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Wind effects on the modulational instability of surface gravity waves

Maura Brunetti (1) and Jérôme Kasparian (2)

(1) GAP-Climate and Institute for Environmental Sciences, University of Geneva, Geneva, Switzerland (maura.brunetti@unige.ch), (2) GAP-Nonlinear, University of Geneva, Geneva, Switzerland

The modulational instability is a fundamental mechanism for nonlinear exchanges of energy between carrier and sideband waves. It is one of the processes at the origin of rogue-wave formation in deep-water. Since the wind is the energy source in surface wave propagation, accurate modelling of the wind is critical for understanding rogue-wave phenomenon.

We describe how different forcing terms, due to different modelling of the wind action, affect the band of positive gain of the modulational instability. In particular, we consider the wind-forced nonlinear Schrödinger equation obtained in the potential flow framework when the Miles growth rate is of the order of the wave steepness [1]. In this case, the form of the wind-forcing terms gives rise to the enhancement of the modulational instability and to a band of positive gain with infinite width [2]. This regime is characterised by the fact that the ratio between wave momentum and norm is not a constant of motion [2], in contrast to what happens in the standard case where the Miles growth rate is of the order of the steepness squared.

References

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