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Simulating ecological changes caused by marine energy devices

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Marine renewable energy from wave and tidal technology has the potential to contribute significantly globally to energy security for future generations. However common to both tidal and wave energy extraction systems is concern regarding the potential environmental consequences of the deployment of the technology as environmental and ecological effects are so far poorly understood. Ecological surveys and studies to investigate the environmental impacts are time consuming and costly and are generally reactive; a more efficient approach is to develop 2 and 3D linked hydrodynamic-ecological modelling which has the potential to be proactive and to allow forecasting of the effects of array installation.

The objective of the study was to explore tools which can help model and evaluate possible far- and near field changes in the environment and ecosystem caused by the introduction of arrays of marine energy devices. Using the commercial software, MIKE by DHI, we can predict and model possible changes in the ecosystem. MIKE21 and ECOLab modelling software provide the opportunity to couple high level hydrodynamic models with process based ecological models and/or agent based models (ABM).

The flow solutions of the model were determined in an idealised tidal basin with the dimensions similar to that of Strangford Lough, Northern Ireland, a body of water renowned for the location of the first grid-connected tidal turbine, SeaGen. In the first instance a simple process oriented ecological NPZD model was developed which are used to model marine and freshwater systems describing four state variables, Nutrient, Phytoplankton, Zooplankton and Detritus.

The ecological model was run and evaluated under two hydrodynamic scenarios of the idealised basin. This included no tidal turbines (control) and an array of 55 turbines, an extreme scenario. Whilst an array of turbines has an effect on the hydrodynamics of the Lough, it is unlikely to see an extreme effect on the NPZD model. Further assessment on primary productivity and filter feeders is currently being implemented to assess impacts on these biological systems. Using MIKE software opens up many further possibilities to allow insights into the impacts of marine energy devices on the ecosystem.