Exploring the effect of accelerated winds on the wave growth and the early stage of surface drift in the laboratory.

F. J. Ocampo-Torres[(1)], H. Branger[(2)], P. Osuna[(1)]

1 CICESE, Oceans Division, Physical Oceanography Department, Ensenada, BC, México
2 IRPHE, CNRS, Aix-Marseille Universite, AMU, case 903, 13288 Marseille France

Abstract

We study the influence of accelerated winds on air-water momentum fluxes with laboratory measurements in a large wind-wave flume. Wind stress, wind-waves and wind-induced surface drift were measured in the 40m long wind-wave tank at IRPHE, Marseille. Momentum fluxes are estimated directly through the eddy correlation method in a central station in the middle of the tank, providing information associated with non-dimensional fetch shorter than previously detailed. While wave evolution is obtained through a series of wave gauges, the wind-induced surface drift is measured at only one stations at the shortest fetch (Station 1) with the use of a acoustic Doppler current profiler (Vectrino II, Nortek). Experimental runs started with very low and constant wind (about 1m/s) for some time, suddenly accelerated to reach about 13 m/s (8 m/s and 5 m/s during different runs) in about 15 sec to as long as 600 sec. The wind was kept constant at that high speed for 2 to 10 min, and then suddenly and was decelerated to 0. Equilibrium conditions for the 3 different wind speed were estimated. However, we focus in the recordings when wind was being constantly accelerated in order to advance our understanding of gustiness, of the implied wind wave growth and of the onset of wind-induced surface drift. Wind-wave growth lag behind the wind stress signal, and apparently a two regime wind stress is noticed, well correlated with a) the incipient growth and appearance of the first waves and b) the arrival of waves from the up-wind section of the tank. Results of non-dimensional wave energy as a function of non-dimensional fetch represent an extension of at least 2 decades shorter non-dimensional fetch to the wave growth curves typically found in the literature. The linear tendency of wave growth compares very well only when wind is reaching its maximum, while during the accelerated wind period a lower non-dimensional wave energy is found. The onset of wind-induced surface drift at the beginning of the tank is also addressed within the context of accelerated wind conditions. This is a RugDiSMar Project (CONACYT 155793) contribution, and we acknowledge the support from ANUIES-ECOS M09-U01 project, CONACYT-187112 Estancia Sabática, and Institute Carnot.

To be considered for presentation at 20th WISE Meeting, College Park, Maryland, USA, 21-25 April 2013.