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The Arctic's role in climate variations associated with Atlantic Multidecadal Oscillation

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Atlantic Multidecadal Oscillation (AMO) is characterized by quasi-periodic variations of sea surface temperatures in the northern North Atlantic. Coherent variations of surface air temperature and sea ice are also observed in the Arctic. AMO is associated with variations of the northward oceanic heat transport in the North Atlantic. Here, we analyze the relative effects of anomalous AMO-related air-sea heat fluxes in the Atlantic and in the Arctic with an atmosphere general circulation model coupled to a slab ocean model. Simulations with anomalous heat fluxes in the Atlantic, in the Arctic and in both regions are compared. The amplitude of the AMO-related forcing is also varied to assess the linearity of the response. It was found that the anomalous heat fluxes and corresponding sea ice changes in the Arctic contribute the major part to the total AMO-related temperature response in the Northern Hemisphere. A statistically significant atmospheric circulation response was also found only in simulations that include anomalous heat fluxes in the Arctic. The wintertime response corresponding to a positive AMO phase projects on the positive phase of the North Atlantic Oscillation. Doubling of the forcing amplitude yields a general sea level pressure decrease over the whole extratropical North Atlantic, thus indicating a non-linearity of the atmospheric response to AMO. We also analyzed the frequency of occurrence weather regimes and found a significant increase of cold winter month probability for some regions in Eurasia in response to positive AMO phase. The results suggest that changes of the oceanic heat transport to the Arctic and anomalous heat fluxes in high latitudes (mostly in the regions of sea ice retreat in the Atlantic Sector) associated with the AMO are important in driving regional and global climate anomalies.