Characteristic records of ocean-bottom presure gauges close to a submarine fault : Effects of complex source time function and dispersion

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New ocean-bottom tsunami observation networks such as S-net and DONET have been recently deployed in the offshore Japan. Both S-net and DONET systems record tsunamis in terms of water pressure changes. During an earthquake, water pressure changes not only by tsunamis (i.e., sea surface heights) but also by water depth change of instruments, vertical accelerations of a seafloor itself (i.e., reaction force from water column), and radiated seismic waves. Tsunami researchers in the past needed wave heights along coast lines and considering only the effect of tsunamis since there were no offshore stations to directly observe water depth changes or sea bottom accelerations.
In this study, we calculated ocean bottom pressure changes during a tsunamigenic earthquake with a two-dimensional fault on seafloor uplift model, in order to compare the effects of tsunamis, water depth changes, and sea bottom accelerations. We carried out two types of comparison: (1) two types of source time functions with a common duration time were compared, and (2) two assumptions between dispersion and its omission, were compared. We adopted the analytical formulation of Saito (2013), based on the Fourie transform for incompressible, non-viscous and homogeneous fluid.
Above the fault, the contribution of sea bottom accelerations dominates over the other factors. This effect is strongly affected by the complexity of source time functions. That is, the more complex the function or uplift history is, the more significantly sea bottom accelerations should affect the observed pressure changes. In contrast, there are no differences in tsunami propagation with different source time functions. Only with a record on far from the epicenter, we therefore would not know details of the source time function. We also found that a low-pass filter effect acts not only sea surface elevation but also reaction force from water column, associated with dispersive character. This means that there are two low-pass filters between sea bottom and sea surface, by water column and by transmission from sea bottom to sea water.

Keywords: tsunami, low-pass filtering effect, dispersion

