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Neural network hindcasting of hydrodynamic boundary conditions for the analysis of medium-term morphodynamics of barred beaches

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The hindcasting of wave characteristics is of primordial importance to relate beach behaviour to external hydrodynamic forcing. Often, datasets of beach profiles covering several years are available, but nearshore wave buoy data in the immediate vicinity of the study area during the observation period are lacking. In the past, several methods were presented to derive wave characteristics at a certain location, as a function of observed parameters at nearby locations. One of the best known examples is numerical modeling of nearshore wave propagation using the SWAN model. Recently, soft computing methods, and notably Artificial Neural Networks (ANN), have gained some popularity as a means for wave forecasting and hindcasting, as they are computationally less demanding and easier to set up than traditional numerical models. In this paper, we use a multi-layer feed-forward ANN for hindcasting hourly wave characteristics at the Westdiep swale in the nearshore zone of the Belgian West Coast. The input for the model are directional wave data from a buoy some 30 kilometer offshore, tides from the nearby port of Nieuwpoort and local wind characteristics at Koksijde. The network is trained and validated based on one year (2007) of observations at the prediction location using the back-propagation algorithm. This period is considered to be long enough to include all the typical patterns of storms and calms. The resulting model is then used to perform a wave characteristics hindcast from 1985 until 1995. For this period, a dataset of nearly monthly beach profiles is available from 4 locations between the French border and the port of Nieuwpoort. The influence of storm intensity, storm chronology, nearshore morphology and human interference on the evolution of the intertidal bars are evaluated, using the wave database as a boundary condition.