



## Observations and modelling of extreme sea level events in the coastal waters of the Pomeranian Bay

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Storm surges represent a particular threat for low-lying coastal areas of the Pomeranian Bay and Szczecin Lagoon (southern Baltic). These rapid short-term sea level fluctuations are associated with the passages of low-pressure systems over the Baltic Sea. The most dangerous storm surges occur during the passages of deep low pressure systems near the coast of the southern Baltic, with an extensive system of winds from northern sector. When they overlap with an already high sea levels in the Baltic Sea, the resulting sea level may be very high, reaching extreme values in some cases. Under such circumstances, the surges are capable of flooding coastal areas, polders, and areas adjacent to the Odra mouth, destroying coastal zone infrastructure, negatively affecting work in harbours, and causing many other problems to inhabitants of West Pomerania.

In 2002-2007, at the coasts of the Pomeranian Bay there were recorded 13 storm events with the level exceeding 1.0 m above MSL. Among them, as many as 6 surges were recorded during stormy winter of 2007. The highest sea level of 1.45 m above MSL, as recorded in Świnoujście, was observed during the storm surge in early November 2006. On the Szczecin Lagoon (Trzebież), the highest water level of 0.97 m above MSL was recorded in January 2007.

Over the recent years, numerical modelling has become an essential tool in offshore zone management and flood protection within the Odra mouth area. In our study a 3-D, operational hydrodynamic model of the Baltic Sea (M3D\_UG), developed at the Institute of Oceanography, University of Gdańsk was applied in post-hoc analyses of extreme sea level events in the coastal waters of the Pomeranian Bay. The model, based on the coastal ocean circulation model known as the Princeton Ocean Model (POM), was adapted to Baltic conditions and to numerical meteorological forecast. Wind-driven water back flow in the Odra mouth necessitated working out an operational model of river discharge, based on water budget in a stream channel. In order to describe bathymetry of the area with a high accuracy, two grids with different spatial spacing were used: about 1 km for the Pomeranian Bay, and about 300 m applicable to the Szczecin Lagoon.

Testing the model on extreme storm surge events in 2002-2007 showed a good agreement between the modelled and observed distributions of sea levels. The model correctly reflected events involving high-amplitude and rapid water level fluctuations; it also generated relatively good water level forecasts. The adequate approximation of storm surge conditions in the coastal waters of the Pomeranian Bay by the model makes it a reliable flood protection tool.