

Towards understanding sediment processes in estuarine environments

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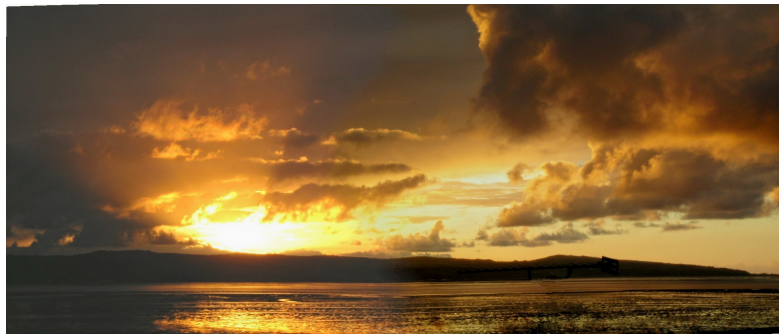
1-NOC-L, 2-SOS Bangor

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Background

The movement of sediments define our coastline, act as reservoirs for nutrients and contaminants, and impact on marine chemistry, biology and ecology. Understanding these linkages is intellectually challenging and of great practical importance; hence sediment transport is studied globally to provide insight into how sediments impact on the planetary coastal system.

Our estuarine environments are some of the most dynamic coastal regions and have great economical, biological and recreational importance. The bed composition of these estuaries is not the clean sand of our beaches, but mixed sediments of muds, silts and sands with cohesive, 'sticky' properties. Trying to understand the dynamic interactions of these mixed sediments under tidal and wave flows is at the cutting edge of our understanding of sediment transport processes.

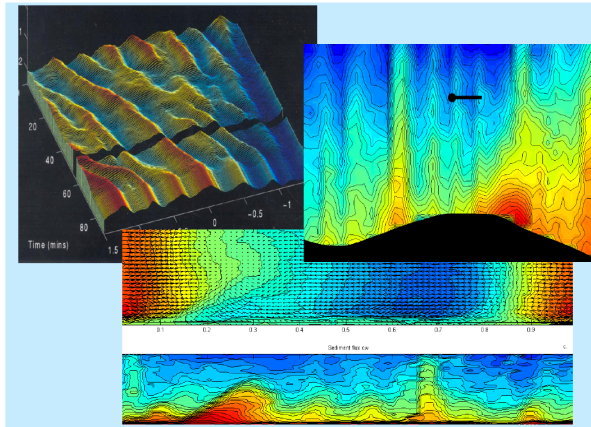


A view over the mixed sediment River Dee estuary at sunset.

The prediction of sediment transport uses regional scale models. At present the output from these regional models often lead to problematic and uncertain sediment transport predictions. This is at least in part due to the formulations representing the underlying physical processes. In this PhD we aim to significantly advance understanding of critical aspects of mixed sediment processes. These include; (i) the onset of motion, (ii) the formation of bedforms, (iii) the entrainment of the sediments into the water column and (iv) the impact of biology. Using full-scale field measurements obtained in the Dee estuary and smaller-scale laboratory simulations carried out at Bangor University, the aim will be to focus on using the understanding delivered in process studies to improve mixed sediment modelling. This will be carried out using data sets already collected and new studies using cutting edge acoustical and optical techniques. These observations will be employed to support the development of next generation physics based sediment transport models for mixed sediment environments.

Key Questions

- (i) How do sediment transport formulae, established for uni-modal clean sand, perform in a mixed sediment environment of sands, clays and muds with a biological component?
- (ii) If the predictive capability of the formulae significantly degrades in these environments, can the established expressions be reformulated to account for the complexity of mixed sediments?



Using advance measurement techniques to study mixed sediments

Workplan

Year 1. An assessment of physics based sediment transport models to identify the areas of weakness with regard to mixed sediments. Assess the data already collected to improve understanding in the areas of weakness and implement this knowledge into physics based models.

Year 2. Assess what measurements need to be carried out to advanced understanding of mixed sediments. Formulate laboratory and field studies to address specific weaknesses not covered in previous studies, using the next generation of optical and acoustical equipment coming online.

Year 3. Assimilate the new observations into formulations which provide an improved description of sediment processes above mixed and biologically active beds.

Training provided

The student will develop a strong background in coastal marine physics, sediment transport and the application of new and novel measurement techniques. They will develop their computing capability, data analysis skills and the application of interpretation to the understanding of physical processes.

The student will have access to some of the most recently collected data in the field of sediment transport research; collected with some of the most advanced techniques. The analysis of the data will be supported by state of the art computational equipment. Opportunities will be available to interact with other PhD students, attend relevant courses and make presentations at national and international conferences. Involvement in new laboratory and field studies will be part of the student's development. Training in academic development and transfer of project outcomes to potential users will be provided by the supervisors and by the Graduate School of the College of Natural Sciences at Bangor University. This training will allow the successful candidate to maximise the impact of their work, and establish a valuable network of professional and societal contacts during their studentship.

Funding for this studentship is restricted to UK and EU nationals who fulfil NERC's eligibility requirements. More information is available from the NERC website: <http://www.nerc.ac.uk/funding/available/postgrad/eligibility.asp>

Recent publications relevant to the research area

Davies A. G. and Thorne P.D. 2008. Advances in the study of moving sediments and evolving seabeds. *Surveys in Geophysics* Vol 29, No 1, January, 1-36.

Thorne, P. D., A. G. Davies, and P. S. Bell. 2009. Observations and analysis of sediment diffusivity profiles over sandy rippled beds under waves, *J. Geophys. Res.*, 114, C02023, doi:10.1029/2008JC004944.

Baas, J.H., Best, J.L. and Peakall, J. (in press) Bedforms and stratification in rapidly decelerating cohesive sediment flows. *Sedimentology*.