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Features of autumnal differential coastal cooling in south-eastern Baltic deduced from data of MODIS spectroradiometers

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Characteristics of profiles of sea surface temperature (SST) from the coastline to deep sea area in Russian sector of the South-Eastern Baltic Sea during seasonal autumnal cooling are identified using the data of spectroradiometers MODIS Aqua. Time periods are chosen when vertical convection and wind mixing make the upper layer (∼ 30-40 m) in deep-sea area practically isothermal, and significant horizontal gradients of temperature/density are formed above shallows and underwater coastal slopes. This picture of differential cooling is formed by the combined action of heat exchange with the atmosphere (which is practically the same in coastal and open areas) and horizontal transport of heat from the sea to the shallow/coastal zone. This allows for estimation of horizontal heat and mass transport between the deep and the coastal area.
The images of October-November 2002-2009 were analyzed, corresponding to periods of fast decrease of air temperature (at a rate of 0.86-2.54 °C/day). Significant linear portion in shallow-most paret is found to be a characteristic feature of the profiles, which is detected above all types of slopes (steep, sloping, irregular), reaching 20% to 70% of the length of the slope. Comparative analysis of the characteristics of the observed profiles above different slopes at the same image, and for the same slope at different dates was performed. The actual profiles of SST are compared with several theoretically predicted cases (in the absence of horizontal exchange, in of the quasi-stationary exchange), and the modeling results. Estimations suggest that horizontal gradient of water temperature favours seasonal slide of the cold/dense water along the underwater slopes (cascading) with a fairly high speed, reaching tens of cm/s at the shelf edge in the case of rapid cooling of water above the underwater slopes. Current speed at the end of the slopes may be quite high (8-20 cm/s), but comparable to the known values. On the base of numerical modeling results, the maximum speed of 5-7 cm/s obtained. The resulting specific volumetric flow rate, estimated from remote sensing data (1.2-4.8 m**2/s) is comparable to that obtained by numerical modeling (2.6-6.0 m**2/s). The specific volumetric flow-rates at the end of the slopes/shelf break is also similar to that observed in other basins (e.g., in Lake Geneva - 0.4-1 m**2/s, Lake Baikal - 5 m**2/s).
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