Curriculum Vitae

Christopher Adam Unsworth B.Sc (Hons), MRes (Hons)

Career Objective:
My overall career goal is to obtain a tenure-track faculty position within 5 years. My present plans are focused on completing my PhD with at least 4 papers published/near publication.

Current Education:
PhD candidate in Earth Science, University of Hull – Supervisor Professor Daniel Parsons.
-Funded by a University of Hull Scholarship.

Previous Education.
Gerhard Jirka summer school in Environmental Fluid Mechanics. Eawag, Dübendorf, Switzerland. 2012. June 11-20

Masters by Research in Geography: MRes (Hons) 1st class.
With 1st class independent research dissertation.
University of Leeds, **School of Geography,** UK, 2010-2011.

Joint Honours Geology and Geography. **Bsc (Hons) 2:1**
With 1st class independent research dissertation, Supervised by Dr Greg Sambrook-Smith
University of Birmingham, UK, 2007 – 2010

Publications:
Extended conference abstract: **Flow structures over fixed 2D bedforms in transient states.** (2013). Unsworth, C.A., Parsons, D.R., Reesink, A.J.H., Best, J.L., Ashworth, P.J., Hardy, R.J. In Van Lanker, V. and Garlan, T. (eds.), MARID 2013. *Forth International Conference on Marine and River Dune Dynamics*. Bruges, Belgium, 15-17 April 2013. Royal Belgian Institute of Natural Sciences and SHOM. VLIZ Special Publication 65 – Flanders Marine Institute (VLIZ). Oostende, Belgium.

Oral Presentations:
"Flow Structures over Fixed 2D Bedforms in Transient States". Marine and River Dune Dynamics (MARID) IV. Bruges, Belgium, 15-16 April 2013.
-Attendance paid for via a Departmental "Research Support Fund" grant.

"Flow Structures over Fixed 2D Bedforms in Transient States". AGU fall meeting 2013 (EP41D-03). *-Attendance paid for via a Departmental "Research Support Fund" grant and funding from the Mekong River Commission.*

"Surface manifestation of coherent flow structures: an experimental investigation" Coherent flow structures in geophysical flows near earth surface. August 3-5, 2011. Simon Frasier University in Burnaby, British Columbia**.**
-Attendance paid for via National Environment Council Research Grant. cf. Dan, Parsons (supervisor).

Bedform hysteresis and cross-set preservation: linking process to product at the event scale

Executive Summary: This application is to cover the costs of a fieldwork campaign to assess the preservation of dune cross sets at event scale. This would be additional to my PhD, and to a fieldwork campaign that is currently planned without the additional aspect of sediment preservation.

Research Outline: River discharge and sediment movement are inherently unstable and the different rates of response of flow, sediment transport and morphological change results in a near constant hysteresis between flow and deposits. This impacts our ability to use our current theoretical and laboratory relationships between river bedform scales and scales of preserved cross-set preservation.

The preservation of dunes as cross sets is based on Leclair's 1/3 preservation rule (Leclair, 2002) which was produced using steady-uniform flow within a laboratory flume. However in natural rivers there is often a lack of consistent scaling between discharge and sediment movement, an example recently reported from the Mississippi (Nittrouer et al., 2008) shows a significant discharge – sediment movement – morphology lag (Figure 1). Carling et al. (2000) demonstrated major changes in bedform shape and sediment transport rates through a flood wave in the Rhine river (Figure 2), importantly noting that the pre-flood, larger scale, bedforms did not relate to recent flow conditions but scaled to previous flood events. These hysteresis affects are un-quantified in traditional preservation models (such as Leclair, 2002) and make bore and cross-section interpretation considerably more complex. My PhD has been investigating these scaling relations in the flume, but it is imperative that field data is gathered to quantity how important flow and sediment unsteadiness and hysteresis affects the preservation of cross strata. Through surveying before, during and after a flood wave, using a combination of ultra-high-resolution sub-bottom profiling (Parametric Echo Sounding, PES) and multibeam echo sounding (MBES), a detailed view of the facies information (at the sub-bedform scale) and 3D river bathymetry can be acquired: effectively linking process to product at the event scale. Through tracking the creation and erosion of bedforms, their deposits through a flood wave, the conditions forming the deposits will be used to produce a HystEresis-Lag-Product (HELP) phase diagram for river bedforms. This would be a step-change on existing models of river dune unsteadiness (e.g. Allen 1974, 1976, 1980) and allow individual outcrops or cores to be placed in a more robust context.

My PhD is primarily focused on detailed experimental work on bedform scales and responses to unsteadiness. A Steve Farrell Memorial Fund award would allow me to participate in an up-coming field campaign on the Mississippi river. This would be an addition to the planned work within my laboratory based thesis on river bedform unsteadiness. This would have a huge impact on my PhD success and longer-term academic development post PhD.

In conjunction with a larger NERC funded project (PI Parsons (Hull)), CI Ashworth, CI Hardy, VI Best, (Illinois)), an extensive fieldwork campaign will be undertaken in April/May 2014 on one of the words largest rivers, the Mississippi - the world's 7th largest river in terms of annual sediment discharge (Milliman and Meade 1983). This project is concerned with changes in bedform geometry during floods and is presently not considering sedimentary aspects of bedform adjustment. April has the highest occurrence of high discharge events (Jordan, 1970, http://waterdata.usgs.gov/usa/nwis/uv?07010000) due to the spring snow melt in the upper catchment. With the well reported cold winter over North America this year, is it expected that a considerable spring flood should occur (http://water.weather.gov/ahps/long_range.php) making it likely to be an excellent opportunity to measure a hydraulic event of considerable scale. The study area (Figure 3) will be based at the Jerry F. Costello Field station (USGS), near the city of St Louis. The survey reach covers and straight channel before the Missouri River mixes with the Mississippi (Figure 3).

Daily measurements of the bed bathymetry using Multi-beam Echosounder (MBES) surveys (e.g. Parsons et al., 2005, their Figure 2) will be taken with simultaneous acoustic Doppler current profiler (aDcp) transects perpendicular to the dune field (e.g. Bradley et al., 2013, their Figure 1) to capture the

flow and suspended sediment structure over the dune field. This would capture the dynamics of the flow and sediment transport hysteresis. Four Parametric Echo Sounder ((PES), see Sambrook-Smith et al., 2013) surveys will be undertaken – additional to this planned work - to measure the sets and co-sets formed by the dunes as they migrate. These PES surveys will be conducted i) before flood to capture the pre flood bedform sedimentary architecture, ii) during the rising limb, and iii) two surveys after the flood to measure the scale and preservation of dune co-sets across the evolving bed. In combining PES, aDcp and MBES surveys I will be able to quantify the entire sediment transport flux and sediment preservation through the section of one of the world's largest rivers in a state of rapid change and will give important insight into: a) how the magnitude of hydraulic event impacts the sediment movement in one of the world's largest rivers, and b) how applicable current preservation models are at the field scale.

An award to conduct this fieldwork on the Mississippi river will have a huge impact on my PhD success and academic development. This work would be in addition to the planned laboratory-based work for my thesis on river bedform unsteadiness, adding in a highly relevant and important component to the topic of fluvial dune set preservation. Fieldwork campaigns commonly produce opportunities to meet people working in the same, or related but previously underutilised, areas and provide opportunities for discussion that often lead to new ideas and collaborations. It would also be an excellent chance for me to promote myself to my peers and demonstrate how I can deliver cutting edge research techniques that reveal new insights into fluvial sedimentology. I will present the results from this fieldwork BSRG 2013 and anticipate it forming an additional chapter in my thesis and ultimately a high-impact international journal paper.

REFERENCES: Leclair ,S. (2002) *Sedimentology*, 49,(6),1157-1180. Nittrouer, J. et al., (2008) *Journal of Geophysical Research*, 113, F03004. Carling, P. et al., (2000) *Sedimentology*, 47,227-252. Allen, J.R. L. (1974) *Earth-Science Reviews*, 10,4 263-342. Allen, J. R. L. (1978) *Sedimentary Geology*, 20, 165-216. Allen, J.R.L. (1980) Sedimentary Geology, 26, 281-328. Milliman, J. Meade, R. (1983) *The Journal of Geology*, 91,(1),1-21. Jordan, R. (1965). *Fluvial Sediment of the Mississippi River at St. Louis, Missouri*. Geological Survey Water-Supply Paper 1802. Washington. Parsons, D. et al., (2005) *Journal of Geophysical Research*, 110, F04S03. Bradley, R.W. et al., (2013) *Journal of Geophysical Research: Earth Surface*, 118, (3), 1693-1709. Sambrook Smith, G. et al., (2013) *Geophysical Research Letters* 40, 3883-3887.

Breakdown of eligible costs:

Flights and transfers	£650	Leeds Bradford - St Louis (USA)
Subsistence	£350	(£25/day-2 weeks)
Accommodation	£420	(£30/day-2 weeks)
Total	*£1,420*	

Amount requested: £710 *(50% Matched Funding agreed with Head of Department, GEES, University of Hull).*

Previous research grant awards (year and amount):

July 2013: British Society for Geomorphology (BSG)

- £175 (September 2013) – For attendance at BSG AGM 2013

March 2013: University of Hull, GEES Department "Research Support Fund"

- £1000 – For attendance at Gerhard Jirka Summer School in Environmental Fluid Mechanics 2012

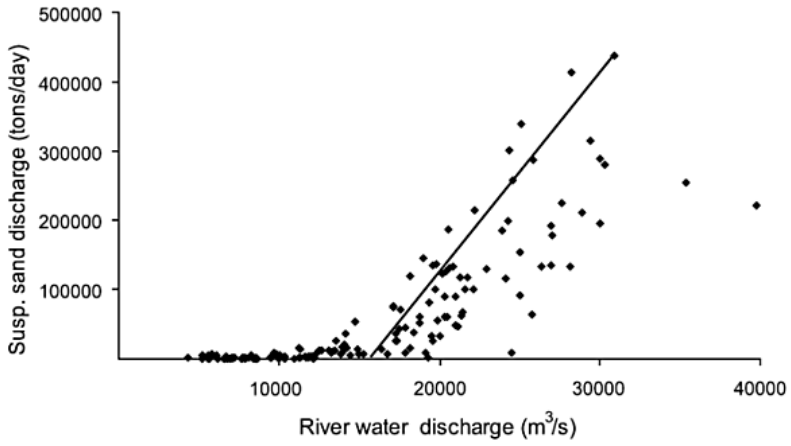

Figure 1: From Nittrouer et al, 2008. Plot showing a considerable flow and sediment discharge hysteresis. Suspended sand discharge is strongly related to the presence of large dunes. The vast majority of sediment movement events occur above a flow threshold of ~16,000m^3s^{-1} because this is where large bedforms start to form.

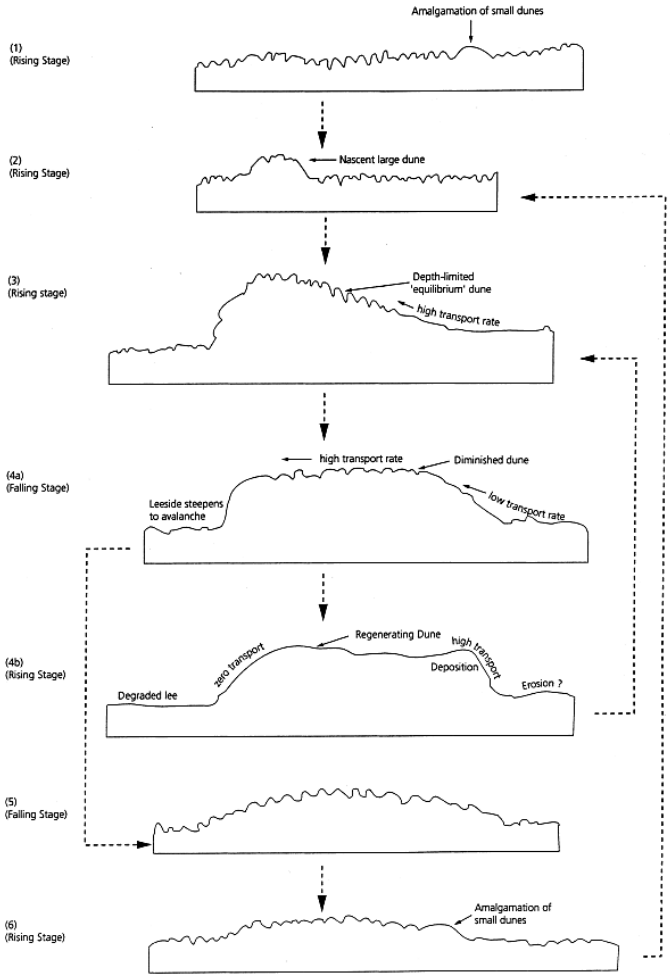

Figure 2: From Carling et al, 2000. Conceptual diagram displaying dune morphology during rising and falling legs of a flood wave. Various scales of bed features form and move downstream depositing cross strata. Such diagrams would be considerably improved by very high resolution measurements of the cross strata and bed morphology through a flood wave, providing event scale preservation potential data.

Figure 3: Field site. The USGS field station is located just above the confluence with the Missouri River, North of the city of St. Louis. The survey reach is a section of straight sandy bed channel ~ 10 km long and 1 km wide with mean annual depths ~12m.