A SHORELINE EVOLUTION MODEL BASED ON EQUILIBRIUM FORMULATIONS

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INTRODUCTION

Traditionally, the shoreline hindcast under the influence of changing marine conditions has been considered by means of existing robust shoreline evolution models, such as one-line, multi-line, combined or 3D models. All of them require long data series, many calibration parameters and are computationally intensive. This study presents a new shoreline evolution model considering the integration of cross-shore, planform and rotation equilibrium-based models, applicable over time-scales spanning days, months or several years.

MODEL DEVELOPMENT

The proposed model is for exclusive use for embayed beaches with parabolic planforms and it's based on two main hypothesis, namely: 1) beach profile and beach planform tend to an equilibrium shape; and 2) beach profile and beach planform are linked so that any variation in the shoreline position due to cross-shore process will affect the planform shape and vice-versa.

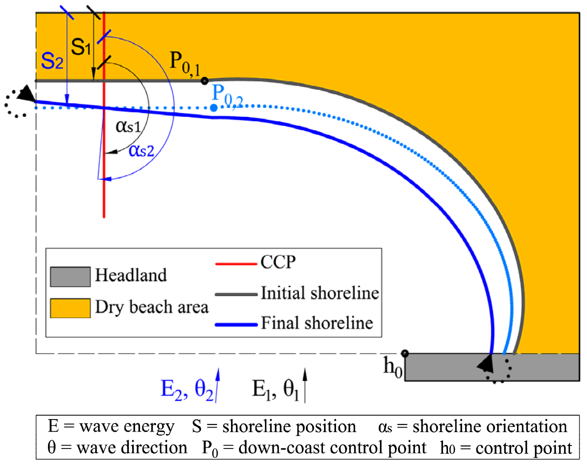

Figure 1. Model scheme. The variables with subscript 1 indicate initial conditions and 2 for future conditions.

The model considers a transect in the most wave-exposed section of the beach as the cross-shore control profile (CCP) (see Figure 1), which governs the forward/backward displacement of the shoreline in the straight alignment. For its definition, translational movement is based on the model developed by Yates et al., (2009) applied wave-by-wave on the CCP. The resulting shoreline position is then used as a boundary to obtain the initial condition for the down-coast control point, P_0, which is the start point of the parabolic beach planform, following the expression defined by Hsu and Evans (1989). Finally, the incoming wave directionality is included by means of a new equilibrium-based shoreline rotation model, which is expressed in terms of beach orientation variability.
The model goes from considering shoreline variability on a unique section, to evaluating the entire dry beach area evolution.

APPLICATION

The proposed model has been initially calibrated and validated by means of the unique long-term (multi-decadal), high resolution (monthly) survey dataset (five transects) within the Narrabeen-Collaroy embayment in southeast Australia. In total, nearly 3 km of coastline have been used to evaluate the model performance. Then, the model has been applied in other beaches using multi-year shoreline data.
The new model successfully reaches the general erosion-accretion trend at a qualitative and quantitative level. As the main conclusion, this is a simple equilibrium-based shoreline evolution model that requires few calibration parameters and is computationally efficient and versatile.

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