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Report on the Webinar Commemorating
the International Day for Monuments and Sites (IDMS) 2026

Disaster Risk Reduction with GIS: Living Heritage Cities — Kyoto and Cairo

21 April 2026

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Introduction

This report was prepared with the aim of organizing the contents of the webinar titled “Disaster Prevention and Risk Reduction Using GIS: Living Historic Cities—Kyoto and Cairo,” held on April 21, 2026, and documenting the key points of each presentation as well as the overall discussion.

This webinar was jointly organized by the Research Center for Disaster Mitigation of Urban Cultural Heritage, Ritsumeikan University, and the Japan National Committee of the International Council on Monuments and Sites (ICOMOS) as a related event for the International Day for Monuments and Sites (IDMS).

In line with the 2026 theme, “Emergency Preparedness for Living Heritage in Times of Conflict and Disaster,” the webinar provided a forum to examine issues related to Disaster Risk Reduction (DRR) in historic cities. More than 50 participants from Japan and abroad attended the event.

The Research Center for Disaster Mitigation of Urban Cultural Heritage at Ritsumeikan University has been recognized since 2006 as a UNESCO Chair site for “Cultural Heritage and Risk Management.” Since then, the center has primarily led training and research activities aimed at protecting cultural heritage from disasters, mainly targeting government officials and researchers from developing countries, while also promoting the development of international networks.

Historic cities possess cultural value formed over long periods of time, while also functioning as “living heritage” where many residents continue to live and urban functions continue to develop. Such cities are characterized by dense building clusters and complex urban structures, making them vulnerable to natural disasters such as earthquakes, fires, and floods. At the same time, they face pressures from rapid urbanization and infrastructure development. Therefore, the protection of cultural heritage in historic cities requires not only the preservation of individual buildings but also a comprehensive disaster prevention and risk reduction approach that addresses the city as a whole.

As an effective means to address these challenges, the webinar focused on the use of Geographic Information Systems (GIS). GIS is a technology that enables the integration of diverse information related to cultural heritage and urban structures and allows for spatial visualization. It plays an important role in identifying disaster risks, assessing vulnerabilities, conducting monitoring, and supporting decision-making in emergency response.

In this webinar, Kyoto and Cairo were presented as two case studies of historic cities utilizing GIS for disaster prevention and risk reduction. While these cities differ in cultural background and historical development, they share common challenges as cities possessing large numbers of cultural heritage assets. In Cairo, the University Heritage Forum project was completed last year with the support of the UNESCO Cairo Office, the Egyptian Ministry of Tourism and Antiquities, and the Cairo municipal authorities, leading to the development of new insights. In contrast, in Kyoto, preservation and utilization initiatives as a World Heritage city have been implemented continuously over the long term. The webinar featured presentations by four experts, each introducing disaster prevention and risk reduction initiatives in historic cities from different perspectives.

Presentation 1

Historical Cairo: A Living Cultural Heritage Site: Infrastructure Expansion, Social Pressure, and the Role of GIS in Management and Emergency Response

Yasser Elshayeb, PhD

1. Historical Cairo as a Living Urban System

Historical Cairo, inscribed on the UNESCO World Heritage List in 1979, is one of the largest and best-preserved historic urban fabrics in the world — an unbroken human settlement spanning more than a millennium. Its dense network of medieval mosques, madrasas, bazars, and domestic architecture comprises over existing 600 monuments within walking distance of one another, making it a site of exceptional universal value. Yet its defining and most challenging characteristic is also its greatest strength: it is not a museum, but a living city. Hundreds of thousands of residents, active markets, active mosques, workshops, and small industries occupy the same fabric that embodies this extraordinary heritage.

This duality — heritage site and functioning metropolis simultaneously — was the central framing of this contribution. The current population within the historic zone is estimated at between 600,000 and 800,000 residents, roughly double the density of fifty years ago. Structural loads on centuries-old buildings now far exceed original design capacity. Informal subdivisions and vertical additions compromise building integrity, while water, sanitation, and electricity networks are critically overstretched. Urban life is, paradoxically, both the soul of Historic Cairo and the primary driver of its heritage stress.

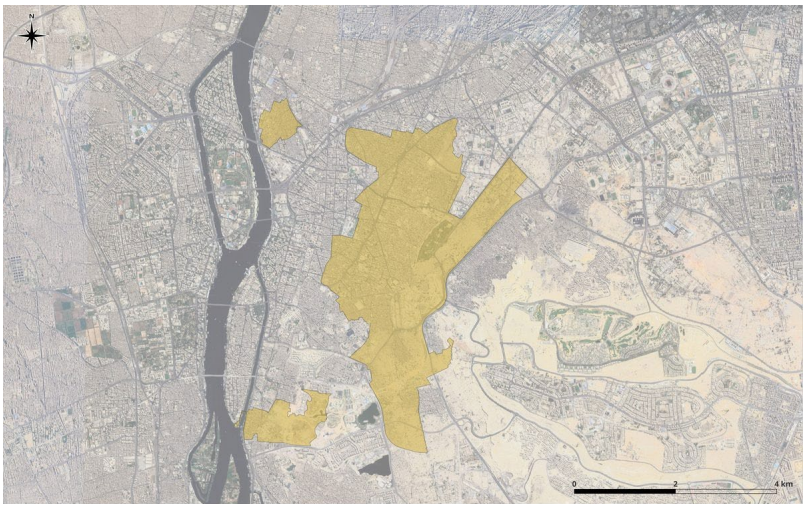

Figure 1. UNESCO World Heritage property boundary (highlighted in gold) within the urban fabric of Cairo

2. Multi-Dimensional Urban Pressures

The presentation identified several categories of pressure acting simultaneously on the historic urban fabric:

- Rapid urbanization exerts relentless strain on the historic core, with new development encroaching on buffer zones,
- Unplanned construction within and adjacent to heritage zones fragments historic streetscapes and overloads aging foundations.

- Outdated utilities, narrow streets, and inadequate sanitation create chronic deterioration that operates independently of any major infrastructure project.

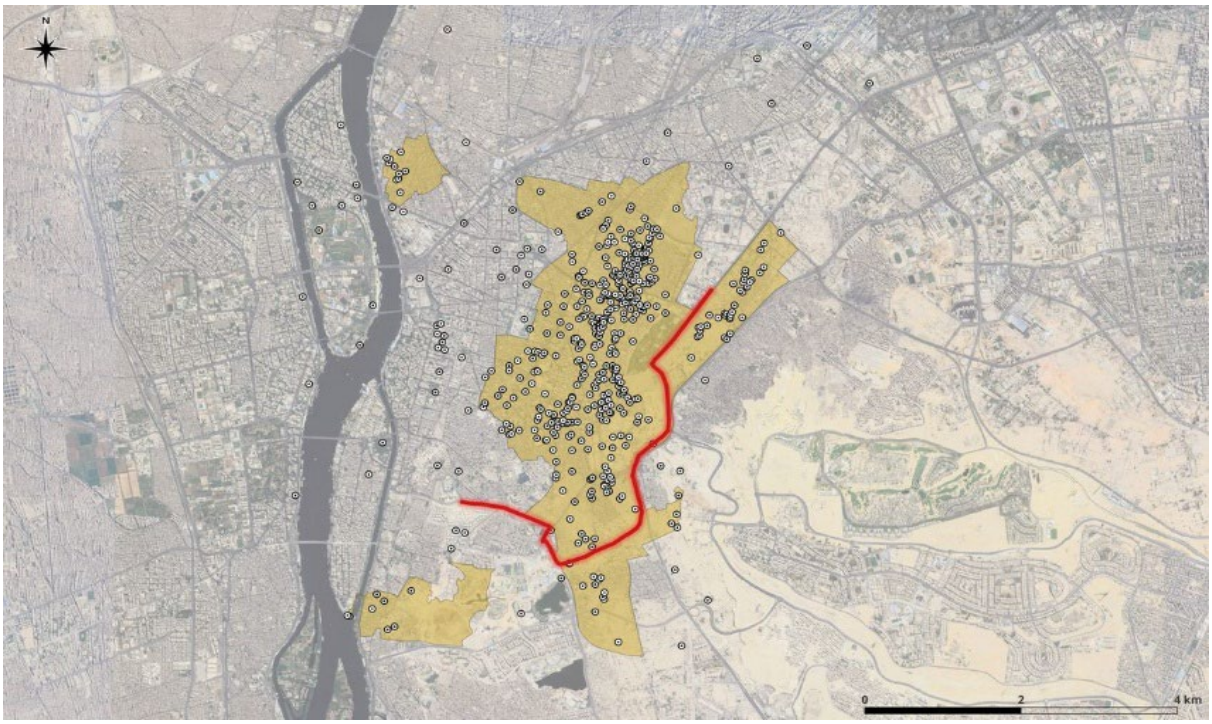

Figure 2. GIS map showing the Salah Salem road corridor (red) in relation to the Historic Cairo heritage boundary and monument locations

Among the most significant ongoing interventions is the Salah Salem road corridor, a major arterial expansion running directly adjacent to the heritage boundary. Its documented impacts include visual intrusion disrupting historic skylines, traffic-induced vibration transmitted to nearby historic foundations, and spatial fragmentation that severs historic neighborhoods from one another.

The metro network expansion — specifically Lines 4 and 6 — presents a dual challenge: while improved connectivity can reduce surface traffic and support the site's long-term management, construction and operational vibrations pose measurable risks to fragile masonry substructures..

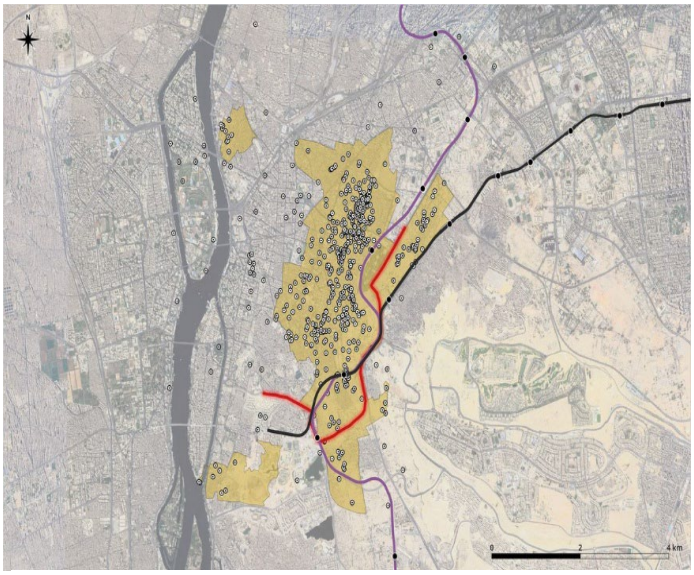

Figure 3. Proposed Metro Lines 4 (black) and 6 (purple) overlaid on the heritage boundary and monument inventory, illustrating

Figure 4. The Sabil-Kuttab of Hasan Agha Kuklian — a representative example of Historic Cairo's underutilized historic structures requiring active conservation and adaptive reuse.

The presentation also highlighted what was termed the "invisible impact" — cumulative, subsurface processes that cannot be observed from street level yet quietly undermine structural integrity over years and decades. Mechanical vibrations from metro construction and heavy road traffic weaken historic masonry and mortar bonds. Infrastructure works alter drainage patterns and groundwater levels, causing subsidence rising damp, and salt crystallization within historic walls. No single event causes collapse; it is the slow accumulation of micro-stresses that ultimately compromises heritage structures.

A further challenge examined was the paradox of underutilized heritage. A significant proportion of Historic Cairo's built assets are vacant, abandoned, or functionally redundant, disconnected from the active urban economy that surrounds them. Unoccupied structures decay rapidly without maintenance, accelerating structural failure and representing a compounding loss of economic, cultural, and social potential.

3. Learning from Kyoto: An International Precedent

To frame the path forward, the presentation drew on Kyoto as an international precedent demonstrating that world-class infrastructure and living heritage can coexist — but only through deliberate, sustained institutional commitment. Kyoto's approach has relied on strict zoning frameworks defining what can be built near heritage zones, regulated development corridors that route infrastructure away from sensitive areas, continuous monitoring of heritage condition linked to development approvals, and genuine community and stakeholder integration in planning decisions. The argument advanced was that Historic Cairo requires a similarly structured, multi-institutional approach, adapted to its specific urban, demographic, and governance context.

4. GIS as a Decision-Support Platform

Another contribution in the presentation was the reframing of Geographic Information Systems (GIS) not merely as a mapping technology but as a comprehensive decision-support platform — integrating spatial, temporal, and thematic data layers into actionable intelligence for planners, heritage authorities, and emergency responders.

Three core operational functions were identified and developed.

- Spatial documentation and monitoring: a comprehensive GIS system geo-references each heritage asset with condition attributes, enables periodic satellite and drone data updates to detect unauthorized change, maps infrastructure project footprints against heritage buffer zones, and integrates historical aerial imagery for longitudinal comparison.

- Risk and vulnerability assessment: Risk in Historic Cairo is not spatially uniform — it results from multiple overlapping factors. GIS enables analysts to stack these layers and identify where vulnerability concentrates. Parameters include structural vulnerability (building age, material condition, maintenance history), population density and human exposure in risk zones, proximity to infrastructure interventions (metro lines, road works, utility projects), and emergency vehicle accessibility and evacuation route analysis. The output — spatially explicit risk zoning maps — provides priority areas for preventive intervention and structural reinforcement.

- Emergency response: During structural emergencies, fires, flooding, or construction accidents, pre-built GIS emergency layers can provide first responders with immediate spatial intelligence, eliminating critical delays caused by information gaps. Specific capabilities include high-risk site identification based on pre-classified structural vulnerability scores, access route mapping for emergency vehicles through dense historic street networks, identification of safe zones for evacuation and staging, and dynamic priority intervention ranking based on occupancy, condition, and proximity to the incident.

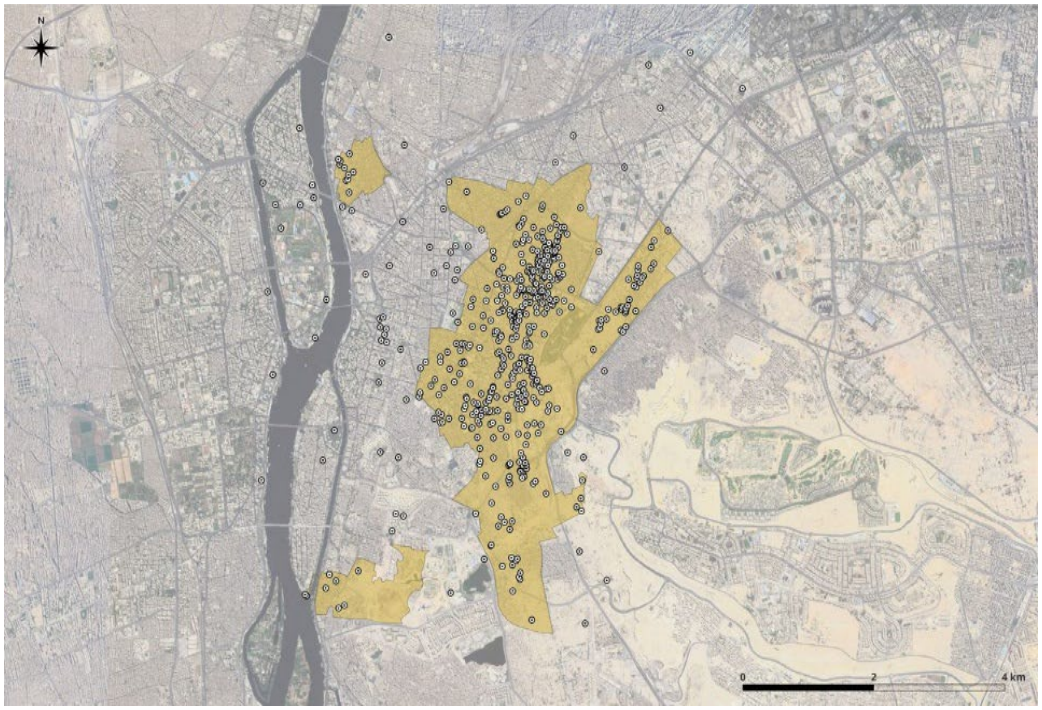

Figure 5. GIS heritage asset inventory: monument locations within the UNESCO property boundary, illustrating the density and spatial distribution of the historic urban fabric

5. Toward an Integrated Management Framework

Building on these analytical foundations, the presentation proposed a comprehensive integrated management framework structured around four mutually reinforcing pillars.

- Strategic urban master plan — spatially explicit, reconciling heritage protection obligations with urban growth requirements over a 25-year horizon.
- Adaptive reuse programme: systematic identification and rehabilitation of underused heritage buildings for economically viable, socially beneficial functions, such as cultural tourism, artisan production, libraries, and civic spaces, with the explicit goal that conservation funds its own sustainability through productive use.
- Genuine social integration, recognizing resident communities not as obstacles to conservation but as essential partners in its long-term success.
- Institutional coordination through a single shared GIS platform accessible to all responsible agencies — heritage authorities, urban planners, infrastructure ministries, and emergency services.

6. A Paradigm Shift: From Reactive to Proactive Heritage Management

The overarching argument of this contribution was the need for a fundamental paradigm shift in how Historic Cairo is managed. The current condition is characterized by fragmented interventions, crisis-driven responses, siloed institutions, and no shared data infrastructure. The required shift is toward coordinated planning, preventive monitoring, a shared GIS platform, and policy-driven management that anticipates rather than merely reacts to threats.

By embedding GIS in both long-term planning and real-time emergency response, the approach transforms heritage management from a fragmented, reactive process to a proactive, adaptive, and resilient system. Critically, the call is not simply for better technology, but for a conceptual reframing: from viewing Historical Cairo as a collection of vulnerable monuments to recognizing it as a dynamic, data-informed urban system in which conservation, urban development, and risk management are integrated as a single, sustainable enterprise.

Presentation 2

Historic Cairo: Between Development and Heritage

Naoko Fukami, PhD

1. Background and Objectives

Dr Fukami's presentation examined the relationship between rapid urban development and cultural heritage conservation in Historic Cairo, with particular attention to the use of historical materials and the role of local communities. Historic Cairo contains a wide range of historical buildings dating from the late tenth century, beginning with the Fatimid dynasty, through to the twentieth century. Moreover, the urban structure dating back at least to the sixteenth century has been largely preserved to the present day. Owing to these historical values, Historic Cairo was inscribed on the UNESCO World Heritage List in 1979.

Dr Fukami noted that, since the modern period, Cairo has experienced multiple waves of urban redevelopment while retaining much of its historic urban structure and cultural heritage. However, in recent years—particularly following the COVID-19 pandemic—large-scale urban development has accelerated, resulting in rapidly increasing impacts on the historic urban fabric. As a result, Historic Cairo is currently facing a significant transitional phase.

The presentation emphasized that, in order to understand urban transformation and appropriately recognize and conserve cultural heritage under conditions of rapid change, it is essential to utilize historical materials and promote community participation. In addition, Dr Fukami discussed the potential of Geographic Information Systems (GIS) as an effective tool for capturing long-term urban transformations.

2. Abundance of Historical Materials and Their Significance for Urban Studies

Dr Fukami highlighted that one of the defining characteristics of Historic Cairo is the abundance of historical materials documenting the city's development. In particular, maps produced in the sixteenth century by Matteo Pagano, as well as detailed urban maps included in *Description de l'Égypte*, were identified as essential resources for understanding the city's spatial structure. These maps contain detailed information on buildings, streets, and public spaces, thereby providing a valuable basis for reconstructing the historical evolution of the urban environment.

She further explained that detailed maps produced in the early twentieth century at scales of 1:1000 and 1:500 serve as important resources for analyzing building arrangements and the distribution of urban functions. By enabling comparison with the present-day urban environment, these materials make it possible to illustrate processes of urban transformation in concrete terms.

The presentation introduced ongoing efforts to integrate these historical materials into GIS platforms and conduct spatial analyses to systematically examine changes in urban structure. Through the application of GIS, materials from different historical periods can be compared in an integrated manner, making it possible to identify changes in urban landscapes and trace the

disappearance or transformation of historic buildings. Such approaches were presented as providing an important foundation for the development of cultural heritage conservation strategies.

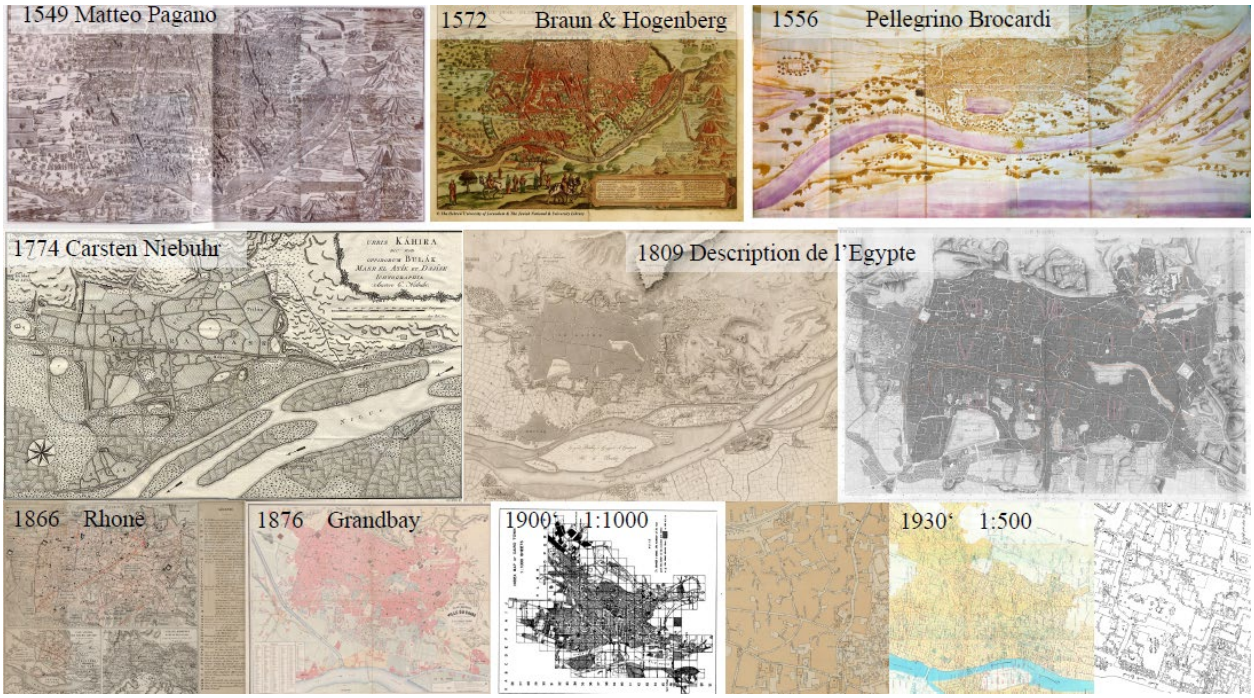

Figure 1. Historical maps of Cairo

3. Field Experience and the Role of Local Communities

Drawing upon approximately ten years of residence in Cairo beginning in 2015, Dr Fukami emphasized the critical role of local communities in cultural heritage conservation. Through long-term engagement in research and heritage-related activities, it became evident that community awareness and participation are essential factors in sustainable heritage protection. In historic cities where cultural heritage forms part of everyday life, it is particularly important that residents recognize the value of heritage and act as its custodians.

Based on this understanding, collaborative activities were carried out with a local researcher, Dr Alaa, using Bayt Yakan as a base. These initiatives aimed to enhance residents' awareness of cultural heritage and encourage recognition of the historical value embedded in their living environments.

However, Dr Fukami observed that government-led large-scale urban development projects possess strong institutional momentum, making it difficult for community-level initiatives alone to influence development processes. This experience highlighted the necessity of institutional frameworks and policy-level support, in addition to community participation, for effective cultural heritage conservation.

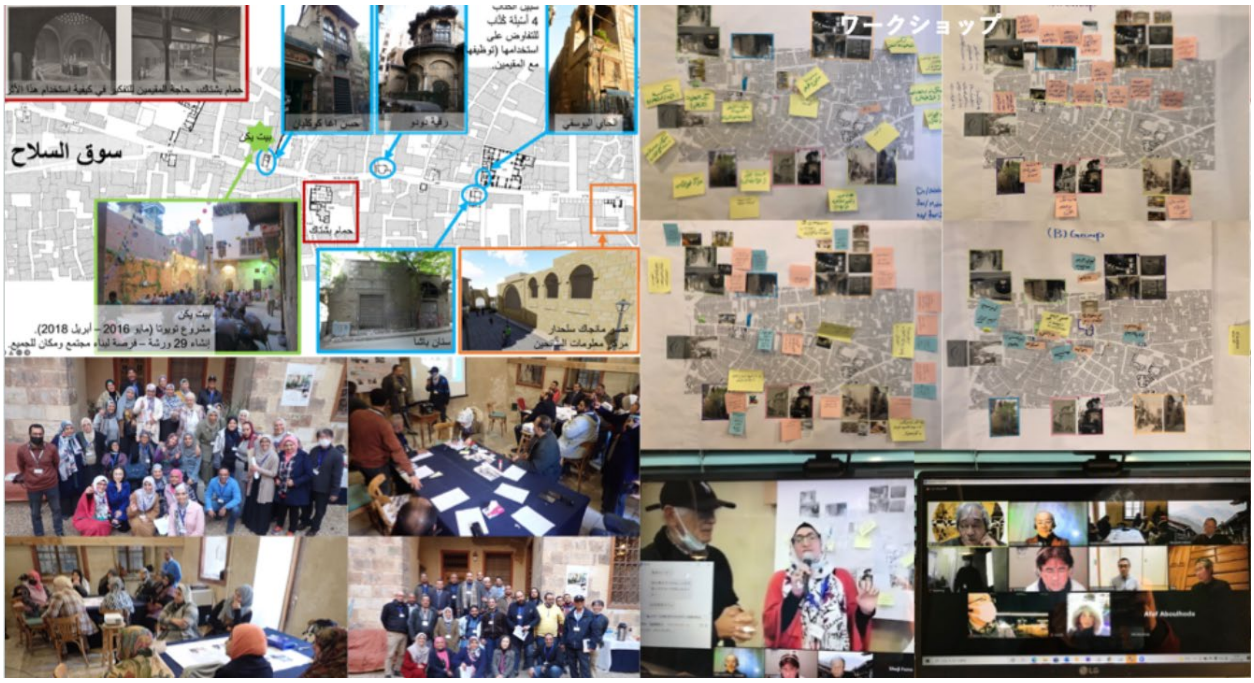

Figure 2. Workshops, online seminars and their outcomes

4. Urban Landscape Reconstruction Using GIS

In addition to the utilization of historical materials, Dr Fukami introduced initiatives focused on reconstructing historic urban landscapes through the application of GIS technologies. Research projects conducted at Tokyo University of Foreign Studies, supported by funding from the Obayashi Foundation and collaboration with Dr Elshayeb, enabled the analysis of detailed maps contained in *Description de l'Égypte*. Moreover, maps at scales of 1:1000 and 1:500 were digitized and incorporated into GIS databases, thereby establishing a foundation for spatial analysis.

Efforts were also undertaken to collect paintings and photographs produced prior to the early twentieth century. These visual materials were identified as valuable sources for reconstructing urban landscapes that no longer exist. By identifying locations depicted in paintings and photographs using surviving historic buildings as reference points, attempts have been made to reconstruct past street environments.

Through these research activities, the appearance of buildings and streets that have disappeared over time has gradually become clearer. The visualization of historical urban transformation was highlighted as being essential for understanding the value of cultural heritage and for supporting the formulation of future conservation policies.

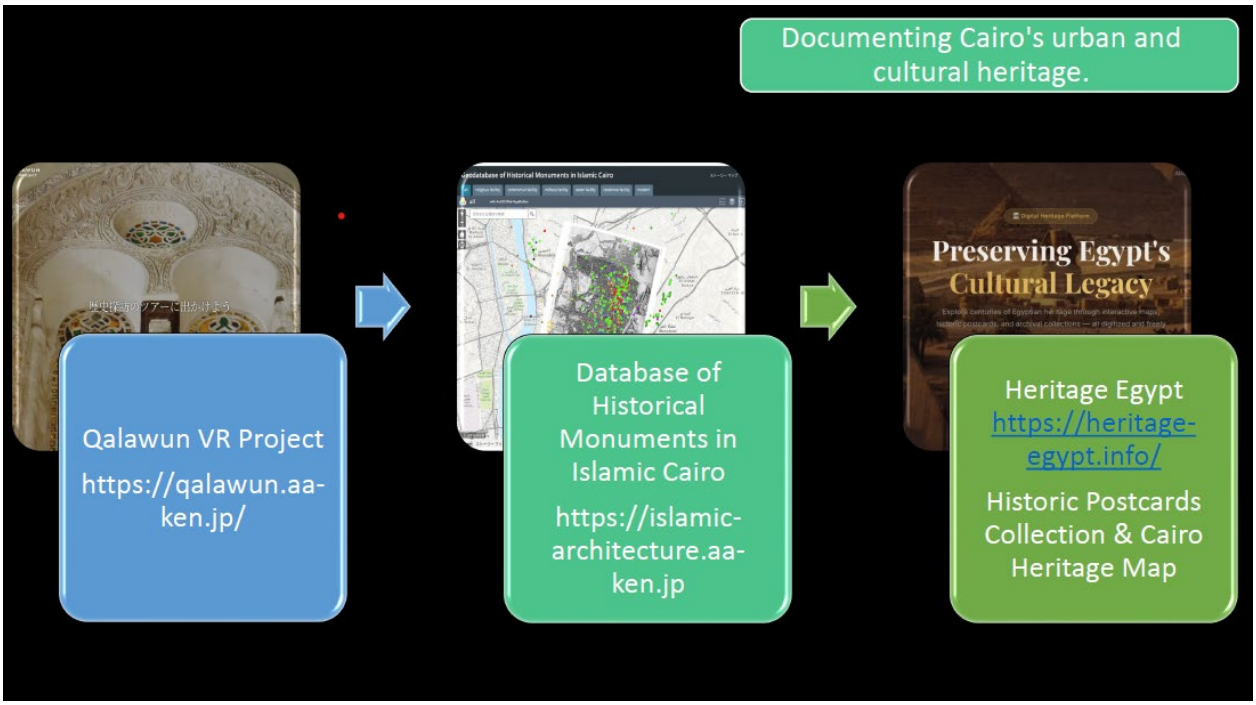

Figure 3. Documenting Cairo's urban and cultural heritage

5. Conclusions and Future Perspectives

In conclusion, Dr Fukami's presentation demonstrated that Historic Cairo is currently undergoing a period of significant transformation driven by rapid urban development. She emphasized that the effective use of historical materials and the active involvement of local communities are indispensable for achieving a balance between cultural heritage conservation and urban development.

The integration of abundant historical materials with GIS-based visualization techniques was presented as providing a critical foundation for both heritage conservation and urban planning. Furthermore, fostering residents' understanding of cultural heritage values and encouraging their active participation were identified as key elements in ensuring long-term conservation.

Looking ahead, the continued collection and analysis of historical materials, together with the further development of GIS-based urban research methodologies, were identified as important steps toward establishing sustainable management approaches for historic cities. In addition, strengthening institutional frameworks and policy support was emphasized as essential for promoting harmonious coexistence between cultural heritage conservation and urban development.

Fig 4: Documenting Cairo's urban heritage

Presentation 3

Accumulation and Utilization of Geospatial Information in the Historic City of Kyoto

Keiji Yano, PhD

1. Background and Objectives

Dr. Keiji Yano's presentation discussed the utilization of accumulated geospatial information in the historic city of Kyoto and its applications to cultural heritage preservation and disaster prevention and mitigation. Kyoto is a city with a long history and is one of the few historic cities in which historical buildings and urban landscapes have been preserved in relatively good condition up to the present day. In particular, because the damage during World War II was relatively limited, many prewar structures—such as temples and shrines, traditional *Kyo-machiya* townhouses, and modern-era buildings—still remain today.

However, with urban modernization and demographic changes, the gradual loss of historic buildings and traditional urban landscapes has been occurring. The decline in the number of *Kyo-machiya* townhouses has become a particularly serious issue for maintaining Kyoto's historic landscape. Against this background, the objective of this presentation was to integrate diverse historical materials and geospatial information in order to visualize urban changes from the past to the present, and to demonstrate methods for applying such information to cultural heritage conservation and urban disaster prevention.

This research is based on the "Virtual Kyoto" project, initiated in 2002 at the Art Research Center of Ritsumeikan University, and has continued to develop in collaboration with the Research Center for Disaster Mitigation of Historic Cities. The project aims to build a digital archive and GIS research infrastructure that integrates spatial and temporal information related to the historic city of Kyoto.

Fig 1. Digitally Archiving the Space of Kyoto – Across Place and Time

2. Integration of Diverse Geospatial Information and Construction of a 4D GIS

A central initiative of this presentation involves integrating various historical materials related to Kyoto into GIS in order to reconstruct the transformation of urban landscapes in both space and time. The materials used include historical maps, illustrated maps, aerial photographs, historical photographs, statistical data, and archaeological excavation records. By spatially linking these data sources, it becomes possible to understand urban historical transformations in detail.

A particularly important concept introduced was the "4D GIS." This 4D GIS incorporates the time axis in addition to conventional two-dimensional planar information and three-dimensional spatial information, enabling visualization of urban change over time. Through this approach, the formation and transformation of urban landscapes can be understood not merely as static information but as dynamic processes.

These datasets are made available not only through two-dimensional and three-dimensional visualizations but also as WebGIS platforms accessible to researchers, government agencies, and citizens. The public availability of such information contributes to sharing the value of cultural heritage widely and supports the formation of a societal foundation for preservation activities.

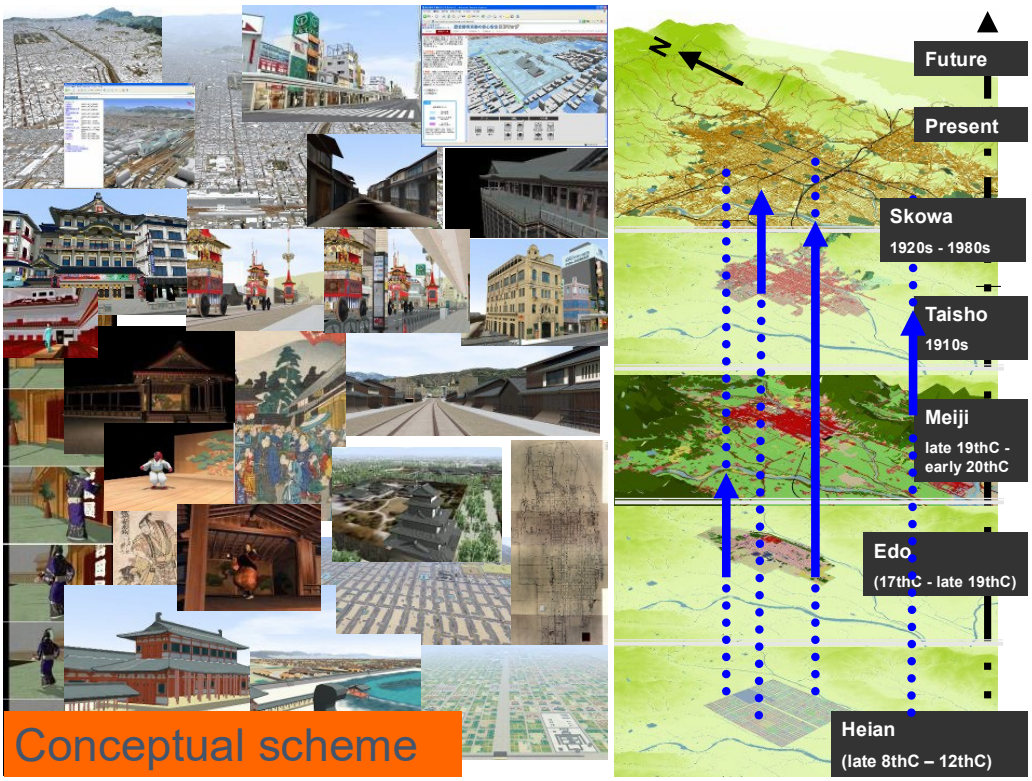

Fig 2. Conceptual scheme of the Virtual Kyoto project

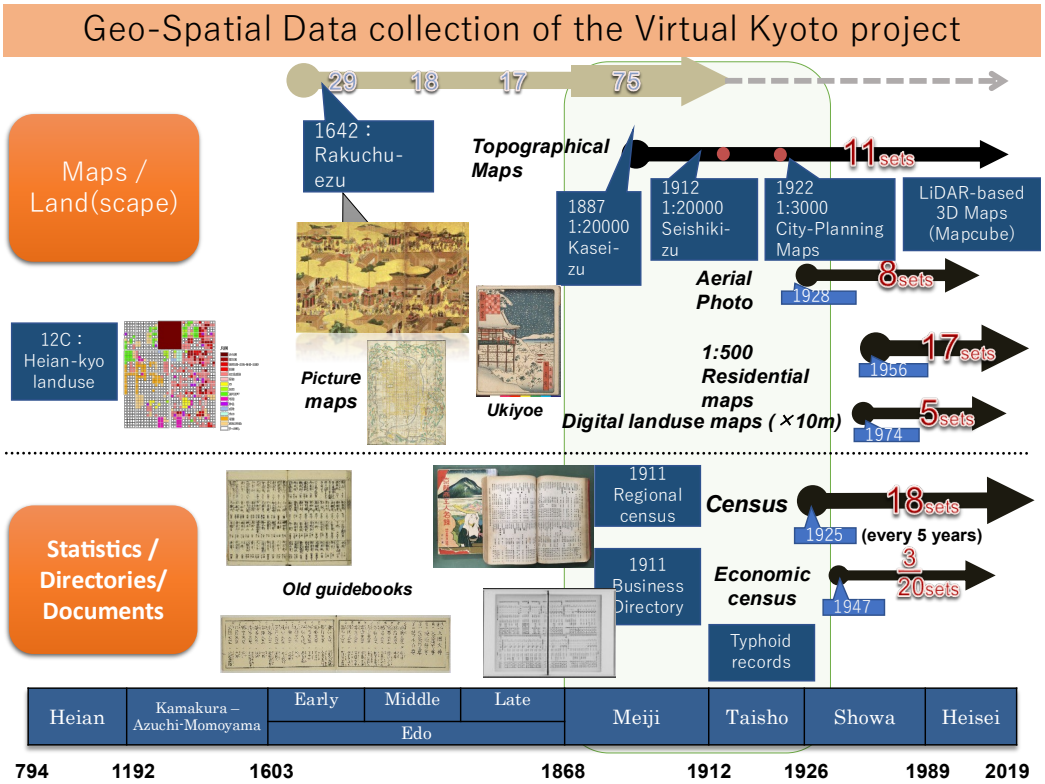

Fig 3. Geo-Spatial Data Collection of the Virtual Kyoto project

3. Reconstruction of Kyoto's Urban Landscape and Use of Historical Materials

The presentation introduced numerous case studies related to reconstructing Kyoto's urban landscape. For example, to understand changes in Kyoto after World War II, detailed urban maps believed to be fire insurance maps, along with Kyoto News materials and historical photographs, were utilized. By integrating these materials into GIS, postwar urban development and changes in buildings can be visually analyzed.

Furthermore, pictorial materials such as Rakuchu-Rakugai-zu folding screens and ukiyo-e prints were used to reconstruct urban landscapes of Kyoto during the early modern and Edo periods. These visual materials serve as important sources of information showing the layout of streets and buildings of the time. By linking them with historical maps in GIS, more accurate landscape reconstructions have been achieved.

In addition, by integrating archaeological excavation records and classical documents, a three-dimensional model of the ancient capital Heian-kyo has been constructed. This model reproduces the city structure extending approximately 5.2 kilometers north to south and 4.5 kilometers east to west, providing an important research platform for understanding urban structure and function.

Moreover, the development of digital archives related to the Gion Festival, a UNESCO Intangible Cultural Heritage, is also underway. By using three-dimensional urban models, it becomes possible to visually demonstrate the spatial development of the festival and its relationship with the city, offering new possibilities for cultural heritage preservation and transmission.

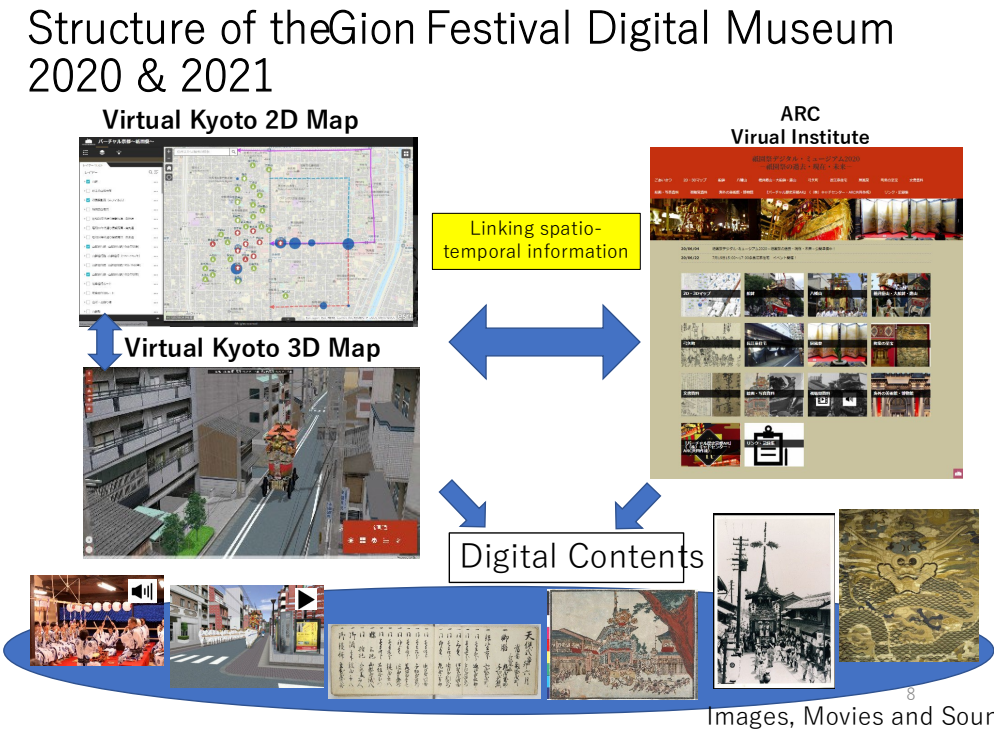

Fig 4. Structure of the Gion Festival Digital Museum

4. Preservation of Kyo-machiya and Urban Management Using GIS

One of the major issues in Kyoto is the decline of *Kyo-machiya* townhouses. These structures are essential elements forming Kyoto's historic urban landscape, and their loss directly affects the city's cultural value.

To address this issue, detailed surveys of existing *Kyo-machiya* were conducted in collaboration with Kyoto City and the Kyoto City Landscape and Town Development Center. As a result, approximately 47,000 *Kyo-machiya* located in urban areas and along historic roads were identified, and their location and building information were organized into GIS datasets.

This database functions as a monitoring system for continuously tracking the preservation status of *Kyo-machiya*, and it has been used as a fundamental resource for establishing regulations and developing urban planning policies. Specifically, this GIS data plays an important role in formulating policies to promote the preservation and restoration of *Kyo-machiya*, as well as in designing systems aimed at conserving cultural landscapes.

Such initiatives present a new perspective in which the preservation of historic buildings is positioned not as isolated activities but as part of comprehensive urban management.

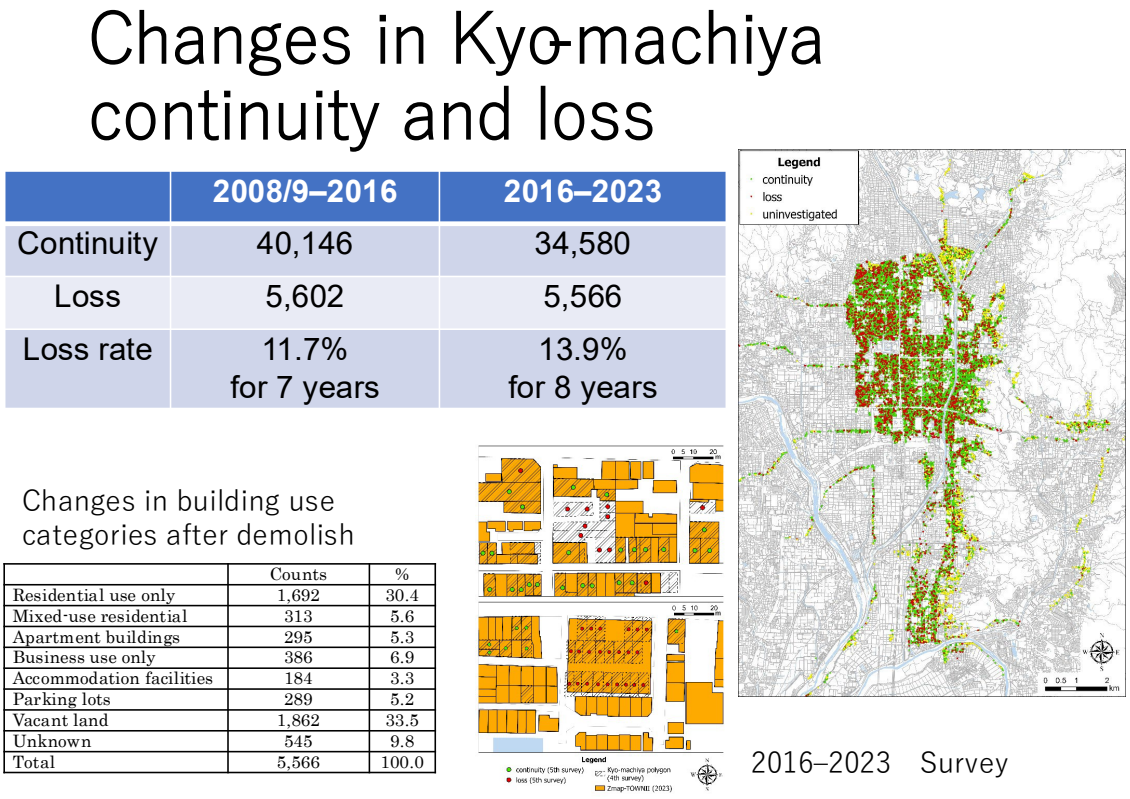

Fig 5. Changes in Kyo-machiya – Continuity and Loss

Fig 6. Urban Landscape of Kyoto in 1928

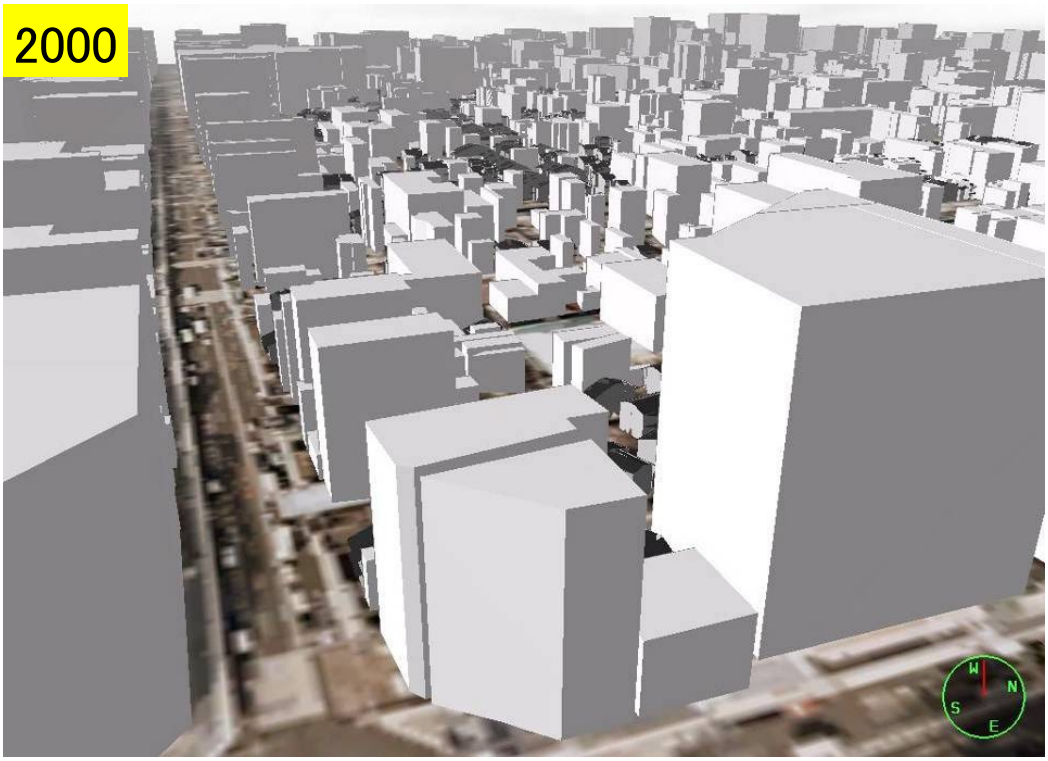

Fig 7. Urban Landscape of Kyoto in 2000

5. Conclusion and Future Prospects

This presentation demonstrated the importance of using geospatial information and digital technologies to visualize changes in historic cities and apply them to cultural heritage conservation and urban disaster prevention. In particular, the introduction of 4D GIS enables urban changes to be understood within a temporal context, suggesting the possibility of achieving more scientific and systematic urban management.

Additionally, the survey and GIS mapping of *Kyo-machiya* represent significant practical methods supporting cultural heritage preservation. Urban management based on such data is expected to play an important role in reducing disaster risks and maintaining urban landscapes.

In the future, further accumulation of data and technological advancements will be necessary to enhance management methods for historic cities. At the same time, it will be essential to establish sustainable cultural heritage protection systems through collaboration among government agencies, citizens, and researchers. The experience gained in Kyoto can also serve as a model applicable to other historic cities and offers important insights for the international field of cultural heritage preservation.

Reference

Yano, K., Nakaya, T., Isoda, Y., Takase, Y., Kawasumi, T., Matsuoka, K., Seto, T., Kawahara, D., Tsukamoto, A., Inoue, M. and Kirimura, T.(2008) “Virtual Kyoto: 4–dimensional GIS incorporating space and time”, Journal of Geography (Chigaku Zasshi), 117(2), Tokyo Geographical Society, pp.464–478.
DOI https://doi.org/10.5026/jgeography.117.464

Presentation 4

Utilization of Historic Water Resources and Open Spaces in Rome for Disaster Risk Management, with Lessons from the Nepal Gorkha Earthquake

Takeyuki Okubo, PhD

1. Introduction

Dr. Takeyuki Okubo's presentation addressed an increasingly important topic in disaster risk management for historic cities: the strategic use of historic water resources and open spaces as complementary systems when modern infrastructure fails during disasters. His work focuses on Rome as a case study while drawing key lessons from the 2015 Nepal Gorkha Earthquake, offering insights that can be applied to other historic cities such as Kyoto and Cairo.

2. Background and Rationale

Modern urban disaster response systems depend heavily on infrastructure such as roads, hydrant systems, and centralized water supply networks. However, major earthquakes frequently damage these systems, leading to road blockages, water outages, and delayed emergency services. In such situations, residents must rely on locally available resources to control fires and sustain evacuation activities during the critical first days following a disaster.

Dr. Okubo emphasized that historic cities such as Rome possess unique assets that have evolved over centuries—fountains, ponds, aqueducts, piazzas, and parks—that can serve as valuable backup systems during emergencies. These features were originally developed for everyday life and urban beautification but can also function as practical resources for disaster response if properly maintained and integrated into planning.

The central objective of the study was to identify and evaluate historic water resources and open spaces across Rome and estimate their potential roles in fire control and evacuation support following a major earthquake.

3. Research Framework

The research was structured around three critical phases of post-earthquake response.
The first phase involves quick fire response by local residents. In the immediate aftermath of an earthquake, small fires often break out simultaneously in multiple locations. Residents must extinguish these fires before they spread. For this purpose, easily accessible water sources such as fountains and ponds are essential. The study analyzed whether historic fountains and ponds could provide sufficient water within walking distance to support bucket brigade firefighting methods.

The second phase focuses on large-scale fire control by professional firefighting teams. If initial fire control fails, large volumes of water become necessary to suppress fires in major buildings. Historic water bodies, rivers, and aqueduct systems were assessed to determine whether they could supply sufficient water for professional firefighting operations using fire engines.

The third phase concerns evacuation and survival support. Following an earthquake, evacuees often require safe open spaces where they can gather, set up temporary shelters, and access drinking water until public services are restored. Historic piazzas and parks were evaluated for their capacity to accommodate evacuees and provide basic living support.

4. Lessons from the Nepal Gorkha Earthquake

A key foundation for the study was the experience of the 2015 Nepal Gorkha Earthquake, which caused severe damage across the Kathmandu Valley. Many historic areas experienced building collapses, infrastructure failure, and displacement of residents.

Despite this damage, traditional spaces such as historic squares, community structures, and water sources proved invaluable during recovery. Historic plazas were used as temporary evacuation sites, allowing residents to gather safely in open areas away from damaged buildings. Traditional water supply structures known as “Hiti” provided essential water when the modern water system failed.

These examples demonstrated that historic urban elements, which had survived earlier disasters, remained functional even under extreme conditions. This observation reinforced the importance of preserving and maintaining traditional resources as part of disaster preparedness strategies.

Fig 1. Nagbahal & Ilanani community in Patan (1)

Fig 2. Nagbahal & Ilanani community in Patan (2)

5. Survey of Historic Water Resources

A major component of the research involved measuring water volumes in 28 major historic fountains and estimating water storage in ponds and other water bodies across Rome. Geographic Information System (GIS) mapping techniques were used to identify the locations of these water sources and calculate their coverage areas.

The study found that most historic fountains and ponds contained sufficient water to support neighborhood-level fire suppression by residents. By estimating bucket brigade distances and walking speeds, researchers determined that fires located within approximately 60 meters of a water source could be controlled quickly by local residents.
In addition, larger fountains and river access points were found capable of supplying enough water for professional firefighting operations. These larger resources are particularly important for suppressing fires in large buildings, where at least 40 cubic meters of water may be required.

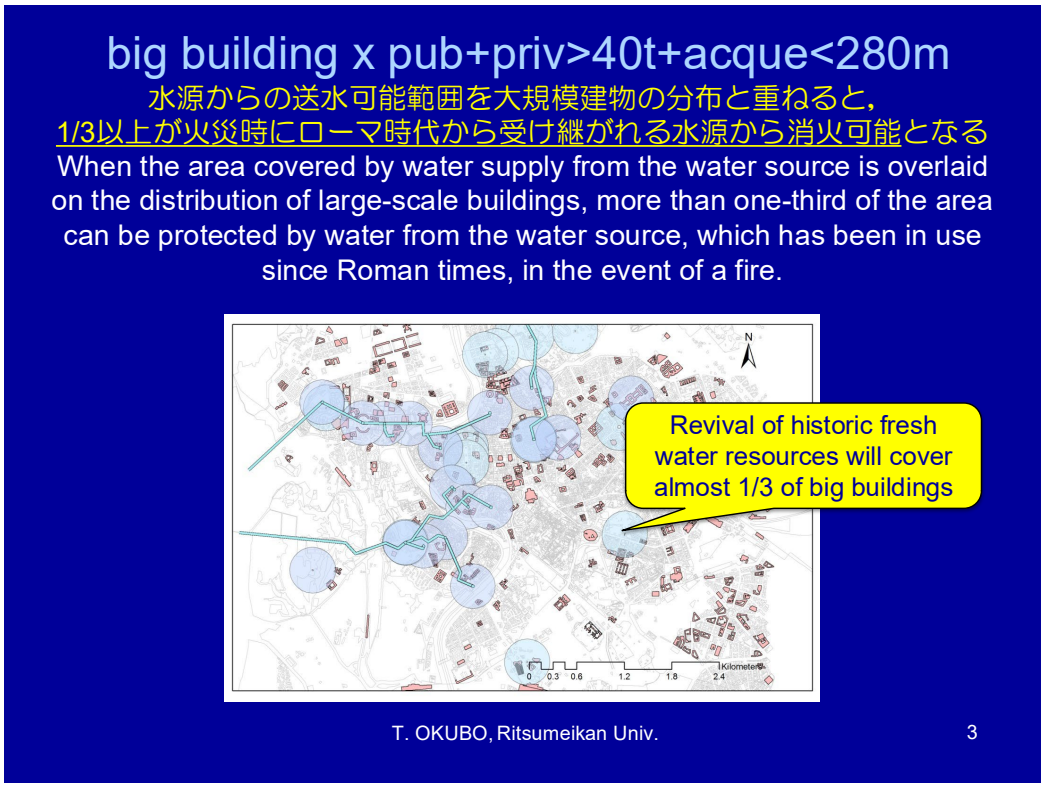

Fig 3. Coverage of historic freshwater resources in Rome

6. Role of Historic Aqueducts and Sewer Systems

Rome's historic aqueduct systems, including Acqua Vergine and Acqua Paola, were also examined. Some of these aqueducts remain active today and continue to distribute water to fountains across the city.

The research demonstrated that these systems could provide continuous water supply during emergencies. If adapted for firefighting use, they could significantly expand the geographic coverage of fire response operations. In some scenarios, historic aqueduct water could support dozens of firefighting vehicles simultaneously.

Historic sewer systems, including the famous Cloaca Maxima, were also identified as potential water sources. Although technical challenges exist—such as pumping water from underground—these systems could provide additional backup water if properly equipped with pumping facilities.

7. Use of River Water

The Tiber River was identified as a major emergency water source for large-scale fires. However, access points to the river are limited. Historical evidence suggests that river access structures existed in earlier periods, particularly near bridge foundations.

Dr. Okubo proposed restoring these historic access points to enable relay-based firefighting operations. Such systems have been successfully used in past disasters, including the 1995 Kobe Earthquake in Japan, where seawater was transported over long distances to control fires.

8. Evaluation of Open Spaces for Evacuation

The study also evaluated the potential of historic piazzas and parks as temporary evacuation sites. Open spaces larger than 1,000 square meters were identified as suitable for sheltering displaced residents.

GIS mapping showed that many large piazzas and parks in Rome could serve as effective evacuation locations, particularly when combined with nearby water sources. Some major sites were found capable of accommodating thousands of evacuees.

For long-term evacuation scenarios, calculations were made based on minimum space requirements and daily water consumption standards. These estimates confirmed that several historic piazzas could sustain evacuation populations for multiple days.

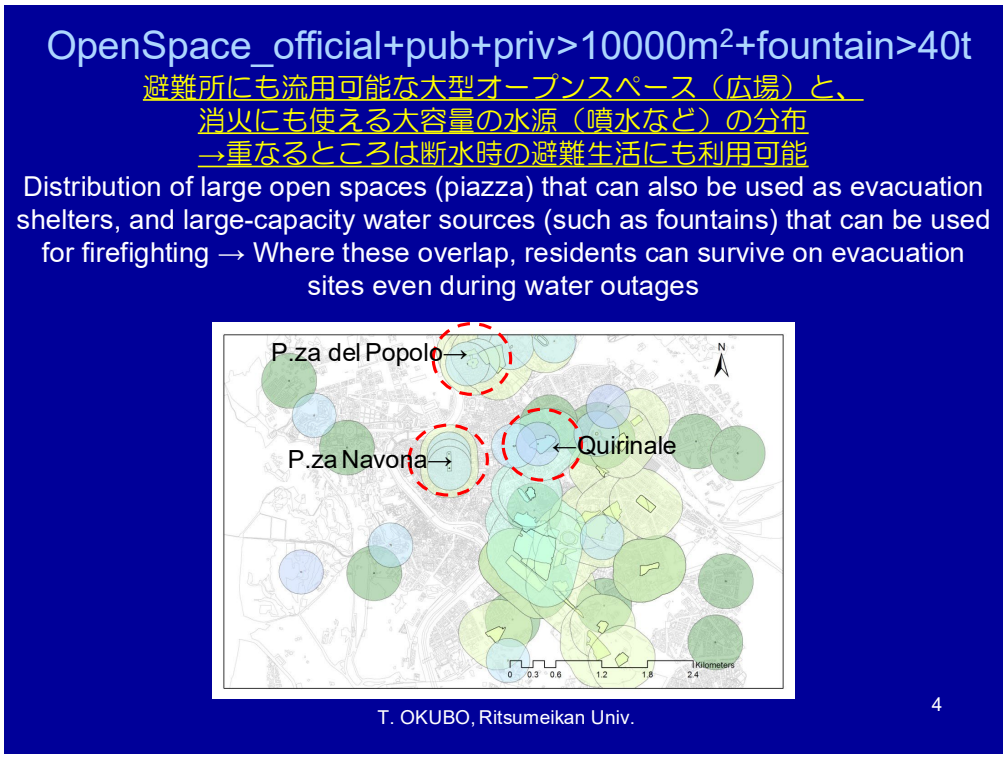

Fig 4. Distribution of large open spaces (piazza) in Rome

9. Key Findings

Dr. Okubo's research produced several significant findings.
First, most historic water resources in Rome remain functional and contain sufficient water for small-scale firefighting by residents.

Second, major fountains, aqueducts, and river systems have the capacity to support professional firefighting operations, particularly when integrated into emergency response plans.

Third, historic piazzas and parks provide valuable evacuation spaces capable of accommodating large numbers of people immediately after earthquakes.

Fourth, integrating historic resources into disaster planning not only improves emergency response capacity but also strengthens the preservation and revitalization of cultural heritage.

10. Conclusion and Implications

The presentation concluded that historic water resources and open spaces should be recognized as essential components of disaster risk management in historic cities. Although modern infrastructure remains vital, reliance solely on contemporary systems leaves cities vulnerable during large-scale disasters.

Reviving and maintaining historic infrastructure—such as fountains, aqueducts, and open spaces—offers a practical and culturally meaningful solution. These resources enhance urban resilience while preserving the historical identity of cities.

Dr. Okubo emphasized that this approach has broad international relevance. Cities such as Kyoto, Cairo, and others with historic urban landscapes could benefit from similar assessments and planning strategies.

Ultimately, the study highlights the importance of integrating historic urban elements into modern disaster preparedness frameworks. By doing so, cities can protect both human life and cultural heritage while ensuring more resilient responses to future disasters.

Summary and conclusion

Yasuyoshi Okada, PhD

As a summary of the webinar, Dr. Okada noted that this webinar was a highly timely initiative, conducted against the backdrop of this year's theme for the International Day for Monuments and Sites (IDMS), "Emergency Response for Living Heritage in Contexts of Conflicts and Disasters."

Dr. Okada observed that each of today's presentations addressed different regions and fields of expertise, yet all were grounded in the shared understanding that historic cities are living heritage. In other words, historic cities are not merely collections of cultural properties, but dynamic spaces where daily life, urban functions, and socio-economic activities continuously take place. This reaffirmed the need for comprehensive management approaches that go beyond conventional site-by-site conservation methods.

The first presentation highlighted the challenges of rapid urban development and cultural heritage protection in Historic Cairo, emphasizing the importance of integrated management using GIS. In particular, the role of GIS as an information infrastructure supporting the spatial understanding of risks and vulnerabilities, as well as enabling rapid response during emergencies, was clearly demonstrated as an indispensable component of future historic city management.

The second presentation underscored the importance of utilizing historical records and involving local communities, emphasizing that cultural heritage protection is not merely a technical matter but also a social and cultural endeavor. The recognition that understanding long-term urban transformation requires accurate interpretation of historical records and their integration with modern technologies provided important insights for future research and practice.

The third presentation focused on the "Virtual Kyoto" project, presenting concrete examples of the accumulation and application of geospatial information. The reconstruction of urban landscapes using four-dimensional GIS and the mapping of the distribution and transformation of traditional Kyoto townhouses (Kyo-machiya) were highlighted as emerging methods that scientifically support cultural heritage conservation. Furthermore, information sharing through digital technologies was shown to serve as an important foundation for promoting collaboration among government authorities, researchers, and citizens.

The fourth presentation examined the potential utilization of historic water resources and open spaces in Rome, emphasizing the importance of supplementary resources during disasters. In particular, lessons learned from the Nepal Gorkha earthquake highlighted the necessity of preparedness measures that assume the failure of modern infrastructure. This provided important insights for the development of practical disaster preparedness planning in historic cities.
Dr. Okada noted that what became evident through these four presentations was that disaster prevention and mitigation in historic cities cannot rely on a single technology or institutional framework; rather, a comprehensive approach integrating multiple elements is required. In other words, sustainable cultural heritage protection can only be realized through the combined use of historical documentation, the introduction of digital technologies such as GIS, community participation, and collaboration among administrative bodies and specialists.

Furthermore, Dr. Okada emphasized that this webinar demonstrated the importance of knowledge sharing from an international perspective by comparing historic cities with different cultural backgrounds—Kyoto and Cairo. While the specific challenges faced by historic cities vary by region, many underlying structural issues are shared. Therefore, international cooperation and the exchange of experience will become increasingly important in the field of cultural heritage protection.

In his closing remarks, Dr. Okada referred to the message issued by ICOMOS International for this year's International Day for Monuments and Sites, noting that the importance of emergency response and preparedness for safeguarding living heritage in times of crisis has been strongly emphasized. He further pointed out that strengthening resilience through adequate preparedness and coordinated responses among relevant stakeholders is becoming increasingly important in the conservation of historic cities. He concluded by expressing his expectation that the knowledge gained through this webinar will contribute to future international cooperation and to the sustainable conservation of historic cities.

Acknowledgements

This webinar, “Disaster Prevention and Mitigation Using GIS: Living Historic Cities—Kyoto and Cairo,” was jointly organized by the Research Center for Disaster Mitigation of Urban Cultural Heritage, Ritsumeikan University, and the ICOMOS Japan National Committee. In the preparation of this report, we would like to express our sincere gratitude to all those concerned for their generous support and cooperation. Through the continued efforts of both organizations and their contributions to the international protection of cultural heritage, this webinar was successfully realized as a meaningful forum for academic exchange in line with the spirit of the International Day for Monuments and Sites (IDMS).

We would also like to extend our heartfelt appreciation to all presenters who shared their valuable insights and research findings during this webinar. The diverse case studies and specialized knowledge regarding disaster prevention, disaster risk reduction, and cultural heritage management in historic cities enriched the content of this webinar and provided participants with an extremely valuable opportunity for knowledge sharing.

Furthermore, we express our deep gratitude to Dr. Akatsuki Takahashi, Visiting Research Associate at Ritsumeikan University, who served as moderator and contributed significantly to the smooth operation of the webinar. The successful management of this international academic exchange in an online format was largely due to his effective facilitation and coordination among all parties involved.

In addition, we sincerely thank the staff members who were responsible for technical support and operational coordination in the preparation and implementation of this webinar. Professional and continuous support was essential for facilitating international information sharing in an online environment, and their contributions were of great importance.

It is our hope that the knowledge gained and discussions generated through this webinar will contribute to future efforts in cultural heritage conservation and disaster risk reduction in historic cities, and ultimately support the development of safer and more sustainable urban environments.

Annex: Concept Note

Disaster Risk Reduction with GIS: Living Heritage Cities, Kyoto & Cairo

Date: 16:00-17:30 on 21 April (Tuesday) 2026

Background

Every April 18th is observed as the **International Day for Monuments and Sites**, also commonly known as **World Heritage Day**. Established in 1982 by **ICOMOS** (International Council on Monuments and Sites)—an international NGO dedicated to cultural heritage conservation—this day celebrates the diversity of heritage while reaffirming the importance of preserving them for future generations. The theme for 2026 is "**Emergency Response for Living Heritage in contexts of Conflicts and Disasters**." Events such as lectures and special events are held globally, providing an international platform to raise awareness about the urgent need to protect cultural heritage in the face of rising threats from natural disasters, climate change, urbanization, and conflict.

Purpose of the Webinar

Historic cities are essentially living heritage. They are particularly vulnerable due to their dense urban fabric, historical structures, and complex socio-cultural contexts. In this regard**, Geographic Information Systems (GIS)** offer powerful tools for disaster risk identification, vulnerability assessment, monitoring, and informed decision-making for emergency response. This webinar contributes to the celebration of IDMS by focusing on Disaster Risk Reduction (DRR) with GIS, using two internationally significant **Living Heritage Cities, Kyoto and Cairo.** Despite differing cultural, social, and governance contexts, both cities face multiple disaster risks, including earthquakes, development pressures, and climate-related hazards. The webinar highlights how GIS-based approaches can support emergency response, proactive heritage management, and resilience planning in historic urban environments.

Objectives

- Demonstrate practical applications of GIS for DRR in living heritage cities
- Share comparative experiences and lessons learned from Cairo and Kyoto
- Encourage interdisciplinary and international knowledge exchange among heritage professionals

Target Audience

- ICOMOS members and National Committees, Heritage professionals and site managers, Urban planners, engineers, and GIS specialists, Researchers, students, and related organizations (e.g., Blue Shield)

Speakers

- Dr. Yasser Elshayeb (Egypt): Professor, Cairo University
- Dr Naoko Fukami (Japan): Former Director, Japan Society for Promotion of Science Cairo Research Station
- Dr. Yano Keiji (Japan): Professor, Ritsumeikan University, President of the Japanese Society of Human Geography
- Dr. Takeyuki Okubo (Japan): Ritsumeikan University, ICOMOS
- Dr. Yasuyuki Okada (Japan): President, ICOMOS Japan

Provisional Program:

16:00		Introduction by MC (Akatsuki Takahashi, Ritsumeikan University)
16:05		**Dr Yasser Elshayeb,** Cairo University Prof. Yasser Elshayeb is Professor of Rock Engineering Applications in Heritage and Archaeology at Cairo University and Deputy Director of the Engineering Center for Archaeology and Environment. He earned his PhD from the Nancy School of Mines, France, specialising in geotechnical risk assessment of ancient monuments. His career bridges engineering, digital documentation, and cultural heritage preservation, including leadership roles as Director of the Egyptian Center for Documentation of Cultural and Natural Heritage and Deputy Director of the ScanPyramids Project. He is an active member of the International Consortium on Landslides, contributing to disaster risk reduction for heritage sites.
16:25		**Dr Naoko Fukami**, Former Director of Japan Society for Promotion of Science Cairo Research Station Dr Naoko Fukami is a distinguished scholar and international academic leader specialising in cross-cultural research collaboration and institutional partnerships. She previously served as Director of the Japan Society for the Promotion of Science (JSPS) Cairo Research Station, where she played a pivotal role in strengthening academic exchange between Japan, Egypt, and the broader Middle East region. During her tenure, she facilitated joint research initiatives, supported emerging scholars, and advanced interdisciplinary cooperation across institutions. Dr Fukami is widely recognised for her commitment to fostering global scientific networks and promoting sustainable academic collaboration grounded in mutual understanding and shared knowledge development.
16:45		**Dr Keiji Yano**, Ritsumeikan University, President of the Japanese Society of Human Geography Dr Keiji Yano is a Professor at Ritsumeikan University and a leading member of the Institute of Disaster Mitigation for Urban Cultural Heritage (DMUCH). His research focuses on urban geography, geographic information systems (GIS), digital humanities, and disaster risk reduction for historic cities. Dr Yano has pioneered the application of spatial analysis and geospatial technologies to cultural heritage management, supporting evidence-based planning and resilience strategies. Through interdisciplinary collaboration, he has contributed to innovative methodologies for safeguarding urban cultural landscapes against natural hazards. His work bridges technology, heritage studies, and urban policy, advancing sustainable approaches to the protection of culturally significant environments.
17:05		**Dr Takeyuki Okubo**, Ritsumeikan University, ICOMOS Dr Takeyuki Okubo is an academic at Ritsumeikan University and a Board Member of ICOMOS, contributing to global heritage governance and heritage conservation policy. He has played a pivotal role in advancing the UNESCO Chair Programme on Cultural Heritage and Risk Management at Ritsumeikan University, fostering international research collaboration and the international training course on Disaster Risk Management of Cultural Heritage. His expertise centres on historic urban landscapes, resilience planning, and sustainable conservation strategies. Through research, advisory work, and global engagement, he promotes the integration of scientific methodologies, community participation, and international standards to safeguard cultural heritage from natural and human-induced hazards.
17:25		Wrap up and closing by Dr Yasuyuki Okada, President of ICOMOS Japan