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Self-organising of wave and beach relief in storm: field experiments

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This paper presents results of waves and morfodynamics observation carried out in frame of complex field experiments "Shkorpilowtsy-2016" and "Shkorpilowtsy-2007", which were made in order to understand how bottom deformations depend on wave parameters and how wave-bottom self-organisation process runs during storm events. Sediment transport and profile deformations were analysed taking into account the presence of underwater bar (data 2007) and without it (data 2016).
Experiments were made on field base of Institute of Oceanology "Fridtjof Nansen" (Bulgarian Academy of Sciences) in Shkorpilowtsy settlement, that is locates on Black Sea coast, 40 km from Varna. The base is equipped with 253 m research pier that provide measuring until 5 m depth on distance 200 m from shore.
During filed works synchronous observations on wave parameters and bottom changes were made on average three times a day for one month: 18.09-08.10.2007 and 07.10-02.11.2016. Morphological observations involved cross-shore beach profile deformations measuring along the scientific pier from shore to sea through each 2 m using metal pole in 2007 and metal or rope lot in 2016. Wave measurements included visual observations of breaking and surf zones location, wave type (wind or swell wave) and direction as well as free surface deviation (wave chronogram) registrations using high-frequency capacitive or resistance sensors mounted along the pier. In 2007 registration of free surface elevation was carried out with 7 capacitance and 8 resistant wire gauges, in 2016 - with 18 capacitance wire gauges. Sampling frequency was 5 Hz in 2007 and 20 Hz in 2016, duration of the records varied from 20 min up to one hour in 2007 and between 10 min and one hour in 2016. Wave spectra computed from chronogram allowed to estimate wave spectral (significant wave height, spectral peak and mean periods and complex) and integral parameters (Irribaren and Ursell numbers) to analyse dependence bottom deformations on it.
Self-organising of bottom relief and waves were studied on a scale of several storms. Results of investigations show that increase of significant wave height and spectral peak period of wave entering in coastal zone as well as Ursell number lead to erosion, which was localised in first 100 m near on barred profile and covered whole observed profile in case without bar.
Features of sediment transport by forming a mobile temporal underwater bar were examined for cases of flat sloping and barred underwater beach profiles. On timescale of one storm type of wave breaking affect sediment transport: plunging wave breaking is responsible for formation and evolution of underwater sand bar as well as decreasing of sediment amount in upper part of beach profile and shoreline regression, while spilling do not lead to significant bottom deformations.
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