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# Toward better accuracy for measurement of ocean crustal deformation -Revision of Analysis System OCDASAN-

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http://www.shizuoka.ac.jp/~geo/Welcome_j.html

We are developing a new geodetic method of monitoring crustal deformation under the ocean. This method is based on techniques of kinematic GPS and acoustic ranging. We deploy a trio of transponders on ocean floor (a seafloor benchmark unit) within distance comparable with the depth. An ultrasonic signal is generated from a surface vessel drifting over the benchmark unit, which is received and replied by the benchmark unit.

In this system, both sound speed structure and the benchmark unit positions were determined simultaneously using a tomographic technique. This analysis system is named OCDASAN (Ocean-bottom Crustal Deformation Analysis tool for Study in Ando labo. Nagoya university; the name is not sophisticated...).

The measurements have been conducted at four sites in two regions near the Nankai trough, where the Philippine Sea plate subducts into the Pacific plate. The two regions are Suruga Bay and the Kumano Basin.

We repeatedly carried out the measurements over the two regions. After almost five years repeating measurements, for KMS site in the Kumano Basin and SNE site in Suruga bay, the horizontal precision of the benchmark location was sigma$_h$=5 cm and its vertical precision was sigma$_v$=10 cm through the repetitive measurements. However, this precision is not enough to research the crustal deformation in detail within the interval of our measurement (from one to a few months) because 5 cm is comparable to annual rate of the plate convergence around the Nankai trough. One of our main subjects is to develop the precision of the benchmark location.

In this study, we revised the analysis system OCDASAN to achieve higher accuracy of the location based on the following concepts;

1. The configuration of the benchmarks consisting of one benchmark unit does not change. The distortion of the triangle is negligible compared with the movement of the weighted center of them.

2. The lesser the estimated model parameter, the more robust the location estimation against observation error and inconsistency between the actual acoustic structure and the adopted model.

In the previous version, we analyzed the data set obtained by each measurement separately. In the each analysis, we have estimated 3 component of the location for 3 benchmarks; 9 unknown values for each data set. Under the new concept, we successively decreased number of the unknowns by solving whole the data sets for the repetitive measurements in one time. We estimated simultaneously only one configuration of the benchmarks and temporal variation of its weighted center. In this procedure, the unknown values related to the benchmark location decreased from 9 to 3 for the each measurement.

As a result of this procedure, the differences of the locations between adjacent couple of measurements were within about 3 cm. The accuracy should be improved. However, the trend of the movement was in a strange way. The weighted center drifted 10 cm to northeast within a year from late 2004 to late 2005 and then jumped westward 8 cm within blank period of one and half a year. The latter movement is consistent with the predicted plate motion around the site but the former one cannot be explained by the plate motion. We can discus, after applying this new method on other data sets, whether this movement reflects the crustal deformation or just some error due to defect of our model and data acquisition.