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Incoherent Hadley cell and jet change in the Last Glacial Maximum: a parameter sweep study using a dynamic-core GCM

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The incoherent Hadley cell (HC)-edge and jet-latitude change is found during the Last Glacial Maximum (LGM), whereas the robust coherent shifts of HC edge and eddy-driven jet latitude are evident in the present and future climate, especially in the Southern hemisphere. By performing parameter sweep experiments, here we investigate this incoherent HC–jet change in the LGM-like and global warming-like experiments with a dry dynamical core of the general circulation model where cooling or heating is imposed in tropical upper-troposphere and polar surface. The LGM-like experiments reveal that an incoherent HC–jet change, i.e., a poleward shift of the jet latitude but an equatorward shift of the HC edge, appears when the polar forcing is substantially stronger than the upper-tropospheric tropical cooling, indicating the broadened baroclinic zone. This broadened baroclinic zone is explained by the separate roles of fast and slow waves. As polar cooling is enhanced, fast waves contribute to the poleward shifted jet in the midlatitudes. However, slow waves in the subtropics do not change much in response to polar cooling due to an equatorward shifted critical latitude by the upper tropospheric cooling, resulting in the HC edge located on the equatorward side compared to the control simulation. Such an incoherent HC–jet change is also found in the global warming-like experiments, suggesting that a poleward HC shift but an equatorward jet shift may occur in the future climate with accelerated Arctic amplification.