PROJECT TITLE: When will Global Warming Stop?

DTP Research Theme(s): Changing Planet
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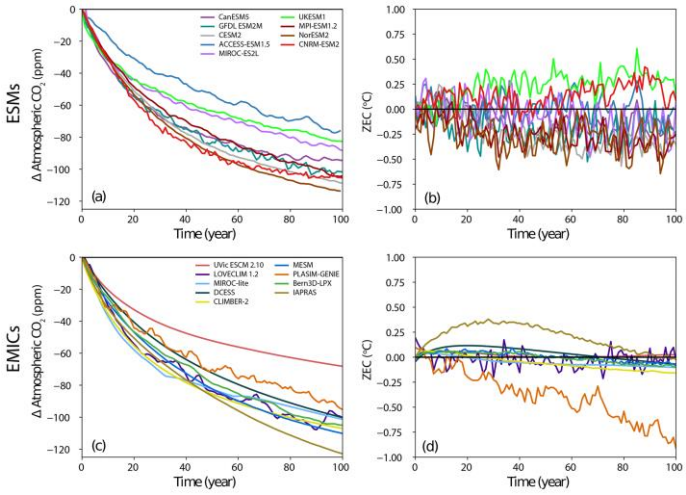
Project keywords: Climate stabilisation, Climate policy, Carbon Cycle, Zero Emissions

Free to use photo:
https://www.pexels.com/photo/silver-steel-mining-crane-on-black-rocky-soil-during-daytime-60008/



From MacDougall et al (2020):
https://bg.copernicus.org/articles/17/2987/2020/

Project Background

There is a (mis)conception that our climate will continue to warm up even if we stop adding greenhouse gases to the atmosphere. But this is not true – if we stop emitting, the world stops warming – or at least approximately. This old idea of committed warming, or "warming in the pipeline" was based on asking what would happen if we kept CO_2 levels constant in the atmosphere. But this is the wrong question – if we stop emitting CO_2 then natural carbon sinks will remove it and CO_2 levels drop. This means that we are not "committed" to ongoing warming after the point of zero emissions – hence it is known as the "Zero Emissions Commitment" or ZEC. The last IPCC report drew on evidence that assessed ZEC was close to zero, but substantial uncertainty remains and we know we might see some residual warming or cooling. It is a vital priority for our knowledge of planning emissions reductions to understand what drives this phenomenon and better quantify the fate of our climate after we stop emitting CO_2.

Project Aims and Methods

The project will draw on a range of climate modelling tools to examine why global warming approximately stops after CO_2 emissions cease. In a nutshell, a problem with the existing research is that some models are too complex to examine this question in detail (because they are very slow and unwieldy to use), and some are too simple (and risk not capturing the correct balance of physical processes). In this project we will find the optimal balance of model complexity using the very well established HadCM3 climate model.

HadCM3 is a full GCM (General Circulation Model) which contributed to multiple IPCC reports. However it is also fast enough to be run easily for multiple assumptions and for long periods of time. This makes it ideal for studying the processes of the Zero Emissions Commitment in detail and bringing an advance in the field.

Initially we will explore the role of different parameters in the model in controlling the future of both land and ocean carbon sinks and how they offset future climate change due to ocean heat uptake. Results will then be compared with available observations of the real world in order to enable constraints on our understanding hitherto not able to be applied.

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, land and ocean physical and biological processes, and the interpretation of results for international climate policy. There will be the opportunity to travel to visit other modelling groups, write up results for publication in leading science journals, and present work at conferences and workshops.

Candidate requirements

The successful student will likely have meteorological/climate knowledge and may have some experience with climate model data and analysis. A background in the physical sciences could be advantageous. We welcome and encourage student applications from under-represented groups. We value a diverse research environment.

Project partners

This work will be done in collaboration with experts at the Met Office Hadley Centre in Exeter. The Hadley Centre is a world leading centre for Climate modelling and research and hosts numerous analysis tools as well as state-of-the-art climate models and supercomputing facilities. This project envisages opportunity to spend time as a visiting scientist at the Met Office Hadley Centre with associated access to experts and analysis tools. Outcomes from the study may feed directly into policy advice to UK government and international climate negotiations.

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. Opportunities will exist to visit the Met Office in Exeter and make use of expertise and analysis tools there.

Background reading and references

MacDougall, A. H. et al: Is there warming in the pipeline? A multi-model analysis of the Zero Emissions Commitment from CO2, Biogeosciences, 17, 2987–3016, https://doi.org/10.5194/bg-17-2987-2020, 2020.

IPCC AR6 Chapter 4, “Future Global Climate: Scenario-based Projections and Near-term Information”, 2021: https://www.ipcc.ch/report/ar6/wg1/chapter/chapter-4/

Useful links

http://www.bristol.ac.uk/geography/courses/postgraduate/

Bristol NERC GW4+ DTP Prospectus:
http://www.bristol.ac.uk/study/postgraduate/2024/sci/phd-great-western-four-doctoral-training-partnership-nerc/

How to apply to the University of Bristol:
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 Tuesday 9 January 2024 at 2359 GMT. Interviews will take place from 26 February to 8 March 2024.

For more information about the NERC GW4+ Doctoral Training Partnership please visit https://www.nercgw4plus.ac.uk.

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