Arctic Ocean warming contributes to reduced Arctic sea-ice coverage

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Abstract

Analysis of modern and historical observations demonstrates that the temperature of the intermediate-depth (150–900 m) Atlantic water (AW) of the Arctic Ocean has increased since the 1960-70s. The AW warming has been uneven in time; a local ~1^{o}C 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^{o}C. Over the past decade, atmospheric thermodynamic forcing played the increasingly important role in shaping changes of the Arctic multiyear ice (MYI). However, analysis of satellite ice motion suggests that the role of ice export through straits connecting the Arctic Ocean with sub-polar basins may be elusive. Available observations suggest a thermodynamic coupling between the heat of the ocean interior and the sea ice. In the Canadian Basin, the impact of Pacific water warmth has been recently documented. While vertical AW heat fluxes are negligible in the Canadian Basin, turbulent mixing may be strong enough in the western Nansen Basin to produce a sizeable effect of AW heat on sea ice. In the eastern Eurasian Basin, double diffusion provides an important alternative to weak turbulent mixing for upward AW heat transport. The relative roles of dynamic and thermodynamic factors in recent changes of the Arctic MYI cover remains to be determined. Quantifying these roles is a high priority if we are to develop reliable forecasts of the future state of Arctic ice coverage.