Effect of free-stream turbulence intensity on free surface deformation of a viscous liquid

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We investigate experimentally the onset of the surface deformation of a viscous liquid by a turbulent wind using the Free Surface Synthetic Schlieren optical method to accurately[1] rebuild the surface deformation. The free-stream wind tunnel turbulence is generated by means of passive turbulence grids. The deformation of the liquid surface has two regimes, as seen in the literature[2]. The first regime, for low wind velocity, shows deformations that are low amplitude elongated streamwise wrinkles. Above a critical wind velocity, gravity-capillary waves are formed with crests perpendicular to the wind direction. Wrinkles still exist in the second regime but their amplitude is an order of magnitude lower than the gravity-capillary waves. We observe that the critical wind velocity at which the wave regime occurred decreases as the turbulence level rises. The amplitude of the wrinkles is found to rise only for the highest turbulence level suggesting a threshold effect. The wrinkles amplitude is found to be constant along the longitudinal axis (fetch) whatever the flow regime (laminar or turbulent). In contrast, in the wave regime it is found that the wave amplitude increases with the fecth in laminar condition, whereas it decreases under turbulent flow condition.

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[1] Moisy et al, *Exp. Fluids* **42**, 1021 (2009)

[2] Paquier et al, *Phys. Fluids* **42**, 122103 (2015)

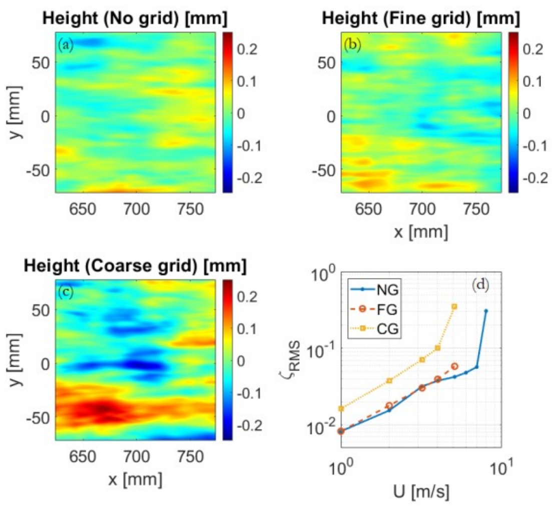

Figure 1: Instantaneous liquid surface height maps for different tests at the same wind velocity of 4.0 m/s (a,b and c). Evolution of the deformation amplitude RMS for different grids and wind velocities (d).