Buoy-mounted system for continuous and real-time seafloor crustal deformation measurements

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Our research group has been testing a measurement system for the continuous seafloor crustal deformation at a moored buoy site operated by Kochi prefecture from March 2018. We performed continuous acoustic ranging tests for a total of 106 days during the following four periods: March 28–31, June 2–July 12, and November 16–December 17 in 2018; and March 24–April 25, 2019. The tests revealed that the developed system can continuously transmit the acoustic ranging signals and send the acquired data to the on-land station via the satellite link, if sufficient electrical power is supplied. The system on the buoy was able to acquire high-quality acoustic waveforms with extremely high maximum cross-correlation coefficients. We coded a program for detecting the arrival time of direct acoustic wave automatically on the basis of thresholds of cross-correlation coefficient and energy ratio to reduce the capacity of data transferred via satellite communication. More than 99 % of the direct acoustic wave onsets at the buoy were correctly distinguished using our program code even if those waveforms had been corrupted with reflected waves. The above experimental studies show that our software system is capable of continuous real-time measurement of seafloor crustal deformation. However, the acoustic ranging controller and the satellite communication modem frequently experienced power failures during the test phase, and we re-designed the power supply part. We found that some of the solar panels were under the shadow of the mast, constructed on the center of the buoy, due to the stable yaw angle of the buoy. The original system was equipped with five 135-Watt solar panels connected in a series and 24 V valve-regulated stationary lead-acid batteries with a capacity of 300 Ah (10-hour rate). In the newly designed system is equipped with additional three (eight in total) solar panels which are separated to two parallel circuits. The power storage is also reinforced with additional two batteries. The re-installation of the new system was started in December 2019; the establishment is planned to be finished by the end of March, 2020. We report the present status of the continuous measurement using the newly designed system.

