

Improvement in sea surface temperature biases at the Southern Ocean in climate model MIROC4m and its impact on climate simulations

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Antarctic and Southern Ocean are key regions for the climate system. A precise simulation of these regions in climate models are necessary to improve our confidence of future climate predictions, performances of paleoclimate simulations and understandings of climate system. However, most climate models suffer from warm sea surface temperature biases in the Southern Ocean in their simulations of modern climate (warm SST bias). Previous studies suggest that the warm SST bias is associated with an overestimation of a downward short wave radiation at the sea surface, which is related to an underestimation of supercooled cloud water in the model. In this study, by improving the representation of supercooled cloud water in MIROC4m AOGCM based on satellite data, we aim to improve the warm SST bias. We also assess the impact of improvements in the warm SST bias on the modern climate and a simulation of the Last Glacial Maximum. Model simulations show a reduction in the downward short wave radiation at the Southern Ocean in response to the modification in the supercooled cloud water. As a result, the warm SST bias at the Southern Ocean is also improved. The simulation of the Last Glacial Maximum also shows improvements in sea ice area over the Southern Ocean and deep ocean circulation compared to those suggested by reconstruction data.

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