JAMSTEC

Forward to integrated understanding of the Oceans, the Earth, Life, Humanity, and create the future of the Earth by co-creation with society.

JAMSTEC
www.jamstec.go.jp

@jamstec.jp
@JAMSTEC.PR
@jamstecchannel
Creating a future for both mankind and the Earth

From April 2019, the Japan Agency for Marine-Earth Science and Technology (JAMSTEC) will start implementing its 4th 7-year mid-term plan. Over the span of the previous three plans, JAMSTEC has evolved from a largely technical organization into a research organization pursuing both scientific research and the development of technology. Now equipped with seven ships and a supercomputer, we have consistently probed the frontiers of science and technology with the aim of building a new intellectual framework based on an understanding of the interactions between the oceans, the Earth and life.

Since the 1980s, surface temperatures of the Earth have risen markedly worldwide, and various phenomena associated with global warming have begun to seriously impact everyday life. At the same time, increasingly accelerated advances in technology have enabled us to literally probe all corners of the Earth. We have built huge cities on coastlines, leaving ourselves vulnerable to frequent disasters associated with earthquakes, tsunami, and extreme weather events. The global ecosystem is undergoing major transformations that are also thought to be triggering a new wave of evolution. The oceans, the Earth, life and mankind comprise a system that is now changing dramatically.

As we implement our 4th mid-term plan, we will seek to further develop an integrated understanding of the oceans, the Earth, life, and human activity, and work with others in society to improve the precision of our predictions and utilize the results of our efforts to benefit Japan and the world. To this end, we will tightly integrate science, technology, and management to create a research community for the next twenty years focused on both basic and applied research, the past and the future, and macro and micro perspectives, changing research methods and targets flexibly and working with universities, research institutions and industry both within Japan and overseas to disseminate outcomes that benefit the world. Achieving these goals requires the building of a world-leading research organization imbued with an ideal balance of firm governance and free-spirited inquiry.

We look forward to receiving your continued support.
We will promote research and development towards solution of global issues by understanding the current status and projecting the future of the global change.

To contribute to the resolution of global issues such as climate change, ocean acidification, and plastic pollution, we will lead international projects to conduct integrated research on oceans at all depths and on the close interactions of oceans with the atmosphere and land masses. We will apply the data obtained from this research to formulate both short-term seasonal predictions and mid- to long-term predictions covering centuries.

We will actively disseminate our research results through international frameworks such as the United Nations Framework Convention on Climate Change (UNFCCC) and the Paris Agreement, the UNESCO Intergovernmental Oceanographic Commission (IOC), the Intergovernmental Panel on Climate Change (IPCC), and the Arctic Council (AC). We will contribute to the achievement of the United Nations Sustainable Development Goals (SDGs) as well as Japanese government policies.

1 Observing and understanding ocean environmental change and developing observation technologies

We will maintain our conventional ocean observation network while at the same time working to develop a new optimized observing system that integrates various observation platforms, including research vessels, drifting floats, and moored systems. Our goal is to understand the physical and chemical states of the ocean and their temporal development, and to uncover the mechanisms of various oceanic phenomena with the aim of producing more reliable forecasts. We also plan to miniaturize and automate observation instruments to better monitor the global ocean.

2 Understanding environmental change in the Arctic region and developing technologies for making observations under sea ice

The impacts of global warming are currently most conspicuous in the Arctic region, and we will conduct observation and prediction research there to better understand interactions between oceans and sea ice and other aspects of Arctic climate systems, and help reduce prediction uncertainties. To this end, we will also develop underwater drones and other new observation technologies to enable us to observe what is going on beneath sea ice, a difficult endeavor up to now.

3 Understanding ecosystems/geochemistry dynamics linking Earth surface sub systems to reveal their interactions with human activities

Based on oceanic and atmospheric observations, lab experiment and model simulations, we understand and evaluate the impacts of ocean acidification, warming, hypoxia, and environmental pollution on changes and processes of ecosystems/geochemistry linking Earth surface sub systems (ocean/atmosphere/land systems) to reveal their interactions with human activities. We also focus on “hotspot” areas, Arctic region, and on Tsugaru Strait driving/representing global or near-Japan climate and environmental changes.

4 Projection of global environment

We work on further sophistication of the simulation models that have been developing at JAMSTEC to better project the environment on various temporal and spatial scale. We promote collaborations among different models taking the best of them, in order to obtain novel insights on phenomena ranging from short-term events such as torrential rain and typhoon, medium-term ones such as El Nino, and long-term ones such as global warming, including interactions among them.

5 Assessing the impact of human activity and global environmental change on biodiversity

In order to evaluate the impacts of human activities on the marine ecosystems, we will seek to understand the changes in marine biodiversity, which are sensitive to variations of the global environment. Particularly to fill the current data and knowledge gaps in the deep-sea ecosystems, we will develop analytical methods for environmental data and measuring methods of pollutants such as microplastics. Through these approaches, we aim to establish and upgrade the integrated environmental impacts assessment measures.
Understanding material circulation and origin of marine resources to ensure sustainable use

Our primary goal is to understand the formation processes of marine resources, including organisms, minerals, and energy resources found in the ocean. In addition to conducting the research that contributes to the sustainable use of oceans, we will seek collaborations with other institutions and industries through providing marine samples and sharing data, technologies, and scientific knowledge to accelerate the utility of the ocean.

1 Effective use of marine organisms and biological functions

We will endeavor to develop a precise understanding of oceanic material circulation through conducting chemical and molecular biological analyses of marine biological, geological, and other specimens, identifying the environmental, physiological, and evolutionary factors controlling circulation, and developing a quantitative understanding of marine bio-resources. We will also investigate the unique capabilities acquired by organisms in the process of adapting to extreme deep-sea environments. We will contribute to society by disseminating the environmental analysis technologies and methodologies developed by JAMSTEC.

Collecting sediment from the bottom of the Challenger Deep (depth: 10,896 m) in the Mariana Trench. Our efforts will hopefully lead to the discovery of novel microbial resources.

Photosynthetic bacteria inhabiting gypsum deposits by seawater evaporation.

2 Effective use of submarine resources

We have sought to shed light on the processes by which submarine resources are formed by conducting field research, collecting and analyzing specimens, analyzing data, and developing numerical models. These efforts have shown that both physical and chemical processes influence the concentration of elements in complex ways over a broad spatiotemporal scale. We will conduct research and development using these research methods to identify correlations between chemical and physical processes and to apply the knowledge gained to build submarine resource formation models that would enable us to theoretically pinpoint promising marine locations. We will also support the development of marine industries by broadly disseminating the knowledge and technologies we have acquired among relevant industries.

Collecting submarine resources from various depths.
Elucidating the actual conditions of earthquakes and volcanic activity to lead to disaster mitigation

Toward understanding and clarifying the actual conditions of offshore earthquakes and volcanic activity, we conduct marine researches and observation around Japan and the western Pacific region, including the presumed coseismic rupture area of the forthcoming megathrust earthquake along the Nankai Trough, by using research vessels and various observation equipment in cooperation with related institutes and universities. In order to forecast earthquakes and volcanic activity based on large-scale, high precision numerical simulation by use of data and results obtained from our surveys and observations, we upgrade methods for analyzing such data.

We continue to provide the scientific knowledge we have gained with human society to make use of mitigating disasters. Moreover, we endeavor to carry out researches and observations and apply our research outcomes in countries that are suffered from frequent disasters as a result of earthquakes, tsunamis, and volcanic activity in line with SDGs 11 (sustainable cities and communities).

1 Understanding seismogenic zones through offshore survey and observation

Compared with onshore earthquakes, we still know very little about offshore events. To improve this situation and make a better understanding of the current status of seismic activity, we develop and deploy a real-time observation system of seafloor crustal deformation and seismic activity. Focusing on regions having high urgency and importance as the presumed source area of large earthquakes and tsunamis, we conduct seismic surveys and observations to investigate three-dimensional crustal structure, seismic activity, the physical properties of faults, paleoseismic record, and other factors. The data we have obtained from our surveys and observations are broadly shared with relevant institutes and universities.

2 Understanding about the generation process and forecasting of earthquake and tsunami

To contribute monitoring of the current status and long-term evaluation of seismogenic zones, we will accumulate and disseminate knowledge that promotes our understanding of earthquake generation mechanisms and our ability to grasp and forecast the status of the inter plate locking and slipping based on the latest data obtained from observations and research on seismogenic zones. To this end, we will integrate various data to improve the precision of our seismogenic zone models and upgrade our real-time tsunami forecasting system.

3 Understanding current status of the Earth’s interior and forecasting its variation as a cause of volcanic activity and the Earth’s evolution

Submarine volcanic eruptions have caused sudden, large-scale disasters. Because of their huge impact on the human society and global environment, forecasting their occurrence and evaluating their impact on the environment are of vital importance. To address these issues, we will conduct ocean drilling surveys using our Deep-sea Scientific Drilling Vessel CHIKYU and investigate the internal structures of the Earth that control volcanic activity, the mechanisms controlling circulation of fluids and energy within the Earth, and magma supply systems from both single volcano and global perspectives.
Probing unknown causal relationships hidden in Earth systems

To identify interrelationships between changes in Earth systems and human activity, we will develop methodologies for integrating the vast amounts of data generated by JAMSTEC R&D activities, and mathematical analysis methods for efficiently processing the resulting integrated data. We will also support the resolution of policy issues and development of sustainable socioeconomic systems by generating and disseminating information tailored to various needs. We will additionally endeavor to expand this initiative to encompass other relevant organizations both in Japan and overseas so as to build a framework for generating even more advanced and useful information.

1 Research and development of numerical analysis and verification methodologies

We will develop data conversion tools to unify the formats of research and development-generated data sets for the various phenomena comprising Earth systems that are based on very different scales of time, space, and other parameters. In order to mathematically process data that has been integrated by unifying formats, we will then carry out time evolution calculation and data assimilation, and develop a large-scale repository of numerical analysis methodologies of various kinds including AI and other advanced functions. As a part of repository development, we will also develop verification technologies to guarantee the quality of the numerical analyses it is used for.

2 R&D on the use of numerical analysis results to generate advanced and optimized information

We will develop a four-dimensional virtual earth as a large-scale data system equipped with advanced data analysis functions and capable of efficiently aggregating and managing data generated by the numerical analysis repository and other sources. Using this four-dimensional virtual earth, we will seek to discover and elucidate the complex relationships between intertwined Earth systems, and based on those relationships, generate information optimized to best serve user needs, making it more valuable to society as a whole.

3 Development and operation of an execution platform optimized for information generation

As an execution platform for the numerical analysis repository and four-dimensional virtual earth, we will build a high-speed computing system capable of handling the huge amount of information stored in the data server, connecting the system and server through a high-speed network. To further advance and support enrichment of this platform, we will also focus on security and compatibility in its development and operation so as to facilitate sharing and collaboration with other organizations and gain more users as a result.

Initiative concept

Four-dimensional virtual earth
Collection of analysis methodologies + high-speed calculation server
Numerical analysis repository
Acquisition of data through field research/observation and other research and development activities

Creation of the most suitable information for the particular needs of different users

Acquisition of data through field research/observation and other research and development activities

Effect of crustal movement on biota (microbial community)
(Formation of a bacterial mat (white part) in conjunction with outflow of spring water from a seabed)

Comprehensive assessment of the health of the marine environment

For fisheries and agriculture
Providing fishermen with fishery area forecast information
Exploratory and challenging research and technological development for the future

Our exploratory and challenging research and development on deep-sea extreme environments, or so to be called the Earth’s last frontiers, will build a scientific, technological, and intellectual platform which will lead to generating diverse knowledge and innovation to support future Japan as a maritime nation. It is expected to raise public interest in science and technology, and contribute significantly to the promotion of Japan’s science and technology policies. We also lead JAMSTEC basic research and development, promote research collaboration between different fields, and accelerate mission achievement.

1 Basic, exploratory and challenging research based on out-of-the-box thinking

We will conduct challenging and highly speculative research with the aim of making breakthroughs and generating systematic understanding that will lead to future paradigm shift in science. Japan has already gained worldwide recognition for the originality of its exploratory research on the role of the ocean in the origin of life and the co-evolution of life and the environment, and on microbial dark matter (unknown microbes occupying dark and extreme environments) and the physiological functions supporting such life forms; by focusing on these themes, we will establish a new academic field in which Japan will lead the world.

2 Building the future of oceanographic technology through pioneering technological development research

With the goal of producing outcomes that transform oceanographic technology, we will engage in highly speculative and pioneering technological development research rather than endeavoring to extend existing technologies. We will focus in particular on developing original technologies that combine new exploratory technologies such as measurement using laser processing and electrochemical processing, and ultra-high resolution nanoscale analysis.

Black smoker in the Beebe Hydrothermal Vent Field of the Mid-Cayman Rise in the Caribbean Sea

Illustration of deep sea hydrothermal activity of 4 billion years ago may have looked

The three domains of the tree of life

Image of the birth of life in a small hole inside a deep sea hydrothermal chimney

Ultra-high resolution nanoscale analysis (NanoSIMS)

Development of deep sea organism identification technology using underwater laser processing technology

Diagram of the tree of life

Illustration of deep sea hydrothermal activity of 4 billion years ago may have looked
Institute for Marine-Earth Exploration and Engineering (MarE3)

Advanced technology bringing new insights of the Earth and its oceans

Oceans occupy about 70% of the Earth’s surface, and are a significant source of dynamic global change. A wide range of important marine Earth research targets, including ocean deeps, tectonic subduction zones (with related earthquakes and volcanic eruptions), hydrothermal vents, and the deep subsea floor are the primary targets of our world-leading scientific research and development program. Implementing this, while also supporting Japan’s ocean policies, we will maintain and improve our advanced capabilities for investigation and observation of the world ocean and seas. We promote the continual technological development and operation of our marine research facilities, capable of supporting research across large and diverse fields of investigation, as part of the greater scientific and research community.

Ocean research platform-related technology development

Addressing social issues related to oceans based on scientific knowledge and data requires the utilization of high-precision observation and research capabilities to appropriately understand and monitor marine environments. To that end, we will further equip ourselves with both remotely operated and autonomous underwater vehicles capable of supporting investigation over wide areas and deep zones, and will continue to consider development of the next generation of manned research submersibles. We will also continue to develop fundamental cutting-edge observation systems, sensors, and other relevant technology.

Development of ultra-deep water and ultra-deep drilling technologies

Ultra-deep water and ultra-deep drilling and related technologies, and borehole observation technologies are required to investigate mechanisms of earthquake generation, the subsea floor biosphere and its functions, and to carry out future mantle drilling. We will accordingly develop these necessary technologies in stages.

Operation of ocean research platforms

We will operate safe, efficient, and stable ocean research platforms that addresses R&D and societal needs. We will continue to upgrade the functions and performance of our equipment and facilities, and incorporate newly developed methodologies and technologies to enable the implementation of sophisticated research and observation. We will also provide users of our oceanographic research platform with scientific and technical support.
Collaboration with others

Through collaborations with countries, universities, private industry, and other parties, we actively participate in joint projects, personnel and information exchanges, and networking events with the aim of developing, enhancing, and raising the profile of our intellectual property. We will further pursue cooperation and collaboration with regional marine industry promotion and human resource development measures, and promote activities aimed at achieving the goals of collaborative initiatives with private industry and other stakeholders.

International cooperation

We actively engage in SDGs and other international frameworks, and will take on leadership roles as required. We also seek to drive the further growth of oceanographic research and technology and strengthen Japan’s research and development capabilities in the field by building effective structures for cooperation with overseas organizations. We will continue to operate “CHIKYU” for international scientific drilling programs such as the Integrated Ocean Drilling Program (IODP), and will pursue a range of initiatives to drive scientific drilling projects.

Human resource development

We will pursue efficient and effective initiatives to nurture young talent in the field of marine science and technology and expand the human resource base by leveraging connections with other organizations. We will actively disseminate information on our human resource development initiatives through our website and other means in a way that encourages young people to consider a career as a researcher or technician.

Public relations

We conduct strategic public relations according to the purposes to promote public awareness and understanding of our activities. We will pursue clear and effective public relations initiatives by leveraging the facilities and equipment of our sites and working with the media, private industry, and other parties.

Research Facilities

![Deep-sea Drilling Vessel CHIKYU](image1.png)
Depth capability: 6,500 m
Length: 212.0 m
Gross tonnage: 47,523 tons
Complement: 200 persons
Commissioned: 2005

![Maned Research Submersable SHINKAI 6500](image2.png)
Depth capability: 6,500 m
Length: 9.7 m
Weight in the air: 26.7 tons

![Research Vessel KAIKEI](image3.png)
Length: 105.3 m
Gross tonnage: 5,707 tons
Complement: 65 persons
Commissioned: 2016

![Support Vessel YOYOSUKA](image4.png)
Length: 103.2 m
Gross tonnage: 4,604 tons
Complement: 60 persons
Commissioned: 1996

![Deep Sea Research Vessel KAIREI](image5.png)
Length: 105.0 m
Gross tonnage: 4,517 tons
Complement: 60 persons
Commissioned: 1997

![Oceanographic Research Vessel MIRAI](image6.png)
Length: 105.6 m
Gross tonnage: 4,617 tons
Complement: 60 persons
Commissioned: 1997

![Research Vessel HAKUHO MARU](image7.png)
Length: 100 m
Gross tonnage: 4,291 tons
Complement: 89 persons
Commissioned: 1989

![Deep Ocean Floor Survey System DEEP TOW](image8.png)
Depth capability: 6,000 m
Length: 33.5 m
Weight in the air: 10.0 tons

![Earth Simulator](image9.png)
Number of processors: 5,120
(Number of Core: 20,480)
Peak performance: 1.31 PFLOPS
Main memory capacity: 320 TB

![Core Repository](image10.png)
Storage capacity: 1.33 Tbytes
Annual 200 m at a maximum
Temperature: about 0 degrees
Humidity: about 30%
The following databases are available on the JAMSTEC website.

**Documents and Reports**
- Earth Simulator Research Results Repository
- JAMSTEC Repository
- JAMSTEC’s Patent List

**Images and Samples**
- JAMSTEC E-library of Deep-sea Images (J-EDI)
- Marine Biological Sample Database
- Deep Sea Rock Sample Database (GANSEKI)
- Core Electronic Database of Ocean floor (COEDO)

**Marine Observation Data**
- Argo JAMSTEC
- TRITON web
- Indo-Pacific
- Subsurface ADCP mooring dataset
- JAMSTEC Compact Arctic Drifter (J-CAD, POPS)*
- JAMSTEC OceanITES
- Database for time-series stations K2 and S1
- Paleoclimate-Ocean Database
- Extremo Base
- Image database of planktonic foraminifera
- Okinotorishima Island Observations*

**Terrestrial Observation Data**
- Cryosphere Data Base

**Earthquake and Geoscience Data**
- Crustal Structural Database Site
- JAMSTEC Ocean-bottom Seismology Database (J-SEIS)
- Google Earth as geoscience data browser project

**Forecasts and Simulations**
- Global Chemical Weather Forecast System
- Japan Coastal Ocean Predictability Experiment (UCOPE) System (ocean weather forecasts)
- Low-latitude Climate Prediction Research
- ALERA (AFES-LETKF experimental ensemble reanalysis)
- ALERA2
- General Ocean Circulation Model for the Earth Simulator Center (OFES)
- Estimated State of Global Ocean for Climate Research

*Japanese only