About the Project

Rationale

The overarching aim of this project is to create a methodology for widespread monitoring and short-term forecasting of cyanobacterial and algal blooms in lakes, using Internet of Things (IoT) sensors, Earth Observation (EO) data, and machine learning, applicable in real-time.  
  
Algae can form nuisance and unsightly blooms in lakes, with cyanobacteria being particularly problematic as they can be toxic and scum-forming, posing a risk to the ecosystem and to public health. The ability to predict cyanobacterial (and algal) blooms is highly desirable to provide pre-warning to society and enable management processes to be activated in advance to limit the impact. Previous work has shown that satellite data from the Sentinel 2 platform can be successfully used for estimating algal concentrations in lakes. The advent and uptake of high resolution in-lake automated water quality sensing technology together with new satellite platforms now enables a step-change in data availability that could be used for monitoring and forecasting of cyanobacterial (and algal) blooms in lakes. Here we aim to utilize EO data, including from new satellite platforms, new in-situ sensor technology, available meteorological data, and field monitored data, combined with machine learning techniques to provide a real-time, intelligent capacity for assessing current state and providing short-term forecasts of likelihood of algal and cyanobacterial blooms for multiple lakes in Scotland.  
  
Methodology  
The project will initially collate EO and meteorological data for the last few years together with water quality data supplied by the Scottish Environment Protection Agency and by Scottish Water. These data will be used to identify historic occurrences of algal and cyanobacterial blooms in lakes. Machine learning techniques will then be used with these data and with site characteristics to develop a probabilistic prediction of blooms. The algorithms will then be useable in real-time through the IoT utilising incoming EO and meteorological data, to provide a short-term forecast of the likelihood of a bloom, dependent on the weather conditions over the next few days. This approach will be complemented by analysing similarity in timing of blooms across nearby lakes, utilising the wealth of lakes for which EO data are available. Coupling the output of the coherence and forecasting studies will increase the number of lakes for which predictions can be made. The third part of the project will involve combining above-lake and within-lake automated sensors and manual sampling to collect water quality data from Airthrey Loch (on the University of Stirling campus). These data will be used to determine the efficacy of utilising data from the nanosatellite constellation, ‘Doves’, which provides data at different wavelengths and at higher spatial resolution than Sentinel 2, for monitoring and forecasting of cyanobacterial blooms, with the possibility of widening this approach using other water quality sensors deployed in the Forth catchment area.  
  
The student will be based at the University of Stirling. Training will be provided in key areas, such as remote sensing, machine learning, or limnology, as appropriate. This project would suit someone numeric and competent at coding, with an interest in the environment, and will include some field work.  
  
Applicants are strongly advised to make an informal enquiry about the PhD to the primary supervisor well before the final submission deadline. Applicants must send a completed application form (available here https://www.hydronationscholars.scot/apply), their Curriculum Vitae and a covering letter to the primary supervisor by the final submission deadline of 8th January.