Geophysical Research Abstracts, Vol. 7, 02101, 2005
SRef-ID: 1607-7962/gra/EGU05-A-02101

Nonlinear waves in marine sediments

B. E. Mcdonald

Naval Research Lab, Washington DC USA (mcdonald@sonar.nrl.navy.mil)

The theory for nonlinear wave propagation in marine sediments is complicated by the presence of a granular frame filled with water and possibly gas bubbles. A bulk stress - strain relation for the sediment contains a contribution varying as strain to the power 3/2, resulting from the deformation of individual elastic grains in contact with each other. The traditional theory of weakly nonlinear waves employs Taylor series expansion of the equation of state (pressure as a function of density). Such a theory is well suited to fluids, but the nonlinearity parameter related to the second pressure derivative diverges in the limit of small strain for granular media. We present a simple nonlinear wave equation model for compressional waves in marine sediments that avoids Taylor expansion and the problem of diverging nonlinearity parameter. Our wave equation is a modification of the nonlinear progressive wave equation (NPE) of McDonald and Kuperman [J. Acoust. Soc. Am. 81, 1406 - 1417, 1987]. Numerical results for nonlinear compressional waves show agreement with similarity solution profiles derived from the nonlinear wave equation applied to shock waves. The same approach can be generalized to include nonlinear shear waves in granular media. The bulk stress - strain relation for our model is found to be generally consistent with available consolidation test results for marine sediments. Work supported by the U. S. Office of Naval Research.