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The role of Atlantic heat transport in future Arctic winter sea ice loss

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During recent decades Arctic sea ice variability and retreat during winter have largely been a result of variable ocean heat transport. The relationship between ocean heat and sea ice anomalies has allowed for skillful predictions of winter sea ice extent, especially in the Barents Sea. Here we use the Community Earth System Model (CESM) large ensemble simulation to disentangle internally and externally forced winter Arctic sea ice variability, and to assess to what extent future winter sea ice variability and trends are driven by Atlantic heat transport. We find that ocean heat transport into the Barents Sea has been, and is at present, a major source of internal Arctic winter sea ice variability and predictability. In a warming world (RCP8.5), ocean heat transport remains a good predictor of winter sea ice variability, although the relation weakens as the sea ice retreats beyond the Barents Sea. The warm Atlantic water gradually spreads downstream from the Barents Sea and further into the Arctic Ocean, leading to a reduced sea ice cover and substantial changes in sea ice thickness. The future long-term increase in Atlantic heat transport is carried by warmer water as the current itself is found to weaken. The weakening of the Barents Sea inflow is not directly related to a slowdown of the Atlantic meridional overturning circulation (AMOC), but rather to regional atmospheric circulation anomalies acting to change the relative strength of Atlantic water pathways into the Arctic.