



The role of adverse current gradients in the formation of freak waves

Alessandro Toffoli (1,2), Takuji Waseda (3), Keri Collins (2), and Miguel Onorato (4)

(1) Swinburne University of Technology, Faculty of Engineering and Industrial Sciences, Hawthorn, Australia (toffoli.alessandro@gmail.com), (2) School of Marine Science and Engineering, Plymouth University, Plymouth, PL4 8AA, UK, (3) Graduate School of Frontier Sciences, University of Tokyo, Kashiwa, Chiba 277-8563, Japan, (4) Dipartimento di Fisica Generale, Università degli Studi di Torino, Via Pietro Giuria 1, 10125 Torino, Italy

Laboratory experiments in a wave flume and a narrow directional wave basin have been carried out to investigate the nonlinear dynamics of mechanically generated water-wave trains when propagating on adverse current gradients. Observations substantiate that the increase of wave steepness induced by the wave-current interaction excites nonlinear mechanisms such as modulational wave instability. This facilitates the formation of freak waves also under those circumstances when they are less likely. Experimental results support recent theoretical achievements based on a current-modified Nonlinear Schrodinger equation, which demonstrate that rogue waves are triggered by current with negative gradient of horizontal velocity.