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Arctic Ocean circulation and variability – advection and external forcing encounter constraints and local processes (Fridtjof Nansen Medal Lecture)

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The hydrographic section from the Laptev Sea to the passage between Greenland and Svalbard obtained by Nansen on the drift by Fram 1893-1896 aptly illustrates the main features of Arctic Ocean oceanography and indicates possible processes active in transforming the water masses in the Arctic Ocean. Many, perhaps most, of these processes were identified already by Nansen, who put his mark on almost all subsequent research in the Arctic Ocean. Here we shall revisit some key questions and follow how our understanding has evolved from the early 20th century to present. What questions, if any, can now be regarded as solved and which remain still open? Five different but connected topics will be discussed: 1) The freshwater input and the stability of the Arctic Ocean and how they influence the vertical heat exchange and its impact on the Arctic, 2) the inflow, circulation and transformation of the Atlantic water, 3) dense water formation on the shelves and the deep water ventilation, 4) mixing processes in the interior of water column and 5) the impact of the Arctic Ocean waters on the Atlantic Meridional Overturning Circulation. Focus will be on the potential effects of increased freshwater input and reduced sea ice export on the freshwater storage and residence time in the Arctic Ocean and on the circulation and relative importance of the two inflows, over the Barents Sea and through Fram Strait, for the distribution of heat in the intermediate layers of the Arctic Ocean.