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TWO DECADES OF THE ATLANTIC WATER VARIABILITY IN FRAM STRAIT AND ITS LINKS TO THE REGIONAL SEA ICE AND ATMOSPHERIC CHANGES

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Before reaching the Arctic Ocean, warm and salty water masses, originating from the North Atlantic, pass the eastern rims of the Nordic Seas and continue northward through Fram Strait. During its poleward advection the Atlantic water (AW) is continuously transformed and its temperature and heat content change significantly. A part of the AW heat is released to the atmosphere while a major share is lost due to lateral exchanges with adjacent waters. Even then, the Atlantic water leaving Fram Strait to the north is the largest oceanic source of heat for the Arctic Ocean. During last two decades the extraordinary warm Atlantic inflow resulted in a prolonged period of the increased poleward oceanic heat flux. However, before it reaches the Arctic Ocean a significant part of warm AW recirculates already in Fram Strait, warming the outflow towards the North Atlantic and influencing sea ice distribution in the strait. Most of heat, carried by the remaining AW that eventually enters the Arctic Ocean, is lost to the atmosphere directly northeast of Fram Strait. A retreat of the sea ice cover observed there in the last decade suggests an increased heat flux from the AW layer below the ice and/or an influence of warming atmosphere above.

This study addresses summer-to-summer variability, transformation, and circulation patterns of the Atlantic water in the region between the northern Norway and northern Fram Strait and its links to changing ice conditions in Fram Strait and north of Svalbard. We present results of the long-term large-scale summer measurements in the Norwegian-Atlantic and West Spitsbergen Currents, carried in 1996-2014 by Institute of Oceanology PAS, and compare them to continuous observations from the moored array maintained by Alfred Wegener Institute in the northern Fram Strait, to account for the impact of seasonal variations on long-term changes in the AW properties.

Significant variability over different time scales has been observed in the properties of the AW over the studied period with the warmest AW inflow in late 90s and 2005-2006 and a significant positive trend in AW salinity. Time series of temperature and salinity at the standard hydrographic sections in Fram Strait reveal a presence of three 5-6 years long cycles. Spatial distributions of AW properties and geostrophic velocities in the studied region show alternating phases of intensified AW inflow into the Barents Sea and periods of increased northward volume and heat transport through Fram Strait. Using atmospheric reanalysis data and meteorological measurements from Svalbard area we attempt to explain possible links between observed changes and large-scale and local atmospheric forcing. Furthermore, in combination with available remote sensing observations of sea ice, we explore the potential impact of the increased oceanic heat flux by AW on seasonal and long-term changes of ice concentration north of and in Fram Strait versus changes resulting from stronger surface melt due to atmospheric warming.