New Network Speeds Up Disaster Detection

Effective use of a new observation network for earthquake, tsunami and volcano that covers all land and sea in Japan has begun with the aim of reducing damage from natural disasters.

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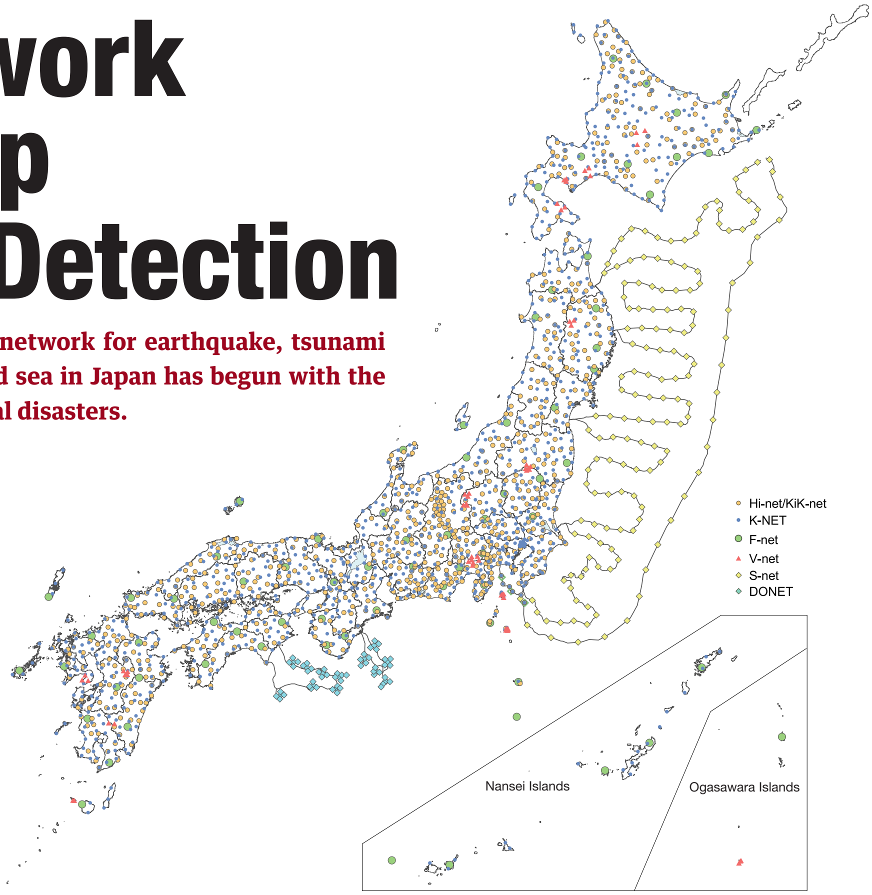
In November 2017, the National Research Institute for Earth Science and Disaster Resilience (NIED) began using a system known as Monitoring of Waves on Land and Seafloor (MOWLAS) to reduce as much potential earthquake damage as possible. MOWLAS is an observation network for earthquake, tsunami and volcano that covers all land and sea in Japan, the largest such network in the world.

NIED is aggregating data collected through this observation network and releasing it to the public. Director-General Shin Aoi at NIED's Network Center for Earthquake, Tsunami and Volcano explains, "MOWLAS is an observation network that took us roughly twenty years to establish, starting with the Great Hanshin-Awaji Earthquake in 1995. That epicentral earthquake was caused by an active fault. It could happen anywhere in Japan at any time."

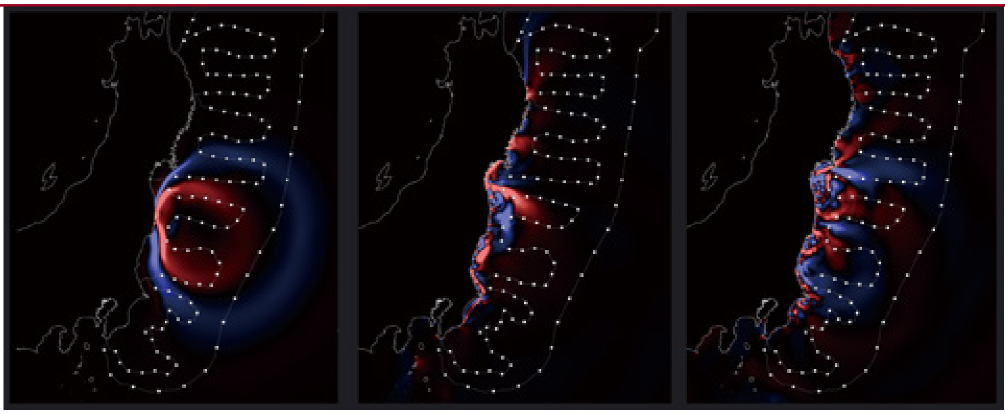
There are about 1,900 MOWLAS observation stations on land alone. They cover all Japanese islands. The combination of three networks identifying different types of shaking defines MOWLAS: High Sensitivity Seismograph Network Japan (Hi-net), which records minor tremors not felt by humans; Full Range Seismograph Network of Japan (F-net), which is capable of measuring shakes ranging from slow to fast; and Kyoshin Network (K-NET) and Kiban Kyoshin Network (KiK-net), which reliably record strong ground motions. In addition, MOWLAS includes the Fundamental Volcano Observation Network (V-net), which was established to monitor sixteen volcanoes in Japan. MOWLAS has an established system for continuously monitoring jolts caused by volcanic activities, in addition to shakes from various earthquakes. It perpetually transmits observation data on a real-time basis to concerned organizations, including NIED and the Japan Meteorological Agency.

"We increased our efforts to construct a new observation network for the sea after the Great East Japan Earthquake in 2011," says Aoi. "This was the result of



Observation networks covering both land and ocean areas for earthquake, tsunami and volcano

Photo: Courtesy of NIED



Tsunami simulation for an earthquake occurring off Fukushima Prefecture on 22 November 2016. Automatic high-speed calculation is carried out for the tsunami, with red indicating push waves, blue indicating pull waves, and the color intensity indicating predicted wave height.

the gigantic tsunami that formed beyond conventional predictions and caused enormous damage to coastal areas at that time."

The newly established observation network is the Seafloor observation network for earthquakes and tsunamis along the Japan Trench (S-net). It took about six years for NIED to install the observation equipment for this network, combining seismometers and tsunami gauges at 150 points on the seafloor off the coast stretching from the Boso Peninsula to Hokkaido. The Dense Oceanfloor Network system for Earthquakes and Tsunamis (DONET), which the Japan Agency for Marine-Earth Science and Technology (JAMSTEC) had established on the seafloor off the coast of the Kii Peninsula and Shikoku, where massive earthquakes are feared to occur, was also transferred to NIED in April 2016. Those steps made it possible for NIED to detect earthquakes in the sea and tsunami near their epicenters, and to transmit the information speedily and accurately.

"Effective use of MOWLAS, the observation network covering land and sea, enabled us to detect jolts caused by subduction-zone earthquakes[i], such as the Great East Japan Earthquake, up to about 30 seconds earlier and the start of a tsunami up to about 20 minutes earlier than before," says Aoi. "We can expect MOWLAS to greatly ensure your safety and sense of security, because it can contribute to advanced early earthquake warnings and immediate tsunami predictions."

In addition to those activities, NIED began to apply the data gathered from the MOWLAS seafloor seismometers to railway controls based on agreements signed with three JR companies, namely, East Japan Railway Company, Central Japan Railway Company and West Japan Railway Company. This system is already at work on certain sections of the Tohoku Shinkansen and Joetsu Shinkansen lines and achieves railway controls up to 20 seconds earlier at maximum.

"In the future, we are planning to use the massive amount of data obtained from MOWLAS to develop a variety of technologies, including those for predicting shakes the moment a big earthquake strikes and others to simulate all stages, from the arrival of a tsunami to its conclusion," says Aoi, describing the potential for MOWLAS. "We believe the observation data gathered through MOWLAS and related research findings will help each and every Japanese citizen increase their disaster awareness, as we are releasing the data and findings extensively to the public through the Internet, in addition to sharing them with other parties, such as relevant government ministries and agencies, research institutions, universities and companies in the infrastructure business. People overseas, such as earthquake researchers, are pinning big hopes on MOWLAS, too."

MOWLAS enables people to gain time before a disaster occurs and will certainly work to improve safety, reduce casualties and protect infrastructure, even though the time gained may only be tens of seconds. Further studies and contributions to the world are expected in this field.

i Subduction-zone earthquakes occur in ocean trenches and troughs that act as boundaries between plates on the landward side and seaward side. They include earthquakes at a plate boundary and intraplate earthquakes. Fault movements on plate boundaries cause the former, while the latter results from fault movements within plates on the seaward side.