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Variations of oceanic and atmospheric heat fluxes in the North Atlantic and their link to the North Atlantic Oscillation Index

Diana Iakovleva[1] and Igor Bashmachnikov[1,2]
[1]Saint Petersburg state University, Institute of Earth sciences, Oceanology, Saint-Petersburg, Russian Federation (dianayak47@mail.ru)
[2]Nansen International Environmental and Remote Sensing Centre, Saint Petersburg, Russian Federation

Interannual variations in the upper ocean heat and freshwater contents in the subpolar North Atlantic has important climatic effect. It affects the intensity of deep convection, which, in turn, forms the link between upper and deep ocean circulation of the global ocean Conveyor Belt.

The upper ocean heat content is primarily affected by two main process: by the ocean-atmosphere heat exchange and by oceanic heat advection. The intensity of both fluxes in the subpolar gyre is linked to the character of atmospheric circulation, largely determined by the phase of the North Atlantic Oscillation (NAO).

To study the interannual variability of the oceanic heat advection (in the upper 500th meters layer) we compare the results from four different data-sets: ARMOR-3D (1993-2018), SODA3.4.2 and SODA3.12.2 (1980-2017), and ORAS5 (1958-2017). The ocean-atmosphere heat exchange is accessed as the sum of the latent and the sensible heat fluxes, obtained from OAFlux data-set (1958-2016).

The oceanic heat advection to the Labrador and to the Irminger seas has high negative correlation (-0.79) with that into the Nordic Seas. During the years with high winter NAO Index (NAOI) the oceanic heat advection into the Subpolar Gyre decreases, while to the Nordic Seas – increases. These variations go in parallel with the intensification of the Norwegian, the West Spitsbergen and the slope East Greenland currents and weakening of the West Greenland and the Irminger Currents. During the years with high NAOI, the ocean heat release (both sensible and latent) over the Labrador and Irminger seas increases, but over the Norwegian Sea it decreases.

In summary, the results show that, during the positive NAO phase, the observed decrease of the heat content in the upper Labrador and Irminger seas is linked to both, a higher oceanic het release and a lower intensity of advection of warm water from the south. In the Norwegian Sea, the opposite sign of variations of the fluxes above leads to a simultaneous warming of the upper ocean.

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