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Linking glacial and future climates through an ensemble of GCM simulations

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Abstract. In this paper we explore the relationships between the modelled climate of the Last Glacial Maximum (LGM) and that for doubled atmospheric carbon dioxide compared to the pre-industrial climate by analysing the output from an ensemble of runs from the MIROC3.2 GCM.

Our results lend support to the idea in other recent work that the Antarctic is a useful place to look for historical data which can be used to validate models used for climate forecasting of future greenhouse gas induced climate changes, at local, regional and global scales. Good results may also be obtainable using tropical temperatures, particularly those over the ocean. While the greater area in the tropics makes them an attractive area for seeking data, polar amplification of temperature changes may mean that the Antarctic provides a clearer signal relative to the uncertainties in data and model results. Our result for Greenland is not so strong, possibly due to difficulties in accurately modelling the sea ice extent.

The MIROC3.2 model shows an asymmetry in climate sensitivity calculated by decreasing rather than increasing the greenhouse gases, with 80% of the ensemble having a weaker cooling than warming. This asymmetry, if confirmed by other studies would mean that direct estimates of climate sensitivity from the LGM are likely to be underestimated by the order of half a degree. Our suspicion is, however, that this result may be highly model dependent. Analysis of the parameters varied in the model suggest the asymmetrical response may be linked to the ice in the clouds, which is therefore indicated as an important area for future research.

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