

Estimate of error factor and precision in seafloor geodetic measurement

Motoyuki Kido[1]; Hiromi Fujimoto[1]; Yukihiro Osada[1]; Aaron Sweeney [1]; Satoshi Miura[1]

[1] RCPEV, Graduate School of Sci., Tohoku Univ.

It is valuable to extend in situ measurements of the crustal displacement from on-land into seafloor because most inter-plate large earthquakes occur beneath the ocean near the trench. Since 2003, our group has started geodetic measurement at Kumano-nada by using GPS/Acoustic combined system. This system indirectly detects the seafloor displacement by means of acoustic ranging between transponders (PXP) on seafloor and transducer equipped on a towed buoy, whose position and attitude are monitored by kinematic GPS measurement.

Total precision of the seafloor positioning is limited only several tens cm at most as far as using a single PXP mainly due to unknown in the time variation of the sound velocity in sea water. However, as proposed by Spiess at the Scripps Institute of Oceanography, the velocity variation has almost no effect (as far as it keeps horizontally stratified structure) on the horizontal positioning when the acoustic measurement is made at the center of the PXP array. In addition, a possible mis-estimate in the individual PXP position equivalently affects on all of the repeated array positionings, which results in the 1--5cm of final precision in detecting the displacement vector of the array.

In order not to be affected by the velocity changes, the transducer must be kept in the array center with a precision of 10m, while we can do that only within 100m since it is on a buoy in our system. We demonstrated with a simple geometric consideration that apparent deviation of the array position is proportional both to deviation of the transducer position from the array center and to amount of mis-estimate in the sound velocity. To minimize the apparent deviation of the array, we estimate time variation of the sound velocity as precise as possible based on apparent vertical variation of the array.

In this talk, we simulate the precision of the seafloor positioning using both computer generated data set and surveyed data set, which obtained during the survey at Kumano-nada in 2004.