Wave Turbulence of Gravity-capillary surface waves.

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Keywords: Wave Turbulence, Surface waves, Non-linear waves, Hydrodynamics

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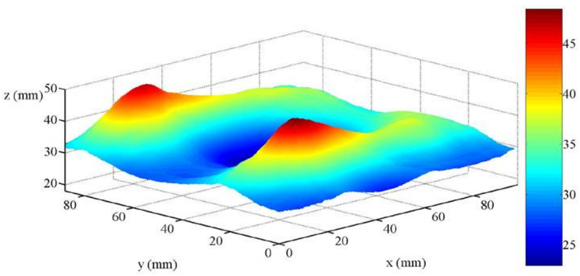
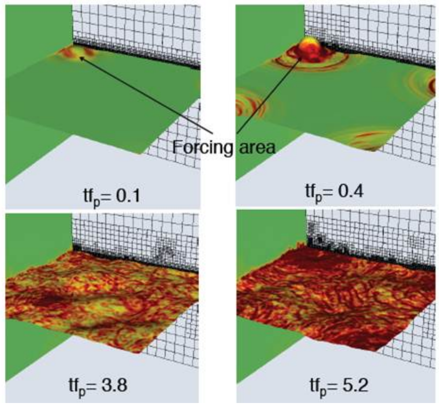
Wave turbulence focuses on the statistical properties of a set of interacting waves where energy is transferred by non-linear interactions from the forcing scales to the dissipative scales. A statistical theory of wave turbulence was developed in the 1960s, the so-called weak turbulence theory which exhibits such energy transfer in out-of-equilibrium situations. This theory has been applied to almost every context involving nonlinear waves: astrophysical plasmas, surface or internal waves in oceanography, Rossby waves in the atmosphere, spin waves in magnetic materials, Kelvin waves in superfluid turbulence, nonlinear optics and elastic waves. Since 2007, our group performed several well-controlled laboratory experiments to test the relevance of wave turbulence theory, for gravity-capillary waves propagating on the fluid surface, which constitutes the most common example of Wave Turbulence.

In this talk, I will focus mainly on our recent results about Capillary Wave Turbulence. By studying decaying regimes, conducting space-time resolved measurements and performing numerical simulations, we obtain spectra in agreement with theoretical predictions. Nevertheless we show also that in experiments where capillary waves are excited by gravity waves, experimental conditions to obtain wave turbulence regimes, do not correspond to the scenario of the Wave Turbulence theory. We observe indeed that viscous dissipation occurs at all scales, whereas theory assumes a Hamiltonian system. Moreover we notice that waves at the forcing scale are in strong non-linear regimes and could act as coherent structures. These features should be included theoretically, to understand dynamics of laboratory waves as well of small scale oceanic waves in turbulent regimes.



(a)



(b)

Figure 1: **Left:** Example of experimental free surface reconstruction using Diffusing Light Photography Technique, in a strongly nonlinear gravity capillary wave turbulence regime. **Right**: Direct Numerical Simulations of capillary wave turbulence solving the full 3D Navier Stokes equations of a two-phase flow using the open source solver Gerris.

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