Abstract:
The overall stability of tidal stream generators can only be assured if the maximum loads expected to arise during the lifetime of the structures are accounted for. These loads typically consist of a predicted maximum wave scenario and a maximum current scenario, which could potentially occur simultaneously. In this paper, combined wave–current offshore conditions are analyzed using a numerical procedure that is based on the unsteady Reynolds-averaged Navier–Stokes equations and incorporates the Volume of Fluid method and Fenton's wave theory. A procedure is introduced that allows for the simulation of non-linear waves in combination with a depth varying current under full consideration of wave–current interaction. The methodology is utilized to investigate the change in the overall loading on a structure subjected to combined wave–current conditions in comparison to a linear superposition of pure wave and pure current loads. It is shown that the peak loads on the structure are significantly higher for the combined load case than those computed for the superimposed individual load scenarios. Finally, the numerical wave channel is applied as part of the design process of a tidal stream generator prototype recently constructed near Jindo Island in South Korea.

Stichwörter:
Numerical wave channel;
Computational fluid dynamics;
Wave–current interaction; Tidal stream generator; Extreme loads; Load prediction

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