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Simulating the Mid-Pliocene Warm Period: how similar are the models?

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The mid-Pliocene Warm Period (MPWP ca. 3.3 to 3 million years ago) provides an unparalleled opportunity to examine the long term response of the Earth System to elevated greenhouse gas concentrations and has been recognised by the Intergovernmental Panel on Climate Change as an accessible example of a world that is similar in many respects to what models estimate could be the Earth of the late 21st Century (Jansen et al., 2007). Understandably the MPWP has become an attractive target for palaeoclimate modelling, with a large number of studies published during the last decade. However, there has been no attempt to assess the degree of model dependency of the results obtained. Here we present a comparison of mid-Pliocene climatologies produced by the Goddard Institute for Space Studies and Hadley Centre for Climate Prediction and Research atmosphere-only General Circulation Models (GCMAM3 and HadAM3). Whilst both models are consistent in the simulation of broad-scale changes in mid-Pliocene surface air temperature and total precipitation rates, significant differences are noted on regional and local scales. Terrestrial data/model comparison using the BIOME 4 model, along with a new data set of Piacenzian Stage land cover (Salzmann et al., 2008), combined with the use of Kappa statistics, indicates that HadAM3 predicted biomes provide a closer fit to proxy data in the mid to high-latitudes. However, biomes predicted using GCMAM3 climatology provides the closest fit to proxy data in the tropics. Results from a terrestrial data/model comparison are also presented using new outputs from the National Center for Atmospheric Research (NCAR) climate model. This study is a contribution to the newly established Pliocene Climate Modelling Intercomparison Project (Plio-MIP), which is part of the Palaeoclimate Modelling Intercomparison Project (PMIP).