Development of analytical method for detecting seafloor crustal deformation from GNSS-A data acquired by moored buoy

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We have been developing observation system on moored buoy off the coast of Ashizuri for monitoring seafloor crustal deformation by global navigation satellite system-acoustic (GNSS-A) technique. The purpose of this work is to develop analytical method for detecting seafloor displacement from the GNSS-A data acquired by moored buoy.
Main cause of an error for seafloor positioning is the misinterpretation of sound speed variation. Sound speed structure in the near from the Kuroshio current has heterogeneity because the temperature gradient is generated by a warm current. Some previous works proposed sound speed model assuming a sloping structure. We also applied this model to analysis using data for two weeks in April 2019 acquired by buoy and obtained position of the seafloor units. The dispersion in the estimated position was within 2 cm, while it was within 30 cm in the case of ignoring horizontal gradient of sound speed.
The buoy we use for this research barely moves around, but stays near from the centroid of units. Generally, it is difficult to estimate seafloor displacement separately from horizontal gradient due to the insufficiency of information for sound speed structure. The theoretical travel time indicates that the displacement can be detected if the direction of displacement is different from azimuth of horizontal gradient. We also obtained the same result by performing simulation using synthetic data. However, the misinterpretation of displacement possibly occurs caused by the positioning error of onboard acoustic transducer and the modeling error for sound speed structure. Then, we will summarize practical issues for analysis using longer term observation data acquired by buoy.

Keywords: GNSS-A, sound speed structure, seafloor crustal deformation, horizontal gradient, buoy

