A fully coupled GCM simulation of the late Miocene - comparison with paleodata

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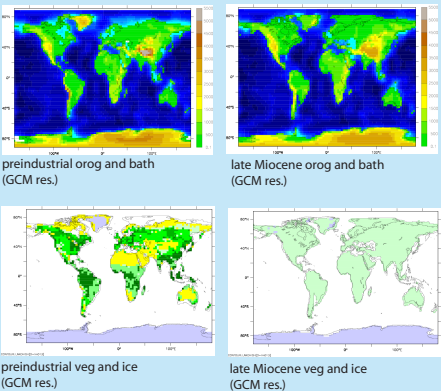XY0302

(1) INTRODUCTION

Here we present results of the first fully coupled GCM simulation of the late Miocene, and a comparison with existing quantitative paleodata. We use the UK Met Office GCM, HadCM3L, and carry out a ~500 year simulation, using realistic paleogeography, paleobathymetry, and CO_2 concentration.

(2) EXPERIMENTAL DESIGN

We use the UK Met Office fully coupled GCM, HadCM3L. We carry out 2 simulations; a pre-industrial control, and a late Miocene simulation. Both are under pre-industrial CO_2 concentrations of 280 ppmv, which is consistent with proxy data (Pagani et al). For the spatial boundary conditions, we use data for orography and ice on a 1 degree resolution from Markwick (2007) :

late Miocene orog (high res.)

late Miocene ice (high res.)
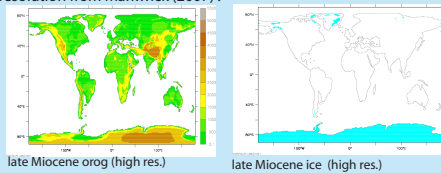
We use these, together with an assumption of modern bathymetry, and globally homogeneous vegetation, to produce the boundary conditions for the late Miocene shown below, right. For comparison, the equivalent boundary conditions are shown for the preindustiral, below left.

preindustrial orog and bath (GCM res.)

late Miocene orog and bath (GCM res.)

preindustrial veg and ice (GCM res.)

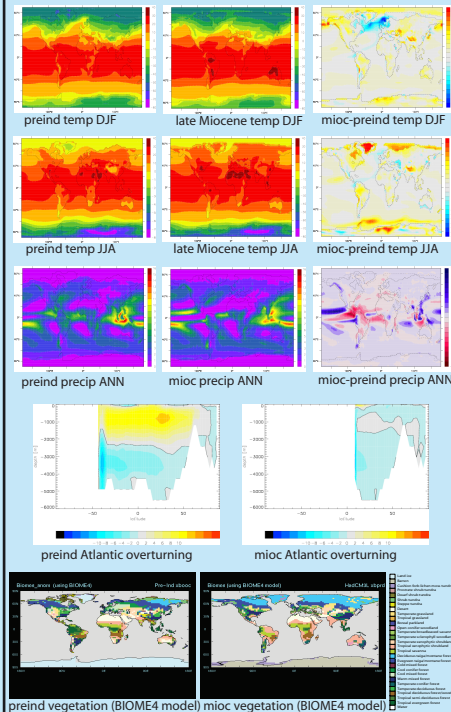late Miocene veg and ice (GCM res.)

(3) GCM RESULTS

The plot below shows the spinup of the two simulations, in terms of the annual global mean temperature at the surface, at a depth of ~700m, and a depth of ~3km.
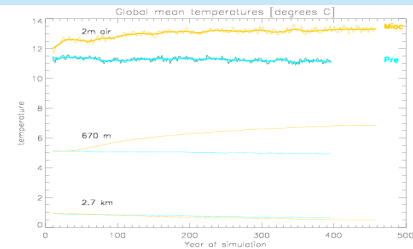

The plots below show several climatic indicators, averaged over the last ~50 years of the simulations..

preind temp DJF

late Miocene temp DJF

mioc-preind temp DJF

preind temp JJA

late Miocene temp JJA

mioc-preind temp JJA

preind precip ANN

mioc precip ANN

mioc-preind precip ANN

preind Atlantic overturning

mioc Atlantic overturning

preind vegetation (BIOME4 model)

mioc vegetation (BIOME4 model)

(4) COMPARISON WITH PALEODATA

Here we make a comparison of our results with a set of late Miocene terrestrial climate proxy data. Here we focus on a representative selection of palaeobotanical sites providing climate estimates, which allow for a broad coverage over the globe. For more details of the dataset, see Lunt et al, in press, EPSL.

Temperature

Precipitation
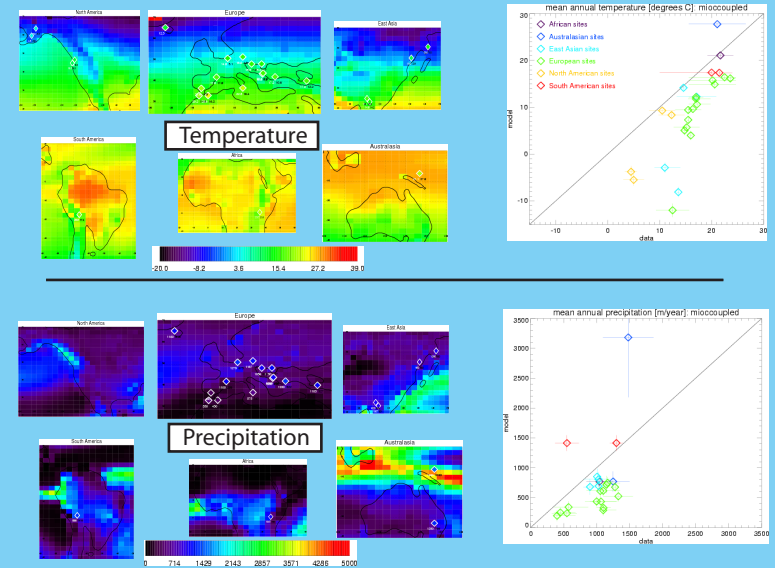
(5) CONCLUSIONS AND FUTURE WORK

We have carried out a fully coupled simulation of the late Miocene, constrained by realistic paleogeography, paleobathymetry, and CO_2 concentration.

Interesting features of the simulation include a collapsed Atlantic THC, and the existence of a 'permanent La-Nina' state in the Tropical Pacific

The model agrees reasonably well with a set of paleodata, although there is a cold bias in the model, and the latitudinal gradient of temperature is too large.

Future work will include sensitivity to CO_2, height of key orography such as the Tibetan Plateau, and configuration of the East Antarctic ice sheet.