

PROJECT TITLE: Using machine learning to predict environmental and biosphere change

University of Bristol Theme: “Climate and Environment Research Challenge Area”, “Digital and Data Research Challenge Area”

Research Group(s): Marine And Terrestrial Environments

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Project keywords: Evolution, Habitability, Machine Learning

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Project Background

Ever growing datasets of environmental change have led to a need for continued testing of our understanding. Firstly, geochemical data has driven our understanding of habitability throughout Earth history, sometimes reliant on very few locally restricted data points. Modelling of global change based on these restrictive proxies has largely allowed for the research community to understand the driving mechanisms and implication of environmental change on other aspects of the environment. As a consequence of this, our understanding of past ecosystem change is sometimes at the mercy of our geochemical understanding. It is important to note that environmental change may not only have a negative impact on ecosystems, but increases in oxygen and nutrient availability have been thought to promote biological innovations throughout Earth history. When taking this forward to understand how modern day ecosystems may respond to environmental change, it is important to predict how different organisms will respond to different stressors.

Project Aims and Methods

This project will apply various machine learning methods to world-leading datasets to constrain the broad geochemical landscape throughout Earth history. Going further biogeochemical modelling will be used to spatially reconstruct the environmental change in space and time, to provide a means to test geochemical sampling efforts. Machine learning will also be used to determine the impact of different environmental stressors on ecosystems, in addition to defining primary and secondary stressors. The open nature of the project would allow the researcher to develop an interest in specific aspects of Earth history or environmental change, but several key questions will be addressed:

- 1) Is it possible to recreate Earth’s biogeochemical landscape through time using currently available data?
- 2) What are the primary stressors on ecosystem change during intervals of drastic environmental change such as mass extinctions?
- 3) Can we effectively use past environmental change to predict how our present biosphere will respond to climate change?

Candidate

Ideally candidates will have knowledge of, or an interest in Earth history or planetary habitability. While a computing background isn’t needed as training will be offered, an interest in developing computer models is advantageous. We value a diverse research environment and welcome and encourage applications from under-represented groups.

Training

This project will provide training in cutting-edge modelling and machine learning for both long term planetary and ecosystem evolution. The researcher will also interact with world leading international researchers to better understand the capabilities of numerous redox proxies, in addition to the impacts of environmental change on the biosphere. The student will also be encouraged to participate in personal development courses to develop both technical and personal skills essential for a successful scientific career. Opportunities to present at conferences will be actively supported.

Background reading and references

Stockey et al. 2024. <https://www.nature.com/articles/s41561-024-01479-1>

Useful links

<http://www.bristol.ac.uk/earthsciences/courses/postgraduate/>

Eligibility

UK and International students are eligible for a University of Bristol Scholarship. UoB Scholarships are fully funded for 4 years and cover university fees, living expenses at the UKRI standard rate, and an allowance of £2100 per year towards research expenses.