EGU22-105, updated on 16 Aug 2022
https://doi.org/10.5194/egusphere-egu22-105
EGU General Assembly 2022

Neural-network-based sea state reconstruction of under-resolved coastal spectral wave computations

Jannik Kuehn[1], Stéphane Abadie[2], and Volker Roeber[1]
[1]Université de Pau et des Pays de l'Adour, E2S UPPA, chair HPC-Waves, SIAME, Anglet, France
[2]Université de Pau et des Pays de l'Adour, E2S UPPA, SIAME, Anglet, France

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 significant amount of time. It is therefore attractive to work with coarser resolutions and benefit from low computational load, to then recover a finer resolution through a reconstruction process of the missing information.

Here, we apply a neural-network-based super-resolution technique to the reconstruction of significant wave height and other sea state variables calculated over coarse resolution by a spectral wave model. Employing the DSC/MS model of Fukami, Fukagata, and Taira (2019) we accomplished a 67-times lower computation time in comparison to the initial time necessary for the equivalent fine resolution, by reconstructing sea state variables with comparable accuracy through the neural network.

We present the potential of the technique by applying it to a case study site located at the Basque Coast near Biarritz, France where we achieved reasonable accuracy using only one year of training data with the help of traditional Machine Learning methods like "Transfer Learning" and "Data Augmentation". 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. We will also comment on the efficiency of the training process and requirements with respect to data quality.

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.