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Dune erosion as a result of the significant storms at the western Polish coast (Dziwnów Spit example).

J. Dudzińska-Nowak (1), K. K. Furmańczyk (1), K. A. Furmańczyk (2), B. Paplińska-Swerpel (3), and N. Brzezowska (1)

(1) Institute of Marine and Coastal Sciences, University of Szczecin, Szczecin, Poland (jotde@univ.szczecin.pl), (2) Department of Applied Mathematics, Warsaw University of Life Sciences, Warsaw, Poland (konrad_furmanczyk@sggw.pl), (3) Institute of Hydro-Enginering Polish Academy of Sciences, Gdańsk, Poland (bep@ibwpan.gda.pl)

Introduction
The storm influence on the southern Baltic coast was examined for a 14-km long section of the western Polish coast along the Dziwnow Spit based on 13 years of post-storm dune erosion observations in the framework of the EU 7FP MICORE project. The Dziwnow Spit consist of marine accumulation sands, where dune height do not exceed 14 m. For the purpose of this study, it was assumed that a storm deemed significant causes noticeable sand dune erosion.
Materials
Significant changes to the coast after each major storm were analysed on a base reports on coastline changes after each significant storm in time period 1986-2009, made available by the Maritime Office in Szczecin. From all the storms reported, only 21 significant storms which had complete parameters of the storms were singled out for the analysis. The multi-decadal high resolution homogeneous data of significant wave height and direction generated in the framework EU-project HIPOCAS were used. Sea level for Dziwnow was calculated as a mean value taken from the tide gauges in Swinoujscie and Kolobrzeg.
Methods
Total dune volume eroded by every storm (D), sea level (F), storm duration (T), max significant wave (H), direction of max significant wave (A) were taken under consideration. Storms were divided into groups using cluster dendrogram ("ward") method. Thresholds values of dune erosion between different groups of storms were defined using tree classification method. Statistical significance of the volume dune eroded to the storm parameters in a different groups of storm were analyzed using log-linear regression methods. The statistical analyses were done using R software.
Results
On a base of experimental studies of the cluster dendrogram and tree classification methods, the 3 group of significant storms was separated:
G1 (6 storms) - weak and medium significant storm that resulted in up to about 5 thou. m3/14km of total eroded dune volume (< 4880.5 m3/14km),
G2 (9 storms) - strong significant storm that brought between about 5-31 thou. m3/14km of total eroded dune volume (4880.5 - 30740.8 m3/14km),
G3 (6 storms) - extremely strong significant storm that resulted in more than about 31 thou. m3/14km of total eroded dune volume (>30740.8 m3/14km).
For the group of the significant storms (G1, G2 and G3) the sea level was the only significant factor influencing the dune erosion. Additionally in the group G1 (dune erosion < 4880.5 m3/14km) the storm duration have also a good correlation to total volume of eroded dune.
Conclusions
On the southern Baltic coast, the sea level is the crucial factor deciding on the extent of the dune erosion during the storm. Other factors such as max significant wave direction and value, and storm duration, besides group G1, had very poor correlation to the eroded dune volume, so did not find their significant influence.