SCIENCE FOR RESILIENCE

NIED INTEGRATED REPORT 2020

SCIENCE FOR RESILIENCE

NIED 防災科研

SCIENCE FOR RESILIENCE

Earthquake, tsunami, volcanoes, violent winds, heavy rains,
snowstorms, floods, and landslides are
natural threats that will always exist.
However, at NIED, we believe that disasters can be reduced.
Therefore, we are constantly developing technologies and strategies
to prepare for and respond to disasters.
With better prediction, smarter prevention, and faster restoration,
we aim to protect lives and livelihoods for a sustainable future.

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NIED's commitment toward our identity.

Disasters caused by natural threats are not only limited to the moment when the disaster occurs, but also have the long-term impacts. In order to sustain Japan into the future, it will be necessary to establish society with resilience for resiliently overcoming disasters. To this end, NIED promotes comprehensive research and development for every kind of natural disaster (all hazards) for each stage (all phases) of before and after occurrence of disaster and pledges to support the lives and livelihoods of all people with our branding identity: "Science for Resilience".

Meaning of the NIED logo

The two blocks in blue and red respectively represent the before and after phases of a disaster, which express NIED's commitment to conduct research and development for all phases of disaster. The blue color used for pre-disaster symbolizes the prediction and prevention of disaster through the accumulation of wisdom. The red color representing post-disaster symbolizes the response and recovery for tackling a disaster with passion. The grey color at bottom represents the research that forms the basis and foundation for creating trust. The white "resilience curve" that runs across from left to right indicates the capability to overcome disasters for a better future.

Co-creating Resilience with Everyone

NIED INTEGRATED REPORT 2020
[Fiscal Year] From April 1st 2019 to March 31st 2020
(Including activities implemented after April 2020)

Since FY2019, NIED has issued Integrated Report with the aim of communicating research initiatives and results in a comprehensible manner, getting public understanding and setting the stage for co-creation.

To save the nation from national catastrophic crises that are expected to strike in the first half of the 21st Century and to achieve sustainable development, NIED promotes various types of research. Since FY2016, NIED has promoted R&D based on the 4th mid-to-long term plan which spans seven years, with the aim of contributing to the creation of a "highly resilient society where each person has a basic level of disaster risk reduction (DRR)". In the first four years that constitute phase 1 of this plan, NIED has focused on formulating a system for creating a cycle through which research based on social needs is used to create research results that brings social transformation, which then initiates research that takes in new social needs.

Designating the remaining three years from FY2020 as phase 2, NIED is aiming for innovation in science and technology for DRR based on the stated keyword of "co-creation". This report, in addition to introducing NIED's concept of "co-creation", will also communicate research initiatives and results to provide the impetus for everybody to think and act toward realizing a "highly resilient society where each person has a basic level of disaster risk reduction".

For detailed reports of NIED's results, please refer to:
https://www.bosai.go.jp/introduction/open/evaluation/annual.html
and for information regarding project reports and plans, please refer to:
https://www.bosai.go.jp/introduction/open/duties.html
We welcome any opinions/comments on this report:
Nied-ir@bosai.go.jp

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Promoting “Co-Creation” of science and technology for DRR, we will work together with all to build a resilient society.

NIED established the Headquarters of Innovation Co-Creation in July 2020, in order to create innovation regarding science and technology for disaster risk reduction (DRR) through cooperation with private companies, universities/research institutions, municipalities/government-related parties, and with all citizens. The Headquarters of Innovation Co-Creation promotes R&D that changes society and contributes to a more resilient society, through co-creation among NIED and related persons/citizens in industry-academia-government.

Aiming for trans-disciplinary innovation in science and technology for DRR

Under its 4th mid-to-long term plan running from FY2016, NIED designated the first four years as the 1st phase, and had been building a system for generating research results through conducting “research that meets the actual needs of society” and “effective research that makes changes in a society”. By doing so, NIED has been creating “Information Products” that lead to each individual's action for DRR.

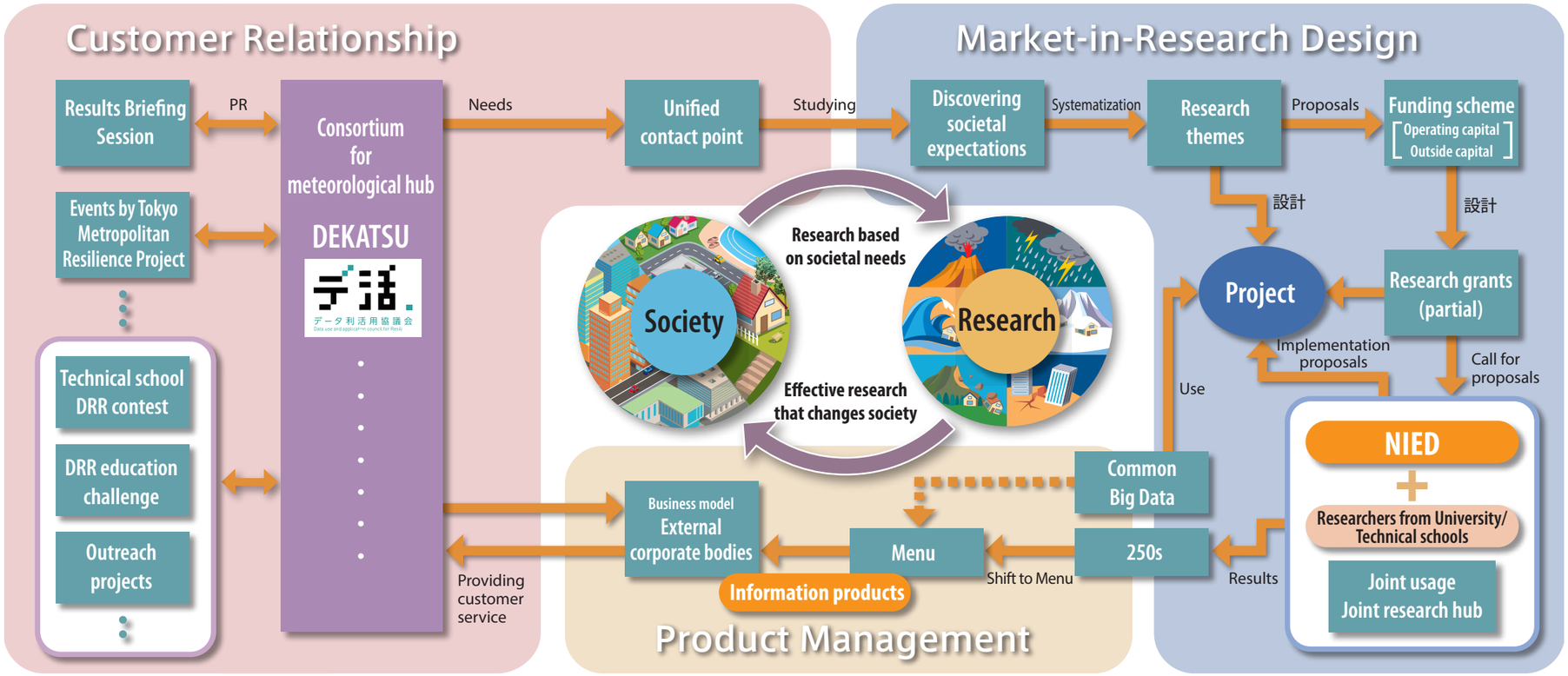
As part of this, NIED coordinates the “Data use and application council for resilience “(DEKATSU) which aims to develop a system for the use and application of observation equipments and data owned by corporations and other bodies. In order to further promote these activities during the 2nd phase of the 4th mid-to-long term plan which has three years left to run, NIED established the ”Headquarters of Innovation Co-Creation”.

Establishment of the “Headquarters of Innovation Co-Creation”

The field of science and technology for DRR is composed of many academic disciplines, and is a domain which strongly requires the implementation of research results into a society. In order to make the results of science and technology for DRR utilized, it is necessary to understand actual societies and to deliver research results that are really needed by the various stakeholders who make up societies. This is the reason why “co-creation” is necessary and NIED has established the “Headquarters of Innovation Co-Creation” in order to promote “co-creation” among NIED as a whole.

Through the initiatives of the Headquarters of Innovation Co-creation, NIED, as a “core institute for innovation in science and technology for DRR”, will share outstanding research results from its enormous observational data sets, large-scale experimental facilities and science and technology for DRR domains with partners in industry, academia, government, or civil societies. NIED will also further strengthen partnerships with collaborating parties in industry, academia, government and with citizens to formulate an ecosystem for continuously promoting innovation related to science and technology for DRR.

System for Co-Creation sought by NIED



Roles and functions of the Headquarters of Innovation Co-Creation

The Headquarters of Innovation Co-Creation is the coordinator and producer of co-creation. Its specific roles and functions are as follows:“Point of contact for co-creation among NIED and related parties in industry, academia, government and citizens”; “Coordination/support for formulating R&D/social implementation projects through co-creation”; “Realization of projects to produce new value utilizing NIED’s Information Products etc.”; “Promotion of overall co-creation for NIED”.

Initiatives for establishing an external corporate body following a revision to the law

Following the revision of the law regarding revitalization of generating innovation in science and technology (effective April 1, 2021), NIED is working on establishing establishing an external corporate body in FY2021. Under this revision, NIED is designated as a “Research and development agency which is able to invest in business operators utilizing its results”, which at the same time clarified the fact that joint research can be conducted with business operators financed by research and development agencies. In response to the needs of various stakeholders, NIED will establish the external corporate body to continually and promptly provide NIED’s research results as “Information Products”, leading to the actions of societies and corporations.

System of "Co-creation" sought by NIED

The Headquarters of Innovation Co-Creation aligns with various research departments and administrative sections of NIED to create new scientific technology/innovation regarding DRR by rotating a cycle composed of three pillars, which in turn contribute to secure high resilience and robustness of DRR capabilities for the nation and at the community level.

1

Constructing a system for cooperation between stakeholders in industry, academia, government and citizens (Customer Relationship)

To provide a forum for new co-creation, NIED will construct a platform encompassing industry, academia, government and citizens in collaboration with the "Consortium for Meteorological Disaster Mitigation" and "DEKATSU".

2

Precisely understand the needs of society, promote R&D that brings social change (Market-in-Research Design)

Based on the needs identified from the industry-academia-government-citizen platform, NIED will work in cooperation with universities and private companies to promote transformation of society through effective research that brings the enhancement of social and economic resilience.

3

Customization/provision of "Information Products" (Product Management)

In order to provide society with R&D results produced through co-creation and to concretely translate them into social/economic resilience, NIED aims to establish an external corporate body for the purpose of flexibly customizing and providing "Information Products" – which are some of the NIED's research results" – based on the needs of users.

Concrete initiatives by four groups engaged in promoting co-creation at NIED

The Co-Creation Promoting Office of the Headquarters of Innovation Co-Creation is composed of four groups for promoting co-creation — "Management", "Design", "Social Cooperation", and "Preparations for External Corporate Body" — through which researchers and administrative employees mobilize their knowledge for carrying out activities.

Management group

Establishing cycles for promoting co-creation

Administers the co-creation promotion committee, which carries out the necessary decision making for the information sharing/debate and promotion of co-creation related to the promotion of co-creation in NIED.

Design group

Market-in-Research Design

Promotes R&D/social implementation projects through co-creation.

Social cooperation group

Customer Relationship

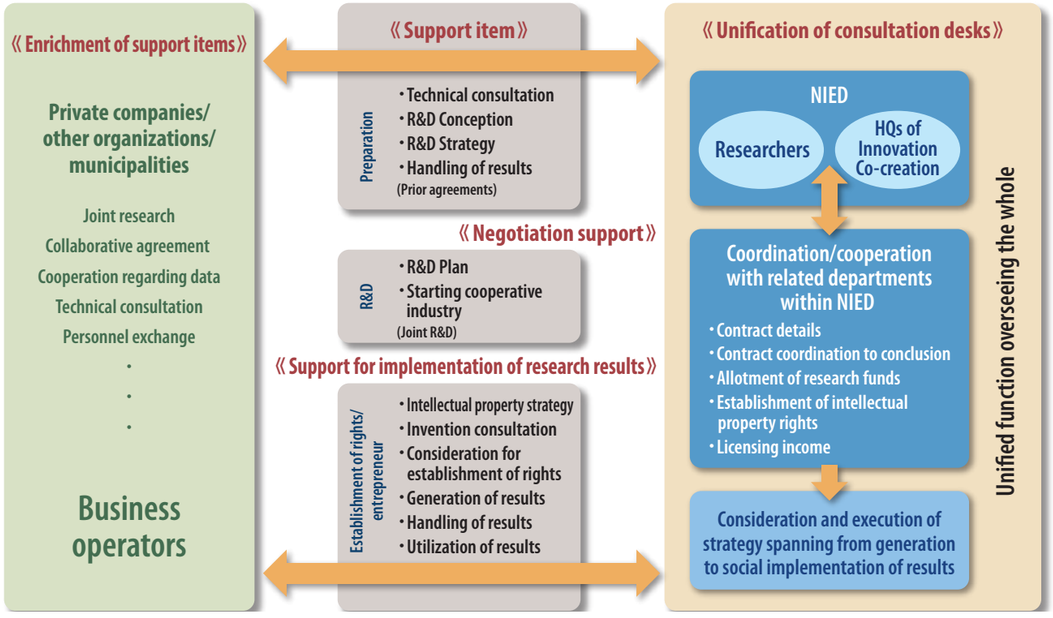
Formulate a social cooperation structure to promote co-creation with researchers in an integrated manner with consultations regarding co-creation from within and outside NIED as a starting point.

Group for preparations for external corporate body

Product Management

Prepares to establish external corporate body in FY2021.

Constructing a social collaboration system for accelerating co-creation



A Message from President

In a transforming society, a collaborative co-de and technology for disaster risk reduction will for the catastrophic crises which might ruin our sign approach in science enhance the resilience nation near future.

HARUO HAYASHI
President, NIED

Under "new normal", our lifestyles as well as science and technology will undergo transformation

Under the COVID-19 pandemic in 2020, the phrase "new normal" has been heard at various locations and occasions. For NIED, a word "New Normal" has two meanings. First is the introduction of a new life style, where tele-commuting and tele-meetings become regular practices thanks to further advancement in information and communication technology. NIED will aim to promote a greater work-life balance where people at NIED can continue to work without difficulty. The second is the integration of knowledge for disaster risk reduction (DRR) based on the new legislation of the Basic Act on Innovation in Science and Technology in June 2020 (in force from 1 April 2021). This law will provide the impetus to promote comprehensive R&D that encompasses social sciences in addition to natural science and engineering. This constitutes a major turning point for the research at NIED. These two "new normal" will bring in major winds of change.

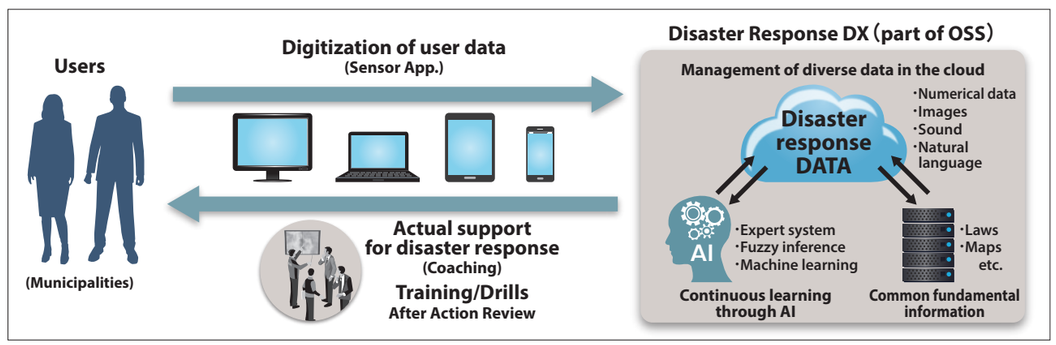
Promoting integrative research and developments in science and technology for DRR

In terms of promoting integrative R&D in science and technology for DRR, it would be crucial how new findings from social sciences will be integrated into those from both natural science and engineering. It does not mean that all of current social sciences will be accepted as the way they are. What is needed rather is the adoption of initiatives that apply empirical scientific methods to analyze issues of the human and societal phenomena in relation to DRR. As indicated in COVID-19 pandemic, human behavior really turned out to be a major determinant of the pandemic outbreak. This example suggests that it is extremely important to take into account disaster as social phenomena in general and human behavior in particular as an indispensable element of science and technology for DRR.

As for the innovative integration of knowledge for DRR, there are three lines of research to be performed. One is "consilience" regarding DRR. While disasters have up till now been mainly viewed through the lens of physical science and engineering, we must also take into account disasters as social phenomena to integrate research regarding DRR.

The second is the research to uncover what society really wants science and technology to explore regarding DRR, which is implementing marketing research in the DRR field, so to speak. DRR is a practical science aiming at reducing damage thus benefiting society. In order to implement research findings successfully, it is indispensable to precisely understand what is societal needs.

The third aspect is academic research of disasters as social phenomena. What to do to be resilient when a disaster strikes is an empirical social science research field. It is necessary to establish a theory focused on the processes of psychology and behavior of people as well as resilience of society from the onset of disaster response until the completion of disaster recovery and reconstruction.



Co-creating effective disaster response with a framework called "Disaster Response DX"

NIED is currently developing a system called "Disaster Response DX (digital transformation) as the basis for promoting disaster response capability based on the standardized principles described in ISO22320 to be successfully operative at the time of anticipated catastrophic disasters which will hit Japan in the first half of 21st century.

There are great disparities among 1700 local governments in terms of their response capability to disasters. To fill such a gap, "Disaster Response DX" can provide a system that aggregates DRR know-how in the cloud, allowing each user to simulate disaster response for training as well as to respond to a real one. Relevant maps and laws will be available in the DX as the basis of disaster response activities, which will be constantly updated. Decision making processes and problem solving processes at the time of disaster response will be navigated based on the knowledge base stored in DX, which will then update DX. All the actions taken in training or in practice will be recorded and added to the DX data-lake which will be a part of response database to be used for the improvement of DRR capabilities of both practitioners and researchers. This framework for "co-creation of everyone by everyone for everyone in DRR" should be refined continuously through the power of science.

Initiatives for improving disaster resilience for national catastrophic crises that are expected to strike in near future

During the first four years that form the first half of the 4th Mid to Long-term Plan, NIED carried out two major research projects to rise to the challenge of co-creation: "Innovation Hub for Meteorological Disaster Mitigation" for extreme weather, and "Tokyo Metropolitan Resilience Project (forR)" for earthquakes. NIED has also clarified its identity through branding activities, declaring its intent to support the lives and livelihoods of people through "Science for Resilience." Concurrent to these initiatives, NIED has formulated concepts for a resilience framework and ecosystem in which a long-term research vision (interim summary) was clarified and elaborated in terms of its research objectives and research projects to be implemented by 2035. There is only limited time left for preparing for the Nankai Trough and Tokyo Metropolitan Near-field Earthquakes which would be the great sources of devastation. How can we attain the level of resilience necessary to overcome such national catastrophic crises? Moving forward, I believe that NIED's mission is to endeavor towards yet more powerful and innovative research and implementation.

NIED provides society with "information products" leading to each individual's actions.

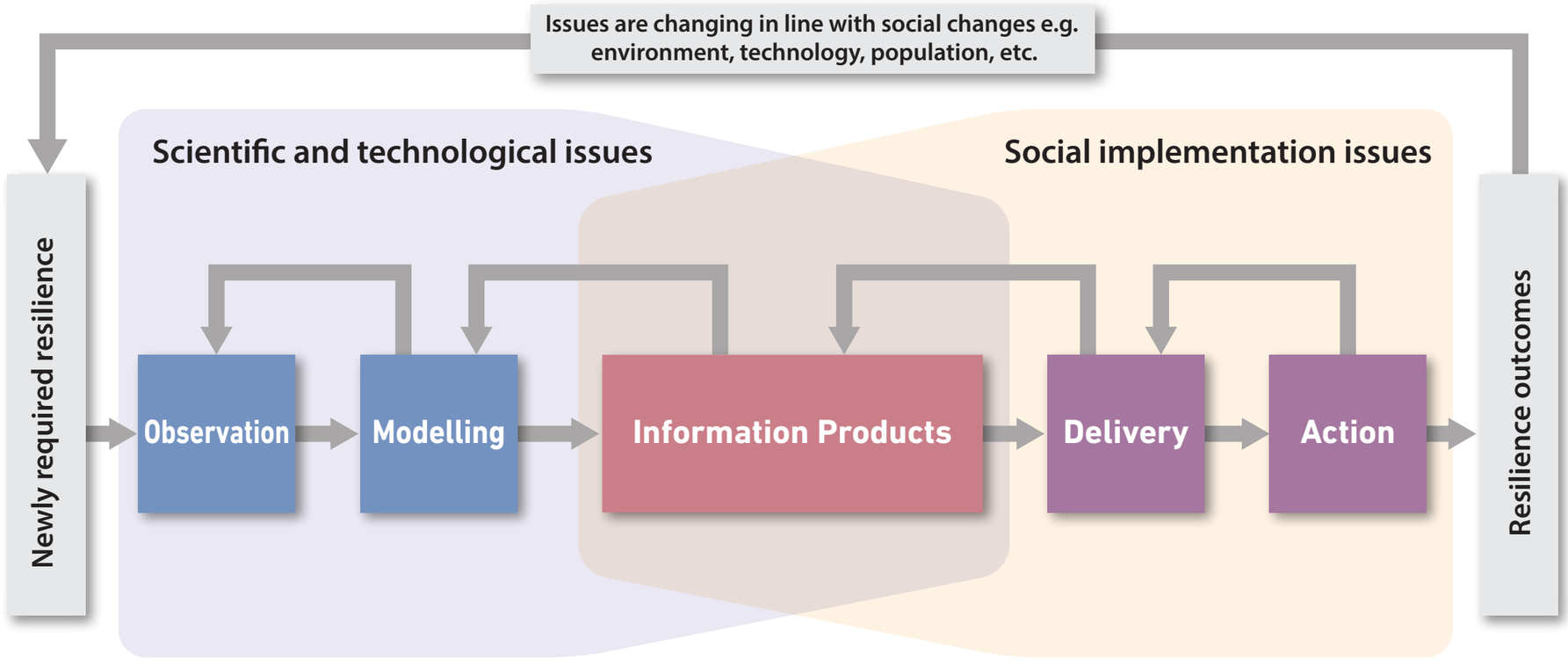
NIED not only observes and analyzes disasters in a scientific and technological manner but also works on research designed to provide society with information products, which lead to the actions of each individual. Our research objects include all types of natural hazards in all phases of disaster prediction, prevention, response, and recovery/ reconstruction.

NIED's value creation model to link science with society.

The value that NIED produces is the creation of information products leading to actions of each individual. The five steps to achieve this are shown in the figure on the right. Data from observation and experiments is modeled (identify and define the characteristics of events) to create information products which will be delivered to stakeholders to lead each individual's actions.

Using feedback to improve quality.

This value creation model is a system that takes in feedback from behavior to experiments/observation, through which it clarifies issues to be solved in terms of social implementation as well as scientific and technological innovation. This two-way process enhances the quality of the respective steps for resolving these issues.



The 4th mid-to-long term plan for materializing the value creation model.

To materialize the value creation model, it is essential to consider science and technology from a viewpoint of social implementation. In the 4th mid-to-long term plan, NIED promotes nine initiatives.

9 initiatives

Formation of core institute for innovation in science and technology for disaster risk reduction (DRR)

- Promotion of industry-academia-government cooperation as a core institute
- Promotion of operation and sharing of observation networks, experimental facilities, information infrastructure
- Contribution to disaster management practice at national government
- Dissemination of R&D results/Application of intellectual properties
- International collaboration on R&D
- Human resource development

Promotion of basic research and fundamental R&D for science and technology for DRR

- Promotion of R&D for observing and predicting disasters in real time
- Promotion of R&D for enhancement of the resilience of social infrastructure
- Promotion of fundamental R&D for reduction of disaster risk

Scientific and technological issues

Comprehensive research on "all hazards × all phases".

NIED is a unique organization in the world that conducts comprehensive research across all phases from prediction and prevention to response and recovery encompassing all natural hazards. We implement a wide range of R&D to create high-quality information products by combining natural science, engineering, and social science, for example, an observation network for earthquake, tsunami, and volcano, Monitoring of Waves on Land and Seafloor (MOWLAS) that covers all land in Japan, and the Shared Information Platform for Disaster Management (SIP4D), a platform that can deliver disaster information between the government, municipalities, private companies, and the others.

Social implementation issues

Providing information products for appropriate "actions".

In order for information products to lead to "action" for overcoming disasters, it is vital to clarify user needs. It is also necessary to ensure that such information products are utilized by users. Therefore, NIED is engaged in R&D for creating high-quality information products that support decision-making at the site of disaster as well as their delivery methods.

NIED implements nine initiatives regarding science and technology for DRR to realize a society with high resilience.

4th Mid-to-Long Term Plan [From FY 2016 to FY 2022]

This IR Report mainly introduces best practices of NIED for "strengthening of function as a core institute for innovation in science and technology for DRR". For more details regarding "Promoting basic research and foundational R&D regarding science and technology for disaster resilience", please refer to NIED's brochure (https://www.bosai.go.jp/ introduction/abstract.html) * Japanese only

As a National Research and Development Agency, NIED, leading Japan in science and technology for disaster risk reduction (DRR), is required to maximize the R&D results, i.e. realization of "a society with high resilience by empowering each individual to have basic ability of DRR".
In the 4th mid-to-long-term plan, we established the following two objectives to promote the actualization of the value creation model.

Activities as a Core Institute for Innovation

NIED plays a core role to implement six initiatives to realize the value creation model in cooperation with diverse organizations such as the governments, municipalities, private companies, universities, and research institutes.

Promotion of Industry-Academia-Government Cooperation

As a core institute for science and technology for DRR, NIED is promoting cooperation with municipalities and private companies (such as infrastructure companies with needs for reducing disaster damage and securing business continuity) on disaster risk reduction and mitigation.

SORA CHECK ソラチェク

Fundamental Observation Network, Advanced Research Facilities, Information Distribution Infrastructure

NIED maintains establishment/stable operation of the fundamental observation network and effective/efficient and safe operation of the advanced research facilities. In addition, we construct information platform regarding science and technology for DRR and disaster information, and promote sharing it with external research institutes including industries.

Contribution to Disaster Management Practice at National Government

As a designated public corporation according to the Basic Act on Disaster Management, after a disaster has occurred, NIED delivers information promptly based on science and technology for DRR to relevant organizations, provides assistance at the disaster site, and strengthens cooperation with the government and municipalities.

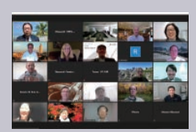
ISUT Information Support Team

Dissemination of Research Results/ Application of Intellectual Properties

By investigating the needs of governments and municipalities on DRR, NIED implements initiatives to reflect these needs in R&D. We are also committed to effective information delivery of our research results and acquisition and licensing of high-quality patent rights.

International Collaboration

As a core institute for innovation in science and technology for DRR of Japan, NIED promotes joint research with foreign organizations and international cooperation through the delivery of information. In light of international needs, we will pursue overseas deployment of Japan's science and technology for DRR.



Human Resource Development

To contribute to the improvement of entire nation's DRR literacy and to the securing of safety and security, NIED promotes researchers and works on municipalities, school education and leaders of local disaster management teams to support fostering of wide range of human resources and enhancing their qualifications.

Promotion of Basic Research and Fundamental R&D

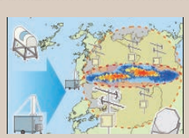
As a driving force for innovation, NIED promotes observation research on hazards, experimental research using world's largest class facilities, and empirical research toward the disaster response and recovery/reconstruction, as well as R&D on technologies to become the nucleus for simulation that integrates the above-mentioned research activities and utilization of the information.

Observation and Prediction of Disasters

We are conducting strategic advanced research for earthquake and tsunami prediction technology, research on mega-earthquake generation process, and research regarding multi-disciplinary evaluation of volcanic activities.

Reduction of Disaster Risk

NIED conducts development of prediction technologies for water-related disasters based on multi-sensing, combined research on grasping degree of risk for changing snow and ice disasters and their whole area prediction, research regarding hazard risk assessment, and research regarding disaster countermeasures based on utilization of information.



Enhancement of the Resilience of Social Infrastructures

NIED conducts earthquake disaster mitigation research using research infrastructure as 3-D Full-Scale Earthquake Testing Facility "E-Defense".

Improving DRR capability through “co-creation.”

TOP PRACTICE REPORT

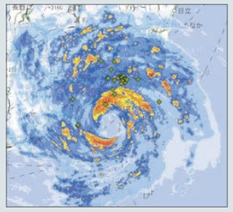
Activities as a core institute for innovation

As initiatives based on the 4th mid-to-long term plan, this section introduces specific application results for information products generated through the value creation model, as well as initiatives for co-creation.

01 P.19-20

Promotion of Industry-Academia-Government Cooperation

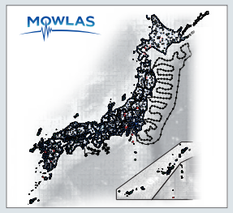
By promoting initiatives for co-creation that transcend the boundaries of organizations and fields, NIED is creating innovative information products useful for DRR.




02 P.21-22

Fundamental Observation Network

In preparation for the Nankai Trough Earthquake, NIED establishes a full scale real-time observation network for earthquakes/tsunami/volcanos covering the whole of Japan.



03 P.23-24

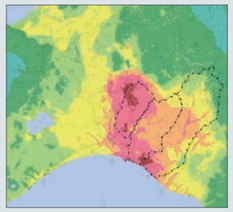
Advanced Research Facilities

Through the use and application of our large-scale experimental facilities, we promote co-creation among industry, academia and government, endeavoring to elevate science and technology for DRR.


04 P.25-26

Information Distribution Infrastructure

NIED has established system that goes beyond single organizations for the information sharing/utilization conducive to the prompt and effective response to disasters.




05 P.27-28

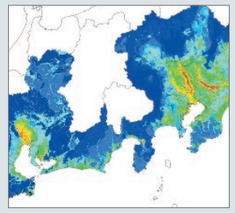
Contribution to Disaster Management Practice at National Government

As seen in the activities of Information Support Team (ISUT), NIED dispatches researchers across Japan to support the disaster countermeasures of governments, which is then fed into R&D for disaster countermeasures.

06 P.29-30

Dissemination of Research Results/ Application of Intellectual Properties

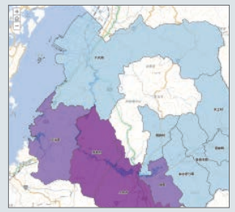
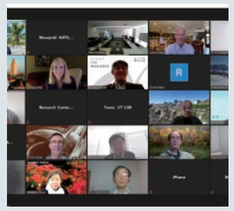
NIED provides various information products on many fronts, in an easy-to-use format. NIED is also working toward dissemination of research results into society.




07 P.31-32

International Collaboration

While strengthening cross-border cooperation, NIED is promoting the utilization of satellite data of each country for DRR, and exchange of knowledge regarding DRR.

08 P.33-34

Human Resource Development

Through participation in programs for academic degree, NIED is keenly supporting the next generation of researchers who will play an important role in science and technology for DRR.


TOP PRACTICE REPORT 01

Promotion of Industry-Academia-Government Cooperation

NIED promotes co-creation that goes beyond individual organizations and fields, achieving innovation for DRR initiatives.

To overcome large-scale disasters,
it is essential to deliver initiatives that go beyond organizations and fields and are "all Japan" in scope.
NIED pushes toward innovation regarding science and technology for DRR, promoting further co-creation
through industry-academia-government linkages, which are then embodied as information products.

NIED has unveiled "SORA CHECK", a system for checking extreme meteorological conditions.

In the densely populated Tokyo metropolitan area, extreme meteorological conditions triggered by developed cumulonimbus clouds (including torrential rain, strong gusts of wind/tornados, lightning strikes and hail) can massively impact daily lives, however localized they are. NIED is independently observing the entire life of cumulonimbus clouds using cutting-edge technologies. For example, NIED is observing lightning in the upper skies with its own observation network which is the first in Japan to conduct long-term continuous observation. Using this data and patented analytical technologies, NIED has developed "SORA CHECK", a website launched in June 2020 that visualizes layers of real-time information on rain, wind, lightning and hail in the Tokyo metropolitan region onto maps.

SORA CHECK is a Web-GIS system capable of displaying layers of meteorological information with social infrastructure information such as the Tokyo 2020 Olympics venues. Capable of displaying the movement of rain and lightning at 250 m intervals, SORA CHECK can perceive imminent danger for factories and sports facilities, which can be utilized for promptly moving people indoors out of harm's way. In terms of utilizing wind direction/wind speed information, NIED has conducted joint verification experiments not only with disaster risk reduction related organizations but also with general constructors, horticultural agriculture companies and outdoor event operators. The hail estimation zone provides information for determining where to spray agrichemicals to prevent the outbreak of disease in crops damaged by hail. Even in cases where it hails over the weekend, the estimated hail zone for the past three days is helpful for related parties to respond as soon as the new week begins.

Starting in February 2021, NIED displays information regarding snow using its own unique methods, including the weight of snow on roofs which gives a hint as to the likelihood of damage occurring to buildings and car ports during heavy snowfalls, as well as the weight of accreted snow that is useful for road management.

SORA CHECK is utilized not only as a tool for disseminating research results, but also as a tool for R&D for contriving creation of information and method of displaying in response to social needs. Aiming to resolve issues faced by organizations in the DRR domain, to improve business continuity capabilities, and toward the creation of shared value, meteorological data owned by NIED is overlaid with data owned by various private companies, which helps to create information to support decision making in disaster scenarios in line with the needs of all parties, and to realize a more resilient society.

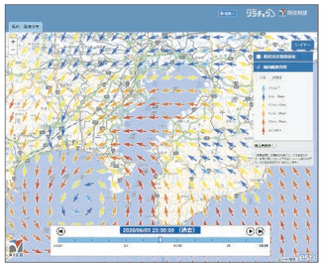
SORA CHECK ソラチェク

The system is called "SORA CHECK" with the intention that by checking localized intense meteorological conditions in the Tokyo metropolitan area, each individual can adopt specific behaviors to mitigate the effects of meteorological disasters. By using the word SORA instead of "sky", we are highlighting Japan's science and technology. The logo mark is designed after cumulonimbus clouds which are the cause of extreme weather.

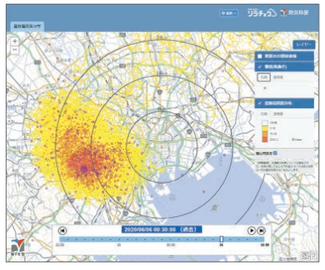
https://isrs.bosai.go.jp/soracheck/storymap/

Example of how SORA CHECK displays meteorological information

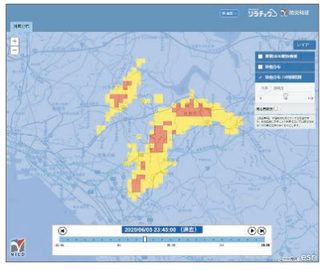
Display example of rainfall distribution



Display example of wind direction/wind speed distribution



Display example of lightning discharge density distribution



Display example of estimated hail distribution (72-hour maximum)

Convening "DEKATSU" symposiums to bring a higher level of resilience to both Tokyo Metropolitan area and Japan

The Tokyo Metropolitan area is the backbone of socio-economic activities, with a concentration of urban functions and population. The "Project to enhance comprehensive resilience mainly for the Tokyo Metropolitan Region" matches research seeds with social needs, and promotes industry-academia-government initiatives to enhance business continuity capabilities and disaster response capabilities. "DEKATSU symposiums" are held four times a year, to allow "DEKATSU (data use and application council)" – made up of industry, academia and government under this project – to discuss key issues to be tackled for improving the resilience of the Tokyo metropolitan area and Japan. For FY2020, a closed discussion was held for full ramping up the activities of the multiple sub-groups that were organized in FY2019. There were also public symposiums with presentations from companies and researchers on the case examples and latest trends, and panel discussions featuring the speakers.

1st Defining the "significance of data use and application" for business continuity systems during the COVID-19 pandemic

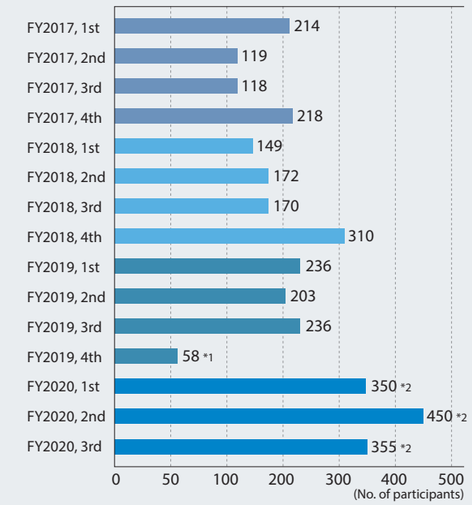
2nd Once again, facing up to a Tokyo Inland Earthquake: issues for the mutual usage and application of observation data.

3rd On enhancing the DRR capabilities of large-scale facilities

Online distribution of DEKATSU symposium
https://forr.bosai.go.jp/duc/

In 2020, symposiums were held online to prevent the spread and infection of COVID-19, and using a method with a voting function participated in viewers from all over Japan. There were more participants than the symposiums held in real venues up until FY2019.

Actual number of participants in DEKATSU symposium



*1 As a measure against COVID-19 infection, switched in haste to holding with no actual audience.
*2 Online hosting through Zoom webinar (also mirror distribution with YouTube Live). Numerics are for maximum concurrent viewers, not accumulated number.

TOP PRACTICE REPORT 02

Fundamental Observation Network

Through an observation network covering all of Japan in real-time, we provide earthquake/tsunami information even a second earlier.

NIED operates "MOWLAS" covering all the land and sea in Japan, an observation network designed to rapidly detect and communicate the occurrence of earthquakes and tsunamis so that individuals can take action as early as possible. NIED is also preparing to deploy a new observation network to cover the occurrence of the Nankai Trough Earthquake which is expected to cause a national catastrophic crisis.

Development and construction for a new observation network in the seismic source region of the Nankai Trough Earthquake go into full swing.

MOWLAS (Monitoring of Waves on Land and Seafloor) composed of 2,100 observation stations from seven observation networks, observes earthquakes/tsunamis/volcanos covering all of the land and sea areas across Japan. As well as research for natural phenomena, MOWLAS is also used for other purposes including emergency response using real-time information dissemination and evaluation of hazard and risk in advance.

The establishment of observation networks, as seen in the 1995 Great Hanshin-Awaji Earthquake and the 2011 Great East Japan Earthquake, constitutes a "chasing after" of disasters that have claimed many lives, while in fact the aim should be for the "forestalling" of disasters. Although there is some 70-80% probability that the Nankai Trough Earthquake will strike within the next 30 years, there is still a blank area in the observation network from off Kochi Prefecture all the way to Hyuga-nada (off Miyazaki Prefecture). NIED will aim to contribute to mitigating damage from anticipated Nankai Trough Earthquake by establishing the Nankai Trough Seafloor Observation Network for Earthquakes and Tsunamis (N-net).

Development and construction for N-net started in 2019 and formulated a proposed ocean cable route, following an ocean survey to select the area suitable for laying cables. Currently, construction work is drilling pipelines to land the cables connecting observation equipment on the seafloor. NIED will continue to make steady progress toward the establishment of N-net.

NIED will maintain stable operation of MOWLAS, and while it will endeavor to deploy new observation networks, these do involve significant costs and the securing of these will be a focus issue.

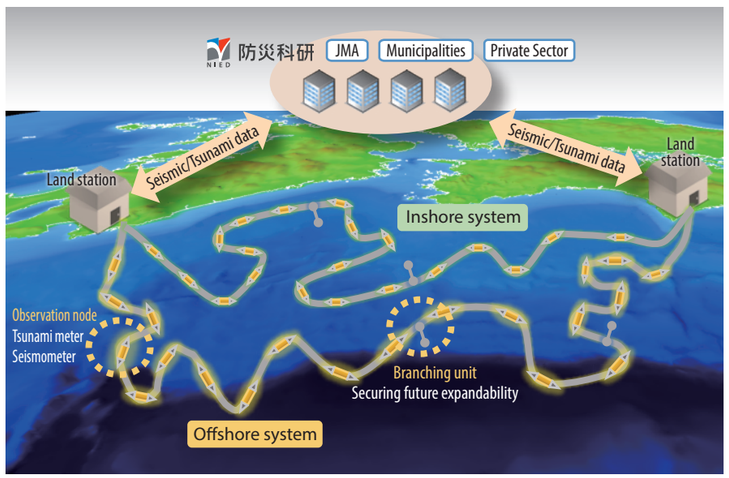


Image of N-net system



Construction work in Kushima City, Miyazaki Pref.

Information products related to MOWLAS observation data are widely utilized by various stakeholders.

General public

Through its "Kyoshin Monitor", NIED transmits information on current seismic shaking in Japan observed by MOWLAS. This information is also sent out on Yahoo! JAPAN and "MDA Situational Indication Linkages", a system for displaying various maritime conditions operated by the Japan Coast Guard.

Private companies

Data from the seafloor observation network for earthquakes and tsunamis is provided to railway companies to improve safety of train operation and preparations are underway for utilization by power companies.

Government institutions

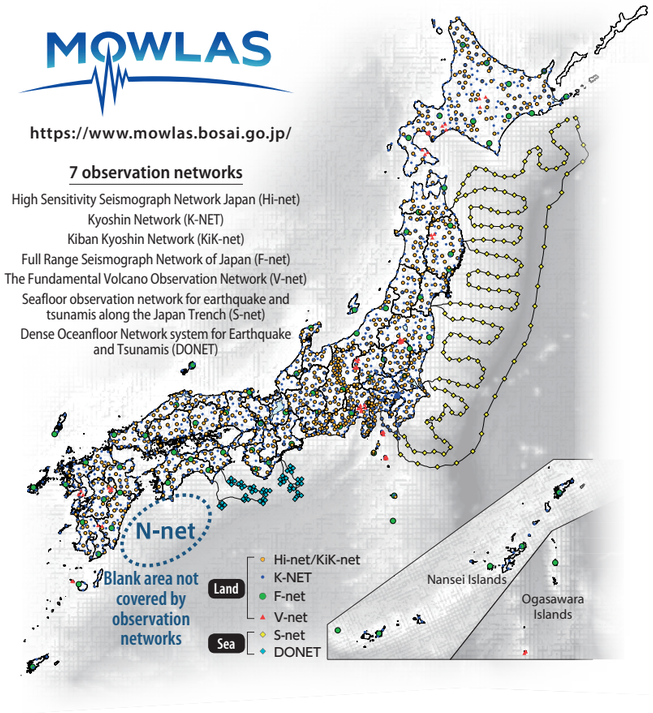
Observation data is utilized as the basic data for creating the "National Seismic Hazard Maps for Japan" by the Headquarters for Earthquake Research Promotion. It is also used by the Japan Meteorological Agency for issuing earthquake early warnings, tsunami warnings, seismic intensity information, hypocenter determination and volcanic observation. In March 2020, application began for S-net's S6 (a sub-system installed to the east of the Japan Trench), which marked the start of the application of observation data for the whole of S-net.

Municipalities

NIED transmits data from seafloor observation networks to Wakayama/Mie/Chiba Prefectures, to allow immediate tsunami prediction.

Researchers

NIED contributes to greater understanding of seismic/tsunami phenomena and volcanic activity.



From our stakeholders Rediscovering the importance of scientific evidence for disaster management administration

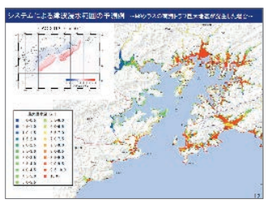
OKUNO Naoyuki

Disaster Prevention and Regional Support Division,
Department of Disaster Prevention, Mie Prefecture
Network Center for Earthquake, Tsunami and Volcano, NIED

I am developing a database to provide the foundation for a "Tsunami prediction and transmission system utilizing DONET". Mie Prefecture has suffered damage from Nankai Trough earthquakes in the past, so in addition to the operation of the system along the Kumano-nada coast in the southern part of the prefecture, we are now preparing to extend operations to cover the Ise Bay coast.

Through my experience of development at NIED, I could develop a more specific approach with regard to the significance of the system and its operating method. Deciphering natural phenomena and putting this understanding into practice are everlasting challenge in disaster management administration. After returning to the prefectural government to implement measures, I re-acknowledged the importance of sharing information with a scientific evidence and which anybody could agree with and act as if it were their own affairs. In anticipation of the Nankai Trough earthquake, I believe it is important to use this point of view in disaster management administration.

Conducting research at NIED allows one to come into contact with cutting-edge research regarding various natural phenomena that accompany disasters, providing a very precious experience. I very much hope that ongoing linkages between Mie Prefecture and NIED will allow the further development of human resources involved in the prefecture's disaster risk reduction. The tsunami prediction system initiative was realized as part of a cooperative agreement signed by NIED, JAMSTEC and Mie Prefecture. We are extremely grateful to everyone who guided the initiative from the very early stages, and also to other related bodies who provided assistance throughout the process.


Example of system's prediction of extent of tsunami inundation

TOP PRACTICE REPORT 03

Advanced Research Facilities

NIED is promoting cooperation and co-creation with industry-academia-government through the utilization of our experimental facilities that can realistically re-create hazards.

When it comes to R&D for disaster risk reduction (DRR) that envisions large scale disasters that only strike once in a century, as well as analyzing historical data, it is indispensable to conduct experiments that realistically re-create hazards. By promoting the use and application of experimental facilities that are among the largest in the world, we are committed to the development of science and technology for DRR through cooperation and co-creation between industry, academia and government.

Photo: ICHIJO Co., Ltd

Flood-Resistant Home co-developed with ICHIJO Co., Ltd selected for "Climate Change Action Environment Minister's Award".

The development and productization of "Flood-Resistant Home" developed by ICHIJO Co., Ltd. together with NIED received recognition, and was selected as the first recipient of the Climate Change Action Environment Ministry's "Environment Minister's Award" (Development & productization category/Adaption area). The experiment involved digging the ground surface inside the research facility into a pool shape, and constructing a Flood-Resistant Home and a normal house alongside each other. Upon recreating heavy rain and flooding damage, the normal house was inundated above floor level, while Flood-Resistant Home did not sustain any damage under the floors or inside the rooms.

Tsukuba (Ibaraki) Generating realistic heavy rain
[Large-scale Rainfall Simulator]

This rainfall experimental facility has one of the largest surface areas for sprinkling water in the world. The facility can control rain from misty rain to torrential rain of 300 mm per hour in 10-minute increments, and are widely utilized by both government organizations and private companies for research on landslides and flooding, as well as for verification experiments using drones and automated driving technologies.

https://www.bosai.go.jp/e/facilities/rainfall.html

[No. of experiments conducted in FY 2019] 6
Research for development of Flood-Resistant Home and performance evaluation (ICHIJO Co., Ltd), others

Conducting performance verification at one and only experimental facilities capable of realistically re-creating hazards.

The reproduction and observation of "extreme conditions" that trigger hazards are indispensable part of R&D into science and technology for DRR. NIED has large-scale experimental facilities almost unparalleled in the world which can be used to conduct cutting-edge research into earthquakes, heavy rain and snow and ice disasters. Through the observation of real data which cannot be obtained at small-scale facilities, we are promoting co-creation between industry, academia and government as well as use and application by private companies and manufacturers. Through the establishment of Center for Advanced Research Facility, NIED promotes user-oriented use and application of its experimental facilities, and is committed to the social implementation of science and technology including standardization of methods for performance verification of building structures.

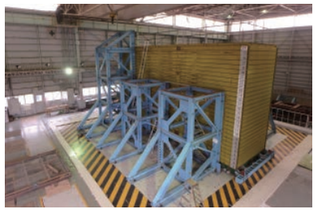
Miki (Hyogo) Re-creating all kinds of seismic motion in 3-D
[E-Defense] (3-D Full-Scale Earthquake Testing Facility)

The world's largest experimental facility (shaking table 20 m × 15 m), which can re-create shaking with a seismic intensity of 7, on the scale of the Great East Japan Earthquake. Capable of realistically reproducing seismic motion including long-period ground motion and inland earthquake, E-Defense is utilized to evaluate seismic performance of residential houses and industrial infrastructures and to verify countermeasures technologies.

https://www.bosai.go.jp/e/facilities/edefense.html

[No. of experiments conducted in FY 2019] 4
Verification for the practical realization of new seismic reinforcement construction method for road embankments using a sandbag structure (Hyogo Prefecture), and others.

Tsukuba (Ibaraki) Verifying seismic performance of full-scale structures
[Large-scale Earthquake Simulator]



This large-scale facility is used not only for academic research, but also for various full-scale seismic experiments on houses, water tanks, and others using the world-leading large-scale 1D shaking table (14.5 m × 15 m). It is possible to ascertain the damage that would be caused by an earthquake on the scale of the Great Hanshin-Awaji Earthquake.

https://www.bosai.go.jp/e/facilities/earthquake.html

[No. of experiments conducted in FY 2019] 6
Evaluation experiment for response reduction effect of control unit for wooden structures (Tokyo University of Science), others

Shinjo (Yamagata) Reproducing near natural snow crystals
[Cryospheric Environment Simulator]

The only experimental facility in the world capable of reproducing near natural crystal shaped snow even in mid-summer. We elucidate snow and ice phenomena, and verify the effectiveness of disaster countermeasures regarding roof snow, snow accretion, blizzards, and avalanches.

https://www.bosai.go.jp/e/facilities/environment.html

No. of experiments conducted in FY 2019] 27
Experiment reproducing snow accretion considering snow quality of snowdrift particles (Railway Technical Research Institute) and others

From our stakeholders **Utilization of advanced research facilities to realize a comprehensive disaster resistant housing.**

IWATA Naoki
Representative Executive
ICHIJO Co., Ltd.

Since establishment 40 years ago in Hamamatsu, ICHIJO Co., Ltd. has valued implementing full-scale experiments and collaboration with researchers in our aim to develop houses that are resilient to earthquakes. For the most recent Flood-Resistant Home experiment also, we were able to fully utilize the functions of the advanced research facility, and for just over a year conducted experiments with NIED. In recent years, there is an increase amount of damage due to unexpected heavy rainfall. Given this, I think we were able to obtain extremely valuable data that can be proposed to society in these times.

Disaster countermeasures require us to think about the phase of before, during and after disasters. This inspired ICHIJO Co., Ltd. to propose "comprehensive disaster resistant housing", which are houses that allow the residents to retain quality of life even after a disaster has occurred, as if they have escaped a disaster.

All data obtained from experiments is open, and is used by researchers and other parties in the housing industry, and we very much hope that this will provide the impetus for more houses all across Japan to "resist" various natural hazards including flooding. From this perspective, I have high hopes for continued use of the advanced experimental facilities.

TOP PRACTICE REPORT 04

Information Distribution Infrastructure

Realization of prompt and effective disaster management by sharing and using information beyond the framework of organizations.

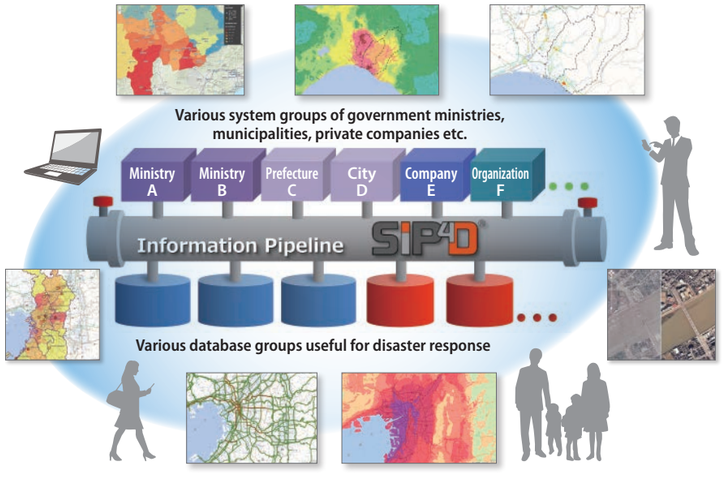
During disasters, a wide variety of information is shared, including the extent of damage, evacuation status, recovery support situation, and analysis results of observational data from each organization collected by the government, municipalities, and infrastructure companies. NIED has formulated a system for aggregating information that transcends the boundaries of agencies and organizations, and for sharing it in an easy-to-use form.

NIED developed and operates "SIP4D", a system for sharing information among relevant organizations.

The Shared Information Platform for Disaster Management "SIP4D" is a system that aggregates the information needed for disaster response activities from a variety of information sources to promptly provide it in an easy-to-use form, so that it can be shared among relevant organizations. Each organization can mutually exchange information by connecting their disaster systems with SIP4D. SIP4D plays a role as a pipeline that can collect water from a variety of water sources (variety of information sources) and provide the purified water (information products) with a certain level of quality from a faucet.

SIP4D contains two core technologies: "automatic data format conversion (converting data format to be easily utilized by users according to their needs)" and "logical integration of information (integrating the aggregated same types of information provided from different organizations into one)". The burden of sharing information can be dramatically reduced by intermediating the processes of connection, conversion, and integration between systems. Also, it is possible to contribute to decision-making by supporting organizations with integration of data provided from private companies and the authorities. It also plays a role as a pipeline connecting the disaster site and researchers, aiming for maximization of effectiveness in the disaster site and research.

SIP4D® Shared Information Platform for Disaster Management

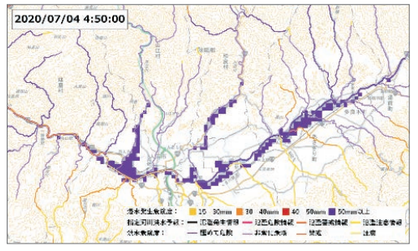


The number of contact points for SIP4D has increased based on the social conditions.

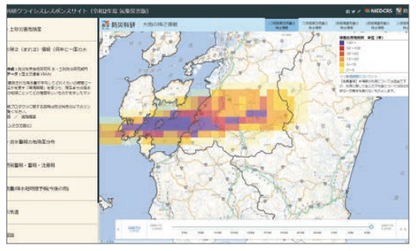
NIED is promoting closer co-ordination with government ministries and relevant organizations. We have also promoted technological establishment to automatically acquire information about electricity outage and communication breakdown by conducting coordinated demonstration experiments including technical verification with the systems operated by relevant organizations. NIED is also enhancing the real-time linkage function with systems of the epidemic prevention field in response to the COVID-19 Pandemic.

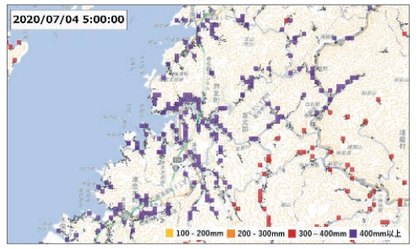
NIED enhanced real-time delivery of risk information for the Heavy Rain Event of July 2020.

When an alert is issued for an imminent disaster or during a time of disaster, NIED has immediately launched the NIED Crisis Response Site (NIED-CRS) to publish the disclosable hazard and damage information that is shared through SIP4D. The information products within SIP4D can be shown as a catalogue, and various types of information products regarding disasters are mashed up to be viewed on a map. NIED is developing a capability that can detect "the occurrence of disaster" as a disaster dynamic state by combining social dynamics with natural dynamics. During the Heavy Rain Event of July 2020, NIED performed the integrated analytical process of effective rainfall amount and regional characteristics such as populated area, assumed inundated area, and sediment disaster caution zone, to deliver risk information of possible flood and sediment disasters. As well as delivering such information to municipalities and other relevant organizations, NIED also evaluates and verifies the concepts.

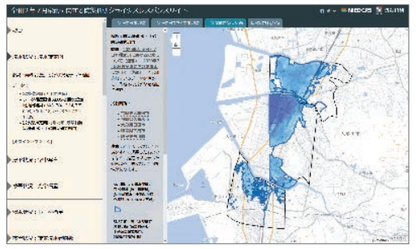


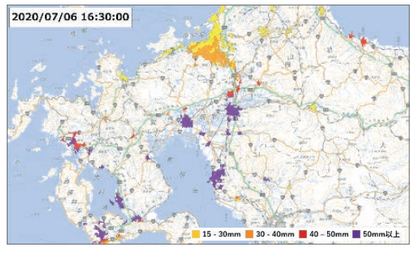
Risk of inundation by river water


Information on rarity of heavy rain

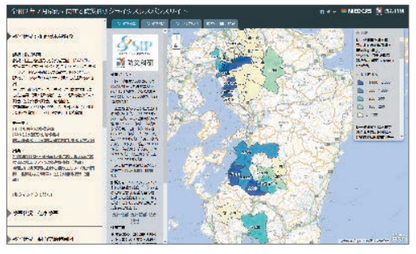


Risk of sediment disaster


Estimated inundation chart



Risk of inland water flooding


Number of estimated inundated buildings

From NIED Crisis Response Site to "bosaiXview"

bosai Xview

When an alert is issued or during a time of disaster, NIED has transmitted useful information with the NIED Crisis Response Site (NIED-CRS). Aiming at more enhancement and effective information delivery, the NIED-CRS was relaunched as a "bosaiXview" (pronounced "bosai cross view") in 2021, meaning "checking multilaterally to see through ahead of disaster" by overlaying all information such as hazard risk information, forecasted/estimated information, disaster occurrence status, progress of recovery, and past disaster records.

TOP PRACTICE REPORT 05

Contribution to Disaster Management Practice at National Government

Providing support through information sharing. The trajectory of disaster response that is continually upgraded.

Under disaster response support utilizing SIP4D, NIED dispatches researchers to the on-site disaster countermeasures HQ to support the sharing of disaster information. In 2019, NIED and the Cabinet Office collaborated to officially establish the Information Support Team (ISUT), which supports disaster countermeasure activities in various regions. Knowledge gained through the activities is used in R&D for disaster countermeasures.

2014 Development of SIP4D begins

- Under Cross-ministerial Strategic Innovation Promotion Program (SIP)
- Cooperation began with case studies on healthcare and reservoirs, aiming to create Japan's first cross-ministry disaster management information sharing system

2015 Disaster response begins

September 2015 Kanto-Tohoku Heavy Rainfall Event
(On-site response period: 9/12-9/30 Joso City Hall, Ibaraki Prefecture)

- SIP4D team's first disaster response
- Information sharing linking City's disaster management HQ with DMAT
- Shift to developmental system centered on on-site disaster response


2016 Supporting on-site disaster response

2016 Kumamoto Earthquake
(On-site response period: 4/15-8/31 Kumamoto Prefectural Government)

- First whole-institute response by NIED
- Deployment/verification of SIP4D prototype
- Cabinet Office established "disaster information hub" to create a structure for sharing information in times of disaster.


2017 Supporting agencies on the front line

2017 Northern Kyushu Heavy Rainfall Event
(On-site response period: 7/6-7/31 Fukuoka Prefectural Government)

- Information sharing among SDF/Fire Department/Police etc.
- Cooperation with ImPACT all-weather drones
- Cabinet Office established "ISUT"


2018 Trial run of ISUT


Earthquake in the Northern Osaka Prefecture on June 18
(On-site response period: 6/18-6/22. Osaka Prefectural Government)

- From trial training to actual deployment
- Data from private sector + Data from administration → utilized for decision-making for SDF bathing support


Heavy Rain Event of July 2018
(on-site response period: 7/7-8/9 Prefectural Government in Hiroshima, Okayama, Ehime)

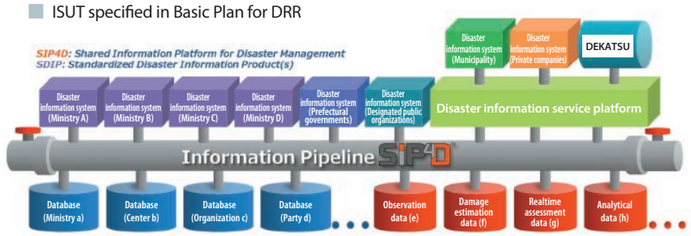
- First wide-area disaster response
- Automatic integration of multiple road data
- SIP4D used by many organizations to discuss disaster response

2018 Hokkaido Eastern Iburi Earthquake
(On-site response period: 9/6-9/28 Hokkaido Government)

- Entered local area accompanied by SDF jet
- Deployed in core of disaster response HQ


2019 Technological development using SIP4D Full-scale operation of ISUT

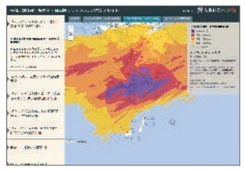
- Full-scale start of R&D through NIED operation grant
- ISUT specified in Basic Plan for DRR



SIP4D® Shared Information Platform for Disaster Management

ISUT Information Support Team

Part 2 Disaster management common to each disaster
Chapter II Emergency disaster control measures
Section 2 Establishment of a system for gathering and transmission of information and for conducting activities immediately after the occurrence of a disaster
6. Activity system of the State
(7) Dispatch of investigation team such as Major Management Headquarters
Establishment of On-site Disaster Management Headquarters
- The State (Cabinet Office, etc.), if necessary, ahead of government investigation team arrival, may urgently dispatch officials to the site of the disaster area by helicopter, etc. At that time, the State (Cabinet Office, etc.) may dispatch ISUT (Information Support Team) consisting of the State (Cabinet Office, etc.) and National Research and Development Agency National Research Institute for Earth Science and Disaster Resilience to support disaster management conducted by local governments, etc., through gathering and organizing disaster information to provide it in the form of maps.




Heavy rain event in late June, 2019
(on-site response period: 7/3-7/5 Kagoshima Prefectural Government)

- First on-site dispatch since full-scale operation of ISUT began


Heavy rain event in late August, 2019
(on-site response period: 8/28-9/4 Saga Prefectural Government)

- Effective rainfall amount + Disaster-dynamic analysis through SNS analysis
- Responded to secondary disasters such as oil spil/ sediment disasters


2019 Typhoon Faxai (Typhoon No.15)
(on-site response period: 9/10-10/4 Chiba Prefectural Government)

- Support for collaborative removal of fallen trees through proposal using ISUT integrated form
- Use of DRR chatbot


2019 Typhoon Hagibis (Typhoon No.19)
(on-site response period: 10/13-11/20 Prefectural Government in Miyagi/Fukushima/Tochigi/ Ibaraki/Saitama/Nagano)

- Analysis of wide-area disaster situation using radar satellite remote sensing data
- Support for collaborative waste material removal spanning government ministries to volunteers

2020 Enhancing of disaster response function

Heavy Rain Event of July 2020
(on-site response period: 7/4-7/29 Prefectural Government in Kumamoto/Kagoshima)

- Provision of disaster-dynamic information that changes minute by minute
- Each organization utilizes ISUT-SITE independently



TOP PRACTICE REPORT 06

Dissemination of Research Results/Application of Intellectual Properties

By providing information products to various users, we endeavor to disseminate research results into society.

NIED owns various types of intellectual property regarding disaster risk reduction.
As well as preparing and providing these as information products that anybody can easily make use of,
NIED is proactive in its PR activities to promote the wide dissemination of these research results.

We are promoting the dissemination of methods for surveying the ground's likelihood to shaking

The land that we inhabit is constantly shaking due to sea waves and human activity. Humans cannot usually sense such "microtremors", but they can be observed by seismometers such as MOWLAS's Hi-net. While microtremor exploration is known as one method for detailed surveying of the likelihood of ground shaking, NIED has patented methods for dynamic observation of microtremors, for which usage is increasing.

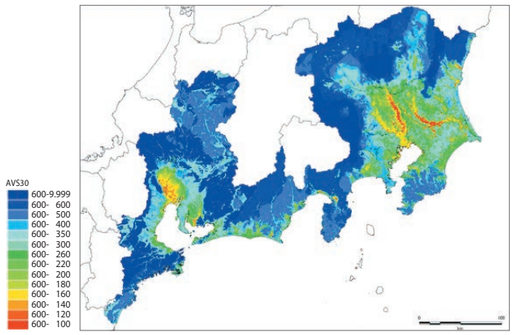
NIED takes part in "National Seismic Hazard Maps", a compilation of seismic hazard assessment issued by the Headquarters for Earthquake Research Promotion, under Ministry of Education, Culture, Sports, Science and Technology (MEXT). Likelihood of shaking for the subsurface layer is evaluated with 250 m grid geomorphologic classification sections (24 varieties), the results of which are publicized through Japan Seismic Hazard Information Station (J-SHIS).

However, at the time of the 2016 Kumamoto Earthquake, there was a huge disparity in the damage sustained by houses that were only several hundred meters apart. To tackle this issue, NIED acquired patents* regarding microtremor observation, and promotes initiatives that enable even non-experienced persons to easily conduct microtremor observation. In future, by translating the geomorphologic classification sections into the results of the 3-D underground structure model using microtremor exploration, it will be possible to grasp the likelihood of shaking accurately for each location, which can be translated into prior risk assessment. NIED is also working toward automatic processing of analysis results and the international standardization of the technologies.

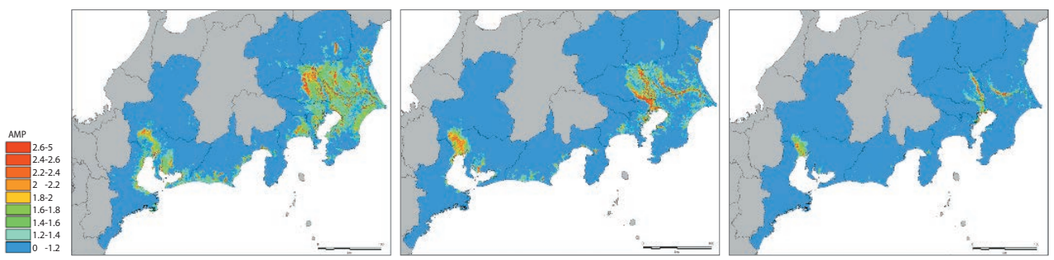
Developing method for evaluation wide area crustal characteristics through microtremor observation

SENNA Shigeki
Senior Research Fellow
Multi-hazard Risk Assessment Research Division

*Patent no. 6544704/ Tools for installing equipment and microtremor measurement equipment
Patent 6682118 /Microtremor measurement equipment and microtremor measurement equipment with tools.



Average S-wave propagation velocity to a depth of 30 m underground



Likelihood of shaking for 0.5 second period | Likelihood of shaking for 1.0 second period | Likelihood of shaking for 2.0 second period

In addition to "Results Briefing Session", we effectively conduct activities to communicate our results.

Since FY2002, NIED has held an annual "Results Briefing Session". This is a presentation of one year's worth of research results at NIED, and includes lectures, poster presentations, and panel discussions. This is a very important activity regarding results communication for NIED along with the public open day, and in FY2019 renowned journalist Akira Ikegami joined a special guest commentator for a specially themed session entitled "Know, Be Prepared, Act". This drew an audience of over a thousand. The session included introduction of NIED's initiatives for disasters that struck in 2019, poster presentations of results by some 140 researchers, and a special talk session between Mr. Ikegami and NIED President Hayashi.

In 2020, in conjunction with AGU (American Geophysical Union) Fall Meeting 2020, NIED produced an English language video outlining its main initiatives. Filming took place in Headquarters Tsukuba in November, including interviews with the President and four researchers. The produced film was streamed online at the Fall Meeting, and is also available on the AGU TV 2020 Website.

Filming interviews at NIED

FY2019 NIED Results Briefing Session

Expanded area of "YukioroSignal" (Snow Load Alert), designed for lifestyles in heavy snow regions

YukioroSignal (meaning "Snow Load Alert") is an information product highly relevant to daily life which provides notification for the appropriate timing for removing snow off the roof. Enjoying a great response since its rollout in the Niigata Prefecture area in January 2018, it was then expanded to Yamagata and Toyama Prefectures in 2019. It was then expanded to Akita Prefecture in 2020, and initiatives are in place to achieve coverage of heavy snow areas all over Japan such as Nagano prefecture. We are cooperating closely with all stakeholders to further promulgate it in areas where it is available and also to enhance the estimation accuracy of its models.

Website of YukioroSignal (Snow Load Alert)

TOP PRACTICE REPORT 07

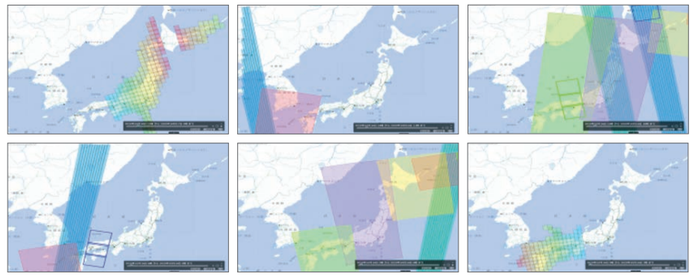
International Collaboration

NIED is strengthening global collaboration, contributing to border-crossing DRR activities.

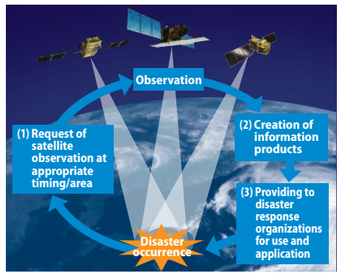
While learning from the many disasters that have affected Japan, NIED feeds the knowledge and cooperation obtained through international cooperation into enhancing the resilience of Japanese society. NIED also promotes initiatives that draw upon these research outcomes for leveraging cross-border disaster risk reduction (DRR) activities.

NIED is developing Technologies that use Satellite Data for Analyzing Disaster Conditions and Prediction Technologies.

To respond to the need for "information to understand disaster conditions over a wide area" during the initial response stage of a disaster, as one theme of "Enhancement of National Resilience against Natural Disasters" under the Cabinet Office's Cross-ministerial Strategic Innovation Promotion Program (SIP) commenced in 2018, NIED, JAXA, the University of Tokyo and private companies are participating in the promotion of R&D for prediction technologies and analysis of disaster conditions using satellites. Utilizing numerous satellites including those of other countries, we are pursuing technological development for generating and sharing useful information products that can steadily observe the affected area immediately after a disaster has occurred.



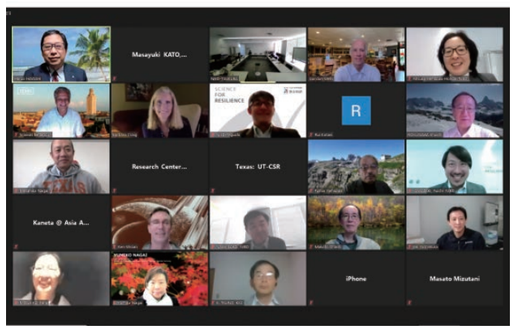
Unified understanding of observable area using satellites



Satellite images: ©JAXA
Development of system for analyzing and sharing disaster conditions using satellite data.

Aiming for further utilization of satellites in cooperation with University of Texas.

In 2019, NIED signed a cooperative agreement for international joint research with the Center for Space Research, the University of Texas at Austin, for the purpose of sharing knowledge for the maximum possible utilization of satellites in disaster response, with a view to expanding the scope of collaboration in future through initiatives in each country. In 2020, given the impact of COVID-19, "International Workshop 2020: Application of Satellite Remote Sensing for Disaster Response" was held online, and featured sharing of the latest R&D situation from the Japan side as well as dialogues regarding leveraging of further R&D. Based on the results of the workshop, plans are in place to hold several workshops each year to tackle technical issues related to the use of data analysis technologies and analysis results.

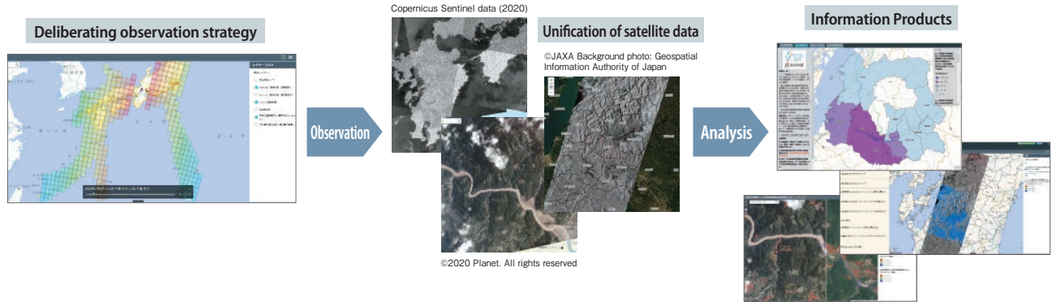


International Workshop 2020 (held online)

NIED is formulating a system for promptly providing information products using satellites after a disaster.

During Typhoon Hagibis in 2019 (East Japan Typhoon), NIED prototyped estimation results for number of inundated buildings by municipality, as an information product using satellite data. The issues that transpired from this were, that it was not possible to consider a proactive satellite observation strategy for wide-area damage, and also that the aggregation of satellite data and the creation and processing of information products were performed manually and thus required time leading up to provision. At this juncture, NIED cooperated with participating organizations to strategically deliberate satellite observation and developed a prototype system capable of aggregating and sharing satellite data and analysis results in a unified manner. This system was trialed in FY2020, and during the "Heavy Rain Event of July 2020", estimation results for number of inundated buildings were provided one and a half days after the disaster struck. It was also reported by ISUT members deployed on-site that these estimation results conformed to the information obtained on-site. During Typhoon Haishen, online meetings were held with related organizations to jointly deliberate the satellite observation strategy to be deployed using this system. The system was used for consideration of warnings for storm surge and river flooding in Kyushu, for activation of the International Charter, and also for consideration of the observation area of ALOS-2 (DAICHI-2). The satellite has a regular orbit and has the potential to be leveraged in countries other than Japan. In future, NIED will promote R&D in anticipation of the possibilities of international expansion.

Experimental operation of prototype system (Heavy Rain Event of July 2020).



We are committed to mitigating snow and ice disasters through concentrating research results of Japan and Switzerland.

The Institute for Snow and Avalanche Research (SLF) belongs to the Swiss Federal Institute for Forest, Snow and Landscape Research (WSL), which carries out research on natural disasters such as flooding, falling rocks, debris flow, and landslides, conducting regular avalanche forecasts and issuing avalanche early warning for the whole of Switzerland.

In collaboration with SLF, NIED has modified the numerical snowpack model (SNOWPACK) developed by SLF to fit the moist snow of Japan. Results from this model are used in research for predicting avalanches, and also in "YukioroSignal", Snow Load Alert, the information product that informs residents of the appropriate timing for removing snow off the roof (p.30).

Given that Switzerland and Japan have markedly different snow and ice environments, the sharing of each other's observation data, disaster-related information and knowledge is extremely important, and research exchange sessions are held annually.

Research exchange session in Switzerland

NIED signed a Memorandum of Cooperation with NCDR (Taiwan).

In March 2020, NIED exchanged a Memorandum of Cooperation with National Science and Technology Center for Disaster Reduction (NCDR) for cooperation regarding joint research and holding annual workshops, the first of initiative of which was the holding of a joint workshop on the theme of use and application of meteorological disasters and DRR information. In the coming years, NIED and NCDR will promote full-scale joint research regarding the three themes of wind and flood disasters, landslide disasters and information sharing in times of disaster.

TOP PRACTICE REPORT 08

Human Resource Development

NIED commits to cultivating human resources through participating in degree programs at universities.

NIED endeavors to cultivate the next generation of young researchers who will play a key role in disaster risk reduction (DRR), by taking in undergraduate and graduate students through a cooperation with University of Tsukuba, and also providing programs where researchers can acquire a degree while working.

NIED proactively participates in academic degree programs.

NIED has up until now concluded agreements with various universities and cooperative graduate schools, in order to intake both students and graduate students. Cultivating human resources is very important in the field of science and technology for DRR, and in December 2017, NIED established the "Resilience Research and Education Promotion Consortium" in conjunction with University of Tsukuba, Tsukuba City and 11 companies/ research institutions in the vicinity, in order to pursue degree programs designed to unlock a new domain in risk resilience research and also to foster academic and global human resources. As a result, the Masters/Doctoral Program in Risk and Resilience Engineering started from April 2020 at University of Tsukuba Graduate School.

This involved the adoption of a hybrid education system under which experts active on the front line from participating institutions in the consortium - including researchers from NIED -participate as instructors for students. As well as driving activities that form the nucleus of risk resilience related education, this program will foster high-end human resources with doctorates ready to equip society with a high level of resilience based on the knowledge and technologies cultivated at each organization.

In order to participate proactively and continuously in the running of this degree program, NIED signed an agreement* with University of Tsukuba regarding cooperation for education and research for Collaborative Graduate School in March 2020. As well as NIED researchers providing lectures and research guidance in their role as instructors at University of Tsukuba (professors, Collaborative Graduate School), younger employees can participate in this degree program as students while still working at NIED.

*Agreement on cooperation for the Collaborative Graduate School's educational research established by the University of Tsukuba and Resilience Research and Education Promotion Consortium

Online session of Consortium

Risk and Resilience Engineering Degree Program Lecturers (NIED Staff) in the fields of urban DRR/social resilience and research themes	
FUJIWARA Hiroyuki	Hazard risk assessment for earthquakes/ tsunami, development of prediction methods for strong motion using numerical simulations, methods for formulating modeling of the subsurface structural, and systems for real-time estimation of earthquake damage.
USUDA Yuichiro	Disaster information, disaster dynamics, cyber physical systems for DRR field, risk communication, decision-making support.
SAKAI Naoki	Geotechnical engineering, sediment disasters, heavy rain disasters, model experiment, IoT/AI, satellite/remote sending data, disaster risk, TDA (trans-disciplinary approach).

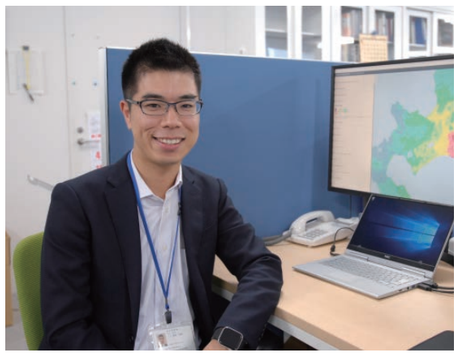
NIED promotes human resource cultivation that strengthens research capabilities.

As part of commitments to cultivating human resources, NIED collaborates and cooperates with higher education institutions to promote an environment for obtaining degrees with the ultimate objective of strengthening research capabilities. It is also possible to obtain a degree while working. NIED permits taking classes under this degree program as a part of work duties at NIED and supports the obtaining of degrees by employees. From April 2020, 2 researchers enrolled in University of Tsukuba Graduate School and are currently taking the Program in Risk and Resilience Engineering as doctoral students.

MIZUI Yoshinobu

University of Tsukuba, Graduate School of Science and Technology Degree Programs in Systems and Information Engineering, (Doctoral Program)
Doctoral Program in Risk and Resilience Engineering, 1st Year
Technical Staff, Disaster Information Research Division

Since the Great East Japan Earthquake of 2011, I have been involved in research along the themes of mutual assistance activities and information sharing. The impetus for obtaining an academic degree came from a desire to carry out research by getting involved with the Social Welfare Council and disaster volunteer centers in each region after disasters have occurred, and digging deep into mutual assistance and community welfare/disaster resilience activities not just during disasters but also in non-disaster settings. In terms of balancing studies with work, while it is sometimes hard to switch between the two perspectives of researcher at a graduate school and a member of society with a job, being able to listen to presentations of students involved in research in other fields has provided major stimulation both for furthering academic work and for promoting research at NIED. In 2020, lectures for the University of Tsukuba Graduate School of Science and Technology were largely held online, and while regrettably I hardly visited the campus I am working steadily towards my degree by attending seminar camp and research presentations under professor Fujiwara (Manager of Multi-hazard Risk Assessment Research Division).



YOSHIMORI Kazushiro

University of Tsukuba, Graduate School of Science and Technology Degree Programs in Systems and Information Engineering, (Doctoral Program)
Doctoral Program in Risk and Resilience Engineering, 1st Year
Technical Staff, Disaster Information Research Division

I was interested in obtaining an academic degree since joining NIED, and when I learned that I could remain an employee at NIED while studying through the Risk and Resilience Engineering degree program, I enrolled in University of Tsukuba Graduate School. As NIED participates in this program, I was able to choose research themes that align well to my daily work and can also pursue research themes that of particular personal interest. While it is hard to devote ample time to study because of my day-to-day work, my manager at NIED (professor Usuda, Manager of Disaster Information Research Division), also provides lectures under this program. Studying under my manager has increased opportunities for communication but has also made it possible to integrate work with studying. Based on my experience of response at actual disaster sites, I intend to focus my research on looking into how we define information conducive to the decision-making of disaster responders.

Creation of science and technology for overcoming disasters.

FUNDAMENTALS

Promotion of Basic Research and Fundamental R&D

We introduce the aspirations and research results of our researchers who engage in basic research and fundamental R&D through interviews with them.

Interview of researchers grappling with disasters 1

Creating a new model for heavy rain countermeasures through co-creation with the private sector, using core technologies for water vapor observation

SHIMIZU Shingo
Chief Researcher
Storm, Flood and Landslide Research Division

Research Theme: Latest technology in water vapor observation for predicting a quasi-stationary convective rainbands

Using new technologies to decipher the mechanisms of quasi-stationary convective rainbands

Quasi-stationary convective rainbands bring record-breaking amounts of rainfall in a small area in a matter of hours. Observation of the amount of water vapor in the low-level atmosphere is vital for predicting the amount of rainfall. Water vapor observation up until now involved releasing balloons fitted with weather sensors twice a day, measuring the conditions in 16 locations across Japan all at once. However, this was not sufficient for temporal and spatial observation density required for observing quasi-stationary convective rainbands that rapidly develop in a small area dozens to several hundred km in four directions.

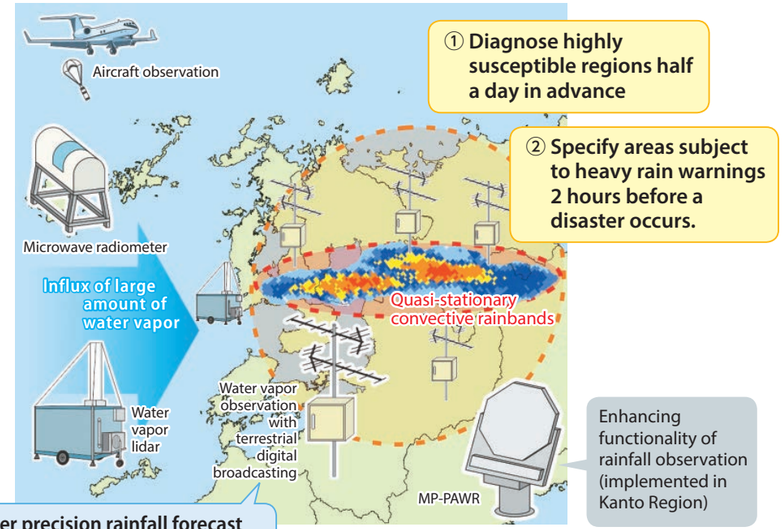
One new core technology by NICT (National Institute of Information and Communications Technology) can measure water vapor using terrestrial digital broadcasting wave, an initiative that is the first of its kind in the world and which can be implemented at low cost. By promoting research that uses "data assimilation" technology to apply this information into prediction, an observation network has been developed in Kyushu and Kanto capable of capturing water vapor distribution on an optimal spatiotemporal scale for cumulonimbus clouds, significantly enhancing accuracy of prediction.

NIED has up until now accumulated technologies for the real-time prediction of sudden torrential rain, and by applying these results with the water vapor observation network, will promote research that can promptly identify where quasi-stationary convective rainbands will occurs.

A step towards constructing a business model enabling co-creation with the private sector

However, leveraging this technology throughout the year all over Japan required large-scale calculators such as supercomputers, presenting problems both in terms of enormous cost and rapidity of prediction. At this point, we thought that the optimal way to implement technology into society would be to narrow down the scope of observation to regions and seasons where quasi-stationary convective rainbands are likely to occur, while collaborating with weather-forecasting private companies that provide services aligned to community needs.

Co-creation with the private sector greatly depends upon whether it will work as a business model. For the current fiscal year, by using a private sector owned cloud computer, we are formulating a low-cost prediction system deployable only in areas and seasons required by private meteorology companies, without needing to sink any running costs into super computers.



Conceptual diagram of system for predicting quasi-stationary convective rainbands

Applying core technologies to develop new information products

When it came to introducing such information products in local municipalities, a major hurdle was having them understand these new technologies. However, by assessing the practicality of prediction through verification experiments, we are identifying concrete needs such as the requests of busy disaster response officers using information products during an actual disaster response, as well as receiving enthusiastic responses from them.

On another front, water vapor observation can be utilized not only in disasters but in non-disaster setting also, and we are currently focusing on initiatives leading to monetization such as constructing business models for the private sector. These include creating the base data for discomfort index by assimilating temperature/water vapor/amount of radiation data, which is used for heatstroke countermeasures, or using data assimilation to calculate advanced wind information which is then provided to construction sites.

In this way, data assimilation is the core technology capable of delivering new information products that could not be grasped with observation alone, and the application of which has resulted in various products. We will redouble our efforts from now on in pursuit of the next core technologies.

FUNDAMENTALS 02 | Reduction of Disaster Risk 2

Interview of researchers grappling with disasters ❷

Bounce back quickly from disasters. Exploring its process with social science.

Disaster Resilience Research Division

Research Theme: Research on the scientific clarification of disaster processes and effective disaster management

UDAGAWA (Senior Research Fellow) SUZUKI (Deputy Manager) NAGAMATSU (Manager) OHTSUKA (Technical Staff) YI (Deputy Manager) IKEDA (Technical Staff)

How do people act during disasters and how does this impact society?

Disaster countermeasures should encompass the entire process of people being affected by the disaster, evacuating, and then starting to make moves toward reconstruction. If economic activities cease, society loses out, and the sense of loss among people is a major problem. To mitigate such disasters, it is essential to elucidate the nature of how people react during disasters, what sorts of problems do they encounter, and how the whole society is impacted by the disaster. The Disaster Resilience Research Division brings clarity to a whole series of phenomena which change over the passage of time, from the moment that lifeline and economic activities are severed, to working out what to do and how to re-open again.

Deciphering "KATA" common to disasters through separate phenomenon.

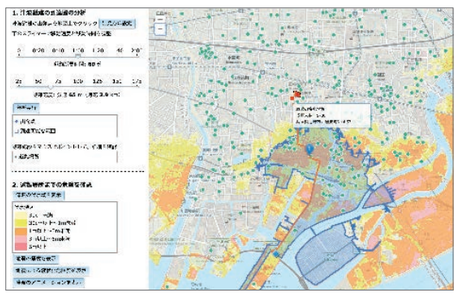
For the most part, natural disasters are phenomena that occurs within certain areas. Our duty is to create the universal systems, "KATA" (form of essence) that could occur in any disaster, by carrying out on-site investigation and research activities to decipher the individual phenomena of each distinct region. For example, because there are certain laws to the behavior of seismic motion or water during a flood, there must also be fundamental laws that explain how people should conduct themselves during disasters. By clarifying these patterns, NIED can establish the "KATA" for disaster risk reduction (DRR) behavior of both citizens and society with a view to raising the capabilities and capacity building for DRR of the whole nation.

Japan's only research institute dedicated to social science in DRR.

Although DRR appears to be associated with sciences and engineering, disasters are what occur when their countermeasures are exceeded. Research into how to bounce back from these is the role of social science, and it shall be established as a scientific principle involving proper theory and scientific clarification. NIED is only research institute in Japan that brings together such a large number of social scientists in the field of DRR. As a national research institute, NIED will lead the further development of social science in Japan's disaster management.

Drawing up evacuation plans through industry-academia-government cooperation utilizing digital tools.

The Amagasaki iron and steel complex is expected to sustain tsunami damage from the Nankai Trough Earthquake, so a drill was conducted through a cooperation between the cooperative union of the complex, Amagasaki City, Kansai University and NIED. For this drill, a tsunami inundation simulation app was combined with NIED's evacuation plan formulation support app "YOU@RISK", to draw up evacuation plans focused on evacuating away from danger with no one left behind when a tsunami occurs.



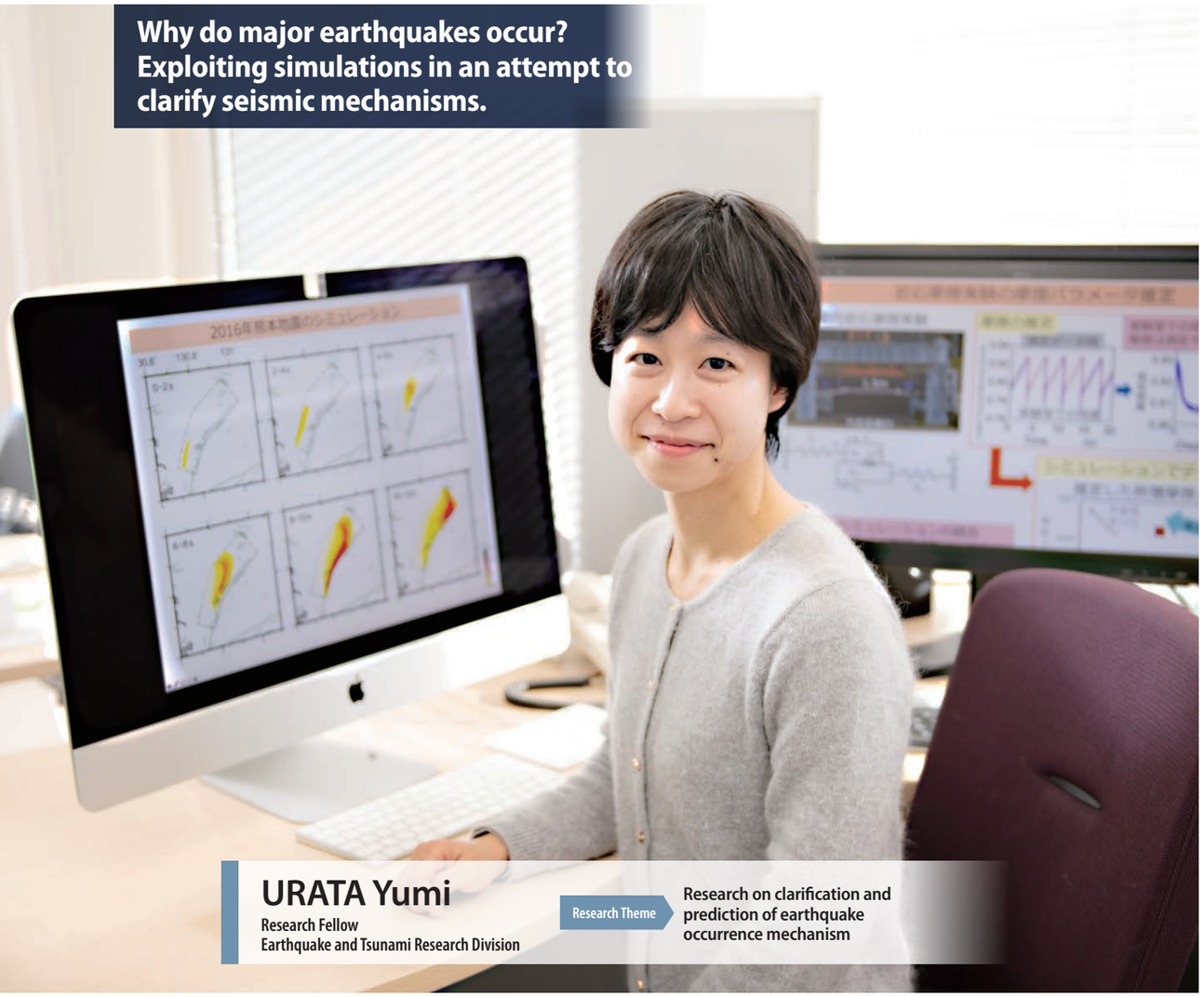
Developing programs that contribute to actions of people in a community to secure their safety

NIED researched and developed a program to support the judgement of adults and children in a community for "action to secure safety" during heavy rain disaster. On the basis of MEXT's new school curriculum guideline and emulating the case of Senju district of Nagaoka City as a model, NIED developed the "Heavy rain disaster prevention education program", and based on this program, also developed "Creating scenarios for responding to heavy rain disasters" which supports the judgement of citizens in a community to act in a way that ensures their safety. "YOU@RISK" is another information support tool developed by NIED.

FUNDAMENTALS 03 | Observation and Prediction of Disasters

Interview of researchers grappling with disasters ❸

Why do major earthquakes occur? Exploiting simulations in an attempt to clarify seismic mechanisms.



URATA Yumi
Research Fellow
Earthquake and Tsunami Research Division

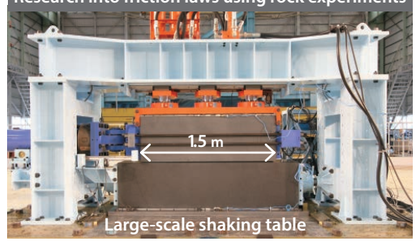
Research Theme: Research on clarification and prediction of earthquake occurrence mechanism

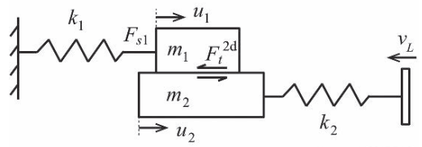
Elucidating friction acting along faults to predict major earthquakes.

Earthquakes are phenomena that occur when faults slip. The characteristics of the friction acting between grounds determine how the fault will slip, in other words what sort of earthquake will occur. The characteristics of friction were investigated using small-scale experiments, under which research was conducted into the behavior of faults on the premise that the characteristic of fault is unique and constant. This time, however, NIED conducted a meter-scale rock friction experiment using the large-scale shaking table, which reproduced conditions closer to reality, and was able to ascertain that the friction characteristics of a fault are not constant, and change during an earthquake, and continue to change as earthquakes repeat.

Based on these results, NIED modelled the fault rupture mechanism of the Kumamoto earthquake that occurred in 2016. Based on data regarding direction of compressional force that the fault is subject to (stress field) which can be analyzed from micro earthquakes that occur beforehand, NIED conducted approximately 150 3D-dynamic rupture propagation simulations. Re-creating the rupture process of the Kumamoto earthquake brought clarity to mechanical conditions of seismic phenomena whereby a large main shock occurs following several foreshocks.

Research into friction laws using rock experiments

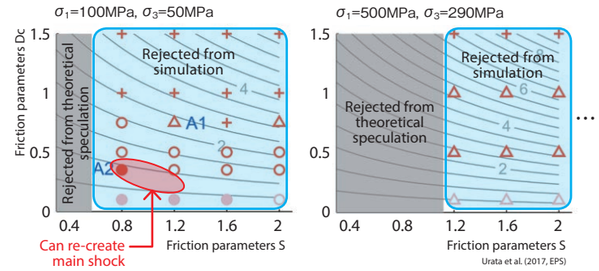




Urata et al. (2017,PAG)

Research for predicting large earthquakes through dynamic rupture propagation simulations of the 2016 Kumamoto Earthquake

Approx. 150 simulation cases ➡ **only a few cases match observed reality**



From theoretical speculation, reject gray range (main shock will not theoretically occur). From simulation results, reject range of + (no possibility of earthquake occurrence), △ (small-scale earthquakes). From the range of ○ (almost same size earthquake as actual Kumamoto earthquake), cases that conform to actual observation results for Kumamoto earthquake can be extracted.

Knowing future "earthquake scenarios" through simulations.

The manner in which fault ruptures propagate and how large an earthquake occur is called an "earthquake scenario". Currently, NIED is promoting initiatives to apply research on developing future earthquake scenarios to the Nankai Trough by integrating simulations with observational information obtained prior to earthquakes occurring. Observational information already exists for the Nankai Trough, and by carrying out multiple simulations using this data, we can assume various scenarios such as when the Tokai, Tonankai, and Nankai earthquakes occur in conjunction, and when they do not.

However, as the anticipated seismic source for the Nankai Trough earthquakes is a wide area, it is necessary to assume cases in the order of hundreds of thousands to millions, and then from these to extract cases that pertain to large-scale earthquakes. Thus, while the high burden on calculation is hindering the practical realization of prediction technology, NIED is promoting research conducive to formulating high quality scenario formulation at a practicable level.

Personal experiences underpin unebbing motivation as a researcher

As an elementary school student, I experienced the Great Hanshin-Awaji Earthquake. Since then I felt a strong conviction to "understand the mechanisms behind major earthquakes", which took me to a faculty of science where I could study simulations as a tool of theoretical research. This notion still provides the motivation for my current research. Daily research involves working with a team of people from diverse research fields, including those overseeing experiments as well as data analysts. Only a team affords you the privilege of learning about fields beyond your own expertise, and carrying out research over extensive discussions. In this respect, NIED is an ideal place to be a researcher, and I feel lucky to work in such an environment.

Large-scale facilities bring together people from diverse fields, whose co-creation gives rise to new value

NAKAZAWA Hiroshi
Center for Advanced Research Facility
Large-scale Earthquake Simulator Strategy Office
Senior Research Fellow, Earthquake Disaster Mitigation Research Division

Research Theme: Experimental research for earthquake disaster mitigation

Detecting new possibilities for conventional civil engineering technology

Currently, while operating the Large-scale Earthquake Simulator and working to promote their usage and application, as an individual researcher I am involved in strengthening the seismic resistance of gabion.

Going all the way back to pre-Christian era China, a gabion is a steel wire mesh structure whereby filled with stones, used in various places as a traditional civil engineering technology. During a damage survey of the 2015 Nepal earthquake, I noticed that among the many gabion used in local houses and infrastructures, some were broken while others weren't. By scientifically probing this disparity, surely, we could establish technology for outstanding seismic resistance. Having sensed that possibility, I begun research into gabion using the Large-scale Earthquake Simulator.


Examples of gabion structure (Photo: Joint survey by Kochi University/NIED and others)

With the slogan of low-tech, low-cost, local.

The majority of damage to residences in Nepal was concentrated in so-called "non-engineered construction", stone-stacked houses built by local builders and residents themselves without any involvement of engineers. At this point, as a low-cost technique for locals to at the very least prevent their homes from collapsing and saving their lives, we proposed "jacketing method" which envelops whole dwelling in wire mesh, thus rendering it into a gabion. This method is a seismic strengthen/retrofitting technology that can be implemented by the local residents without high technical ability, and experiments using NIED's shaking table together with Nepal's local surveys have confirmed that the high binding effect of wire mesh provides tenaciousness and prevents collapse.

While very old as a technology, gabion is a novel research subject, with no research into their structure implemented so far in Japan or other countries; it is thus necessary to newly provide and establish technical standards. Currently, we are promoting establishment of gabion as a technology with the slogan of: "3L Technology – sciencing low-tech, seeking low cost and applying in local". Currently, NIED is working towards implementation and popularization in Nepal. We utilize crowdfunding that has the dual function of information transmission and PR effectiveness.

The strength of gabion changes in line with how the wire mesh is knitted together. Thus, research involves not only verification experiments into their effectiveness in strengthen/retrofitting seismic resistance using the Large-scale Earthquake Simulator, but also focuses on an exchange of knowledge with private sector companies and bodies, including cooperation with Japanese wire netting manufacturers to conduct tensile tests, and initiatives for reflecting.

Confirming effectiveness of jacketing method using Large-scale Earthquake Simulator (photo: joint research by NIED/Chiba University and others)

Interchange of expertise through large-scale facility.

Opened in 1970, the Large-scale Earthquake Simulator for fifty years played an instrumental role in supporting the foundation for formulating design criteria for energy facilities, bridges and houses. NIED also currently operates E-Defense which is capable of recreating 3-D seismic motion, and each facility is currently used and applied by private companies in accordance with the nature of the project and scale of the enterprise. The strength of possessing these large-scale facilities likes in the fact that they bring together people and expertise, providing a venue for debate and for bringing forth novel concepts and co-creation. I believe that pursuing these possibilities is one real pleasure of operating large-scale facilities.

NIED conducts basic research to provide the driving force for promoting co-creation in science and technology for Disaster Risk Reduction (DRR).

NIED conducts basic research for all hazards including earthquakes, tsunami, volcanic eruptions, strong wind, torrential rain, heavy snow and landslides, as well as science and technology for DRR spanning all of the phases before and after disasters. Results are presented in numerous papers by researchers, receiving positive feedback from various parties.

Including numerous awards, NIED's research activities have received wide-ranging recognition.

JDR Award 2019

In recognition of the fact that JDR's (Journal of Disaster Research) "Special Issue on NIED Frontier Researches on Science and Technology for Disaster Risk Reduction and Resilience 2017 was the most downloaded special issue in the last three years, guest editor and Head Center for Comprehensive Management of Disaster Information Mr. Yuichiro Usuda was awarded the Fifth JDR Award.

NIED Awarded "2020 Environment Minister's Award for Climate Action".

In 2019, NIED teamed up with ICHIJO CO., LTD. to launch a water damage mitigation project as a joint government-private sector climate change adoption measure, under which NIED has conducted R&D regarding strategic preparations for torrential rain and flooding risks, and the ideal conduct of residents in times of disaster. "Development of 'Flood-Resistant Home' in line with extreme meteorological risks" between ICHIJO CO., LTD. and NIED was selected as the first recipient of the Environment Ministry's "FY2020 Environment Minister's Award for Climate Change Action" (Development & Productization Division/Adaption Division).

"FY2019 Seismological Society of Japan Young Scholar Encouragement Award"

Yumi Urata, Research Fellow in the Earthquake and Tsunami Research Division, was awarded the Young Scholar Encouragement Award for "Three-dimensional dynamic rupture propagation including fault weakening processes and stress conditions" (pp.41-42). This award is made to members under 35 years old with particularly outstanding results in the field of seismology, in recognition of excellent results and future prospects.

"FY2019 Seismological Society of Japan Paper Award".

Network Center for Earthquake, Tsunami and Volcano "Adjoint tomography of the crust and upper mantle structure beneath the Kanto region using broadband seismograms", the paper presented at Progress in Earth and Planetary Science by Network Center for Earthquake, Tsunami and Volcano Principal Researcher Takayuki Miyoshi was highly evaluated for progressiveness, and received the award in recognition of the significant contribution made to seismology.

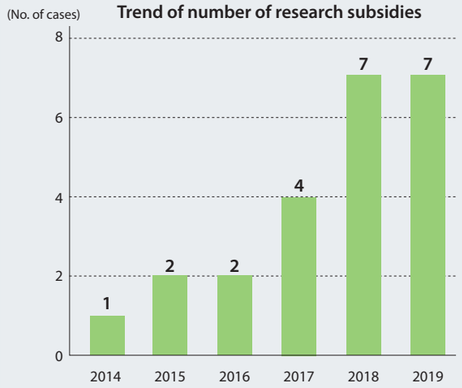
NIED Recipient of Esri's SAG Award (Special Achievement in GIS Award)

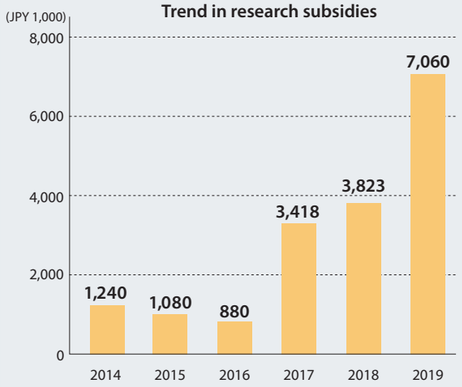
NIED makes publicly available SIP4D and NIED's Crisis Response Site (NIED-CRS) (pp.25-28). The award was in recognition of the contribution these make to enhancing the overall resilience of society, by spatiotemporally visualizing and sharing all kinds of information to support decision-making during disasters and to reduce the economic loss suffered in a disaster and expedite a prompt recovery.

NIED publishes many research results, including those attained through research subsidies.

Research subsidies

While NIED's research is largely supported by operation cost funds from the government, commission income and Grants-in-Aid for Scientific Research (KAKENHI p.53), research grants from non-governmental bodies is also an important financial pillar. NIED is also promoting various kinds of research through grants provided by the SECOM Science and Technology Foundation and the Hitachi Global Foundation.





Number of academic papers presented

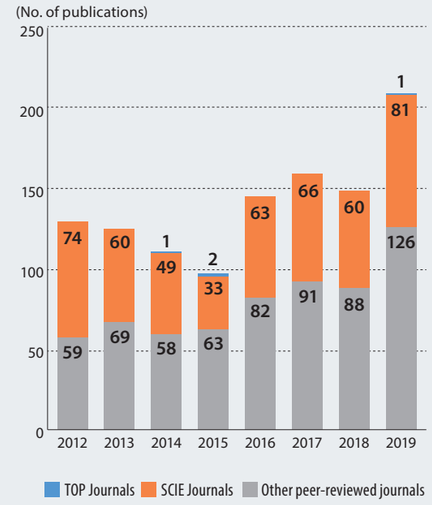
Every researcher at NIED publishes at least one paper every year. In FY2019, a total of 208 papers were published, reflecting the lively research activities taking place. As NIED approaches the final year of the 4th med-to-long term plan, we will consolidate research results and transmit R&D results required by society.

Definition in this integrated report

TOP Journals
Authoritative scientific journals such as Nature, Science, with stringent peer review, and which are said to only include only one tenth of a submitted paper.

SCIE Journals
Highly credible and strictly selected journals compiled in Web of Science

Other peer-reviewed journals
Journals not included in TOP/SCIE journals, mainly compilations of academic papers.



NIED continues to evolve, both as a core DRR institute for science and technology for DRR and as a hub for co-creation.

Leaning lessons from many past disasters in Japan and in order to rebound from coming disasters, NIED has expanded the scope of its research to encompass hazard prediction to prevention, response and recovery. In future, NIED will continue to lead the development of science and technology for disaster risk reduction (DRR) through cross-disciplinary co-creation between natural sciences, engineering and social science.

1959 Ise Bay Typhoon

The Ise Bay Typhoon can legitimately be described as Japan's worst flooding disaster in history, causing catastrophic damage including 5,098 fatalities/missing persons, 40,862 houses destroyed or washed away, 113,068 partially destroyed houses and 363,611 inundated houses.

As a National Research Institute

Sep. 1959 – Ise Bay Typhoon –
Jan. 1963 – Showa 38 Heavy Snow –
Apr. 1963 National Research Center for Disaster Prevention (NRCDP) established as a national research institute under the jurisdiction of the Science and Technology Agency [Ginza, Tokyo]
Jun. 1964 – Niigata Earthquake –
Dec. 1964 Institute of Snow and Ice Studies established [Nagaoka]
Aug. 1965 Marine Observation Tower completed [Hiratsuka]
Jun. 1967 Strong Motion Earthquake Observation Council established
Jun. 1967 Hiratsuka branch established
Oct. 1969 Shinjo branch established
Jun. 1970 Large-scale Earthquake Simulator completed (The first research facility in Tsukuba Science City)
Mar. 1973 Iwatsuki Crustal Activity Observatory completed
Mar. 1974 Large-scale Rainfall Simulator completed
Apr. 1978 HQs of NRCDP moved from Tokyo to Tsukuba Science City
Mar. 1984 Kanto and Tokai Crustal Activity Observation Network formed
Mar. 1988 Doppler Radar completed
Jun. 1990 Institute's name changed to "National Research Institute for Earth Science and Disaster Prevention"
Jan. 1995 – Southern Hyogo Prefecture Earthquake (Great Hanshin-Awaji Earthquake) –
Mar. 1996 Sagami-Bay Sea Bottom Earthquake Observatory completed
Jun. 1996 Operation of K-NET (Kyoshin Network) started
Mar. 1997 Cryospheric Environment Simulator completed [Shinjo]
Apr. 1997 Construction of Hi-net (High Sensitivity Seismograph Network Japan), KiK-net (Kiban Kyoshin Network), and F-net (Full Range Seismograph Network of Japan) started
Mar. 2000 Multi-parameter radar system completed
Jan. 2001 Jurisdiction of NIED changed to MEXT after reorganization of the ministries

1963 Research institute established

Triggered by the damage inflicted by the Ise Bay Typhoon, National Research Center for Disaster Prevention (NRCDP), the predecessor to NIED, was established as an institute for researching science and technology for DRR.

E-Defense
(3-D Full-Scale Earthquake Testing Facility)

1995 Southern Hyogo Prefecture Earthquake (Great Hanshin-Awaji Earthquake)

In response to the Great Hanshin-Awaji Earthquake, as a new initiative in the fields of natural science and engineering, NIED began construction of the fundamental earthquake observation network and the E-Defense (3-D Full-Scale Earthquake Testing Facility).

As an Independent Administrative Agency

Apr. 2001 Independent Administrative Agency NIED established
Earthquake Disaster Mitigation Research Center (EDM) transferred to NIED from RIKEN [Miki]
The 1st mid-term objectives and plan launched
Oct. 2002 Kawasaki Laboratory established as an additional branch of EDM [Kawasaki]
Apr. 2003 EDM moved to Kobe
Oct. 2004 Hyogo Earthquake Engineering Research Center [Miki]
Apr. 2005 Operation of Three-Dimensional Full-Scale Earthquake Testing Facility (E-Defense) started [Miki]
Apr. 2006 The 2nd mid-term objectives and plan launched
Mar. 2007 Kawasaki Laboratory closed down
Mar. 2008 Marine Observation Tower at Hiratsuka Experiment Station closed down
Apr. 2010 Operation of V-net (The Fundamental Volcano Observation Network) started
Mar. 2011 – 2011 off the Pacific coast of Tōhoku Earthquake (Great East Japan Earthquake) –
Mar. 2011 EDM closed down
Apr. 2011 The 3rd mid-term objectives and plan launched
Aug. 2011 Construction of S-net (Seafloor observation network for earthquakes and tsunamis along the Japan Trench) started
Apr. 2013 Snow and Ice Research Center reorganized (Shinjo branch changed to Shinjo Cryospheric Environment Laboratory)
Sep. 2014 – Mt. Ontake erupted –
Oct. 2014 Research Center for Reinforcement of Resilient Function established

2011 Great East Japan Earthquake

Following the Great East Japan Earthquake disaster triggered by the 2011 off the Pacific Coast of Tōhoku Earthquake, NIED constructed Seafloor observation network for earthquakes and tsunamis along the Japan Trench (S-net).

Observation units of S-net

2016 Kumamoto Earthquake

At the Kumamoto Earthquake Onsite Disaster Management Headquarters, the Shared Information Platform for Disaster Management (SIP4D) was used for the first time ever by utilizing the results of R&D for DRR in the field of social science. These activities subsequently led into ISUT (Information Support Team).

As a National Research and Development Agency

Apr. 2015 The Status of NIED changed to National Research and Development Agency from Independent Administrative Agency
Apr. 2016 - Institute's name changed to National Research Institute for Earth Science and Disaster Resilience
- The 4th mid- and long-term objectives and plan launched
- Innovation Center for Meteorological Disaster Mitigation established
- Center for Integrated Volcano Research established
- DONET (Dense Oceanfloor Network system for Earthquakes and Tsunamis) transferred to NIED from JAMSTEC
Apr. 2016 – Kumamoto Earthquake –
Apr. 2017 Research Center for Enhancing Metropolitan Resilience established
Nov. 2017 Integrated operation of Monitoring of Waves on Land and Seafloor (MOWLAS) began
Apr. 2018 SIP Program Management Office established
Dec. 2018 Research Center for National Disaster Resilience established
Feb. 2019 - Construction of Nankai Trough Seafloor Observation Network for Earthquakes and Tsunamis (N-net) started NIED's Identity unveiled
Jun. 2020 50th anniversary of the establishment of Large-scale Earthquake Simulator
Jul. 2020 Headquarters of Innovation Co-Creation

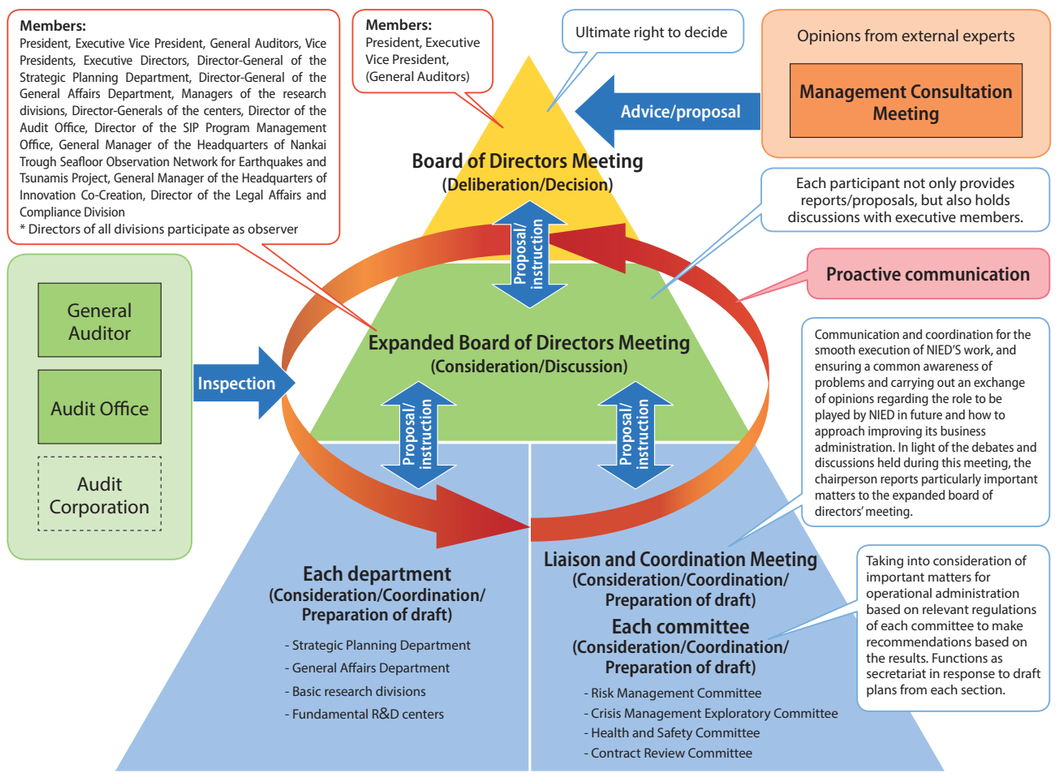
Governance and compliance for NIED

Aiming to maximize the results of R&D, NIED is a national research and development agency that conducts business operations under a unique medium-to-long-term management by objectives that is aligned to the long-term nature and highly specialized nature of NIED's work. Under the decision-making of the President appointed by the Minister of Education, Culture, Sports, Science and Technology, an Executive Vice President assists with the duties of the President, while a General Auditor appointed by the same Minister audits the work of the President. Internal controls are established as part of governance under this structure, whereby under the President, duties are conducted observing laws and ordinances based on the mid-to-long term goals and under systems put in place for efficiently and effectively achieving NIED's mission as a national research and development agency.

Initiatives and operations for governance

Under the leadership of the President and aiming for "maximization of results of R&D", NIED is strengthening its R&D capabilities as well as business management capabilities.

NIED puts in place and operates a system for implementing management under which an Executive Vice President is appointed. Strategic Planning Department, General Affairs Department, research divisions and centers are also established. Headquarters and offices which are under the direct supervision of the President are also established under this system. (refer to organizational diagram on P60). Furthermore, in addition to holding regular board of directors meetings/expanded board of directors meetings, NIED also convenes management consultation meetings with external experts, as well as liaison coordination meetings to coordinate items related to business operations and various committees for deliberating matters of high importance. The President also provides opportunities for exchanging opinions and consultations with individual researchers and employees, and implements appropriate management measures including holding meetings for budget allocation for driving each kind of project.



Board of Directors Meeting/Expanded Board of Directors' Meeting

Board of Directors Meetings are held regularly to hold deliberations and make decisions for important items related to basic operational policy and business execution, as well as for important matters requiring decisions by management. Furthermore, Expanded Board of Directors Meetings are held for in-depth discussion on items placed on the agenda at Board of Directors Meetings, and for highly important matters regarding the management of NIED.

Management Consultation Meeting

By convening management consultation meetings composed of external experts, NIED can obtain external recommendations and proposals from objective, specialist and wide-ranging perspectives. As well as using these to grasp business operational issues and to deliberate solutions, NIED is committed to bringing a higher level of efficiency and transparency of operations.

Liaison and Coordination Meeting

In principle, this meeting is held once a month in order to gain shared understanding on issues in the administrative and research divisions. Agenda items include those regarding research activities such as the next-term mid-term plan and long-term vision, and also items regarding optimization of procedures, and upgrading of communications environment. Items deemed to be particularly important are escalated to the Expanded Board of Directors/Board of Directors Meetings.

Initiatives for internal controls

With regard to executing the medium-to-long-term plan aligned to the medium-to-long goals as well the fiscal year plan based on this plan, the President uses occasions such as the new year greetings and ceremony for anniversary of establishment to communicate to all employees the directionality, mission and six initiatives as a core institute for maximizing results of R&D, as well as for disseminating information among executives and stuff, and for building consensus and raising awareness. Furthermore, through the Expanded Board of Directors Meeting, the President is able to grasp current state of execution of duties within NIED and to dispense ideas and instructions to division heads regarding operational matters.

In order to identify and dynamically respond to specific organizational and operational risks, NIED reviews the nature and cause of risks, and establishes a risk management committee to debate and determine priority countermeasures. Furthermore, NIED implements internal audits and General Auditor's inspections to provide advice to the President and others regarding business administration. Through these activities, NIED promotes internal controls based on the leadership of the President.

General auditor's inspection

Based on various related laws and ordinances as well as the research institute's official regulations, NIED implements General Auditor's inspections regarding the efficiency and validity of its operational management and regarding the status of achieving objectives as well as regarding the veracity, accuracy and compliance of financial accounting. In particular, from the standpoint of ascertaining that work defined under the med-to-long term plan is proceeding smoothly, particular emphasis is placed on the status of promoting internal controls, the current state of research and administrative work and the operational state of the organization. To this end, proposals are provided to the President conducive to improving operational management.

Information security

To protect information assets from risks including leakage due to unlawful access (internal and external) and system destruction and in order to put in place systematic defense measures, NIED has prescribed "Information Security Policy for National Research and Development Agency The National Research Institute for Earth Science and Disaster Resilience" under which it promotes information security led by the Chief Security Officer (CSO), NIED's Director. Coupled with this, every fiscal year all employees are obliged to undergo training (e-learning) regarding Personal Information Protection and Information Security.

Preventing improper research activities

With regard to preventing the wrongful acts in research activities and unauthorized use of research funds, based on government-stipulated guidelines, NIED has put in place the necessary structures for fair research activities as an organization by prescribing internal regulations and guidelines for fair handling of public research funds, for preventing improper research activities, and for the proper administration/storage of research records. Furthermore, given the necessity to exhort each individual researcher to develop self-awareness for preventing wrongful acts in research activities, all researchers are obliged to undergo training regarding research ethics, using research ethics education e-learning materials provided by APRIN (Association for the Promotion of Research Integrity).

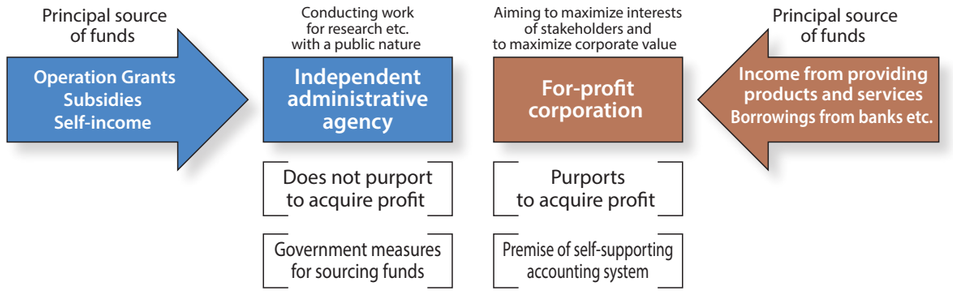
Initiatives for ethical issues regarding research targeted at humans

In light of the increasing amount of research dealing with humanities and social sciences such as research into group evacuation behavior, NIED prescribed ethics regulations regarding research targeted at humans in September 2020, to ensure the appropriate promotion of such research. NIED has established an Ethics Review Committee and is putting in place a system for review including creation of ethics checklists. Furthermore, to enhance the awareness of researchers, NIED has commenced a training course regarding ethics for research targeted at humans as part of its e-learning training.

Accounting system for independent administrative agency

Accounting different to a for-profit enterprise, emphasizing publicness.

An independent administrative agency is one that carries out business/work with a public element, does not pursue profit as an objective, and does not presuppose a self-supporting accounting system such as that of a for-profit enterprise such as a joint-stock corporation. Thus, while in principle it conforms to corporate accounting principles, its accounting differs to that of a for-profit enterprise.



Formulating a system for profit and loss equilibrium

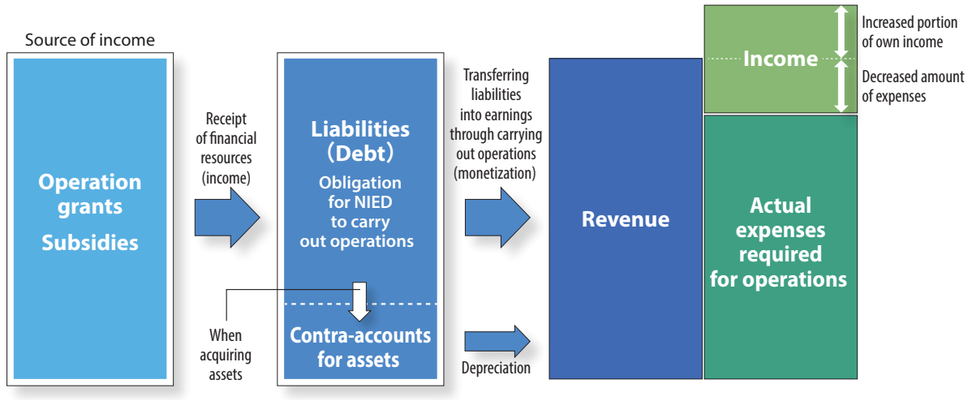
Due to the fact that National and Research Development Agencies are public in nature and do not aim to turn a profit and do not presuppose a self-supporting accounting system, in terms of the relationship between financing measures such as operation grants and subsidies, in principle a system is formulated to ensure profit and loss equilibrium.

For example, when operation grants or subsidies are received, NIED deems that it has borne the responsibility to implement a project, and books this as a liability (debt). Then, by implementing projects using these as a financial source, it is deemed that the obligation has been fulfilled, and accounting is processed to transfer liabilities into earnings.

Similarly, in cases where NIED has acquired assets using operation grants and subsidies as a financial source, these are transferred to contra-accounts for assets, and by taking away the same amount consequent upon depreciation costs and transferring liabilities into earnings, profit and loss are balanced out.

In addition, in cases where costs have been curtailed through increased self-income and management efforts including cost reduction, profit will be generated. A portion of the profit approved by Minister of Education, Culture, Sports, Science and Technology can be used in the next fiscal year onward.

Flow of accounting at independent administrative agency

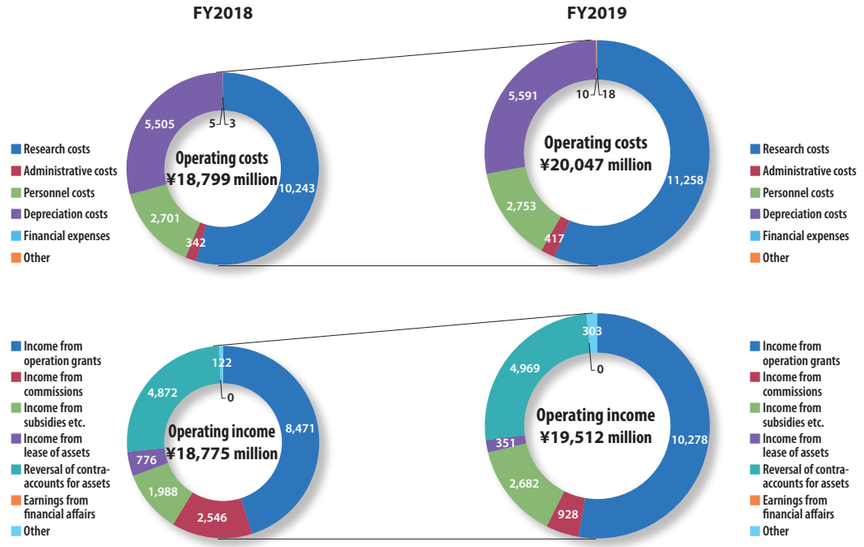


Transition of costs and earnings

Below is a comparison of costs and earnings for FY2018 and FY2019. Compared to FY2018, budgets increased in FY2019 for both operation grants and subsidies.

Costs were ¥20.04 billion, an increase of ¥1.24 billion compared to the end of the preceding fiscal year. This was mainly due to an increase in research work costs consequent upon the renewal of the large-scale experimental facilities.

Earnings were ¥19.51 billion, an increase of ¥736 million compared to the end of the preceding fiscal year. This was mainly due to an increase in income from operation grants and subsidies consequent upon an increase in expenditure using operation grants and subsidies for facilities improvement costs as financial resources.



●Construction of N-net started in FY2019

State of affairs of major costs (FY2019)

NIED demarcates projects using three segments - "promotion of R&D", "formation of a core institute", "corporate common" – and numerical values booked on financial statements are disclosed as segment units.

Promotion of R&D (¥5.39 billion)

The following eight projects are in the scope of these costs.

- Advanced earthquake and tsunami forecasting technologies project
- Research on mega earthquake generation process
- Research on multidisciplinary evaluation of volcanic activity
- Research and development to enhance the resilience of social infrastructure
- Developing technology to predict water-related disasters based on multi-sensing
- Research on combining risk monitoring and forecasting technologies for mitigation of increasingly diverse snow disaster
- Research on hazard and risk assessment
- Research for the effective creation, distribution, and usage/application technologies of disaster information

Formation of a core institute (¥ 13.81 billion)

The following six initiatives are in the scope of these costs, for expediting the strengthening of NIED's function as a core institute for innovation in science and technology for DRR.

- Promotion of industry-academia-government cooperation as a core institute.
- Operation/promotion of joint usage of observation networks/experimental facilities/information foundation
- Contribution to DRR governance
- Dissemination of R&D results/facilitating use of intellectual property
- International leverage of R&D
- Personnel development

Corporate Common (¥84.7 million)

Management divisions including General Affairs Division are in the scope of these costs.

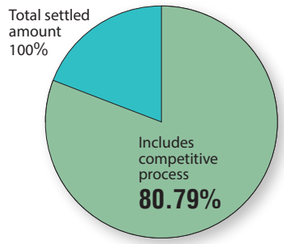
Main income sources (FY2019)

In addition to operation grant from the government, NIED is operated through income from commissions and income from leasing facilities, as well as self-income including income from patents.

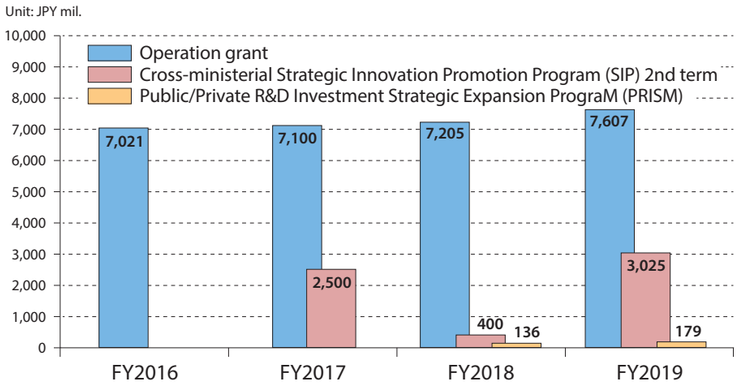
The majority of income from commissions comes from funds acquired following a competitive process

The bulk of income from commissions for FY2019 was obtained through competitive processes screened by government agencies, fund distribution organizations, and foundations. The ration of income obtained through competitive processes is 80.79%.

Ratio of income from commissions obtained through competitive process



Transition of operation grant

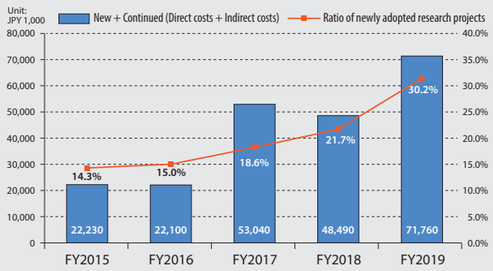


Regarding "KAKENHI" that are not shown on financial statements

Grants-in-Aid for Scientific Research (KAKENHI) are "competitive research funds" aimed at developing research, provided by Ministry of Education, Culture, Sports, Science and Technology (MEXT) to foster original and pioneering research.

KAKENHI do not show up on financial statements due to being processed as deposits received. Since FY2016, NIED has been deeply committed to acquiring KAKENHI under the mid-to-long term plan. NIED's ranking for number of research projects adopted is going up every year, as is the ratio of newly adopted projects.

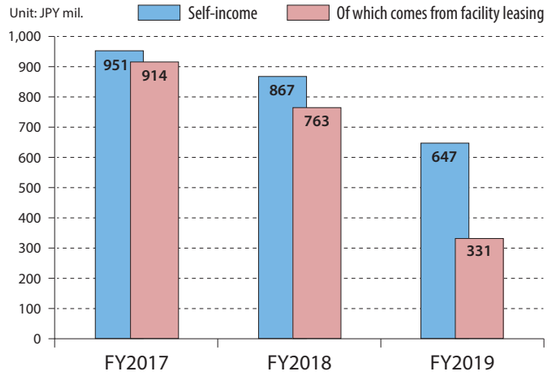
Transition of amount of KAKENHI acquired



Majority of self-income is made up of income from leasing facilities.

The majority of NIED's self-income comes almost entirely from the leasing of facilities.

Transition of self-income together with income from leasing facilities

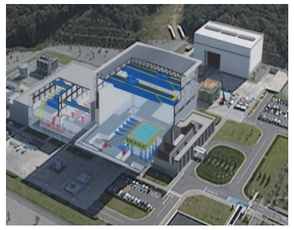


*In FY2019, E-Defense lease income was low due to undergoing major improvements

Income from leasing facilities

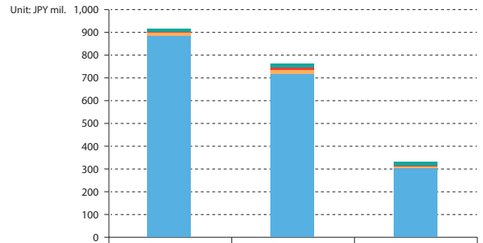
NIED promotes the use and application of its advanced research facilities.

In terms of leasing income by facility, E-Defense (three-dimensional full-scale earthquake testing facility) acquires the most amount of self-income, playing an instrumental role in assessing housing and industrial infrastructure. NIED is similarly actively promoting the use and application of other facilities.



E-Defense (Hyogo)

Transition of leasing income by facility



	FY2017	FY2018	FY2019
Cryospheric Environment Simulator	11	16	17
Large-scale Rainfall Simulator	3	12	3
Large-scale Earthquake Simulator	16	17	7
E-Defense	885	718	303
Total	JPY 914 mil.	JPY 763 mil.	JPY 331 mil.

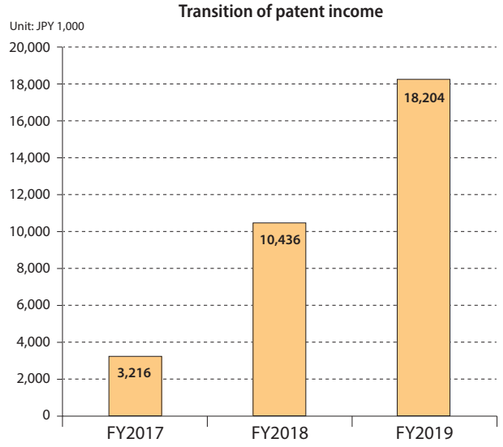
*In FY2019, E-Defense lease income was low due to undergoing major improvements
*Related to rounding off of fractions, total amount does not match total income from leasing facilities.

Patent Income

Increasing income related to patents for observing microtremors

In recent years, income for NIED related to patents is increasing significantly. The main driver of this is income related to patents for microtremor observation (Patent No. 6544704/ JIG for installing instrument, and microtremor measuring instrument Patent No.6682118 / Microtremor measurement equipment and microtremor measurement equipment with tools) (p.29). Utilization of these technologies by private companies led to an increase in patent-related income, and NIED is currently working towards international standardization of these technologies.

Transition of patent income



Balance Sheet

A balance sheet is a report displaying all owned assets, liabilities, and the balance of net assets, to clarify the financial condition of a corporate body at the end of the accounting period,

①Assets are foundational property for conducting business. For NIED, these mainly constitute assets for research use and software for R&D use that were used to put in place MOWLAS (NIED observation network for earthquake, tsunami and volcano) using operating expense grants and subsidies. The balance for these at the end of FY2019 was ¥82.9 billion, an increase of ¥670 million compared to the end of the preceding fiscal year. This was mainly due to acquisition of research assets related to N-net (Nankai Trough Seafloor Observation Network for Earthquakes and Tsunamis) which is currently under construction through subsidies.

②Liabilities are yet unadministered portions of projects among sources of funds conferred for implementing projects (debts), and obligations to provide other parties with a specified amount of assets or services. For NIED, these are principally the balance carried forward to the following fiscal year from conferred operating expense grants and subsidies due to factors including the ensuring of flexible project execution conducive to higher results as a function of progress of R&D, and contra accounts for assets booked under the system of profit and loss equilibrium. Liabilities at the end of FY2019 were ¥41.1 billion, an increase of ¥3.1 billion compared to the end of the preceding fiscal year. This was principally due to an increase in the equivalent amount for research-use assets (contra-accounts for assets) acquired for N-net (Nankai Trough Seafloor Observation Network for Earthquakes and Tsunamis) that is currently under construction through subsidies. Furthermore, there were revisions made to the Accounting Standards for Independent Administrative Corporations from the current fiscal year, under which bonus reserves and retirement benefit reserves are to be booked as liabilities, while the same amounts are also to booked as assets, namely as contra-accounts for bonus reserves and contra-accounts for retirement benefit reserves. This does not have any impact on ordinary income in profit and loss statement.

③Net assets are the sum total of the amount of investment provided by investors and the income resulting from activities by the organization. For NIED, these are principally the investment (contribution in kind) received from the state in FY2001 when research institutes shifted to independent administrative corporations, and capital surplus that was booked as the equivalent amount deemed to constitute the financial basis among acquired fixed assets. The balance of net assets at the end of FY2019 was ¥40.68 billion, a decrease of ¥2.34 billion compared to the end of the preceding fiscal year. This was largely due to deprecation of research-use assets put in place and funded by subsidies for facility outfitting costs. N.B., consequent upon the revisions to Accounting Standards for Independent Administrative Corporations, accumulated depreciation, impairment loss, and accumulated difference in retired and disposed assets will be indicated as other accumulated administrative costs.

Balance Sheet (Indicates financial situation as of settlement day (March 31))

(Unit: JPY1,000)

	FY2018	FY2019	Increase (Decrease)
1. Assets	81,425,073	82,095,323	670,250
Ⅰ Current Assets	7,456,999	9,687,842	2,230,843
Cash and deposits	6,950,176	9,233,784	2,283,608
Uncompleted commissioned research disbursements	161,287	12,866	(148,420)
Prepayment	4,900	114,806	109,906
Prepaid expenses	10,564	10,776	212
Account receivable	330,073	233,053	(97,020)
Contra-accounts for bonus reserves	0	82,557	82,557
Ⅱ Fixed Assets	73,968,073	72,407,481	(1,560,593)
1. Tangible fixed assets	73,537,520	71,346,587	(2,190,933)
Buildings	11,542,220	11,026,424	(515,796)
Structures	28,113,838	24,194,890	(3,918,948)
Machinery	11,172,908	9,282,120	(1,890,788)
Motor vehicles and transport equipment	1,485	6,097	4,611
Tools, equipment and fixtures	4,840,998	5,786,848	945,850
Land	17,839,565	17,839,565	0
Construction in progress	26,505	3,210,643	3,184,138
(Depreciation amount for current term	9,641,799	8,826,917	(814,881))
(Impairment loss for current term	0	0	0)
2. Intangible fixed assets	418,180	441,529	23,349
Patent rights	9,898	10,498	599
(Depreciation amount for current term	1,620	1,926	306)
Trademark rights	6,604	5,880	(724)
(Depreciation amount for current term	437	724	287)
Telephone subscription right	5,244	5,244	0
Software	332,171	319,879	(12,293)
(Depreciation amount for current term	122,583	168,083	45,500)
(Impairment loss for current term	0	0	0)
Intellectual property rights in progress	12,072	13,439	1,367
Software in progress	52,191	86,590	34,399
3. Investments, other assets	12,373	619,364	606,992
Long-term pre-paid costs	8,928	0	(8,928)
Deposits	3,300	3,300	0
(Depreciation amount for current term	0	0	0)
Money on deposit	145	129	(16)
Contra-liabilities for retirement benefit reserves	0	615,935	615,935

	FY2018	FY2019	Increase (Decrease)
2. Liabilities	38,405,597	41,415,115	3,009,518
Ⅰ Current liabilities	7,561,443	9,993,691	2,432,248
Operating expenses grants liabilities	2,120,258	1,999,063	(121,195)
Received facilities costs	18,428	137,392	118,964
Received subsidies etc.	40,109	2,769	(37,340)
Received donations	2,796	11,531	8,735
Arrears	5,032,654	7,348,059	2,315,405
Advance received	189,231	36,333	(152,898)
Withholdings	39,251	48,787	9,536
Bonus allowances	0	82,557	82,557
Short-term lease debt	118,716	327,200	208,484
			0
Ⅱ Fixed liabilities	30,844,154	31,421,424	577,270
Contra-accounts for assets	30,710,932	29,725,013	(985,919)
Assets funded by operational grants	2,313,830	2,395,856	82,027
Encumbrance for assets-subsidy for operation	20,839,983	17,892,399	(2,947,584)
Encumbrance for assets donated	7,507,637	6,207,703	(1,299,933)
Assets funded by donations	22,977	18,411	(4,566)
Construction in progress funded by operational grants.	18,541	35,283	16,741
Construction in progress funded by donations	7,964	3,175,361	3,167,397
Reserves for retirement benefits	0	615,935	615,935
Long-term lease debts	133,222	1,080,476	947,254
3. Net Assets	43,019,476	40,680,208	(2,339,268)
Ⅰ Capital stick			
Government investment	58,902,885	58,902,885	0
Ⅱ Capital surplus	(17,344,501)	(19,348,023)	(2,003,522)
Capital surplus	53,150,696	61,907,377	8,756,680
Accumulated amount for other administration costs	-	(81,255,400)	(81,255,400)
Accumulated depreciation amount	(70,209,528)	(73,573,589)	(3,364,062)
Accumulated impairment loss	(285,670)	(285,670)	0
Accumulated difference in retired and disposed assets	-	(7,396,141)	(7,396,141)
Ⅲ Retained earnings	1,461,092	1,125,346	(335,746)
Reserve fund carried over from the previous mid-term objectives period	799,276	653,690	(145,586)
Reserves	532,032	661,816	129,784
Unappropriated retained earnings (minus is total loss for current period)	129,784	(190,160)	(319,944)

Account Statement for Administration Costs

The account statement for administration cost is a report showing results of work (output information) with "administrative cost" (= cost required to achieve work results) as comparative information (*1), from the perspective of providing information pursuant to the appropriate assessment of the work of an independent administrative corporation

In addition to costs on the profit and loss statement, other administrative costs that are also included and which do not show up on the account statement are costs for depreciation amount for depreciable assets processed in accordance with Independent Administrative Corporation Accounting Standards No.87 ("Account processing for equivalent amount of costs related to specific assets") (*2).

Administrative costs for FY2019 were ¥24.2 billion, and the main drivers of these costs were the costs amounting to ¥20.8 billion booked on the profit and loss statement, and other administrative costs amounting to ¥3.47 billion due to depreciation of assets for research use acquired using funds including government investment and subsidies for maintaining facilities conferred by the State.

Account statement for administrative costs (From April 1, 2019 to March 31, 2020) (Unit: JPY)

Ⅰ Costs on Profit and Loss Statement			
Research costs		19,172,697,386	
Administrative costs		846,692,374	
Financial costs		9,526,919	
Miscellaneous losses		18,376,660	
Extraordinary loss		706,769,840	
	Total costs on Profit and Loss Statement		20,754,063,179
Ⅱ Other Administrative Costs			
Depreciation amount		3,406,869,165	
Sales and retirement difference amount		98,785	
	Total other administrative costs		3,406,967,950
Ⅲ Administrative costs			24,161,031,129

*1 Due to revisions of accounting standards for independent administrative corporations made on September 3, 2018, the organization of financial statements has changed. While this now requires the preparation of "Account Statement for Administrative Costs" and "Statement of Accounts for Net Assets Fluctuation", "Account Statement for Implementation Costs of Administrative Services" was abolished.

*2 Among depreciable assets owned by Independent Administrative Corporations, for those specific assets for which acquisition of earnings is scheduled to correspond to the depreciation, the depreciation amount for such assets will not be booked as costs on the profit and loss statement, and shall instead constitute a reduction on capital surplus.

Statement of Income

The Profit and Loss Statement is a report indicating expenses for research activities (costs) and the financial sources required to fund them (revenue), in order to clarify the operational circumstances for the accounting period (April 1st to March 31st).

① Operating expenses were ¥20.47 billion, an increase of ¥1.25 billion compared to the end of the preceding fiscal year. This was largely due to an increase in subcontracting costs consequent upon renewal of the large-scale experimental facilities.

②Recurring revenue was ¥19.51 billion, an increase of ¥736 million compared to the end of the preceding fiscal year. This was largely due to the fact that operating expense subsidies and earnings for facilities costs increased consequent upon an increase in expenditure funded by operating expenses grants and subsidies for maintaining facilities.

③The ¥76 million for provision of reserve for bonuses consequent upon the revision of accounting standards for independent administrative corporations and ¥631 million for retirement benefit costs consequent upon the revision of accounting standards for independent administrative corporations that were booked as extraordinary loss, were both portions occurring before FY2018.

④The ¥76 million revenue for contra-accounts for bonus reserves and ¥631 million for contra-accounts for retirement benefit that were booked as extraordinary loss were revenue for contra-accounts for bonus reserves and revenue for contra-accounts for retirement benefit booked at the beginning of the term consequent upon the revision of accounting standards for independent administrative corporations.

⑤ Gross loss for the current period refers to that which arose due to account processing based on accounting standards for independent administrative corporations for depreciation costs of assets acquired through commission income during the term of the current mid-to-long-term plan (FY2016 onwards).

Statement of Income (to clarify operational circumstances for the relevant FY)

(Unit: JPY1,000)

	FY2018	FY2019	Increase (Decrease)
1. Ordinary expenses	18,799,438	20,047,293	1,247,856
Research expenses	18,038,997	19,172,697	1,133,700
Personnel expenses	2,322,412	2,252,683	(69,729)
Business consignment expenses	7,603,140	8,430,267	827,128
Communications expenses	899,457	928,979	29,523
Depreciation	5,473,296	5,560,440	87,145
Provision for bonuses	0	67,017	67,017
Retirement benefit expenses	0	34,251	34,251
Expenses	1,740,693	1,899,059	158,366
General and administrative expenses	752,613	846,692	94,079
Personnel expenses	378,695	375,542	(3,153)
Business consignment expenses	185,113	184,396	(717)
Communications expenses	1,965	2,218	253
Taxes and dues	926	50,815	49,889
Depreciation	31,431	30,340	(1,091)
Provision for bonuses	0	15,539	15,539
Retirement benefit expenses	0	8,258	8,258
Expenses	154,484	179,584	25,100
Financial expenses			
Interest paid	4,906	9,527	4,621
Miscellaneous losses	2,922	18,377	15,455
2. Recurring revenue	18,775,360	19,511,547	736,187
Revenue from operating expense grants	8,471,373	10,278,083	1,806,710
Government commissioned income	302,396	299,218	(3,178)
Other commissioned income	2,244,063	628,538	(1,615,525)
Subsidies for facilities	395,196	1,327,653	932,457

	FY2018	FY2019	Increase (Decrease)
Revenue from subsidies etc.	1,592,614	1,354,272	(238,343)
Revenue from donations	1,491	265	(1,226)
Revenue related to contra-accounts for bonus reserves	0	82,557	82,557
Revenue related to contra-accounts for retirement benefit reserves	0	42,509	42,509
Reversal of contra-accounts for assets	4,872,285	4,969,022	96,737
Property leasing income	775,593	351,330	(424,263)
Interest and dividends received	75	0	(75)
Miscellaneous income	120,276	178,101	57,826
(Recurring profit (Loss)	(24,078)	(535,746)	(511,668))
3. Extraordinary loss			
Provision for bonus reserves consequent upon revision to accounting standards	0	75,558	75,558
Retirement benefit costs consequent upon revision to accounting standards	0	631,212	631,212
4. Non-recurring revenue			
Settlement payment received	0	200,000	200,000
Revenue for contra-accounts for bonus reserves consequent upon revision to accounting standards	0	75,558	75,558
Revenue for contra-accounts for retirement benefit consequent upon revision to accounting standards	0	631,212	631,212
5. Current net income (Loss)	(24,078)	(335,746)	(311,668)
6. Reversal of reserve fund carried over from the previous mid-term objectives period	153,862	145,586	(8,276)
7. Current gross income (Loss)	129,784	(190,160)	(319,944)

OVERVIEW [Visualization of NIED Keywords/Concepts]

For a deeper understanding of NIED's activities.

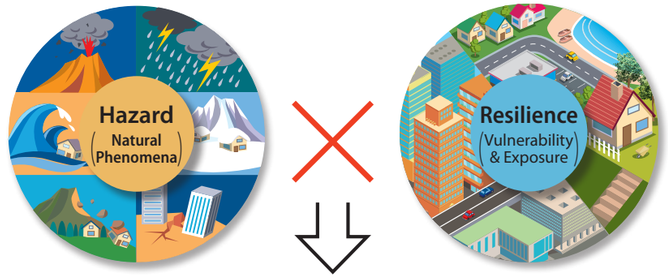
KEYWORD 1

"Disaster"

Phenomena that occur at the intersection of hazards (natural phenomena) and the disaster resilience of society.

The word "disaster" tends to conjure up a threat from actual hazards (natural phenomena) such as earthquakes, tsunami, volcanos, violent winds, torrential rains, snowstorms, typhoons, landslides and so on. However, the amount of damage that these hazards cause (becoming a disaster) depends enormously on the level of disaster resilience of society. This is why NIED promotes research on both hazards and the disaster resilience of society.

Even for the same hazard (natural phenomena), the amount of damage differs greatly depending on the disaster resilience of society.



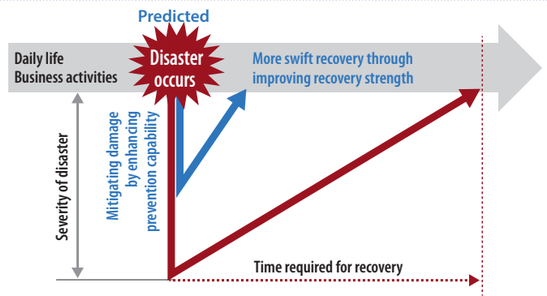
Damage is sustained when the hazard overwhelms the disaster resilience of society. The scale of the "disaster" largely depends on the disaster resilience of society.

KEYWORD 2

"Resilience"

Comprehensive resilience encompassing prediction/prevention capabilities with recovery strength.

In order that livelihoods are not devastated by the threat of natural hazards, it is vital to approach disasters both from the aspect of "damage prevention and mitigation to the absolute minimum (prevention capability)", and "swift recovery" after the disaster has occurred (recovery strength). The comprehensive actions will enhance "resilience".

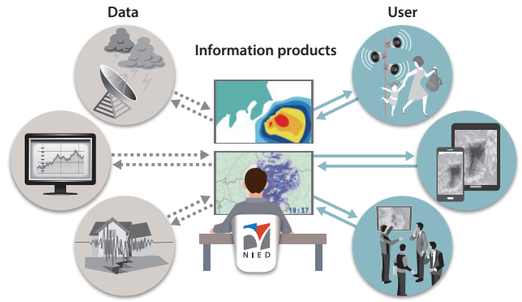


KEYWORD 3

"Information Products"

Processed information including observation data to meet user's needs.

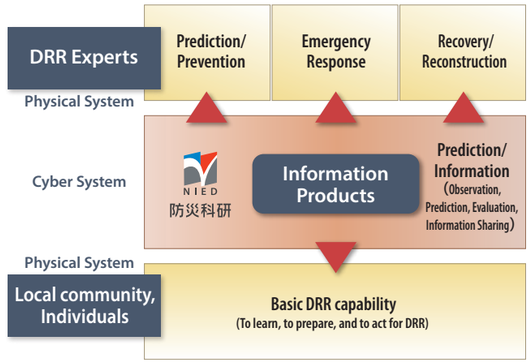
In some cases, hazard observation data cannot be understood nor used in its original state. For example, at the site of a torrential rain disaster, countermeasures only become possible once you have combined rainfall information with information pertaining to rivers and topography, as well as information on buildings and roads. "Information products" involve taking raw data such as real-time observation information and rendering into a form that can be utilized in line with user needs, in other words, intellectually processed information in order to provide solutions. NIED is committed to R&D for "information products" useful to users' decision making as well as for social implementation.



CONCEPT VISUAL 1

Cyber-Physical System of DRR domain for Society 5.0

Japan aims to realize Society 5.0 under the 5th Period Basic Plan for Science and Technology, and NIED is deliberating the ideal state of the DRR domain there. Society 5.0 is a world where the information realm (Cyber) and the physical realm (Physical) are melded to a high degree. For DRR in the physical realm, communities of experts each involved in prevention, emergency response, and recovery/reconstruction play an instrumental role in overcoming disasters as a physical force. In the cyber realm, creating information products tailored to various aspects will combine the four physical capabilities with the aim of realizing an overall resilient society.

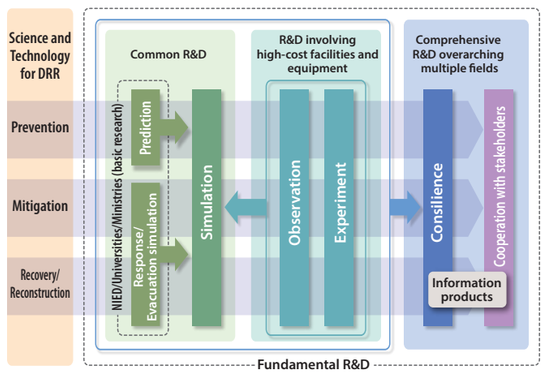


CONCEPT VISUAL 2

R&D for DRR science and technology

Science and Technology for DRR refers to that conducive to preventing disasters before they occur (prevention), mitigating the damage (emergency response), and expediting recovery/ reconstruction from disasters.

- Common R&D: In addition to fundamental research in specialized fields, research aimed at simulations of entire disasters by combining common technologies and date including AI, GIS, and big data.
- R&D involving high-cost facilities and equipment: Research using one-of-a-kind facilities/equipment, utilizing the foundational observation networks and cutting-edge experimental facilities.
- Comprehensive R&D overarching multiple fields: R&D through multi-lateral cooperation spanning multiple domains with all stakeholders for co-creation.



OVERVIEW [Institute Information]

Facts

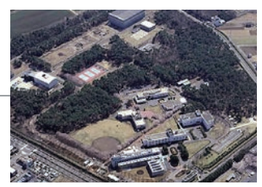
Institute name	National Research Institute for Earth Science and Disaster Resilience	
Abbreviation	NIED	
Board members	President	HAYASHI Haruo
	Executive Vice President	ANDO Yoshiaki
	General Auditor	SATO Takeshi, JINNO Norie (part-time)
Employees	338 (including 170 researchers, 168 clerical staff) * As of October 1st 2020	
Annual budget	7.61 billion yen (Operation grant) * FY2020	
Jurisdiction	Ministry of Education, Culture, Sports, Science and Technology (MEXT)	

NIED HQs and Research Centers

Snow and Ice Research Center
(Nagaoka, Niigata Prefecture)

Snow and Ice Research Center, Shinjo Cryospheric Environment Laboratory
(Shinjo, Yamagata Prefecture)

Hyogo Earthquake Engineering Research Center
(Miki, Hyogo Prefecture)



Tsukuba HQs
(Tsukuba, Ibaraki Prefecture)

Organizational Chart

(FY2020)

- President
- Executive Vice President
- General Auditor
- Headquarters of Innovation Co-Creation
- Headquarters of Nankai Trough Seafloor Observation Network for Earthquakes and Tsunamis Project
- SIP Program Management Office
- Strategic Planning Department
- General Affairs Department
- Legal Affairs and Compliance Division
- Audit Office

[Basic Research Division] 8 divisions

- Earthquake and Tsunami Research Division
- Volcano Disaster Resilience Research Division
- Earthquake Disaster Mitigation Research Division
- Storm, Flood and Landslide Research Division
- Snow and Ice Research Division
- Multi-hazard Risk Assessment Research Division
- Disaster Information Research Division
- Disaster Resilience Research Division

[Center for Fundamental R&D] 6 centers

Operation Management Center
- Network Center for Earthquake, Tsunami and Volcano
- Center for Comprehensive Management of Disaster Information

Center for Performance Assessment
- Center for Advanced Research Facility

Research Program Center
- Center for Integrated Volcano Research
- Research Center for Enhancing Metropolitan Resilience
- Research Center for National Disaster Resilience

https://www.bosai.go.jp/e/

Headquarters Tsukuba
3-1 Tennodai, Tsukuba-shi, Ibaraki, 305-0006, JAPAN
Tel. +81-29-851-1611　Fax. +81-29-851-3246
E-mail: toiawase@bosai.go.jp

Snow and Ice Research Center
187-16 Maeyama, Suyoshi, Nagaoka-shi, Niigata, 940-0821, JAPAN
Tel. +81-258-35-7520　Fax. +81-258-35-0020

Shinjo Cryospheric Environment Laboratory, Snow and Ice Research Center
1400 Takadan, Tokamachi, Shinjo-shi, Yamagata, 996-0091, JAPAN
Tel. +81-233-22-7550　Fax. +81-233-22-7554

Hyogo Earthquake Engineering Research Center
1501-21 Nishikameya, Mitsuta, Shijimi-cho Miki-shi, Hyogo, 673-0515, JAPAN
Tel. +81-794-85-8211　Fax. +81-794-85-7994

SCIENCE FOR RESILIENCE

NIED 防災科研