Introduction of main measures

Improvement of emergency response by providing weather and water level information

Development of a system to conduct data assimilation method using observed water levels and provide predicted water levels using forecast rainfall data for small and medium-sized rivers

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Original measure: Improvement of flood forecasting (MLIT)

Issues and Goal

Standardize the provision of water-level prediction information for small and medium-sized rivers for which such information has so far not been provided.

Out of so many small and medium-sized rivers in Japan, which are mainly managed by prefectures, water-level prediction information is provided only for 128 rivers because such rivers often start flooding in a very short time after rainfall and also because their water levels and river channel information are not readily available due to technical difficulties.
However, among the many rivers for which no water-level prediction information is provided, about 1,500 rivers are considered to cause significant damage if flooding. In fact, such rivers have become more prone to flood as extreme rainfall becomes frequent, claiming the lives of many people in recent years. In these circumstances, the Japanese government has been working diligently to achieve no casualties in flood events. Water-level prediction information, in addition to observed rainfall and river water levels, can play a vital role in achieving this goal. With water-level prediction information, local governments can issue early evacuation information and encourage residents to start early evacuation, thereby ensuring a lead time long enough for them to evacuate safely.
There are so many small and medium-sized rivers in Japan, and the prefectures are having a hard time collecting accurate information on those rivers under their management. On the other hand, they are the rivers that require real-time responses to prevent damage because they can flood in a short time after rainfall. For these reasons, this measure aims to develop flood forecasting technology that is fast in calculation, low-cost, simple, and adequately accurate and then standardize the provision of water-level prediction information for small and medium-sized rivers.

Overview

Enhancement of the water level observation network (original measure)

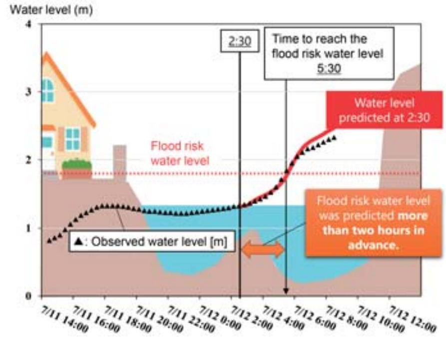
○ Efforts have been made to improve and expand flood monitoring by increasing the number of water-level observation points from about 7,000 to about 17,000. The water level observation network will cover far more small and medium-sized rivers across Japan with the additional 10,000 observation points, where low-cost water level gauges specialized for water level observation during floods will be installed.

Development of water level prediction technology that is fast in calculation, low-cost, simple, and adequately accurate (PRISM)

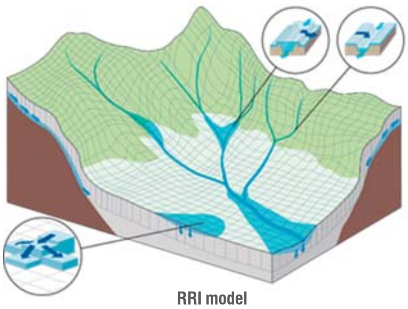
○ This project aims to develop a water-level prediction system that is fast in calculation, low-cost, simple, and adequately accurate in order to install the system for about 1,500 prefecture-managed rivers. To assist residents in safe evacuation from floods, the system should be capable of predicting when the river water level will reach the level at which local governments should consider issuing an evacuation order (i.e., flood risk water level or alert level 4) at least about two hours in advance, using various data, including ones collected from low-cost water level gauges specialized for water level observation during floods

○ The flood forecasting method to be developed should be designed to accommodate different situations and conditions. For example, collecting essential data and information, such as water levels at water-level observation stations, correlations between the water level and the discharge (H-Q equations), and river channel shape, can be difficult in the case of prefecture-managed rivers.

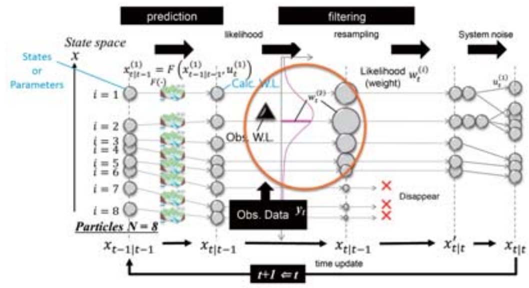
○ In FY2021, this project will develop new models for additional 30 rivers (about 130 rivers in total) in addition to the previously developed models. The model development will continue while developing not only standard models but also ones applicable to rivers with insufficient data.



Predict when the river water level will reach the flood risk water level more than two hours in advance



RRI model



Particle filter method

Achievements to date and expected positive ripple effects

R&D achievements

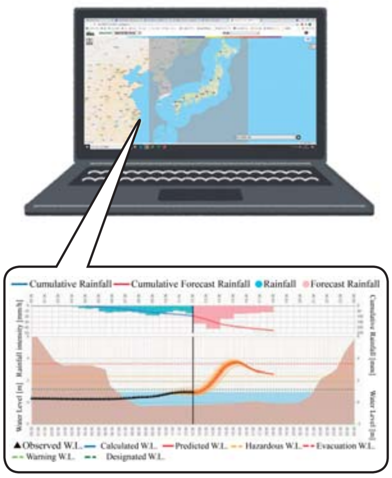
○ We selected the RRI (Rainfall-Runoff-Inundation) model as a low-cost, simple runoff analysis model with high flood reproducibility and developed a method to calculate water levels in a short time based on calculated flow rates using the water level-flow conversion formula (H-Q formula).

○ We selected the particle filter method to improve the accuracy of the water-level prediction model by continuously calibrating the model using real-time observed water levels because the selected method demonstrates high applicability, capable of treating state quantities, and parameters.

○ We applied the SCE-UA method to the RRI model as an automatic parameter adjuster to reduce the model building effort.

○ We proposed a method to prepare actual rainfall by effectively combining highly accurate analyzed rainfall with analyzed rainfall for prompt reports, which have delivery intervals short enough to capture heavy rainfall with fewer delivery delays. We also proposed a method to forecast rainfall by combining short-interval forecast rainfall with short-interval forecast rainfall for prompt reports, which have shorter delivery intervals and fewer delivery delays.

○ We built models for about 100 rivers by FY2020 and tested them to confirm if they would run properly on the real-time automatic flood forecasting system. The models were also tested for different events from the one used for parameterization to see if they could predict when the river water level would reach the flood risk water level more than two hours in advance. The results showed that about 40% of the models predicted the accurate time more than two hours in advance. Also, when actual rainfall was used as for prediction instead of forecast rainfall, about 80% reaching the flood risk water level could be predicted more than two hours in advance.



Application to real-time analysis and real-time automatic distribution systems

Exit strategy

○ With the method developed in PRISM, it will become possible to provide water-level prediction information for about additional 1,500 small and medium-sized rivers, which are considered likely to cause considerable damage to people and their property once flooded.

○ As water-level prediction information becomes available for public use, information distribution businesses that process and provide water-level observation and prediction information will be further promoted.

Introduction of main measures

Constructing information service platform for disaster risk reduction through public-private partnership to promote effective disaster response

*Name of the old measure: Analysis of long-period seismic motion/detailed seismic intensity distribution, etc., and promotion of emergency response based on such analysis results

Program Director HAYASHI Haruo President, National Research Institute for Earth Science and Disaster Resilience (NIED)

Original measure: Management Expenses Grants for National Research Institute for Earth Science and Disaster Resilience Tokyo Metropolitan Resilience Project (MEXT)

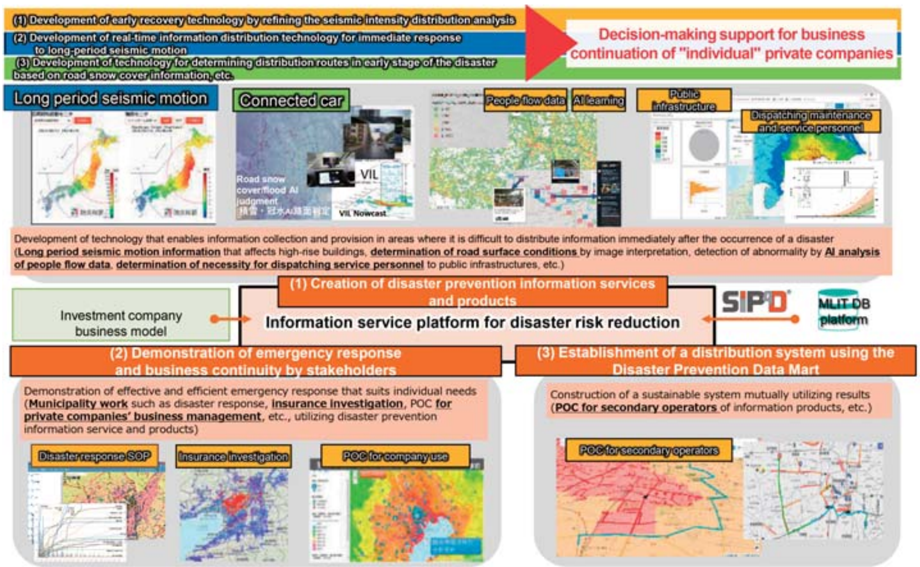
Issues and Goal

Realization of a sustainable and resilient society that induces investment through co-creation by industry, academia, government, and the private sector

Disasters caused by natural threats, such as earthquakes directly occurring under the Tokyo Metropolitan Area, which is expected to cause 95 trillion yen of economic damage, and frequent occurrence of abnormal weather disasters, would be a major blow to society and the economy. On the other hand, there is a lack of a sustainable system that enables development and utilization of new services and products based on individual needs of the information required by each company to respond to disasters, and thus resilience has not been improved by utilizing the vitality of the private sector.
The purpose of this measure is to examine what is required for disaster response and business continuity in the private sector, and to create unprecedented "disaster prevention information services and products" based on big data, technology, and know-how including hazard and risk information, past disaster cases, and human flow information owned by companies.
Furthermore, we will "establish a distribution system using the Disaster Prevention Data Mart" based on a cost-sharing measure so that the achievements can be continuously used by companies which need them, and we will also create a system to match seeds and needs in "emergency response by stakeholders/ demonstrations in business continuity", aiming to realize a highly resilient society.

Overview

Creating achievements that will support decision-making on disaster response and business continuity of private companies



The implementing agency, NIED has obtained a variety of hazard and risk information through promotion of the original measure. Utilizing such information, PRISM examined what is really necessary for disaster response and business continuity of private companies through monitor surveys. By utilizing public information and information owned by companies, etc., we will carry out the following three projects: (1) Conducting R&D based on a cost-sharing measure with companies to create disaster prevention information services and products that meet needs of private companies. (2) Aiming to realize more appropriate achievements by extracting technical issues, missing information, elements, etc., through demonstration of emergency response and business continuity by stakeholders. (3) Building a distribution system using disaster prevention data marts; building a cooperative system with businesses that utilize the achievements based on revision of the "Law on the Revitalization of Science, Technology and Innovation Creation"; and we will continue to cooperate with those businesses even after the end of this project to demonstrate a system to continuously provide disaster prevention information services and products that attract continuous private investment with "actual actions".

Achievements to date and expected positive ripple effects

Creation of disaster prevention information services and products that meet individual needs of companies

PRISM utilizes the information above to develop technology and systems that enable identification of areas where abnormalities are occurring, for example, forecast information distribution technology according to the forecast work of long-period seismic motion approved by the Japan Meteorological Agency based on PRISM's research results, and construction of AI judgment models based on a vast amount of human flow data, images acquired from in-vehicle sensors, and information on the response characteristics of building infrastructures.
We are implementing sophistication and optimization through demonstration experiments with industries and companies that are actual users, so that our efforts can support decision-making for emergency response required for corporate business continuity, such as maintenance and inspection of buildings, roads, insurance assets, etc., dispatch of investigators, and determination of road closures, and thereby contribute to smooth situation recovery.

Realization of a sustainable R&D system based on a cost-sharing measure

Based on these achievements, we conducted training using a tool that packaged actual disaster records, and conducted questionnaires, interviews, and monitoring surveys at companies to identify further issues and needs, as well as to investigate market trends and needs. Also, NIED invested in companies that would utilize the achievements of the project and established the R&D system centering on such companies. Thus, we aim at business development that can sustainably operate and develop the achievements of the project by attracting private sector investment even after completion of PRISM.


A screen integrating the rarity information of heavy rain and the business information of the company in the company's system


Secondary delivery service that identifies roads with high inundation risks in real time and searches for danger avoidance routes