[JJ] Evening Poster | S (Solid Earth Sciences) | S-CG Complex & General

[S-CG67]Ocean area observation to detect crustal activity under the seafloor: Present and future

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Recent progress of seafloor observations for earthquake and crustal deformation, such as deployment of submarine cable networks of S-net and DONET, and repeated observations of GNSS/A and acoustic extensometer (direct path acoustic ranging), enable us to evaluate on-going crustal activities in the megathrust regions along the Japan trench and the Nankai trough. We review the present status and the future plans of such seafloor observations, and discuss the future directions of seafloor observation networks, especially for real-time monitoring of crustal activities. Toward these directions, we welcome papers introducing the present status of novel approaches and systems such as optical fiber, laser ranging or seafloor SAR and real-time geodetic observations using mooring buoys or wave glider, and so on. We also welcome future plans to integrate observation for the crustal activity under the seafloor with observation for ocean and climate changes.

[SCG67-P03]Spatially non-linear property of sound speed structure in GPS-acoustic measurement

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Introduction

GPS-acoustic technique, combining kinematic GPS positioning and underwater acoustic ranging, is one of the measures to detect seafloor displacement. Its positioning accuracy highly depends on the uncertainty in sound speed structure in ocean. Although the current analytic method can deal with time-varying stratified structure, non-modeled spatial inhomogeneity in the horizontal direction results in apparent fluctuation in estimated positions of a seafloor transponder array [e.g., Spiess et al., 1998]. Therefore, at least 12 hours of time average is needed to achieve enough precision. Kido (2007) demonstrated that any multiple combination of spatial variation in sound speed having large enough wavelengths can be approximated by a single gradient in total, and that the two-dimensional gradient can be solved as well as averaged sound speed and horizontal array position using a single ranging. However, applying algorithm above to the observed data at G19 site off-Fukushima having six transponders, the positioning result was getting further unstable, which indicates the existence if shorter wavelength inhomogeneity (Matsui et al., 2017).

Synthetic test of internal gravity wave model

We performed synthetic positioning test with the following conditions assuming a time-varying spatial variation in a sound speed structure because of an internal gravity wave. The time-varying spatial variation is represented as oscillation of a reference sound speed profile with the oscillation center at the depth of 800 m and with an amplitude of 20 m, which has been often observed in our XBT in-situ measurement. We generated synthetic traveltimes for various wavelength of the internal gravity wave and solved the array position by the algorithm of Kido (2007), which expects spatially linear variation (a gradient structure). We found that spatial variation can be well solved in the case of wavelength longer than 5000 m. However, positioning is getting unstable just like as the observed data in the case of wavelength around 1500 m. This indicates the possibility of the existence of internal waves having shorter wavelength than expected.

Application to observed data

Based on the above result above, we contrived an algorithm to determine array position considering an internal gravity wave with a finite wavelength, not a simple gradient. In order to minimize the unknowns, we represent an internal gravity wave with seven parameters: period, phase, amplitude, center depth of oscillation, depth extent of oscillation, wavelength, and propagating direction. However, no proper model that can well explain traveltimes of the observed data for the G19 site was found by a grid search approach.

Issued in progress

At this moment, application of the new model to the observed data is only a single example. Currently, we are employing other observed data to examine the validity of our internal wave model. Furthermore, we are also plan to introduce a model with multiple internal gravity waves at different depths.