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On the instability of wave-fields with JONSWAP spectra to inhomogeneous disturbances, and the consequent long-time evolution

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The instability of two-dimensional wave-fields and its subsequent evolution in time are studied by means of the Alber equation for narrow-banded random surface-waves in deep water subject to inhomogeneous disturbances. A linear partial differential equation (PDE) is obtained after applying an inhomogeneous disturbance to the Alber's equation and based on the solution of this PDE, the instability of the ocean wave surface is studied for a JONSWAP spectrum, which is a realistic ocean spectrum with variable directional spreading and steepness. The steepness of the JONSWAP spectrum depends on γ and α which are the peak-enhancement factor and energy scale of the spectrum respectively and it is found that instability depends on the directional spreading, α and γ. Specifically, if the instability stops due to the directional spreading, increase of the steepness by increasing α or γ can reactivate it. This result is in qualitative agreement with the recent large-scale experiment and new theoretical results. In the instability area of α-γ plane, a long-time evolution has been simulated by integrating Alber's equation numerically and recurrent evolution is obtained which is the stochastic counterpart of the Fermi–Pasta–Ulam recurrence obtained for the cubic Schrödinger equation.