



## Catalogues of sea level storm surges and falls on the Polish Coast

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An essential aim is presenting of catalogues of sea level storm (positive) surges and falls (negative surges) along the Polish coast that closely relate to flood warning and alarm levels, and, similarly, warning and alarm sea levels crucial for the safety of navigation, protection of the sea coast and safety of marine structures.

The catalogue of storm surges covers 252 events in the years 1947-2007. The storm surge as adopted in the catalogue is assumed to be an observed sea level equal to or higher by 70 cm than the gauge zero level (-500 cm N.N.) that occurred at least in one of the five Polish ports considered herein: Świnoujście, Kołobrzeg, Ustka, Władysławowo or Gdańsk. The number of storm surges on the Polish coast clearly has been increasing from two storms in 1947 to six storms a year at present ( $y = 0.0743x + 1.8443$ ). Besides, the number of storm surges on Poland's western coast is visibly larger (Świnoujście - Kołobrzeg) as compared to the central or eastern coast. If we take account of only the number of very high surges in each port regarded as  $\geq 600$  cm N.N. (extreme alarm surges), then Świnoujście witnessed 50 such events, Kołobrzeg - 53, Ustka - 30, Władysławowo - 27 and Gdańsk - 40.

The analysis of storm surge probability (when sea level  $\geq 570$  cm N.N.) has confirmed that higher surges should be forecast for the western coast. The Pareto distribution implies that every thousandth storm surge at Świnoujście may reach a level of 667.49 cm N.N., at Kołobrzeg - 651.47 cm N.N., at Ustka - 647.93 cm N.N., at Władysławowo - 665.29 cm N.N. and at Gdańsk - 645.52 cm N.N., while every tenth surge at each port will exceed the respective gauge zero level by one metre.

The catalogue of storm water level falls includes 107 events over the years 1947-2006. The criterion to separate these levels was the level equal to or lower than 430 cm N.N. that occurred at least in one of the ports under consideration. In the years 1947-2006 the number of storm sea level falls was slightly increasing by 1.3 to 2.2 a year. These negative surges mainly took place in autumn and winter, i.e. October through March, similarly to storm positive surges. The catalogue indicates a substantial variation in the number of low sea levels occurring ( $\leq 430$  cm N.N.) in particular ports. The relevant figures are as follows: Świnoujście - 104, Kołobrzeg - 35, Ustka - 17, Władysławowo - 12, Gdańsk - 10 times. The extremely low alarming sea levels  $\leq 400$  cm N.N. were recorded only six times at Świnoujście and three times at Kołobrzeg. This fact is confirmed by an analysis of the probability of storm sea level fall occurrence which gives grounds to forecast that once in a thousand events the sea level at Świnoujście and Kołobrzeg will fall by more than 1.50 m below their respective gauge zero levels.