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Data assimilation of ocean wind waves using Neural Networks

A novel approach of data assimilation based on Neural Networks (NN's) is presented and applied to a wave model WAM. A case study demonstrated here is the German Bight. The method takes advantage of the ability of NN's to emulate models and to invert them. Combining forward and inverse model NN with the Levenberg–Marquardt algorithm provides boundary values or wind fields in agreement with measured wave integrated parameters. Synthesized HF- radar wave data are used to test the technique for two academic cases. The approach proposed here uses an' inverse' NN to estimate the wave parameters at the wave model's open boundary from the observations. These estimated boundary conditions are used as input for a run with a physically-based model (the wave model WAM). A forward NN is trained to generate output for a limited number of output locations. The twin experiments' results are promising and confirm the practicability of the assimilation technique based on the ML approach. The method has several advantages compared with other methods: it can be easily implemented for other wave models and regions since it only requires model output and measurements. Additionally, it can be adapted to specific problems (derive improved wind fields and/or boundary conditions or any other model parameter of interest). Data Assimilation using Neural Networks is computational very efficient compared to other advanced (non-local) assimilation strategies.

Which theme does your abstract refer to?

Applications of machine learning in data assimilation

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