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Ocean-atmosphere state dependence of the atmospheric response to Arctic sea ice loss

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The Arctic is warming faster than the global average. This disproportionate warming – known as Arctic amplification – has caused significant local changes to the Arctic system and more uncertain remote changes across the Northern Hemisphere midlatitudes. Here, an atmospheric general circulation model (AGCM) is used to test the sensitivity of the atmospheric and surface response to Arctic sea ice loss to the phase of the Atlantic Multidecadal Oscillation (AMO), which varies on (multi-) decadal time scales. Four experiments are performed, combining low and high sea ice states with global sea surface temperature (SST) anomalies associated with opposite phases of the AMO. A trough-ridge-trough response to wintertime sea ice loss is seen in the Pacific-North American sector in the negative phase of the AMO. We propose that this is a consequence of an increased meridional temperature gradient in response to sea ice loss, just south of the climatological maximum, in the midlatitudes of the central North Pacific. This causes a southward shift in the North Pacific storm track, which strengthens the Aleutian low with circulation anomalies propagating into North America. While the climate response to sea ice loss is sensitive to AMO-related SST anomalies in the North Pacific, there is little sensitivity to larger-magnitude SST anomalies in the North Atlantic. With background ocean-atmosphere states persisting for a number of years, there is the potential to improve predictions of the impacts of Arctic sea ice loss on decadal time scales.