

Project title: The application of novel real-time sensors for high spatial resolution monitoring of aquatic pollution

Ref: OP2441

Keywords: Trace detection of aquatic pollutants; microfibre sensors; rivers; lakes; marine

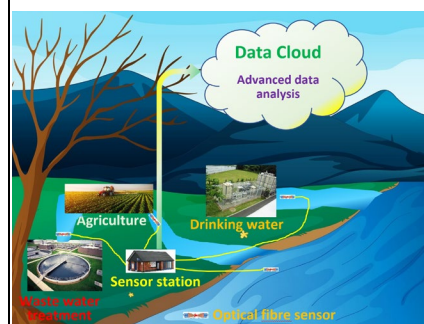
One Planet Research Theme:

Climate & Climate Change | Earth System Processes | Anthropocene | Environmental Informatics

Lead Supervisor: Dr. Michael Deary, Northumbria University

Key Research Gaps and Questions:

Extreme and unpredictable weather events arising from climatic change creates an increased risk of aquatic pollution because of damage to urban infrastructure, overwhelmed sewerage systems and drainage from contaminated land. Current monitoring schemes have low spatial and temporal resolution, limiting our ability to evaluate catchment quality. Therefore, this project seeks to: (a) *evaluate the role of networks of low-cost sensors, based on optical fibre technology, to measure aquatic pollutants in real time; and (b) utilise the data collected from sensor networks to model aquatic pollutant dispersion pathways under different weather conditions.*



Project Description:

Sensor technologies that can monitor water quality continuously are desirable when trying to detect episodic pollution events. Current commercially available sensor technologies are not capable of real time monitoring, they tend to have high costs, need frequent calibration and offer relative low sensitivity. Optical fibre sensor technology, incorporating molecularly imprinted polymers, can provide a solution to these problems, specifically, they have in-situ monitoring capability, are low cost (<£1k) and demonstrate ultra-high sensitivity (ppb/ppt levels for metal ions) (DOI 10.1039/d1an01982a). The low cost of such sensors allows for their deployment at high spatial resolution, and thus provides the ability to detect specific sources of pollutants and to determine dispersion pathways through catchments.

In this project, optical fibre sensors, will be evaluated for application to remote, long-term catchment area monitoring, using an array of online sensors. With an initial focus on toxic metal ions, the main tasks will include: (i) sensor characterisation in terms of scope of application to different metal ions and the evaluation of respective detection limits compared to traditional analytical techniques; (ii) assessing the selectivity of the sensors for specific pollutants by repeating the sensitivity measurements in the presence of a mixture of potentially interfering chemical substances (e.g. typical water components such as carbonates, phosphates, nitrates, and other metal ions); (iii) evaluation of the sensitivity and selectivity in real aquatic environments where organic and inorganic complexation of metal ions may occur. Subsequent to the sensor evaluation stages, a suitable North-East catchment area (for example, the Team Valley) will be selected for deployment of a sensor network array. Data collected from the network will be used to model pollutant dispersion through the catchment using software such as the US EPA Water Quality Analysis Simulation Program. This will increase our understanding of the impact of extreme weather events on catchment quality and contribute to the design of mitigating measures.

Prerequisites: This project would suit a candidate with practical experience in analytical and environmental chemistry/geochemistry. For more information, please contact Michael Deary (michael.deary@northumbria.ac.uk).

