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Performance of shoreline evolution strategies: a perspective look and the use of one-line shoreline evolution modelling

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Summary

The main objective of this thesis is to contribute to the improvement of coastal protection and planning. The main contribution consists of quantifying the uncertainty associated with the use of reduced complexity, one-line, shoreline evolution models. This uncertainty is associated both with the simplification of the physical processes represented by the model such as considering a constant value of the wave transmission coefficient past a submerged breakwater or choosing a certain transport formula, but also with the choice of input data sources, such as the initial shoreline or wave series.

The use of various types of satellite imagery to extract the initial shoreline position is strongly conditioned by the type of shoreline indicator, the study site characteristics and the time scale used. For long-term studies, Red, Green and Blue (RGB) images are recommended for shoreline extraction. Small differences in pixel resolution are of little relevance. Synthetic Aperture Radar (SAR) images showed great potential for shoreline detection, however, further studies are needed to improve the image processing technique and shoreline extraction with an adequate resolution for shoreline evolution studies that need some detail, especially near defence structures.

Coastal sediment transport is an extraordinarily complex process that is simplified in numerical one-line models by empirical formulas. Knowing the morphological response of a given study site, it is possible to choose the most appropriate formula for each case. Although the formula of MilHomens et al. (2013) shows good results in the literature for the Portuguese west coast, the original Kamphuis formula (1991) showed better long-term results for the study area of Ria de Aveiro inlet to Mira beach (in the Portuguese northwest coast). Further studies can be conducted with field data to validate this choice.

Despite their reduced complexity, shoreline evolution one-line models have been used for decades in the conception and design of coastal protection works, showing good results despite its limitations. All these contributions meet the objective of improving the ability to respond to longterm coastal risks by providing ways to quantify the uncertainty associated with the use of reduced complexity models, thus improving the design and conception of coastal defence works.

Keywords

Numerical models, shoreline, uncertainty, coastal defence, transmission coefficient, wave chronology.

Shoreline Evolution in the Espinho-Esmoriz stretch. Imagery from LandSat 5, 7 and 8.