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PMIP4/CMIP6 last interglacial simulations using three different versions of MIROC: importance of vegetation

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We carry out three sets of last interglacial (LIG) experiments, named lig127k, and of pre-industrial experiments, named piControl, both as part of PMIP4/CMIP6 using three versions of the MIROC model: MIROC4m, MIROC4m-LPJ, and MIROC-ES2L. The results are compared with reconstructions from climate proxy data. All models show summer warming over northern high-latitude land, reflecting the differences between the distributions of the LIG and present-day solar irradiance. Globally averaged temperature changes are -0.94 K (MIROC4m), -0.39 K (MIROC4m-LPJ), and -0.43 K (MIROC-ES2L).

Only MIROC4m-LPJ, which includes dynamical vegetation feedback from the change in vegetation distribution, shows annual mean warming signals at northern high latitudes, as indicated by proxy data. In contrast, the latest Earth system model (ESM) of MIROC, MIROC-ES2L, which considers only a partial vegetation effect through the leaf area index, shows no change or even annual cooling over large parts of the Northern Hemisphere. Results from the series of experiments show that the inclusion of full vegetation feedback is necessary for the reproduction of the strong annual warming over land at northern high latitudes. The LIG experimental results show that the warming predicted by models is still underestimated, even with dynamical vegetation, compared to reconstructions from proxy data, suggesting that further investigation and improvement to the climate feedback mechanism are needed.