EGU21-8402
https://doi.org/10.5194/egusphere-egu21-8402
EGU General Assembly 2021

On the connection between spectral bandwidth and dynamic properties of breaking waves

Rui Cao and Adrian Callaghan
Department of Civil and Environmental, Imperial College London, London, United Kingdom of Great Britain – England, Scotland, Wales (rui.cao17@imperial.ac.uk)

An experimental investigation on dispersively focused 2-D deep-water breaking wave groups with JONSWAP type spectra is presented. Specifically, this paper describes the role of spectral bandwidth (as determined by the peak enhancement factor of the spectra, γ) on several properties of breaking wave groups such as the evolution of spectral energy magnitude and distribution, changes in bandwidth, energy dissipation and its rate, and the breaking strength parameter b. These parameters are examined in the context of two definitions of wave group spectral slope (or just slope), S_s and S_p. The first, S_s, incorporates the role of spectral bandwidth in its definition, where S_p does not consider any explicit bandwidth effect.

Our results show that the spectrally-distributed magnitude of energy loss due to breaking, relative to the peak frequency of the underlying wave group, is broader for broad banded breakers, than for narrow banded breakers, where the energy loss is more concentrated around the peak frequency. In terms of changes to bandwidth post-breaking, it is found that the bandwidth of narrower banded wave groups is more likely to be widened as a result of breaking. For a given wave slope definition, the breaking onset is affected by the spectral bandwidth - broad banded wave groups break at relatively lower values of wave slope, and result in a higher fractional loss at a given value of wave slope.

The laboratory results indicate that the absolute energy loss and its rate are linearly related to wave slope, and that data scatter is reduced when the bandwidth is explicitly incorporated into the definition of wave slope (S_s). In addition, we find that scatter in the fractional wave energy loss as a function of wave slope is also reduced when S_s is used compared to S_p, again indicating the important role of bandwidth in the breaking process. Furthermore, the collapse of the data from breaking wave groups with different bandwidths can be further improved by accounted for the breaking onset in the definition of wave slope. Finally, a quasi-linear dependence of b on bandwidth-dependent wave slope is found, in general agreement with the numerical work of Derakhti and Kirby (2016).