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Arctic Ocean warming contributes to reduced polar ice cap

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Analysis of modern and historical observations demonstrates that the temperature of the intermediate-depth (150–900m) Atlantic Water (AW) of the Arctic Ocean has increased in recent decades. The AW warming has been uneven in time; a local ∼1C maximum was observed in the mid-1990s, followed by an intervening minimum and an additional warming that culminated in 2007 with temperatures higher than in the 1990s by 0.24°C. Relative to climatology from all data prior to 1999, the most extreme 2007 temperature anomalies of up to 1oC and higher were observed in the Eurasian and Makarov basins. The AW warming was associated with a substantial (up to 75-90m) shoaling of the upper AW boundary in the central Arctic Ocean and weakening of the Eurasian Basin upper-ocean stratification. Taken together, these observations suggest that the changes in the Eurasian Basin facilitated greater upward transfer of AW heat to the ocean surface layer. Available limited observations and results from a 1D ocean column model support this surmised upward spread of AW heat through the Eurasian Basin halocline. Experiments with a 3D coupled ice-ocean model in turn suggest a loss of 28–35cm of ice thickness after ∼50 years in response to the 0.5 Wm-2 increase in AW ocean heat flux suggested by the 1D model. This amount of thinning is comparable to the 29 cm of ice thickness loss due to local atmospheric thermodynamic forcing estimated from observations of fast-ice thickness decline. The implication is that AW warming helped precondition the polar ice cap for the extreme ice loss observed in recent years.