Evaluation of the positioning accuracy of long range kinematic GPS technique using L3 distances

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The performance of 3 dimensional positioning of survey vessel with carrier phase based GPS measurement data, which is called kinematic GPS technique, is evaluated. This technique is important for the improvement the accuracy of the sea bottom crustal movement observations with GPS acoustic ranging technique. The post processing program is IT developed by Dr. Colombo, which employs the algorithm to double difference of L3 distances. L3 distance is the linear combination of L1 and L2 distances and is free from the ionospheric delays. In this program IT, the so called integer ambiguity is estimate as a real number, not integer. This is a weak point of the use of L3 distance for the robust estimation. However, this algorithm is useful for the long range precise GPS positioning.

The quality control of GPS measurement data is very important for the long range kinematic GPS positioning. The quality check is executed by calculating the linear combinations of code range and carrier phase data for the single station, which are proposed at UNAVCO and called MP1 and MP2. Also the effect of obstacles which may produce noises in the GPS measurement must be removed. By executing these pre-processing for the quality control of GPS measurement data, we can obtain unbiased precise estimations of positions. However, around Japan, there exists bad satellite constellation periods, in which the accuracy of positioning is not good. In that time, the DOP (dilution of Precision) become large. The procedures to remove suspicious data should be avoided, if possible, because they expand such bad satellite constellation periods.

The performance this algorithms with quality control processes is evaluated with four approaches. The first is the comparison of high frequency height changes of survey vessel with dynamic heave sensor. The second is the kinematic analysis of static stations' data. The third is the comparison of estimated height of survey vessel with geoid and ocean tide models. The fourth is the analysis of stop and go kinematic GPS data. I also demonstrate the signal of dynamic sea height changes, which may illustrate the oceanographic event occurring at the vicinity of ocean current, with the comparison with oceanographic data obtained by survey vessels.