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Seasonal thermally-induced front in the Baltic Sea

N. Demchenko

P.P.Shirshov Institute of Oceanology of Russian Academy of Sciences, Atlantic Branch, Kaliningrad, Russia
(ndemchenko@mail.ru/+7(4012)359589)

Mean-annual characteristics of thermohaline fields (1990-1996; Janssen et al., 1999) of the Baltic Sea along the section "Gdansk bay – Gotland sea" under conditions of early-spring heating are analyzed. Location of water with temperature of maximum density (hereafter T_{md}; T_{md} ~2.4˚C for S=7.6 psu) is identified. Under the same conditions of heating from the surface, shallow parts are stably thermally stratified, whilst waters in deeper regions have temperature near the T_{md} throughout the upper layer of the thickness of about 30 m. Mean-annual horizontal density gradient between these parts is about 10^{-6}-10^{-7}kg/m^4, what is of the same order than in Ladoga lake (Drabkova, Rumiantsev, 2002) under corresponding conditions. Mean-annual speed of propagation of the isotherm, corresponding to the T_{md} (accounting for the salinity variations) is about 15 km/day.

Analysis of field measurements, performed by Leibniz Institute for Baltic Sea Research (Institut für Ostseeforschung Warnemünde, IOW) in frames of HELCOM program along a section in southern and central Baltic in spring period (21^{st}-31^{st} of March; 2-12^{th} of May, 2003; 16^{th} -27^{th} of March; 30^{th} – 10^{th} of May, 2004) showed, that in the beginning of the spring heating these two regions are observed as well: in one of them, water temperature is near the T_{md} (T_{md}=2.3˚C; S=8 psu) down to the bottom; whilst another one still has an inverse temperature stratification. Analysis of the satellite images for these dates showed, that the SST is close to the T_{md} (T_{md}=2.3-2.5˚C; S=7-8 psu) in southern part of the Baltic, while in other areas is still below it (T<1˚C). These two parts do persist throughout further heating as long as the T_{md} is present at water surface. The isotherm, which marks their interface, is tilted towards the deep part. Important to note, that water salinity in the upper layer (D=60-70 m) is vertically homogeneous.

Analysis of subsurface temperature, salinity and chlorophyll - a along the section Travemuende-Helsinki, performed at the same dates by Finnish Institute of Marine Research (Ship of Opportunity program), showed an obvious surface temperature jump while passing the T_{md}; horizontal temperature gradient in this area was 10 - 100 times as large as mean-annual value; horizontal density gradient in this area was 10^{-6} – 10^{-5} kg/m^4; speed of propagation of frontal zone – about 11.4 km/day; its width - about 20-45 km. Thus, the frontal zone associated with the T_{md} does exist in the Baltic Sea in spring period. The work is supported by grant of RFBR 07-05-00850, 06-05-64138 and INTAS 06-1000014-6508.