Data collection, analysis, and application of findings to society

1. Data handled by the NILIM and its characteristics

As a national research institute in the field of housing and social infrastructure, the National Institute of Land and Infrastructure Management (NILIM) conducts research and development for the collection, data collection, reorganization of the collected data, and accumulation and management of the data so that the huge amount of field data collected for administrative purposes can be utilized for research. The accumulated data are used for research to solve administrative problems and for on-site support, while some of the data are made available to the public. In addition, the NILIM is exploring the possibility of making the data available as open data in order to promote the use of technology by private companies and induce technological development.

1. Use of data at the **NILIM**

○ **Use for research (clarification of phenomena, problem solving)**
Examples: Strong-motion earthquake monitoring systems, understanding of actual conditions, such as energy-saving performance of buildings, and port and marine transportation data from AIS

○ **Creating rules for proper operations**
Examples: Analysis and revision of road structure inspection procedures, project evaluation chart systems, costing database systems, etc.
Electronic delivery, storage, and management systems

○ **Technological development for data collection**
Example: XRAIN

2. Provision of data to **regional development bureau and local governments**

○ **Operation support through the provision of information and sharing of know-how, such as case studies**
Examples: Database on sewer pipe deterioration, database on earthquake damage to sewer pipelines, wave run-up height forecasting system, etc.
Landslide disaster database, volcano real-time hazard maps, accident countermeasure database, and Road traffic research platform, sharing and utilization of road natural environment conservation achievements, and the River Base Computerization System (RBCON)

○ **Promote the use of technology by simultaneously providing interfaces such as simple tabulation tools.**
Examples: ETC 2.0 probe data, establishment of specifications for traffic observation with AI image recognition, Program for estimating the number of households in need of housing security, future population projection tool

3. Provision of data to **universities, private sector, etc.**

○ **Regular and continuous collection of information and provision of easy-to-use information**
Example: River environment database

○ **Induce the private sector to develop technologies and services by disclosing information, data, and performance requirements.**
Examples: Provision of ETC 2.0 probe data as open data and smart cities

○ **Standardization of data**
Examples: Formulation of electronic delivery guidelines, establishment of ICT civil engineering standards, establishment of the proposal of 3D model notation standards

2. Use of data at the NILIM

The NILIM collects data gathered for administrative purposes and data from external organizations and reorganize them to use them in research.

(1) Grasping the actual status of energy-saving performance and other conditions of buildings based on data reported in relation to energy conservation standards

The NILIM collects and analyzes information on procedures etc. based on the Act on the Rational Use of Energy and published the results of surveys on the energy-saving performance and other factors of newly constructed or expanded/renovated non-residential buildings in March 2020 and January 2021. The published data organize energy efficiency by use, size, and region, as well as design specifications (heat insulation performance, efficiency of air conditioning equipment, etc.). The national and local governments can use this information as basic reference when planning energy efficiency and conservation measures and when examining specifications to design actual structures.

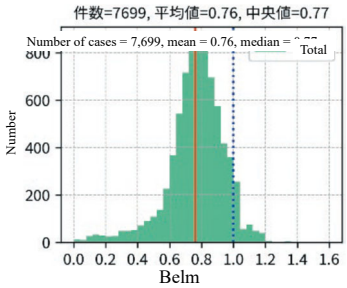


Figure. Distribution of energy conservation performance evaluation (BElm)
(six areas, model building method)

Region	Floor area	Num	Thermal transmittance [W/m²K]			Thermal transmittance [W/m²K]		
			Average	Median	Standard	Average	Median	Standard
Two regions (Cold)	All	110	0.58	0.54	0.29	3.39	3.22	0.89
	Less than 300 m²	23	0.55	0.44	0.26	3.32	2.91	1.23
	300 m² to 2,000 m²	69	0.60	0.53	0.32	3.39	3.34	0.76
	2,000 m² to 10,000 m²	18	0.57	0.58	0.19	3.49	3.29	0.84
	10,000 m² or more	0	–	–	–	–	–	–
Six regions (Warm)	All	2662	0.94	0.72	0.63	4.53	4.28	1.13
	Less than 300 m²	655	0.90	0.66	0.68	4.65	4.50	1.20
	300 m² to 2,000 m²	1681	0.94	0.73	0.63	4.61	4.39	1.10
	2,000 m² to 10,000 m²	279	1.03	0.89	0.51	3.92	3.70	0.88
	10,000 m² or more	47	0.99	0.89	0.41	3.44	3.28	0.71

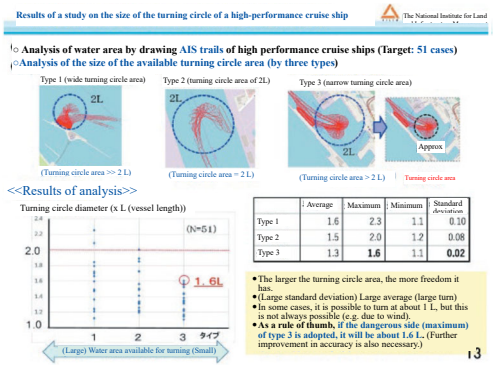
Table 1. Thermal transmittance of exterior walls and windows
(Only the office, two regions and six regions are excerpted.)

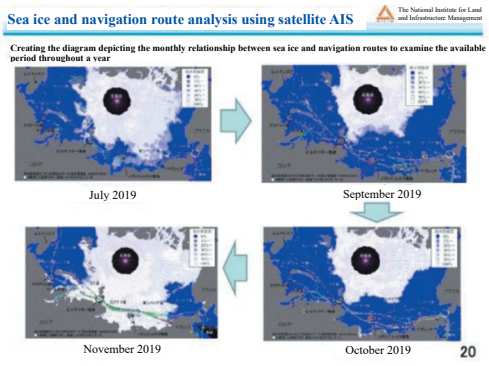
Region	Main heat source type	Num	Heat source capacity (cooling) [W/m²]			Heat source efficiency [–]		
			Average	Median	Standard	Average	Median	Standard
Two regions (Cold)	All types	94	170.8	171.6	67.6	1.29	1.27	0.22
	Packaged air conditioner (air-cooled)	70	171.1	171.6	65.8	1.34	1.28	0.21
	Gas heat pump air conditioning and heating	12	211.7	207.0	69.1	1.16	1.15	0.16
	Room air conditioner	7	135.4	122.2	45.0	1.19	1.31	0.21
Six regions (Warm)	All types	2548	240.1	230.8	110.9	1.29	1.24	0.45
	Packaged air conditioner (air-cooled)	2236	242.3	232.0	107.2	1.30	1.25	0.47
	Room air conditioner	190	201.0	193.9	89.4	1.23	1.20	0.20
	Gas heat pump air conditioning and heating	87	263.3	248.2	84.2	1.15	1.15	0.09

Table 2. Capacity and efficiency of heat source equipment for cooling
(Only the office, average of all models and top 3 models are excerpted.)

(2) AIS and other port and marine transport data

In addition to the analysis of ship navigation in ports and Arctic Ocean routes using AIS data (NILIM-AIS and satellite data), the NILIM collects and analyzes Lloyd's data on ship specifications, PIERS data on North American cargo movements, and SAR (radar) satellite data in ports.





(3) XRAIN

Based on the knowledge gained from many years of wide-area observations using radar rain gauges and the technology developed through research into high-precision observations using the latest radar rain gauges developed in recent years, the rainfall calculation algorithm for C-band MP radar rain gauges and technology for combining C-band MP radar rainfall with X-band MP radar rainfall developed by the NILIM have improved observation quality and stability. The XRAIN distribution area was thus expanded in July 2016.

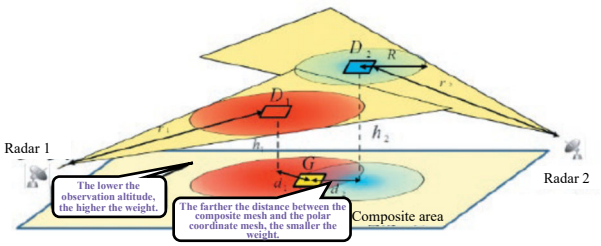


Figure 1. Image of composite technology of C-band MP radar rainfall and X-band MP radar rainfall

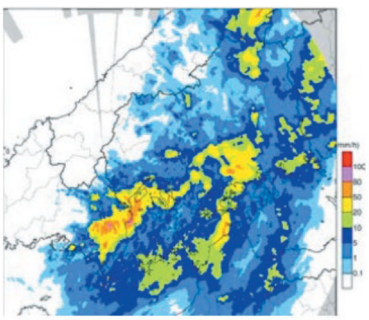


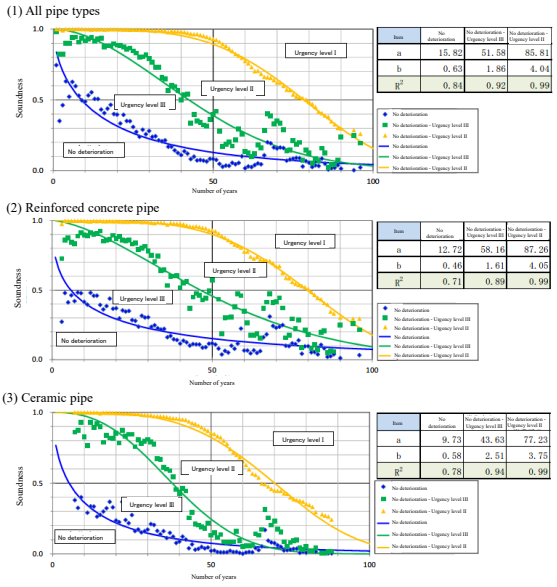
Figure 2. Example of observation using rainfall calculation algorithm suitable for C-band MP radar rain gauge.
(250 m mesh, one-minute interval observation)

3. Provision of data and operational support for Regional Development Bureaus and local governments

The NILIM combines and utilizes the collected information as big data to conduct research on monitoring the condition of infrastructure and deriving improvement measures and then provides the data and operational support to Regional Development Bureaus and local governments.

(1) Sewer pipe deterioration database

In order to support sewer pipe stock management in local governments, the Sewer Pipe Soundness Prediction Formula 2017 and the Deterioration Database Ver. 2 were released in June 2017. The Sewer Pipe Soundness Prediction Formula expresses the change in the ratio of deteriorated pipes over time based on results of TV camera surveys of sewerage pipes by local governments. It indicates the progress of the deterioration in the entire pipeline facilities. The Deterioration Database collects the TV camera survey data used to create the Sewer Pipe Soundness Prediction Formula and organizes the results of determining deterioration, such as pipe type, age, corrosion, and sagging. It can be used as supplementary data for local governments to formulate maintenance and management plans for existing pipelines and to forecast the amount of reconstruction projects and as basic data for research to develop new pipe materials and repair technologies.



$$R(t) = \exp\left[-\left(\frac{t}{a}\right)^{b}\right]$$

R(t): soundness, t: number of years elapsed, a, b: constants, R^2: coefficient of determination
(The closer R^2 is to 1, the better the accuracy of that prediction formula.)

Figure 2. Sewer Pipe Soundness rate prediction equation 2017

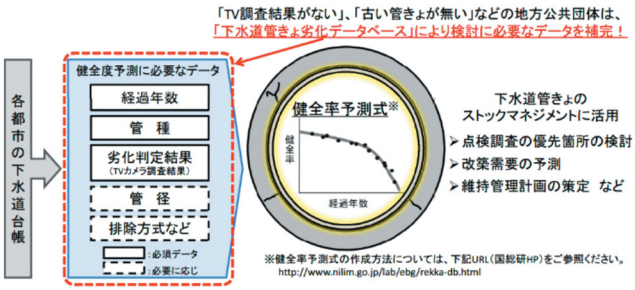


Figure 1. Image of using the Sewer Pipe Deterioration Database

(2) Wave run-up height prediction system

The wave run-up height prediction system uses the tide level and wave forecast of each coast by the Japan Meteorological Agency as input data for external forces, predicts the run-up height, and compares it with the top height of the embankment to determine when wave overtopping will become severe. This information can be provided to coastal administrators to reinforce their countermeasures against high waves in the coastal areas.

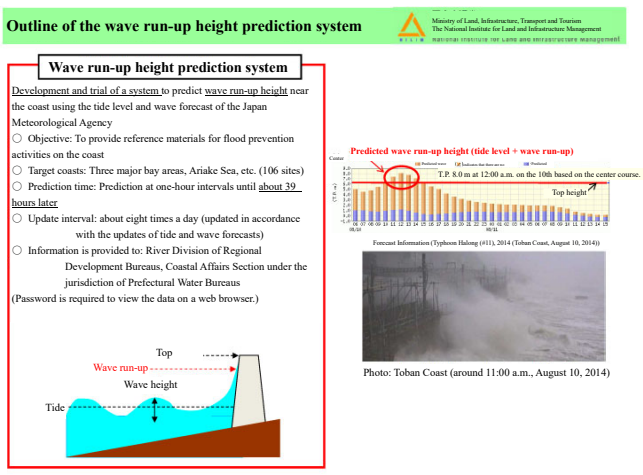


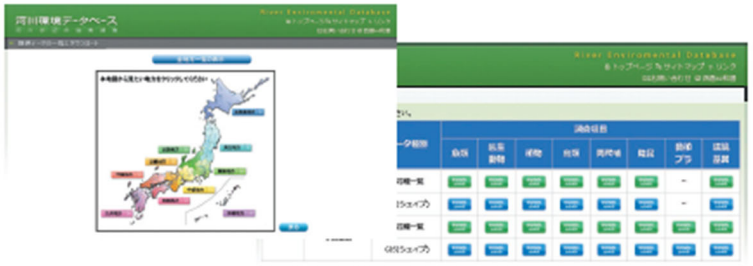
Photo: Toban Coast (around 11:00 a.m., August 10, 2014)

4. Provision of data to universities, private sector, etc.

The NILIM is studying the possibility of making the collected information open for use by the private sector and universities. In addition, the results of regular and ongoing surveys are being converted into data for easier use by users when the information is provided.

(1) Release of the river environment database (the National Census of Riverine Areas)

The results of the National Census of Riverine Areas, which provide periodic, continuous, and unified basic information on rivers from the perspective of the environment, are converted into a data format that is easy for users to use, and the information is made available on the website.



Downloaded data can be used to easily create analysis charts etc. in GIS.

(2) Study for private sector utilization of ETC 2.0 probe data information

In order for the private sector to use the ETC 2.0 probe information, which has been used by road administrators to understand issues related to road traffic and to study measures, the NILIM is studying the data format to be provided to the private sector and how to protect privacy.

5. Future prospects

The Ministry of Land, Infrastructure, Transport and Tourism (MLIT) will use data and digital technology to transform social infrastructure and public services in the infrastructure sector in response to the rapid changes in socioeconomic conditions. The MLIT also promotes public understanding of infrastructure by transforming the operation itself, the organization, the processes, and the culture and working style of the construction industry and the MLIT. At the same time, the MLIT is promoting digital transformation (DX) in the infrastructure field to realize safe, secure, and prosperous lifestyles.

At the NILIM as well, research is being conducted to establish an environment for storing and utilizing 3D data, such as BIM/CIM models of infrastructure and buildings (DX Data Center), as well as an infrastructure data platform that aggregates and links data from the infrastructure sector of the national government, local governments, and the private sector.

The NILIM expects to continue the development of technologies for data collection, analysis, and utilization in the field of infrastructure, and that these technologies will be introduced into research and the field, and that the information and data will be made public to contribute to the development of technologies in universities and the private sector.