MEASUREMENT OF PERIODIC NONLINEAR SURFACE WAVETRAINS APPROACHING THE COAST AND SOLITON FISSION

A.R.OSBORNE
Istituto di Cosmogeofisica del CNR,
Corso Fiume 4, 10133 Torino, Italy
A.PROVENZALE, L.BERGAMASCO e P.TRIVERO
Istituto di Fisica Generale dell'Universita',
Corso M.d'Azeglio 46, 10125 Torino, Italy

SUMMARY

We consider the dynamics of nonlinear surface waves approaching the coast and entering a shallow water regime. The Korteweg-de Vries equation with periodic boundary conditions is used to model the wave motion. We discuss a program of "in situ" measurements to check the theoretical predictions.

Nous traitons ici la dynamique des ondes non linéaires en eau basse. L'équation de Korteweg-de Vries avec conditions au contour périodiques est utilisée comme modèle pour l'évolution des ondes dans ce contexte. Enfin un programme de mesures "in situ" pour vérifier les prédictions théoriques est discuté .

TEXT

The dynamics of surface water waves in shallow water is essentially nonlinear and cannot be accurately described by the well established methods of linear (Fourier) spectral analysis.

The motion of nonlinear shallow water waves may conversely be studied by using the recent techniques of nonlinear spectral analysis based upon the theory of the scattering transform [Osborne et al.,1982a,b], which constitutes an extension of the Fourier method to a wide class of nonlinear problems of oceanographical interest. The central idea of this theory is the definition of a nonlinear spectrum (analogous to the Fourier spectrum) composed of a "soliton" part (typically nonlinear) and of an "almost linear" radiative part which in some cases may contain less energy than the former.

We consider here the propagation of surface wavetrains toward the coast and use the well-known Korteweg-de Vries equation, with periodic boundary conditons, for modeling the wave evolution [Osborne and Malanotte Rizzoli eds.,1981].

Typical predictions of the scattering transform theory in this context are that the soliton component becomes more important as the wavetrain approaches shallow water and that each soliton may undergo a process of fission, generating two smaller solitons.

A program of measurements in a coastal region is being planned to obtain the surface wavefield at different distances from the coast (and thus in different water depths). The location must be characterized by a gently sloping bottom and the measuring buoys must be aligned perpendicularly to the coastline, in water depths ranging from 2 to 20 meters. The nonlinear spectra which will be obtained at each buoy location by nonlinear Fourier analysis [Osborne,1983] of the data will furnish an experimental check (outside the laboratory) of this very recent periodic-domain nonlinear spectral theory. The spectra will also allow the evaluation and definition of higher order nonlinear effects.

REFERENCES

A.R.Osborne, A.Provenzale and L.Bergamasco; "Nonlinear Fourier analysis of localized wave fields described by the Korteweg-de Vries equation", Nuovo Cimento, 5C, 612-632, (1982a).

A.R.Osborne, A.Provenzale and L.Bergamasco; "Theoretical and numerical methods for the nonlinear Fourier analysis of shallow-water wave data", Nuovo Cimento, 5C, 633-648 (1982b).

A.R.Osborne, L.Bergamasco; "The small amplitude limit of the spectral transform for the periodic Korteweg-de Vries equation", Nuovo Cimento B, in press.

A.R.Osborne; "The Spectral Transform: Methods for the Fourier analysis of nonlinear wave data", in Statics and dynamics of nonlinear systems, edited by G.Benedek, H.Bilz and R.Zeyher, Spriger Verlag 1983.

A.R.Osborne and P.Malanotte Rizzoli eds.; "Topics in Ocean Physics", New Holland 1981.