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Understanding the Initial Results of the Plio-QUMP Project: Why was the model driven this way?

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The Plio-QUMP project utilised the recent development at the UK Met Office of the Perturbed Physics Ensemble (PPE) and applied it to the mid-Pliocene Warm Period (mPWP; 3.3 to 3.0 Ma BP) where the climate was the 3°C warmer than the pre-industrial. The initial three member ensemble was run on the UK Met Office fully coupled atmosphere-ocean general circulation model, HadCM3.

The ensemble contained a 'High Sensitivity' member (Charney sensitivity for a doubling of CO2: 7.1°C), a 'Low Sensitivity' member (Charney sensitivity: 2.1°C) and a HadCM3 Control (Charney Sensitivity: 3.3°C). The high sensitivity member produced a warm climate which improved the data/model comparison with the US Geological Survey Pliocene Research Interpretations and Synoptic Mappings (PRISM) Mean Annual Sea Surface Temperature (MASST) dataset, especially the areas of less skill for mid-Pliocene climate models in the higher latitudes. However, the cost of this was a reduction in the strength of the relationship between the mid-Pliocene vegetation dataset of the PRISM3D reconstruction and the model (based on Kappa statistical analysis). The low sensitivity member was a weaker member of the ensemble than the control simulation in both the data/model comparisons with the PRISM MASST and PRISM3D vegetation datasets.

The question these results raise is why did the model respond in this way to the changes that were made? It is important to understand this as for both mid-Pliocene and predictive climate studies as we need to develop an ability to produce predictions which represent a warmer world both over in terms of the temperature response and the biome response. Following on from previous work from the QUMP project at the UK Met Office (on the slab ocean model, HadSM3), we will analyse the results from the model simulations completed so far to find out which parameters (of the 31 being perturbed) are causing the greatest effect on the model outputs.

This presentation will present a more thorough analysis of the initial data/model comparisons, and then a detailed analysis of the key parameters and which perturbations are having the greatest impact on these results. This next stage in the project is vital to understanding what has the greatest effect in driving the reconstructions created by a climate model. While this work has been done for predictive climate studies, it has not been undertaken on a palaeo-environment which is warmer than the present day and with a wide range of available palaeo-data to test the model simulations against.