The Pacific-North-American Teleconnection in Different Climate States

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Abstract

The Pacific-North-American (PNA) teleconnection is one of the most prominent teleconnection patterns, which links climate variations between the tropical Pacific and North America. The PNA spatial pattern and temporal variabilities largely depend on tropical SSTs and the extratropical atmospheric wave guide. In the present work, we study how the PNA teleconnection varies in different climate states, using simulation results for the Last Glacial Maximum (LGM) and CMIP5 Representative Concertation Pathways (RCP) 8.5. The PNA spatial patterns in the cold and warm climate states are compared with that of the present. It is found that the PNA teleconnection in LGM breaks up because the teleconnection centers near Alberta and Gulf almost disappear. For the RCP8.5 global warming scenario, the PNA teleconnection is weaker than that of the present, with shifts of locations of teleconnection centers. Our diagnostic demonstrates that the weakening of the PNA patterns in LGM and RCP8.5 is because of changes in the extratropical wave guide. In LGM, the large and high Laurentide Ice Sheet separates the westerly jet stream into two branches of zonal flows. It largely alters the wave guide for Rossby wave propagation and causes the disappearance of the Alberta connection center. For the RCP8.5 warm state, meridional temperature gradients are much weaker than that of the present. It causes deceleration of extratropical westerly flows, altering Rossby wave propagation and resulting in shifts of connection centers and weakening of the PNA teleconnection. These results suggest that responses of North American climates to tropical SST variations are weaker in LGM the global-warming scenario than at present.