Geophysical Research Abstracts
Vol. 21, EGU2019-16060, 2019
EGU General Assembly 2019

The UK contribution to paleoclimate modelling for CMIP6/PMIP4/DeepMIP: Experimental design and preliminary results of the early Eocene simulation using HadGEM3

Charles Williams (1,2), Daniel Lunt (1), William Roberts (3), and Alistair Sellar (4)

(1) University of Bristol, School of Geographical Sciences, Bristol, United Kingdom (c.j.r.williams@bristol.ac.uk), (2) University of Reading, NCAS-Climate, Department of Meteorology, Reading, United Kingdom (c.j.r.williams@reading.ac.uk), (3) Northumbria University, Geography and Environmental Sciences, Northumbria, United Kingdom (william.roberts@northumbria.ac.uk), (4) UK Meteorological Office, Exeter, United Kingdom (alistair.sellar@metoffice.gov.uk)

The use of physically-based tools, such as Global Climate Models (GCMs) or Earth System Models (ESMs), to better understand environmental and climate changes during the geological past is a well-established technique. Moreover, the modelling of paleoclimate is regarded as an excellent way to test the GCMs/ESMs currently being used for future climate change projections, by providing an out-of-sample test for the models. By simulating past climates, and comparing these simulations to existing proxy data, the models' ability to reproduce climates that were radically different from our own can be assessed. Over time scales of ∼100,000 years, the Paleoclimate Modelling Intercomparison Project (PMIP, now at phase 4) spearheads the paleoclimate contribution to the current phase of the Coupled Model Intercomparison Project (CMIP6). However, of the time periods covered by PMIP, many are either colder than today (e.g. the Last Glacial Maximum, LGM, ∼21 kya) or any enhanced warming is primarily due to differences in orbital configuration rather than elevated greenhouse gases (e.g. the mid-Holocene, MH, ∼6 kya); this naturally limits their use for testing the models' ability to make future climate projections. In contrast, over time scales of millions of years, proxy data tell us that there were several periods which experienced increased global temperatures that are primarily attributable to enhanced CO_2. It is time periods within these timescales that the DeepTime Model Intercomparison Project (DeepMIP) focuses on.

In preparation for the forthcoming IPCC Assessment Report (AR6), DeepMIP is coordinating the modelling of 3 time periods within the longer timescale Eocene Epoque (∼56-33.9 Ma). One of these is the early Eocene (∼55-50 Ma), which possibly shows the most similarity to future projections in terms of its global temperatures and CO_2 concentrations. Reconstructions suggest CO_2 levels of ∼1000ppm during the early Eocene, although the high level of uncertainty means that double this is also possible, and tropical (high latitude) land surface temperatures 5°C (20°C) higher than today. Concerning the UK contribution to DeepMIP, using the UK Met Office's most recent GCM (HadGEM3.1), the fully-coupled version of the Eocene simulation is currently underway and a number of atmosphere-only (AMIP) Eocene sensitivity experiments have been completed. In conjunction with the fully-coupled version using HadGEM3.1, this will also be repeated in the near future using the UK Met Office's most recent ESM (UKESM1).

Here, we will firstly present the model set up and experimental design of the fully-coupled version of the Eocene simulation, detailing the various changes made to the driving geography, topography, bathymetry and atmospheric/oceanic fields. Secondly, early output coming out of this simulation will be presented, focusing primarily on the spin-up period to test whether the simulation has reached acceptable equilibrium. Lastly, preliminary results from the AMIP Eocene sensitivity experiments will be presented, compared to a similar control experiment that uses modern driving data (geography, topography etc).