Project Title: AI for Environmental Sciences

Lead Institution/Department: University of Bristol, School of Geographical Sciences
Lead Supervisor: Dr Chris Williamson, Geographical Sciences
Co-Supervisor: Dr Levi Wolf, Geographical Sciences
Co-Supervisor: Dr Rupert Perkins, Cardiff University, School of Earth and Ocean Sciences

Summary: A fully funded PhD studentship (UK fees + annual stipend + research budget) is available at the University of Bristol, working at the interface between Artificial Intelligence and Environmental Sciences. This will suit an outstanding candidate with knowledge of machine learning and image analysis using convolutional neural networks. The position aims to begin in January 2024 and runs for 4 years. The deadline for application is Friday 24th November, 2023. Please contact c.williamson@bristol.ac.uk if you are interested in this position.

Project Background: Artificial Intelligence (AI) holds significant potential to revolutionise environmental sciences, particularly where monitoring of environmental resources is required. In freshwater ecosystems, microalgae and cyanobacteria are a key component of the water system but under the right conditions can form dense algal blooms, producing toxins and other deleterious effects. These algal blooms are expected to increase in both frequency and intensity into the future on a global scale. Current monitoring practices involve manual identification and counting of algae within water samples using traditional microscope techniques that are time consuming, labour intensive and do not provide sufficient granularity to be used in predictive modelling of risk. There is a significant need to advance algal monitoring techniques. This project will address this need through design and implementation of an AI-based solution.

Project aims and methods: Building on proof-of-concept work already undertaken at the University of Bristol, this project will design and implement a Convolutional Neural Network (CNN) based machine learning pipeline capable of accurate identification and enumeration of algal communities from imagery. The PhD student will spend the first two years of the project developing the CNN architecture and training data processing steps required to make the most efficient monitoring algorithm. This work will be supported by a dedicated research technician who is responsible for training dataset production, and a parallel PhD studentship at Cardiff University who will do complimentary eDNA sequencing for ground-truthing of our CNN-based approach. The third year of the PhD will be spent bench-marking our CNN pipeline against traditional techniques in a real-world setting, allowing to demonstrate the advances that our AI-based approach provides for environmental monitoring. The final phase of the PhD will be used to demonstrate the advanced predictive capabilities offered by the higher-resolution community datasets that our approach will produce, likely using ML techniques.
**Candidate Requirements:** This project would suit an outstanding candidate with knowledge of artificial intelligence, machine learning and/or convolutional neural network construction, optimisation and application. **The funding associated with this project requires that the applicant is already eligible to study in the UK,** hence we cannot accept international applicants. Experience in coding (e.g. Python, R) is strongly desired. No microalgae and/or environmental sciences experience is required. We welcome and encourage applications from under-represented groups.

**Project Partners:** This PhD forms part of a larger research project funded by the Ofwat Water Breakthrough Challenge Round 3. The main academic partners include the University of Bristol (School of Geographical Sciences), Cardiff University (School of Earth and Ocean Sciences) and Dwr Cymru Welsh Water. There are also 4 other UK water companies included in the project who will provide samples for training dataset compilation. You will be based in the School of Geographical Sciences, University of Bristol, and form part of this larger team, along with another PhD student based at Cardiff University, and a research technician based at Bristol.

The School of Geographical Sciences, University of Bristol, holds particular expertise in algal monitoring, machine learning and CNN development and you will be supervised there by x2 leaders in this field (Dr Chris Williamson and Dr Levi Wolf). Dr Rupert Perkins at Cardiff University has a long history of working between academia and the UK water industry and will also act as co-supervisor for this PhD, allowing to tie in with the other studentship based in Cardiff. Dr Williamson and Welsh Water have been working in collaboration on this topic for several years. Welsh Water will act as lead water company on the larger project and will provide the platform against which to bench-mark our CNN products as the project proceeds. There will be significant opportunity to interact with industry leaders throughout this studentship if desired, allowing to see the applied outputs of your work.

**Training:** You will receive extensive training in image analysis, data augmentation, machine learning, and convolutional neural network design, optimisation and implementation. You will emerge with a strong background in interdisciplinary sciences, including the application of artificial intelligence to problems of environmental sciences, positioning yourself at the leading edge of this rapidly advancing field. A demonstrable track-record in highly marketable transferable skills, including coding, numeracy, written and spoken presentation, and an ability to work effectively within a multidisciplinary team that spans academia and industry will also be developed. You will have opportunities for overseas travel for networking (conferences).

**Useful Links**
- [http://www.bristol.ac.uk/geography/courses/postgraduate/](http://www.bristol.ac.uk/geography/courses/postgraduate/)
- [https://www.bristol.ac.uk/study/postgraduate/research/geographical-sciences-physical-geography/](https://www.bristol.ac.uk/study/postgraduate/research/geographical-sciences-physical-geography/)

**How to Apply**
The deadline for this position is Friday 24th November, 2023. The studentship will aim to begin in January 2024. Please note, the funding for this position is already secured and is not competitive against other projects. Please email Dr Williamson ([c.williamson@bristol.ac.uk](mailto:c.williamson@bristol.ac.uk)) in addition to making your official application. For the official application, please apply to the “PhD in Geographical Sciences (Physical Geography)” research programme, using this link: [https://www.bristol.ac.uk/study/postgraduate/apply/](https://www.bristol.ac.uk/study/postgraduate/apply/)