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Improvement of accuracy in measurement of ocean floor crustal deformation by data screening and a new analysis

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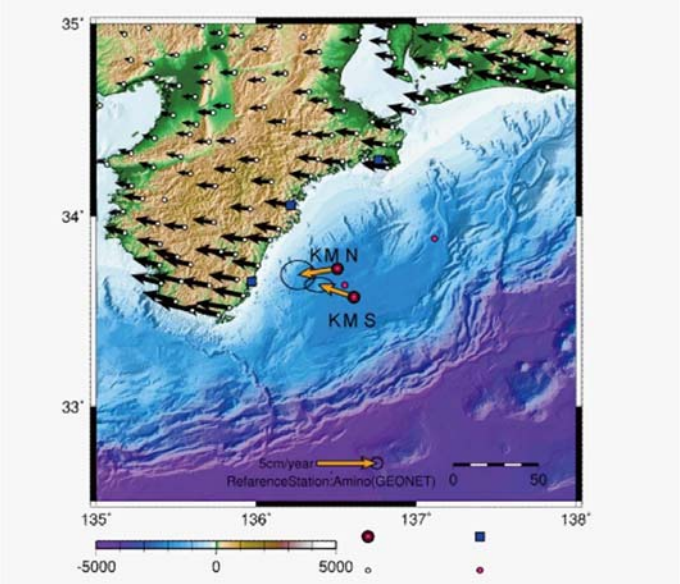

We are developing a geodetic method for monitoring crustal deformation under the ocean. This method is based on techniques of kinematic GPS and acoustic ranging. In our system, we determined the position of seafloor benchmark unit from the vessel with acoustic ranging techniques, while the location of the transducer on the vessel was determined by kinematic GPS techniques.
After almost five-year-long repeated measurement in Kumano basin, continental side of Nankai Trough, we successfully detected a constant trend of the seafloor motion corresponding to subduction of the Philippine Plate. The present observation system achieves RMS repeatability of about 5 cm in horizontal component with 10 hours-long-observation for each measurement.
However, the accuracy is not enough to detect spatial or temporal variation of inter-plate coupling beneath the site.
In this study, we tried to improve the quality of the data and also the analytical approach.
The total dataset consists of three sub-components, which are kinematic GPS positioning data, attitude data of vessel by relative positioning of three onboard GPS antennae, and travel time of acoustic ranging. We reprocessed the kinematic GPS and attitude data with more reliable procedures than the previous ones. And then, we screened the bad acoustic ranging data which is due to depletion of the on-board transducer. After these procedures, the uncertainty of the benchmark positioning was reduced to be 42 % and 11 % of the previous ones in the NS and EW components, respectively.
Then, we applied a new analysis method OCDASAN ver.2.0, which was reported by Ikuta et al. (Presentation in the previous JPGU, 2009), to the modified data. The new method enabled us to solve altitude of the benchmark unit as well as its horizontal position. The results by the repeated observations from 2004 to 2009 were fitted by a linear trend of about 3+-1 cm/year toward west-southwest. The standard deviation of determined position from the linear trend was about 3.1 cm and 4.7 cm in the NS and EW components, respectively. The vertical displacement rate was 0.4+-1.5 cm/year uplift and the standard deviation from the linear trend was about 8.5 cm.
The horizontal velocity rate of the benchmark unit was consistent with the drag of the continental plate by the subducting Philippine Sea Plate. The accuracy of the estimated vertical velocity

remains not yet enough to define the dragging motion. We need some more additional observations in the next few years or more reliable data with longer observation time for each measurement for better vertical accuracy.

Keywords: Ocean floor, Crustal deformation, Acoustic ranging, kinematic GPS