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Evaluation of wave conditions and morphological response linkage for establishment of a set of storm impact thresholds

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Storms are one of the phenomena determining the short-term evolution of the coasts. Certain storm conditions can cause severe beach erosion, partial or complete destruction of coastal structures and human life and occupation. The majority of the unfavourable consequences could be mitigated by means of early warnings. This implies establishment of a set of thresholds triggering critical morphological response.

The study explores a linkage between the wave conditions and morphological changes along the western Black sea coast. The methodology is based upon the interdependence between hydrodynamic factors (wave energy and wave induced flow), lythodynamic response (sediment transport) and morphological effects (sea bad evolution, shoreline retreat). The sea state history in representative offshore locations is reconstructed through hindcasting. The morphological changes are assessed using long-term series of coastal measurements. Furthermore, for a couple of storms there is evidence for damages on coastal infrastructures.

It is found out that the thickness of the eroded layer seems to be more responsive feature with respect to the variation of the storm intensity. Moreover, in most of the cases, the more energetic the event, the larger the bottom erosion. For that reason, this feature's behavior is considered more useful for definition of the threshold for significant beach change. The sea bed erosion of the order of 0.4-0.5m is considered typical for seasonal variations to which corresponds a retreat of about 2-4m, for which the profile shape is observed to be recovering during the post storm period. However, the measured profile deformations and shoreline displacement after a particular storm (January 1977) greatly exceeded the usual seasonal course. On the whole, it is assumed that the majority of storms are not intense enough to call forth hazardous effect. Therefore, only storms with intensity similar to that of January 1977 or February 1979 are considered capable of generating damages to infrastructure and possible threat to human lives.

The set of threshold for morphological impact of the storms can be described in more details as follows. The first critical value, called initial wave threshold, accounts for wave conditions (significant wave height, mean period and mean direction of wave propagation) causing intense sediment transport. The storm thresholds determining significant morphological changes and morphological damage are established by consideration of integrated wave energy accounting for both wave pattern and storm duration. As a result, it is concluded that storms with integrated wave energy between 0.30 - 0.66x10^6 Jm^{-2} can produce important morphological changes, while more energetic storms are considered extreme events with high destructive potential.