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Machine Learning Methods for Ocean Wave Analyses

Abstract:

Having access to accurate and high-resolution wave height forecasts is paramount for the safety of coastal communities all over the world. However, even on computer clusters, computations of high-resolution forecasts for larger parts of the coast are still taking a large amount of time. Using a neural-network-based approach we reconstruct high-resolution significant wave height and other sea state variables calculated over a coarse resolution by a spectral wave model. This method is up to 67 times faster than running a traditional spectral wave model at high resolution, while conserving similar accuracy. Though the present formulation only allows for the use of the super-resolution technique in combination with uniform grids, the method has potential to be expanded to non-uniform grids and other coastal wave models based on different governing equations. Overall, incorporation of the presented method into major wave forecasting models like SWAN or WAVEWATCH III has the potential to allow for the creation of "zoomed-in" areas of interest without the requirement for supplementary calculations at higher resolution.

Results:

In a study case at the Basque Coast in Biarritz, France we converted the results of a spectral wave model from a 10x10 grid (left in the figure) to a 160x160 grid (in the middle), with only a minor loss in accuracy (compare with figure on the right).