Postdoc position 2019

The onset of wind waves

Laboratories FAST (Université Paris-Sud, CNRS) and LadHyX (Ecole Polytechnique, CNRS)

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Project page (movies and papers): www.fast.u-psud.fr/~moisy/windwaves
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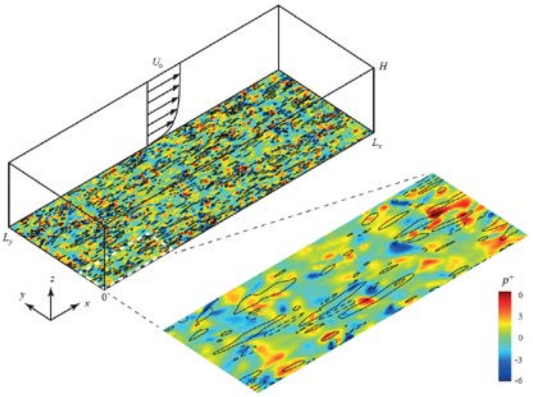

When wind blows over a liquid surface, waves can be generated and propagate downstream. Even though this simple phenomenon has inspired over a century of research, understanding the physics of wind wave generation is still a challenge. Remarkably, even for a wind speed lower than the critical threshold for wave generation, the surface of a liquid subjected to a tangent air flow is never strictly plane: the surface is populated by small disorganized deformations, called "wrinkles", of amplitude of the order of 1 - 10 µm (Paquier *et al.*, 2015, 2016). The physical origin of this pre-wave regime was recently elucidated: wrinkles can be described as a set of uncoherent wakes generated by the turbulent pressure and shear stress patches traveling in the turbulent boundary layer in the air (Perrard *et al.*, 2018).

The aim of the present project is to identify the role of this stochastic base state in the transition towards "classical" (quasi-monochromatic) waves as the wind velocity is increased. Previous work (see Perrard *et al.*, 2018) used a linear modeling for the flow in the liquid phase, forced by a prescribed turbulent stress field taken from a turbulent channel flow over a no-slip rigid surface. This approach successfully predicted the wrinkle amplitude and size, but could not provide any insight into the resonant mechanism that leads to the amplification of wrinkles to regular waves. Here, we aim to develop a new weakly nonlinear approach, by performing a full numerical resolution of the viscous flow in the liquid phase, forced by a prescribed turbulence in a gas phase confined in a thin layer. This approach, less computationally demanding than a full two-phase flow approach, should provide new insight in the long-standing question of the critical wind velocity for the onset of waves.

Applicants should have a strong background in fluid mechanics, with an expertise in numerical methods.

M. Benzaquen, A. Darmon and E. Raphaël, Wake pattern and wave resistance for anisotropic moving disturbances, Physics of Fluids **26**, 092106 (2014).
F. Moisy and M. Rabaud, Mach-like capillary-gravity wakes, Phys. Rev. E **90**, 023009 (2014).
R. Ledesma-Alonso, M. Benzaquen, T. Salez and E. Raphaël, Wake and wave resistance on viscous thin films, J. Fluid Mech. **792**, 829 (2016).
A. Paquier, F. Moisy and M. Rabaud. Surface deformations and wave generation by wind blowing over a viscous liquid. Phys. Fluids, **27**, 122103 (2015).
A. Paquier, F. Moisy and M. Rabaud. Viscosity effects in wind wave generation. Phys. Rev. Fluids **1**, 083901 (2016).
S. Perrard, A. Lozano-Duran, M. Rabaud, M. Benzaquen, F. Moisy. Turbulent windprint on a liquid surface, J. Fluid Mech. (in preparation, 2018).