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Simulating breaking waves with a Reynolds stress turbulence model

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ABSTRACT

We present novel CFD research of breaking surface waves utilizing the Reynolds stress–ω [1] turbulence closure model, where ω is the specific dissipation rate. Highlights of two studies will be presented. In the first study [2] breaking waves are considered in the absence of any structures. CFD results with seemingly unprecedented accuracy are achieved, superior to the best of our recently-developed "stabilized" two-equation models [3]. Specifically, the Reynolds stress–ω model: naturally avoids turbulence over-production prior to breaking, accurately predicts the break point, provides reasonable evolution of turbulent normal stresses, while also yielding accurate evolution of undertow velocity structure and magnitude across the surf zone, for both spilling and plunging cases. In the second study [4] waves breaking incipiently on a monopile structure are considered (Figure 1). We show that the break point and build up to peak structural force are independent of the turbulence model utilized, whereas turbulence modelling is essential for accurate simulation of the secondary load cycle. Results in relation to recent work of [5] will be discussed.

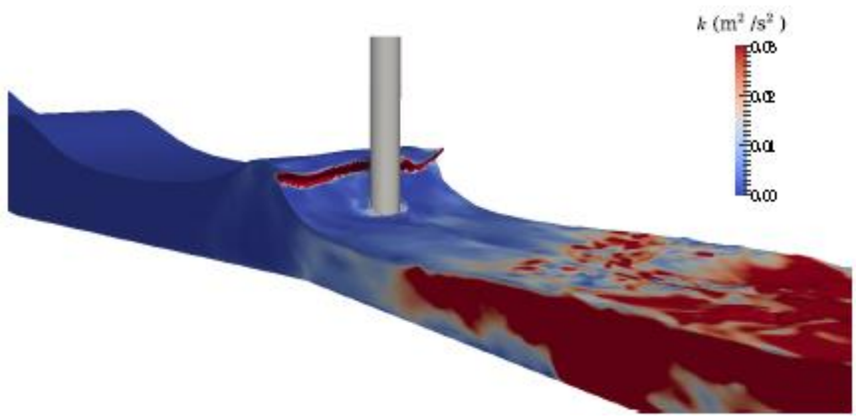

Figure 1. Computed waves breaking on a monopile, colored by the turbulent kinetic energy density (*k*).

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