

BSRG FUNDING APPLICATION

"THE INFLUENCE OF SUSPENDED SEDIMENT ON FLUXES OF NITROGEN AND PHOSPHORUS IN ESTUARIES"

MISS EMMA. L. PIDDUCK

Present and Proposed Research

The principle aim of my PhD is to investigate the influence of suspended sediments on fluxes of nitrogen (N) and phosphorus (P) in UK estuaries, with a subsequent view to measuring the effect of nutrient fluxes on water quality. As a key global issue, water quality is controlled by strict legislation to manage the input of nutrients to natural waters – nonetheless, freshwater eutrophication and harmful algal blooms in coastal and estuarine waters persist, leading to a cost of approximately £114 million in measures to defend and repair the damage.

As dynamic systems with vital links to industry, economy and transport, estuaries have long been a topic of research in order to preserve and protect them. Historically, the variable conditions within and between these systems made it difficult to clearly discern the cause and effect relationships between sedimentary processes, nutrient concentrations and the consequent biological impact. This high degree of temporal and spatial variability can be attributed to the changes in factors such as, river discharge, tides, weather and climate that further result in changes to current speeds, turbidity, temperature and salinity – regarded as controlling aspects in sedimentary processes.

An integrated approach will be undertaken to understand the sedimentary fluxes of N & P from a physical and a chemical perspective, with an extensive data set collected both *in situ* and in the laboratory.



Figure 1. The mini-annular flume (Manning et al., 2007)

Laboratory tests will be conducted using sediment (bed and suspended) and water samples collected from two important UK estuaries, the Tamar and Dee. A mini-annular flume (figure 1) (Manning et al., 2007) and LabSFLOC camera system (Manning et al., 2007) will be used to emulate the environment of each estuary, but allow closer observation and control of the many variables such as, salinity, temperature, current velocity and sediment concentration. With changes in each variable, sediment properties, such as settling velocity, floc size, effective density and porosity will be recorded and water samples collected and analysed for nutrient concentration to allow comparison.

Nitrate, nitrite and phosphate analysis will be conducted using the SKALAR Continuous Flow Analysis system (CFA) while ammonium concentrations will be determined using a Hitachi F4500 fluorimeter. Total Dissolved Nitrogen (TDN) and Total Organic Carbon (TOC) will also be measured.

In situ data will also be collected using instruments such as the LISST-100X (Laser In-Situ Scattering Transmissometry), an ADCP (Acoustic Doppler Current Profiler), and ABS (Acoustic Backscatter Sensor), OBS (Optical Backscatter Sensor), ADV (Acoustic Doppler Velocimeter) and the LabSFLOC camera system. ADCP will allow indications of the suspended sediment fluxes over tidal cycles to be established, as it is anticipated that comparing nutrient concentrations to sediment fluxes calculated over a tidal cycle will determine the greatest input of nutrients when compared with the flow velocities and floc properties. ADV measurements will indicate levels of shear stress in the water column and allow direct

comparison to that of shear stress data from the flume. ABS and OBS sensors will also provide accurate information about sediment properties providing a form of quality assurance of the results provided by ADCP, LabSFLOC and LISST-100C.

Appreciation of the significance of this research was highlighted by the offer of an additional field site in France, in collaboration with the well-respected '*Institut français de recherche pour l'exploitation de la mer*' (IFREMER). This opportunity for the collection of data on the River Seine will facilitate a comparison of sediment-nutrient relationships within an international context.

The unforeseen costs of this opportunity are the principal reason for this funding application; transfer of the LISST-100C to France will require specialist shipping due to the dimensions and fragile nature.. Similarly, in order to preserve the composition of and subsequent processing of water samples, additional chemicals and consumables are required, namely - Ortho-Phthaldialdehyde (OPA), Hydrochloric Acid (HPLC Grade) and Sterilised Pipette Tips (for both the 100 to 1000 μ L range and the 2 to 10mL range).

I believe this research project will provide invaluable experience and insight in to the realms of sedimentary research, with the additional benefit of the application of existing skills and the chance to learn new ones under the guidance and tutorage of esteemed scientists on an international collaborative project. As a young scientist, with a passion for the dynamics of sediments in the marine environment, I feel this opportunity is an exciting prospect that I consider to be a privilege.

References:

- Manning, A. J., Friend, P. L., Prowse, N. and Amos, C. L.** (2007). Estuarine mud flocculation properties determined using an annular mini-flume and the LabSFLOC system. *Continental Shelf Research*. **27** (8): 1080 – 1095.

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Cost Breakdown:

The following table details the breakdown of how funding would be spent.

Item/Chemical/Transport	Description	Cost
LISST-100C	Transport to and from France using Parcelforce Worldwide.	£240
Ortho-Phthalodialdehyde (OPA)	Used, in conjunction with other chemicals, to determine ammonium concentration.	£40.00 for 10g
Hydrochloric Acid – HPLC Grade	Used for the acid washing of glassware, plastic ware and in ammonium determination.	£21.41 for 2.5L
Sterilised Pipette Tips (racked) 100 to 1000µL range	Tips for sampling (one per sample) and transfer of working reagent etc.	£19.00 for 960
Pipette Tips for 2 to 10mL range	As above.	£31.21 for 120
	Total:	£351.62

This application is for a **partial award** of the Gill Harwood Memorial fund. All other costs, such as accommodation, personal transport and consumables, will be paid for by IFREMER from their project budget.