

## Atmosferyczne uwarunkowania występowania upwellingu przybrzeżnego w Morzu Bałtyckim

The project concerns mechanisms of interaction between the atmosphere and sea waters, which is a complex issue, however, not yet fully understood. Upwelling is one of the examples of complicated marine phenomena generated by atmospheric forcing. The physical process of upwelling consists in an ascending motion of subsurface water by which water from deeper layers is brought into the surface layer. The off-shore water currents in the coastal upwelling are induced by an alongshore blowing wind, which has the coast on its left in the Northern Hemisphere. The direction of sea surface currents is explained by Ekman's theory, taking into consideration the effect of the Earth's rotation and frictional forces. The main objective of the study is to determine circulation patterns that govern the occurrence of coastal upwelling in different parts of the Baltic Sea.

In summer, when seawaters are thermally stratified, warm surface water taken offshore is replaced by colder water welling up from deeper layers, usually from below the thermocline. This means the essential drop in the temperature of coastal surface waters. Changes in the temperature of the active surface i.e. surface waters modify the local meteorological conditions of boundary layer. Besides, the replacement of warm surface water by colder water from below the thermocline has an important environmental impact, as it increases the concentration of nutrients and phytoplankton growth. These mean that determining the predictors of upwelling occurrence seems to be essential in planning and development of the summer coastal tourism in regard to the rapid changes in sea water temperature and also in marine fishery in regard to the fluctuations in water nutrition during the upwelling events.

It is assumed that particular circulation patterns induce and enhance upwelling in different parts of Baltic coast and the dislocation of pressure centres cause change in wind conditions which inhibits the elaborated phenomenon. The main reason for undertaking this subject was lack in the climatological literature of the integral and consensual opinions concerning this matter. The coherent elaboration based at homogenous and complete data is supposed to resolve doubts concerning synoptic situations favorable for upwelling and to determine which synoptic conditions contribute to suppressing the phenomenon, which has not been investigated yet.

Reanalysis grid data concerning sea surface temperature and concerning particular meteorological elements, such as the air pressure and the air temperature will be used in the analysis. The automatic detection of upwelling events will consist in computing differences in sea surface temperature of particular grids. The low temperature along the shore in comparison to surrounding waters indicates the occurrence of the investigated phenomenon. After the selection of upwelling instances some quantitative characteristics of its occurrence along the Baltic coast will be computed. Then, for the chosen days, composite and anomaly maps of sea level pressure will be constructed. The maps will picture the pressure patterns inducing and inhibiting occurrence of upwelling in particular regions of the Baltic coast. Furthermore, different circulation types conducive to upwelling will be distinguished. To this end the Principal Component Analysis will be applied or – alternatively – one of the clustering techniques. Additionally, anomaly maps of air temperature for the days of upwelling will be produced. This will give a general idea of thermal conditions accompanying the 'cold sea' events in summer. All described proceedings will be carried out for each distinguished region separately.

The results of the project would improve the comprehension of the relationships between the atmosphere and hydrosphere. Recognizing the circulation patterns and atmospheric conditions governing occurrence of coastal upwelling will contribute to better understanding the atmospheric forcing to the marine environment including, fluctuations in the water temperature, biogeochemical processes and water circulation in a small basin. Recognizing the predictors of upwelling occurrence seems to be useful in planning and development of the touristic and economic activities along the Baltic Sea shores.