# Mon. May 31, 2021

[J] Oral | U (Union )：Union

9:00 AM - 10:30 AM JST | 12:00 AM - 1:30 AM UTC | Ch.01 Zoom Room 01

## [U-01] Earth and Planetary Science Community and the Science Council of Japan

convener:Eiichi Tajika(Department of Earth and Planetary Science, Graduate School of Science, The University of Tokyo), Kenji Satake(Earthquake Research Institute, University of Tokyo), Taikan Oki(Graduate School of Engineering, The University of Tokyo), Gaku Kimura(Japan Agency for Marine-Earth Science and Technology), Chairperson:Eiichi Tajika(Department of Earth and Planetary Science, Graduate School of Science, The University of Tokyo), Taikan Oki(Graduate School of Engineering, The University of Tokyo)

9:00 AM - 9:05 AM JST | 12:00 AM - 12:05 AM UTC

[U01-01] Introduction

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9:05 AM - 9:30 AM JST | 12:05 AM - 12:30 AM UTC

[U01-02] Science Council of Japan, Scientific advices, Academy

★Invited Papers

*Takaaki Kajita[1,2] (1.Science Council of Japan, 2.The University of Tokyo)

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9:30 AM - 9:45 AM JST | 12:30 AM - 12:45 AM UTC

[U01-03] Science Council of Japan from the perspective of science and technology diplomacy

★Invited Papers

*Teruo Kishi[1,2] (1.The Innovative Structural Materials Association, 2.The University of Tokyo)

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9:45 AM - 10:00 AM JST | 12:45 AM - 1:00 AM UTC

[U01-04] Science Council of Japan: The System since the 20th Period

★Invited Papers

*Masaru Kono[1] (1.Tokyo Institute of Technology)

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10:00 AM - 10:15 AM JST | 1:00 AM - 1:15 AM UTC

[U01-05] Multidisciplinary view of cross-cutting academic fields

★Invited Papers

*Shigeko Haruyama[1] (1.Mie University)

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10:15 AM - 10:30 AM JST | 1:15 AM - 1:30 AM UTC

[U01-06] Recognizing an interface between science and decision making and promoting consilience

★Invited Papers

*Toshio Koike[1,2] (1.Professor Emeritus, the University of Tokyo, 2.Council Member of Science Council of Japan, Cabinet Office)

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10:45 AM - 12:15 PM JST | 1:45 AM - 3:15 AM UTC | Ch.01 Zoom Room 01

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10:45 AM - 11:00 AM JST | 1:45 AM - 2:00 AM UTC

[U01-07] The formulation of the Master Plan for large research projects by the Science Council of Japan

★Invited Papers

*Ryoichi Fujii[1] (1.Research Organization of Information and Systems)

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11:00 AM - 11:15 AM JST | 2:00 AM - 2:15 AM UTC

[U01-08] Contribution of the SCJ as a National Academy to International Scientific Organizations

★Invited Papers

*Nobuko Saigusa[1] (1.National Institute for Environmental Studies)

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11:15 AM - 11:30 AM JST | 2:15 AM - 2:30 AM UTC

[U01-09] Young Academy of Japan

★Invited Papers

*Shinsuke Kawagucci[1,2] (1.Japan Agency for Marine-Earth Science & Technology, 2.Young Academy of Japan)

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11:30 AM - 12:15 PM JST | 2:30 AM - 3:15 AM UTC

[U01-10] Discussion

[J] Oral | U (Union ) : Union

1:45 PM - 3:15 PM JST | 4:45 AM - 6:15 AM UTC | Ch.01 Zoom Room 01

## [U-02] Ten years from the 2011 Tohoku Earthquake: A milestone of earth science

convener:Ryota Hino(Graduate School of Science, Tohoku University), Katsunori FUJIKURA(Japan Agency for Marine-Earth Science and Technology), Motoyuki Kido(International Research Institute for Disaster Science, Tohoku University), Chairperson:Shuichi Kodaira(Research Institute of Marine Geodynamics, Japan Agency for Marine-Earth Science and Technology), Motoyuki Kido(International Research Institute for Disaster Science, Tohoku University)

1:45 PM - 2:03 PM JST | 4:45 AM - 5:03 AM UTC

[U02-01] **Overview of the 2011 off the Pacific coast of Tohoku Earthquake and the lessons learned from the earthquake**

★Invited Papers

*Toru Matsuzawa[1] (1.Research Center for Prediction of Earthquakes and Volcanic Eruptions, Graduate School of Science, Tohoku University)

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2:03 PM - 2:21 PM JST | 5:03 AM - 5:21 AM UTC

[U02-02] Tsunami source of the 2011 Tohoku earthquake

★Invited Papers

*Kenji Satake[1], Yushiro Fujii[2] (1.Earthquake Research Institute, University of Tokyo, 2.IISEE, Building Research Institute)

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2:21 PM - 2:39 PM JST | 5:21 AM - 5:39 AM UTC

[U02-03] **Ten years behavior of radionuclides in the North Pacific Ocean derived from TEPCO Fukushima Dai-ichi Nuclear Power Plant accident**

★Invited Papers

*Michio Aoyama[1,2] (1.Center for Research in Isotopes and Environmental Dynamic, Faculty of Life and Environmental Sciences, University of Tsukuba, 2.Institute of Environmental radioactivity, Fukushima University)

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2:39 PM - 2:57 PM JST | 5:39 AM - 5:57 AM UTC

[U02-04] The impact and fate of fallout radionuclides by Fukushima Daiichi Nuclear Power Plant Accident in Terrestrial systems

★Invited Papers

*Yuichi Onda[1] (1.Center for Research on Isotopes and Environmental Dynamics, University of Tsukuba)

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2:57 PM - 3:15 PM JST | 5:57 AM - 6:15 AM UTC

[U02-05] Progress of "Comprehensive Disaster Prevention Education" at Japan Geoscience Union Meeting

★Invited Papers

*Hitoshi Nakai[1] (1.Kobuchisawa Research Institute for Nature and Education)

[J] Oral | U (Union ) : Union

3:30 PM - 5:00 PM JST | 6:30 AM - 8:00 AM UTC | Ch.01 Zoom Room 01

## [U-02] Ten years from the 2011 Tohoku Earthquake: A milestone of earth science

convener:Ryota Hino(Graduate School of Science, Tohoku University), Katsunori FUJIKURA(Japan Agency for Marine-Earth Science and Technology), Motoyuki Kido(International Research Institute for Disaster Science, Tohoku University), Chairperson:Katsunori FUJIKURA(Japan Agency for Marine-Earth Science and Technology), Ryota Hino(Graduate School of Science, Tohoku University)

3:30 PM - 3:48 PM JST | 6:30 AM - 6:48 AM UTC

[U02-06] Reconstruction of fisheries from the Great East Japan Earthquake and tsunami (GEJE)- Studies on reconstruction of fisheries by TEAMS Project-

★Invited Papers

*Akihiro Kijima[1], Toshi Nagata[2], Katsunori Fujikura[3] (1.Tohoku University, 2.AORI, 3.JAMSTEC)

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3:48 PM - 4:06 PM JST | 6:48 AM - 7:06 AM UTC

[U02-07] Early warnings of ground motion and tsunami: Research development of last 10 years

★Invited Papers

*Mitsuyuki Hoshiba[1], Hiroaki Tsushima[1] (1.Meteorological Research Institute)

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4:06 PM - 4:24 PM JST | 7:06 AM - 7:24 AM UTC

[U02-08] Progress in tsunami deposit study after the 2011 Tohoku Earthquake

★Invited Papers

*Masanobu Shishikura[1] (1.Institute of Earthquake and Volcano Geology, National Institute of Advanced Industrial Science and Technology)

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4:24 PM - 4:42 PM JST | 7:24 AM - 7:42 AM UTC

[U02-09] Study of giant tsunamis based on geological data in the future

★Invited Papers

*Yukinobu Okamura[1] (1.Research Institute of Earthquake and Vocano Geology, National Institute of Advanced Industrial Science and Technology)

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4:42 PM - 5:00 PM JST | 7:42 AM - 8:00 AM UTC

[U02-10] Nuclear Power and Geoscience in Japan: 10 years after the 3.11 complex disaster

★Invited Papers

*Daisuke Suetsugu[1], Satoshi Kaneshima[2], Takeshi Sagiya[4], Kohta Juraku[3] (1.institute for Marine Geodynamics, Japan Agency for Marine-Earth Science and Technology, 2.Department of Earth and Planetary Sciences, Kyushu University, 3.Department of Humanities, Social and Health Sciences, School of Engineering, Tokyo Denki University, 4.Disaster Mitigation Research Center, Nagoya University)

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## [U-01] Earth and Planetary Science Community and the Science Council of Japan

convener:Eiichi Tajika(Department of Earth and Planetary Science, Graduate School of Science, The University of Tokyo), Kenji Satake(Earthquake Research Institute, University of Tokyo), Taikan Oki(Graduate School of Engineering, The University of Tokyo), Gaku Kimura(Japan Agency for Marine-Earth Science and Technology), Chairperson:Eiichi Tajika(Department of Earth and Planetary Science, Graduate School of Science, The University of Tokyo), Taikan Oki(Graduate School of Engineering, The University of Tokyo)

The future of the Science Council of Japan (SCJ) is now being discussed. The reform of SCJ in 2005 has weakened the relationship between SCJ and the academic societies. Not only young researchers but also mid-career and above researchers are becoming distant, and some researchers profess that they will not be in trouble without SCJ. But is that true? The Earth and Planetary Science Committee is the largest organization in SCJ, consisting of a total of about 60 committees. The SCJ also serves as the contact point for international academic societies on the Japanese side, and related organizations in the field of Earth and planetary science account for one-third of the total. This is also the largest among all academic committee in SCJ. In addition, the "Master Plan for Large-scale Academic Facility and Large-scale Research Projects", which is revised by SCJ every three years, is extremely important for the realization of large-scale scientific projects, so we are supporting applications throughout the field of Earth and planetary science. , 13 projects were adopted for Master Plan 2020, and 4 projects were adopted for Priority Large-scale Research Plan. We will discuss the role and significance of SCJ for the Earth and planetary science community and society, and what is needed for SCJ to be a literal "representative organization of our scientific community"

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Mon. May 31, 2021 9:00 AM - 10:30 AM Ch.01 (Zoom Room 01)

The future of the Science Council of Japan (SCJ) is now being discussed. The reform of SCJ in 2005 has weakened the relationship between SCJ and the academic societies. Not only young researchers but also mid-career and above researchers are becoming distant, and some researchers profess that they will not be in trouble without SCJ. But is that true? The Earth and Planetary Science Committee is the largest organization in SCJ, consisting of a total of about 60 committees. The SCJ also serves as the contact point for international academic societies on the Japanese side, and related organizations in the field of Earth and planetary science account for one-third of the total. This is also the largest among all academic committee in SCJ. In addition, the "Master Plan for Large-scale Academic Facility and Large-scale Research Projects", which is revised by SCJ every three years, is extremely important for the realization of large-scale scientific projects, so we are supporting applications throughout the field of Earth and planetary science. , 13 projects were adopted for Master Plan 2020, and 4 projects were adopted for Priority Large-scale Research Plan. We will discuss the role and significance of SCJ for the Earth and planetary science community and society, and what is needed for SCJ to be a literal "representative organization of our scientific community"

9:00 AM - 9:05 AM

## [U01-01]Introduction

# Science Council of Japan, Scientific advices, Academy

*Takaaki Kajita[1,2]

1. Science Council of Japan, 2. The University of Tokyo

Many countries have national academies. that maintain independence from the government. These academies propose future visions of society from an unbiased and scientific point of view and form common understandings of science through international collaborative activities. The Science Council of Japan was established in 1949 with the conviction that science is the foundation of a cultural nation, with the aim of reflecting science in administration, industry and people's lives, and has since served as the Japanese academy.

In the last 70 years, science has developed tremendously; human activities have become enormous, people's lives have been enriched, and, as a consequence, problems that threaten human sustainability, such as global warming and marine plastic problems, have become apparent. In addition, modern society faces many problems such as declining and aging population, intergenerational, gender and minority disparities, and constant regional conflicts. The Science Council of Japan wants to contribute to improve society by disseminating insightful proposals and opinions in cooperation with academies around the world.

As the times change, the role required to the Science Council of Japan is also changing. Therefore, the Science Council of Japan issued "Toward a better role of the Science Council of Japan (interim report)" in December 2020. We are also preparing to issue the final report in April this year. In this talk, I would like to introduce what we are thinking for the better role of the Science Council of Japan and think together with you about the future of the Science Council of Japan.

Keywords: Science Council of Japan, Scientific advices, Academy

# Science Council of Japan from the perspective of science and technology diplomacy

*Teruo Kishi[1,2]

1. The Innovative Structural Materials Association, 2. The University of Tokyo

In 2015, a Science and Technology Advisor to the Minister for Foreign Affairs was placed in the Ministry of Foreign Affairs, and I was appointed as the first advisor and had worked in science and technology diplomacy for about four and a half years. Science and technology (hereinafter abbreviated as science) diplomacy has the following three roles.

The first is "Science in Diplomacy", where advice and recommendations to the Minister for Foreign Affairs play an important role. For example, regarding the STI for SDGs, I recommended to make a roadmap through international cooperation, which I had a presentation to the world at the United Nations Headquarters in New York.

The second is "Diplomacy for Science", which aims to contribute to the improvement of science and technology in Japan through diplomatic activities. In collaboration with the Japanese embassy abroad and the Cabinet Office, I introduced the status of research and development for innovation in Japan to each country and discussed future international cooperation.

The third is "Science for Diplomacy". I have formed a network with the people in charge of science and technology diplomacy in each country and have explored the contribution of science and technology to future diplomacy. The Ministry of Foreign Affairs Science and Technology Advisory Network (FMSTAN) was established in 2016 in the United States, the United Kingdom, New Zealand, and Japan, and has considered the ideal way of scientific advice.

Replacing the term of “diplomacy” with “policy” means "Science in Policy", "Policy for Science" and "Science for Policy". These words are directly linked to the positioning of advice, recommendations, and exhortations, which are the most important roles of the academy. In the world of science and technology in Japan, the Science in Policy is promoted by the Council for Science, Technology and Innovation (CSTI) in the Cabinet Office, and the councils take on the role in each ministry and agency. Policy for Science is the CSTI's most important task. On the other hand, it is the role of the academy to promote Science for Policy.

The promotion that clarifies these positions is not understood well in Japan. For example, even in the case of COVID-19's countermeasures, scientists have been taken in by the government, and there is no place to truly consider Science for Policy without leaving the area of Science in Policy. Infectious diseases are a long-term issue, and it is expected that the Science Council of Japan will continue to set up an infectious disease control committee that gathers top-level researchers.

On the other hand, the Science Council also exposed a big problem in the appointment of members. It is hard to admit that the government has refused to appoint, but the Science Council of Japan, which has omitted this time, is also responsible for the fact that the previous appointment of members had substantive prior consultations. However, it is difficult to understand why the organizational review has surfaced.

The Japan Academy Prize exists as an honorary institution, and the organization that is separated from the Science Council of Japan as a discussion institution is one of the characteristics of Japan. The idea of persuasiveness is an important point of view because it is a report of a prestigious scientist. Members are appointed by Co-optation all over the world, but only Japan has a fixed term system. The definition of a researcher as the basis for selecting members is based on the holder of a PhD degree. Consideration of this point is also necessary for the quota allocation.

Another important point is the assumption that science has no borders, and it is necessary to always cooperate with academic conferences around the world and disseminate information from global perspectives.

The last thing I would like to add is the approach to dual use. This is the reason why the Japanese government has repelled this time, and it is important for sensible adults to respond to the fact that it is difficult to separate military research from civil one. In addition, research integrity, such as the diversion and transposition of technology, will become a major issue in the future, and we must pay attention to this point as well.

Keywords: science and technology diplomacy, Science Council of Japan

# Science Council of Japan: The System since the 20th Period

*Masaru Kono[1]

1. Tokyo Institute of Technology

The Science Council of Japan was established in 1949, and actively submitted many recommendations and opinions to the government. But the relation between the government and the SCJ was not smooth all the time. The law of the SCJ was updated in 2004, and a new system for the SCJ was introduced in 2005 at the start of the 20th Period.

The important changes implemented at the 20th Period are (1) the SCJ consists of 3 Sections instead of the former 7 divisions, (2) the members are elected by co-optation, and others. In the area of science familier with us, the most important change was, (3) whereas there were separate Kenkyu-Renraku-Iinkais for Geology, Geography, and Geophysics before the change, all of these disciplines were merged into a single disciplinary committee of Earth and Planetary Sciences.

This system was continued to the present day without big changes. Accordingly, we need to examine the system since 2005 to understand the problems the SCJ is facing today.

Keywords: The Science Council of Japan

 

# Multidisciplinary view of cross-cutting academic fields

*Shigeko Haruyama[1]

1. Mie University

The Science Council of Japan is a specific organization that has scientists in a wide range of academic fields including the humanities and social sciences, life sciences, natural science and engineering. Demonstrating these academic fields as a comprehensive strength, it is possible to examine and develop super-interdisciplinary issues as addressing research goals from more bird’ s-eye view. In addition, considering the role as a “resource of knowledge of society” considering the unique characteristics of the existence of the Science Council of Japan itself, developing cross-disciplinary discussions will challenge future sciences and society in Japan for conquest of various issues.

Keywords: interdiscipline, Science Council of Japan, environmental problem

 

# Recognizing an interface between science and decision making and promoting consilience

*Toshio Koike[1,2]

1. Professor Emeritus, the University of Tokyo, 2. Council Member of Science Council of Japan, Cabinet Office

The Charter of the Science Council of Japan (SCJ) declares: “The Science Council of Japan shall, after a process of careful deliberation, publicly communicate scientifically-based information, well-informed recommendations and opinions, thereby contributing to social choices regarding public policies and social institutions.” Dr. A. Weinberg, who pioneered the boiling water reactor, argues that there are “questions which can be asked of science and yet which cannot be answered by science.” Society and science definitely need to engage in deep deliberation on an interface between responsibility for making decisions by politics and society and careful science-based deliberation by the science community.

In the process of an administrative reform in Japan, SCJ faced a crisis of existence under the criticism that its raison d'etre was not clear for citizens to understand. In response to such criticism, at the beginning of its 18th term (2000-2003), SCJ started to discuss a new scientific system based on circumstances surrounding science and the relationship between science and society, and finalized a report, "A New Scientific System: Science for society and the harmonization of social and natural sciences." In its 20th term (2005-2008), SCJ issued an external report, "Proposal: Integration of Knowledge: Toward Science for Society," and proposed that an enhanced linkage between cognizing science and designing science is important for "science for society." In its 21st term (2008-2011), SCJ issued another report, "Recommendation toward 'Consilience' as Science for Society," and recommended developing "consilience knowledge base" as a basis of consilience and cultivating and increasing human resources. SCJ should further promote consilience so that science can contribute to resolving social problems by people and sovereign.

Based on the ideas described in the two paragraphs, “public communication”, which is declared as one of the key missions of SCJ in its Charter, will be discussed by quoting several examples.

Keywords: consilience, science-based deliberation, decision making

 

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★Invited Papers

*Ryoichi Fujii[1] (1.Research Organization of Information and Systems)

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★Invited Papers

*Shinsuke Kawagucci[1,2] (1.Japan Agency for Marine-Earth Science & Technology, 2.Young Academy of Japan)

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11:30 AM - 12:15 PM JST | 2:30 AM - 3:15 AM UTC

### [U01-10] Discussion

# The formulation of the Master Plan for large research projects by the Science Council of Japan

*Ryoichi Fujii[1]

1. Research Organization of Information and Systems

The Science Council of Japan has been formulating the Master Plan for large research projects every three years. The latest Master Plan was issued in 2020, to which 150 projects were proposed from 22 fields including integrated fields in which two or more fields were involved. The Master Plan places importance on bottom-up involvement by scientist communities and it formulates large research projects covering with all scientific fields and out of which it selects important large research projects that should be implemented particularly promptly from among the proposed projects. The master plan aims at providing academic perspective on how Japanese large research projects should be, and hence the evaluation and adoption of the proposal projects are purely based on scientific significance. It should be noted that it is principally not directly related to budget allocation for research budget allocation organizations.

Keywords: large research projects , Master Plan, Science Council of Japan

 

# Contribution of the SCJ as a National Academy to International Scientific Organizations

*Nobuko Saigusa[1]

1. National Institute for Environmental Studies

Earth and planetary sciences cover a wide range of fields, from planets in the solar system, atmospheric and hydrospheric sciences, solid earth science, biogeochemistry, and environmental and global sustainability. When scientists from various countries and regions work together on the common research target of "the Earth", international collaboration is indispensable for global observation, future predictions, social implementation, and the development of human resources necessary for all of these activities.

The Science Council of Japan (SCJ) has dozens of subcommittees in the field of earth and planetary sciences, many of which serve as Japan's liaison to international academic organizations. SCJ is a member of 44 international scientific organizations, 12 of which are in the field of earth and planetary sciences. The community of the earth and planetary sciences has a particularly important task in strengthening international collaboration and human resource development.

International academic organizations play a variety of roles. For example, the role of the international academy is essential in coordinating the standardization of geographic information and mapping methods. Standardization is also required for developing various observational methods, Quality Control and Quality Assurance of the data, and global observation networks and databases to understand the Earth system. Scientific evidences compiled by international organizations are also essential for the establishment of international environmental regulations. Discussion in this presentation will include various roles of the international academic organizations and SCJ’s contribution to the organizations as a national academy.

Keywords: SCJ, International Promotion, National Academy

# Young Academy of Japan

*Shinsuke Kawagucci[1,2]

1. Japan Agency for Marine-Earth Science & Technology, 2. Young Academy of Japan

Young Academy of Japan is made up of researchers under the age of 45 who are engaged in cutting-edge research in a variety of fields, including the humanities, social sciences and natural sciences. As a unique organisation, characterised by specific expertise and diverse backgrounds, Young Academy of Japan carries out a wide range of activities from the point of view of young researchers, the future of academia.

Keywords: Young Academy of Japan

 

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# [U-01] Earth and Planetary Science Community and the Science Council of Japan

convener:Eiichi Tajika(Department of Earth and Planetary Science, Graduate School of Science, The University of Tokyo), Kenji Satake(Earthquake Research Institute, University of Tokyo), Taikan Oki(Graduate School of Engineering, The University of Tokyo), Gaku Kimura(Japan Agency for Marine-Earth Science and Technology), Chairperson:Kenji Satake(Earthquake Research Institute, University of Tokyo), Gaku Kimura(Japan Agency for Marine-Earth Science and Technology)

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## [U-02] Ten years from the 2011 Tohoku Earthquake: A milestone of earth science

convener:Ryota Hino(Graduate School of Science, Tohoku University), Katsunori FUJIKURA(Japan Agency for Marine-Earth Science and Technology), Motoyuki Kido(International Research Institute for Disaster Science, Tohoku University), Chairperson:Shuichi Kodaira(Research Institute of Marine Geodynamics, Japan Agency for Marine-Earth Science and Technology), Motoyuki Kido(International Research Institute for Disaster Science, Tohoku University)

The 2011 Tohoku-Oki Earthquake prompted active research in a wide range of fields of earth science. Through researches on the generation mechanism and recurrence history of the earthquake associating massive tsunami itself, as well as researches on various kinds of large-scaled postseismic phenomena progressing over a broad area after the earthquake, a number of important aspects of the earth interior has been brought about. This earthquake also served as a turning point in research on forecasting of earthquakes and tsunamis, highlighting the difficulty of long-term forecasting of low-frequency but gigantic earthquakes and tsunamis, while promoting research and development on early warning technologies based on real-time observations. Furthermore, the huge earthquake and tsunami, as well as the nuclear power plant accident, gave a significant impact on the natural environment over a wide area centered on eastern Japan. Earth scientists have made significant effort to understand the actual situation of the impact and also to monitor the temporal variation. On the other hand, lively discussions have been held on how the knowledge gained through such energetic research activities can be utilized for disaster prediction / countermeasures and recovery from disasters. In this session, we will discuss the path that earth science research should take in the future, based on the results of research in the 10 years since the 2011 Tohoku-Oki Earthquake and the Disaster.

1:45 PM - 2:03 PM JST | 4:45 AM - 5:03 AM UTC

[U02-01] **Overview of the 2011 off the Pacific coast of Tohoku Earthquake and the lessons learned from the earthquake**

★Invited Papers

*Toru Matsuzawa[1] (1.Research Center for Prediction of Earthquakes and Volcanic Eruptions, Graduate School of Science, Tohoku University)

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2:03 PM - 2:21 PM JST | 5:03 AM - 5:21 AM UTC

[U02-02] Tsunami source of the 2011 Tohoku earthquake

★Invited Papers

*Kenji Satake[1], Yushiro Fujii[2] (1.Earthquake Research Institute, University of Tokyo, 2.IISEE, Building Research Institute)

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2:21 PM - 2:39 PM JST | 5:21 AM - 5:39 AM UTC

[U02-03] **Ten years behavior of radionuclides in the North Pacific Ocean derived from TEPCO Fukushima Dai-ichi Nuclear Power Plant accident**

★Invited Papers

*Michio Aoyama[1,2] (1.Center for Research in Isotopes and Environmental Dynamic, Faculty of Life and Environmental Sciences, University of Tsukuba, 2.Institute of Environmental radioactivity, Fukushima University)

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2:39 PM - 2:57 PM JST | 5:39 AM - 5:57 AM UTC

[U02-04] The impact and fate of fallout radionuclides by Fukushima Daiichi Nuclear Power Plant Accident in Terrestrial systems

★Invited Papers

*Yuichi Onda[1] (1.Center for Research on Isotopes and Environmental Dynamics, University of Tsukuba)

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2:57 PM - 3:15 PM JST | 5:57 AM - 6:15 AM UTC

## [U02-05] Progress of "Comprehensive Disaster Prevention Education" at Japan Geoscience Union Meeting

★Invited Papers

*Hitoshi Nakai[1] (1.Kobuchisawa Research Institute for Nature and Education)

# Overview of the 2011 off the Pacific coast of Tohoku Earthquake and the lessons learned from the earthquake

*Toru Matsuzawa[1]

1. Research Center for Prediction of Earthquakes and Volcanic Eruptions, Graduate School of Science, Tohoku University

## 1. Introduction

Ten years have passed since the 2011 off the Pacific coast of Tohoku earthquake of M9.0 (hereinafter referred to as the "Tohoku-oki earthquake"). The whole picture of this earthquake is gradually becoming more evident. In my talk, I will describe an overview of this earthquake and the lessons learned from it. Please refer to Dr. Shishikura's lecture in this session for details of the tsunami deposits and Prof. Satake's lecture for details of the tsunami.

## 2. Before the earthquake

Although an ancient document showed a huge earthquake with a large tsunami in Miyagi prefecture in 869 A.D., it was not until around 2000 that the existence of the earthquake was proven from the tsunami deposits. It was only in 2010 that we learned that similar earthquakes had repeatedly occurred at intervals of about 600 years, with the last event about 600 years ago (Okamura et al., 2010).

On the other hand, the plate boundary off Miyagi and Fukushima prefectures had been strongly locked from the beginning of GNSS observations in Japan in 1994 until the end of the 20th century. Since the beginning of the 21st century, the locking had been loosened (e.g., Suito et al., 2011), which is considered as a precursor to the Tohoku-Oki earthquake. However, seismic quiescence was observed during the period when the locking appeared to be strong (Katsumata, 2016), and thus the strong-locking period might be rather abnormal.

A slow-slip event occurred off Miyagi Prefecture from February 2011, which triggered the March 9 foreshock (M7.3), and the afterslip of this foreshock is thought to have triggered the March 11 main shock (Ito et al., 2013). In other words, seismic slip and slow slip occurred alternately like a domino effect, leading to the occurrence of the Tohoku-oki earthquake.

## 3. Main shock

At the time of the earthquake, a vast plate boundary extending about 500 km N-S and about 200 km E-W was slipped, and a slip of about 50 m occurred near the trench (e.g., Iinuma et al. l., 2012). The reasons for such large slip include the existence of a large strong patch (e.g., Kato and Yoshida, 2011), the fact that the slip penetrated the trench (Ide et al., 2011), the occurrence of the thermal pressurization (e.g., Mitsui et al., 2012), and small elastic constants in the shallow part (Lay et al., 2011). The reasons for the vast slip area are considered to be wide conditionally stable regions (Hori and Miyazaki, 2011) as well as the large strong patch.

## 4. After the earthquake

The earthquake was followed by large-scale afterslip and viscoelastic relaxation (e.g., Sun et al., 2014). The Pacific coastline had been subsiding for more than 100 years before the earthquake (e.g., Nishimura, 2012), and it also subsided at the time of the earthquake, followed by uplift to the present. This pattern occurred because of the main rupture zone location, which was on the shallower side of the plate boundary, and the viscoelastic relaxation (Sun and Wang, 2015). According to a viscoelastic relaxation model inferred from the postseismic deformation data, such an earthquake is expected to be followed by the uplift of the coastline for about 300 years, followed by subsidence for about 300 years before the next M9 earthquake occurs (Sasajima et al., 2019).

**5. Concluding remarks: lessons learned from the earthquake**

The reason why we could not foresee such a huge earthquake can be summed up in one sentence: we "overlearned" the limited information we had. The information obtained from this earthquake is invaluable, and it is vital to learn from it, but we should not overlearn it. Otherwise, what we have learned will turn into preconceptions, and the next M9 earthquake will be an "unexpected earthquake" again. Great care must be taken to prevent this from happening.

Keywords: Tohoku-oki earthquake, lessons learned from the earthquake

# Tsunami source of the 2011 Tohoku earthquake

*Kenji Satake[1], Yushiro Fujii[2]

1. Earthquake Research Institute, University of Tokyo, 2. IISEE, Building Research Institute

For the 2011 Tohoku earthquake, many models of slip distribution based on seismic waves, geodetic and tsunami data have been proposed. The maximum slip is located at around 38°N near the epicenter off Miyagi prefecture, and the northern edges of most models are at around 39.5°N. The coastal tsunami height was largest around Miyako city at 39.5°N, which is roughly 100 km north of the maximum slip.

Satake et al. (2013, BSSA) made inversion of tsunami waveforms recorded on bottom pressure, GPS and costal wave and tide gauges to estimate the spatial and temporal distribution of coseismic slips. Their result indicates that a very large slip (maximum 69 m) occurred near the trench axis, and it propagated toward the north along the trench. They concluded that the delayed slip in the northern source region (39.5 –40°N) near the trench axis was the main cause of the largest tsunami in Iwate prefecture.

Tsunami waveform inversion reconstructs the temporal and spatial distribution of sea surface (seafloor) displacement, but cannot give the cause. Tappin et al. (2014, Marine Geology) claimed that the cause of the large tsunami on the Iwate coast is a submarine landslide. Their analysis indicates that the submarine landslide occurred at 135 seconds after the origin time at around 39.5°N along Japan Trench, with a length of 40 km, a width of 20 km, a slope thickness of 2 km, a vertical offset (rotation) of 100 m. The total landslide volume was estimated as 500 $km^3$. Fujiwara et al. (2017, GRL), based on the differential bathymetry mapping before and after the earthquake, found no larger-scale (> 20 m) horizontal displacement of the seafloor was detected on the north (39.5°N), while they detected such displacement near the epicenter (38 –38.5°N). Yamazaki et al. (2018, JGR) started from a source model based on seismic waves, and modified it to reproduce the tsunami observations (waveforms and runup data), and reached a source model similar to Satake et al., extending to 39.5°N along the trench axis. They further confirmed that this model can explain the observed seismic and geodetic data, indicating that the slip at 39.5°N near the trench axis was not resolvable from seismic or geodetic data.

Near the trench axis off Iwate prefecture, the 1896 Sanriku tsunami earthquake occurred. The coastal tsunami heights on Sanriku coasts were similar for the 1896 and 2011 events, while amplitudes of the 2011 tsunami waveforms were much larger in Hokkaido (Hanasaki), Southern Tohoku (Ayukawa) and Kanto (Choshi). Such differences can be reproduced by a model that the 1896 tsunami source was slightly far from the trench axis, on 3.5 –7 km depth (compared to 0 –3.5 km in 2011). Both the 1896 and 2011 tsunami earthquakes were generated near the trench axis off Iwate prefecture, but their depth was slightly different (Satake et al., 2017, Geoscience Letters).

Keywords: Tohoku earthquake, Tsunami, Japan Trench, 1896 Sanriku earthquake

# Ten years behavior of radionuclides in the North Pacific Ocean derived from TEPCO Fukushima Dai-ichi Nuclear Power Plant accident

*Michio Aoyama[1,2]

1. Center for Research in Isotopes and Environmental Dynamic, Faculty of Life and Environmental Sciences, University of Tsukuba, 2. Institute of Environmental radioactivity, Fukushima University

As a result of the big earthquake and the huge Tsunami on 11 March 2011, and the reactor accident at the Fukushima Daiichi Nuclear Power Plant, hereafter FNPP1, due to total power loss made meltdown of three cores of FNPP1. Then, a large amount of radionuclides was released into the environment. The total amount of radiocaesium released into the environment is one of the global concerns, as the major long-lived radionuclides released from the accident were long-lived radiocaesium, namely 134Cs and 137Cs. Based on the law of conservation of mass, I and my collaborators had estimated the total amount of released radiocaesium based on ocean observations of radiocaesium activity concentration taking into account mass balance. By observing the North Pacific Ocean by the ships and deposition estimated by three atmospheric transport model results, we were able to estimate the total amount of 137Cs in the North Pacific. This amount was estimated to be 15-18 PBq. This estimation has been verified by two methods. From the results of coastal modeling, the total amount of direct discharge of 137Cs was 3.5 ± 0.7 PBq, which was the first and most accurate result. Since the amount of direct release is accurately determined, the amount of 137Cs released into the atmosphere is also properly determined in consideration of mass balance. After injected into the ocean, half of the injected radiocaesium remained in the surface layer while the second half of the injected radiocaesium subducted into the two mode waters, namely STMW and CMW. On the other hand, most of the deposited radiocaesium on land stayed there and a very small amount of radiocaesium was transported to the ocean.
In the wide area of the western North Pacific Ocean, the radiocaesium concentrations increased rapidly due to the atmospheric deposition and the direct discharge, afterward they decreased rapidly, or they were gradually decreasing depending on the distance and direction from the FNPP1 site. In the adjacent seas of the North Pacific Ocean (the Sea of Japan, the East China Sea, and the Bering Sea), features of temporal variations of radiocaesium activity concentrations were different, as delayed increases of radiocaesium activity concentrations were observed due to advection/transport of water masses from highly contaminated areas with different time scales. In general, the transport processes of FNPP1 derived radiocaesium in the surface layer in the North Pacific Ocean will depend mainly on two current systems −the subarctic gyre and the subtropical gyre. The main surface pathway of Fukushima derived radiocaesium followed Kuroshio and Kuroshio extension and arrived at the west coast of the American continent in 2014/2015 and bifurcated to north and south. The northern branch reached at the Bering Sea while the behaviors of the southern branch are unclear due to fewer observations. Regarding the transport of radiocaesium to the East China Sea and the Sea of Japan through the ocean interior, a part of the FNPP1-derived radiocaesium in the STMW moved west and reached the bottom of the north of the East China Sea (ECS), then the signal abducted to the surface layer and continued to the Sea of Japan (SOJ). The apparent half-life due to advection-diffusion after radioactive decay correction was 18.9 years for the Ogasawara region for the period 2012-2020 and 12.3 years for 2016-2020, while it is slightly longer at 22.4 years for 2016-2020 in the southern part of the Sea of Japan. On the other hand, in the vicinity of Yonaguni Island, there is no change or a slight increase in 2017-2020. Also, the 134Cs / 137Cs ratio increased in the vicinity of Yonaguni Island, reaching ca. 0.5 in 2020, which is about the same as those observed at Ogasawara and the Sea of Japan. These transports might mainly follow the subtropical gyre.

Keywords: Fukushima Dai-ichi Nuclear Power Plant accident, radionuclides, ocean, radiocaesium

 

# The impact and fate of fallout radionuclides by Fukushima Daiichi Nuclear Power Plant Accident in Terrestrial systems

*Yuichi Onda[1]

1. Center for Research on Isotopes and Environmental Dynamics, University of Tsukuba

The Fukushima Daiichi Nuclear Power Plant (FDNPP) accident released the largest quantity of radiocaesium into the terrestrial environment since the Chernobyl nuclear accident. The surrounding land received 2.7 PBq of radiocaesium to forests, agricultural lands, grasslands, and urban areas, from which the radionuclides migrated through soil and waterways. In this presentation, the deposition and distribution of radionuclides, especially radiocaesium, in the terrestrial environment as a result of the FDNPP accident are discussed based on the past 10 years' intensive dataset. Anthropogenic activities such as rice and vegetable cultivation and residential activities in the upstream area have led to a rapid decline in the activity concertation of 137Cs of suspended sediment (SS) transport in the river network, and these declines directly control the dissolved 137Cs concentration in the river water. We outline the environmental and anthropogenic factors that influenced the subsequent transport and impacts of radionuclides through the environment.

Keywords: Cs-137, Fukushima Daiichi Nuclear Power plant accident, Riverine transport, Fixation, downward migration

 

# Progress of "Comprehensive Disaster Prevention Education" at Japan Geoscience Union Meeting

*Hitoshi Nakai[1]

1. Kobuchisawa Research Institute for Nature and Education

The Great East Japan Earthquake had a great impact on all fields in which the Japan Geoscience Union was involved. The impact varies from field to field. In the field of education, it was a shock that disaster prevention education was powerless against the disaster. On the other hand, repeated evacuation drills worked for some of schools surviving the tsunami safely. Such cases impressively proved the effectiveness of disaster prevention education. Therefore, the people concerned with education insisted after the disaster on the implement of systematic disaster prevention education. However, at that time, I think it was not possible for any person including this author to think concretely about "systematic disaster prevention education."

Many of people involved in disaster prevention education feel difficulty to maintain continuity and universality. For example, even in an area where a volcanic disaster occurred hundreds of years ago, it is very difficult to pass on the history of the disaster from generation to generation through a long low-activity period. Moreover, even immediately after a disaster, it is not easy to expand the activation of disaster prevention education outside the disaster area. For example, after the Great Hanshin Awaji Earthquake, the Environmental Disaster Prevention Department was set up at one of the high schools in Hyogo Prefecture, but in the neighboring Osaka prefecture where the author worked, there was no particular emphasis on disaster prevention education.

Given these difficulties, the author and his collaborators tried to go back to the starting point and explore what can be taught about disaster risk reduction in the first place. Then, in the 2012 Japan Geoscience Union (JpGU) Meeting we held a public session titled as "Disaster Prevention Education: What can we teach to overcome disasters?" . It was held also in 2013 and 2014, and a total of 17 experts gave lectures. The fields of each lecturer are diverse, such as disaster prevention administration, disaster prevention law, school education, psychology, disasters in the world and Japan, regional disaster prevention, disaster prevention, earthquakes, volcanoes, and tsunamis. Through these lectures, it became clear that disaster prevention issues can be roughly divided into four areas. They are "disaster prevention mechanisms", "role of state and government", "disaster prevention technology and engineering", and "regional disaster prevention". Each area contains many fields. For example, "disaster mechanisms" includes earthquakes, volcanic activity, and meteorological disasters, and "role of state and government" includes disaster law and administrative response. Although these fields are independent of each other, they are actually closely related to each other. If such relationships can be clearly shown, it is expected that the aggregate of these four fields will form a system that can be called "disaster prevention science." At the proposal stage of the session, there was a voice asking why legal scholars were invited to the JpGU Meeting. On the questionnaire after the lecture, however, some people wrote that they got understand that the legal knowledge is essential to think about disaster prevention. This remark emphasizes the necessity for systematic disaster prevention knowledge.

I edited and published "A text book for the disaster prevention education at schools" in 2018 based on the lectures in the public sessions. There are many disaster prevention related issues beyond those covered in the sessions. Regarding these fields, we explained the purpose of the publication to researchers of each field and asked for their cooperation. Eventually I could get cooperation with 37 disaster prevention researchers and educators. This book is one of the milestones bound for the disaster prevention education, but it's also a starting point.

Keywords: comprehensive disaster prevention education, universality and continuity of disaster prevention education, systematization of disaster prevention education

[J] Oral | U (Union )：Union

Mon. May 31, 2021 3:30 PM - 5:00 PM JST | Mon. May 31, 2021 6:30 AM - 8:00 AM UTC | Ch.01 Zoom Room 01

## [U-02] Ten years from the 2011 Tohoku Earthquake: A milestone of earth science

convener:Ryota Hino(Graduate School of Science, Tohoku University), Katsunori FUJIKURA(Japan Agency for Marine-Earth Science and Technology), Motoyuki Kido(International Research Institute for Disaster Science, Tohoku University), Chairperson:Katsunori FUJIKURA(Japan Agency for Marine-Earth Science and Technology), Ryota Hino(Graduate School of Science, Tohoku University)

The 2011 Tohoku-Oki Earthquake prompted active research in a wide range of fields of earth science. Through researches on the generation mechanism and recurrence history of the earthquake associating massive tsunami itself, as well as researches on various kinds of large-scaled postseismic phenomena progressing over a broad area after the earthquake, a number of important aspects of the earth interior has been brought about. This earthquake also served as a turning point in research on forecasting of earthquakes and tsunamis, highlighting the difficulty of long-term forecasting of low-frequency but gigantic earthquakes and tsunamis, while promoting research and development on early warning technologies based on real-time observations. Furthermore, the huge earthquake and tsunami, as well as the nuclear power plant accident, gave a significant impact on the natural environment over a wide area centered on eastern Japan. Earth scientists have made significant effort to understand the actual situation of the impact and also to monitor the temporal variation. On the other hand, lively discussions have been held on how the knowledge gained through such energetic research activities can be utilized for disaster prediction / countermeasures and recovery from disasters. In this session, we will discuss the path that earth science research should take in the future, based on the results of research in the 10 years since the 2011 Tohoku-Oki Earthquake and the Disaster.

3:30 PM - 3:48 PM JST | 6:30 AM - 6:48 AM UTC

### [U02-06] Reconstruction of fisheries from the Great East Japan Earthquake and tsunami (GEJE)- Studies on reconstruction of fisheries by TEAMS Project-

★Invited Papers

*Akihiro Kijima[1], Toshi Nagata[2], Katsunori Fujikura[3] (1.Tohoku University, 2.AORI, 3.JAMSTEC)

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3:48 PM - 4:06 PM JST | 6:48 AM - 7:06 AM UTC

### [U02-07] Early warnings of ground motion and tsunami: Research development of last 10 years

★Invited Papers

*Mitsuyuki Hoshiba[1], Hiroaki Tsushima[1] (1.Meteorological Research Institute)

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4:06 PM - 4:24 PM JST | 7:06 AM - 7:24 AM UTC

### [U02-08] Progress in tsunami deposit study after the 2011 Tohoku Earthquake

★Invited Papers

*Masanobu Shishikura[1] (1.Institute of Earthquake and Volcano Geology, National Institute of Advanced Industrial Science and Technology)

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4:24 PM - 4:42 PM JST | 7:24 AM - 7:42 AM UTC

### [U02-09] Study of giant tsunamis based on geological data in the future

★Invited Papers

*Yukinobu Okamura[1] (1.Research Institute of Earthquake and Vocano Geology, National Institute of Advanced Industrial Science and Technology)

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4:42 PM - 5:00 PM JST | 7:42 AM - 8:00 AM UTC

### [U02-10] Nuclear Power and Geoscience in Japan: 10 years after the 3.11 complex disaster

★Invited Papers

*Daisuke Suetsugu[1], Satoshi Kaneshima[2], Takeshi Sagiya[4], Kohta Juraku[3] (1.institute for Marine Geodynamics, Japan Agency for Marine-Earth Science and Technology, 2.Department of Earth and Planetary Sciences, Kyushu University, 3.Department of Humanities, Social and Health Sciences, School of Engineering, Tokyo Denki University, 4.Disaster Mitigation Research Center, Nagoya University)

# Reconstruction of fisheries from the Great East Japan Earthquake and tsunami (GEJE)- Studies on reconstruction of fisheries by TEAMS Project-

*Akihiro Kijima[1], Toshi Nagata[2], Katsunori Fujikura[3]

1. Tohoku University, 2. AORI, 3. JAMSTEC

On March 11,2011, the Great East Japan Earthquake had occurred and big tsunami hit the coastal area in the Pacific coast of Tohoku region in northeast Japan. In the coastal area, many houses, buildings, fish processing factories, fishing vessels, ports, seawalls, and most of all facilities were destroyed. About 75% of destroyed materials and objects flowed to the sea and then fisheries had collapsed almost completely. Although the damage situation on land is quite obvious, however, in ocean is quite difficult, because it cannot see easily, the actual conditions, such as quantity of rubble, existence of a toxic substance, a situation of fish and shellfishes, etc. were not known at all. It had to depend on investigation by a specialist of using research vessels, diving apparatus, scientific knowledge, etc. The Ministry of Education, Culture, Sports, Science and Technology started the project, that is, "Tohoku Ecosystem-Associated Marine Sciences (TEAMS)" aiming at contributing to reconstruction of fisheries by scientific approaches. As the composition organization of a project, a representative organization is Tohoku University and vice ones are AORI and JAMSTEC. In addition, Tokyo University of Marine Science and Technology, Iwate University, Kitasato University, Tokai University, and Yammer Co., participated as organizations. Also many scientists and researchers have participated belonging to a lot of Universities and Research Institutes. Fisheries including aquaculture are the industries which utilized the natural productive capacity, such as environment and ecosystem in the sea (also include a river and a lake) . Therefore, when revival of fisheries is aimed at, it becomes a base to get to know correctly whether marine environment and marine ecosystem changed into what kind of state by the GEJE scientifically. Neither the policy of reconstruction nor a vision can be formed without such information. TEAMS for which the experts of all the fields of marine sciences gathered, was begun from investigating the state of the range from the Sanriku coast to offshore, from the surface to the bottom. Change of bottom topography, the quantity of rubble, and the species and quantity of zooplankton and phytoplankton, sea water temperature and salinity, etc. The damage situation has been clarified by physical, chemical, biological, and earth scientific research are performed and compared with the data before the GEJE, such as quantity of distribution of a toxic substance, distribution of rubble, seed composition and distribution of a living thing, and nutrition salt, and a flow. Since the investigation area reached far and wide too much, the Onagawa and the Otsuchi bay were investigated at the base centering in Miyagi and Iwate Prefecture whose damage was the most serious.

The government specified the basic policy, that is, first five years as "concentration rehabilitation period" and following five years as "revival / creation period". TEAMS has clarified change of the marine environment and ecosystems which serves as a base of fisheries revival in the first five years. As a result of going focusing on marine environment and marine ecosystem monitoring investigation, there were the case returns to the situation or continues change still more, compare with the that before the GEJE. On the other hand, aquaculture began to be restarted. So, in the following period, monitoring investigation have been continued for accumulating the data, and the scientific research activities were also carried out. Furthermore, in order to contribute to deployment of future sustainable fisheries, the long-term monitoring data were utilized, and creation of a habitat map and construction of the physical model were performed. These results of investigations have presented not only in scientific symposia and meetings in and outside of Japan, but also for the stakeholders, such as fishermen, fisheries-related organization, local governments, citizens, students.

Keywords: the Great East Japan Earthquake, reconstruction of fisheries, Tohoku Ecosystem-Associated Marine Sciences (TEAMS), marine ecosystem

Japan Geoscience Union Meeting 2021

# Early warnings of ground motion and tsunami: Research development of last 10 years

*Mitsuyuki Hoshiba[1], Hiroaki Tsushima[1]

1. Meteorological Research Institute

During the 2011 Tohoku earthquake (M9.0), earthquake early warning (EEW) was issued from the Japan Meteorological Agency (JMA) 15s before strong shaking hit Tohoku region, as designed. However, strength of shaking was underpredicted at Kanto due to underestimation of the source extent. When multiple aftershocks occurred simultaneously, the EEW system did not identify appropriately the multiple events, which led to false alarms. Tsunami early warning (TEW) was issued based on M7.9 which was estimated just after the mainshock. The underestimation of M caused underprediction of tsunami height. The warning was upgraded rapidly using tsunami data from offshore GNSS buoy, but the data from ocean-bottom pressure (OBP) gauges located far offshore were not used for update of the warning.
We will review the research development of last 10 years regarding EEW and TEW, which were conducted on lessons learned from the above experiences. We will also explain the recent improvements of EEW and TEW of JMA.
To avoid M underestimation during gigantic earthquakes, use of long-period seismic waves is important. Improvements of the M estimation have been investigated by using the data from sophisticated seismometers which enables to monitor the long period waves, and those from GNSS which can record static displacement without oversaturation in real-time (Kawamoto et al, 2017).
Several methods have been proposed for rapid, precise, and robust estimation of source parameters (hypocenter location, M, source extent and so on) for EEW: source-based algorithms. For rapid estimation of source extent, pattern recognition technology is applied by identifying extent of strong-shaking area (Bose et al, 2017). This method is proposed for ShakeAlert (EEW system of California). To address simultaneous multiple events, a new technique has been studied in which not only arrival time of seismic phases but also amplitude is used to determine hypocenter location (Tamaribuchi et al, 2014; IPF method).
Another approach has been investigated: wavefield-based (or ground-motion based) algorithms in which current wavefield is estimated precisely and then future wavefield is predicted using physics of wave propagation (Hoshiba and Aoki, 2015). Because source parameters are not required, this algorithm works well even for large extent of source and multiple simultaneous events.
Smart-phone seismometer is an interesting development of last 10 years. Because acceleration sensor is equipped in smart-phones, seismic observation, data transmission and also warning receiver are realized in a single smart-phone. Some authors have developed an application which is downloaded by general public. Downloads by many people could lead to virtual dense seismic observation network (Kong et al., 2020). More people have reportedly downloaded the application particularly in developing countries.
After the 2011 Tohoku earthquake, dense ocean-bottom observation systems were developed around Japan. Several tsunami-forecast methods using the OBP data have been proposed, such as tsunami-source estimation approach (Tsushima et al., 2009; tFISH) and the tsunami-wavefield estimation approach (Maeda et al., 2015).
JMA introduced IPF method into EEW operation in 2016 for addressing the problem of multiple simultaneous events, and PLUM method (simplified version of wavefield-based algorithm) in 2018 for large source extent. PLUM contributes to reduce underprediction of shaking strength (missed alarm). To enhance observation, cabled ocean bottom seismometers (JMA cables, DONET and S-net of NIED) and borehole seismometers (depth 500-3500m) at southern Kanto have been utilized, which contributes to

rapid EEW.
For improvement of TEW, JMA has installed the method to estimate M using long-period seismic waves (Katsumata et al., 2013) in 2013. In addition, JMA uses dense OBP data in operational tsunami monitoring since 2016. Moreover, tFISH has been used since 2019 for more accurate forecast.

Keywords: early warning of ground motion, early warning of tsunami, Earthquake early warning of JMA, Tsunami early warning of JMA, The 2011 Tohoku earthquake, development of researches

# Progress in tsunami deposit study after the 2011 Tohoku Earthquake

*Masanobu Shishikura[1]

1. Institute of Earthquake and Volcano Geology, National Institute of Advanced Industrial Science and Technology

Tsunami deposit has been attracting attention since the 2011 Tohoku earthquake, but it used as one of the methods for paleoseismological study since the late 1980s in Japan. In particular, the tsunami deposits of the 869 Jogan earthquake have been already investigated by Tohoku University and others 30 years ago, and the possibility of a giant tsunami in the near future was indicated based on the recurrence interval. In the 2000s, GSJ/AIST proposed the fault models for the Jogan earthquake as an inter-plate earthquake along the Japan Trench. These data were considered into the long-term evaluation for the subduction zone earthquake along the Japan Trench by the government's Headquarters for Earthquake Research Promotion (HERP), but the 2011 Tohoku Earthquake occurred just before the announcement. Although the information could not be distributed socially, the tsunami inundation area was consequently almost overlapped between the 2011 Tohoku Earthquake and the 869 Jogan earthquake. As a result, the usefulness of the tsunami deposit study for disaster prevention was recognized, and the tsunami deposit survey was conducted everywhere in Japan. The amount of information on tsunami deposits has increased drastically in the past decade.
On the other hand, a number of problems have emerged immediately after the 2011 Tohoku earthquake. To solve them, new analyses have been conducted in the past decade. One of the issues is the accurate assessment of tsunami inundation magnitude, which are two perspectives of micro and macro.
The inundation area of past tsunamis has usually been reconstructed based on the distribution of visible sand layers. However, the 2011 tsunami inundation in the coastal plains reached further inland than the distribution of sandy deposits. In other words, an ordinally geological method using visible sand layers may underestimate the actual inundation area, which also affects the constraint for assuming the source fault. To develop the identification method for tsunami deposits, various analyses such as microfossil, grain size, and organic geochemistry was being applied to the deposits formed by the 2011 tsunami as a modern analog.
The issue from the macroscopic viewpoint is the verification of the maximum class tsunami assumption. After the 2011 Tohoku earthquake, the national and local governments reviewed their tsunami disaster prevention measure, and the maximum class inundation assumptions were established in many areas. However, it is unclear whether such tsunamis actually occurred in the past. It has to examine the existence of tsunami deposits around the inland limit of the assumed inundation area.
In this presentation, I will show the examples of these studies and discuss the future prospects.

Keywords: 2011 Tohoku earthquake, 869 Jogan earthquake, Tsunami deposit

# Study of giant tsunamis based on geological data in the future

*Yukinobu Okamura[1]

1. Research Institute of Earthquake and Vocano Geology, National Institute of Advanced Industrial Science and Technology

Before the 2011 Tohoku earthquake, giant tsunami models had been proposed along the Kuril and the Japan Trenches based on tsunami deposit data. Unprecedented tsunami had been inferred by tsunami deposits studies along the Nankai Trough. Unfortunately, these studies had not had much attention. The 2011 Tohoku giant earthquake revealed the significance of the tsunami deposits as records of ancient giant tsunamis. Many tsunami deposits indicating ancient giant tsunamis have been reported from coastal areas of Japan after the 2011 giant tsunamis. Government has constructed source models of the largest-possible tsunami along the coastal areas of Japan, and the survey data of tsunami deposits have provided important information to construct the models. We need to understand that some high-quality survey data of tsunami deposits have important information of tsunami sources that have not been used well. Using this information, it may be possible to confirm different types of the plate boundary earthquakes along the Nankai Trough and to infer the type of the next earthquake from tsunami deposits and other paleo-seismological data.

Keywords: paleoseismological data, giant tsunami, Nankai Trough

 

# Nuclear Power and Geoscience in Japan: 10 years after the 3.11 complex disaster

*Daisuke Suetsugu[1], Satoshi Kaneshima[2], Takeshi Sagiya[4], Kohta Juraku[3]

1. institute for Marine Geodynamics, Japan Agency for Marine-Earth Science and Technology, 2. Department of Earth and Planetary Sciences, Kyushu University, 3. Department of Humanities, Social and Health Sciences, School of Engineering, Tokyo Denki University, 4. Disaster Mitigation Research Center, Nagoya University

We have organized sessions in the JpGU meeting on the risk of nuclear power utilization in Japan mainly from the point of view of geoscience since 2013. It has shed new light on various aspects of the risk of nuclear power related to earthquakes, volcanic activities and tsunamis. The 2021 JpGU meeting will be held 10 years after the 3.11 complex disaster: the Great East Japan Earthquake with the Fukushima-Daiichi nuclear accident. On this occasion, we review what we have discussed and understood through the past sessions or public debates: What should geoscience take the stance on the issue of scientific uncertainty and nuclear risk? How could scientists and engineers work together for public goods?

Keywords: Nuclear power plants, Geoscience