Funded PhD Project

Optical-biogeochemical dynamics of oligotrophic lakes

Supervisory team: E. Spyrakos[1], P. Hunter[1], A. Tyler[1], S. Simis[2], D. Odermatt[3]
[1]University of Stirling [2]Plymouth Marine Laboratory [3]Swiss Federal Institute of Aquatic Science and Technology

The project

Rationale/Background: Lakes have been described as 'sentinels, integrators and regulators' as a result of their sensitivity to climate change either directly or through effects on their catchments. The availability of freshwater is ranked among the highest threats to the global economy, and yet only a very small fraction of the global population of lakes are regularly monitored. Remote sensing of optical water quality, in particular biogeochemically, ecologically and economically relevant variables such as the standing stock of phytoplankton, has reached a level of maturity allowing initiatives such as the NERC-GloboLakes (www.globolakes.ac.uk) and ESA-Diversity II (http://www.diversity2.info/) projects to map, optical water quality at larger scales and over long-term time-series. However, significant challenges remain, particularly in regards to the accurate retrieval of water quality information in highly absorbing inland waters with low to moderate biomass due to the strong presence of dissolved organic matter. There is an urgent need to develop and validate new algorithms to improve the accuracy with which we can retrieve essential water quality parameters such as chlorophyll-a in these waters to improve our quantitative understanding of the status of inland waters and the impact of stressors such as climate and land use change on these otherwise relatively unimpacted waters at the global scale.

Research questions: This PhD project will: a) Define optimal algorithms to retrieve Chl-a (within the context of coloured dissolved organic matter and suspended particulates) in oligotrophic and mesotrophic inland waterbodies; b) Use hyperspectral simulations and observation data to determine optimal configurations of said algorithms in the context of current and future satellites, to ultimately assess which (future) satellite configurations offer essential 'breakthrough' capabilities to monitor these waterbodies?

Methods: This PhD will bring together Earth observation, in-water optics (including field sampling), and data analytics. *Earth observation*: Data from the Sentinel-2/-3 and ENVISAT satellites will be exploited to retrieve water constituents from these environments. These data are then used in a framework for rapid algorithm evaluation and validation (at PML), available to the student. *In situ data*: New data will be collected to complement available datasets, where seasonal representativeness is currently lacking for the water types under study. In situ characterisation of the optical-

biogeochemical properties and water-leaving reflectance in collaboration with Eawag and other institutions will be used for algorithm validation including atmospheric correction. *Simulated data*: Simulated (Hydrolight) spectra will also be generated to fill gaps in the *in situ* data record, to contribute to algorithm development and uncertainty characterisation.

Outputs: We anticipate that this studentship will make a significant contribution to the scientific literature including the improvement of water constituent retrieval and detection limits for mesotrophic and oligotrophic lakes. The research will contribute to the further development of satellite early warning systems. Studying these lakes will provide a better understanding of how climate change drivers may impact on these systems now and in future. The existing collaboration between USTIR and PML means that a global time series dataset (2002 – ongoing) for > 1000 lakes will be using the improved algorithms.

The studentship

This studentship provides an exceptional opportunity for a student to join a team with internationally recognised expertise in Earth observation. The student will primarily be based at Stirling, but will collaborate and spend periods of time working with scientists from the Plymouth Marine Laboratory (PML) and Swiss Federal Institute of Aquatic Science and Technology (Eawag). The student will have access to state-of-the-art instrumentation and facilities and will receive specialist training in radiative transfer modelling, satellite data processing, collection/processing of bio-optical data and statistical analysis. The student will also receive training in transferable skills through the Stirling Graduate Research School. The successful student must be prepared to spend short periods undertaking fieldwork in the UK and overseas.

This is a tied project studentship funded by the University of Stirling, PML and Eawag. We welcome applications from all interested individuals, but a first class degree (or equivalent, typically >70% or >8 for different grade points systems) in (geo)physical, environmental sciences or a closely related discipline and/or MSc with distinction is recommended.

The studentship is available for three-years. For the successful candidate, the studentship will cover tuition fees and provide a tax-free stipend (estimated £14,777 for Session 2017-18). We will consider applications from UK/EU candidates (but see University of Stirling funding rules for exceptions regarding EU citizens). We also welcome applications from international students if the additional funding for the international fees and visas can be guaranteed by the applicant.

To Apply

Please email you CV and Covering letter with the names and contact details of at least two academic referees to Dr Evangelos Spyrakos: evangelos.spyrakos@stir.ac.uk by 31 May 2018.

Your covering letter should clearly set out your suitability and motivation for this PhD with reference to your experience and achievements. Informal enquiries should be directed to evangelos.spyrakos@stir.ac.uk; +44 (0) 1786 467759.

Related Subjects

Environmental Physics; Geophysics; Aquatic Sciences; Biology; Environmental Science; Geography
Remote Sensing; Marine Sciences; Limnology; Geo informatics