PROJECT TITLE: The temperature of our planet – modelling and communicating a 500-million year history.

DTP Research Theme(s): Changing Planet

Lead Institution: University of Bristol

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

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

Co-Supervisor: Carrie Lear, University of Cardiff

Co-Supervisor: Scott Wing, Smithsonian institution, Washington DC, USA

Co-Supervisor: Chris Scotese, Northwestern University, USA

Co-Supervisor: Ethan Grossman, Texas A&M University, USA

Project Enquiries: (Dan Lunt – d.j.lunt@bristol.ac.uk)

Project keywords: “climate” “paleoclimate” “science communication”

---

Modelled temperatures during the super-warm Cretaceous, 100 million years ago, when dinosaurs ruled the world.

Artist’s impression of the forthcoming Fossil Hall exhibit, “Deep Time”, at the Smithsonian Institution, Washington DC.

---

Project Background

Over the last 500 million years, Earth’s temperature has fluctuated considerably, from the extreme cold of the last ice age, 20,000 years ago, to the super-warmth of the mid Cretaceous, 100 million years ago. However, exactly how this temperature has evolved as a global mean is not well known at all, due in part to the sparsity of indicators of temperature preserved in the geological record, and partly to uncertainties in the calibration of these indicators. A robust global mean temperature curve would be an incredible tool for public outreach, illustrating the swings in climate that have occurred naturally in the past. In this project, in conjunction with the Smithsonian Institution in Washington, we will aim to produce such a temperature history for the first time.

Project Aims and Methods

We will aim to produce a global mean temperature history of the last 500 million years, using climate model simulations to interpolate and contextualise sparse geochemical indicators of temperature from the geological record. We will use the UK Met Office model, HadCM3, and a unique set of paleogeographic maps that cover these time periods and include information on topography and bathymetry, to simulate global and regional temperature under varying carbon dioxide concentrations. Statistical methods will be used to combine these model simulations with temperature estimates derived from oxygen isotopes from various geological archives. Taking into account uncertainties in calibration, the sparsity of the data, and
uncertainties in the climate model simulations themselves, we will produce a temperature record with error bars that fully reflect our best understanding of how temperature has changed over this time period. Combined with estimates of carbon dioxide concentrations over time, this will also allow an estimation of how “climate sensitivity” has varied over time – a key metric used in the Intergovernmental Panel on Climate Change reports. Furthermore, model sensitivity studies will allow us to understand the mechanisms for the changes in temperature, for example the relative importance of CO₂ versus plate tectonics versus changes in Earth’s orbit or the strength of the sun.

**Candidate Requirements**
This project would be ideally suited to someone with a strong quantitative background, familiar with climate science, and comfortable with computer programming. You should also be passionate about science communication, and ideally have an interest in Earth’s past climate history.

**CASE or Collaborative Partner**
The Smithsonian Institution is in the process of building a new Fossil Hall exhibit – “Deep Time”, which will provide a walk-through of the last 500 million years. Part of this exhibition will include an aspect of changing temperatures. The PhD student will work closely with the Smithsonian to explore how best to communicate the concept of varying temperatures over time, and how recent global warming can be put into the context of past changes.

**Training**
The student will develop skills in climate modelling, interpretation of paleoclimate data, and model-data comparisons. They will spend time in Washington DC at the Smithsonian Institution, and develop skills in science communication and outreach.

**References / Background reading list**

**Links:**
School URL –
http://www.bristol.ac.uk/geography/courses/postgraduate/

NERC GW4+ DTP Website:
http://nercgw4plus.ac.uk/

Bristol NERC GW4+ DTP Prospectus:
http://www.bristol.ac.uk/study/postgraduate/2019/doctoral/phd-great-western-four-dtp/

Application deadline:  16:00 GMT, Monday 7 January 2019
How to apply to the University of Bristol:
http://www.bristol.ac.uk/study/postgraduate/apply/

General Enquiries:
Bristol NERC GW4+ DTP Administrator
Email: bristol-nercgw4plusdtp-admin@bristol.ac.uk