Early spring SST distribution in the Baltic Sea: in search of the coldest water

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We examine three hypotheses of formation of waters of the Cold Intermediate Layer (CIL) in the Baltic Sea: the coldest baltic waters are formed (1) at the beginning of spring warming in the Arkona and Bornholm basins, (2) in the centers of mesoscale vortexes (similar to those in the Black Sea), and (3) in the convergence zones of alongshore fronts while cooling over shelves (as in the Mediterranean Sea).

In search of the coldest surface water we analyzed the dynamics of sea surface temperature (SST) in the Baltic Proper for February-April 2003-2019 from satellite imagery of infrared sensors (MODIS-Terra/Aqua and VIIRS-Suomi-NPP), and microwave sensors (AMSR-E-Aqua, AMSR-2-GCOM-W1, and WindSat-Coriolis).

Long-term mean SST maps (for February, March, April 2003-2019) show patterns that indicate rather quick, abrupt re-structuring of thermohaline fields in late March - early April, especially evident in the Arkona and Bornholm basins. This supports the idea that seasonal transfer from two-layered winter-time vertical water stratification to the summer-time three-layered stratification is driven in the Baltic Sea not by the direct heat fluxes through the surface, but rather by the large-scale north-south water exchange.

Coastal fronts may persist for a few weeks, however their location is changeable. Stable frontal zones and vortexes are not observed under long-term SST averaging. However the sequential warming of waters from south to north direction due to geographical reasons is clearly seen with long-term averaging.

The features of spring differential warming development above shallows and along shore can be observed only from daily SST maps (not from annually averaged maps).

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