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Continental ice sheet topography and the southward ITCZ displacement during the last glacial period

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The tropical Pacific zonal and meridional gradients in sea surface temperature (SST) significantly influence tropical Hadley and Walker circulation that potentially may lead to global climate change. Studies applying marine proxy records and GCM simulations have indicated tropical Pacific climate changes during the Last Glacial Maximum (LGM). The tropical Pacific climate responses to glacial forcing during the last glacial, however, has yet reached consensus. This model study investigates the impacts of changes in continental ice sheet topography on the position of Pacific Intertropical convergence zone (ITCZ) in glacial climate. Simulations using an AGCM coupled to a reduced-gravity ocean where the LGM ice sheet were successively increased from zero thickness to 100% suggest that continental ice sheet growth lead to marked changes in tropical Pacific climate including a reduction in zonal SST gradient, a southward shift of the ITCZ, and a strengthening (weakening) of mean-annual northern (southern) hemisphere Hadley circulation. The southward ITCZ displacement causes a phase change in tropical SST annual cycle, weakening in equatorial Pacific upwelling and a deepening in the mean thermocline depth. The movement of ITCZ and altered Hadley circulation might be associated with extratropical poleward stationary eddy heat transport introduced by the ice sheet topography. The results suggest that the ice sheet topographic forcing has a significant impact on tropical climate change during the last glacial period and potentially have implications for how the northern hemisphere ice sheet may also reorganize global climate via tropical feedback.