

ベクトル津波計による微小津波の検出

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Detection of micro-tsunamis by using Vector Tsunameter

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We developed a new type of offshore tsunami meter called Vector TsunaMeter (VTM) for the purpose of providing early and reliable information on the generation and propagation of tsunamis in order to predict the tsunami impact at the coastal area. The VTM observes and records three components of the geomagnetic fields, two horizontal components of the electric fields and tilts, and a differential bottom pressure for more than a year at sea floor up to 6000 m of water depth. The VTM is designed to detect the temporal variations of sea level change, and particle motion associated with the tsunami passages. Arrival time, arrival direction, and phase velocity of tsunamis can also be calculated from the observed record of the VTM. These characteristics of tsunamis observed at deep ocean far from the coastline are very useful to forecast the arrival time and the size of tsunamis before the tsunami reaches the coastline. The first seafloor observation of VTM was made during 2012-2013, in which the VTM was installed by KR12-18 cruise of R/V KAIREI on November 20, 2012 at 25 45.94N, 137 00.48E, depth=4894m, and recovered during KR13-02 cruise on February 9, 2013. The VTM continuously record the data sets of, Bx, By, Bz, Ex, Ey, TiltX, TiltY, and Bottom Pressure from Nov. 20, 2012 to the recovery time, i.e. Feb. 9, 2013. Three days before the recovery date, a Mw=8.0 earthquake occurred at the Solomon islands (10.738S, 165.138E) on 2013-02-06 01:12:27UTC. The earthquake generated tsunamis, which hit near Solomon islands and caused damages to human beings and houses. Since the main energy of the tsunami propagates along the north-east to south-west direction from the epicenter of the earthquake, the tsunamis observed at Japanese coast were low. At the observational site of VTM, amplitude of the first wave is as small as 1 cm, but the VTM clearly records the variations of sea level change for more than several hours after the tsunami arrival around 2013-02-06 08:40 UTC. This observation indicates the resolution limit of VTM is less than 1 mm of sea level change.

The next seafloor measurement of VTM started on March 13, 2014, in which the VTM was installed during KS14-2 cruise of R/V Shinsei-maru. We installed the VTM on the seafloor at 38 14.0 N, 143 35.13 E, depth=3420.1 m, and, after the installation of VTM, we deployed the Wave Glider on the sea surface around the VTM site, and started real-time monitoring of the seafloor VTM signal right after the installation. During the real-time observation period, we succeeded in detecting the micro-tsunami from the Chile earthquake. The Chile tsunami was generated by the Mw=8.2 earthquake, occurred on 2014-04-01 23:46:46 UTC, at 95km (59mi) NW of Iquique, Chile (19.642 S 70.817 W). The tsunami arrived at the VTM site in the early morning of April 3, 2014. Since the arrival of the tsunami was expected about a day beforehand, we could observe the tsunami with the VTM of tsunami mode, in which the tsunami signals with 10-second sampling interval was transferred to the land station every one minute. Although the tsunami signal at the VTM site is very small, and the amplitude of the first wave is as small as 0.1 cm, the arrival of tsunami was clearly detected by the DPG raw data at around 06:00 LT. After applying the high pass filter, the pressure variation faithfully reproduce the wave form of the tsunami. The amplitude of the tsunami signals in the north-south component of the electric field and the east-west component of the magnetic field is much higher than the other component, indicating the tsunami arrived from the east direction.