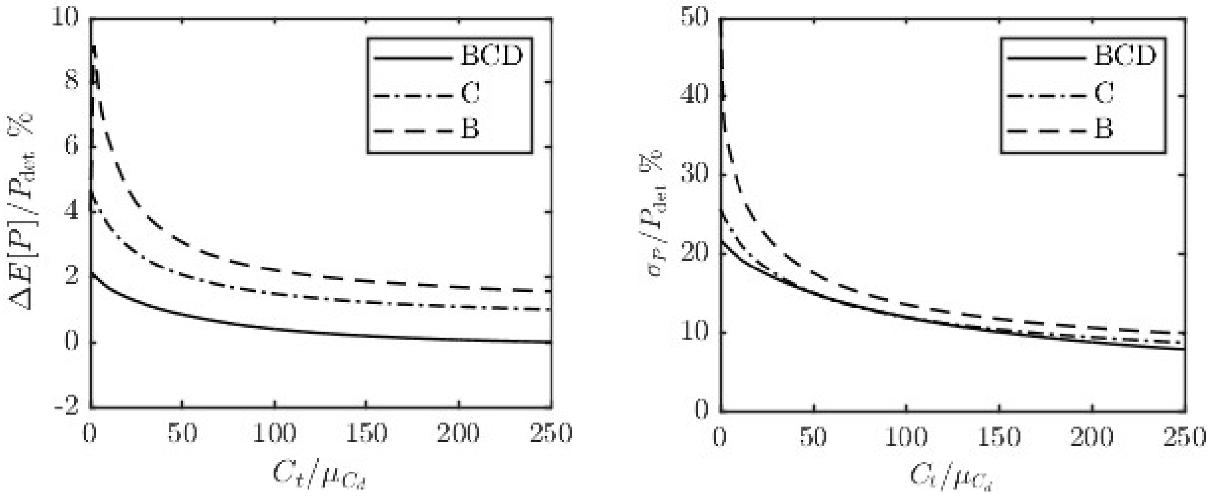


Figure 1 – Effect of uncertainty in bed roughness coefficient on power statistics.

References

Adcock T.A.A., Draper S., Houlsby G.T., Borthwick A.G.L. and Serhadlıoğlu S., (2013) The available power from tidal stream turbines in the Pentland Firth. *Proc. Royal Soc. Series A,* **469**.

Kreitmair M.J. (2018) The effect of uncertainty on tidal stream energy resource estimates, PhD thesis, The University of Edinburgh, UK.

Wednesday Session 6

Predicting the effects of thermal discharges in UK transitional and coastal waters – the importance of long-term hydrodynamic model simulations

Lofthouse[1], E.K. and Wood[1], M.J.

[1]HR Wallingford, Wallingford, Oxfordshire, OX10 8BA, UK
(e.lofthouse@hrwallingford.com corresponding author)

The discharge of warmed water from power plants and other industries into Transitional and Coastal (TraC) waters has long been of concern to environmental regulators. In the UK, the acceptability of thermal discharges is assessed by the Environment Agency with reference to standards that are designed to protect factors including water quality, marine life, habitats and designated conservation sites.

These standards include specific temperature thresholds, or mixing zones around the outfalls. The Environment Agency requires that the areal extents of the mixing zones are predicted using hydrodynamic and dispersion/dilution models.

The standards are based on annual statistics, such as yearly 98th-percentiles, or maxima. Modellers typically estimate these annual mixing zones using a series of shorter tests, perhaps covering a few weeks or months during the year, and the results are then extrapolated (or combined statistically) to cover the year.

The authors regularly carry out hydrodynamic and dispersion assessments to support the planning of new outfalls in the UK's TraC waters. Several recent studies have highlighted the deficiencies in the standard approach, where annual mixing zones are based on shorter tests. Particularly for complex hydrodynamic environments, where mixing and dispersion might be strongly affected by numerous processes (including tides, winds, waves, river flows, and seasonal conditions), the authors have found it necessary to carry out year-long simulations or, in some cases, multi-year simulations to generate accurate mixing zones. The importance of carrying out long-term simulations for such sites will be demonstrated, and the potential dangers of simpler approaches will be highlighted.

Tuesday Session 2

Increased coastal wave hazard generated by differential wind and wave direction in hyper-tidal estuaries

Charlotte E. Lyddon[1,2], Jennifer M. Brown[2], Nicoletta Leonardi[1], Andrew J. Plater[1]

[1]University of Liverpool, School of Environmental Sciences, Liverpool, L69 7ZT, United Kingdom (c.e.lyddon@liverpool.ac.uk; N.Leonardi@liverpool.ac.uk; gg07@liverpool.ac.uk)
[2]National Oceanography Centre Liverpool, Joseph Proudman Building, 6 Brownlow Street, Liverpool, Merseyside L3 5DA, United Kingdom (jebro@noc.ac.uk)

Wave overtopping and subsequent coastal wave hazard is strongly controlled by wind and water levels, and is especially critical in hyper-tidal estuaries where even small changes in wave heights can be catastrophic if they are concurrent with high spring tide. Wave hazard in estuaries is largely attributed to high amplitude shorter period, locally generated wind waves; while low amplitude longer period waves rarely impact low-lying coastal zones up-estuary. Delft3D-WAVE is used to investigate the effect of wind and wave properties on up-estuary wave propagation and the sensitivity of significant wave height along the shoreline of the Severn Estuary, southwest England, as an example. Representative values for wind speed and direction, wave height, period and direction are used to identify key combinations of factors that define the wave hazard generation. High amplitude, short period wind waves are sensitive to opposing winds, with a steepening effect that varies along the estuary shoreline, highlighting the effect of estuarine geometry on wave hazard. Low amplitude, long period wind waves respond with maximum variability in significant wave height to strong winds resulting in their propagation further up-estuary. Our results advance current understanding of the complex, compound interaction between different drivers of coastal wave hazard, and identify critical conditions maximizing the hazard along the shoreline. The outcomes from this research can help to avoid economic losses from operational downtime in ports and harbours, inform sustainable coastal sea defence design and understand how wave hazard may vary under future climate due to changing storm tracks.

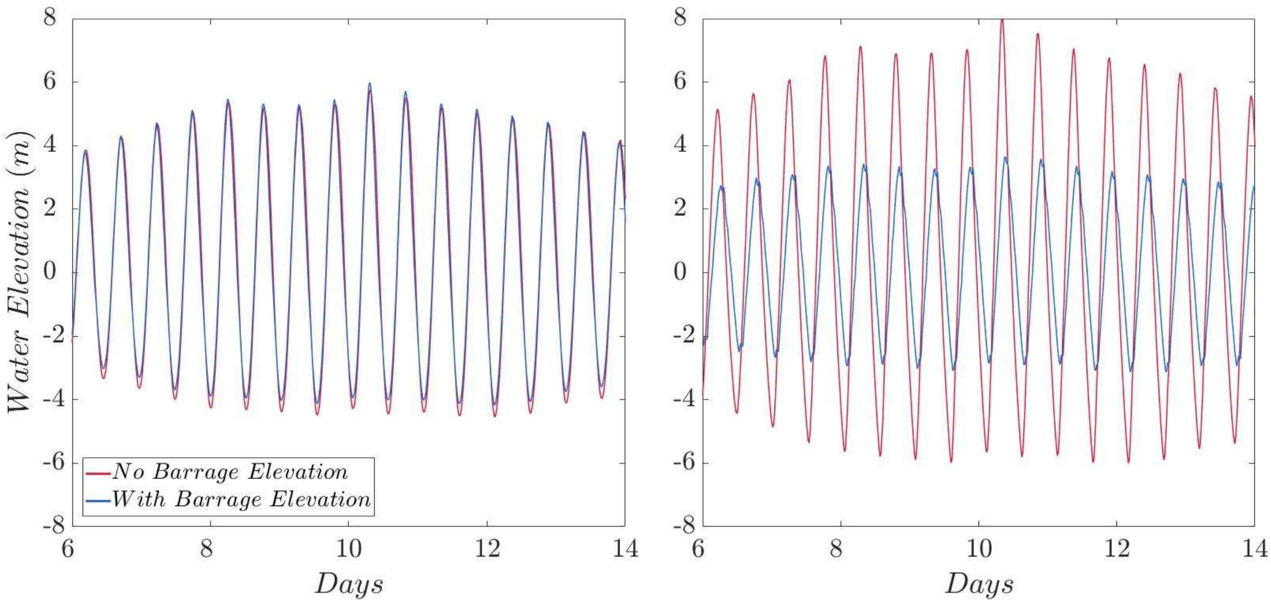
Tuesday Session 2

The impact of a tidal barrage on storm surge in the Severn Estuary

Qian Ma[1] & Tulio Marcondes Moriera[2] & Thomas A.A. Adcock[3]

[1]University of Oxford, Oxford, OX1 3PJ, UK
(qian.ma@eng.ox.ac.uk)
[2]Federal University of Minas Gerais, Belo Horizonte, 6627, Brazil
(tmoreira@eng-civ.grad.ufmg.br)
[3]University of Oxford, Oxford, OX1 3PJ, UK
(thomas.adcock@eng.ox.ac.uk)

The proposed Seven barrage is a controversial but widely discussed proposal to generate clean and renewable energy. A key concern with this technology is that such structures may cause other environmental problems. However, such structures might also create beneficial environmental effects in some areas, such as mitigating the impact of storm surges. In this project we model the hydrodynamics of the Severn barrage and surrounding area using a depth-averaged numerical model. We simulate a number of storm surge events from the past 40 years and analyse how the presence of the Severn barrage modifies the resulting water levels. The figures below illustrate the simulation results of the barrage implementation during the storm surge event at both the ocean (west) and basin (east) side of the barrage. The results indicate the significant reduction of the water level, and hence the flooding risk, in the basin region due to the barrage implementation. The level peak time is delayed during the storm surge event on both sides of the barrage. The negative impact of the barrage inclusion, as seen in the left figure, is the maximum water level increases on the ocean side. We then consider how different barrage operating strategies would influence the resulting water levels and the optimum strategy is selected for the flooding benefit of the whole Seven Estuary.



Figures 1 – Interaction of barrage implementation with storm surge: a) in the ocean (west) side (left); b) in the basin (east) side (right).

Tuesday Session 3

Enhancing the ecological value of coastal infrastructure

Mairi MacArthur[1], Larissa Naylor[1], Jim Hansom[1] and Michael Burrows[2]
[1]University of Glasgow, Scotland
(m.mac-arthur.1@research.gla.ac.uk; Larissa.Naylor@glasgow.ac.uk; Jim.Hansom@glasgow.ac.uk)
[2]Scottish Association for Marine Science, Scotland
(michael.burrows@sams.ac.uk)

Hard engineering structures continue to proliferate in the coastal zone globally in response to increasing pressures associated with climate change and coastal urbanisation. These structures are typically smooth and featureless, functioning as poor ecological surrogates for natural rocky shores. Ecological enhancement can be seen as a hybridisation of artificial structures, whereby components of nature are incorporated into their design to improve their sustainability and multifunctionality.

To determine the optimal design for improving the intertidal habitat quality of vertical coastal structures, we conducted an ecological enhancement trial involving 160 artificial concrete tiles of different design complexity and 24 cleared natural surfaces (150x150mm) at three sites in the UK. Surface texture and complexity was varied at the mm-cm scale to test the effect of settlement surface texture on the success of colonisation and biodiversity in the mid-upper intertidal zone. The different designs replicated topographic features of high ecological importance that are found on natural rocky shores and were designed using ecological and biogeomorphological theory

Within 18 months, tile designs with intermediate levels of complexity (mm-scale surface roughness) were optimal in increasing barnacle abundance compared to plain-cast tiles. Tiles with high complexity (with microhabitat recesses up to 30mm deep) developed greatest species richness and mobile species abundance and had lowest peak air temperatures and highest humidity. These textured ecological enhancements can help improve the habitat value of existing and future hard coastal structures by favouring the conservation of intertidal species in urban marine habitats.

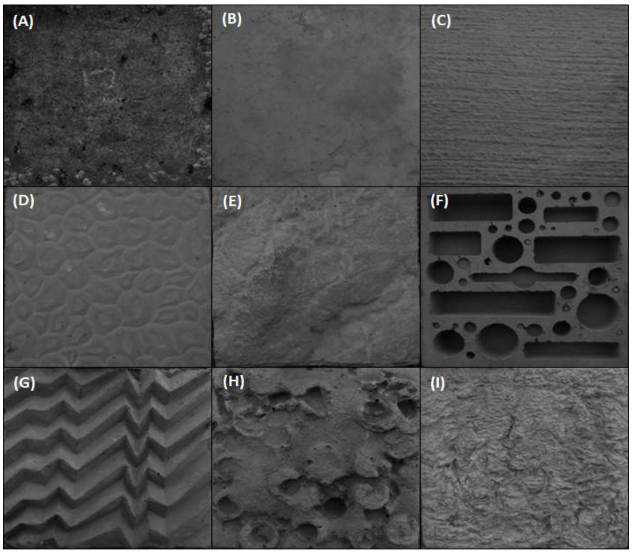


Figure 1. Textured surfaces (150x150mm) of a (A) natural clearing tile area and the tile designs (B) Control(smooth), (C) Grooved, (D) Barnacle, (E) Geotile, (F) Singapore, (G) Art 1, (H) Art 2, (I) Art 3.

Wednesday Session 6

Investigating the influence of freshwater discharge on deltaic systems

Constantinos Matsoukis[1] , Nicoletta Leonardi[1], Lucy Bricheno[2], Laurent Amoudry[2]

[1] Department of Geography and Planning, School of Environmental Sciences, University of Liverpool, Roxby Building, Chatham St., Liverpool L69 7ZT, UK
(c.matsoukis@liv.ac.uk, N.Leonardi@liverpool.ac.uk)

[2] National Oceanography Centre, Joseph Proudman Building, 6 Brownlow Street, Liverpool, Merseyside, L3 5DA
(laou@noc.ac.uk, luic@noc.ac.uk)

River deltas are important natural environments and the centre of numerous anthropogenic activities. Changes in climate and sea level rise can strongly influence river deltas and there are many uncertainties on how deltaic systems will respond to such changes. Specifically, there are great concerns about a possible increase in salinity due to changes in sea level rise and river discharge as this can be especially deleterious for agriculture and biodiversity. This project focuses on changes in salinity patterns that are expected to be developed in river deltas as a consequence of sea level rise and endeavours to achieve a parameterization of salinity with delta's geometry. Numerical modelling is an excellent tool that facilitates our capability to understand and predict future delta configurations. An idealized 3D model is built and setup in DELFT3D for this purpose. A river-dominated delta is chosen as a test case and an annual flow distribution is implemented to examine salinity seasonality with varying river flow. Salinity and river discharge were found to be exponentially and negatively correlated. This agrees with findings from other similar works. The salinity – river discharge exponential equation of our regression analysis is further explored to include the delta depth and/or the distance from the river. Based on our results, there is also a trend between salinity and channels bifurcation order. Salinity increases linearly as the stream order decrease. The future project goal is to compare model results with real observations and implement the same methods to other delta types (i.e. tide and wave dominated).

Tuesday Session 1

Experimental investigation of extreme wave run-up on a monopile coastal structure.

William Mortimer
University of Plymouth, PL4 8AA
(william.mortimer@postgrad.plymouth.ac.uk)

Coastal infrastructure is becoming increasingly vulnerable to progressive climatic pressures. Sea-level rise and increased storminess, make potential for extreme wave events more likely with higher consequences. To ensure structural resilience, extreme wave responses (run-up, overtopping and wave loading) on coastal structures must be examined to better inform future design codes.

The present work investigates extreme wave run-up on a monopile structure with a steep sloping base - proxy for a light-house or wind-turbine. A physical modelling approach uses a singular linear focused wave group as the impacting wave force. The group is varied over five focus locations and four group phases (0, 90, 180, 270) with the aim of finding a statistical link between extreme wave conditions and extreme run-up.

Using an established analytical methodology and set-up from the on-going EPSRC-funded STORMLAMP project at Plymouth. The wave group impact is filmed in a high frame rate (400fps). Manual image analysis of the maximum vertical run-up allows a link between focus location and run-up to be made. Figure 1 shows the experimental set-up. Preliminary findings show that group phase is more important than focus location proximity in producing the greatest run-up – interestingly a trough focused wave group leads to greater run-up than a crest focused group. Conclusive findings are expected by mid-March with analysis of second-order error wave contributions to follow.

This investigation is a starting point in development of a second-order corrected wave facility in Plymouth, for use in accurate extreme response investigations throughout the PhD.

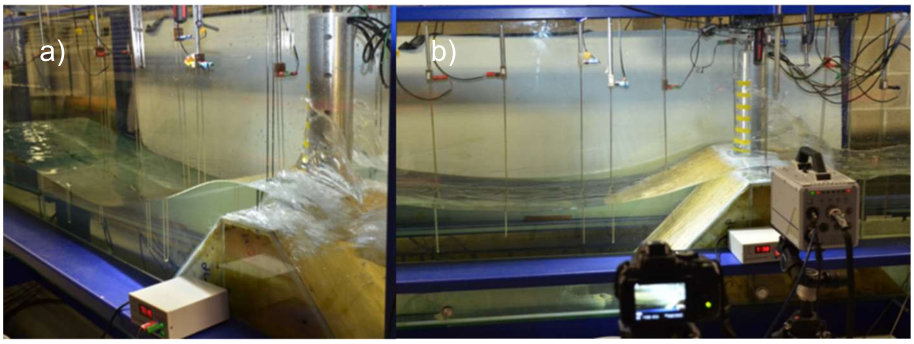


Figure 2: a) Crest focused wave group impact upon the monopile structure. b) A side on view of the experimental set-up with the high-speed camera bottom left.

Wednesday Session 5

Prediction of coastal evolution in Scotland: Process-driven modelling driven by climate change across decadal timescales

Freya M. E. Muir[1], Martin D. Hurst[1], Sean Vitousek[2], Jim D. Hansom[1], Alistair F. Rennie[1&3] & James M. Fitton[1&4]

[1]University of Glasgow, Glasgow, G12 8QQ, UK
(freya.muir@glasgow.ac.uk)
[2]University of Chicago at Illinois, Chicago, IL, 60607-7023, US
(s.vitousek@uic.edu)
[3]Scottish Natural Heritage, Inverness, IV3 8NW, UK
(alistair.rennie@nature.scot)
[4]Aalborg University, Aalborg, 9000, Denmark
(james@plan.aau.dk)

While coastal evolution is complex and challenging to predict, there is an ever-increasing requirement for reliable models capable of predicting shoreline evolution over a range of timescales and change scenarios. Scotland has a varied and dynamic coastline with 19% of this being soft and susceptible to erosion. These soft areas face an increased risk of erosion and flooding driven by sea level rise and storm surge intensity. We adapted the Coastal One-Line Assimilated Simulation Tool (CoSMoS-COAST) (Vitousek et al., 2017; doi:10.1002/2016JF004065) to model the evolution of an economically and environmentally vulnerable site at Montrose under different climate change scenarios. The model combines a one-line approach of longshore sediment transport processes with cross-shore transport processes due to wave action and beach profile change due to a rising sea level. Variations in coastal geology allow for greater complexity in the simulated processes as well as insight into the level of human influence on shoreline change. The model is calibrated using data assimilation with records of mean high water spring (MHWS) lines stretching back to 1901 and validated using recent MHWS positions extracted from aerial surveys and digital elevation models. Shoreline change ensembles are then able to be simulated using multiple Representative Concentration Pathways within the recent UKCP18 marine predictions, giving predictions of shoreline change under low to high emissions scenarios up to the year 2100. We report anticipated future coastal erosion at Montrose where important coastal assets (e.g. transport infrastructure, tourism and cultural heritage) are at direct risk. Producing coastal change predictions for a range of coastal types and climate situations will then enable more accurate risk assessment and guide resilience and adaptation of Scotland's most vulnerable coastal areas.

Tuesday Session 3

Hydrodynamics of large-amplitude oscillatory flows through cylinder arrays

Otto Neshamar[1], Dominic van der A[1] & Tom O'Donoghue[1]

[1]School of Engineering, University of Aberdeen, Aberdeen, AB24 3FX, United Kingdom (o.neshamar@abdn.ac.uk)

Coastal vegetation such as seagrass and salt marsh can contribute to coastal defence through improving bed stability and attenuating wave energy; as a result, the hydrodynamics of wave-vegetation interactions are the subject of much research. Several previous laboratory studies have investigated in-canopy hydrodynamics in small-scale wave flumes under moderate wave conditions. However, behaviour under large storm-scale waves is still poorly understood.

Experiments were conducted in the Aberdeen Oscillatory Flow Tunnel (AOFT), where a submerged array of rigid cylinders (representing a vegetation canopy) was exposed to large-amplitude oscillatory flows, similar to near-bed conditions under large storm waves. Cylinders (200 mm tall and 8 mm in diameter) were fixed on a smooth PVC bed in a uniform 'staggered' arrangement with a density of 430 cylinders/m^2 (Figure 1). Velocities were measured within and above the array using Laser Doppler Anemometry (LDA). In addition, one individual cylinder within the array was mounted on a 6-axis load cell, measuring all forces and moments acting on the cylinder.

Figure 2 shows example results: vertical profiles of RMS horizontal velocity measured under different flow amplitudes. The figure shows that there is a significant reduction in 'in-canopy' velocities at high flow amplitudes. More detailed hydrodynamics and turbulence within and above the array will be presented, focusing in particular on the interface between the array and the 'free-stream', where shear stresses are high. Drag coefficients (determined directly from force data) will also be discussed, and results will be compared to analytical modelling of in-canopy hydrodynamics.

Figure 1 – Cylinder array within the AOFT test section

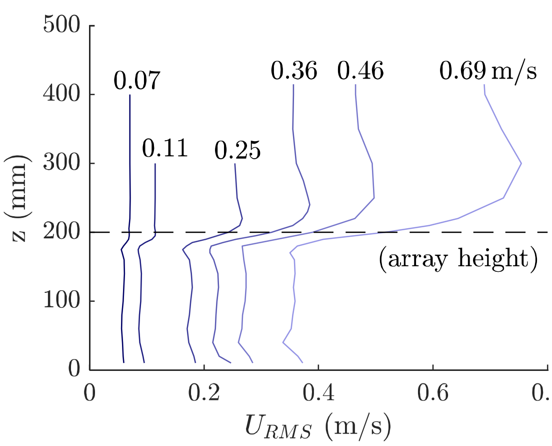


Figure 2 – Vertical profiles of RMS velocity for 6 oscillatory flow amplitudes, U_{RMS} = 0.07 – 0.69 m/s

Poster P5

Stonehaven Erosion Study

Hannah Otton[1] & Douglas Pender[1]

[1]JBA Consulting, Edinburgh, EH14 4AP, Scotland
(hannah.otton@jbaconsulting.com)

Stonehaven is situated 25 miles south of Aberdeen, on the east coast of Scotland. community is at risk from coastal erosion and flooding and is fronted by substantial coastal defences to provide crucial protection to the town. Should these fail, the infrastructure behind would be exposed to direct wave attack resulting in significant erosion and economic damage.

JBA Consulting were commissioned by Aberdeenshire Council to develop a combined flood and erosion protection scheme for the bay. To understand the assets at risk of erosion after defence failure, future projections of the shoreline were required. As the shoreline is effectively held at a constant location, historic analysis of shoreline positions (e.g. NCCA) cannot capture future erosion risk.

Morphodynamic modelling was undertaken to assess how the beach responds to extreme events. This was undertaken using the XBeach suite of models which includes XBeach for sandy beaches, and XBeachG for gravel beaches. Both were used here due to the variation in sediment and observed beach response.

Post-failure modelling of extreme events was undertaken to understand the response of the natural coastline during these conditions. A range of events were modelled and used to estimate an annual average erosion response. This was then projected at different epochs to highlight the risk from unchecked erosion (Fig. 1).

The results show how the variation in sediment diameter and beach profile lead to different retreat rates north to south, with a maximum retreat of 1.66m/year experienced at the north of the bay.

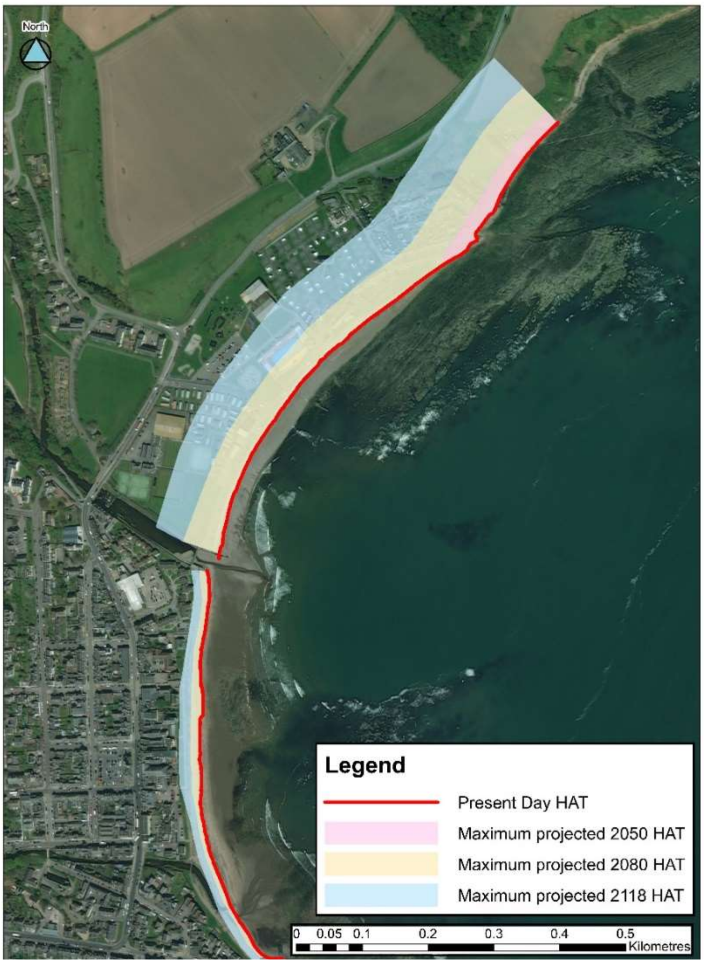


Figure 3: Projected HAT movement by 2050, 2080 and 2118

Poster P6

COVE: A new vector based gravel barrier evolution model

Benjamin T. Phillips[1,2], Jennifer M. Brown[1], Martin D. Hurst[3] & Andrew J. Plater[2]

[1]National Oceanography Centre, Liverpool, L3 5DA, UK
(b.t.phillips@liverpool.ac.uk, jebro@noc.ac.uk)
[2]University of Liverpool, Liverpool, L69 7ZT, UK
(gg07@liverpool.ac.uk)
[3]Glasgow University, Glasgow, G12 8QQ, UK
(martin.hurst@glasgow.ac.uk)

In this contribution, we describe the modification of the COastal Vector Evolution model (COVE), a 'one-line' coastal evolution model, to perform gravel barrier applications. This is motivated by a need for accurate, quantitative predictions of these crucial, naturally evolving defences.

Our modifications include: a longshore sediment transport formula more appropriate for gravel sediment applications, the capability for spatially variable alongshore wave conditions, the addition of tidal and synthetic skew surge forcing, and modelling wave breaking to be more consistent with the hydrodynamics experienced by gravel coasts. Model validation of the evolving shoreline position is ongoing work, but we present some comparisons in transformed wave heights between COVE (which uses linear wave theory) and a coastal area model (POLCOMS-WAM), for Dungeness, a drift-aligned gravel barrier in south-east England.

Our model developments discussed in this contribution, once fully validated, will increase the applicability of COVE at mesoscale spatial scales, allowing for spatially variable shoreface and barrier topography, however, maintaining the existing assumptions inherent in 'one-line' coastal evolution modelling. Future work will chain COVE to XBeach-G to capture cross-shore perturbations at the event scales, and to continue the longshore evolution modeling with COVE accordingly.

Tuesday Session 2

The future of the Isles of Scilly: Flood risk in 2116

Callum Rowett[1] and Fay Fishford[1]

[1]JBA Consulting, 1 Belle Vue Square, Broughton Road, Skipton, BD23 1FJ
+44 (0)1756 699500
callum.rowett@jbaconsulting.com

Recent UKCP18 and previous UKCP09 guidance provide UK climate change predictions, including estimated increases in sea level and changes to the offshore wave climate. Coastal managers must understand how these changes will impact flood risk.

Uncertainty in projections of storm track changes leads to uncertain future wave climate predictions. UKCP18 predicts a decrease (~10%) in offshore significant wave height but there is little consensus between climate models, with some predicting a potentially large (10-15%) change in maximum offshore significant wave height.

This study focused on the Isles of Scilly, an archipelago off the south-west tip of England. Flood risk across the islands can be largely attributed to wave overtopping. The study investigated the risk to key infrastructure, such as freshwater lakes supplying drinking water, and used detailed wave transformation and wave overtopping modelling to convert the predicted UKCP18 changes in the offshore wave climate and mean sea level into future changes in flooding. Tests were performed keeping the mean sea level constant and changing the offshore wave climate.

Although results show an increase in future wave height across the islands, leading to an increase in defence overtopping, these increases are marginal. The study shows that inshore wave conditions are less sensitive to changes in the offshore wave climate due to depth limiting of the waves (i.e. a 10% increase in offshore wave heights results in a <10% increase in inshore wave heights), with the largest wave conditions being least sensitive to climate change-induced increases in offshore conditions.

Poster P7

Scoping study: The impact of climate change and coastal hazards on the Solomon Islands

Marie Schlenker[1], Robert J. Nicholls[1], Ivan D. Haigh[2], David A. Sear[1]

[1]University of Southampton, Southampton, SO17 1BJ, United Kingdom
(m.schlenker@soton.ac.uk; r.j.nicholls@soton.ac.uk; d.sear@soton.ac.uk)
[2]National Oceanography Centre, University of Southampton, Southampton, SO14 3ZH
(i.d.haigh@soton.ac.uk)

Recent UKCP18 and previous UKCP09 guidance provide UK climate change predictions, including estimated increases in sea level and changes to the offshore wave climate. Coastal managers must understand how these changes will impact flood risk.

Uncertainty in projections of storm track changes leads to uncertain future wave climate predictions. UKCP18 predicts a decrease (~10%) in offshore significant wave height but there is little consensus between climate models, with some predicting a potentially large (10-15%) change in maximum offshore significant wave height.

This study focused on the Isles of Scilly, an archipelago off the south-west tip of England. Flood risk across the islands can be largely attributed to wave overtopping. The study investigated the risk to key infrastructure, such as freshwater lakes supplying drinking water, and used detailed wave transformation and wave overtopping modelling to convert the predicted UKCP18 changes in the offshore wave climate and mean sea level into future changes in flooding. Tests were performed keeping the mean sea level constant and changing the offshore wave climate.

Although results show an increase in future wave height across the islands, leading to an increase in defence overtopping, these increases are marginal. The study shows that inshore wave conditions are less sensitive to changes in the offshore wave climate due to depth limiting of the waves (i.e. a 10% increase in offshore wave heights results in a <10% increase in inshore wave heights), with the largest wave conditions being least sensitive to climate change-induced increases in offshore conditions.

Wednesday Session 6

Effects of nearshore spatial discretisation on modelling shoreline change

Avidesh Seenath[1a], Ian Shennan[1], Richard Hardy[1], & Laura Turnbull-Lloyd[1]

[1]Department of Geography, Durham University, Durham, DH1 3LE, UK
[a] Corresponding author: avidesh.seenath@durham.ac.uk

Coastal Numerical Models (CNMs) provide predictions of shoreline change across different timescales, which can guide coastal management. Shoreline evolution studies in data-poor countries may be limited to globally available data, such as the ETOPO1 Global Relief Model (1 arc-minute). The usefulness of coarse datasets in modelling shoreline change, particularly where the outputs inform coastal management, is under-researched. This paper examines how nearshore spatial discretisation influences the accuracy and precision of shoreline change predictions. To simulate the interactions between hard structures, coastal processes, sediment redistribution, and coastal morphological changes, CNMs require a good representation of the nearshore in the computational mesh. An inaccurate solution of nearshore morphodynamics will compromise a model prediction of shoreline change. Input data and their resolution influence the accuracy and precision of model predictions. We consider a managed sandy shoreline in the Long Beach Barrier Island, New York. We use a coastal elevation model from the National Center for Environmental Information to produce computational grids with varying nearshore discretisations, referenced to mean high water. These provide the basis for a two-dimensional coupled wave, flow, and sediment transport model to simulate shoreline change at the site using the MIKE 21 Coupled Model. We quantify the impacts of varying nearshore discretisations on predicted shoreline changes and net littoral drift. From these, we identify an optimal nearshore spatial resolution for modelling shoreline change to refine CNMs and improve their applicability to guide coastal management in data-poor countries.

Poster P8

Quantifying millennial-scale coastal erosion rates using ^{10}Be CRN analysis and numerical models for the UK - new findings of a decelerating coastline in SW England.

Jennifer R. Shadrick[1], Dylan H. Rood[1], Martin D. Hurst[2], Bethany G. Hebditch[1], Alexander J. Seal[1], Michael A. Ellis[3], Klaus M. Wilcken[4]

[1]Department of Earth Science and Engineering, Imperial College London, London SW7 2AZ
(jrs17@ic.ac.uk, d.rood@ic.ac.uk, bethany.hebditch15@ic.ac.uk, ajseal94@gmail.com)
[2]School of Geographical and Earth Sciences, University of Glasgow, Glasgow G12 8QQ, United Kingdom
(Martin.Hurst@glasgow.ac.uk)
[3]British Geological Survey, Keyworth, Nottinghamshire NG12 5GG, United Kingdom
(mich3@bgs.ac.uk)
[4] Institute for Environmental Research (IER), Australian Nuclear Science and Technology Organisation (ANSTO), Lucas Heights, NSW 2234, Australia
(Klaus.wilcken@ansto.gov.au)

Understanding the antecedent trajectory of a rock coast, cliff-platform profile is central to the development of predictive models of cliff retreat that integrate a changing climate. It is critical that these coastal landscapes are studied over timescales that integrate climate variability, the return period of episodic erosion events and precede the influence of anthropogenic modifications to the coastline.

Coupling cosmogenic radionuclide (CRN) measurements and numerical models allows us to constrain the long-term rate of cliff retreat averaged over the Holocene. Samples for CRN analysis have been measured at 5 sites that traverse a range of relative sea level (RSL) histories and rock types across the UK. Results for a site on the south-west coast in north Devon (Bideford) suggest that a gradual decline in cliff retreat rate from ~8 cm y^{-1} to ~1 cm y^{-1} best fits the observed platform morphology under an equilibrium retreat scenario.

A difference between measured and modelled ^{10}Be concentrations implies that the model is overestimating retreat rates, which advocates for a transition away from equilibrium evolution by using a morphodynamic model that can incorporate transient profile geometries and accounting for the missing nuclide inventory.

Our results contrast findings of an accelerating retreat rate on the south coast (Hurst *et al.,* 2016) and reveal variability in coastline responses to changing boundary conditions. At Bideford, the slowing rate of RSL rise over the Holocene is a primary control on retreat rate, implying that future increases in RSL rise rate could accelerate cliff retreat.

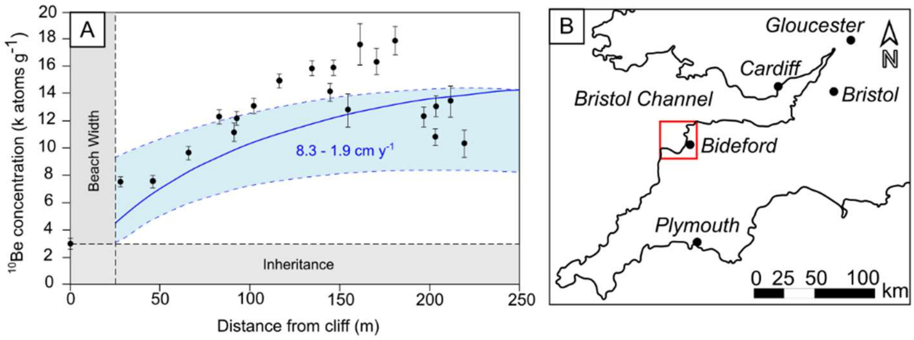


Figure 1. – (A) Background corrected, AMS measured ^{10}Be concentrations and 1σ uncertainties (circle and whiskers, respectively) plotted against distance of sample point from cliff. Most likely retreat scenarios are plotted in blue; the solid line represents the median value and dashed lines and enclosed shaded region represents uncertainties defined by the 5th and 95th confidence intervals. The minimum measured concentration (cliff sample) is assumed to represent the inherited concentration of ^{10}Be. (B) Position of Bideford in SW England.

Poster P9

Investigating the role of small-scale bio-physical linkages in erosion processes at salt marsh margins

Olivia Shears[1], Dr Iris Möller[1], Professor Tom Spencer[1], Professor Kate Royse[2]

[1]Cambridge Coastal Research Unit, Department of Geography, University of Cambridge, Cambridge, CB2 3EN, UK

[2]The British Geological Survey, Environmental Science Centre, Keyworth, Nottingham NG12 5GG

(oms26@cam.ac.uk; im1003@cam.ac.uk; ts111@cam.ac.uk)

Coastal salt marshes can reduce flood and erosion risk. As such, there is considerable interest in incorporating these ecosystems into more 'nature-based' approaches to coastal protection. This includes creating coastal salt marsh though managed realignment – the breaching of sea defences to flood an area of previously protected land.

Previous research has indicated that although the vegetated coastal salt marsh surfaces are resistant to storm impact and can keep pace with sea level rise through vertical growth (provided there is enough sediment available), they are vulnerable to reduction in aerial extent through erosion at the seaward marsh margin. This vulnerability is dependent on poorly understood interactions between ecological, geomorphological and biogeochemical states under varying hydrodynamic forcing. How such linkages operate is likely to vary between natural marsh sites and managed realignment sites. Little is understood about this variability and its role in erosion processes.

Through field and laboratory experiments, this project seeks to improve understanding of small-scale linkages between above-ground vegetation and below-ground substrate structure in managed realignment and comparative natural salt marshes in the UK. A field experiment has been piloted on the Essex coast, designed to investigate erosive processes on a vertical marsh-cliff face at the cm scale, focusing particularly on the changes in volume surrounding structures such as root spaces. Through repeat observations over a period of several months, this experiment highlights how bio-physical controls act to determine changes in structure and volume of marsh soils exposed to conditions typical of macro-tidal marsh to tidal flat transitions.