

Dynamical Mechanisms of the Poleward Intensification of the Southern Hemispheric Westerlies During the Last Glacial Maximum

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Structures of the southern hemispheric westerly during the Last Glacial Maximum (LGM) are examined using a general circulation model (GCM). The GCM simulation with the standard LGM forcings[J1] reproduces the tropospheric cooling and stratospheric warming reasonably. Particularly, an enhanced cooling over Antarctica and the poleward intensification of the southern hemispheric westerlies are clearly observed in the LGM simulation compared to the preindustrial run, which are also reported in many Paleoclimate Modelling Intercomparison Project (PMIP) simulations. The poleward intensification of the tropospheric westerlies is well explained by an enhanced meridional temperature gradient due to the Antarctic amplification of cooling compared to the mid-latitude regions. The same but a stronger intensification of the westerlies are found in the stratosphere, which is largely driven by combined impacts from the tropospheric and stratospheric cooling over the Antarctic region. This Antarctic cooling in the stratosphere is well coupled with weakened poleward heat flux and slowdown of the stratospheric overturning circulation. However, this stratospheric cooling is only observed in prescribed-SST (atmosphere-only) simulation, while tropospheric cooling is robustly simulated in both atmosphere-only and ocean coupled simulations.