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Spatial variation of extreme storm characteristics over Gulf of Gdańsk and their long-term temporal changes

Witold Cieślíkiewicz and **Aleksandra Cupiał**

University of Gdansk, Institute of Oceanography, Physical Oceanography, Gdynia, Poland (ciesl@ug.edu.pl)

In this work we present the principal results of analysis of spatio-temporal variations of extreme storm features over the Gulf of Gdańsk located in the southern Baltic Sea. By extreme storms we mean storms that induce highest waves in various regions of Gulf of Gdańsk. The analysis of meteorological conditions over the Baltic Sea and wind wave fields in the Gulf of Gdańsk was carried out using 44-year long time series of gridded hindcast REMO meteorological data (Jacob and Podzun, 1997; Feser et al., 2001) and HIPOCAS wind wave data (Cieślíkiewicz et al., 2005).

An important aim of this study is to obtain the most characteristic features of extreme storms that had created extreme risks and hazards in the Gulf of Gdańsk during the investigated period 1958–2001. The Gulf of Gdańsk is a very important sea basin for Poland. Two of three largest ports in Poland are in the Gulf of Gdańsk: the Port of Gdańsk and the Port of Gdynia.

In this study an objective measure of spatial variability of characteristic storm patterns linked with extreme local wave conditions is proposed. That variability measure is constructed based on special selection procedure of extreme storms using long-term significant wave height time series. We define a general spatial storm variability coefficient that may be estimated for various sea basins. In the present work this storm variability coefficient is determined for the Gulf of Gdańsk and its estimation procedure is described in detail.

In our study the long-term change in basic statistics of wind wave field over Gulf of Gdańsk is also analysed. This may be referred to as wind wave climate change analysis. It is done by determination of trends in statistical properties of basic wind wave parameters such as significant wave height, mean wave period and wave direction. An attempt is made to relate the trends found in extreme wind wave statistical characteristics to change in associated extreme storm patterns.

In this study probability distributions of significant wave height and mean wave period are determined. The presentation of spatial and temporal variations of the parameters of those probability distributions is yet another way of examining and presenting the spatio-temporal changes of wind wave climate in the Gulf of Gdańsk. Again, an attempt is made to relate those changes to change in characteristic features of meteorological conditions over the Baltic Sea, including storm patterns causing extreme local wave in various regions of the Gulf.

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