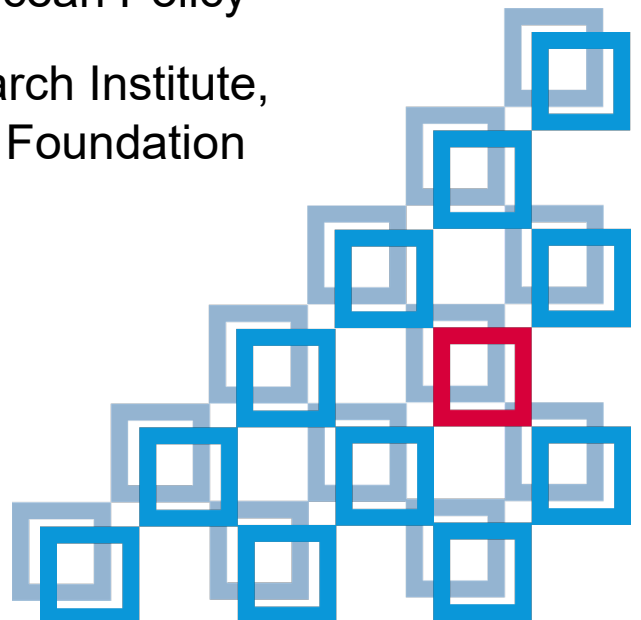


2021 United Nations Decade
2030 of Ocean Science
for Sustainable Development

Japan's Initiatives for UN Decade of Ocean Science

(1st edition)

Japan Society of Ocean Policy
Ocean Policy Research Institute,
Sasakawa Peace Foundation



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Japan's Initiatives for UN Decade of Ocean Science

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The Japan Society of Ocean Policy

Sasakawa Peace Foundation Building 6F, 1-15-16 Toranomom, Minato-ku, Tokyo 105-0001

Tel./fax +81-3-6457-9701

<https://www.oceanpolicy.jp>

The Ocean Policy Research Institute of The Sasakawa Peace Foundation (OPRI-SPF)

Sasakawa Peace Foundation Building 6F, 1-15-16 Toranomom, Minato-ku, Tokyo 105-8524

Tel. +81-3-5157-5210 Fax +81-3-5157-5230

<https://www.spf.org/opri/>

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Introduction

The United Nations Decade of Ocean Science for Sustainable Development began in January 2021. It was proclaimed during the seventy-second session of the United Nations General Assembly in 2017, and for the next decade, until 2030, initiatives with a particular focus on the ocean, a sector with many areas that remain largely unknown, will be pursued with a view to realizing various sustainable development goals (SDGs), especially Goal 14 or SDG14 (Life Below Water).

As Japan professes itself to be a maritime but also a science and technology state, the promotion of ocean science is an important issue, constituting the basis of its marine policy. Japan is also expected to show leadership in terms of diplomacy related to science and technology. Nevertheless, coordination among industry, government, academia, and the private sector in the field of ocean science in Japan is not always sufficient. The United Nations Decade of Ocean Science is not meant to be implemented by ocean researchers alone. Instead, co-design, co-production, and co-delivery work should be undertaken on a collaborative basis with various concerned parties. In this connection, in August 2020, the Japan Society of Ocean Policy and The Sasakawa Peace Foundation's Ocean Policy Research Institute established the Study Group on the United Nations Decade of Ocean Science as a base for collaboration and have since been promoting discussions toward this end.

Marking the start of the Decade of Ocean Science, this collection of initiatives was planned and produced in response to a proposal put forth by this Study Group with the aim of disseminating to the world the ocean science initiatives that have been carried out to date in Japan. Nothing would please us more than knowing that the use of this collection of initiatives by various parties engaged in marine activities in Japan and overseas is helping to promote further collaboration and accelerating and promoting cross-sectional initiatives for the United Nations Decade of Ocean Science.

SAKAMOTO Shigeki

Chairperson, Japan Society of Ocean Policy








SUNAMI Atsushi








President, The Sasakawa Peace Foundation

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Correspondence table by outcome

Name	Implementing organization	Outcome							Applicable region		Page
		Clean ocean	Healthy & resilient ocean	Productive ocean	Predictable ocean	Safe ocean	Accessible ocean	Inspiring & engaging ocean	International activities	Domestic activities	
											
Promoting measures to deal with marine litter and ocean plastic waste	Ministry of the Environment and others	★							●	●	7
Change for the Blue, a project of comprehensive measures for dealing with marine litter	Nippon Foundation and others	★							●	●	8
Cross-sectoral marine plastics research conducted as part of the Japan-Palau Goodwill Yacht Race	Japan Agency for Marine-Earth Science and Technology and others	★					●	●	●	●	9
Large-scale open-ocean survey of microplastics	NYK Line and others	★					●		●	●	9
For the environmental conservation and suitability of enclosed coastal seas	International EMECS Center	★	●	●		●	●	●	●	●	10
International contributions to the conservation of coastal ecosystems	Tokyo Institute of Technology and others		★	●	●		●	●	●	●	11
Marine biotechnology targeting marine environmental bacteria	Department of Life Science and Medical Bioscience, Graduate School of Advanced Science and Engineering, Waseda University, and others	●	★	●	●	●		●	●	●	12
Promoting polar research	National Institute of Polar Research and others	●	★	●	●	●			●	●	13
International Partnership for the Satoyama Initiative (IPSI)	United Nations University Institute for the Advanced Study of Sustainability		★	●					●	●	14
Research on the vision of the country in the twenty-first century from the perspective of the ocean	Society of Ocean Romantics and others		★	●	●				●	●	14
Research for effective management of ships' biofouling to minimize the transfer of invasive aquatic species	Japan Ship Technology Research Association	●	★						●	●	15
Certification program and eco-labeling for sustainable fisheries	Marine Stewardship Council			★					●	●	16
Marine Eco-Label Japan (MEL)	Marine Eco-Label Japan Council and others			★						●	16
SH "U" N project	Japan Fisheries Research and Education Agency			★				●		●	17
Blue Seafood Guide	Sailors for the Sea Japan			★						●	17
Promoting initiatives to eradicate IUU fishing	Fisheries Agency			★					●		18
Indonesian coastal fishing village project based on ODA provided by the government of Japan	North Pacific Marine Science Organization and others	●		★		●	●		●		18

Name	Implementing organization	Outcome							Applicable region		Page
		A clean ocean	A healthy & resilient ocean	A productive ocean	A predictable ocean	A safe ocean	An accessible ocean	An inspiring & engaging ocean	International activities	Domestic activities	
											
Technology development program to promote the use of marine resources	Ministry of Education, Culture, Sports, Science and Technology	●	●	★	●	●	●			●	19
IoT and AI proof-of-concept testing for tuna aquaculture farming operations	Sojitz Corporation and others			★						●	19
Aquaculture farming efficiency improvement project to help restore mackerel populations	Obama City and others			★						●	20
Argo Program	Intergovernmental Oceanographic Commission of UNESCO and others		●	●	★	●	●	●	●	●	21
Problem solving by taking integrated approach towards understanding the current status of global environmental change and predicting the future	Japan Agency for Marine-Earth Science and Technology		●		★		●	●	●	●	21
Research and development for the Sustainability Initiative in the Marginal Seas of South and East Asia (SIMSEA)	Japan Agency for Marine-Earth Science and Technology and others	●			★	●	●			●	22
Ocean Prediction for Coastal Fisheries around Kyushu Island	Research Institute for Applied Mechanics, Kyushu University, and others			●	★					●	22
Undersea weather forecasting system for which satellite data have been assimilated	Japan Aerospace Exploration Agency and others		●	●	★	●	●			●	23
Kuroshio/Oyashio Watch, an initiative for forecasting ocean conditions along the coast of Japan	Application Laboratory, Japan Agency for Marine-Earth Science and Technology				★		●			●	23
Support system for the operation and management of work vessels for which meteorological and hydrographic conditions are taken into account	Taisei Corporation				★					●	24
Northwest Pacific Tsunami Information Center	Japan Meteorological Agency					★			●	●	25
Monitoring of Waves on Land and Seafloor (MOWLAS)	National Research Institute for Earth Science and Disaster Resilience					★				●	25
Seafloor geodetic observation to elucidate the mechanism of megathrust earthquakes	Japan Coast Guard and others					★				●	26
Realizing a safe ocean through research and development on seismic and volcanic activities in ocean areas	Japan Agency for Marine-Earth Science and Technology					★	●			●	26
Academic research on the Great East Japan Earthquake and Tsunami	International joint survey group organized centering on the Japan Society of Civil Engineers					★			●	●	27
Contributing to coastal disaster prevention with the provision of detailed information on ocean currents and seawater temperatures	Japan Meteorological Agency				●	★	●			●	27
Predicting the occurrence of red tides through the use of satellite images	Tokio Marine Holdings, Inc., and others			●	●	★				●	28
Operations of the Japan Oceanographic Data Center	Japan Coast Guard and others						★		●	●	29
Hydrographic observations along the 137°E meridian	Japan Meteorological Agency	●	●		●		★		●	●	29

Name	Implementing organization	Outcome							Applicable region		Page
		A clean ocean	A healthy & resilient ocean	A productive ocean	A predictable ocean	A safe ocean	An accessible ocean	An inspiring & engaging ocean	International activities	Domestic activities	
Satellite observation of the ocean environment and the release of observation data	Japan Aerospace Exploration Agency	●	●	●	●	●	★		●	●	30
Effective operation and improving the function of MDA Situational Indication Linkages (MSIL)	Cabinet Secretariat and others						★			●	31
Developing and promoting cross-sectoral synergy-creating wind farm technology	Research Institute for Ocean Economics and others	●	●	●	●		★	●		●	32
Utilizing and conserving coastal and remote island sea areas through next-generation oceanic mobility	Ministry of Land, Infrastructure, Transport and Tourism, and others	●	●	●	●	●	★	●		●	32
Accumulating and disseminating research data at the Global Oceanographic Data Center (GODAC)	Japan Agency for Marine-Earth Science and Technology	●	●		●	●	★	●	●	●	33
Marine research facilities along the Japanese coast: marine biological laboratories, fisheries research stations, and more	National, public, and private universities	●	●				★	●		●	33
Comparative research on wellbeing as derived from the ocean in six north Pacific countries	North Pacific Marine Science Organization							★	●	●	34
Marine Open Innovation Project (MaOI Project)	Shizuoka Prefecture and others	●	●	●	●	●	●	★		●	34
Cultivating human resources in the field of ocean science	Japan Science Society	●	●	●	●	●	●	★	●	●	35
UNESCO-associated schools	Ministry of Education, Culture, Sports, Science and Technology							★	●	●	36
Ocean Education Pioneer School Program	Nippon Foundation and others							★		●	36
Organizing a project for the formation of ocean education research centers and holding the National Ocean Literacy and Education Summit	Center for Ocean Literacy and Education, Graduate School of Education, the University of Tokyo, and others	●		●		●	●	★		●	37

- This list is presented in a matrix form that shows how organizations, universities, companies, and other parties are working on initiatives for the United Nations Decade of Ocean Education in seven different outcomes.
- ★ denotes the primary outcome corresponding to the given initiative while ● denotes other relevant outcomes for the given initiative.

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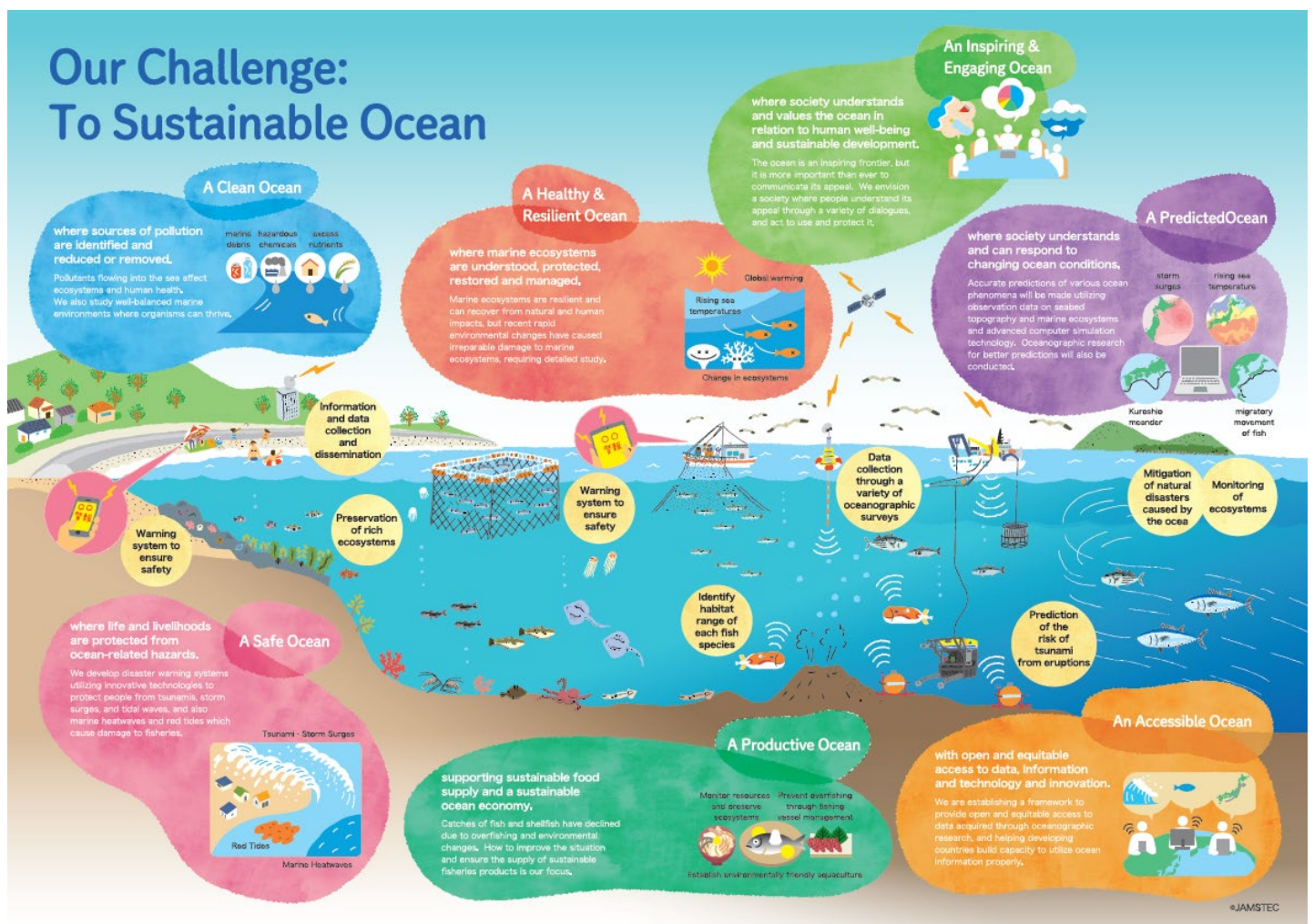
Seven outcomes for the United Nations Decade of Ocean Science

The following seven outcomes conceptually outline the ocean we hope to realize, the Ocean We Want, through activities over the next ten years within the framework of the United Nations Decade of Ocean Science:

- A clean ocean: Surveying the impact of pollutants on people and organisms.
- A healthy & resilient ocean: Surveying changes affecting ecosystems due to rapid changes to the ocean environment.
- A productive ocean: Working to realize an ocean that is rich enough to enable fish to be caught generation after generation.
- A predictable ocean: Being able to accurately predict various oceanic phenomena.
- A safe ocean: Protecting lives from various types of oceanic disasters.
- An accessible ocean: Making it possible for people around the world to effectively use information on the ocean.
- An inspiring & engaging ocean: Making it possible for people around the world to harness the ocean and act to protect it through their understanding of the sea.

In this collection, initiatives being undertaken in Japan are introduced across seven different outcomes.

Reference: Website for the United Nations Decade of Ocean Science (<https://oceandecade.com/>)



Source: Japan Agency for Marine-Earth Science and Technology (JAMSTEC)

Promoting measures to deal with marine litter and ocean plastic waste



Project Promoting Local Measures Against Coastal Litter

Period: From 2009

Organizations: Ministry of the Environment, prefectures, municipalities, and others

Recent years have seen growing concern over reduced coastal functions, the deterioration of the environment and landscapes, and impediments caused to marine navigation due to marine litter. The Ministry of the Environment has been providing support through subsidies, in accordance with the Act on Promoting the Treatment of Articles that Drift Ashore, for projects that relate to the formulation of local plans concerning marine litter, the collection and disposal of marine litter, and measures to inhibit the generation of marine litter (including events consisting of beach clean-up activities and the provision of environmental education carried out for the purpose of raising awareness) as implemented by prefectures and municipalities. In addition to conserving the ocean environment through the promotion of measures to deal with marine litter throughout the country, this project endeavors to promote and conserve exceptional marine landscapes for the future and thereby maintain the ocean in a beautiful and rich state, which is vital for promoting local communities and such key local industries as fishing and tourism.



Collection and disposal of marine litter with heavy machinery and volunteers

Source: Materials from the 12th conference of the Committee for Promoting the Treatment of Articles that Drift Ashore

(https://www.env.go.jp/water/marine_litter/conf/c02-12.html, Ministry of the Environment)

Plastics Smart

Period: From 2019

Organization: Ministry of the Environment

Plastics Smart is an initiative promoted by the Ministry of the Environment to help solve the problem of plastic waste in the ocean. Ministries, agencies, industry organizations, companies, local governments, NGOs, consumers, and other parties are invited to submit smart ideas for living with plastics, such as those that involve reducing the amount of unnecessary single-use plastics and developing and utilizing substitute materials. These ideas are then disseminated widely across Japan and overseas using a variety of different opportunities and methods. As of the first of 2021, more than 2,200 ideas have been registered to the website (<http://plastics-smart.env.go.jp/>) that was set up as part of these efforts.



Plastics Smart logo mark

This logo mark is provided free of charge for use by supporters of this initiative. Affixing this mark to news releases, product catalogs, business cards, and other items helps to publicize the fact that initiatives to help solve the problem of plastic waste in the ocean are being implemented.

Investigating and Building an Ocean Plastic Waste Mapping Database

Period: From 2020

Organization: Ministry of the Environment

In order to eradicate the worldwide problem of plastic waste in the ocean, on a global scale, it will be necessary to have countries around the world share scientific data on the distribution of plastic waste and establish effective measures based on such data. This initiative will collect and centralize data related to the monitoring of plastic waste in the ocean as conducted around the world and study the development of a global center for the collection of data.

Change for the Blue, a project of comprehensive measures for dealing with marine litter



Change for the Blue is a project through which the Nippon Foundation collaborates with various stakeholders from industry, government, academia, and the private sector to forge models for eliminating marine litter and share them within Japan and overseas for the purpose of promoting a movement to raise awareness across society of the need to stop adding more waste to the ocean. Among the initiatives being carried out is the UMIGOMI Zero Award, which is being run in collaboration with the Ministry of the Environment, and the University of Tokyo FSI - Nippon Foundation Research Project on Marine Plastics.



UMIGOMI Zero Award

Period: From 2019
Organizations: Nippon Foundation, Ministry of the Environment

For the UMIGOMI Zero Award, outstanding initiatives in connection with measures for dealing with marine litter are accepted and selected from across Japan and disseminated to the world as Japanese model case studies.

This award is divided into two divisions for the submission of initiatives: an Action Division for practical activities and awareness-raising initiatives involving effective actions that are continuously and expansively deployed and that are recognized for yielding achievements that are notable, and an Innovation Division for initiatives centered on the development of technologies and products that are recognized for being innovative and for yielding achievements that are exceptional in terms of the smooth disposal of marine litter and controls for preventing marine litter from being generated.

In fiscal year 2020, 246 submissions in the Action Division and 65 submissions in the Innovation Division were made by companies, NGOs/NPOs, local governments, schools, and others. Upon a review of the submissions, the grand prize was awarded for the Ventforet Kofu Eco-Stadium Project. This project was carried out by Ventforet Yamanashi Sports Club, Inc., which introduced reusable containers for food and drinks sold in their stadium and ushered in a deposit system to get visitors to participate in this project on a proactive basis. Awards were given for three other submissions in each division (two divisions) and one special jury prize was also conferred.



Reference: UMIGOMI Zero Award
(https://uminohi.jp/umigomizero_award2020/)

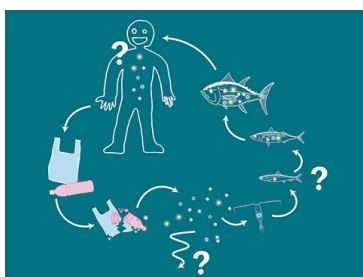
Research Project on Marine Plastics

Period: From 2019
Organizations: University of Tokyo, Nippon Foundation

The University of Tokyo's Future Society Initiative (FSI) and The Nippon Foundation have established the Research Project on Marine Plastics and will engage in research and disseminate information on measures for dealing with plastic waste in the ocean in collaboration with domestic and overseas research institutes for a period of three years beginning in 2019.

When thinking about the issue of plastic waste in the ocean, it is important to enhance scientific knowledge and grasp issues in accordance with a reliable scientific foundation. To this end, partnerships with various universities and research institutes have been formed, with the University of Tokyo taking the lead in this respect. Surveys and research activities are being carried out for such purposes as the ascertainment of actual conditions concerning marine microplastics, the assessment of the ecological impact of microplastics, and the conducting of comprehensive research on measures to eradicate plastic waste.

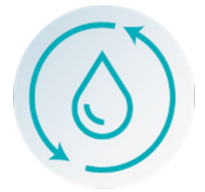
In addition, members of this project have held meetings and symposiums to encourage dialogue among researchers and experts in Japan and overseas, participated in international research conventions hosted by UN bodies and other organizations, and helped develop capacity and engage in outreach activities for people in Asia.



Food chain and microplastics

Source: The University of Tokyo FSI - Nippon Foundation
Research Project on Marine Plastics
(<https://fsi-mp.aori.u-tokyo.ac.jp/index.html>)

Cross-sectoral marine plastics research conducted as part of the Japan-Palau Goodwill Yacht Race



Period: December 2019 to January 2020 (Phase 1), 2024 (Phase 2)

Organizations: Japan Agency for Marine-Earth Science and Technology (JAMSTEC), Promotion of Global Human Resource Development Organization, Mitsui O.S.K. Lines, Ltd., Japan-Palau Goodwill Yacht Race Executive Committee, Yamaha Motor Co., Ltd.

During the Japan-Palau Goodwill Yacht Race, microplastics sampling equipment was installed to one of the participating racing yachts and sail training ship MIRAIE for microplastics sampling. JAMSTEC researcher also boarded MIRAIE to conduct numerous surveys including conventional net sampling with a Neuston net.

Young people and other general public from Republic of Palau were also invited to board MIRAIE. They participated in various educational program such as observing research activities as well as attending onboard seminars to deepen their understanding on ocean environment. First phase of this project was completed successfully in January 2020. Its second phase is scheduled to take place in 2024.



Sail training ship MIRAIE



Ocean plastics sampling survey



Microplastics sampler

Reference: Conducting a cross-sectoral marine plastics survey in collaboration with various sectors in the Japan-Palau Goodwill Yacht Race (JAMSTEC, <http://www.jamstec.go.jp/spfo/j/>)

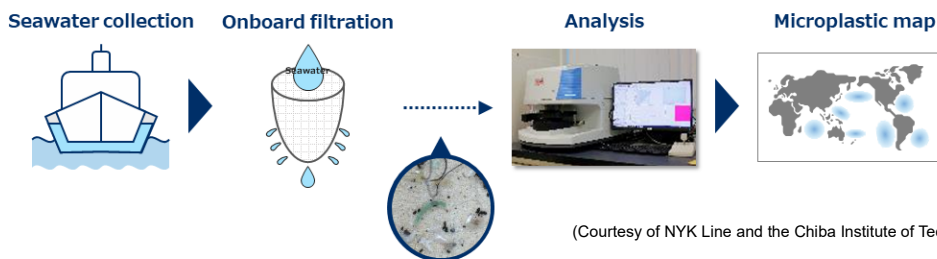
Large-scale open-ocean survey of microplastics



Period: From 2020

Organizations: Nippon Yusen Kaisha, Chiba Institute of Technology

A network of approximately 750 operating vessels operated by NYK Line will be harnessed to collect samples of microplastics during voyages, which will then undergo analysis by the Chiba Institute of Technology to help produce a map of plastic waste in the oceans of the world with which the size, density distribution, and age of microplastics can be better understood. The aim is to amass big data on microplastics and produce a detailed plastic waste map on a global scale by linking the results of the analysis to sampling times, positional information, and meteorological and oceanographic data. As of today, it is reported that more than 100 samples at 100 locations have been implemented and NYK Line and Chiba Institute of Technology are aiming to extend and deepen the research for the objective of FY2021.



(Courtesy of NYK Line and the Chiba Institute of Technology)

Flow of steps undertaken for the open-ocean survey of microplastics

Reference: Commencing the first large-scale open-ocean survey of the distribution of microplastics to be conducted in the world (NYK Line, https://www.nyk.com/news/2020/20200306_01.html)

For the environmental management and appropriate use of enclosed coastal seas



Period: Established in 1994; became a public interest incorporated foundation in 2012
 Organization: International EMECS Center

The International EMECS Center is an organization that was established in order to promote conservation and creation of environments in enclosed coastal seas around the world and establish a society of sustainable growth in which various forms of nature and humankind can live in harmony by building an organic network of governments, researchers, businesses, citizens, and other key stakeholders, promoting international and academic exchanges, and organizing projects to carry out survey-based research and training programs and provide support for activities. This organization holds global conferences “EMECS Conference” on conserving the environment in enclosed coastal seas, international EMECS seminars, collects and provides information through the issuance of a newsletter and the production of a database, conducts survey-based research, and engages in the training of human resources and in awareness-raising projects. The International EMECS Center participates in Partnerships in Environmental Management for the Seas of East Asia (PEMSEA) as a non-country partner and works to promote development that is consistent with environmental conservation in ocean areas situated in east and southeast Asia.



Major enclosed coastal seas around the world (including the Sea of Japan and the Seto Inland Sea)

Reference: The International EMECS Center (<https://www.emecs.or.jp/>)



Newsletter

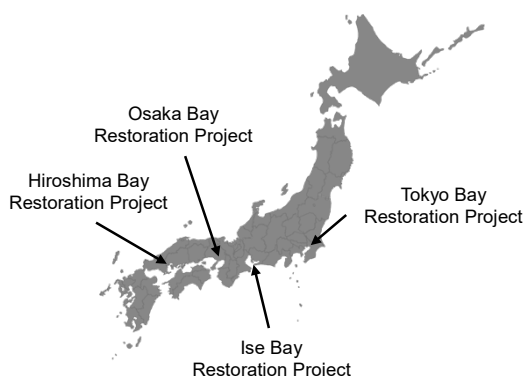
Column

National Sea Restoration Project

In a place like Tokyo Bay, which is an enclosed coastal sea area with a large city behind it, large volumes of domestic wastewater flow into the sea and the water does not circulate with water from the open sea very well, thereby causing all sorts of problems, such as chronic red tides and anoxic water masses caused by organic pollution, which can have a huge impact on aquatic animals and plants.

The National Sea Restoration Project is promoting various types of measures for the restoration of the ocean through collaborations primarily with the Japan Coast Guard and the Ministry of Land, Infrastructure, Transport and Tourism as well as other relevant ministries and agencies and local governments in order to address these problems. The Tokyo Bay Restoration Project, which began in 2002, kicked off a number of sea restoration projects that are now being undertaken at four locations nationwide (Tokyo Bay, Osaka Bay, Ise Bay, and Hiroshima Bay).

Source: Produced based on *Restoring Tokyo Bay* (Japan Port and Harbour Association, “Ports and Harbours”, July 2017 edition)



Sea areas where sea restoration projects are being implemented

International contributions to the conservation of coastal ecosystems



Evaluating coastal seas for the realization of a sustainable society and promotion of social change (COAST Card)

Period: April 1, 2020 to March 31, 2024

Organizations: [In Japan] Tokyo Institute of Technology, Association for Shore Environment Creation, Tokyo University of Marine Science and Technology, Japan Fisheries Research and Education Agency and others
 [Overseas] University of Maryland (US), University of the Philippines Diliman (Philippines), Council of Scientific & Industrial Research/National Institute of Oceanography (India), University of Bergen (Norway)

This research is being undertaken for the purpose of building a new framework based on a super-interdisciplinary network that will enable rational policy decisions to be made for the realization of a sustainable state of coexistence between society and coastal ecosystems through the development and application of COAST Card, an integrated system comprising innovative tools consisting of Report Card (RC), Social Network Analysis (SNA), and System Dynamics Modeling (SDM). COAST Card allows stakeholders in applicable areas to be closely tied to the process of developing core elements of the system and play proactive roles in the operation of the system. For this reason, an interface environment designed for general users is also being developed.



Coastal Ecosystem Conservation and Adaptive Management (CECAM) project in the Philippines

Period: June 1, 2009 to February 28, 2015

Organizations: [In Japan] Tokyo Institute of Technology, Atmosphere and Ocean Research Institute of the University of Tokyo, Asian Natural Environmental Science Center of the University of Tokyo, Hokkaido University, Hachinohe Institute of Technology, Kochi University, Nagasaki University, University of the Ryukyus, Port and Airport Research Institute
 [Overseas] University of the Philippines Diliman (Philippines) and others

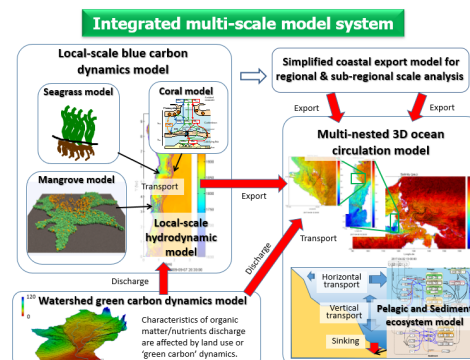
Ecosystems in the biodiversity-rich coastal areas of southeast Asia are rapidly degrading due to the interplay of environmental stress caused by human activities and the impact of changes in the global environment. This research project, which is being undertaken in the Philippines, seeks to clarify the mechanisms by which the biodiversity of coastal ecosystems is maintained, comprehensively evaluate the actual state of environmental stress, and analyze the response of ecosystems and processes by which ecosystems recover in the face of multiple sources of stress as well as the socioeconomic structures of local communities that cause such sources of stress. Accordingly, a new scheme for the conservation and management of coastal ecosystems will be developed and deployed in order to maintain a high level of biodiversity and disaster-prevention functions in a stable manner and make it possible for local communities to sustainably grow.

Comprehensive evaluations and conservation strategies in the Coral Triangle ecosystem (BlueCARES)

Period: June 1, 2016 to March 31, 2022

Organizations: [In Japan] Tokyo Institute of Technology, Atmosphere and Ocean Research Institute of the University of Tokyo, Hokkaido University, Nagoya University, Hachinohe Institute of Technology, Forestry and Forest Products Research Institute of the Forest Research and Management Organization, Japan International Research Center for Agricultural Sciences, and others
 [Overseas] University of the Philippines Diliman (Philippines), Ministry of Marine Affairs and Fisheries (Indonesia), Bandung Institute of Technology (Indonesia), and others

The primary purpose of this research project is to formulate and declare, based on various surveys and the development and analysis of models, a Blue Carbon Strategy for the Philippines and Indonesia, which lie at the heart of the Coral Triangle, one of the most biodiverse places on earth. In implementing this strategy, focus will be directed towards blue carbon, which refers to carbon stored by coastal ecosystems, and support will be given to the reinforcement of blue carbon through the conservation of coastal ecosystems and increasing the ability of these ecosystems to recover, which should thereby help improve the global environment.



Marine biotechnology targeting marine environmental bacteria

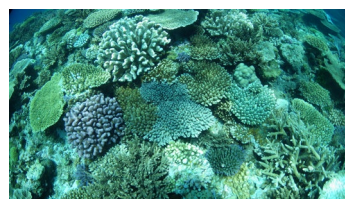


Research on the function of coral symbiotic bacteria for coral health using genomic analysis

Period: From 2012

Organizations: Department of Life Science and Medical Bioscience, Graduate School of Advanced Science and Engineering, Waseda University; Faculty of Science, University of the Ryukyus; Tropical Biosphere Research Center, University of the Ryukyus; Okinawa Institute of Science and Technology Graduate University

Coral holobionts are ecological units consisting of coral, obligate dinoflagellate endosymbionts, and symbiotic bacteria. There has been a great deal of research focusing on dinoflagellate endosymbionts in the context of coral bleaching, but the function of symbiotic bacteria is unknown. We focus on symbiotic bacteria in corals in Okinawa Prefecture and study the impact of bacteria on coral health using single-cell genomic analysis.



Coral reef in Okinawa

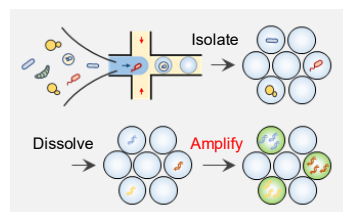


Single-cell genome sequencing of marine microbes in the Red Sea

Period: From 2017

Organizations: Department of Life Science and Medical Bioscience, Graduate School of Advanced Science and Engineering, Waseda University; King Abdullah University of Science and Technology (KAUST), AIST-Waseda University Computational Bio Big-Data Open Innovation Laboratory

We have developed a single-cell genome sequencing technology for environmental microbes with droplet microfluidics. As an example of the application of this technology, we have conducted extensive single-cell genomics of marine microbes in the Red Sea collected in 2017. We have demonstrated that comparative genomics at strain-level resolutions could be performed, and it could be applied to detect viral signals and biosynthetic gene clusters (BGCs) at the single-cell level.



Droplet microfluidics for single-cell genomics

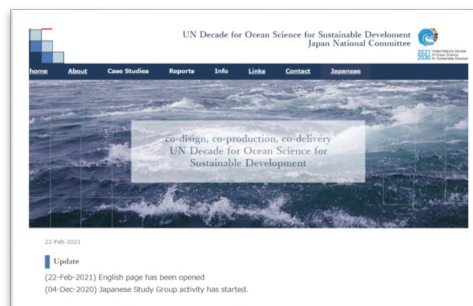
Reference: Biomolecular Engineering Laboratory (Takeyama Laboratory), Department of Life Science and Medical Bioscience, Graduate School of Advanced Science and Engineering, Waseda University <http://www.takeyama-lab.sci.waseda.ac.jp/>

Column

Study Group on the UN Decade of Ocean Science

Rather than an initiative meant to be carried out by ocean researchers alone, the UN Decade of Ocean Science is to be *co-designed, co-produced, and co-delivered* on a collaborative basis with a range of different concerned parties. In this connection, the Japan Society of Ocean Policy and the Sasakawa Peace Foundation's Ocean Policy Research Institute established the Study Group on the UN Decade of Ocean Science in August 2020 as a foundation for collaborations and partnerships.

In the wake of discussions by the Study Group, a Japanese National Committee on the UN Decade of Ocean Science for sustainable development was set up and a public symposium to kick off its activities was held in February 2021. As a maritime nation and a nation of science and technology, Japan will seek to demonstrate leadership in promoting the UN Decade of Ocean Science.



Website for the Study Group
(<https://oceanpolicy.jp/decade/>)

Promoting polar research



Period: From 1955

Organizations: National Institute of Polar Research (NIPR), Japan Agency for Marine-Earth Science and Technology (JAMSTEC), Hokkaido University, Ministry of the Environment, Ministry of Internal Affairs and Communications (National Institute of Information and Communications Technology), Ministry of Land, Infrastructure, Transport and Tourism (Geospatial Information Authority of Japan, Japan Meteorological Agency, Japan Coast Guard), Ministry of Defense, The University of Marine Science and Technology and others



There is a substantial need in society to understand the system of climate changes globally and predict future weather patterns with high accuracy. In recent years, it has become clear that the state of the atmosphere and ocean in both polar regions has a substantial impact on the weather of places like Japan that lie in the middle latitudes. In this age of human activities spanning the entire globe, observations of the polar regions, geographically isolated, are essential, and this importance is expected to become more significant.

For this reason, Antarctic research has been continuously implementing long-term research and observational activities by taking advantage of unique characteristics of the Antarctic, where the impact of human actions is exceedingly low. In the oceanographical study, joint observations conducted with the Shirase, an Antarctic observation vessel, and Umitaka-maru, an ocean survey vessel, have allowed us to continuously survey the ocean environment, such as concerning ocean acidification which is an especially prevalent issue in the polar regions.

In the Arctic region, a place where the impact of global warming is very apparent, such as in terms of the rapid decline of sea ice, has become most pronounced in recent years, researches on upgrading and refining meteorological and climatic predictions and strategically working on cultivating human resources and disseminating information are carried on through the Arctic Challenge for Sustainability II (ArCS II).

Moreover, an Arctic research vessel with ice-breaking capabilities that will allow it to be used to observe sea ice areas in the Arctic Ocean is to be built and operated as an international research platform for the Arctic region. Research in the polar regions will thereby be pursued through such initiatives.



Image of a completed Arctic research vessel



Polar research acceleration project

Source: *What is ArCS II?* (National Institute of Polar Research, <https://www.nipr.ac.jp/arcs2/about/>)

International Partnership for the Satoyama Initiative (IPSI)

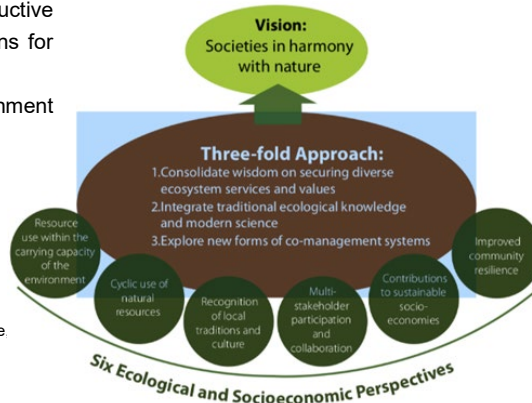


Period: From 2010

Organization: United Nations University Institute for the Advanced Study of Sustainability (UNU-IAS)

The IPSI is an international partnership established on the occasion of the 10th meeting of the Conference of the Parties to the Convention on Biological Diversity (CBD) to help realize a society in harmony with nature through the conservation and management of biodiversity cultivated within the framework of interrelationships between human and nature. It seeks to promote the accumulation and sharing of knowledge concerning the conservation and sustainable use of socio-ecologically productive landscapes and seascapes and issue policy recommendations for communities not just on land but also in coastal areas.

The IPSI Secretariat is hosted by the UNU-IAS. The government of Japan funds for operating this partnership.



Concept of the Satoyama Initiative

Source: *Satoyama Initiative* (International Partnership for the Satoyama Initiative) <https://satoyama-initiative.org/ja/concept/satoyama-initiative/>

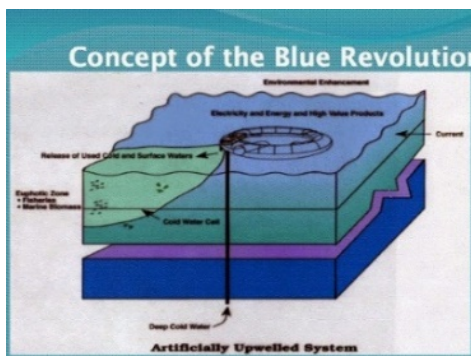
Research on a vision for national territory in the 21st century from the perspective of the ocean



Period: From 2016

Organization: Society of Ocean Romantics (ORS), Institute of Ocean Energy Saga University (IOES), Deep Ocean Water Applications Society (DOWAS), Ocean Thermal Energy Conversion Association Institute (GOSEA)

In accordance with the idea that the 21st century corresponds to the era of development of a new maritime civilization, the organizations involved will support ocean-related research and educators and preside over ocean resource and energy research groups in order to deepen knowledge on the majesty and diversity of the oceans, which belong to all of mankind, and introduce the results of their research to a broad range of people. As part of the relevant activities, the organizations involved are intensively studying the effects on sea areas around Japan of a measure to weaken hurricanes and enhancing ocean productivity due to the lowering of ocean surface temperatures caused by bringing up large volumes of cold and nutrient rich ocean water from deep below the surface, as covered in a report issued by GESAMP (Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection).



Conceptual diagram outlining the Blue Revolution, which is based on the use of seawater resources as proposed by Professor Emeritus P. Takahashi of the University of Hawaii

Reference: Society of Ocean Romantics website (<http://ur21.net/ur21/k-bunkakai.html>)
GOSEA website (<http://www.gosea.info/jp/>)

Research for effective management of ships' biofouling to minimize the transfer of invasive aquatic species



Period: From 2013

Organization: Japan Ship Technology Research Association

The Ballast Water Management Convention entered into force globally on 8 September 2017. The Convention aims to prevent the spread of potentially harmful aquatic organisms and pathogens in ballast water carried by ships. Ballast water is sea water used to stabilize vessels when unloading cargoes, and its risk of transfer of organisms from one ecosystem to another had been an international concern. In accordance with the Convention, the vessels carrying ballast water during international voyages are required to install the treatment system to kill organisms contained in the ballast water.

Besides, the risk of transfer of invasive aquatic species by biofouling on ships (accumulation of aquatic organisms such as micro-organisms, plants and animals on ship's surfaces) has also been an international concern. To minimize the risk, the International Maritime Organization (IMO) developed the guidelines on the control and management of ships' biofouling in 2011, which have been under review since 2013. To improve the guidelines to be more practical and effective, Japan Ship Technology Research Association has contributed to the review of the guidelines by gathering information from stakeholders in Japan on the best practices and challenges for biofouling management and providing feedback to the IMO.



Biofouling on ship's surface before cleaning

Biofouling before cleaning

Ship's surface after cleaning

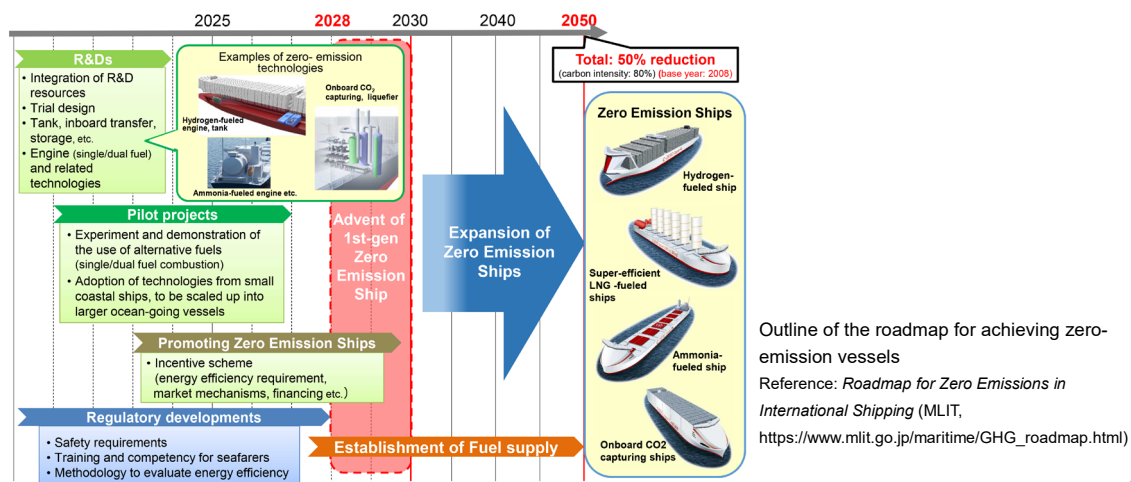
After cleaning

Reference: *Strategic Response to the IMO* (Japan Ship Technology Research Association, <https://www.jstra.jp/a2b01/a3b02/>)

Column

International shipping GHG zero emissions project

The Ministry of Land, Infrastructure, Transport and Tourism (MLIT), in collaboration with the shipping, shipbuilding, and marine industries as well as research institutes and public bodies, developed the "Roadmap to Zero Emission from International Shipping" in March 2020. The identified actions to be taken immediately is to develop necessary international rules and promote the development and pilot projects on the zero-emission technologies. It further aims to achieve commercial operations of the first-generation zero-emission ship by 2028.



Certification program and eco-labeling for sustainable fisheries



Period: From 1997

Organization: Marine Stewardship Council (MSC)

The MSC ecolabel is used only for seafood caught by fisheries that meet the MSC Fisheries Standard, a benchmark for sustainable fishing based on the UN FAO Code of Conduct for Responsible Fisheries. The MSC Fisheries Standard is used when assessing whether fishing activities are being carried out in a sustainable manner based on appropriate management practices, taking impact on marine resources and the environment into account. If a fishery is certified as having satisfied the MSC Fisheries Standard, seafood coming from the certified fisheries will be entitled to affix the MSC ecolabel. To ensure only certified seafood carries the label, every business in the supply chain must be certified against the MSC Chain of Custody Standard. This standard is applicable to all fisheries that catch fishes living in natural seawater and freshwater bodies. The scope of eligible species includes fish, shellfish, and crustaceans (but not mammals, birds, amphibians, or reptiles). A fishery is assessed by a third-party independent assessment body that has been independently accredited by Assurance Services International (ASI).



MSC ecolabel

Reference: MSC website (<https://www.msc.org/jp>)

Marine Eco-Label Japan (MEL)



Period: From 2007

Organizations: Marine Eco-Label Japan Council, Japan Fisheries Resource Conservation Association (JFRCA), Marine Ecology Research Institute (MERI)

MEL was established by the Japan Fisheries Association in 2007 in line with a set of guidelines applicable to the production stage (fisheries) and seafood processing and distribution stages for the sustainable use of seafood, as adopted by the U.N. Food and Agriculture Organization (FAO) in 2005. This organization was taken over by the Marine Eco-Label Japan Council in 2016, as the scheme owner tasked with promoting international standardization while adding aquaculture standard and taking the characteristics of Japan's fishery diversity into account. The certification standards were revised and approved by the Global Sustainable Seafood Initiative (GSSI) in December 2019. As the certification body for this scheme, the JFRCA grants certifications by accepting applications to conduct assessments for applicants and having assessment conducted by certified auditors in accordance with MEL's scheme. The JFRCA has been accredited as MEL's certification body by the Japan Accreditation Board (JAB). Since the JAB, a member of the International Accreditation Forum (IAF), accredits product certification bodies and inspection agencies in accordance with ISO standards, MEL can be described as an internationally recognized eco-label for seafood.

As a second certification body for this scheme, the MERI is presently working to be granted JAB accreditation.



Logo mark of Marine Eco-Label Japan



Examples of utilization for real products

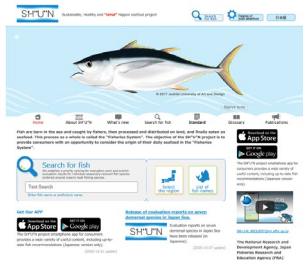
Reference: Marine Eco-Label Japan Council website (<https://melj.jp>)

SH "U" N project

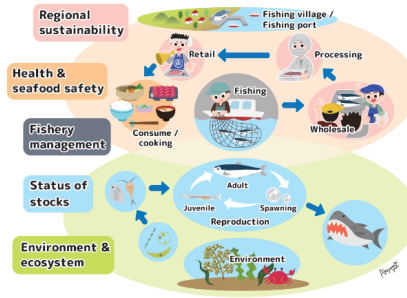


Period: From 2016
 Organization: Japan Fisheries Research and Education Agency

The Japan Fisheries Research and Education Agency launched the SH "U" N (Sustainable, Healthy, and *Umai* (delicious) Nippon Seafood) project in 2016 to convey easy-to-understand scientific information for the purpose of helping consumers strive to maintain the sustainability of resources through their own decisions. Seafood cannot be sustainably used if we fail to address any one of the following issues: the volume and changes in the volume of fish in the sea, marine ecosystems, fishing activities in the sea, local industries and society surrounding the fishing industry, and the health, safety, and security of seafood in terms of food. Initiatives designed to get people to reexamine the links between the food we eat and the sea and to think about how we can continue eating seafood into the future will be implemented through the SH "U" N project.



SH "U" N project website
 (<http://sh-u-n.fra.gov.jp/>)



Conceptual diagram of the seafood system in the SH "U" N project

Blue Seafood Guide



Period: From 2013
 Organization: Sailors for the Sea Japan

It is well known that even fish stocks that have been severely depleted can be restored through appropriately managed fishing. The Blue Seafood Guide evaluates seafood resources in Japan by using a proprietary approach in combination with the foundation of international standards for measuring the sustainability of fisheries and then endorses earth-friendly sustainable seafood.

The website does not just list Blue Seafood but also introduces suggested recipes for such seafood items as well as restaurants that serve dishes made using such seafood items. By prioritizing the consumption of sustainable seafood that comes from abundant catches, you can help restore depleted marine resources while supporting the fishing industry in Japan.

おいしい、たのしく、地球にやさしく。 2020 Blue Seafood

Blue Seafood Choices フルサーフワイド推奨品
 2020年のブルーシーフードガイドは日本の水産資源に対して、良質な持続可能な漁獲資源を有する国産の水産物を主に紹介しています。また、海外の水産資源についても、持続可能な漁獲資源を有する国産の水産物と同等の品質を有するものとして紹介しています。日本の漁獲資源については、フルサーフワイドと連携して紹介しています。また、2020年から漁獲量の豊富な水産物も追加して紹介し続けています。詳しくはこちらをご覧ください。 www.sailorsforthesea.jp/bluefood/

シーフードウォッチ Seafood Watch Best Choice
 アメリカ、ヨーロッパなどによる、水産物の持続可能性を促進する機関であるシーフードウォッチが、科学的なデータに基づいて、水産物の持続可能性を評価し、フルサーフワイドと連携して紹介しています。詳しくはこちらをご覧ください。 www.seafoodwatch.org/

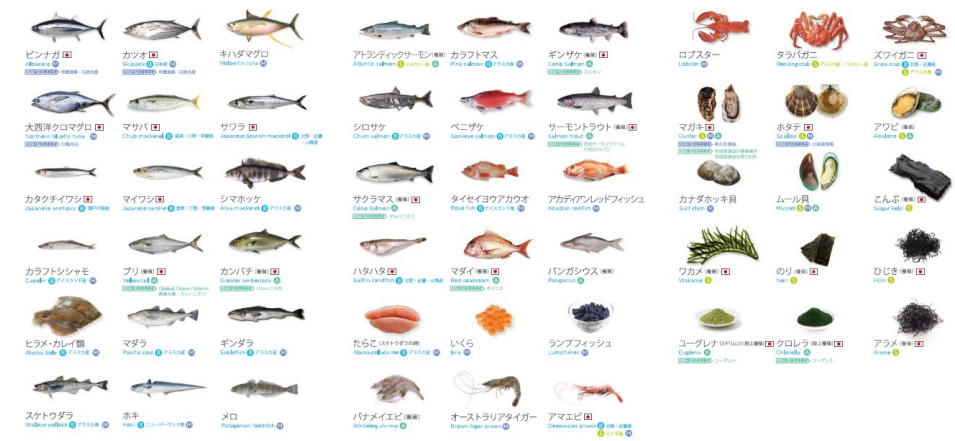
MSC Marine Stewardship Council 持続可能な水産物
 MSCは、持続可能な水産物の持続可能性を評価し、フルサーフワイドと連携して紹介しています。詳しくはこちらをご覧ください。 www.msc.com/

ASC Aquaculture Stewardship Council 持続可能な水産物
 ASCは、持続可能な水産物の持続可能性を評価し、フルサーフワイドと連携して紹介しています。詳しくはこちらをご覧ください。 www.asc-aqua.com/

日本の漁獲資源
 日本の漁獲資源は、フルサーフワイドと連携して紹介しています。詳しくはこちらをご覧ください。 www.sailorsforthesea.jp/

GLOBAL SEAFOOD ALLIANCE
 持続可能な水産物の持続可能性を促進する国際的な組織です。詳しくはこちらをご覧ください。 www.gsa-alliance.org/

ブルーシーフードウォッチ
 シーフードウォッチは、アメリカのSeafood Watchの組織に、ロンドンオリンピックでも採用されたオーストラリアのMarine Conservation SocietyやフランスのGood Fishなど、持続可能な水産物の持続可能性を評価する国際的な組織と連携して紹介しています。詳しくはこちらをご覧ください。 www.seafoodwatch.org/



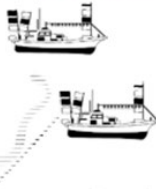
Blue Seafood Guide 2020 Autumn (Sailors for the Sea Japan, <https://sailorsforthesea.jp/common/data/bluseafoodguide.pdf>)

Promoting initiatives to eradicate IUU fishing



Period: From 2020
 Organization: Fisheries Agency

Fishing grounds have deteriorated due to the overexploitation by illegal, unreported, and unregulated (IUU) fishing, such that measures to combat IUU fishing have become a matter of global importance. The Fisheries Agency supports initiatives to build fishery management systems in line with actual local conditions in developing countries and teach techniques with a view to eradicating IUU fishing in order to promote the sustainable use of marine resources and conserve the ocean environment.



Collecting real-time information on red-tide outbreaks, IUU fishing, and other concerns



Training human resources, building databases, and producing manuals

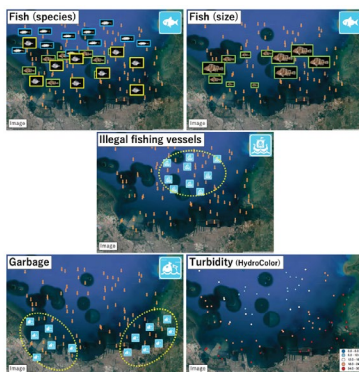
Source: Materials provided by the Fisheries Agency

Indonesian coastal fishing village project based on ODA provided by the government of Japan

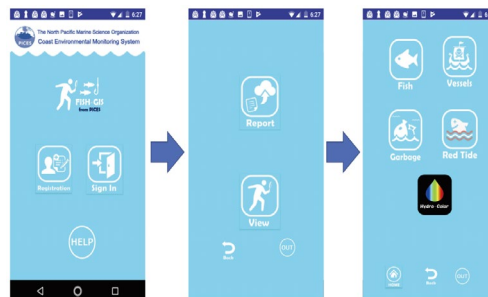


Period: From 2017
 Organizations: North Pacific Marine Science Organization (PICES), Agency for the Assessment and Application of Technology (BPPT; Indonesia), University of Tokyo, Japan Fisheries Research and Education Agency, Hokkaido University, University of Maine, and others

An environmental and resource monitoring study based on the use of smartphones has been jointly designed and implemented together with small-scale coastal fisheries operators in Indonesia. People involved in local fishing industries use their smartphones to take photos of five subjects: water quality, harmful plankton, fish catches, illegal fishing operations, and plastic waste in the ocean. They then forward these geotagged photographs to the BPPT and other governmental research institutions through a GIS app that was developed for this project. Analytical results are then shared as feedback with local areas. In the second phase of this project, which began in 2020 (and is known as the Ciguatera Project), monitoring functions related to food safety, information for dealing with tsunamis, and other aspects of a safe ocean are also slated to become incorporated



Maps shown by the FishGIS app



User interface for the FishGIS app

Reference: Building capacity for coastal monitoring by local small-scale fishery operators (PICES, <https://meetings.pices.int/projects/FishGIS>)

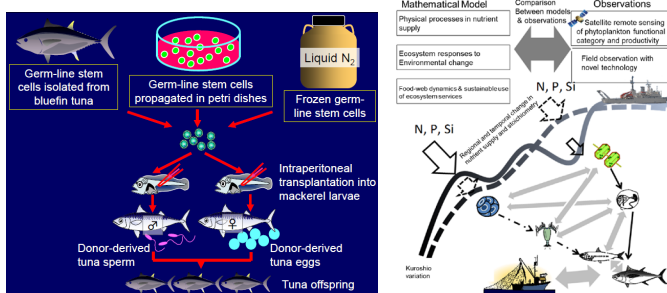
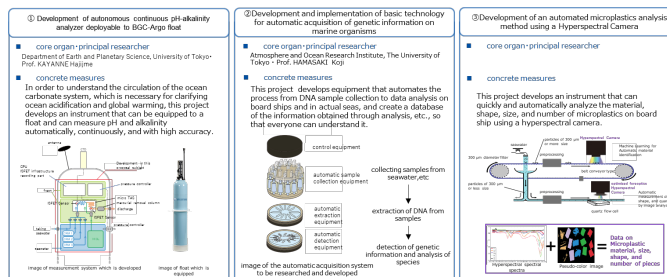
Technology development program to promote the use of marine resources



Period: From 2011

Organization: Ministry of Education, Culture, Sports, Science and Technology

Technology for domestically produced sensors and other tools are being developed in order to promote the proactive development and use of marine resources. This is also a research and development program carried out to improve productivity through the development of technologies to clarify the physiology of marine organisms and thereby bring about innovative approaches to production that have never been seen before, it is also comprehensively elucidate not just ecosystems for specific species of fish but also ecosystems within the broader context of the ocean environment as a whole in order to make accurate predictions of resource volumes in terms.



Source: Materials provided by the Ministry of Education, Culture, Sports, Science and Technology



IoT and AI proof-of-concept testing for tuna aquaculture farming operations



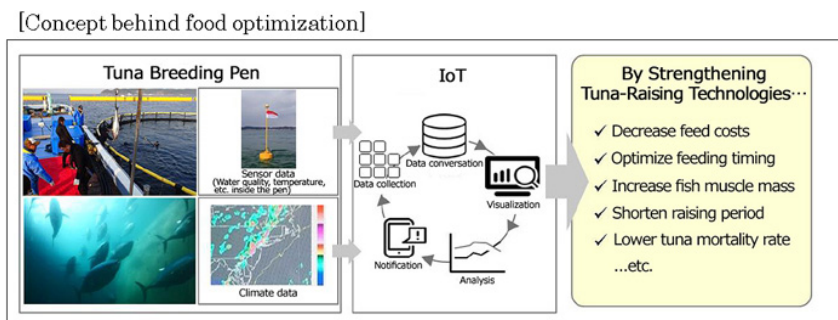
Period: From 2018

Organizations: Sojitz Corporation, Sojitz Tuna Farm Takashima Corporation, NTT DOCOMO Inc., Information Services International-Dentsu, Ltd.

The organizations involved in this proof-of-concept testing aim to improve the efficiency of aquaculture farming by using IoT and AI to visualize and quantify tuna aquaculture techniques.

Sensors and applications equipped with IoT technology will be harnessed to visualize water temperature and other data and artificial intelligence will then be utilized to analyze correlations and relationships between data. In addition, image-analyzing technology will enable automatic fish counting, improving the efficiency and accuracy of work to ascertain population sizes.

These initiatives are expected to provide improvements to tuna aquaculture by optimizing proper feed amounts, feed timing, and other tuna farming techniques, enhancing the fish pen environment, determining appropriate volumes and times for shipping each batch of tuna, increasing the accuracy of sales projections, and optimizing costs.



Source: News Release of the Sojitz Corporation
(<https://www.sojitz.com/en/news/2017/08/20170808.php>)

Aquaculture farming efficiency improvement project to help restore mackerel populations

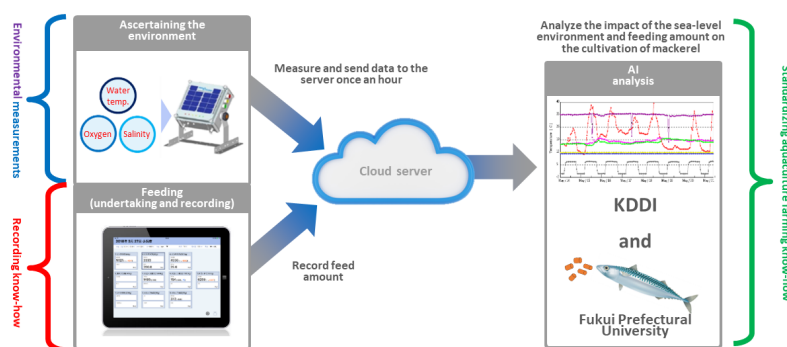


Period: From 2016

Organizations: Obama City, Fukui Prefectural University, Tagarasu Suisan Co., Ltd., KDDI Corporation

Obama City began a mackerel restoration project in 2016 for the purpose of stimulating industry and attracting visitors through the development of a new mackerel-based food culture. It has been engaged in this project with a view to improving the efficiency of aquaculture farming through the use of ICT and the IoT in collaboration with Fukui Prefectural University, Tagarasu Suisan Co., Ltd., and KDDI Corporation.

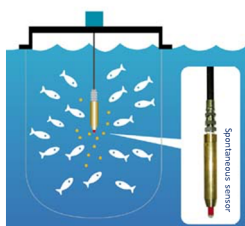
The aim of this project is to realize efficient aquaculture farming based on the use of real-time data by way of the visualization of fishing through the use of the IoT. By installing IoT sensors in aquaculture ponds in order to enable measurements to be taken of water temperature, oxygen concentration, and salinity, and then sending data via mobile lines, you can ascertain the state of a site without having to use your vessel. In addition, the know-how of fishermen, which has been shaped by experience and intuition, will be converted into data by introducing a mackerel aquaculture farming management app to allow users to input and manage the location, amount, and timing of feeding actions from their tablets. Participants will also work with Fukui Prefectural University to manage the amount that mackerels are fed using a spontaneous feeding system and estimate fish size using underwater cameras. In the future, the project aims to analyze the correlation between accumulated external environmental data and data on the know-how possessed by fishermen, improve the efficiency of aquaculture farming, and help solve problems in terms of cultivating successors to take over aquaculture farming operations.



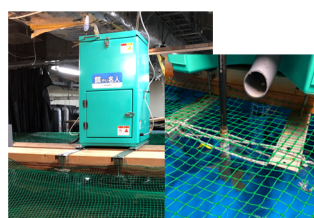
Feeding system

(spontaneous feeding and feed amount management)

Spontaneous feeding mechanism (illustration) Exterior of the system
(in the Research Center for Marine Bioresources, the Fukui Prefectural University)



↑ Picture courtesy of Fukushima Electric Co., Ltd.



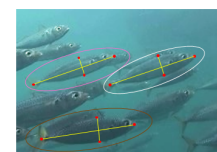
Fish as much as you want to eat at any time Pilot study is being conducted in a water tank

Feeding times, amounts, and actions can be monitored

Estimating fish size using an underwater camera



Lowering the camera (Furuno Electric)



↑ Picture courtesy of Furuno Electric

- Measuring the length and height of mackerel in the fish preserve
- Estimating fish weight based on fish body size measurements

Improved aquaculture farming efficiency can be expected by introducing this approach to an aquaculture farm (less labor, reduced stress on fish, and improved data accuracy)

Initiatives for the aquaculture farming efficiency improvement project

Source: Introducing case studies: Restoring mackerel in Obama City, Fukui Prefecture – the current state of an aquaculture farming efficiency improvement project (KDDI Corporation, <https://www.kddi.com/corporate/csr/regional-initiative/case-study/case23/>)

(New release by KDDI Corporation, <http://news.kddi.com/kddi/corporate/newsrelease/2017/11/20/2801.html>)

Argo Program



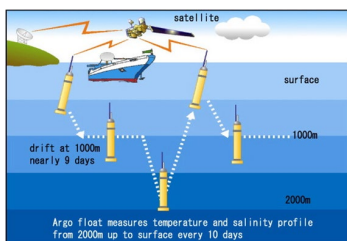
Period: From 1999

Organizations: Intergovernmental Oceanographic Commission of UNESCO, World Meteorological Organization (WMO), Japan Agency for Marine-Earth Science and Technology (JAMSTEC), Japan Meteorological Agency (JMA), US National Oceanic and Atmospheric Administration (NOAA), and others

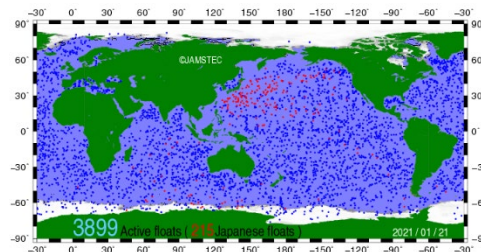


Argo is an international program to build a system for constantly monitoring and understanding the state of the entire world's oceans using observational robots (Argo floats). A global ocean observing network comprising these Argo floats has been developed with the cooperation of over 30 countries and organizations to enable temperature and salinity profile data from the surface to a depth of 2,000 meters to be quality controlled in near real time and provided to the world without any restrictions.

Data collected through the Argo Program are used by the meteorological and oceanographic agencies in various countries for weather forecasting, seasonal forecasting, and the monitoring and forecasting of oceanographic conditions as well as by scientists around the world for research. Presently, work is being carried out to expand the scope of the program, including extending the observation range to the seafloor and measuring biogeochemical variables.



Conceptual diagram of the operating cycle of an Argo float



Distribution of floats around the world and around Japan

Source: Japan Argo (JAMSTEC, http://www.jamstec.go.jp/J-ARGO/index_j.html)

Problem solving by taking integrated approach towards understanding the current status of global environmental change and predicting the future



Period: From 2020

Organization: Japan Agency for Marine-Earth Science and Technology (JAMSTEC)



JAMSTEC contributes to achieving SDGs by providing scientific knowledge through research and development by understanding the current status of global environmental change and making future predictions. JAMSTEC also promotes activities related to Maritime Domain Awareness (MDA) and contributes toward safety and security of the ocean.

[Main areas of research and development]

- Development of automated and efficient observation technologies to enable more accurate and efficient understanding of current marine environment.
- Development of hyperspectral measurement technologies to enable observations of marine microplastics, aerosols, chlorophyll and other inorganic and organic particles.
- Development of new sensors to widen the scope of possible observations.
- Capacity building by working together with industrial sectors to enable sustainable service of [i] understanding the needs of stakeholders, [ii] gathering necessary information and data, [iii] making predictions based on gathered information and data and [iv] providing them as useful information that meets the needs of stakeholders.



(Courtesy of JAMSTEC)

Oceanographic research vessel Mirai

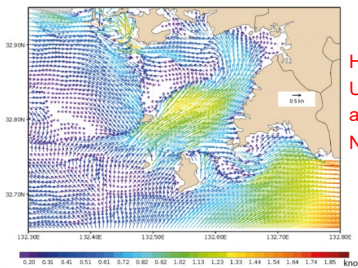
Research and development for the Sustainability Initiative in the Marginal Seas of South and East Asia (SIMSEA)



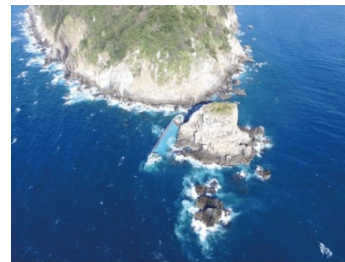
Period: From 2014

Organizations: Japan Agency for Marine-Earth Science and Technology (JAMSTEC), Sasakawa Peace Foundation

To promote the Sustainability Initiative in the Marginal Seas of South and East Asia (SIMSEA), which is a transdisciplinary as well as interdisciplinary research program launched in 2014 by the Regional Committee for Asia and the Pacific (RCAP) of the International Council for Science (ICSU), we have developed a system to forecast ocean conditions and conducted a research on changes in fish catches jointly with local stakeholders in Sukumo Bay, Kochi Prefecture. Forecast information on the sea conditions on the following day is now provided on an hourly basis through the JAMSTEC's official website, and is used not only to increase sustainable efficiency of fisheries but also to deal with possible oil leaks from a stranded ship in an unlikely event. This activity is strongly supported by local stakeholders.



Hourly
Up to 1 day
ahead
Now available



(Courtesy of Masanori Tateda in Sukumo City)
Survey of stranded cargo ships

System to forecast ocean conditions in Sukumo Bay (200 m resolution)

Source: Report on community development based on the use of the sea in Sukumo Bay 2, 3 (JAMSTEC Application Laboratory, <http://www.jamstec.go.jp/aplinfo/kowatch/?p=2306>, <http://www.jamstec.go.jp/aplinfo/kowatch/?p=4548>)

Ocean Prediction for Coastal Fisheries around Kyushu Island

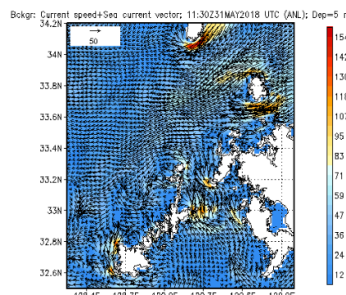


Period: From 2017

Organizations: Research Institute for Applied Mechanics, Kyushu University; Nagasaki University; Fukuoka Prefecture; Saga Prefecture; Nagasaki Prefecture; JFE Advantech Co., Ltd.; IDEA Consultants, Inc.; Japan Fisheries Information Service Center; Furuno Electric Co., Ltd.

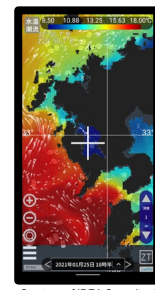
Japan's small-vessel coastal fishing industry is faced with a number of issues, including declining fishery resources, soaring costs of fuel, and shortages of successors. In order to turn around the sluggish conditions, members of industry, the government, academia, and the private sector formed a consortium to work on using ICT to render the coastal fishing industry smarter through a project commissioned by the Fisheries Agency to develop ICT-based fisheries technologies.

The in-situ measurement has been very sparse in the coastal areas, and thus the assimilation of new observation data obtained by fishery operators has allowed for the development of a model for rendering forecasts of ocean conditions in high-resolution images. Fishery operators can receive the results of forecasts of ocean conditions using an app installed on their smart phones, which is helpful for deciding the time and location of fishing. The visualization of fishing conditions also helps to make the fishing industry more efficient in terms of reducing the amount of fuel and labor costs.



Ocean current in the Tsushima Strait in northern Kyushu as predicted by a numerical model

Source: *DREAMS_D Forecasts of Ocean Conditions* (Research Institute for Applied Mechanics, Kyushu University, <https://dreams-d.riam.kyushu-u.ac.jp/vwp/>)



App for displaying forecasts (under development)
Water temperatures, salinity, and current can be displayed.

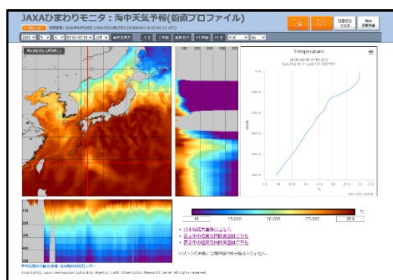
Undersea weather forecasting system for which satellite data have been assimilated



Period: From 2018

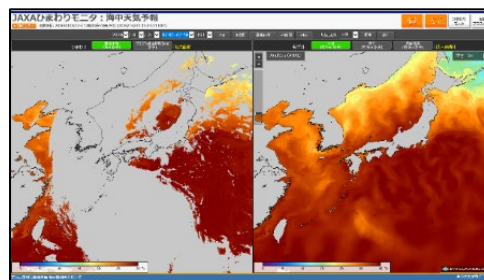
Organizations: Japan Aerospace Exploration Agency (JAXA), Japan Agency for Marine-Earth Science and Technology (JAMSTEC)

A system has been developed for issuing undersea weather forecasts around Japan through the integration of sea surface water temperature data obtained by multiple JAXA satellites with a high-temporal-and-spatial-resolution (intervals of approximately three kilometers and hourly) regional ocean model developed by JAMSTEC for the area around Japan. Ocean conditions are forecasted for approximately the next 10 days and routinely disclosed to the public via the website. The provision of data sets that are complete and that include the ocean interior will contribute to such fields as fisheries, transportation, and the monitoring of ocean conditions.



Undersea weather forecast website example

The left side shows observations made by the Himawari satellite while the right side shows ocean model outputs at the same time to enable comparisons and future predictions to be seen (07:00, September 6, 2020, Japan time in this case).



Undersea weather forecast website example

A vertical profile extending from the surface of the sea to a depth of 500 meters as well as latitudinal and longitudinal cross-sections can be displayed (07:00, September 6, 2020, Japan time in this case).

Source: JAXA Himawari Monitor: Undersea Weather Forecasting (JAXA Earth Observation Research Center, https://www.eorc.jaxa.jp/tree/ocean_model/index_j.html)

Kuroshio/Oyashio Watch, an initiative for forecasting ocean conditions along the coast of Japan



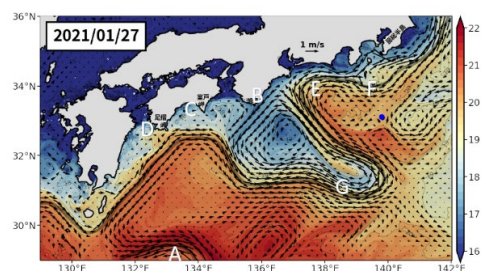
Period: From 2015

Organization: Application Laboratory, Japan Agency for Marine-Earth Science and Technology (JAMSTEC)

The JAMSTEC Application Laboratory has developed an ocean change forecasting system to deepen our understanding of changes in the Kuroshio and Oyashio Currents and predict ocean conditions in the coastal areas of Japan (Japan Coastal Ocean Predictability Experiment: JCOPE). Kuroshio/Oyashio Watch is a website that provides easily understandable explanations of forecast results for the Kuroshio and Oyashio Currents, based on JCOPE, as well as of various related issues. Short-term Kuroshio predictions of ocean currents and the distribution of seawater temperatures up to ten days in advance are updated once a week..



Kuroshio-Oyashio Watch, a website for explaining ocean predictions, <http://www.jamstec.go.jp/aplinfo/kowatch/>



Example of a short-term Kuroshio prediction (January 27, 2021) Arrows indicate the flow of water near the surface, colors correspond to the temperature of the surface (centigrade), and the bold black lines constitute contour lines where the daily mean sea surface water level is at 0.3 meters and are an indicator of the axial flow of the Kuroshio Current.