防災力強靭化のための海域観測データの利活用
Real-time use of ocean-floor data for disaster resilience

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Recently, seafloor network systems for earthquakes and tsunamis were constructed. One is a Dense Oceanfloor Network system for Earthquakes and Tsunamis with 51 observatories and 12 science nodes (DONET, Kaneda et al., 2015; Kawaguchi et al., 2015), and the other is a Seafloor observation Network for Earthquakes and Tsunamis long the Japan Trench with 150 observatories (S-net, Kanazawa et al., 2016). Many large earthquakes and tsunamis has been occurred repeatedly by subduction processes around Japan, and the huge damages were brought until now. Above network systems installed on the seafloor have ability for early detection of earthquakes and tsunamis, and a part of the real-time data is already used for emergency earthquake and tsunami warnings by Japan Meteorological Agency. The network system was planned to supply battery and recover data via two routes, and the data recovery will continue without deficit even if the main cable will be cut with one place. It is also one of important functions to realize stable data transmission. And, data reliability is needed for observation of tsunamis and crustal deformation. DONET has observed many types of tsunami signals, and they have been compared with synthetic waveforms, and succeeded to measure crustal deformation by 2016 off southeastern Mie Prefecture event.

We has constructed a real-time tsunami prediction system using above superiorities of the seafloor network system (Takahashi et al., 2017). It predicts arrival time, tsunami height and coastal inundation areas of coastal target points in real-time every second based on the tsunami amplification from the tsunami source to coastal prediction point using input pressure data of DONET. The core of the system is a tsunami database that includes tsunami propagation times from specific fault segments to DONET observatories and to target points on the coastline, maximum tsunami heights at the observatories and target points, inundation areas at each target point, and tsunami waveforms at the target points. We already implemented it on some local governments and infra-structure company and the predicted contents are shared with each community. In addition, we investigated validity and effectiveness of the system for possible complicated tsunami propagation paths as an example of Sakaide in the Inland Sea.

However, there are locations not to be constructed such seafloor network system as the western half of the Nankai Trough area. For such areas, we has developed a new mobile system for real-time observation of tsunami and crustal deformation using a seafloor pressure sensor, an array of seafloor transponders and a PPP (Precise Point Positioning) system on a buoy. The seafloor pressure sensor and the PPP system detect tsunamis, and the pressure sensor and the transponder array measure crustal deformation. Because seismogenic zones near Japan lie in areas of strong currents like the Kuroshio, which reaches speeds of over 5 knots around the Nankai Trough. Our techniques include slack mooring and new acoustic transmission methods using double pulses for sending tsunami data. We succeeded the sea trials and obtained data for tsunami and crustal deformation. To improve the accuracy for crustal deformation and data stability, we have some issues to be resolved, and developed currently.
DONET also seismometers for strong motions and broadband signals. Using these data, Suzuki et al

(2016) indicated time-spatial change of seismicity around the DONET area using ETAS model technique. The microseismicity and distribution of slow events could be an index to monitor stress change in the crust. There are much issues to be resolved for the system construction for the monitoring, and we start the first step to construct 3-dimensional P- and S-velocity structure around the Nankai Trough area. It is indispensable to detect small events for the monitoring using dense and reliable network system and prepare structural basic information as the background.

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