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Recent trends and variations in Baltic Sea temperature, salinity, stratification and circulation

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The presentation highlights the results of physical oceanography from BACC II (Second BALTEX Assessment of Climate Change for the Baltic Sea basin) book based on the review of recent literature published until 2013. We include also information from some more recent publications.

A recent warming trend in sea surface waters has been clearly demonstrated by all available methods: in-situ measurements, remote sensing data and modelling tools. In particular, remote sensing data for the period 1990–2008 indicate that the annual mean SST has increased even by 1°C per decade, with the greatest increase in the northern Bothnian Bay and also with large increases in the Gulf of Finland, the Gulf of Riga, and the northern Baltic Proper. Although the increase in the northern areas is affected by the recent decline in the extent and duration of sea ice, and corresponding changes in surface albedo, warming is still evident during all seasons and with the greatest increase occurring in summer. The least warming of surface waters (0.3–0.5°C per decade) occurred northeast of Bornholm Island up to and along the Swedish coast, probably owing to an increase in the frequency of coastal upwelling forced by the westerly wind events. Comparing observations with the results of centennial-scale modelling, recent changes in sea water temperature appear to be within the range of the variability observed during the past 500 years.

Overall salinity pattern and stratification conditions are controlled by river runoff, wind conditions, and salt water inflows through the Danish straits. The mean top-layer salinity is mainly influenced by the accumulated river runoff, with higher salinity during dry periods and lower salinity during wet periods. Observations reveal a low-salinity period above the halocline starting in the 1980s. The strength of stratification and deep salinity are reduced when the mean zonal wind stress increases, as it occurred since 1987. Major Baltic Inflows of highly saline water of North Sea origin occur sporadically and transport high-saline water into the deep layers of the Baltic Sea. These inflow events occur when high pressure over the Baltic region with easterly winds is followed by several weeks of strong westerly winds; changes in the inflow activity are related to the frequency of deep cyclones and their pathways over the Baltic area. Major inflows are often followed by a period of stagnation during which saline stratification decreases and oxygen deficiency develops in the deep basins of the central Baltic. Major inflows are usually of barotropic character. They normally occur during winter and spring and transport relatively cold, salty and oxygen-rich waters to the deep basins. Since 1996, another type of inflows have been observed during summer or early autumn. These inflows are of baroclinic character and transport high-saline, but warm and low-oxygen water into the deep layers of the Baltic Sea. Event-like water exchange and mixing anomalies, driven by specific atmospheric forcing patterns like sequences of deep cyclones, occur also in other parts of the Baltic Sea.