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Time and space variability of freshwater content, heat content and seasonal ice melt in the Arctic Ocean

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The Arctic Ocean water column is strongly stratified in salinity due to large freshwater input from river runoff, net precipitation and the inflow of low salinity Pacific water through Bering Strait: The strong stability allows sea ice to form in winter and to be exported. In summer seasonal ice melt adds freshwater to the stability in the upper part of the water column. The distribution of heat, relative to –1.9C, and freshwater, relative to 34.9, in the upper 1000m of the water column and in different areas of the Arctic Ocean, as well as the amount and distribution of seasonal ice melt have been determined from hydrographic data obtained from ice breaker cruises conducted in the Arctic Ocean during the last 15 years. The water column is subdivided into six layers: the Polar Mixed Layer, the upper halocline (S<34), the lower halocline (S>34, T<0C), two Atlantic layers (T>0C) separated at the temperature maximum, and the intermediate layer (T<0C) down to 1000m. The time variability of thickness, freshwater content and heat content in these layers is then determined for the Nansen Basin, the Gakkel Ridge, the Amundsen Basin, the Lomonosov Ridge, the Makarov Basin, the northern Canada Basin and the southern Canada Basin. The temporal variations in freshwater content are largest in the uppermost layers, the Polar Mixed Layer and the upper halocline and magnify towards Bering Strait. The seasonal ice melt is estimated from the freshwater stored in the Polar Surface Layer above the temperature minimum indicating the depth of the local winter convection and homogenisation. The melt water content is computed relative to the salinity at the temperature minimum. The required latent heat of melting and the sensible heat stored above the temperature minimum are compared with the NCEP/NCAR reanalysis heat input data. The estimated freshwater input is 1-2m, in Nansen Basin usually below 1m and over the Lomonosov Ridge and in the Makarov Basin sometimes above 2m. This is close to but generally less than the potential ice melt deduced from the reanalyses. The differences could be due to melt water stored onto or beneath the ice floes, to advection of freshwater and to the neglect of the heat capacity of sea ice.