



Is the PMIP ensemble large enough?

Julia C. Hargreaves and James D. Annan

BlueSkiesResearch.org.uk, SETTLE, United Kingdom (jules@blueskiesresearch.org.uk)

Climate sensitivity, defined as the change in globally averaged surface air temperature for a doubling of atmospheric carbon dioxide, differs between models, and is uncertain for the real climate system. The Last Glacial Maximum has been a major focus for attempts to estimate climate sensitivity because it is the most recent period in the past when atmospheric CO₂ (and surface temperature) was very different to the modern climate. Using the previous (PMIP2) generation of models, Hargreaves et al. (2012) found a statistically significant correlation between tropical temperature change at the LGM and equilibrium sensitivity, and used this relationship to generate an estimate of the climate sensitivity of 0.5-4.0 °C. However, one major caveat was the small size of the ensemble on which this calculation was based, and therefore it was proposed that the forthcoming PMIP3/CMIP5 ensemble would be an interesting test of this correlation and might provide further information due to the increased ensemble size which was anticipated to be as many as 15 models. The PMIP3 ensemble presently contains only 7 models with climate sensitivity estimates, but repeating the analysis from Hargreaves et al. (2012), we obtain a quite different result for the new ensemble, finding no correlation and therefore no constraint on climate sensitivity. Combining the PMIP2 and PMIP3 ensembles by taking the mean of the outputs where more than one integration was performed by closely related models. This gives a total of 11 simulations and a weak correlation between tropical temperature at the LGM and equilibrium climate sensitivity, which is barely significant at the 90% level. This provides an estimate of climate sensitivity in the range of 1.4-4.4 °C, but the tenuous nature of the correlation cannot be ignored when assessing the credibility of this result. Reasons for the differing results between the two ensembles require further investigation, but one conclusion to draw is that the small ensemble size is a major issue hindering confidence in attempts to constrain the multi-model ensembles using data.