# Total Sediment Transport Rate Predictions in Wave–Current Sheet Flow with Graded Sand

# (LUBA)

## OBJECTIVES

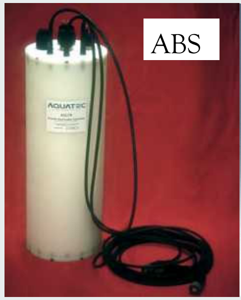
The joint research Project between the University of Liverpool (UL), University of Aberdeen (UA) and University of Wales, Bangor (UWB) aims to achieve an understanding of complex sheet flow processes. It will use new experimental results, especially those involving fine and graded sediments, to implement the essential physics into new intra-wave computer models for combined wave and current flows, which will predict more accurately the sheet flow sediment transport. The following processes which are currently poorly represented will be investigated in the Project:

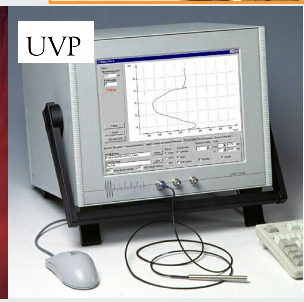
- convective sediment entrainment events
- sand grain size gradation effects
- particle-particle and particle-flow interactions

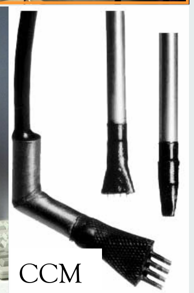
Acquisition and analysis of comprehensive laboratory data and the development of sophisticated numerical models will be undertaken to achieve the project objectives. Project results will be systematically parameterised into simple engineering formulae calibrated for a range of typical nearshore conditions and suitable for easy inclusion into large area morphodynamic models.

## METHODOLOGY

To systematise knowledge of convective sediment entrainment by analysing existing data sets and new data to be obtained using the UA oscillatory flow tunnel, particularly on data involving fine and medium sand beds (UL/UA). The analysis will also include the results from a new UL 2D, 2-phase flow model. A robust parameterisation of the convective entrainment process will be derived for the first time allowing a reformulation of the bottom boundary condition used for suspended sediment in models such as the UWB 1DV k-ε model, (UWB). In addition, the relationships between the transport rates of individual size fractions will be satisfied, given knowledge of the volume composition of the individual fractions in the bed. New grain hiding/sheltering formulations will

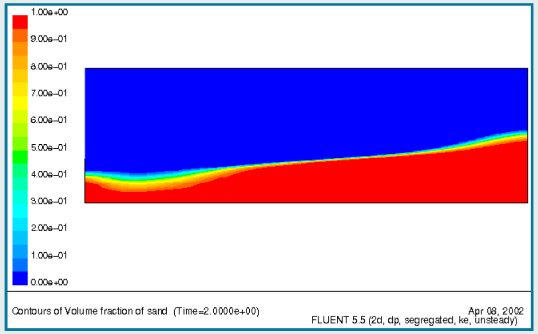



then be derived from the existing data and introduced into the models above, together with erosion depth concepts.

Understanding of grain-grain and grain-fluid interactions will be obtained by developing of a 2D,




2-phase flow model for both steady and unsteady flows (UL), and the development of a new two-layer model that includes a semi-analytical sheet flow layer with realistic properties (UWB).

Information on the relative importance of current- and wave-related components of transport for both combined wave and current flows and also asymmetrical waves will be evaluated and used in runs of the 1DV k-ε model over wide parameter ranges to allow practical parameterised transport formulae to be developed.

## INVESTIGATORS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- Dr Alan Davies, School of Ocean Sciences, University of Wales, Bangor
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## PROJECT DURATION

1 April 2001—31 March 2004 (36 Months)

EPSRC RESEARCH PROJECT

EPSRC

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## Summary

The LUBA Project represents a tripartite partnership between the University of Liverpool (UL), the University of Wales, Bangor (UWB) and the University of Aberdeen (UA). The project aims to improve engineering prediction and physical understanding of sediment transport in combined wave and current conditions in the sheet flow regime for situations in which the bed comprises a mixture of sand grain sizes by physical and numerical models. UL is to develop new wave-current sheet flow computer models, at simple engineering and sophisticated numerical levels, as well as obtain unique oscillatory sheet flow laboratory data with UA using advanced measuring techniques (ABS, UVP and CCMs) to systemise understanding of 'convective' sediment entrainment events at flow reversal. UWB is to extend its existing intra-wave numerical sand transport model to represent grain size mixtures and also account for the effect on the transport rate of 'convective' sediment entrainment events at flow reversal, and to develop a new, two-layer, numerical sand transport model in which the lower layer represents the high-concentration sheet flow region between the stationary bed and the outer suspension layer. Both models will be validated using existing data, and also new data obtained by UA/UL, in the oscillatory sheet flow regime.



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