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Oceanic Heat Contribution to Arctic Sea Ice Melt

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The recent warming and record breaking summer reduction of sea ice cover in the Arctic Ocean have gained attention of both the scientific community as well as the general public. However, most of these changes have been so far primarily associated with the atmospheric forcing and ice-albedo feedback. We analyze output from a high resolution coupled ice-ocean model of the pan-Arctic region validated with available observations to determine the relative importance of the internal oceanic forcing of regional sea ice melt. In particular, the thermodynamic coupling at the ice-ocean interface downstream of summer Pacific Water inflow in the western Arctic and Atlantic Water inflow in the eastern Arctic is investigated. We find that under-ice ablation by anomalously warm water advected from the shelves and along the continental slope and distributed at the subsurface layer in the deep Arctic Ocean can explain regionally over 60% of the total variance of sea ice thickness. Similarly regional changes from net ice production to net ice melt are well correlated with the increased oceanic heat content in the upper ocean. We hypothesize that the excess oceanic heat that has been accumulating below the surface during summer in recent years is a critical initial factor in reducing ice concentration and thickness in the western Arctic Ocean at the early melting season and onwards the following year. In addition we argue that the warmer upper ocean affects the atmospheric conditions especially in spring and fall and that such air-sea interactions are poorly represented in present climate models. Observational data and more realistic model representation of feedback processes between the upper ocean and the atmosphere under diminishing ice cover are critical to test this hypothesis and to advance Arctic climate prediction.