Artificial Intelligence for wave climate predictions

A novel Artificial Intelligence (AI) model to study future coastal maritime climate under the context of climate change is proposed. This model integrates statistical analysis, Monte Carlo simulations, and Artificial Neural Networks (ANNs) to predict and downscale future wave climate. AI models demonstrate incredible potential, and their application in ocean and coastal engineering offers substantial advantages. In this study, we merge statistical methodologies with AI techniques to develop a model that enables the study of future wave climate and the propagation of waves to the coast. We employ probabilistic methods, specifically Monte Carlo simulations, to generate synthetic data series. The use of ANNs facilitates the handling of large data sets at a minimal computational cost, while Monte Carlo simulations allow for the generation of future climate change projections at a regional level. The aim of this paper is to leverage the strengths of both methodologies: the data generation capabilities of probabilistic techniques and the extensive data analysis capabilities of AI techniques. The combination of these methodologies results in a highly accurate (MSE of 0.02 m and 1 s) and computationally efficient hybrid model for projecting coastal maritime climate considering climate change. This new methodology has been validated and applied in the Western Mediterranean, specifically in the area of Valencia, for both long-term regimes and extreme events. The results indicate increases in extreme wave events by up to 1.5 m in wave height and 1.8 s in wave period by 2050.

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