

Construction of N-net to eliminate the observation blank area in the anticipated Nankai Trough earthquake source area

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Observation of earthquakes and tsunamis that occur in the ocean in the vicinity of their source area is important both for academic and disaster mitigation purposes. The area from off Kochi to the Hyuga-nada, which is the western half of the anticipated Nankai Trough earthquake source area, is a blank area of observation. To fill in the blank, NIED is now constructing Nankai Trough Seafloor Observation Network for Earthquakes and Tsunami (N-net) (Aoi et al., 2020, EPS; Aoi et al., 2023, UT2023).

Based on the oceanographic surveys, totally 36 in-line observatories of N-net are positioned to cover the blank area as spatially homogeneous as possible. These instruments are connected by beads of fiber-optic cables totaling approximately 1,600 km in length on the seafloor. Each in-line observatory is equipped with voltage output strong motion accelerometers (JA-5 of Japan Aviation Electronics Industry, Ltd) and conventional velocity seismometers (OMNI-2400 of Geospace Technologies). Two sets of both seismometers are installed for redundancy. Since these seismographs do not need to be mounted vertically/horizontally, N-net does not have a gimbal mechanism. For tsunami observation, the each in-line observatory is equipped with two high-sensitivity pressure gauges newly developed by Yokogawa Electric Corporation. In order to reduce the effects of posture fluctuations and shaking of the observation equipment due to earthquakes, we have developed a new type of water pressure gauge that measures pressure by introducing pressure directly into MEMS sensor. N-net consists of two subsystems, the offshore system and the coastal system, both of which are equipped with 18 in-line observatories and landed at two stations through horizontal directional drilling (HDD) bore holes. By preparing two landing stations, clockwise and counter-clockwise paths are ensured for data transmission and power supplies, and realtime data will be secured for redundancy when troubles occur in landing station equipment or cable cut off. With the construction of N-net, it is expected that earthquakes and tsunamis can be directly detected up to about 20 seconds and 20 minutes earlier, respectively.

There are two main designs for the cable-type observation network. One is in-line system, connects each observatory directly to the main cable in a row. This system is adopted by many systems, including S-net, and allows for the simultaneous installation of cables and observatories by cable ship, thus enabling wide coverage in a short-time construction at a relatively low cost. Second is the plug-in node system that connects the observatory and the science node with an extension optical cable. The main cable is laid by a cable ship, but the node, extension cable, and observatory are all laid by a remotely operated vehicle. DONET employs this system, and it is designed to allow replacement and expansion of observation instrument at a later time. By adopting a hybrid system that combines the merits of the in-line and the plug-in node systems, N-net is designed to enable the rapid and relatively inexpensive installation of a wide-area observation network and to ensure its expandability in the future. Four branch units (BUs) will be installed to allow for future expansion. The locations of these BUs are determined by taking into account the location of the slow slip events, low frequency earthquakes, potential slip region, and other factors.

The construction of the new Kushima land station and HDD bore holes were completed. The Muroto Geopark land station of DONET2 is currently undergoing renovation to greatly enhance the power,

emergency generator, air conditioning, etc. to also serve as the N-net land station. The development and design of the observation equipment and land-based equipment is complete, and manufacturing is currently in progress. The project is scheduled for completion in the spring of 2025 after installation of the equipment on the seafloor and at land stations.

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