

PAMIP Webinar Series

Atmospheric circulation sensitivity to changes in the vertical structure of polar warming

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Abstract

This study examines the effects of the vertical structure of polar warming on the remote atmospheric circulation. We apply thermal forcing at different vertical levels in the Northern Hemisphere polar region in two atmospheric global climate models of different complexity, both coupled to an aquaplanet slab ocean. The efficacy of polar heating in perturbing the remote climate increases with the altitude at which it is applied. This robust sensitivity arises from the dominance of surface temperature contribution to the outgoing longwave radiation owing to the large emissivity of the polar troposphere. An upper-level polar heating has a smaller fraction of forcing balanced by radiative flux changes and a larger contribution from atmospheric energy transport changes, which provokes larger shifts in the extratropical jet and Hadley circulation. Our results suggest increasingly far-reaching impacts of Arctic warming as a less surface-trapped profile is projected for seasonally ice-free conditions in the near future.



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