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# Rogue wave variational modelling through the interaction of two solitary waves

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The extreme and unexpected characteristics of Rogue waves have made them legendary for centuries. It is only on the 1st of January 1995 that these mariners' tales started to raise scientist's curiosity, when such a wave was recorded in the North Sea; a sudden wall of water hit the Draupner offshore platform, more than twice higher than the other waves, providing evidence of the existence of rogue or freak waves. Since then, studies have shown that these surface gravity waves of high amplitude (at least twice the height of the other sea waves [Dyste et al., 2008]) appear in non-linear dispersive water motion [Drazin and Johnson, 1989], at any depth, and have caused a lot of damage in recent years [Nikolkina and Didenkulova, 2011 ]. So far, most of the studies have tried to determine their probability of occurrence, but no conclusion has been achieved yet, which means that we are currently unenable to predict or avoid these monster waves. An accurate mathematical and numerical water-wave model would enable simulation and observation of this external forcing on boats and offshore structures and hence reduce their threat.

In this work, we aim to model rogue waves through a soliton splash generated by the interaction of two solitons coming from different channels at a specific angle. Kodama indeed showed that one way to produce extreme waves is through the intersection of two solitary waves, or one solitary wave and its oblique reflection on a vertical wall [Yeh, Li and Kodama, 2010 ]. While he modelled Mach reflection from Kadomtsev–Petviashvili (KP) theory, we aim to model rogue waves from the three-dimensional potential flow equations and/or their asymptotic equivalent described by Benney and Luke [Benney and Luke, 1964]. These theories have the advantage to allow wave propagation in several directions, which is not the case with KP equations. The initial solitary waves are generated by removing a sluice gate in each channel.

The equations are derived through a variational approach, based on Luke's variational principle [Luke, 1967], and its dynamical equivalent from Miles [Miles, 1977], that describe incompressible and inviscid potential flows with free surface, through the variations of the Lagrangian. This Lagrangian, obtained from Bernouilli's equations, can be expressed in a Hamiltonian form, for which robust time integrators have been derived [Gagarina et al., 2015]. A Galerkin finite element method is then used to solve the system numerically, and we aim to compare our simulations to exact solutions of the KP-equation.