THE OCCURRENCE OF EXTREME WAVES IN DIRECTIONAL WAVE FIELDS

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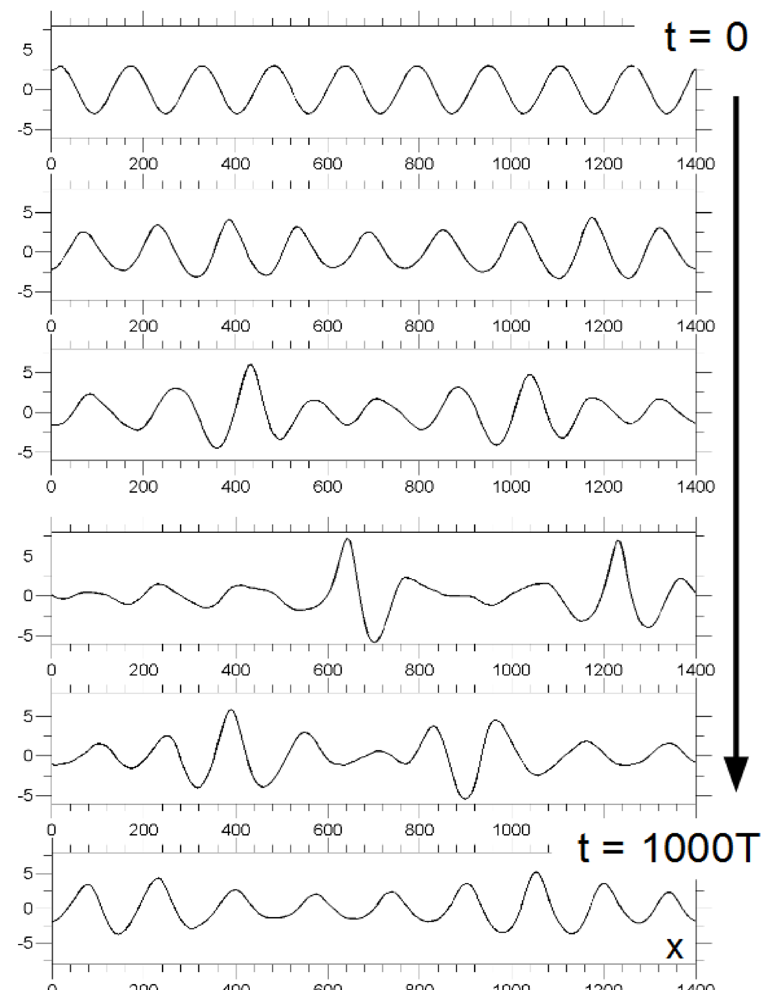
I THE INSTABILITY OF FREE WAVES

The modulational instability of wave packets is responsible for the formation of large amplitude waves. In a random system, this is responsible for substantial deviations from Gaussian statistics, provided waves are long crested (i.e. unidirectional), narrow banded and sufficiently steep (see, e.g., Onorato et al. 2001; Janssen 2003). For more realistic short crested (i.e. directional) wave fields, numerical simulations of Schrödinger-type equations (Onorato et al. 2002, Socquet-Juglard et al. 2005) showed that the the effect of modulational instability is substantially suppressed. These equations, however, are a narrow banded approximation of the equation describing the wave motion. Therefore, *a priori*, it is not possible to be sure on this results, especially when waves are broad banded such as wind sea waves.

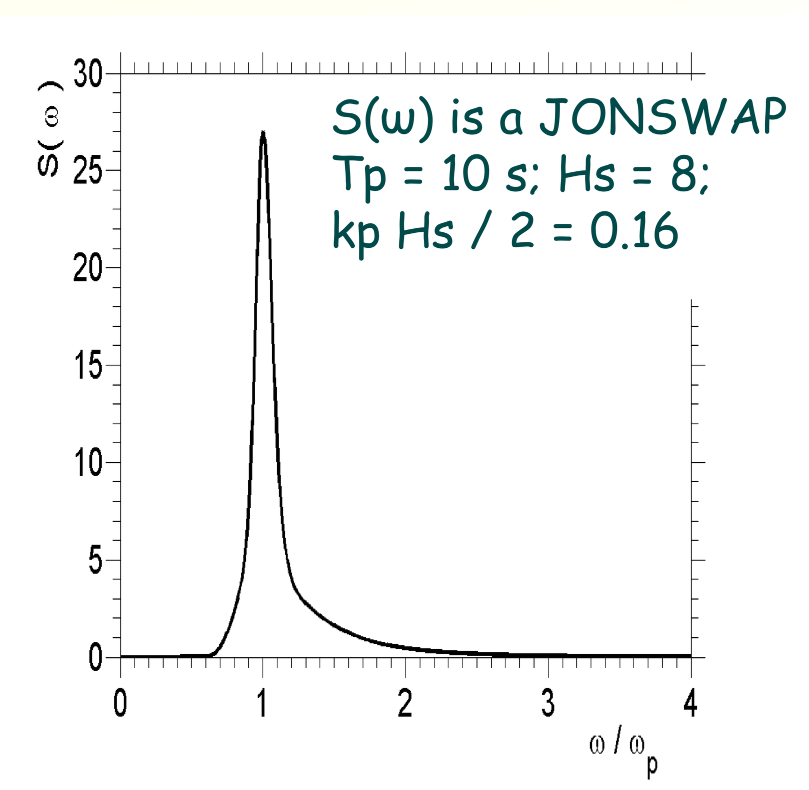
Key mechanism: the modulational instability of free waves



II MODELING THE SURFACE ELEVATION

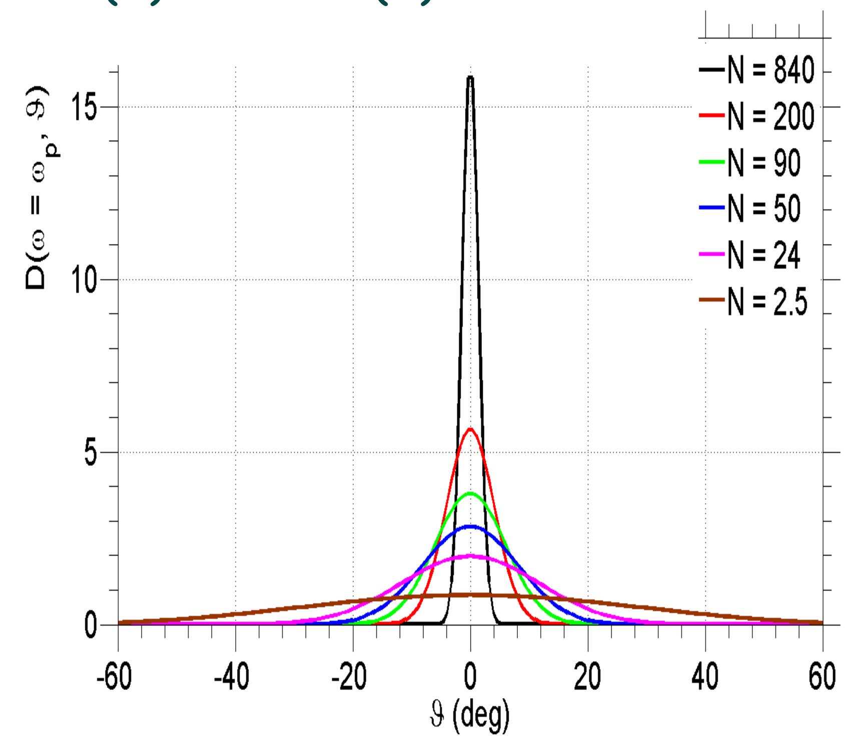
Numerical simulations of truncated potential Euler equations can be used to model the dynamical evolution of the surface elevation without any constrains on the spectral bandwidth. The equations are solved numerically by using the Higher Order Spectral Method (HOSM) proposed by West et al. (1987). The only significant limitations is represented by the order of the truncation; here a third order expansion is used so that the effect of modulationa instability can be modeled.

III INITIAL CONDITIONS



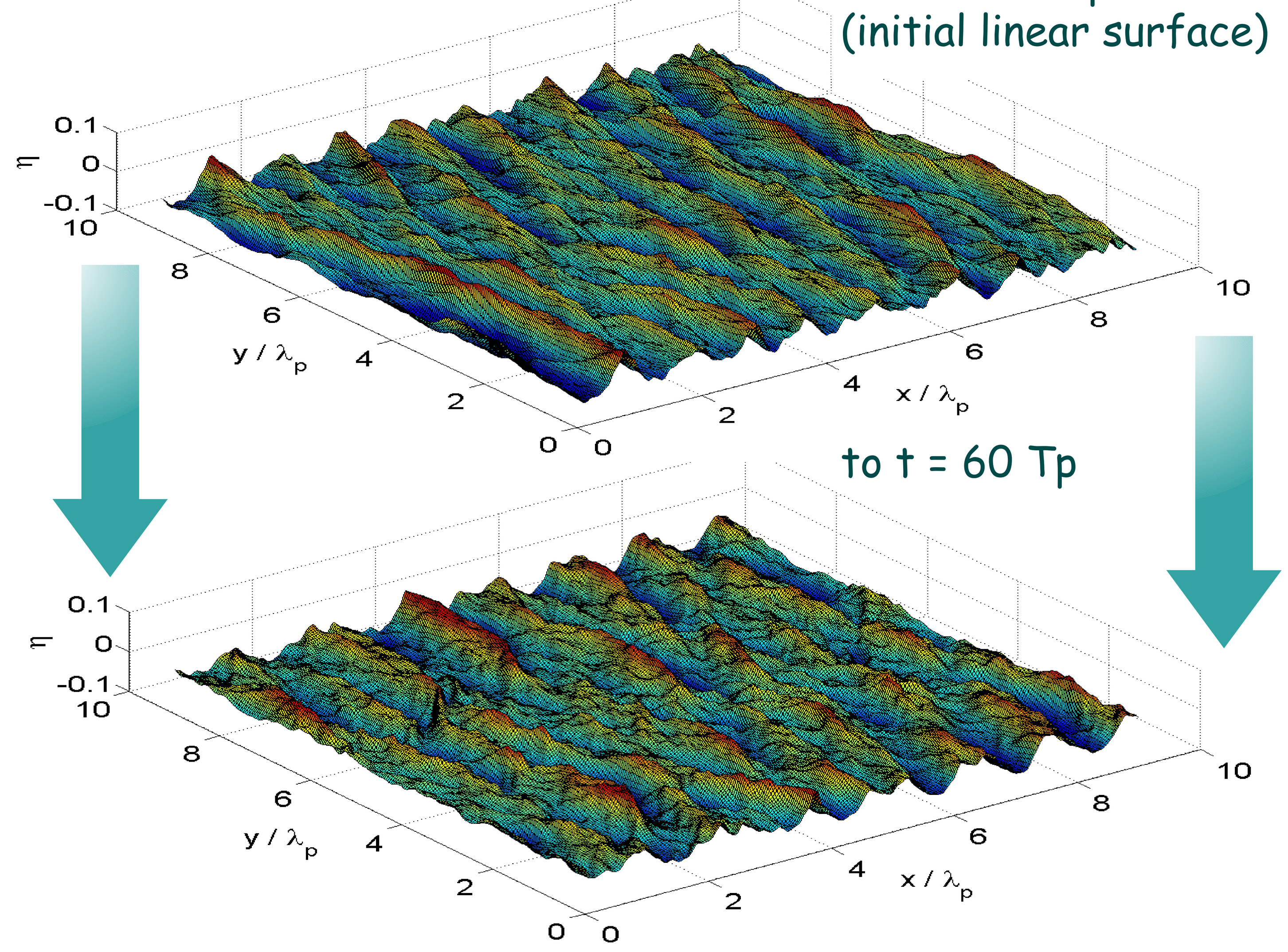
+

D(θ) is a cos^N(θ) function

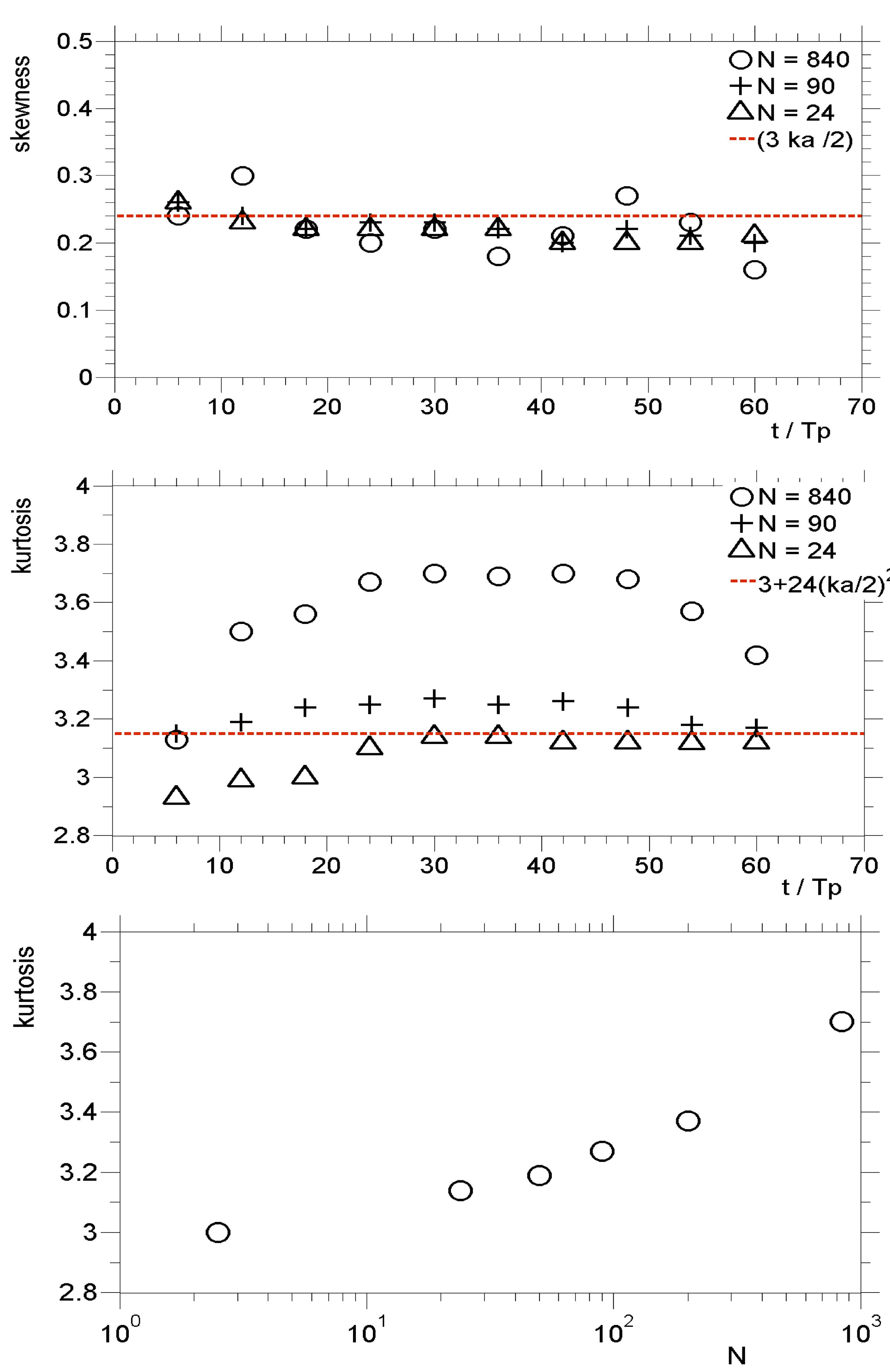


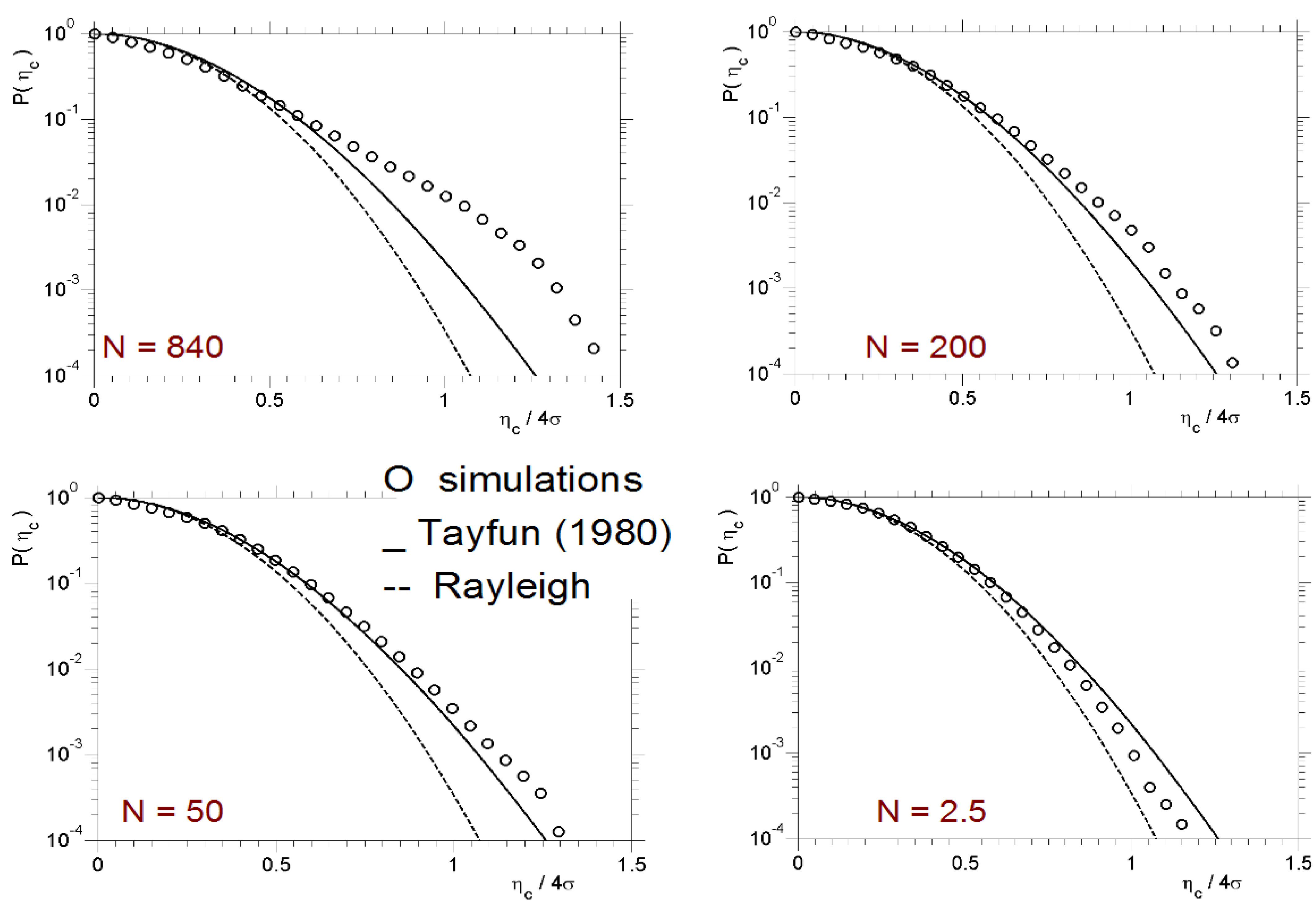
IV SIMULATIONS

The simulation consists in the temporal evolution of the initial (linear) surface elevation η(x,y,t=0). A small time step (Δt = Tp/100) is used to minimize the energy leakage. About 100 repetitions are performed using the same spectral energy by different random amplitudes and phases.



IV STATISTICAL PROPERTIES OF DIRECTIONAL WAVE FIELDS





ACKNOWLEDGEMENTS

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