

# Influence of the Jeffreys' sheltering mechanism on rogue waves

C. Kharif †

and

J.P. Giovanangeli †, J. Touboul †, E. Pelinovsky ‡

- (†) Institut de Recherche sur les Phénomènes Hors Equilibre, Laboratoire  
Intéraction Océan Atmosphère, Marseille, France.  
(‡) Institute of Applied Physics. Laboratory of Hydrophysics and Nonlinear  
Acoustics, Nizhny Novgorod, Russia.

## Abstract

Rogue wave generation can be explained on the basis of the spatio-temporal focusing concept. The paper reports on a series of experiments conducted in the large Air-Sea interactions facility at IRPHE (see Fig 1.) and numerical simulations based on a BIEM method. The time-variable frequency of the paddle is chosen to produce a modulated wave train which transforms into a rogue wave (due to spatio-temporal focusing) at a given fetch without wind (see Fig. 2). In Fig. 2 is shown the focusing and defocusing stages. The same experiment is reproduced in presence of wind (see Fig. 3). One can observe that the short group of waves containing the freak wave event is sustain longer. This feature is clearly shown in Fig. 4. The amplification factor is  $A(X, U) = H_{max}(X, U)/H_{ref}$  where  $H_{max}(X, U)$  is the maximal wave height between two consecutive crest and trough in the transient wave group at fetch  $X$  when the wind speed is  $U$  and  $H_{ref}$  is the height of the quasi uniform wave train generated at the entrance of the tank (measured at  $1m$  fetch). The experiments emphasized the importance of the form drag associated with flow separation. Hence, in the numerical approach the air flow separation occurring on the leeward side of wave crests is described by the Jeffreys' sheltering model. Numerical simulations performed for different values of the wind speed confirmed the behavior observed in the experiments (see Fig. 5), namely that the time of occurrence of the freak wave event increases as wind speed increases.

Both experimental and numerical results are in quite qualitative agreement. It is shown experimentally and numerically that the effect of the wind is twofold: (i) it increases slightly the amplification of the envelope of the short group containing the rogue wave and more

importantly (ii) it increases the time of existence of this group. This means that the Jeffreys' sheltering phenomenon may sustain rogue waves by increasing their time of occurrence.

A more detailed presentation can be found in the paper by Touboul *et al* (2006)

### Reference

**J. Touboul, J.P. Giovanangeli, C. Kharif and E. Pelinovsky** 2006, Freak waves under the action of wind: Experiments and simulations. Submitted to *Eur. J. Mech. B/Fluids*.

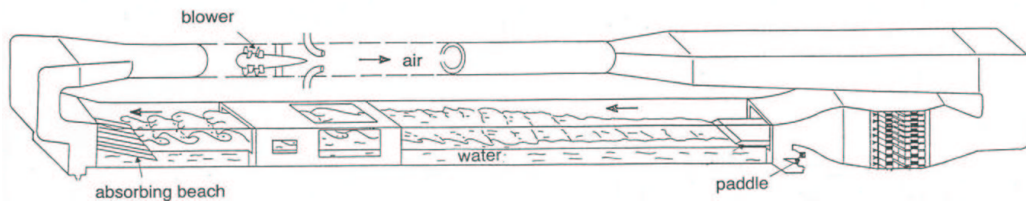


Figure 1: A schematic representation of the Large Air-Sea Interactions Facility (LASIF).

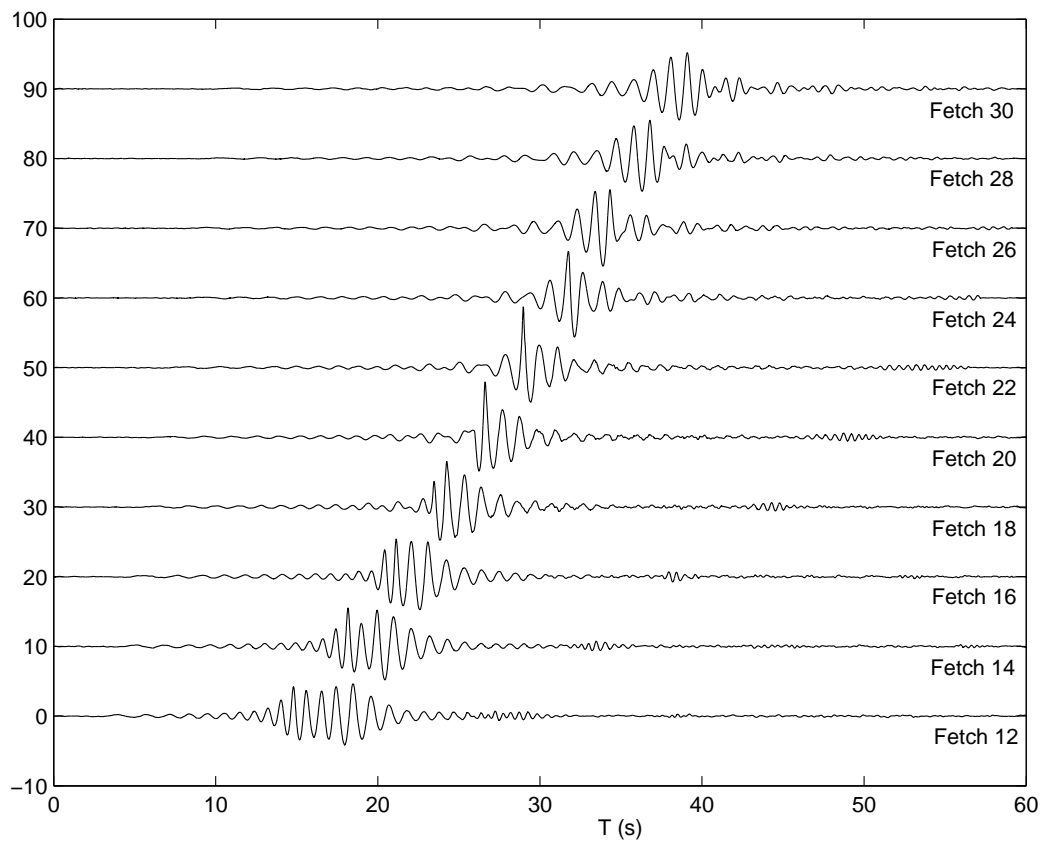


Figure 2: Surface elevation (in *cm*) at different fetches (in *m*) as a function of time without wind

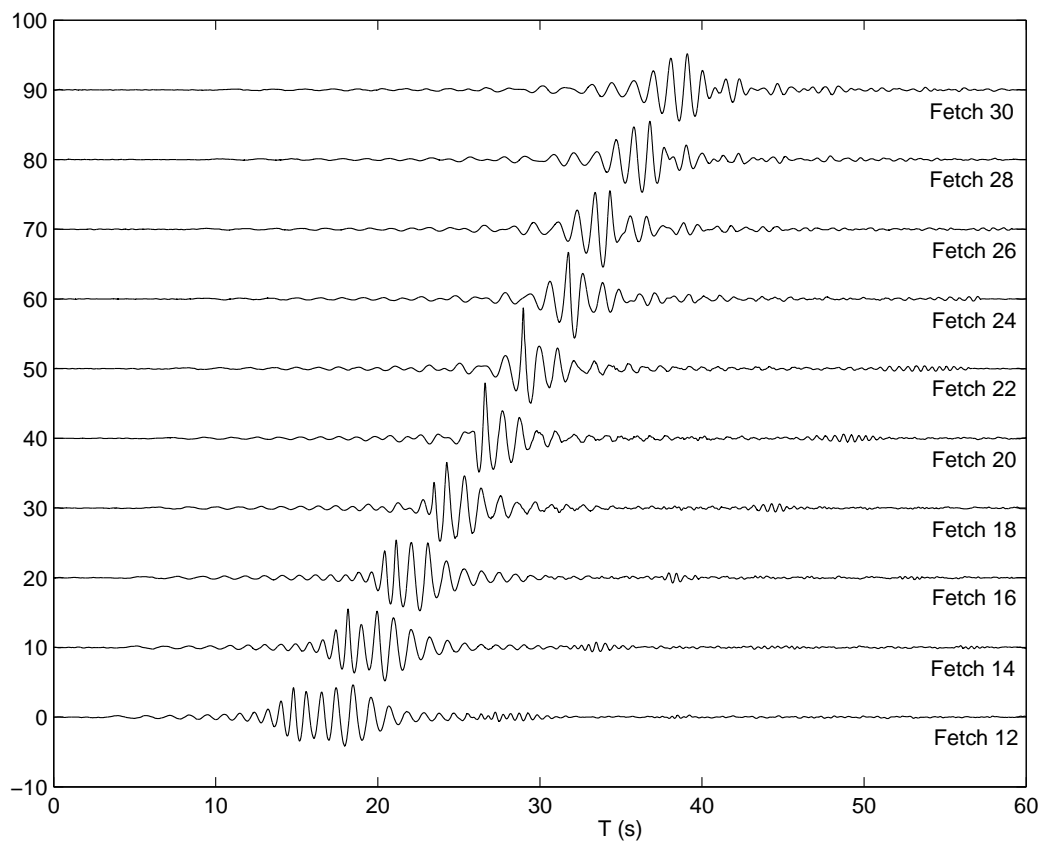


Figure 3: Surface elevation (in  $cm$ ) at different fetches (in  $m$ ) as a function of time for a wind speed  $U = 6m/s$

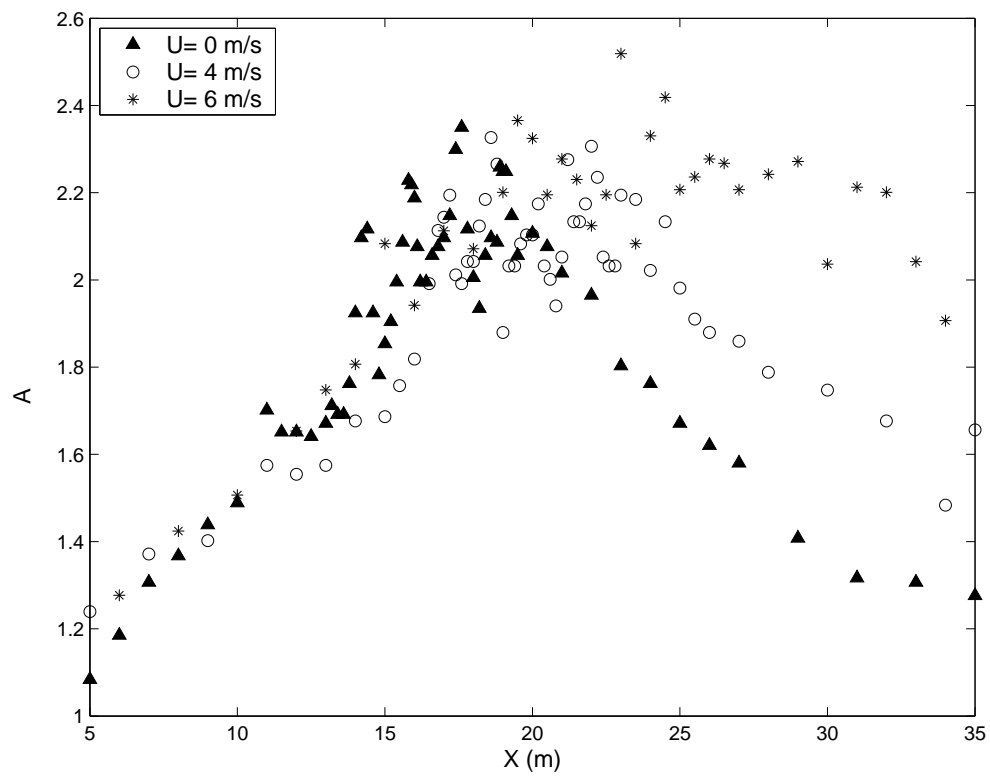


Figure 4: Experimental amplification factor as a function of the fetch for several values of the wind speed.

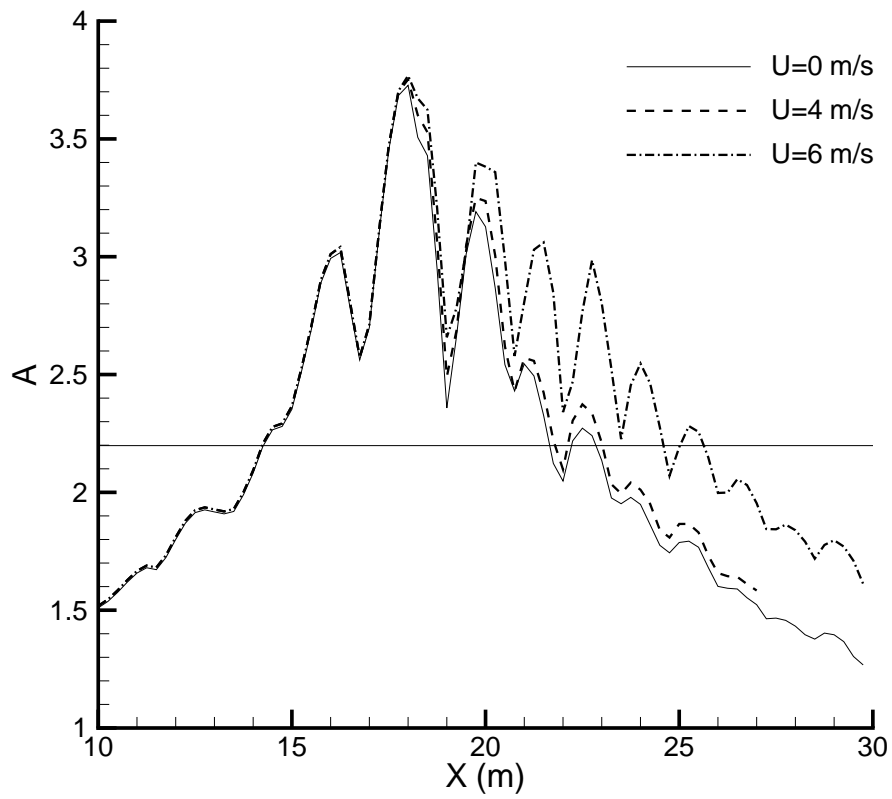


Figure 5: Numerical amplification factor as a function of the fetch for several values of the wind speed.