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Estimating wave attenuation by vegetation using regression and decision tree models

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Environmental compatibility of coastal protection plays an important role in today's development and realization of new projects as well as in redesigning existing protection measures. In coastal protection strategies, natural structures like foreshore vegetation fields could be included as supportive element against wave forces and at the same time contributing to ecosystem quality and health. Specifically, numerous studies investigated wave damping by foreshore vegetation in the past decades, highlighting that loads on the dike behind can be significantly reduced. However, existing studies often focus on one or two species and consider only a limited range of wave forcing. Furthermore, for practical applications such as coastal protection measures robust estimates of wave attenuation by vegetation are needed.

Here we present* the development of a generalized model enabling to estimate the wave attenuation induced by vegetation. Our model is based on data from different published campaigns, laboratory experiments, and numerical models. In the current stage, parameters including the vegetation characteristics (e.g. plant density, stem diameter), foreshore (e.g. foreshore slope, water depth), and wave parameters (e.g. wave height) are combined in a linear regression model. For various foreshore setups covering the entire published range of parameters, the model shows a good agreement between modelled and observed wave attenuation (R^2 = 0.9). However, in practical applications no exact input values exist, but the parameters vary within ranges. Therefore a more robust solution for the prediction of wave attenuation by vegetation is needed.

To provide an approach useful for engineering applications and as input for coastal protection strategies, the prediction of the attenuation capability of foreshore setups is simplified by classification. A decision tree is set up using the same data as above but assigning different ranges of values and combinations of vegetation characteristics to three classes of wave attenuation (i.e. low, medium, or high attenuation capability). The result is a more flexible prediction model with regard to the input data and a more practical estimation of the damping capability. Next, both the regression model and the decision tree need further improvement by including more data and by updating the selection of predictors.

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