SHORT-TERM PREDICTION OF BEACH MORPHOLOGY USING ARTIFICIAL NEURAL NETWORKS

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Near-shore morphodynamics is a collection of highly non-linear interactive processes and is often investigated by a conventional process-based modeling approach with several computational modules. These are interactive modules for hydrodynamics, including wave propagation and breaking, sediment transport and bathymetry changes. However, the processes are not yet fully understood, especially with respect to the cross-shore transport processes. Also, in coastal morphodynamics one must deal with high-dimensional data spatially and also often temporally, which makes this approach rather costly.

Data-driven artificial intelligence techniques, such as Artificial Neural Network (ANN) offer cost effective alternatives to conventional modeling techniques. Compared to the conventional approach, such techniques are less assumption dependent and mostly are able to deal with noisy data. The ANN has been increasingly applied to diverse research areas of water science in recent years. Although coastal engineering problems are not exception, in areas such as near-shore sediment transport or morphodynamics, the application of ANN is relatively new.

The authors previously attempted to predict beach morphology changes short-term ahead in time by ANN based on the downsampled cross-shore profiles. The profiles are considered as a whole and Principal Component Analysis (PCA) and wavelet transform are used for profile data downsampling purpose. However, the PCA and wavelet transform appear to scatter the information on profile changes into a several sets of parameters that are not necessarily correlated to each other. It might be better to base the estimation simply on local individual points and make use of information from the neighboring bathymetry points.

Therefore, the objective of this study was to investigate the possibility of estimating morphology development tendency point-wise by using information from several neighboring points on a spatial and temporal scale. The case study is based on bathymetry data for a period of two years, covering parts of Kiel Bay, Germany. The time intervals between the bathymetry measurements differ from 10 to 73 days, although the most frequent intervals are about 6 weeks. Thus, it was attempted to take non-equidistant temporal scales into account by weighting.

The ANN models estimated the changes on regular grid points using weighted values from directly neighboring points at the preceding measurement instances. Up to three preceding measurements are used for deriving development tendency. The results are then compared to those obtained by using elevations from neighboring points of the preceding measurements directly. Although the performance indices do not differ significantly, the results on individual profiles with several sandbars indicate slightly improved performances when weighted values are used as model inputs.