Geophysical Research Abstracts,
Vol. 11, EGU2009-3206, 2009
EGU General Assembly 2009
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Using palaeodata in probabilistic predictions of future climate

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Testing the ability of climate models to simulate palaeoclimates, by comparing them with the various terrestrial and marine palaeodata records for different eras, is an important part of increasing our confidence in model predictions of future climate change (e.g. the Palaeoclimate Modelling Intercomparison Project, PMIP: http://pmip2.lsce.ipsl.fr). However, such records can also yield quantitative constraints on future predictions. In a perturbed physics ensemble of palaeoclimate simulations, the most successful model parameter values can be inferred from the relative agreement of each simulation with palaeodata, and these model versions given higher weighting in probabilistic predictions of future climate (or, more usually, of the simpler metric of equilibrium climate sensitivity).

This is a newly developing field, and previously the assessment of simulations with palaeodata has been somewhat simplistic compared with analogous studies using observational climate data (for example, using large-scale regional averages of palaeodata); in addition, the climate models have been limited to those with simplified oceans or with intermediate complexity throughout (slab GCMs, EMICs), due to the expense of simulating the equilibration of climate states that are very different to the present day.

The UK NERC-funded project PalaeoQUMP brings together the Bayesian inferential methodology of previous studies inferring climate sensitivity from observational data, with a more extensive use of palaeodata information (in particular, spatial patterns) and ensembles of fully coupled HadCM3 simulations of two palaeoclimate eras (the mid-Holocene, 6 000 calendar years BP, and the Last Glacial Maximum, 21 000 calendar years BP). The ultimate aim is to combine data constraints from both palaeoclimates and the modern day for a new probabilistic estimate of climate sensitivity. We present here new results using the perturbed physics palaeo-ensembles.