Geophysical Research Abstracts
Vol. 15, EGU2013-8261, 2013
EGU General Assembly 2013
© Author(s) 2013. CC Attribution 3.0 License.

Method of estimation of sea-shelf water exchange using information on differential coastal cooling above underwater slopes

Irina Chubarenko

P.P.Shirshov Institute of Oceanology, Atlantic Branch, Hydrophysical Dpt, Kaliningrad, Russian Federation (irina_chubarenko@mail.ru)

Physics of formation of differential coastal cooling in areas with sloping bottom, as well as the associated water dynamics, is already quite well investigated. This allows for using this knowledge for quantitative estimation of deep sea – coastal area (cross-shore) water-exchange. It is especially effective during periods of seasonal autumnal cooling, when vertical gravitational convection reaches bottom in shallower coastal areas. Then, the water temperature in sloping area (the picture of differential coastal cooling) is formed by combined effect of the heat exchange with the cooler atmosphere and horizontal heat transport due to water-exchange with the warmer sea. If the heat loss to the atmosphere in the open area and in coastal region can be taken approximately the same, then time rate of decrease of water temperature in deep-sea surface layer provides its measure, which can be applied also in sloping area. Thus, the heat transport by horizontal (cross-shore) exchange can be estimated.
Theoretical considerations were checked using the results of original laboratory experiments, 3D numerical modeling in basins with sloping bottom, comparison with field measurement and satellite data for the South-Eastern Baltic Sea. Analytical expressions for cross-shore temperature variations during periods of the developed vertical convection were obtained for several flow regimes (e.g., no exchange with the sea, quasi-steady-state exchange due to the cross-shore density gradients). Series of laboratory experiments have demonstrated the particular features of the coast-sea temperature profiles in different flow regimes (see poster EGU2013-502). Three-dimensional non-hydrostatic hydrodynamic model MIKE3-FlowModel (DHI Water & Environment) was applied to reproduce both the laboratory experiments and the results of field measurements in the Gdansk bay of the Baltic Sea (74 cruise of r/v 'Prof. Stockman', October, 2005). Data of spectroradiometers MODIS Aqua for October-November 2002-2009, the South-Eastern Baltic Sea, were analyzed (see poster EGU2013-7446) demonstrating typical features of the coast-sea SST-profiles above different slopes of the given region. Overall, the method of estimation of shelf-sea water exchange on the base of information on differential coastal cooling above underwater slopes works well in laboratory and numerical experiments, and its applicability at the sea scale seems to be reasonable, however it still needs verification by real measurements of water-exchange in field, which are difficult and very expensive and thus - very rare.
Investigations are supported by RFBR, grants number 10-05-00540a and 13-05-01041a.