BEACH MULTI-HAZARD ASSESSMENT AND MAPPING FOR RISK MITIGATION AND SUSTAINABLE RESPONSES

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Beaches are often the basis of economic and social development, especially when tourism activities are considered, but they are also among the most dynamic and exposed systems in the coastal zone. This exposure is related to the local conditioning and triggering factors such as waves, tides, sediment size, morphology and planimetric shape of the beach system that can promote dramatic morphological changes and/or flooding during extreme events. Every year changes associated with beach planimetric retreat due to profile volume loss and marine flooding through overwash endanger people and property and therefore have a socio-economic impact on local communities. It must be stressed that this type of coastal systems have resilient properties even if the impacts of storms are considered, but this common characteristic hardly means a significant protection to local communities when extreme events are considered.

Due to the multi-hazard nature of beach systems and its close relations to the often dense human territorial occupation it is necessary to establish assessment frameworks that can evaluate coastal communities exposure to the local types of coastal hazards. As in most exposed coasts, beach specific hazards are directly dependent on wave climate and wave power among other variables and coast line recession and inland flooding due to wave overwash are among the most frequent events with destructive potential.

This research proposes two indexes that can express the local beach susceptibility to erosion and to marine inland flooding due to extreme storm events. These indexes are builded, calculated and mapped using field data and model predictions and have the objective to provide a tool for accurate coastal risk mitigation and sustainable responses preparedness.

The flooding potential index (*fpi*) and the erosion potential index (*epi*)(Trindade, 2010) were applied and tested in three beach systems in the west coast of Portugal (NW of Lisbon), the S^{ta}. Rita beach (a composite beach-dune/beach-cliff embayed system), the Azul beach (a large beach-dune system) and the Foz do Lizandro beach (a small beach-dune system). This wave dominated stretch of coast is a high energetic coastal environment with winter offshore mean significant wave height reaching 2,5m. Storms are frequent and beach erosion is a common phenomena. (Pita e Santos, 1989; Costa, 1994; Gama et al., 1994).

The *fpi*represents a predicted extreme water level attainable in a 100 year storm wave height return period and depends on incident wave parameters, mean spring tide heights (*MST*), storm surge heights (SS_{max}) and runup levels ($R_{2\%}$, Stockdon*et al.* (2006) (eq. 1). The state of the beach profile previous to the storm occurrence is carefully taken into account by considering a near reflective ($_{tan\beta\ max}$) and a dissipative ($_{tan\beta\ min}$) starting profiles.

$$fpi_{tan\beta\ min}^{tan\beta\ max} = 0m\ (msl) + MST + SS_{max} + R_{2\%} \qquad \text{eq. 1}$$

The *epi*is representative of extreme beach profile retreat due to de same type of storm event considered in the determination of the *fpi*. It is calculated and mapped as a result of the beach profile extreme response empirical modelling. Results include local model calibration and validation with high accurate beach profile data.

Flooding and erosion susceptibility mapping is used to accurately predict extreme storm impact on local coastal systems and communities that rely on coastal resources.

References

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