TSUNAMI AND ACOUSTIC-GRAVITY WAVES IN WATER OF CONSTANT DEPTH

A new method for analyzing significant submarine disturbances is presented giving rise to solutions for the Tsunami and Acoustic-Gravity waves in water of constant depth.

The waves under consideration are generated by vertical motion submarine earthquake. A simplified 3-dimensional model is used, describing a transient motion of a disturbance, located at the bottom of a slightly compressible ocean of constant depth. An analytic solution is implemented, providing additional significance to the results. It is shown theoretically, that a set of propagating Acoustic-Gravity waves, resulting from physical properties of water compressibility, can be detected as pressure oscillation at the ocean bottom.

The Mathematical formulation for a simplified model, based on a circular disturbance, yields a set of analytic expressions for radial and temporal fields of water surface elevation and bottom pressure. Since these expressions contain integrals of special functions, several solution methods are discussed.

The solution for the circular disturbance then serves as the basis for a generalization technique for a wider range of geometrical shapes of disturbance cross-sections. The technique is tested to prove its validity over a range of geometrical shapes.

While the velocity of Tsunami depends on water depth and assumed to be close to $\sqrt{gh}$ (g is the gravity acceleration and h is the water depth), the Acoustic-Gravity modes are propagating in a constant speed, approximately $c = 1500\, m/\sec$, which depends on the compressibility of water. Therefore, for a typical submarine earthquake the Acoustic-Gravity waves travel about 7.5 times faster than Tsunami. Thus, the Acoustic-Gravity ocean waves can provide an indication for the slower, but more important Tsunami gravity wave. The purpose of this study is to suggest a novel model for early detection of Acoustic Gravity waves, as potential indication of deep-ocean Tsunami wave. Furthermore, the study outlines a simplified inverse method for extracting the earthquake parameters from the bottom pressure signature of the Acoustic-Gravity waves.