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Tsunami generation and propagation due to sea-bottom deformation: A linear potential theory

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The present study obtained a solution of the velocity potential for sea-bottom deformation with an arbitrary source time function for constant water depth. By using this velocity potential, we theoretically derived semi-analytical solutions of the velocity distributions in the sea, the water height at the surface, and the pressure at the bottom. The velocity distribution is represented by the sum of the direct and indirect components excited from the sea-bottom deformation: the direct component is the velocity distribution excited directly from the sea-bottom deformation and the indirect component the velocity distribution excited from the water height distribution at the surface. The semi-analytical solution indicates that the direct component should be zero or the initial velocity distribution be zero as the initial condition for 2-D tsunami propagation simulations. The pressure at the bottom is represented by the sum of hydrostatic and dynamic components. When the sea-bottom uplifts with an increasing rate, the sea-bottom pressure becomes larger than the hydrostatic pressure. This is noteworthy when we rapidly estimate a magnitude of tsunami by analyzing ocean-bottom pressure gauges deployed inside a focal region.

Keywords: tsunami, linear theory