PROJECT TITLE: Methane in ancient climates – a hidden climate feedback?

DTP Research Theme(s): Changing Planet

Lead Institution: University of Bristol

Lead Supervisor: Dan Lunt, University of Bristol, School of Geographical Sciences

Co-Supervisor: David Naafs, University of Bristol, School of Chemistry

Co-Supervisor: Paul Valdes, University of Bristol, School of Geographical Sciences

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Project keywords: methane, climate modelling, climate sensitivity, paleoclimate

Wetlands are one of the major sources of methane, which is a key climate feedback mechanism. We will use climate modelling to understand methane feedbacks on timescales of millions of years, and its implications for climate sensitivity.

Project Background

Over timescales of many millions of years, atmospheric carbon dioxide changes (driven by the balance between volcanic emissions and weathering) are the primary forcing of Earth system change. However, there are multiple feedback processes that mediate this CO₂ forcing. Some of these are relatively well understood, such as snow and seaice albedo feedbacks, and water vapour and lapse rate feedbacks, and there have been recent advances in understanding cloud feedbacks. However, methane feedbacks have the potential to be play a huge role on these timescales, but until now have been neglected. In this project we will explore these methane feedbacks using a modelling approach, and in particular examine the implications for climate sensitivity and model evaluation in past climates.

Project Aims and Methods

Climate models are often evaluated by their ability to predict past climates. However, if these models neglect key feedbacks that were likely active in the past, then this evaluation is flawed. On timescales of millions of years, it is likely that methane concentrations were considerably different to today, due to natural methane feedbacks. However, these are often not included in models. As such, it is critical that we advance our understanding of atmospheric methane changes in past climates.
We will aim to simulate methane emissions, and ultimately the methane cycle, using an atmosphere-ocean climate model coupled to a wetland emission model. We will benefit from recent work in Bristol which has added improvements to the UK Met Office climate model, HadCM3L, making it appropriate for use on timescales of multi millions of years. Using this model we will build on existing simulations of the last 500 million years, and explore the sources of methane relevant on these timescales.

The results will inform model-data comparisons in past climates, lead to a shift in our understanding of climate sensitivity, and ultimately feed into future model development.

The successful applicant will have a key role in shaping the project, in particular in the latter stages. The student will gain skills in climate modelling, and also in interpreting geological data.

**Candidate requirements**
The successful student will likely have some experience of modelling, and may have experience with geological (paleoclimate) data. We welcome and encourage student applications from under-represented groups. We value a diverse research environment.

**Project partners**
The project will benefit hugely from input from paleoclimate experts from the geological community, both in Bristol (David Naafs) and Cardiff (Carrie Lear).

**Training**
We will provide training to run the climate models that will be used in this project, and the underlying analysis tools and environments, such as Python and Linux.

**Background reading and references**

**Useful links**
[http://www.bristol.ac.uk/geography/courses/postgraduate/](http://www.bristol.ac.uk/geography/courses/postgraduate/)

Bristol NERC GW4+ DTP Prospectus: [http://www.bristol.ac.uk/study/postgraduate/2023/doctoral/phd-great-western-four-dtp/](http://www.bristol.ac.uk/study/postgraduate/2023/doctoral/phd-great-western-four-dtp/)

How to apply to the University of Bristol: [http://www.bristol.ac.uk/study/postgraduate/apply/](http://www.bristol.ac.uk/study/postgraduate/apply/)

Please note: If you wish to apply for more than one project please contact the Bristol NERC GW4+ DTP Administrator to find out the process for doing this.

The application deadline is Monday 9 January 2023 at 2359 GMT. Interviews will take place during the period 22 February – 8 March 2023.

NERC GW4+ DTP Website: For more information about the NERC GW4+ Doctoral Training Partnership please visit [https://www.nercgw4plus.ac.uk](https://www.nercgw4plus.ac.uk).

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