THE NONLINEAR SPECTRAL ANALYSIS OF INTERNAL WAVE DATA

A. R. Osborne and A. Provenzale

Istituto di Cosmo-Geofisica del C.N.R., Corso Fiume 4,
10133 Torino, Italy

SUMMARY

We discuss nonlinear spectral analysis procedures, based upon the spectral (or scattering) transform, which may be used to analyze nonlinear internal wave motion described approximately by the Korteweg-deVries equation. Such methods may be applicable to internal wave evolution in the Straits of Gibraltar and the Straits of Messina.

Sont traités ici des méthods d'analyse spectrale nonlinéaire, basées sur la théorie de la "spectral transform (ou scattering transform)", qui peuvent être utilisées pour l'analyse du mouvement des ondes internes nonlinéaires modelées par l'équation de Korteweg-deVries. C'est possible appliquer ces méthods a l'etude del'évolution des ondes internes dans le Détroit de Gibraltar ou dans le Détroit de Messina.

TEXT

Conventionally measurements of wave motion in the ocean are often subjected to spectral analysis by the Fourier transform, a method which implicitly assumes linear behavior. That physical fluid dynamical systems are nonlinear is well known, but historically spectral analysis procedures have not rigorously accounted for nonlinear effects. It is possible to isolate the behavior of selected frequency components of a linear system by Fourier analysis; we submit that the analogous capability for spectrally analyzing nonlinear systems may also be realized using modern mathematical techniques based upon a generalization of the FT referred to as the spectral (or scattering) transform (ST). In this context we have developed numerical methods for implementing the ST in a form suitable for the processing of data from nonlinear systems whose motion is assumed to be dominated by long wave components [Osborne, et al, 1982b]. We emphasize the importance of (1) the direct spectral transform (DST) as a wavenumber or frequency domain

representation of nonlinear data and (2) the inverse spectral transform (IST) as a means for nonlinear filtering and for determining the long time evolution of wave systems.

We stress the applicability of nonlinear spectral procedures to the analysis of field and laboratory data. In particular we note an important feature of the methods discussed herein: the ST is spectral analysis at one order of approximation above that for a linear, dispersive wave system. Thus the ST may be useful for probing nonlinear effects at and beyond the order of the KdV equation. We have applied these methods to the analyses of the Andaman Sea data [Osborne and Burch, 1980] [Osborne, et al 1982a] and of laboratory data [Osborne, et al 1982b].

We finally discuss the possibility of applying these methods to internal wave data from the Straits of Gibraltar [Lacombe, 1964] [Frassetto, 1964] [Ziegenbein, 1969] [Boyce, 1975] and to the Strait of Messina [Abbate, et al 1982].

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