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Heat loss from the Atlantic water layer in the St. Anna Trough (northern Kara Seas): Causes and consequences

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A distinct, subsurface density front along the eastern St. Anna Trough (SAT) in the northern Kara Sea is inferred from hydrographic observations in 1996 and 2008-2010. Direct velocity measurements show a persistent northward subsurface current ($\sim$20 cm/s) along the SAT eastern flank, consistent with both model simulations and geostrophic velocity calculations. This sheared flow, carrying the outflow from the Barents and Kara Seas to the Arctic Ocean, favors vertical mixing and enhances the upward heat loss from the intermediate warm Atlantic Water (AW) layer. The associated upward vertical heat flux from the AW layer along the SAT eastern flank is inferred to $\sim$100 W m-2. This results in a consistently delayed freeze-up onset during fall and a reduction in the sea-ice thickness during winter, as evident from sea-ice remote sensing. Although the AW heat loss effectively reduces the sea-ice thickness by approximately 20 cm, its main fraction is consumed by modifying the overlaying water. Hence, the SAT is a hotspot in the Arctic in terms of AW heat loss.