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# Multiyear ice decline in the Arctic Ocean: the role of density stratification in leads

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An unprecedented degradation of the multiyear sea ice is observed in the Arctic Ocean since the latest decade of the 20th century. Comparison of ice observations at Russian manned drifting station North Pole-31 (NP-31, 1991) with observations at the international SHEBA drifting station (1998) allowed to assume that rapid decrease of multiyear ice volume (area and thickness) in the central Arctic Ocean commenced in early 1990s. Increase of sea surface air temperature in the Arctic and continuous outflow of ice through Fram strait provided the major external forcing, which shaped the present ice conditions. We investigate the hypothesis that besides these external impacts an important contribution to accelerated decrease of ice volume was provided by internal factors. We introduce the term "stratification effect" (SE) to characterise this internal factors action. SE emerges as a result of fresh melt water entrapping within a thin (1-3 m) surface layer of lead by extremely strong density gradient below. SE provides additional heating of the fresh water layer (FWL) during summer ice and snow melt. Melt water create FWL in the leads between the multiyear ice fields. Strong halo-pycnoclyne isolates FWL from cold and salty mixed layer underneath, leading to additional accumulation of incoming short wave solar radiation and preservation of heat inside FWL, because of supressed turbulent mixing at its lower boundary. Local stratification, which develops within the FWL during weak wind conditions, additionally contributes to FWL heating. According to observations at NP-31 surplus SE-caused heating may reach several degrees. The heat, accumulated in the lead is able to increase efficiency of bottom and lateral ice melting. SE increases the positive feedback between ice melt and open water area. Small albedo of sea water provides more intensive absorption of short wave radiation, which is in turn consumed on extra ice melt from the bottom and side walls. If the near-surface layer of water is stratified, it acquires more solar radiation, additionally warms up and causes more intensive ice melt, then otherwise. We anticipate that albedo feedback mechanism, reinforced by the "stratification effect" facilitated almost two-fold decrease of the multiyear ice thickness (by 1-1.5 m) in the Canadian Arctic between 1990 and 1998.