Modulation of Arctic Sea Ice Loss by Atmospheric Teleconnections from Atlantic Multi-Decadal Variability

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Observed September Arctic sea ice has declined sharply over the satellite observations era. While most climate models forced by observed external forcing simulate a decline, few show trends matching the observations, suggesting either model deficiencies or significant contributions from natural variability. Using a set of perturbed climate model experiments, we provide evidence that atmospheric teleconnections associated with the Atlantic Multi-decadal Variability (AMV) drive low-frequency Arctic sea ice fluctuations. Even without AMV–related changes in ocean heat transport, imposing AMV–like surface temperature anomalies gives rise to shifts in atmospheric circulation that produce similar Arctic sea ice changes in three different climate models. Positive AMV anomalies induce a decrease in the frequency of winter polar anticyclones, which is reflected both in the sea level pressure as a weakening of the Beaufort Sea High and in the surface temperature as warm anomalies in response to increased low-cloud cover. Positive AMV anomalies are also shown to favor an increased prevalence of an Arctic Dipole–like sea level pressure pattern in late winter / early spring. The resulting anomalous winds drive anomalous ice motions (dynamic effect). Combined with the reduced winter sea ice formation (thermodynamic effect), the Arctic sea ice becomes a thinner and younger pack which is more prone to melt in summer, leading to reduced ice extent at the end of the melting season. Decadal trends in Arctic sea ice volume due to AMV–related atmospheric teleconnections are found to be of the order of 10–20% of an estimate of the anthropogenically-forced multi-decadal trends in sea ice volume loss.