Representation of sound speed gradient structure in the GNSS-A observation and analysis constraint conditions

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The GNSS-A seafloor geodetic observation array (SGO-A) has been operated in about 20 years by the Japan Coast Guard [Ishikawa et al., 2020]. It has become possible to measure complicated crustal events as shallow slow slip events (SSEs) along the Nankai Trough in recent years [Yokota and Ishikawa, 2020; Watanabe et al., 2021]. For understanding the detail physical process of the plate boundary (e.g., SSE), it is necessary to understand the GNSS-A accuracy and the error source. The SGO-A dataset and GARPOS were used in this study [Watanabe et al., 2020].
This presentation focuses specifically on gradient parameters of sound speed strctures. Gradient fields have a strong effect on the horizontal accuracy. The expression of this field can be investigated by plotting the time change on a plane as discussed in Yokota [2021] and Yokota et al. [under review], and investigating the state of the field, the envirnment of the observation site and the unexpected noise source. We here call this plot "G-plot."
G-plot allows us to understand the characteristics of various ocean structures. For example, not only a simple gradient layer (eg, due to an internal wave) but also the complicated case where a water mass passes can be expressed easily on the G-plot. The effect of misalignment of the seafloor station array, which is not well understood, can also be distinguished as an anomalous G-plot.
The km-scale ocean field can be understood from the relationship between the G-plot and the change in the average sound speed in the field. When the G-plot vibrates, the intrusion direction of internal waves and water masses and the scale of the inflow field can be understood from the phase relationship.
Understanding the effects of ocean fields on GNSS-A may improve the constraints of the analysis. For example, in Honsho et al. [2019], an gradient field model assuming a simple ocean structure was used. The G-plot results of the actual data on the Nankai Trough side indicate that such cases occur frequently on the Nankai Trough side [Yokota et al., Under review]. On the other hand, there are some observational data and observation points for which it is better to adopt various constraints. This shows the characteristics of the oceanic state at each observation case and observation point, and suggests that appropriate determination of constraints is the key to the observation accuracy of GNSS-A.

SGO-A data: https://www1.kaiho.mlit.go.jp/KOHO/chikaku/kaitei/sgs/datalist_e.html
GARPOS: https://doi.org/10.5281/zenodo.4522027

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