The long distance Kinematic GPS positioning for the observation of sea bottom crustal movements

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In 2000, Japan Hydrographic Department has deployed sea bottom geodetic stations at 6 sites, each of which consists of 3 or 4 acoustic transponders on the seafloor, for the detection of sea bottom crustal deformations at the subduction plate boundary with the GPS/Acoustic ranging method. In this method, the key for the success of observation is the precision and accuracy of Kinematic GPS positioning of sea surface platforms. We have analyzed GPS data collected at sea of Kumano-nada and two reference stations on land, Shimosato and Daio-zaki. The baseline lengths are about 100km and 70km respectively. The sampling rate was 0.5 second. The scatters of slant ranges between two GPS antenna fixed on the survey vessel were about 10 cm or better in the good circumstances for GPS observation.

We have a plan to observe the sea bottom crustal deformation at the subduction plate boundary around Japan. The technique employed to realize this challenge is the linkage of precise positioning of sea surface platform and precise acoustic ranging between sea surface platform and sea bottom transponders. One important key in this technique is the accuracy and precision of sea surface positioning of moving sea surface platform, while that movement is difficult to predict. Kinematic GPS technique is expected to be one of solutions for our demand.

To realize the observation at subduction plate boundary around Japan, the distance from reference fixed station on land reaches to 200 km or longer. In 2000, Japan Hydrographic Department has established sea bottom geodetic stations at 6 sites, each of which consists from 3 or 4 acoustic transponders on the seafloor. Several cruises were conducted to collect field data, not only acoustic ranging data with Survey Vessels, but also the GPS carrier phase data in addition to acoustic ranging data on board Trimble 4000 SSi GPS receives. The sampling rate on board receiver was typically 0.5 second. In some cruises, only one GPS antenna was set on board, while in other cruises multi GPS antennas were set to verify the precision of positioning by investigating the slant range between two antennas. For the post-processing of data to obtain the trajectory of survey vessel two methods are available, the software "WAVE" by Trimble and the program developed by Dr. Colombo.

In the presentation, we mainly report the result of cruises conducted in May and August, 2000, at Kumano-nada sea bottom geodetic stations, east of Kii Peninsula, with the two land reference GPS stations at Shimosato, baseline length is about 100km and Daio-zaki, the baseline of 70 km. In the good circumstances for the observation of GPS signals, the precision seems about 10 cm or better with the baseline length of 70 km, by monitoring the scattering of slant range of two antennas fixed on the survey vessel. These results encourage us in our promotion of the sea bottom crustal deformation observations conducted cooperatively by the Japan Hydrographic Department and by Institute of Industrial science, the University of Tokyo.