Geophysical Research Abstracts, Vol. 9, 05716, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-05716

Influence of internal waves on deflections of sea ice cover

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The influence of internal waves on the sea ice cover is a problem, which is practically important but poorly studied. It is a common assumption that the rigid lid approximation that filters out the surface mode and describes well the properties of internal waves should be valid also in the case, when the free surface is substituted by an ice cover. Since the vertical velocity at the surface is zero in the approximation, there should be no vertical displacements of the ice cover along the vertical. Thus internal waves can not be recorded on the basis of fluctuations of the sea ice cover. Such conclusion, however, contradicts the data of observations.

We have developed theoretical model, which describes propagation of internal waves under ice cover. The sea water is considered inviscid, non-rotating, and incompressible, the Brunt–Väisälä frequency is supposed to be constant. The ice is considered of uniform thickness, with constant values of Young's modulus, Poisson's ratio, density and compressive stress in the ice. The boundary conditions are such that the normal velocity at the bottom is zero and at the undersurface of the ice the linearized kinematical and dynamic boundary conditions are satisfied. According to our results the deflections of the sea ice surface with the frequencies close but smaller than the Brunt–Väisälä frequency (i.e., with periods of tens minutes) can gain amplitudes sufficient for recording of internal waves. A comparison of the theory with observations in the Arctic Ocean showed a satisfactory agreement.

This study was supported by the Russian Foundation for Basic Research (project no. 06-05-65210).