Spatio-temporal characters of an ocean field that affects the GNSS-A observation

*Yusuke Yokota[1], Tadashi Ishikawa[2], Shun-ichi Watanabe[2], Yuto Nakamura[2]

1. Institute of Industrial Science, The University of Tokyo, 2. Hydrographic and Oceanographic Department, Japan Coast Guard

In the GNSS-A (Global Navigation Satellite System –Acoustic Ranging Coupling) observations, the effect of disturbances in the ocean field is the largest error factor. In recent years, GNSS-A technology has made great progress in order to monitor spatiotemporally fine behaviors such as the postseismic phase of a large earthquake, interplate coupling, and slow slip on the shallow side. The key to capture such observations is understanding the effects of oceanic disturbances.

A technique for correcting disturbances affecting GNSS-A observations has been proposed in Fujita et al. (2006, EPS). They developed an analysis method that reduces the effects of the gradient ocean structure using only the movement of the on-board station. In Yokota et al. (2018, MGR), we developed a method to reduce the effect of gradient structure considering different effects for each seafloor station, and confirmed the improvement of the accuracy of seafloor crustal deformation observation. The gradient ocean structure detected by GNSS-A has been confirmed to reflect the global ocean field (e.g., Yokota & Ishikawa, 2019, SN Applied Sciences).

However, in reality, it is assumed that there are temporal variations smaller than the daily variation, and the influence of internal gravity waves that cannot be estimated by the global ocean model. In this presentation, we describe the results of an investigation on the spatial scale of the fine structure affecting GNSS-A through comparisons with the ocean model (JCOPE2M) off Kii channel and XBT continuous observations. As a result, it was confirmed that km-scale gradient structure found only in actual XBT observations, which is not considered in the ocean model, affects GNSS-A observations. In addition, it was suggested that the structure could be extracted appropriately and that it could be discussed in the oceanography.

Also, the limit of time resolution in the present GNSS-A oceanography was investigated. As a result of investigating some cases, it is found that the time resolution of the current seafloor crustal deformation observation network is about 1 hour at a depth of 1500 m. Since this value depends on the survey line length (depending on the seafloor depth), the time resolution decreases as the seafloor depth increases. It is thought that the minute temporal change of the ocean-scale gradient structure on the km scale is caused by internal gravity waves. In order to improve the accuracy of seafloor crustal deformation observations and understand minute ocean structures, it is necessary to further investigate the characteristics of spatiotemporal changes in microstructures using GNSS-A data.

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