2020 CONTENTS

Japan and the World's Ocean Initiative

1 The Oceans and Climate Change

Global warming is greatly affecting the oceans. It affects the ocean ecosystem and coastal zones and people living in coastal zones. With rising seawater temperature, the increase of density stratification, acidification, oxygen deficiency, and change in net primary production (NPP)[1], the oceans are facing an unprecedented future.

In 2019, the Intergovernmental Panel on Climate Change (IPCC) cast a renewed light on these scientific findings, and issues of "oceans and climate change" have become the focus of attention. The Special Report on the Ocean and Cryosphere in a Changing Climate (SROCC) was published by the IPCC in September. The 25th Conference of Parties (COP25) of the United Nations Framework Convention on Climate Change (UNFCCC), also known as Blue COP, was held in December. This article summarizes the discussions that took place in 2019 concerning the oceans and climate change.

1 Net primary production is the rate at which all the photosynthetic autotrophs in an ecosystem produce net organic material from CO_2 in the atmosphere.

1 The IPCC Special Report on the Ocean and Cryosphere in a Changing Climate

1 Key Findings of SROCC

In September 2019, the IPCC published SROCC, which was its first report specifically on climate change and the ocean and cryosphere (polar regions and high mountain areas).

104 experts from 36 countries participated in the writing of the report and as many as 6,981 papers were referenced. More than 30,000 comments were received and the draft was revised multiple times based on the comments. At the 51st session of the IPCC panel convened in Monaco from September 20 to 24, 2019, discussions were held every day until late at night to work out important details. It took until noon of September 24th, the last day of the session, for participating countries to approve by consensus the Summary for Policymakers (SPM) of SROCC and accept the underlying report.

The message of SROCC is clear. Alarming events suggest a tipping point has already been reached for certain ocean ecosystems. The oceans and even the earth itself are in perilous condition, and the report cautions, "choices made now are critical for the future of our ocean." [2]

It is particularly worth noting that the projection of sea level rise has been revised upwards significantly. In the IPCC's Fifth Assessment Report (AR5) published in 2013, there was not enough scientific knowledge about the water input from ice sheets in Antarctica, and its contribution was underestimated[3]. In the latest projection, the contribution of the Antarctic ice sheet to sea level rise was revised upwards to improve the reliability of the assessment. As a result, it is projected

2 September 25, 2019, IPCC Press Release, https://www.ipcc.ch/site/assets/uploads/2019/09/srocc-P51-press-release.pdf

3 IPCC AR 5 WG1, Figure 13.13

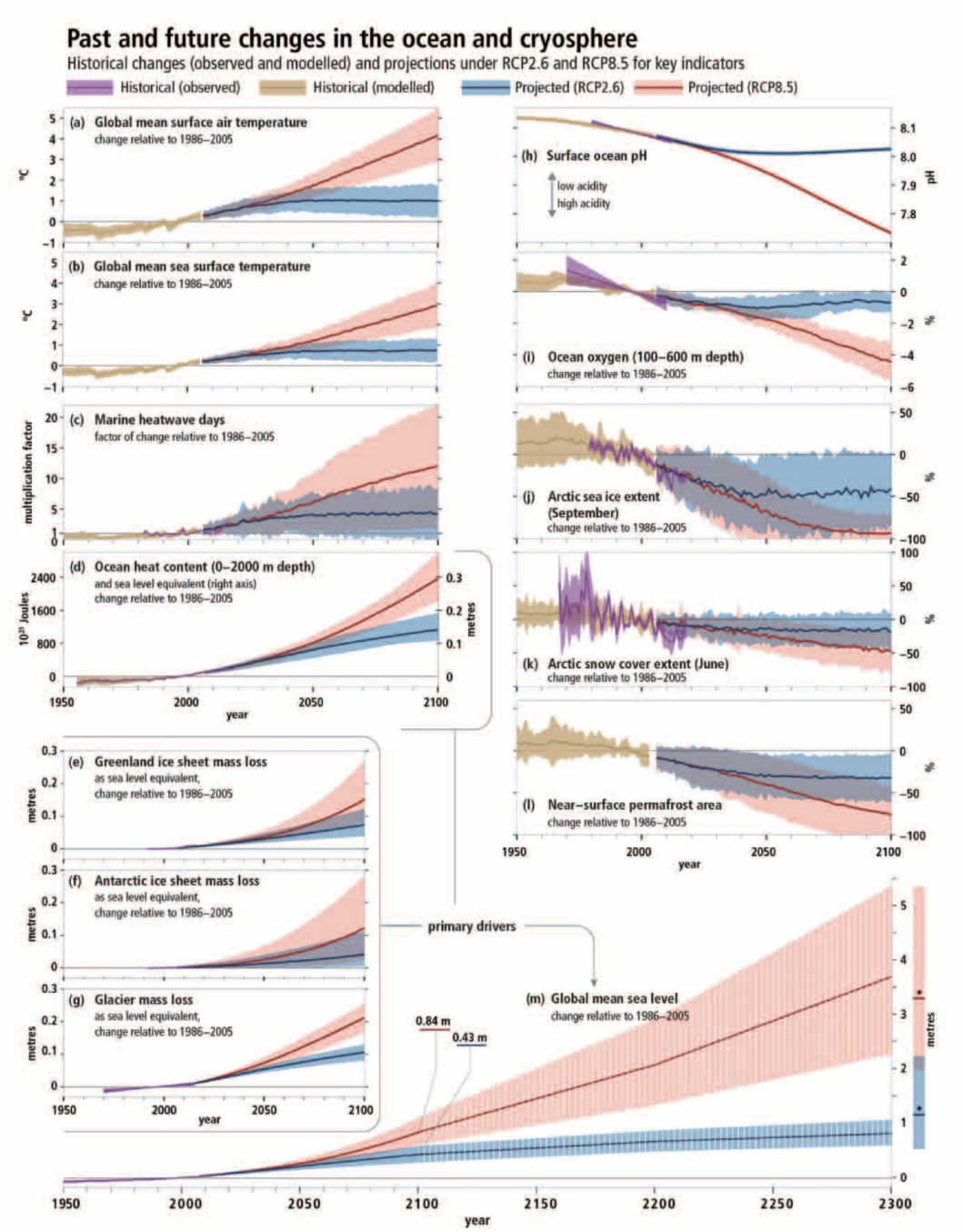


Figure 1-1 Past and Future Changes in the Ocean and CryosphereSource
(SROCC Figure SPM.1)

that sea level rise could reach up to 110cm in 2100, and the mean sea level rise for the period between 2081–2100 could be up to 92cm, 10cm higher than the assessment in AR5.[4]

In addition, the projection goes far beyond 2100. SROCC clearly shows that climate change is already irreversible, that the oceans will continue to change in the long-term, and that the degree of change will depend on the degree of success of policy measures which will be implemented from now on (See Figure 1-1). Comparing historical and projected future changes under a low greenhouse gas (GHG) emissions scenario (RCP2.6) and high GHG emissions scenario (RCP 8.5), the gap widens over time for every indicator. Under the high emission scenario, it is projected that sea levels will continue to rise beyond 2300. We are in-

4 IPCC SROCC Summary for Policymakers (SPM), B 3.1; AR5 WG1 SPM Table SPM.2

deed standing at a crossroads where “choices made now are critical for the future of our oceans.”

Compared to AR5, more accounts from the humanities are found in SROCC, including accounts of lives of indigenous populations of the Arctic region and coastal communities. SROCC introduced the term “climate literacy” to highlight the importance of developing and leveraging knowledge on climate change. The importance of promoting climate literacy, leveraging local knowledge from coastal communities and indigenous communities in the Arctic and combining them with scientific knowledge was emphasized.

2 Policy Recommendations Based on the Findings of SROCC

Three weeks after the official release of the SROCC, the Ocean Policy Research Institute of the Sasakawa Peace Foundation (OPRI-SPF) held the “Symposium on the Special Report on the Ocean and Cryosphere in a Changing Climate” on October 15, 2019, and issued a policy recommendation based on the findings of the report to promptly disseminate the scientific findings of SROCC and their significance to the public.

The OPRI-SPF proposal was composed of emergency recommendations on the following 10 topics:

1. Ocean-based mitigation
2. Blue Carbon
3. Disaster prevention and adaptation measures
4. Comprehensive measures to combat climate change as well as land-based pollution
5. Fisheries management
6. Marine Protected Areas
7. Scientific research
8. Innovation
9. Education and climate literacy
10. Business sector


IPCC 海洋・雪氷圏特別報告書を受けた 10 の提言

Figure 1-2 10 recommendations based on IPCC SROCC

This is a message from OPRI-SPF to the various stakeholders, beginning with the Japanese government, involved with oceans and fisheries and climate change countermeasures. For details, please refer to “OPRI’s Policy Recommendations based on findings of IPCC SROCC.” [5]

5 https://www.spf.org/en/global-data/opri/news_191015_IPCC_Rec-en.pdf

2 The Oceans in the United Nations Framework Convention on Climate Change and the 25th Conference of Parties (COP25)

1 The Oceans in the United Nations Framework Convention on Climate Change

As SROCC shows, the oceans are inextricably linked to climate change. However, the language of the United Nations Framework Convention on Climate

Change (UNFCCC) makes very limited reference to the oceans. In UNFCCC, the oceans are mentioned only in the preamble and Article 4 section 1(d) on sinks and reservoirs of greenhouse gases. In the Paris Agreement, "the importance of ensuring the integrity of all ecosystems, including oceans, and the protection of biodiversity" is noted in the 13th paragraph of the preamble, while there is no mention of the oceans in the text itself.

However, some articles involve the oceans without directly referring to them. For example, Article 5 of the UNFCCC, "Research and Systematic Observation," requires the Parties to support and further develop research and systematic observation (Article 5(a)) and to support international efforts to promote access to and exchange data obtained from areas beyond national jurisdiction (Article 5(b)). The Global Climate Observing System (GCOS), established in 1992 to support the UNFCCC, has been promoting cooperation for observation of climate systems, including the oceans. Under many articles about adaptation and support for small island nations, ocean related issues are discussed to varying degrees.

In recent years, global dialogue has been actively promoted on the topic of the oceans and climate change. A large variety of issues are attracting attention, including the important roles the oceans play in the climate system, mitigation measures related to the oceans such as emission reduction, adaptation of coastal regions (especially on an ecosystem basis), relocation of people due to the rising sea level, and support for small island nations and capacity building. While some are discussed as existing agendas under the framework of UNFCCC, others do not have formal forums for discussion in the present state of affairs. However, several informal ocean related groups under the UNFCCC have been driving discussion on the issue of oceans and climate change. The "Because the Ocean Initiative" (informally launched at COP21) and "The Ocean Pathway" (launched at COP23 in 2017 under the leadership of Fiji, the host country) are signatory nation-driven initiatives. Based on the COP21 decision[6], the Marrakech Partnership for Global Climate Action was launched at COP22. It is a mechanism to facilitate participation of non-state stakeholders. "The Roadmap to Oceans and Climate Action (ROCA)" has taken up one of the eight themes of the Marrakesh Partnership, oceans and coastal zones. OPRI-SPF participates in ROCA.

Greenhouse gas emissions from international shipping is also one of the issues relevant to the oceans and climate change. As it has heretofore been discussed exclusively at the International Maritime Organization (IMO), it is often overlooked in discussions at the ocean forums of the UNFCCC. However, it is important to ensure cooperation between the UNFCCC and IMO. IMO's efforts to address GHG emissions should be taken up at the Global Stocktake in 2023, which is conducted every five year to access progress toward the Paris Agreement's goal, according to Article 14.3 of the Agreement.

2 Conference of the Parties 25 (Blue COP)

Two months after the IPCC published SROCC, COP25 was held in Madrid, Spain from December 2nd to the 15th 2019. The session was extended for two days

6 UNFCCC Decision 1/CP.21, paras 133-134

Figure 1-3 COP25 Venue and a scene from the plenary session

past the scheduled end. The government of Chile, the presidency holder, conceived the summit as "the Blue COP," to focus on the oceans and cryosphere, with more than 100 ocean-related events at the summit. The government of Chile announced the launching of the Platform for Science-Based Ocean Solutions (PSBOS) as a "blue accomplishment." In government-level talks, countries such as Fiji, Costa Rica, and Indonesia urged highlighting the issues of the oceans and climate change. While details of the negotiations are not publicly available, for the first time "the importance of the ocean, including as an integral part of the Earth's climate system" was mentioned in COP Decisions[7]. It was decided that a dialogue on the ocean and climate change should be convened at the 52nd session of the Subsidiary Body for Scientific and Technological Advice (SBSTA), to be held in October 2020. Parties and non-Party stakeholders were invited to submit input by March 31st 2020.

7 UNFCCC Decision 1/CP.25, para 30

OPRI-SPF hosted the two-day Oceans Action Day event at COP25. At this year's Oceans Action Day, the Marrakech Partnership for Global Climate Action Oceans and Coastal Zones Action Event was held on the afternoon of the 6th, and 5 events followed on the afternoon of the 7th : (1) Oceans and Climate Nexus, (2) Incorporating Ocean-related Options in Nationally Determined Contributions (NDCs), (3) Adaptation and Displacement Solutions, (4) Galvanizing Support for Oceans and Climate Action and (5) the Reception. Over the two days of events, 80 speakers and panelists took the stage representing international organizations, governments, research organizations, and NGOs involved in oceans and climate change, with more than 400 people in attendance. Discussions were held on a variety of issues, including adaptation and mitigation strategies from an ocean perspective, ocean science, funding, and displacement and immigration.

3 Enhancing Use of the UNFCCC Forum

SROCC finds that the ocean and cryosphere are already experiencing alarming changes, projects that the change will accelerate in the future, and raises an alarm over the critical condition of the entire earth. It is said that there will be a huge difference in the effects and risks that climate change could pose to humans and the ecosystem at 1.5℃ and 2.0℃ above pre-industrial levels of global warming. Countries around the world including Japan adopted the Paris Agreement and agreed on the decarbonization of society. Even when the measures

based on Nationally Determined Contributions (NDCs) are fully implemented, the global temperature could rise to 3℃ above pre-industrial levels by the end of the century, thus failing to achieve the goals of the Paris Agreement. An unwavering will to implement the measures to achieve the goals is essential.

As the link between the oceans and climate was mentioned for the first time in COP Decisions at COP25, the importance of the oceans in climate change issues is now being recognized more and more. On the other hand, Japan's dependence on coal fired power generation is under increasing international criticism and it was taken up for discussion on and off the floor at COP25. Japan, as an ocean state, should be committed to adaptation of coastal zone and fisheries management, as well as lead the world by leveraging the oceans to mitigate GHG effects. Specifically, taking advantage of its technological capability and experiences as an ocean state, Japan should initiate a global climate change strategy focusing on the oceans, and adapt as a country in appropriate ways to the changing ocean environment.

Local governments and businesses, as well as national governments, are important stakeholders. In recent years, COP of UNFCCC has served not only as a forum for inter-governmental negotiations but also provided opportunities for local governments, businesses, NGOs, and researchers to gather together for networking and for presentation and promotion of their efforts. Aiming to decarbonize society, more and more local public entities in Japan have declared initiatives toward net-zero CO_2 emission by 2050 (Zero-carbon city). As of January 2020, 33 local governments including Tokyo, Kyoto City, and Yokohama City have made this declaration.

There are also international networks and initiatives all over the world being driven by business sectors to address climate change and SDGs. Under the Science Based Targets Initiative, 321 companies' targets are validated and listed as of November 2019. 58 Japanese companies are listed with validated reduction targets. The Japanese shipping companies NYK Line and K Line set targets to reduce GHG emissions by 50% by 2050.

Japan is an ocean state with the world's 6th largest exclusive economic zone (EEZ) and a long coastline. People of Japan have lived close to the ocean and the country has developed enjoying its bounties. The lives of Japanese people could be deeply affected by current and future changes in the oceans. It is important that the whole country should commit to address issues related to the oceans and climate change, involving the national government, local public entities and business sectors. For that purpose, it is necessary to enhance understanding of the findings of IPCC and leverage UNFCCC. We have to understand clearly that choices made now are critical for the future of the Earth as well as Japan.

(Mai Fujii)

COLUMN 01 A New Horizon for Blue Finance

Blue Finance refers to any financial instrument or investment issued in exchange for conservation of the ocean environment through promotion of Blue Economy (the economic activity through sustainable use of the oceans). The concept is gradually attracting attention. In October 2018, the Republic of Seychelles issued the world's first sovereign "blue bond," a pioneering financial instrument for Blue Finance. It was a 10-year bond designed to support sustainable marine and fisheries projects, which raised US$ 15 million from international investors. Blue bonds are derived from green bonds, financial instruments intended to support marine environmental preservation projects which have recently come into the spotlight. While guidelines for green bonds are established and burgeoning across the world, blue bonds are not yet internationally defined, and only recently appeared as a relatively novel concept. The blue bond that the Seychelles issued was primarily supported by the World Bank and the Global Environmental Facility (GEF).

Emergence of Blue Finance

In March 2018, the European Investment Bank (EIB), in cooperation with the European Commission and the World Wildlife Fund (WWF), published the Sustainable Blue Economy Finance Principles. These principles set out investment guidelines to promote Blue economy and are endorsed by the World Bank and the United Nations Principles for Sustainable Insurance (PSI), as well as a growing number of financial institutions and NGOs.

Following Europe's Blue Finance wave, Multilateral Development Banks (MDBs) are investing in ocean related projects. In September 2018, the World Bank announced establishment of PROBLUE, a new multi-donor trust fund, aiming to support fisheries and aquaculture, efforts to address marine pollution, and other activities to achieve Sustainable Development Goal (SDG) #14, "Conserve and sustainably use the oceans, seas and marine resources for sustainable development." Donors include the United States, European Commission, and other countries. In 2019, the Asian Development Bank (ADB) also launched the Oceans Financing Initiative, which aims to expand investment to US$ 5 billion over the next five years to promote marine plastic pollution control, preservation of ocean resources, ocean ecosystems and other issues in Asia and the Pacific. Furthermore, the Nordic Investment Bank (NIB) and The Nature Conservancy (TNC), announced their intent to fund ocean conservancy efforts through issuing blue bonds.

While more and more public aid organizations have started to invest in sustainable development and conservation of the oceans, mobilizing private investments in this area remains a challenge. Private funding schemes specifically targeting the oceans are needed. At its meeting held in December 2019, the Asia Pacific Economic Cooperation (APEC) advocated creating an initiative platform for public-private partnerships (PPP) for environmental preservation of the oceans and sustainable development of ocean energy. In addition, the Blue Finance Project supported by the United Nations Environmental Programme (UNEP) has started efforts to establish PPP for management and sustainable financing of Marine Protected Areas in the Caribbean, South East Asia, and elsewhere. International frameworks for public funding with private financing participation are being put in place. To encourage and facilitate the participation of the private sector in Blue Finance, establishment of legal and regulatory incentive mechanisms are necessary.

Looking Forward

As illustrated by the case of the Seychelles, to finance ocean conservation efforts, especially in developing nations, partnerships among countries, international organizations, and financial institutions are essential. The Ocean Policy Research Institute (OPRI) of the Sasakawa Peace Foundation launched a project to design a blue finance framework through support of evidence-based research. OPRI intends to be a guide for Blue Finance by providing analytical assistance regarding ocean risks as well as sustainability evaluations.

(Nagisa Yoshioka and Michael C. Huang)

Proposed Blue Financing Mechanism

2 The Nippon Foundation-GEBCO Seabed 2030

The Nippon Foundation–GEBCO Seabed 2030 (Seabed 2030) is a collaborative project between The Nippon Foundation and the Guiding Committee for the General Bathymetric Chart of the Oceans (GEBCO) to map the world's entire ocean floor. Initiated in 1903 by Prince Albert I of Monaco, GEBCO, an international project comprising experts in seafloor mapping, has been providing the most authoritative publicly available bathymetry of the world's oceans.

Although bathymetric information compiled and provided by GEBCO as well as other ocean floor maps appear to illustrate the world ocean floor in detail, only 6% of the bathymetric data is from actual measured value. The rest was supplemented with calculated values based on surface gravity value which is obtained by satellite altimetry. On the other hand, topographic maps of the Moon and Mars show details with 100% coverage. When a Malaysian airplane went missing in 2014, the search team initially prepared bathymetric survey equipment based on the water depth data of GEBCO. However, the actual depth turned out to be far deeper than was indicated by GEBCO resulting in a delay in action being taken.

In recent years, the need for a more accurate bathymetric dataset than that currently provided by GEBCO has become apparent in addressing a wide range of issues ranging from global climate change, seafloor earthquakes, tsunamis, storm surges and other natural hazards, ecosystem and biodiversity issues, search and rescue operations at sea, exploration and development of underwater resources, navigation, and marine spatial management among others. Against this backdrop, in June 2016, The Nippon Foundation and the GEBCO Guiding Committee jointly held the "Forum for Future Ocean Floor Mapping" in Monaco in order to discuss a vision for the future of bathymetric charts. Taking into account the findings at the Forum, The Nippon Foundation and GEBCO Guiding Committee made a decision to launch Seabed 2030 and announced the inauguration of the project at the United Nations Ocean Conference in July 2017.

Seabed 2030 aims to produce the definitive map of the world's ocean floor by 2030. The GEBCO Grid is a topographic grid model of the global sea floor at 30 arc-second (30 seconds in degree of latitude ; about 900 m at the equator), which provides water depth for each grid. When Seabed 2030 started, only 6% of grids had

Figure 2-1 Seabed 2030 project event held in October 2019

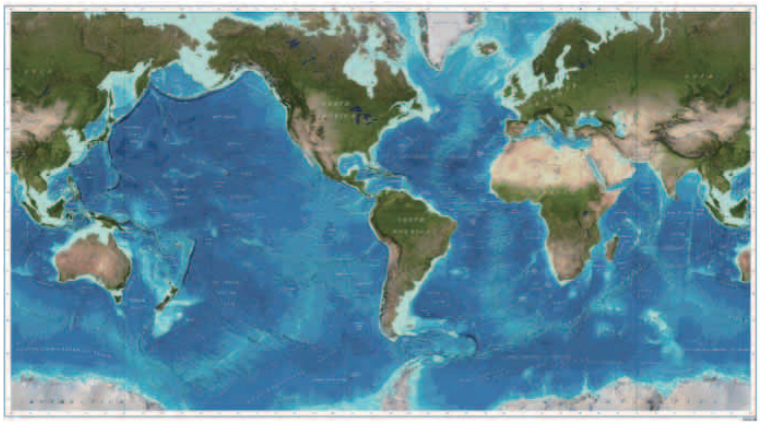


Figure 2–2 The GEBCO Ocean Map

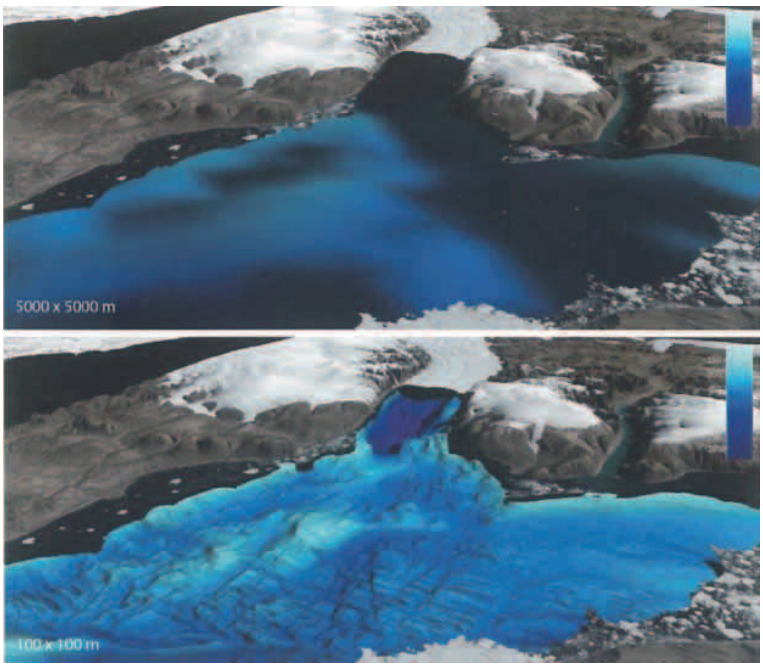


Figure 2–3 Bathymetry around fjord
(Comparison between Resolution 100 × 100m and 5000 × 5000m)

at least one actual measured value per grid. Led by Seabed 2030, the percentage more than doubled to 15% within 2 years.

To acquire at least one actual measured depth value for each grid, Seabed 2030 is reaching out for existing data as its first step. Seabed topography has been measured for installation of undersea communication cables, exploration of oil, gas and underwater mineral resources, and various other purposes. However very few of these data have been released for use by GEBCO. Seabed 2030 has established four Regional Centers, who reach out to data owners and carry out individual negotiations for data contribution. Fugro, a world leading geo-data specialist, and the National Oceanic and Atmospheric Administration (NOAA) of the United States are among 106 companies, research institutions and governmental agencies which have so far enlisted as data contributors.

Even if all the existing data is made available, there remains a vast area of the ocean where depths have never been measured. The search area of the missing

Malaysian airplane was one such area. Nonetheless, vessels do transit these areas. These vessels only need to be fitted with data-gathering equipment to measure the depth of uncharted water. Cruise ships and cargo vessels on regular courses have great potential for this, as do others, including fishing vessels. Some are already equipped with fish finders and do have depth measurement capability. By installing data loggers slightly larger than a pack of cigarettes, bathymetric information could be obtained from areas where survey ships have never been, without placing extra workload for the mariners or fishermen. This initiative is called "crowd-sourced bathymetry" and is already in progress. Furthermore, development of innovative depth measurement solutions entirely different from the existing ones is expected.

Seabed 2030 's four Regional Centers and a Global Center are realizing these objectives through networking within their designated regions, with industries, and across regions. What was not possible before Seabed 2030 with only members of GEBCO operating without full-time staff has now become possible with the establishment of this global structure and dedicated staff coordinating efforts to speed up the process of gathering ocean floor data across the world.

One of the networks supporting Seabed 2030 at its base is the network of

Figure 2-4 Autonomous seafloor mapping system developed by GEBCO-NF Alumni Team

Figure 2-6 GEBCO-NF Alumni Team members and The Nippon Foundation staff celebrating winning the grand prize at the XPRIZE award ceremony

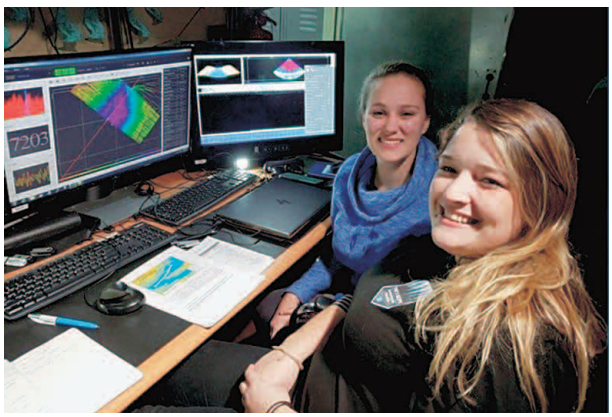


Figure 2-5 GEBCO-NF Fellows analyzing survey data

Figure 2-7 GEBCO-NF Alumni Team members reporting winning of the grand prize of XPRIZE to the Prime Minister

alumni of The Nippon Foundation–GEBCO training program on ocean bathymetry data (GEBCO–NF Fellows). The GEBCO–NF Fellows not only participate actively at the Regional Centers, but have comprised the GEBCO–NF Alumni Team who became the grand prize winner of the Shell Ocean Discovery XPRIZE, an international competition for autonomous ocean exploration technology. The technology developed and used by the Alumni Team, which enables bathymetric data to be obtained autonomously with very high horizontal resolution even in deep water, is one example of the aforementioned innovative solutions.

More participation and technology innovation are required to attain the goal by 2030. In October 2019, a Seabed 2030 event was convened at The Royal Society in London to mark its progress and examine plans to address future challenges. In cooperation with diverse partners, The Nippon Foundation and GEBCO will continue to work towards realizing the dream of mankind to uncover the mysteries of the world's ocean floor.

(Shin Tani)

COLUMN 02 Toward Our Ocean Conference (OOC) 2020 Palau

In recent years, an increasing number of international conferences have been organized to comprehensively address ocean issues. It was planned to convene the second United Nations Ocean Conference was June 2020 in Lisbon though it has now been postponed due to the COVID-19 virus.

The Our Ocean Conference (OOC) is another conference that is given great importance. The seventh OOC was scheduled to take place on August 17-18, 2020 in Palau, but is rescheduled for December 7-8, 2020 due the same reason. The OOC has evolved over the past six years. The first OOC was held in 2014 in Washington D.C. under the initiative of Mr. John Kerry, then Secretary of State of the United States in the Obama Administration. The OOC is intended to motivate stakeholders to address threats to the ocean such as illegal fishing, ocean acidification caused by the increasing concentration of greenhouse gases in the atmosphere, coral bleaching, and the decrease of marine biodiversity. The 5th OOC was held in Bali, Indonesia in 2018 followed by the 6th in Oslo, Norway in 2019. The OOC will be held for the first time in a small island developing state in Palau in 2020.

At the 2019 Oslo Conference, H.E. Mr. Ola Elvestuen, Minister of Climate and Environment of Norway, made a voluntary commitment to take a lead in the process to develop by 2023 an international convention to effectively halt the inflow of plastics into the oceans. The commitment was praised as outstanding, as it aimed to address a very arduous and urgent task by developing a global policy framework.

While no declarations or action plans are adopted at the OOC, it does catalyze voluntary commitments through a mechanism similar to the one used for the United Nations Ocean Conference. A total of 1,345 commitments have been registered at the OOC over the past six years. Youth leadership summits and various side events have also been held at the OOC to encourage diverse stakeholders to engage in lively discussions.

Significance of the OOC 2020 in Palau

The Republic of Palau is implementing progressive ocean policies under the leadership of President Tommy Remengesau Jr. The Palau National Marine Sanctuary Act, enacted in 2015, is a good example as it designates 80 percent of Palau's territorial water and exclusive economic zone (EEZ) as a marine sanctuary, that is, a no-take zone where all extractive activities (such as fishing) are prohibited. In 2019, the Act was amended to relocate the fishing zone and allow exemptions to the requirement of landing fish in Palau. The revised Act came into full effect on January 1, 2020.

The Rock Islands Southern Lagoon located in southern Palau, the most popular tourist destination, was designated a UNESCO World Heritage Site in 2012. Many tourists visit there to enjoy snorkeling and diving. Eve in that area, however, coral reef damage and bleaching were reported due to the 2012-2013 typhoons and recent rise in sea water temperatures.

President Remengesau is at the forefront of international efforts to promote a sustainable ocean economy and take actions against climate change. He co-chairs with H.E. Ms. Erna Solberg, Prime Minister of Norway, the High Level Panel for a Sustainable Ocean Economy (HLP). HLP was established in 2018 by the government of Norway, and includes H.E. Mr. Shinzo Abe, Prime Minister of Japan, as a member. At the OOC 2020, it is anticipated that Palau will mobilize the perspectives of island ocean states, which are most susceptible to the degradation of the marine environment and vulnerable to climate change. It is expected that President Remengesau will unite the leaders of these states in order to bolster the global coalition and invigorate efforts to tackle the marine environment degradation and climate change and to promote international cooperation for promoting a sustainable blue economy.

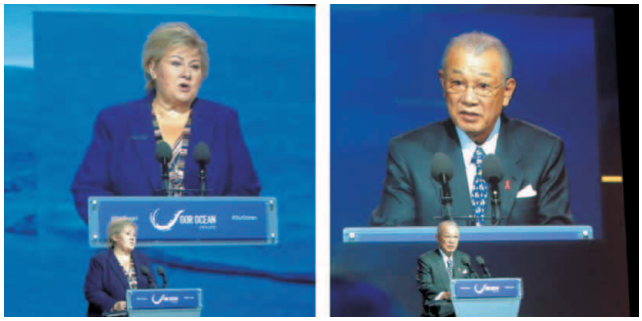
The OOC 2020 Palau and Japan

Seven yachts sailed across the Pacific from Yokohama to Palau for 12 days in the Japan-Palau Goodwill Yacht Race that started on December 29, 2019. The Race was to celebrate the 25th anniversary of Japan-Palau diplomatic relations. This reminds us that Japan and Palau are connected through a vast ocean. Japan and Palau are in a unique position to promote the conservation and sustainable use of ocean and marine resources and to foster a sustainable blue economy.

Japan-Palau cooperation in ocean fields is developing in manifold ways. For example, the Nippon Foundation has provided a new marine surveillance vessel and berth, the Sasakawa Peace Foundation supports the training of crews to operate the surveillance vessel, and the Japan International Cooperation Agency (JICA) has supported the reconstruction of the Palau Mariculture Demonstration Center. Also, the Ocean Policy Research Institute of the Sasakawa Peace Foundation supports the Government of Palau in planning policy dialogues and analyzing voluntary commitments in the process to prepare for OOC 2020 and to ensure its success

Japan and Palau are geographically and historically interlinked and promote bilateral cooperation and cultural exchange. It is hoped that the two ocean states will play a leading role in advancing exemplary policies at the international level to achieve a sustainable ocean on our planet.

(Masanori Kobayashi)



Erna Solberg, Prime Minister of Norway (left) and Yohei Sasakawa, Chairman of The Nippon Foundation (right) addressing OOC 2019 in Oslo.

3 Promotion of Scientific Research in the Arctic

1 Background

The Arctic can be defined geographically by latitude (the polar region north of the 66° 33'N where the midnight sun occurs), or by temperature and vegetation (the area combining the Arctic tundra zone -- where average temperature for the warmest month is above 0℃ and below 10℃ – and the Arctic Ocean). The Arctic Ocean is often defined by average ocean surface temperature and distribution of sea ice.

Until the end of the 20th Century, the Arctic was heavily ice and snow-bound. While it attracted scientific and cultural interest, it was unlikely to be the subject of international territorial conflicts. However, global warming (Figure 3-1) has caused sea-ice retreat (Figure 3-2) and permafrost thaw has caused changes in the terrain and vegetation. The Arctic, once considered an undisturbed and remote place, is now more accessible, resulting in world-wide interest in its potential economic and industrial value.

In September 1996, the Arctic Council was established to promote cooperation and coordination on issues such as sustainable development and environmental protection of the Arctic. The Arctic Council is a high-level intergovernmental forum, whose members include eight Arctic States[8] and six Permanent Participants representing the indigenous people of the Arctic. Currently, the Council conducts its activities through six working groups: Arctic Contaminants Action Program (ACAP), Arctic Monitoring and Assessment Programme (AMAP), Conservation of Arctic Flora and Fauna (CAFF), Emergency Prevention, Preparedness and Response (EPPR), Protection of the Arctic Marine Environment (PAME), and Sustainable Development Working Group (SDWG).

In 2011, Japan launched "Rapid Change of the Arctic Climate System and its Global Influences," a research project within the framework of GRENE (Green Network of Excellence), a new national strategy for growth. It helped Japan to earn Observer Status in the Arctic Council in 2013. At around the same time, Japan's Second Basic Plan on Ocean Policy was formulated and authorized. It clearly stated that comprehensive and strategic measures should be taken to address issues surrounding the Arctic, such as promotion of research and survey activities, promotion of international coordination and cooperation, and assessment of the potential of the Arctic Sea Route. The meaning and significance to Japan of research and study of the remote Arctic region has been changing ever since.

In September 2015, following the formulation of the Second Plan, the Arctic Challenge for Sustainability (ArCS) research project was launched by the Ministry of Education, Culture, Sports, Science and Technology (MEXT). In October 2015,

8 Canada, Denmark, Finland, Iceland, Norway, the Federation of Russia, Sweden, and the United States

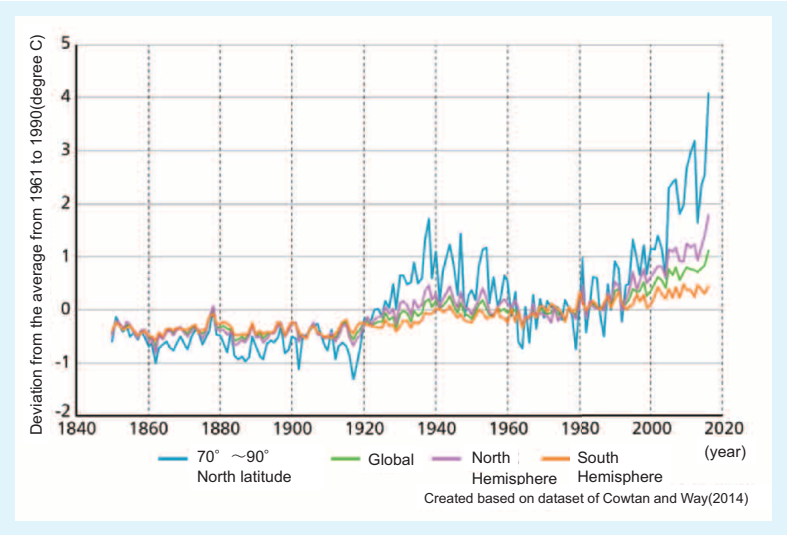


Figure 3–1 Trend in Average Global Surface Temperature
(Courtesy of Dr. Tetsuo Sueyoshi)

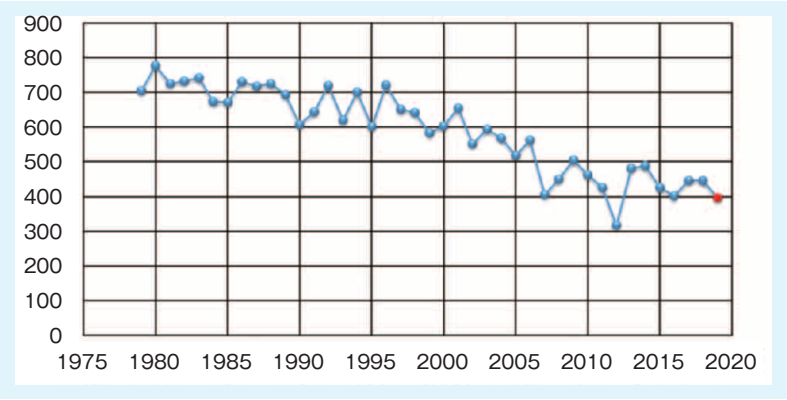


Figure 3–2 Minimum Area of the Arctic Sea-Ice (10,000km²)
(Courtesy of Dr. Tetsuo Sueyoshi)

Japan formulated an Arctic policy that outlined ArCS's mission to make sustainable use of the Arctic region possible by enhancing Japan's capability to lead the international discussion and to contribute science and technology to the world's effort, especially to the Arctic States, at which Japan excels.

Millennium Development Goals (MDGs), based on the Millennium Declaration adopted at the United Nations Millennium Summit in September 2000, were concluded in 2015 and replaced with Sustainable Development Goals (SDGs) adopted within the 2030 Agenda. The 2030 Agenda identified three dimensions of sustainable development : economic, social and environmental, and the proper balance necessary to sustain development of society and to ensure the dignity of mankind.

Japan's Artic Challenge for Sustainability project was initiated against the backdrop of these circumstances surrounding the Arctic.

2 Structure and Purpose of ArCS

Since its inception, ArCS has assumed the mission of providing scientific find-

ings in an easy-to-digest manner for policy makers, decision makers in the private sector, other stakeholders such as the indigenous people of the Arctic, and the Japanese people in general.

Findings and data obtained from six natural sciences and engineering research projects in the International Collaborative Researches Program are compiled in Arctic Data archive Systems (ADS)[9] managed by the National Institute of Polar Research and shared with the humanities and social science study project, which then process the data to produce socially relevant information to be disseminated to domestic and international stakeholders.

In the beginning, ArCS set out to gain the public's understanding of the significance of Japan's research on the Arctic. To generate interest in the Arctic amongst the general public, ArCS put an emphasis on public relations efforts, such as giving public lectures. From the second half of fiscal year 2018 to fiscal year 2019, ArCS also took on a project to illustrate the current status and future vision of the Arctic from the viewpoint of the natural environment, the Arctic Sea Route, the Arctic ecosystem, and the life of the indigenous people. This resulted in publication of an easy-to-read booklet entitled *The Future of the Arctic*, which reported findings of the projects to policymakers and the public.

9 Arctic Data archive System, https://ads.nipr.ac.jp/.

3 Activities of ArCS

1 Scientific Findings

To complement the Arctic policy of Japan and the world as well as to support the PDCA (plan-do-check-act) cycle of future Arctic policy, we should maintain diversity in Arctic research. We need research that communicates to society adequate scientific findings and projections on the natural environment, ecosystems, and the vulnerability of the indigenous people of the Arctic. As a national research project, ArCS is expected to produce outcomes that directly contribute to the national interest. Nonetheless, to avoid a situation where the subjects of study are limited and the scientific findings are few, ArCS has made a conscious effort to take on a broad range of subjects.

2 Research Infrastructure

ArCS has built up its research infrastructure by expanding research and observation stations(Figure 3–3), sending researchers to overseas research facilities, dispatching experts to international meetings, and broadening data management.

As a result, the number of research and observation stations and partner countries have both increased, and Japan has established an international presence in Arctic study. At each station, Japanese ArCS and Arctic States researchers are engaged in collaborative study. Dispatching experts to the working groups within the framework of the Arctic Council and research activities in the Arctic States has provided us opportunities to discuss the activities and outcomes of ArCS. Our data management program has established the Arctic Data archive System(ADS)

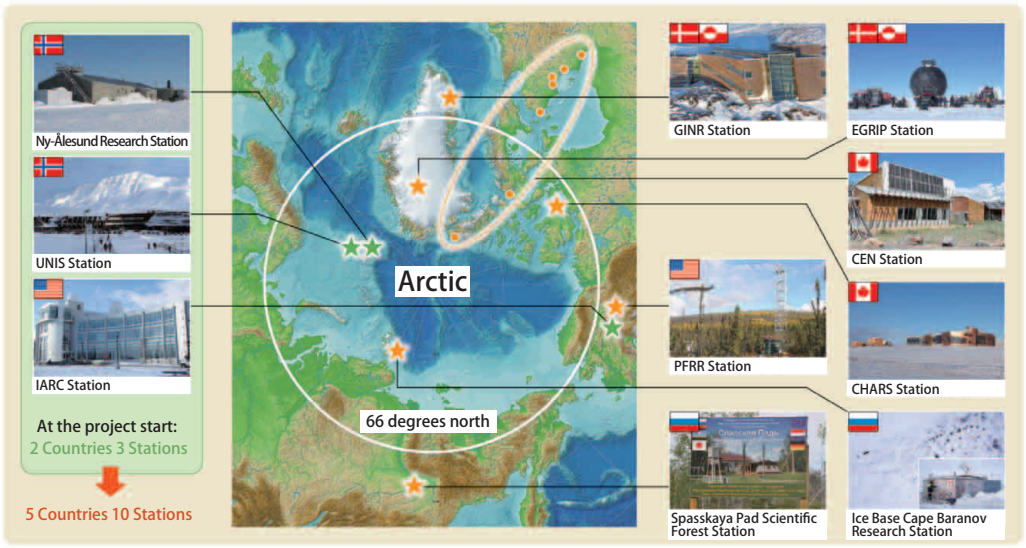


Figure 3–3 Research and Observation Stations

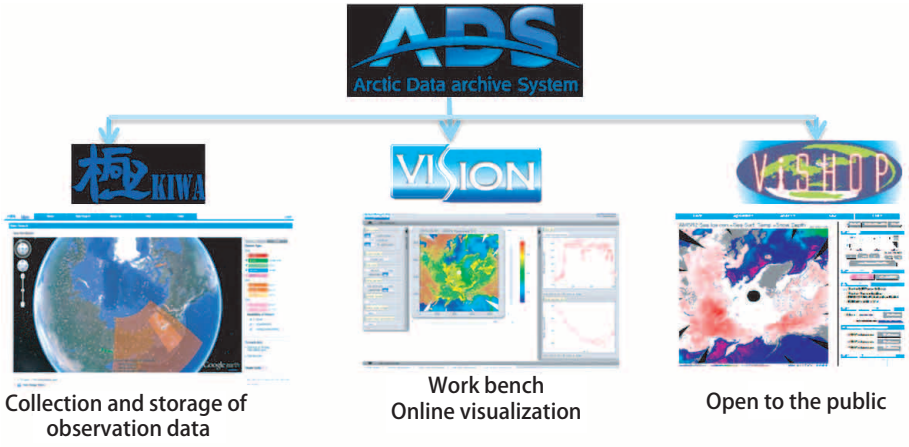


Figure3–4 Operations of ADS

(Figure 3–4), which compiles various data from observations and research conducted in the Arctic region, and serves as an online "work bench" where all the data from the project can be visualized and made publicly accessible.

3 Project Outreach

ArCS's outreach efforts include administration of the project website[10] (Figure 3–5), publishing e-mail newsletters, and giving lectures for the general public. We established an International Advisory Board with prominent domestic and international members and a council whose membership includes people not involved in Arctic research. In the second half of fiscal year 2018, the fourth year of the project, we published a booklet on the Arctic, *The Future of the Arctic*, targeting non-specialist readers.

At the International Advisory Board meetings, we discussed the scientific progress of ArCS and its international contributions. The council served as a forum for the project participants and the public to exchange views. It contributed to the visibility of Arctic research and improvement of ArCS's social standing. *The Future of the Arctic*[11], published to provide information to the public, showcased some

10 https://www.nipr.ac.jp/arcs/e/index.html

11 https://www.arcs-pro.jp/about/pamphlet/booklet201903b.pdf

Figure 3–5 Website of ArCS

Figure 3–6 The booklet, *The Future of the Arctic*

ArCS research themes with an emphasis on the future of nature and human life in the Arctic.

4 Social Effects (Outcome)

ArCS's accomplishments include not only the publication of scientific papers and books, and presentations at conferences, but also the dispatching of experts to attend Arctic-related meetings and to contribute to Artic-related reports, as well as the expansion of overseas research and observation stations. As a whole, ArCS integrates individual findings into relevant information and discloses it to the public. In this way, ArCS intends to change public perceptions, and drive Japanese Arctic policy forward. Japan will be co-hosting the 3rd Arctic Science Ministerial (ASM3) with Iceland in 2021 in Tokyo. Japanese mass media now often reports the significance of the Arctic. The relative proportion of the Arctic issues in the Third Basic Plan on Ocean Policy formulated in 2018 has increased. Japanese presence in Arctic research is now much more visible.

Japan's Arctic policy is expected to be revised and the outcome of ArCS's efforts to influence current Arctic policy will likely be reflected in the revision. This was the anticipated outcome of ArCS being promoted as a national project.

4 Challenges for the Future

ArCS will be concluded at the end of fiscal year 2019. The succeeding national project on Arctic research should build upon the lessons learned from ArCS. Top priority must be placed on informing policymakers about the past, present, and possible future of the Arctic in an accurate and easily understood manner. Chal-

lenges are as follows:

- Financial support structure making it possible for more researchers to participate.
- Establish a research institute or research organization to conduct comprehensive Arctic study for Japan, and enhance administrative support for research projects.
- Develop human resources who have global and panhuman views and encourage them to participate in Arctic research.
- Promote social implementation of scientific ideas, and take advantage of researchers with an engineering perspective.
- Establish an effective framework to provide policymakers information on which Arctic policy could be based.

None of the challenges above can possibly be accomplished overnight, but as Japan continues Arctic research as a national project, steady advance on each challenge is expected.

Existing Arctic research efforts, including ArCS, have focused on participation in the working groups under the auspices of the Arctic Council and on contributions to the Arctic Council and Arctic States through collaboration with the indigenous people. In the future, the aforementioned five challenges are important for Japanese Arctic research to stay internationally competitive while remaining rooted in Japanese society, and are important in making Japan's participation in Arctic governance welcomed and appreciated not only by Arctic States but the world at large.

(Masao Fukasawa)

COLUMN 03 The Seventh Tokyo International Conference on African Development (TICAD) was held in Yokohama

The Tokyo International Conference on African Development (TICAD), is a conference led by the government of Japan and co-hosted by the United Nations, the United Nations Development Programme (UNDP), the World Bank Group, and the African Union Commission (AUC) to facilitate cooperation for sustainable development among government and business leaders in Japan and African countries. The first TICAD was held in Tokyo in 1993 and is now held every three years, alternately in Africa and Japan. The seventh TICAD (TICAD7) was held on 28–30 August 2019 at Pacifico Yokohama, Yokohama, Japan, with more than 10,000 attendees, including representatives from 53 African countries, of which 42 were heads of state or government, representatives from 52 development partner countries, 108 heads of international and regional organizations, representatives of civil society and the private sector.

Discussions Concerning the Oceans at TICAD7

Prime Minister Abe co-chaired the conference with President El-Sisi of Egypt, and Deputy Prime Minister Aso, Foreign Minister Kono, and relevant ministers and heads of government agencies of Japan were also in attendance. Under the theme, "Advancing Africa's Development through People, Technology and Innovation," six plenary sessions and five thematic sessions were held. At the closing ceremony, *Yokohama Declaration 2019* was adopted with an accompanying document, *Yokohama Plan of Action 2019*.

As for oceans issues, Foreign Minister Kono chaired a thematic session on Blue Economy. In his opening remarks, Mr. Kono showcased Japan's efforts to promote Blue Economy in Africa, such as strengthening of physical and institutional connectivity, development of ocean energy resources, utilization of marine and fishery resources including inland aquaculture, and enhancing maritime security, including anti-piracy measures. He also announced Japan's initiative to provide training for 1,000 people to support Blue Economy in Africa.

There were many side events pertaining to the oceans. Japan Agency for Marine-Earth Science and Technology (JAMSTEC) held a workshop on climate studies in South Africa. The Ocean Policy Research Institute of the Sasakawa Peace Foundation (OPRI-SPF) held two official side events on Blue Economy and on Blue Carbon. In addition, OPRI-SPF held an informal event, the High-Level Roundtable Meeting on Blue Economy in Africa. The roundtable meeting was intended to strengthen partnerships among governments, businesses and other stakeholders in Japan and African countries and received a great response.

Yokohama Declaration 2019 and looking forward

Yokohama Declaration 2019 adopted at TICAD7 includes a notable statement from the perspective of ocean governance, which underscores "the need to galvanize bilateral, regional and international stakeholders' collaboration in maritime security, including the fight against piracy, IUU (illegal, unreported and unregulated) fishing and other maritime crimes, and maintaining a rules-based maritime order in accordance with the principles of international law." Acknowledging a Japan-driven initiative that Prime Minister Abe called for in his keynote address at the last TICAD, the declaration also included the statement that "we take good note of the initiative of a free and open Indo-Pacific announced by Prime Minister Shinzo Abe at TICAD6 in Nairobi."

TICAD 8 will be held in 2022 in further grown Africa, where it is expected to further advance strategic partnerships between Africa and Japan, starting from the TICAD7 discussions.

(Teruaki Aizawa)

Discussion at TICAD7 (Source : MOFA website)

Speakers and others at the side event, "Sustainable Blue Economy in Africa"

4 New Development in Ocean Education

In recent years, new developments have been seen in ocean education in Japan. For example, in 2019, the Center for Ocean Literacy and Education (COLE) was established in the Graduate School of Education of The University of Tokyo. With a coalition of researchers in scientific, engineering and educational fields, COLE is advancing ocean education through a new curriculum in school and social education. COLE is the successor of the Research Center for Marine Education (RCME), Ocean Alliance, the University of Tokyo, which was launched in 2010. RCME was a part of the Ocean Alliance, a cross-disciplinary network at The University of Tokyo founded in 2007 with the support of The Nippon Foundation for cross-disciplinary and comprehensive educational research on the oceans. RCME promoted ocean education in primary and secondary schools for nine years. The Nippon Foundation also supports the activities of the newly established Center. This article outlines the activities of COLE and presents ocean education concepts developed by RCME and the philosophy behind them.

1 COLE Ocean Education Projects

① Joint Development of Ocean Education Curricula

Succeeding RCME's program, the Center develops tailored ocean education curricula in partnership with local school boards, schools, local governments, and social education facilities all across Japan. One of the outcomes of the project is the publication of *Ocean Education Style Book in the Era of the New Government Guidelines for Education : Practical Guide to Link Communities and Schools* (*Shogakukan Inc., 2019*), which compiled model cases of ocean education.

② Development of Original Ocean Education Materials

Drawing on the expertise of education and oceanography teachers and researchers involved with the Center, COLE develops innovative ocean education materials. Another fruit of the project is the publication of *The Root of Ocean Education in Japan— (Post War Era) Science* (Ichigeisha Inc., 2019). It uncovers the historical fact that in postwar Japan excellent educational materials on the oceans were used in school education, and discusses its significance.

③ Policy Recommendation on Ocean Education

In addition to publishing books, the Center issues policy recommendation briefs on subjects such as the historical context of ocean education, the future of ocean education, and the latest oceanographic findings, in order to make policy recommendations to education and general administration agencies. One of the major outcomes is the *Ocean Education Policy Brief Series*. So far, COLE has published six issues.

Figure 4-1 A scene from the Children's Summit on Ocean Education

④ Ocean Education Colloquium Series

The center convenes a number of meetings in partnership with The Nippon Foundation and the Ocean Policy Research Institute of the Sasakawa Peace Foundation. The most prominent of these meetings is the annual National Ocean Education Summit, which enters its seventh year in 2020. Since 2016, the Center has convened the Children's Summit on Ocean Education, which is planned and managed mainly by local school children. The Children's Summit is currently held in the Tohoku and Kyushu regions, and is expected to expand to other regions.

⑤ Training of Teachers of Ocean Education

To encourage locally initiated, regionally tailored ocean education and to address global issues such as ocean warming and increasing marine debris, the Center started the Training Program for Teachers of Ocean Education in 2017 and offers training to teachers and education administration agency personnel who are in charge of development or delivery of ocean education curricula.

⑥ Supporting Development of Ocean Education Curricula

In 2016, the Center, in cooperation with The Nippon Foundation and Ocean Policy Research Institute of the Sasakawa Peace Foundation, started the *Ocean Education Pioneer School Program*[12] to encourage and support development of ocean education curricula by individual organizations. The center also conducts *Learning from the Oceans : Lifelong Learning Project* for social education facilities.

12 https://www.spf.org/pioneerschool/

2 Sections and Categories of Ocean Education

While the Center took over projects from its predecessor and expanded them, it is currently in the process of restructuring its program by setting pragmatic objectives for ocean education with a long time horizon.

1 Activity Sections

① International Networking

This section promotes cooperation with international organizations such as the United Nations and UNESCO and plans and administers events and international academic conferences on global issues concerning the oceans. In fiscal year 2019, COLE started to coordinate with the Japan Agency for Marine-Earth Science and Technology (JAMSTEC) to present papers at each other's events.

② Academic Research

Researchers of the Center, in collaboration with outside researchers and teach-

ers of oceanography and education, conduct basic academic research to develop innovative ocean education curricula. This includes educational research to formulate "Japanese Style Ocean Literacy".

③ Curricula Development

This section expands the curriculum/program development projects of the former Center. As one outcome, in fiscal year 2019 we published *Teacher's Guide for Ocean Education — Guidebook for Learning from the Ocean at school : Primary and Secondary School* (Dainippon Tosho Co., Ltd., 2019).

④ Communications

This section is in charge of disseminating outcomes of ocean education nationally and internationally. It compiles and edits outcomes of other sections as well as plans and produces original popular content. In fiscal year 2019, it produced *The Oceans — A Journey following the Cycle of Life*, an animated short film (Director : Yosuke Omori, Production : Crafter Studio, 2019).

2 Subject Categories

Three categories — *life*, *environment*, and *security* — are not stand-alone categories but are interconnected through three cross-categorical disciplines — global, socioeconomics, and cultural. They constitute a model of ocean education. Subcategories of the model are also interconnected (Figure 4–2).

The description of ocean education added in the revised *General Policies Regarding Curriculum Formulation Government Guidelines for Education* only covers the discipline of "security" from the ocean education model in Japan. It is true that to assure Japan's security, consideration of Japan's territory, territorial seas, exclusive economic zone (EEZ), and sea lanes is needed. However, if we conduct ocean education emphasizing only that perspective, the oceans will continue to be regarded as no more than an object of possession (as will be discussed later).

For the first time, the current edition of *General Policies Regarding Curriculum Formulation* includes a preamble, in which the intent of the revisions is stated.

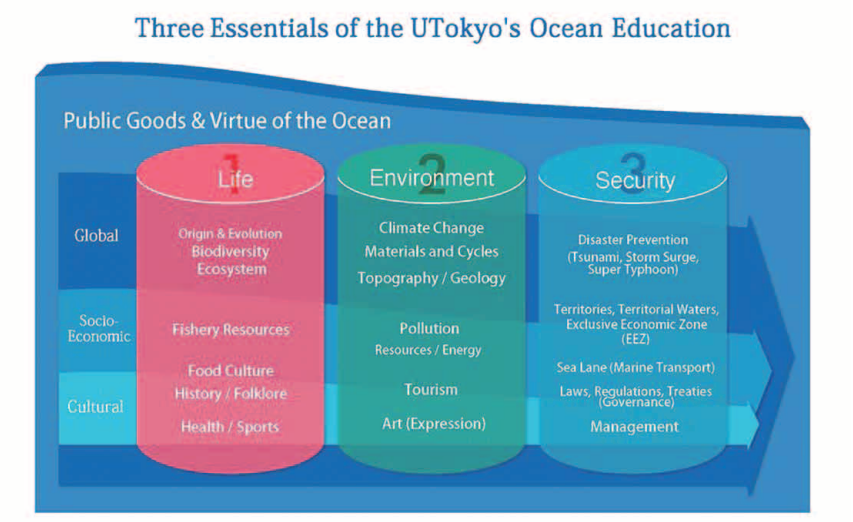


Figure 4–2 Three Essentials of Ocean Education of The University of Tokyo
Three Pillars of Ocean Education of Tokyo University
The Oceans as Public Property

"Cultivating creative drivers toward sustainable society" is one of the educational purposes it sets. Based on this educational purpose, ocean education should be defined as education that positions the oceans as the cornerstone of habitability ; constructs educational practices based on the three subject categories of *life*, *environment*, and *security* to address current issues emerging both regionally and globally ; and cultivates "creative drivers toward sustainable society."

However, existing ocean education in Japan has several challenges. First of all, an interdisciplinary approach is needed, especially between "Social Studies" and "Science." For example, while aquaculture and global warming are subjects taught under "Social Studies" in primary schools, their scientific aspects — for example, marine ecosystems and mechanisms of global warming — are taught at secondary schools under geology. It could lead to a situation where primary school children learn about the oceans without knowing the causal links in place and their background. The "*life cycle*" of oceans affects the ocean *environment* through the materials cycle, and ultimately affects our *security*. Marine debris, tsunamis, torrential rains, expansion of ocean dead zones, and heat waves are subjects to be taught and learned integrally in the context of social studies with a scientific knowledge base.

The second challenge is compartmentalization of ocean related fields. Oceanography is specialized into fields concerning *life* such as marine biology, marine ecology, and fisheries science ; fields concerning *environment* such as physical oceanography, chemical oceanography, marine geology, and marine engineering ; and fields concerning *security* such as coastal works, disaster prevention, law of the sea, and maritime affairs. Each field has its own academic society, and the purpose and terminology varies from one field to another. This presents a challenge when we attempt to teach school children the latest findings in an easy-to-understand format. The gap between oceanography and the study of education is greater than that among the various fields in oceanography. The study of education currently leans toward academic development and tends to focus on educational methods. Originally, education was an academic discipline separated from philosophy to encourage character building and social reform. The current study of education has not totally lost interest in character development and social reform, however. For example, environmental education places emphasis on the issue of global warming and aims at a "decarbonized society." However, in many cases, ocean warming, which causes natural disasters, is not discussed. For better ocean education, an interdisciplinary approach not only among specialties in oceanography but also between oceanography and the study of education is essential.

The third challenge is that ocean education must face the question for which there is no single correct answer : *what kind of society do we envisage and how should we live?* Ocean education should be more than teaching school children the mechanisms of ocean warming, or providing them opportunities to experience the mysteries and marvels of deep ocean dwellers. For example, children themselves have to think about the consequence of living in natural disaster-prone areas, and about the way to address risks, including evacuation, mitigation, and re-

Figure 4–3 Children playing on a beach

construction. It is not enough to teach them to address global warming by saving energy just because they are told to do so. We should guide them to reflect on the problems of social structure and lifestyles behind global warming, and to work for reform.

In searching for answers to "the question with no single correct answer," it is important for our children to recognize the oceans not only as public property which belongs to everyone but also as a public good (*res publica*), and to appreciate and care about all life that is gifted and bestowed by the oceans. In other words, our most urgent challenge is to position the concepts of *public good* and *bestowal* (*the giver and the given relationship*) as philosophies that ocean education should aim for, and to bridge the gap among various specialties of oceanography and between oceanography and the study of education.

3 Philosophies of Ocean Education

While both *public property* and *public good* originate from the Latin term *res publica*, these are two separate concepts. *Public property* means a physical object that can be owned. On the other hand, we cannot own a *public good*, as it is a denotation. While the oceans as a physical presence are owned by States, the oceans as a public good cannot be owned since the oceans are the historical origin of all life, including human beings. As the term, "Mother Ocean" suggests, life first emerged from the pristine oceans and we human beings evolved from this first life form. The oceans are the matrix of all life.

Another reason the oceans as public good cannot be owned is because they are the foundation for the existence of all life. A habitable environment, in which air, water, food, and proper temperature exist, are required for any life to exist. It is the oceans that support this habitable environment. Ocean warming is causing extreme weather events such as heat waves, torrential rains, and super typhoons, as well as undermining the biodiversity of the oceans and thus threatening habitability. The oceans are essential for an environment that supports all life, including human beings.

If we accept the fact that the oceans are our matrix, our origin, and the essential condition for habitability, they assume a surpassing existence and should thus be considered an object of awe. Our life is a gift given and sustained by the oceans. In this giver and receiver relationship between the oceans and people, we

are not autonomous individuals but collective human beings, who must unconditionally appreciate and value the gift, which are the oceans themselves.

The study of education has advocated making us more human through ethical education. From now on we should advocate making human beings more human in ocean education, too. What we should teach children is not only engineering approaches to realize a sustainable society, but also the humanity to sustain a habitable world, which is the prerequisite for a sustainable society.

Ocean governance without this humanity might remain a mere vision. People who appreciate and care about others, and people who appreciate and value the oceans as the matrix of life are the two sides of the coin of education. It is the goal of ocean education to embrace both sides.

(Satoshi Tanaka)

COLUMN 04 Marine Plastics Research Project and Promotion of Ocean Literacy in Collaboration with Japan-Palau Goodwill Yacht Race

There is only one ocean. Regional destruction of marine ecosystems, either by the effects of climate change or direct environmental load of human activities, is inextricably linked to global issues. Such global issues defy unilateral solutions. Through international collaboration, it is the responsibility of the ocean science community to collect and share scientific evidence with society to support effective policymaking. However, establishment of a global observation system requires a continuous injection of substantial resources. The capacity of existing research organizations is insufficient. For this reason, an effort to develop ocean observation networks in collaboration with commercial vessels (such as ferries and tankers) and the pleasure boating community (such as yachting) is attracting attention.

The Japan-Palau Goodwill Yacht Race celebrating the 25th anniversary of diplomatic relations between Japan and the Republic of Palau was held from the end of 2019 to the beginning of 2020[1]. The planning committee expressed their desire to take this opportunity to contribute to the conservation of the ocean environment as a group of ocean-loving sailors. The Japan Agency for Marine-Earth Science and Technology (JAMSTEC), in collaboration with the racing yacht TREKEE and escort sail training ship MIRAIE, conducted marine plastic observations during the race. Unlike research vessels, these ships cannot be equipped with conventional observation facilities. It requires a small, easy to use, and affordable monitoring system for non-research vessels to conduct marine plastic observation. In this project, subCtech's microplastic sampler[2] was installed on both ships. It will exponentially accelerate data accumulation and global comparative analysis of the data when more and more in the pleasure boating community choose to install such samplers.

The significance of the project does not stop there. Collaboration with various sectors is leading to promotion of ocean literacy. To build a bridge of friendship with Palau, six children from Palau, who excelled in the OP Dinghy[3] lessons arranged by the yacht race planning committee, were invited with their families on board the MIRAIE, where the JAMSTEC team conducted a series of ocean literacy programs for them. The children, who were between ages 8 to 14, experienced various activities: studying on the deck under a blue sky, observing Neuston Net's sampling, helping process the samples collected, and carrying out microscopic observations in a meeting room that was turned into a make-shift laboratory. The lessons included advanced subjects such as "What is Marine Protected Area?" and "Let's create an eco-friendly city" (which required creativity and imagination). It made us happy to witness their passion to learn, high level of awareness, and wealth of knowledge about ocean environment issues. Is it because the lives of the people of Palau are intimately involved with the oceans? We have a lot to learn from them and it made us think about what it means to live in an island nation. President Remengesau of Palau reiterated that these children were "the future of our country." I hope they will grow up to be a leading force for the future of the oceans internationally.

JAMSTEC conducted this project as its commitment toward the achievement of SDG 14.1 "Reduction of Marine Pollution," SDG 17 "Partnership for the Goals," and SDG 5 "Gender Equality." In addition to SDG 14.1, whose relevance is obvious, Palau will address SDG 17 by hosting the *Our Ocean Conference*, a high-level policy conference concerning the oceans in December 2020 for the first time as a member of the Small Islands Developing States (SIDS). Both Japan and Palau benefit heavily from the oceans. It is expected that the relationship between the two countries will be deepened through ocean science and marine sports.

As for SDG 5, the research team was made up solely of women from various backgrounds, including the author, Ms. Holly Griffin from the UN Environment Programme World Conservation Monitoring Centre (UNEP–WCMC), a specialist in ocean literacy, and Ms. Yurie Seki from Yamaha Motor Co. Ltd., an international-class sailor. Women's participation in ocean science in Japan is far behind in comparison with the global standard. We strongly hope that more women will actively participate in ocean science in greater numbers in the future.

(Sanae Chiba)

* The project was conducted in partnership with Mitsui O.S.K. Lines and Yamaha Motor Co. Ltd.

Note 1 : https : //japan-palau-yachtrace.com/

Note 2 : subCTech's Microplastic sampler was adopted in the Volvo Ocean Race 2017–2018. Its operability on board racing yachts sailing in rough waters on the high sea is demonstrated.

Note 3 : A cabin-less yacht for 1 or 2 crew with a length of 2.31m and width of 1.13m.

Children of Palau having lessons on the deck of the sail training ship MIRAIE.

Research Team members (Ms. Seki, the author, and Ms. Griffin) and the project flag.

5 New Developments in Japan's Marine Information Management

The ocean offers an extremely broad range of information that covers all phenomena arising in the ocean, such as waves and currents, water quality, marine organisms, marine minerals, and ship behavior. Due to this characteristically diverse and widely varying mixture of information, even information that has been acquired with the government's budget has been difficult to manage in a centrally integrated manner to date. In addition to the diverse nature of the information, the poor demand for sharing information that each ministry and agency has been collecting and using for their own respective purposes is another reason for the lack of progress in consolidating ocean information.

In response to the Basic Act on Ocean Policy enacted in April 2007, Japan finally took its first steps towards integration of its ocean information. In April 2019, the Japan Coast Guard commenced the operation of MDA Situational Indication Linkages (MSIL), an information service that superimposes and displays satellite information, marine weather information, and other ocean information collected and held by the government, on Web-GIS. This article provides an overview of the background leading up to the integration of ocean information and the future outlook, while introducing the categories of ocean information and Maritime Domain Awareness (MDA) system.

1 Three Categories of Ocean Information: Cadastre, Nature, Human Activities

1 Social Information of the Ocean

The foundation of ocean information is comprised of social information, which offers a spatial indication of the boundary of rights and interests in the ocean. This includes port areas and mining areas, fishery rights, and training waters. Overseas, a system known as Marine Cadastre was developed in each country from around the year 2000 along with the advancement of the Geographic Information System (GIS) (Tsunoda et al, 2010[13]). In Japan, reviews for a cross-ministerial platform commenced with the enactment of the Basic Act on Ocean Policy in 2007, and this platform was launched by the Japan Coast Guard in the form of the Marine Cadastre system in 2012. It is characterized by its ease of management on GIS due to the small volume of information (volume of data) and few temporal variations.

13 Tomohiko T., et al. "Towards the Development of Marine Cadastre" in *Kayiyo Monthly No.53*. 2010.

2 Social Information of the Ocean

The second category of information, conversely, has a large information volume and significant temporal variation. This is natural science information. Tsunoda et al (2010) have presented this as information obtained through oceanographic sur-

veys, such as physical information, chemical and environmental information, and biological resource information of the oceans. For example, hydrographic conditions, which are shown in Figure 5-1, are not as simple as the current charts presented in an atlas. There are many eddies with a scale of about several tens to several hundreds of kilometres, and this changes from day to day. Variations in the flow channel, such as the well-known direct flow or large meander of the Kuroshio, is also a type of eddy activity, and can have an impact up to a water depth of about one hundred to several hundred meters. For those engaged in fishery activities, the natural science information of the ocean is vital not only for safe operations, but also for understanding their fishing grounds such as the junction where two ocean currents meet.

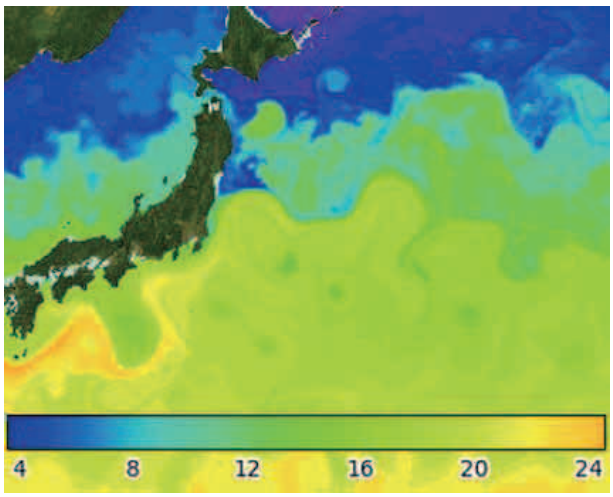


Figure 5-1 Estimated hydrographic conditions in May, 2019 (temperature at a depth of 50m)
(Source : https://www.marinecrisiswatch.jp)

In order to capture such natural science information of the ocean, survey activities are carried out through observation vessels and other means. The long-term observation study conducted for more than 50 years by the Japan Meteorological Agency along 137 degrees east longitude is one such famous example, and basic data from the monitoring of the climate is provided worldwide. Aspects that cannot be adequately captured by vessels alone are also covered through the use of

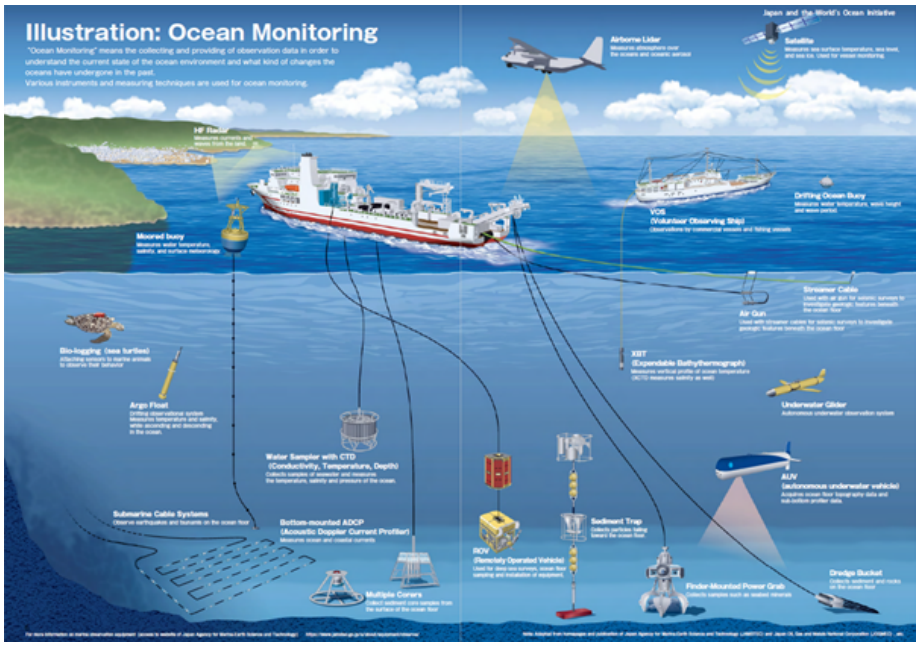


Figure 5-2 Overview of ocean monitoring
(Source : White Paper on the Oceans and Ocean Policy in Japan 2019)

data collected by artificial satellites and automated observation equipment, including Argo Floats. An overview of such marine monitoring is shown in Figure 5–2. Furthermore, numerical forecasting, known as the "ocean forecast," is also carried out by incorporating such observation data into numerical simulations of the ocean. This makes it possible to predict the conditions of the ocean around Japan, including the Kuroshio, approximately one month in advance, in a way that is similar to a weather forecast.

3 Information on Vessels

Finally, the third category of information is a type of ocean information that has recently been attracting attention. This is information that is related to vessel activity, which changes every day. While it had been difficult to comprehensively capture the movements of vessels that move on the seas (such as fishing vessels, commercial vessels, and navy vessels), the situation was drastically transformed with the emergence of a system known as the Automatic Identification System (AIS), which automatically transmits and receives vessel information such as vessel name, position, and destination through VHF-band radio waves to facilitate the exchange of information between vessels, and between vessels and land facilities. When it first became mandatory for vessels that meet a certain criterion to be fitted with the AIS under the International Convention for the Safety of Life at Sea (SOLAS), which entered into force in 2002, this system was used as a tool to ensure safety of navigation in congested waters, etc., in line with the objectives of the SOLAS. However, as it enabled anyone to receive vessel information that is transmitted through VHF band, AIS became a means of capturing vessel movement.

Moreover, two forms of technological innovation in recent years have dramatically propelled the monitoring of vessel movement forward. The first is artificial satellites, which not only made it possible to analyse the movement of vessels around the world through the receipt of AIS information seamlessly from satellites, but also enabled the monitoring of vessels at high frequency through the use of satellite information, alongside the launch of a large number of small satellites that can capture images of the sea. Images of the sea are useful for monitoring suspicious vessels that are operating with their AIS switched off. The second technological innovation is artificial intelligence (AI). The massive volume of AIS information, which can no longer be adequately processed by humans

Figure 5–3 Example of how vessel movement is captured through the AIS (around the Osumi Peninsula)
(Source : 10th Regional Coast Guard Headquarters)

alone, as well as images of the sea, can be efficiently and effectively analysed through the use of the latest AI technology, and applied for monitoring purposes. By comparing this information with the vast volume of past vessel data that has accumulated, it is possible to extract information on vessels with abnormal behaviour through AI technology.

2 Maritime Domain Awareness (MDA) and Consolidating Ocean information

1 Advancement of MDA in Japan

According to the Basic Plan on Ocean Policy, which is revised by the government every five years, Maritime Domain Awareness (MDA) is defined as "The efficient understanding of situations associated with the oceans while bearing in mind how to handle the effective collection, consolidation, and sharing of diverse information about the ocean that contribute to maritime security, ocean environmental protection, marine industry promotion, and science and technology development." As this is a concept developed in the United States in response to the synchronized terrorist attacks on September 11, 2001, MDA tends to be perceived as a concept with security implications. However, it involves the collection, consolidation, and sharing of a broad range of ocean information, such as information on the marine environment. As explained earlier, information about the ocean is diverse and of a wide variety, and capturing information accurately, even for general information such as data on the waves and ocean currents, can have great significance for security. From this perspective as well, it makes sense for MDA to target a wide range of ocean information, and it is possible to understand MDA from a dual-use viewpoint.

In Japan, reviews on MDA commenced with the establishment of a liaison and coordination council for MDA-related ministries and agencies in May 2015, in cooperation with the National Security Secretariat and the Secretariat of the Headquarters for Ocean Policy (now the National Ocean Policy Secretariat) under the Cabinet Secretariat. This liaison and coordination council published a concept paper in October 2015, in which it establishes that the ideal vision of MDA in Japan is not limited to the area of security, but includes a wide range of objectives such as natural disaster measures, and comprises information and systems with a basic three-tier structure. Furthermore, the document on strengthening the capacity of MDA approved by the Headquarters for Ocean Policy in July 2016, presents a structure headed by the National Security Council, the Secretariat of the Headquarters for Ocean Policy, and the National Space Policy Secretariat as the three "control towers," with the Japan Coast Guard managing and operating systems in the first and second tiers. Here, the three tiers are established as follows: the first tier is information systems that can also be used by the private sector; the second tier is information and systems that are shared among government agencies; and the third tier is the real-time sharing of information between ministries and agencies that are related to security. The review of MDA in Japan became

more in-depth in response to these decisions, and MDA was upgraded as a new item in Chapter 2 of the third Basic Plan on Ocean Policy, approved by the Cabinet in May 2018. MDA is positioned as a measure that serves as a "foundation for contributing to reinforcement of maritime security," which is also clear from the positioning of "Comprehensive Maritime Security" at the beginning of the Basic Policy in the third Basic Plan on Ocean Policy. Reviews and the development of systems related to MDA are progressing based on this Basic Plan.

2 Start of the Operation of Information Systems to Handle MDA

In April 2019, the government consolidated the ocean information collected and held by itself, and commenced the operation of MDA Situational Indication Linkages (MSIL), an information service that superimposes and displays the information on Web-GIS. This service targets the first and second tiers of MDA that the Japan Coast Guard is responsible for, and information from the first tier is made widely available to the general public through the Internet.

The main characteristic of MSIL is that it consolidates the wide range of ocean information managed by the relevant ministries and agencies, and integrates both the social information and natural science information of the ocean on the same central platform. While there is also much information that has not been included in the first tier, such as vessel movements, the consolidation of Japan's ocean information has finally reached its starting point with the operation of this system. Through MSIL, there are also plans to actively apply this ocean information, which is also a public asset, to the maritime industry.

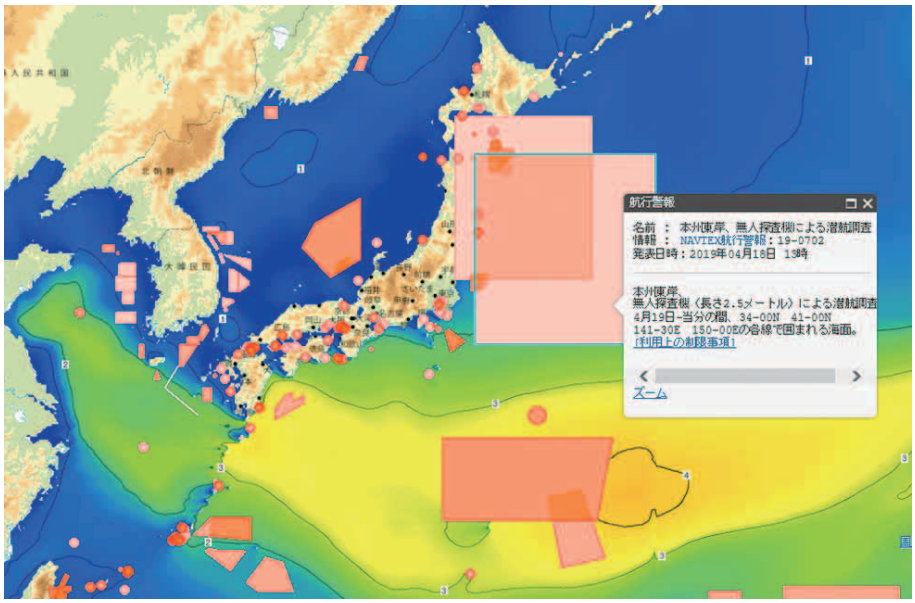


Figure 5-4 Example of information display on MSIL
(Superimposition of navigational warning zones on a wave map)
(Source : Prepared based on https://www.msil.go.jp)

3 Ocean information in the Future —Towards Ocean Information Ventures

As explained above, the positioning of MDA initiatives as a "foundation for contributing to reinforcement of maritime security" in the third Basic Plan on Ocean Policy played an important role in the realization of the consolidation of ocean information through MSIL, which had previously been difficult to realize. We could say that MDA has created a major demand for the sharing of information. Meanwhile, in addition to this policy-related perspective, a technological perspective that covers the aspect of the advancement of information technology is also vital. In other words, Geographical Information Systems (GIS) and the data processing technologies that support GIS have advanced by leaps and bounds over the last decade, enabling the real-time handling of natural science information, which is characterized by vast information volume and significant temporal variations. Technological innovation is gradually bringing about significant changes to the world of the ocean. In the near future, how will it impact ocean information systems?

For example, autonomous operation technology is developing in the shipping sector just as it has advanced in the automotive sector, and demonstration experiments of these ships are being conducted around the world. As autonomous-operating ships need to share a large volume of navigation-related data with the land, there is the possibility that ship information could move swiftly in the direction of Big Data in the future. The fisheries industry has also changed its direction significantly towards becoming a "profitable fishery industry," in response to the amendments to the Fishery Act in December 2018. The highlight of these amendments is the IoT fishery industry, underscoring the fact that the information revolution is advancing even in the fishery industry, including in the aquaculture industry. Furthermore, moves to establish offshore wind farms have also accelerated with the entering into force of the Act on Promoting Utilization of Sea Areas in Development of Power Generation Facilities Using Maritime Renewable Energy Resources[14] in April 2019.

There have also been advancements in the development of technology for collecting information. For example, Planet Labs, Inc. has achieved daily monitoring through high-resolution images produced by using close to 200 small satellites. VHF Data Exchange System (VDES), a next-generation AIS, may commence operations during the 2020s, and is expected to function as base communications infrastructure on the seas. Other forms of technological innovation include the development of ultra-compact marine observing buoys and technology for understanding ecosystems known as "Environmental DNA," and the list of new and innovative technologies goes on. The organization that embodies such ocean information management in the near future is Google, the giant of the IT sector. Global Fishing Watch, an international non-profit organization established in June 2017 with the support of Google, harnesses AI to eradicate illegal fishing. By analysing a vast volume of information about fishing vessels through means such as artificial satellites and AIS, it visualizes fishery activities around the world and releases this

14 Tsunoda T., "Towards the Popularization of Offshore Wind Power Generation — The Enactment of the Act to Promote Offshore Use by Offshore Renewable Energy Facilities" in *Ocean Newsletter No. 448*. 2019.

information to the public. The actual situation with regard to fishery activities that had been kept within a “black box” till now, has been brought to light through Google.

Going forward, ocean information will become a mixture of wheat and chaff, and will be accessible to anyone who has the means and skills to do so. It will be up to the user to make it into worthless trash, or to transform it into a treasure trove. MSIL is one such mixture, and motivated initiatives by the private sector will stimulate the further utilization of ocean information. Information ventures will also emerge in the maritime sector, just as in various other industries. These will promote new uses of the ocean, and the creation of a virtuous cycle for ocean information and utilization of the ocean is anticipated.

(Tomohiko Tsunoda)