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Understanding microbial/DOM interactions using fluorescence and flow cytometry

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The transformation and movement of dissolved organic carbon (DOC) within freshwater aquatic systems is an important factor in the global cycling of carbon. DOC within aquatic systems is known to underpin the microbial food web and therefore plays an essential role in supporting and maintaining the aquatic ecosystem. Despite this the interactions between bacteria and dissolved organic matter (DOM) are not well understood, although the literature indicates that the microbial processing of bioavailable DOM is essential during the production of autochthonous, labile, DOM. DOM can be broadly characterised by its fluorescing properties and Coble et al. (2014) define terrestrially derived DOM as exhibiting “peak C” fluorescence, whilst labile microbially derived DOM is defined as showing “peak T” fluorescence. Our work explores the microbial/DOM interactions by analysing aquatic samples using fluorescence excitation and emission matrices (EEMs) in conjunction with microbial consumption of dissolved oxygen.

Environmental and synthetic water samples were subjected to fluorescence characterisation using both fluorescence spectroscopy and in situ fluorescence sensors (Chelsea Technologies Group Ltd.). PARAFAC analysis and peak picking were performed on EEMs and compared with flow cytometry data, used to quantify bacterial numbers present within samples. Synthetic samples were created using glucose, glutamic acid, nutrient-rich water and a standard bacterial seed. Synthetic samples were provided with terrestrially derived DOM via the addition of an aliquot of environmental water. Using a closed system approach, samples were incubated over time (up to a maximum of 20 days) and analysed at pre-defined intervals.

The main focus of our work is to improve our understanding of microbial/DOM interactions and how these interactions affect both the DOM characteristics and microbial food web in freshwater aquatic systems. The information gained, in relation to the origin, microbial processing and subsequent production of DOM, will inform the development of a new generation of in situ fluorescence sensors. Ultimately, our aim is develop a novel technology that enables the monitoring of ecosystem health in freshwater aquatic systems.