GNSS Buoy Array in the Ocean for a Synthetic Geohazards Monitoring System

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The GNSS buoy system for tsunami early warning has been developed in Japan and has been implemented as the national wave monitoring system since around 2008. Its record was used to update the tsunami warning at the 11 March 2011 Tohoku-oki earthquake and tsunami, Japan. Yet, the buoys are placed only less than 20km from the coast and are not far enough for effective evacuation of people. We are thus trying to improve the system for putting the buoys much farther from the coast. For this purpose, we employ a new PPP-AR analysis algorithm, instead of conventional RTK-GPS, for positioning. In addition, we use a two-way satellite data transmission in contrast with current surface radio system. We have conducted a series of experiments using this new system in 2013 and 2014, using a buoy used for a fish bed located about 40km south of Cape Muroto, Shikoku, southwest Japan. GEONET data were used to obtain precise orbits and clocks of satellites. Then, the information was transferred to the GNSS buoy using a satellite communication system of the Japanese positioning satellite called Michibiki. The received information on the buoy were used for real-time PPP-AR analysis for every second. The obtained buoy position was then transmitted back to the ground base through a geostationary satellite called ETS-VIII. The received data was then disseminated to public through the internet. The success of these experiments indicate that the GNSS buoy can be placed at nearly anywhere in the ocean. Given this success, we made up a new research plan in which we test a commercially available satellite communication system and try to develop a new GPS-acoustic system for monitoring ocean bottom crustal movements nearly continuously. Moreover, we seek for further application of GNSS data for ionospheric and atmospheric researches. Deployment of such GNSS buoy system as an array in a wide ocean will be a powerful tool for monitoring geohazards in the region as well as for other basic research on earth sciences. The new project started in June 2016 and we are now designing a regional GNSS buoy array in the western Pacific. The first newly designed GNSS system is established at another buoy for fish bed, located about 40km south of Cape Ashizuri, southwest Japan. The system is now under testing. We are planning to implement a GNSS-acoustic system for monitoring crustal movements of the sea floor in early 2017 fiscal year at the same buoy.

Keywords: GNSS buoy, geohazard monitoring, tsunami, ocean bottom crustal movement, GNSS meteorology, ionosphere

