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Pacific contribution to decadal temperature trends in the Arctic during the 20th century

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Instrumental records show multidecadal variability in Arctic surface temperature throughout the 20th century. This variability is thought to be caused by a combination of external forcing and internal variability, but their relative importance is not clear. Since decadal variability in the Pacific has been linked to 'hiatuses' and accelerated warming trends in global temperatures, we hypothesize that the Pacific could also impact decadal temperature trends in the Arctic. To investigate this, we compare two ensembles of historical all-forcing 20th century simulations with the Norwegian Earth System Model (NorESM): one fully coupled ensemble and one ensemble where momentum flux anomalies from reanalysis are prescribed over the Indo-Pacific Ocean to constrain Pacific sea surface temperature variability. We find that decadal variability in the tropical and extratropical Pacific contributed to ∼50% of the observed Arctic warming during the early 20th century, and we identify a mechanism for this connection involving both horizontal advection in the lower troposphere and adiabatic heating through a stratospheric pathway, mediated by Aleutian Low variations. This Pacific-Arctic teleconnection is detected across the 20th century, but the response in Arctic surface temperature is moderated by external forcing. Our results also indicate that warming in the Atlantic could have compensated for the cooling Pacific at the turn of the century, leading to a continued Arctic warming trend. In addition, we compare these results with pre-industrial control simulations as well as multi-model SST pacemaker experiments in which interannual and decadal SST variability in the tropical Pacific is forced to follow observations. The multi-model analysis shows robust influence from the Pacific to the Arctic. However, the magnitude of the Arctic response to Pacific variability differs among models and we speculate that the Pacific-Arctic link is sensitive to the location of the climatological Aleutian Low. These results have implications for understanding the present Arctic warming and future climate variations.