# GNSS-Acoustic seafloor geodetic observations using a Wave Glider off Tohoku

*Fumiaki Tomita[1], Takeshi Iinuma[2], Motoyuki Kido[1], Yusaku Ohta[3], Chie Honsho[3], Tatsuya Fukuda[2]

1. International Research Institute of Disaster Science, Tohoku University, 2. Japan Agency for Marine-Earth Science and Technology, 3. Graduate School of Science, Tohoku University

Using the GNSS-Acoustic (GNSS-A) seafloor geodetic observation technique, seafloor crustal deformation associated with an earthquake cycle has been documented [e.g., Honsho et al., 2019, JGR]. In the GNSS-A observation, we require a sea-surface platform which conducts GNSS measurement and acoustic ranging between the sea-surface and the seafloor; a research vessel has been generally used as a sea-surface platform. However, employment of a research vessel requires high financial and human resources, which makes frequent GNSS-A observations for many sites difficult. Therefore, JAMSTEC and Tohoku University have developed a GNSS-A observation system that employs a Wave Glider (WG) as a sea-surface platform. The WG is an unmanned surface vehicle which can move by sea-surface wave energy. We conducted a trial short-term observation using the WG at a certain site in July 2019, and we found out that precision of the GNSS-A measurement using the WG was comparable with that using research vessels [Iinuma et al., 2021, Frontiers in Earth Science]. Moreover, we repeatedly conducted long-term (~ one month) campaign surveys; in the single campaign survey, we collected the GNSS-A observational data at several sites [Tomita et al., 2021, JpGU2021]. In this presentation, we report outline of the GNSS-A observation surveys using WG conducted in Apr.–May 2021 and in Oct.–Nov. 2021, and then we report the current situation of the GNSS-A observation surveys using WG.

[Survey in Apr.–May 2021] We deployed WG at G22 site off Nemuro on April 6 during the KS-21-05 cruise. After the campaign survey for 48 days at 17 GNSS-A sites, we recovered WG at G14 site off Miyagi by a charter vessel on May 25. Although WG was occasionally flowed from the observational sites by strong sea currents off North-Sanriku, we successfully operated the observations. In the past GNSS-A observation using WG before 2020, we only conducted a point survey (acoustic-ranging at a fixed point) for each site considering the moving speed of WG. However, to detect a sound speed gradient in the sea and uplift displacements, we conducted a moving survey that WG moved along a circle of the seafloor transponder array.

[Survey in Oct.–Nov. 2021] We deployed WG near G05 site off Sanriku on Oct. 28 during the KS-21-25 cruise. After the campaign survey for 28 days at 7 GNSS-A sites, we recovered WG off Miyagi by a charter vessel on Nov. 25. Because of strong sea currents off North-Sanriku, WG once failed to arrive at a certain site. Moreover, during the survey, a pole attached on WG, which equipped meteorological sensors and satellite communication devices, was broken. Due to this damage, we sometimes faced the situations that it is difficult to check the navigation status of WG. In spite of these difficulties, we successfully collected GNSS-A observational data at the above 7 sites. After repairing and taking a step against the damage of WG, we will utilize WG for upcoming surveys in 2022.

We processed the above observational data collected by WG and estimated seafloor transponder array displacements. The estimated array displacements are generally well consistent with trends from the past observational results; thus, they are expected to be demonstrate the postseismic deformation following the 2011 Tohoku-oki earthquake. At this moment, these estimation results are preliminary. Therefore, we will carefully examine the data and the estimation results and then will report the current condition of the seafloor crustal deformation in the presentation.

Keywords: GNSS-Acoustic observation, Wave Glider, Seafloor geodetic observation, Postseismic deformation