Geophysical Research Abstracts,
Vol. 10, EGU2008-A-01875, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-01875
EGU General Assembly 2008

Generation of modulations of surface gravity waves in a shallow-water resonator

A. Ezersky (1,2), **A. Slunyaev** (2), D. Mouazé (1)

(1) UMR CNRS 6143 "Morphodynamique Continentale et Côtière" (M2C) Université de Caen-Basse Normandie, Caen, France, (2) Institute of Applied Physics, Russian Academy of Sciences, Nizhny Novgorod, Russia (abezersky@mail.ru)

Arising of modulations of nonlinear shallow water waves in a resonator with a periodic external excitation is observed and studied in detail. It is shown in laboratory experiments that the wave modulation results from the instability of a standing wave when the wave amplitude exceeds a certain threshold. The instability leads to the excitation of the resonator modes. It is revealed that at the initial stage of instability, the neighboring modes of the initial standing wave are the most unstable. The instability causes generation of gravity waves of large amplitude that may break. Three qualitative regimes of the wave dynamics may be distinguished on the “external force amplitude – external force frequency” plane; these are: (1) a standing periodic wave, (2) modulated waves without breaking, and (3) breaking modulated waves. The modulation growth starts at the minimum external force amplitude when the excitation frequency lies equidistantly between the frequencies of the nearest modes. The regimes without and with modulations are reproduced in numerical simulations by means of the strongly nonlinear Dommermuth & Yue code with external local periodic forcing. The important role of the wave damping for different types of wave dynamics is shown. The dynamics of free weakly perturbed standing periodic waves without dissipation is studied. The quadratic nonlinearity is shown to be responsible for the leading order of wave modulation growth. The observed instability is evidently explained by the resonance between the carrier wave spectral satellites and the second harmonic of the initial strongly nonlinear cnoidal standing waves.

The observed effect may lead to the formation of unexpectedly large breaking waves

in semi-close basins such as bays and harbors.