Project Organization

- Development of Dense Ocean Floor Network System for Earthquakes and Tsunamis (DONET)
  - Theme of contract research for Ministry of Education, Culture, Sports, Science and Technology (MEXT)
  - Implementing institution: Japan Agency for Marine-Earth Science and Technology (JAMSTEC)

- Development of Ocean Floor Network System
  - JAMSTEC
  - Development of main system JAMSTEC
  - Development of an ocean floor GPS system Tohoku University, Nagoya University
  - Development of inline systems in the next generation Earthquake Research Institute, University of Tokyo

- Development of a High-Precision Earthquake Simulation Model
  - JAMSTEC

- Deployment of Seismometers in Subduction Areas with Mega-Thrust Earthquakes, and Understanding of Mega-Thrust Earthquake Occurrence Mechanisms
  - JAMSTEC, National Research Institute for Earth Science and Disaster Prevention

Previous Research and Technological Development

- JAMSTEC’s Development of Submarine Cable Technology
  - Real time deep ocean floor observatory off Hatsushima Island in the Sagami湾 (started in 1993)
  - Observatory for instrument development
  - Long-term deep ocean floor observatory off Muroto Cape in the Nankai Trough (started in 1997)
  - The first cabled ocean floor observatory installed by JAMSTEC
  - Long-term deep ocean floor observatory off Kushino-Tokachi in the Kuril Trench (started in 1996)
  - The observatory recorded the 2003 Tokachi-oki earthquake and provided valuable data in the near field about the generation of the tsunami and the crustal deformation.

- Research Progress on Mega-Thrust Earthquakes in the Nankai Trough
  - Tonankai seismogenic zone: Imaging of a slip fault (which is considered to work as a barrier inhibiting the Tonankai earthquake rupture from propagating seaward)
  - Boundary of the Tonankai and Nankai seismogenic zones: Imaging of irregular structures (which are considered to control the segmentation and synchronization of the Tonankai and Nankai earthquake rupture zones)
  - Nankai seismogenic zone: Imaging of a subducting large seamount (which is considered to work as a barrier inhibiting the Nankai earthquake seismogenic brittle rupture from propagating seaward)
  - Numerical simulation of earthquake cycles: The results of simulation indicated that the seismic ruptures started from the source area of the Tonankai earthquake, successfully simulating the series of synchronization among the Tokai, Tonankai, and Nankai earthquakes. The pattern of the recent megathrust earthquakes in the Nankai Trough shows that the Nankai earthquake occurred about 32 hours after the Tonankai earthquake in 1854, and that the Tonankai earthquake in 1944 occurred about 2 years before the Nankai earthquake in 1946. Results of simulation are consistent with these observations.

- Earthquake and Disaster-Reduction Research Division, Research and Development Bureau, Ministry of Education, Culture, Sports, Science and Technology
  - 2-55, Hongo, Chiyoda-ku, Tokyo 113-8656, Japan
  - Tel: +81-3-5803-8000

- Research Center for Prediction of Earthquakes and Volcanic Eruptions, Graduate School of Science, Tohoku University
  - 6-6-1 Aoba, Aramaki, Sendai, Miyagi 980-8578, Japan
  - Tel: +81-22-215-5868

- Research Center for Seismology, Volcanology and Disaster Mitigation, Graduate School of Environmental Studies, Nagoya University
  - Furo-cho, Chikusa-ku, Nagoya 464-8603, Japan
  - Tel: +81-52-789-3066

- Earthquake Observation Center, Earthquake Research Institute, University of Tokyo
  - 3-7-25, Hongo, Bunkyo-ku, Tokyo 113-0032, Japan
  - Tel: +81-3-5841-6200

- Earthquake Research Department, National Research Institute for Earth Science and Disaster Prevention
  - 37, Tendo, Takadanobaba, Shinjuku-ku, Tokyo 169-0802, Japan
  - Tel: +81-3-3285-1601
Promotion of Real-time Ocean Floor Observation in Seismogenic Zone with Mega-Thrust Earthquakes

M 8 class mega-thrust earthquakes occurred repeatedly with recurrence intervals about 100-150 years along the Nankai trough formed by the descending Philippine Sea plate beneath the southwestern Japan from the Tokai to the southern part of Kyushu districts. The latest these earthquakes in the Nankai trough were the Tonankai earthquake in 1944 and the Nankai earthquake in 1946. The Japanese Government’s Earthquake Research Committee has assessed that the occurrence probability of a great earthquake in the next 30 years is about 60% for the Tonankai seismogenic zone and 50% for the Nankai seismogenic zone. The deployment of ocean floor observatory is urgently needed in the seismogenic zones with mega-thrust earthquakes. "Development of Dense Oceanfloor Network System for Earthquakes and Tsunamis (DONET)" funded by Ministry of Education, Culture, Sports, Science and Technology (MEXT) is performed mainly by Japan Agency for Marine-Earth Science and Technology (JAMSTEC). This project aims to develop a real-time dense "ocean floor network system" using advanced ocean floor observation technologies around the seismogenic zone of the 1944 Tonankai earthquake in order to improve simulation models of earthquake recurrence and contribute to disaster reduction and mitigation.

Three Major Targets of the Ocean Floor Network System

Ocean Floor Network System

- Contribution to Disaster Reduction and Mitigation
- Advancement of Earthquake Simulation Models
- Development of Most Advanced and Leading Technologies

This is a new network system for real-time observation at multiple deep ocean floor sites that could not be carried out by conventional observation systems. For the immediate detection of mega-thrust earthquakes and tsunamis, key factors for system development are: Advancement of simulation models, development of the power supply and optical data transfer technologies for long-term ocean floor observation, and advancement of submarine operations using remotely operated vehicles (ROVs).

Outline of the Ocean Floor Network System

- Plan of the Observation and Monitoring System for Earthquakes and Tsunamis
  Twenty stations (indicated by the white triangles in the right square in the figure below) will be installed in the seismogenic zone with mega-thrust earthquakes in the four-year period from 2006 through 2009. Each station is composed of high-precision seismometers, a water pressure gauge (tsunami meter), and other instruments. All the sites will be connected with submarine cables to form dense networks to start a more extensive, and higher-precision, continuous observation in 2010. Additionally, the project will start to develop a new ocean floor network on the western side.

- Image of the Ocean Floor Network System
  The observation sites, which are distributed planarly and densely, are connected to the land station with submarine cables for the purpose of improvement of the observation precision. Real-time power supply and data transference are conducted via the land station, and the acquired data are transferred to JAMSTEC and other related institutions.

Expected Products

- Example of real-time analyses using ocean floor network data
- Provision of Information and Technology against Mega-Thrust Earthquakes

- Contribution to Disaster Reduction and Mitigation
  - Detection of mega-thrust earthquakes by the observation instruments densely distributed on the ocean floor just above the source area enables to provide information of the scale of strong ground motions and/or tsunami prior to their arrivals.
  - More detailed, and more advanced and precise simulations will contribute to detailed measures for disaster reduction and mitigation.
  - The precise detection of crustal deformation prior to the occurrence of mega-thrust earthquakes is improved.

- Advancement of Earthquake Simulation Models
  - Real-time estimation of seismic source factors and development of seismic source models using data from the ocean floor network.
  - Advancement of simulation models of earthquake recurrences using long-term crustal deformation data obtained from the ocean floor network.
  - Progress in the study of the mega-thrust earthquake generation mechanism through long-term monitoring of crustal deformation (in interseismic, preseismic, coseismic, postseismic, and healing stages).

- Development of Most Advanced and Leading Technologies
  - The world’s first dense ocean floor network developed in a seismic source area.
  - Improvements in extendability, redundancy, and maintainability for long-term observation, and development of submarine operation technologies for the replacement of sensor units.
  - Development of instruments to obtain more precise data.
  - Development of new observation technology, such as GPS/Acoustic ocean floor positioning system.