EVALUATION AND COMPARISON OF BEACH NOURISHMENT MODELS: CASE STUDIES: FOLLY BEACH AND HUNTING ISLAND, SOUTH CAROLINA

Harry Dallon Weathers III

ABSTRACT

Beach nourishment has become an increasingly common means by which coastal erosion is addressed. However, it is also a costly undertaking. Monitoring and modeling beach fill losses have become essential elements to beach management. This study addresses beach fill modeling, specifically four models: a Linear Erosion model, the Verhagen model, the One-Line and the newly introduced Combined model.

The Linear Erosion model assumes that beach nourishment losses follow a linear trend, while the Verhagen model incorporates linear erosion as well as exponential erosion, which is the result of the added sediment adjusting towards equilibrium. The form of the One-Line model used describes partial nourishment of a barrier island and also incorporates linear and nourishment induced erosion. Finally, the Combined model, developed herein, incorporates elements of the Verhagen and the One-Line models and is tested in its ability to describe beach fill evolution.

These four models were applied to beach nourishment volume loss data that were calculated using beach profile data from two locations in South Carolina: Folly Beach and Hunting Island. Each model was applied by fitting the model equations to the volume-time series from each study site. Results from model fitting determined the values of parameters related to decay rate in the Verhagen, One-Line, and Combined models. In the Linear Erosion model, the linear erosion rate (a) is determined. Three parameters are determined through fitting in the Verhagen model: the linear erosion rate, a, a decay term describing fill induced erosion, T_c, as well as a parameter which describes the relative importance of each process, p. In the One-Line model, parameters that quantify linear erosion and fill induced erosion are determined. The relationship of the One-Line model, along with its fill decay term (G), to sediment transport allows for evaluation of the model fit in light of other related data, such as nearshore wave conditions and beach morphology. In the Combined model, the parameters p from the Verhagen model and G from the One-Line model were determined.

The Linear Erosion, the Verhagen, and the Combined models failed to adequately describe fill evolution at either Folly Beach or Hunting Island. On the other hand, the One-Line model was found to be able to describe beach fill volume evolution at both locations. The success of the latter model, coupled with its inclusion of parameters related to beach morphology, suggest that it is a more versatile approach in predicting volume losses and could be used at locations other than the sites included in this study. Furthermore, detailed investigation at each site indicates that both the role of barrier island processes and inlet dynamics in the evolution of beaches and beach fill are not fully recognized by the models and should be a part of any modeling study related to beach nourishment at barrier islands.