# A fully analytical approach to the problem of tsunami generation by nonlinear acoustic mechanism

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Bottom earthquakes give rise to both gravitational and hydroacoustic waves. In particular, the whole water column performs elastic oscillations (normal modes) with dominating period T=4H/c, where c is the sound velocity in water, H is the ocean depth. Recently, the existence of the elastic oscillations was confirmed by direct measurements in the Tokachi-Oki 2003 tsunami source. Due to non-linear energy transfer, the elastic oscillations may contribute the long gravitational waves (tsunamis). In this study we suggest an analytical approach to the problem of mathematical description of tsunami generation by the nonlinear mechanism. We consider 2D problem in a vertical plane Oxz. Mathematical model is based on the nonlinear Euler equations where we assume all the fluid fields (velocity, pressure, density) to consist of fast-oscillating and time-averaged (slow) terms. Then, the equations are averaged in time. The non-linearity of the Euler equations introduces additional terms in the time-averaged flow equations. These additional terms can be interpreted as external mass force and distributed mass source; we consider them as a non-linear tsunami source. Being linearized the time-averaged flow equations are reduced to heterogeneous wave equation. The elastic oscillations of water column are expressed as a sum of normal modes. We assume that due to the refraction of the hydroacoustic waves into the underlying elastic half-space amplitude of the normal modes exponentially decrease in time. Finally, for the tsunami generated by nonlinear mechanism we calculate wave profile, amplitude and energy.