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Winter sea ice decay in the Atlantic sector of the Arctic Ocean: intensification of seasonal variability

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Over the last two decades Arctic sea ice has continued to decrease in extent and volume. Recent observations from space point out that in the Atlantic sector of the Arctic Ocean substantial reduction of sea ice is happening not only in summer, but in winter as well. The reason behind winter ice decay might be the heat impact from the deep ocean via thermohaline convection. Warm water inflow from mid-latitudes shapes vertical structure of the water column in the Arctic Ocean in the way that in the upper few hundred meters temperature and salinity increase with depth. Due to cooling in winter, the water at the ocean surface becomes heavier than deep water, thus providing favorable conditions for vertical convection. We hypothesize that continuously shrinking Arctic ice cover together with the advective heat of the Atlantic origin water create favorable prerequisite conditions for deep convection development in mid-winter. The basis for this hypothesis is the activation of positive feedback between the temperature in the inflowing Atlantic origin water (AW) and ice properties. Recent shift to thinner Arctic sea ice facilitated convection development in winter along the pathways of warm water inflow in the Atlantic sector of the Arctic Ocean. Model-based results support the concept on the decisive influence of oceanic heat, released upwards via convection in shaping winter sea ice conditions in the areas of AW inflow to the Arctic Ocean. The formulated theoretical concept is substantiated by a simplified mathematical model, ocean reanalysis data, satellite images and direct observations.