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Coastal abrasion of the Swina Gate Sandbar (Pomeranian Bay coast) caused by the heavy storm surge on 15 October 2009

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The Swina Gate Sandbar (the southern Baltic Sea) is exposed to coastal retreat caused by storm surges occurring during autumn-winter season. In the present study a detailed analysis of changes in the coastal relief of the sandbar during the 15 October 2009 storm surge is presented.

At the Pomeranian Bay coast, storm surges are associated with the passages of low-pressure systems entering the Baltic Sea from SW to NW, producing onshore northwesterly to northeasterly winds. The most catastrophic surges are observed with a sea level 1.0 m above its mean state. In those cases the sea floods the beach and overflows over the low ridges up to 3.0-3.2 m above MSL. Over the recent years, at the Pomeranian Bay coasts the highest sea level of 1.85 m above MSL was observed in early November 1995. The 15 October 2009 storm surge with maximum sea height reaching 1.49 m above MSL in Swinoujscie (0.69 m above the alarm level) was one of the most severe storm events.

The studied area is a sandbar located on the coast of the Pomeranian Bay where the Swina Strait (the main outlet of the Odra River) connects the Baltic Sea with the Szczecin Lagoon. Measurements of coastal relief were taken along every 1 km of the sandbar (profiles established and measured since 2001). Data, collected two days after the storm surge, show the coastal relief changed by the described event. The profiles served to calculate the changes in the height and width of the dune and beach. These results served to calculate the volume of sediment which was moved in every 1 m^2. The meteorological and hydrological description of the storm surge was based on the routine data provided by the Harbour Master's Office in Swinoujscie.

The calculated changes in sand volume indicated that the greatest decrease in sediment on the dune and beach occurred in the western and eastern sections of the sandbar. The dune sand balance was negative due to a considerable lowering of the beach caused firstly by deflation (onshore strong winds at speed of 12-16 m/s) and secondly by abrasion. In the eastern part of the sandbar, both beach and foredune were subject to a considerable wash-off, losing on average up to 0.6 m^3/m^2 sediment on the profile. The dune retreat exceeded 6m and beach retreat was up to 30m. Along examined area upper beach was lowered about 1.0 to 1.5 m. Strong onshore winds resulted in aeolian accumulation behind the foredunes. In the middle part of the coast, where water didn't enter upper beach, aeolian accumulation exceeded 0.34 m^3/m^2. The biggest abrasion and dunes retreat was on the coast with beaches lower than 3 m above MSL.