

# Preliminary analysis of earthquake detection probabilities and completeness levels for the Dense Oceanfloor Network system for Earthquakes and Tsunamis (DONET)

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To constantly monitor earthquakes and tsunamis along the Nankai Trough, the Dense Oceanfloor Network system for Earthquakes and Tsunamis (DONET) is in operation<sup>2,3</sup>. Each station within DONET is equipped with strong-motion seismometers, broadband seismometers, quartz pressure gauges, and differential pressure gauges to detect all types of seafloor movement, from slow movements such as crustal deformation to fast movements such as ground motion generated by earthquakes. DONET was developed and installed by the Japan Agency for Marine-Earth Science and Technology (JAMSTEC), and is currently being transferred to and operated by the National Research Institute for Earth Science and Disaster Resilience (NIED).

Parts of DONET stations started to be used in 2020 to create the earthquake catalog maintained by the Japan Meteorological Agency (JMA) as an open resource to evaluate seismicity, especially along the Nankai Trough, as well as for its use in long-term seismic evaluation and basic research. On the other hand, JAMSTEC, following the installation of DONET, has processed waveform data to create an earthquake catalog for its own sake. These are invaluable resources for seismicity-related studies. It is thus vital to establish clear quality benchmarks for the catalog. A common benchmark is the magnitude of completeness, above which all events are assumed to be detected by the seismic network<sup>8</sup>. Such completeness quantities are a necessary input for virtually any study involving the statistical properties of earthquake populations, for example, rate estimates or estimates of the *b*-value of the Gutenberg-Richter distribution<sup>1,6</sup>. They provide descriptions of completeness for the direct use by end users, such as cutting the catalog at a level of completeness to contain only events with magnitudes that are considered to be completely recorded.

In this presentation, we provide a preliminary report on earthquake detection probabilities and completeness levels for the catalog created and maintained by JAMSTEC. Among the various existing methods to compute these detection probabilities and completeness levels, we employed the probability-based magnitude of completeness method<sup>4,5,7,8</sup>. Using this method, for 52 stations, detection capabilities were derived over time from empirical data only, namely earthquake information, phase data, station information, and network-specific attenuation relations. From the entire phase-data history, we estimated the operational times of each station, then synthesized detection-probability maps for specific magnitudes or completeness maps. These maps could be computed for any time in 2015-2019, a period in which dataset was available for our study.

A possible use of this method is the assessment of a network's performance for cases where virtual stations are added to the existing DONET<sup>4,5</sup>. We propose the use of this application when devising a strategic plan of DONET to extend its coverage. This extension, which would allow DONET to cover the entire Nankai Trough, is important because the probability of the occurrence of an impending large

earthquake along the Nankai Trough is 70-80% in the next 30 years  
([https://www.jishin.go.jp/regional\\_seismicity/rs\\_kaiko/k\\_nankai/](https://www.jishin.go.jp/regional_seismicity/rs_kaiko/k_nankai/)).

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