WHAM: A next generation Wave-Hydrodynamics-Atmosphere Model

Publieke samenvatting / Public summary

Aanleiding

Accurate information about atmosphere, wave and ocean conditions are crucial throughout the entire lifetime of an offshore wind farm. Planning, design, engineering, construction, operations & maintenance, electricity trading and end-of-life decisions are all informed by data from numerical models. Today's numerical models, however, are still fraught with uncertainty due to 1) their coarse grid resolution 2) an inaccurate description of the physics at the air-sea interface 3) a one-way coupling between atmospheric, wave and ocean models, or 4) a combination of the above. Advances in scientific computing using NVIDIA GPUs have now paved the way for a new approach that overcomes the weaknesses described above. By using the vast acceleration offered by modern hybrid CPU-GPU infrastructures, it becomes feasible to run three state-of-the-art high-resolution models in parallel and to exchange information between them. This proposed development of online and two-way coupling is beyond state of the art and expected to further result in increased accuracy.

Doelstelling

The goal of this project is to radically bring down uncertainties in MetOcean conditions of offshore wind farms by creating the world's most advanced numerical model for atmosphere, wave and hydrodynamic predictions. The project will contribute to integrated offshore energy systems as follows. Better atmospheric predictions bring down power forecasting errors and thus lead to lower

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balancing costs. More accurate MetOcean predictions for workability reduce unnecessary downtimes in construction and operations & maintenance works. More precise MetOcean assessments can better inform the design of offshore wind farms. Lower uncertainties in wind resource and yield assessment lead to lower financing costs of offshore wind farms. Besides these direct use-cases, the coupled model can accelerate innovation in other areas relevant to the energy system: floating solar, multi-use wind farms, water quality and integrated turbine design. Applications outside the energy sector include flood risk assessment, climate impact studies and various uses in the maritime sector. The broad application areas illustrate the economic potential of the proposed innovation, both nationally and internationally.

Korte omschrijving

In the work package on model development, the coupling between the three models (the atmospheric model ASPIRE, the hydrodynamic model Delft3D and the wave model SWAN) will be investigated with an emphasis on atmospheric and oceanographic physics. The goal is to develop an accurate numerical representation of the physical processes on the air-sea interface with information available from the three models. The second work package focusses on numerical and computational aspects. Here we deploy the coupled models on modern GPU-CPU infrastructure in a way that optimally exploits these architectures. The basic modelling interface (BMI) is used as a code for coupling the models. In the third work package we apply the developed model on 4 use-cases relevant for offshore wind farms: power forecasts, MetOcean forecasts, wind resource assessment, MetOcean assessment. A number of open datasets will be produced with the coupled model infrastructure. To stimulate further innovation, in the 4th work package we will organize a number of workshops with stakeholders related to other use-cases that our advanced model will enable.

Resultaat

The project delivers a validated next generation wave-hydrodynamic-atmosphere model. After the project, the model will be included in the operational models and existing products and services of the project partners. In addition, the model can be used for further research through an API that allows interaction with other computer codes. The project delivers technical reports on the geo-scientific and computational aspects of the coupled model. Documentation for users to run and interact with the model will be provided. Technical reports describing the four use-cases and validation results will be delivered. One-of-a-kind open datasets covering the North Sea area will be produced and disseminated to the public. These datasets will provide further opportunities for validation, analysis and can be used as input for AI based numerical models. Workshops to inform stakeholders and stimulate further innovation will be organized.

De data in deze applicatie is afkomstig van de Rijksdienst voor Ondernemend Nederland (RVO) en wordt in samenwerking met de Topsector Energie ontsloten.
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