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Research on Spatial Information Transmission and Decision Support for Emergency Broadcast Hosting Empowered by GIS Technology

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ABSTRACT

Focusing on emergency broadcasting scenarios during sudden incidents, this study adopts a core perspective of spatial analysis and real-time visualization technologies within Geographic Information Science (GIS). By examining case studies of emergency broadcasts for disasters such as earthquakes and floods, it systematically analyzes the application forms of GIS technology in presenting emergency information, as well as the strategies hosts employ to convey spatial information and its value in decision support. Based on crisis communication theory and spatial information cognition theory, this study examines the relationship between anchors'"spatial information interpretation capabilities"and"risk warning accuracy" versus public risk avoidance decision-making efficiency and societal panic mitigation effectiveness through case comparisons and simulation experiments. It reveals issues such as the fragmentation and lag risk warning accuracy"of anchors with the efficiency of public risk avoidance decisions and the effectiveness of alleviating social panic. This study reveals issues such as the fragmentation and lag in spatial information transmission during current emergency broadcasts, proposing a collaborative emergency communication pathway of "technical support - anchor delivery - public response." This framework provides theoretical support for enhancing the professionalism and practicality of emergency broadcasting.

KEYWORDS

GIS technology; Emergency broadcast anchoring; Spatial information delivery; Decision support; Crisis communication

1 Introduction

Against the backdrop of deep integration between a globalized risk society and media-driven governance, emergencies exhibit the characteristics of “high frequency, broad impact, and multiple ramifications.” Emergency broadcasts serve as the critical link between rescue systems and the public. The accuracy, timeliness, and spatial relevance of the information they convey directly determine the public's ability to evacuate safely and maintain social order [1].

During the Henan floods, “life-saving documents” enabled efficient risk communication through lightweight spatial information integration, demonstrating the public's urgent need for spatialized emergency information. During the Jishishan earthquake in Gansu and the Shigatse earthquake in Tibet, mainstream media utilized GIS technology to visualize spatial information such as epicenter distributions and rescue routes. Significantly enhance the effectiveness of public opinion guidance. This demonstrates that GIS technology has evolved from a mere technical tool into the “spatial information hub” for emergency broadcasting. As the “translator” of GIS information, the host's quality of filtering, interpreting, and conveying spatial data, It directly impacts the public's spatial cognition and the efficiency of risk avoidance decisions, and even affects the credibility of the national emergency management system.

2 Core Concepts and Theoretical Foundations

2.1 Core Concept Definition

In emergency broadcasts, GIS spatial information is redefined in light of the “information stratification” theory in risk communication as "the entire process of an emergency incident, “A layered data collection and visualization output generated using GIS technology to meet the spatial information needs of different entities, [3]” Its core characteristics include spatial relevance, real-time dynamics, and decision-oriented functionality, with the addition of “tiered adaptability”—categorizing information into four levels based on the needs of different stakeholders such as the public, rescue personnel, and decision-makers:

Basic Perception Layer: Such as earthquake epicenter coordinates and flood inundation maps, meeting the public's fundamental spatial awareness needs regarding “Where”;

Safety Guidance Layer: Includes distribution of shelters and evacuation route maps, addressing the public's need for “How to go” safety actions;

Rescue Decision Layer: Features such as heatmaps of trapped individuals and resource deployment distribution maps support rescue teams' resource allocation needs for determining “Where to rescue.”

Governance Evaluation Layer: Such as spatial assessments of disaster losses and post-disaster reconstruction planning maps, serving the government's long-term governance needs regarding “How to recover.”

The presentation of spatial information adopts a "mediation governance" perspective, defined as "the dynamic process whereby emergency broadcast presenters, supported by GIS technology and collaborating with specialized teams, perform 'technical decoding - content encoding - emotional adaptation' on layered GIS spatial information.[5]" Its core responsibilities extend beyond mere information transmission to include:

Technical translation: Converting specialized GIS terminology (such as "spatial overlay analysis" and "buffer analysis") into colloquial expressions that are easily understood by the general public;

Risk Communication: Integrating emotion-focused coping theory, we incorporate humanistic care when conveying spatial information to alleviate public panic.

Decision Guidance: By prioritizing spatial information, guide the public and rescue personnel to focus on critical decision points [7], such as prioritizing the spatial distribution of "lifeline corridors" within the first 72 hours after an earthquake.

2.2 Theoretical Support System

Risk communication theory draws upon the "information stratification model" to propose a "risk-demand" matching framework for GIS spatial information:During the crisis incubation period (such as the typhoon formation stage), the host leverages GIS to release risk warning spatial information (typhoon path prediction maps).Serve as a "risk monitor"; during crisis outbreaks (e.g., after an earthquake), focus on assessing current situation information (such as distribution maps of damaged facilities around the epicenter) and fulfill the role of "information producer";During the crisis escalation phase (e.g., flood spread stage), prioritize response guidance information (dynamic evacuation route maps) to fulfill the role of "communicator." During the recovery and reconstruction phase, disseminate recovery and reconstruction information (such as reconstruction plans for disaster-affected areas) to become a "governance enabler."

The theory of mediatized governance posits that emergency broadcast anchoring empowered by GIS technology is essentially "the concrete manifestation of mainstream media's participation in the governance of sudden public crises.[4]" Through the visualization of GIS spatial information, the host transforms abstract emergency decision-making into intuitive spatial narratives. For instance, during the broadcast of the "life-saving document" for the Henan floods, the host integrated GIS maps to mark distress points and rescue force deployments, achieving spatial alignment between "public needs and government response." This approach propels emergency governance from an "administrative-led" model toward a "multi-stakeholder collaborative" transformation.

Drawing on research into disaster reporting frameworks on short-video platforms, this study proposes a "three-tier narrative framework" for GIS spatial information:The high-level framework focuses on spatial information themes (such as "lifeline protection" and "optimized resource allocation"). Mid-level frameworks construct spatial narrative logic (e. g., linking rescue progress through a "time axis + spatial axis");Low-level frameworks optimize spatial symbol representation (e. g., using different colors to indicate risk levels, employing dynamic arrows to show evacuation directions), helping presenters construct clear and persuasive spatial narratives.

3 Application Forms of GIS Technology in Emergency Broadcasts and Current Status of Host Communication

3.1 Spatial Information Presentation: From "Single Visualization" to "Layered Interaction"

Multimodal visualizations adapt to different audiences. For the general public, "lightweight visualization" formats are employed, such as in the Gansu Jishishan earthquake broadcast.The host utilized a GIS-generated "dynamic heatmap" to visually represent the density of trapped individuals using red, yellow, and green colors.For colloquial interpretation: "The red zone is the current rescue priority, with two shelters within a 3-kilometer radius." For rescue personnel [5], provide "specialized visualization" —such as generating a "rescue resource supply-demand gap map" through GIS overlay analysis—to mark each rescue team's coverage area and material reserves, enabling the host to accurately convey decision-making information.

Real-time interactive features enhance engagement. Drawing from research on Henan's flood "life-saving documents," broadcasts now incorporate GIS interactive modules. For instance, anchors guide the public to scan QR codes for "personalized evacuation maps." By inputting their location, users instantly access real-time capacity and supply status of the nearest shelters. Set up a "Spatial Information Feedback" portal on the live broadcast interface, enabling the public to report hazards in their vicinity (such as road collapse sites)[6]. The host will integrate this feedback with GIS to update the map in real time, creating a closed-loop system of "broadcast - feedback - update."

3.2 Information Processing Leadership: From"Passive Transmission"to"Active Empowerment"

Spatial Information Screening: A Tiered Strategy Based on "Risk Priority" Guided by the logic of information stratification, the host adheres to the"Three Priorities"principle during information screening:Prioritize the transmission of "life-related"spatial information (such as the locations of hospitals and shelters);Prioritize updating dynamically changing spatial information (such as real-time adjustments to flood inundation areas);Prioritize the provision of spatial information of public concern (such as progress in search and rescue operations for trapped individuals) [7]. For instance, in the Shigatse, Tibet earthquake report, the anchor first announced "damage to three hospitals within 5 kilometers of the epicenter," then updated "the range of townships potentially affected by aftershocks," and finally addressed "rescue route planning for remote villages,"ensuring targeted delivery of spatial information.

Interpreting Spatial Information: Translation Techniques for "Technical Terminology + Real-Life Scenarios" Given the specialized nature of GIS technology, the host employs a "scenario-based translation" approach: Interpret "buffer zone analysis" as "the area within a 5-kilometer radius centered on the epicenter that requires priority investigation." Translate "spatial overlay analysis" as "overlaying the distribution map of damaged buildings with the distribution map of rescue forces to identify areas with the greatest rescue gaps." At the same time, by integrating framework theory, we incorporate emotional resonance into the interpretation.When reporting that "traffic is flowing smoothly around a certain elementary school and rescue teams have arrived," simultaneously display the real-time locations of the school and rescue vehicles on a GIS map to boost public confidence.

Spatial Information Prioritization: Three-Dimensional Integration of "Time - Space - Needs" Within the time dimension, adjust information priority according to phases such as the "Golden 72 Hours" and the "Recovery and Reconstruction Period";In spatial dimensions, prioritize reporting according to the hierarchy: core area, radiation area, and peripheral area [2]. On the demand dimension, prioritize information based on the distinct needs of the public, rescue personnel, and decision-makers.For example, in flood reports, the anchor first conveys the "current distribution of shelters in the flooded core urban areas" (spatial core + public demand). Updating the "townships expected to experience flood expansion over the next 6 hours" (time-sensitive + decision-making requirement). Last updated: "Rescue vessel dispatch routes" (spatial correlation + rescue demand).

3.3 Decision Support Function: From"Information Support"to"Action Empowerment"

Public Risk Avoidance Decision-Making: Research on Combining "Spatial Guidance + Behavioral Prompts" for Responding to Accident and Disaster-Related Public SentimentThe host marked "Safe Zone - Risk Zone - No Entry Zone" on the GIS map [2]. Follow the specific action prompts, such as: "Residents living on XX Street, please proceed in the direction indicated by the blue arrow on the GIS map." Evacuate to Shelter XX within 30 minutes. Supply points available for stops along the route are marked with yellow dots. Simultaneously, to address the "digital divide," broadcasts accommodate non-smart device users such as the elderly by conveying core spatial information through a combination of "voice narration + text captions + simplified maps."

Rescue Team Decision-Making: "Spatial Matching + Resource Optimization" The coordinator leverages the GIS's "multi-source data integration" capabilities, Provide rescue teams with "spatial decision-making recommendations," For instance, in earthquake reporting, a "rescue resource supply-demand gap map" can be generated through GIS overlay analysis. Mark the coverage area and supply reserves for each rescue team to help the host accurately convey decision-making information. Team A is traveling along Highway XX toward the epicenter and can prioritize rescue operations at three trapped locations [4]. One bridge along the route is damaged and requires a detour. In the material allocation report, display the spatial distance and transportation time between "material storage points and demand points." Recommend "prioritizing the allocation of tents from XX warehouse to the western mountainous region, with a travel time of approximately 2 hours, capable of covering 5 villages."

Government Governance Decision-Making: "Spatial Assessment + Long-Term Planning" During the Recovery and Reconstruction Period,The host presented the GIS-generated "spatial assessment map of disaster losses," Interpretation of "The most severely affected XX region requires priority reconstruction of public facilities such as schools and hospitals"; Based on the "reconstruction plan," it is announced that "XX District will construct earthquake-resistant housing units, with three community service centers built in the surrounding area." Assist governments in transforming governance decisions into tangible spatial narratives that resonate with the public, thereby enhancing the credibility of governance. Simultaneously, leveraging the coverage advantages of the emergency broadcast platform, GIS spatial information can be transmitted through broadcast channels to reach audiences in remote areas, achieving a multi-dimensional information delivery system that combines visual and auditory elements.

4 Spatial Information Delivery Strategies for Emergency Broadcast Hosting Empowered by GIS Technology

4.1 Existing Challenges: Synergy Gaps in Technology, Leadership, and Governance

Insufficient technical adaptability The "specialized nature" of GIS technology conflicts with the "popular accessibility" required for emergency broadcasting. Complex spatial analysis results are difficult to quickly translate into colloquial expressions; Some GIS systems experience response delays, failing to update data in real time during crisis outbreaks, resulting in lagging spatial information broadcast by anchors. Additionally, the integration between the emergency broadcast platform and GIS technology is insufficient, making it difficult to achieve simultaneous delivery of "map information + voice announcements," resulting in limited coverage.

Hosting Capability Gap Hosts lack foundational GIS technical knowledge.Insufficient understanding of concepts such as "spatial overlay analysis" and "topological relationships" hinders the accurate interpretation of specialized data. Overemphasizing technological presentation in spatial narratives while neglecting emotional communication [3], Displaying only GIS maps without incorporating stories of affected residents diminishes the impact of the information.In the face of sudden public opinion incidents (such as public skepticism regarding spatial information), the lack of rapid response and clarification capabilities can easily lead to confusion in public perception.

Weak governance coordination has resulted in inadequate integration of public feedback data into GIS systems. For instance, public distress signals from "life-saving documents" cannot be seamlessly fed into GIS systems in real time, causing discrepancies between the spatial information broadcast by hosts and the actual needs of the public.GIS data from mainstream media, government departments, and rescue teams remains disconnected, creating "information silos." If the government's foundational data on disaster-affected areas cannot be shared with rescue teams' real-time resource data, it will impact the collaborative efficiency of emergency decision-making [7]. The emergency broadcast platform and short video platform lack integrated GIS information, making it difficult to achieve the dual objectives of "broad coverage and precise targeting."

4.2 Optimization Path: Establishing a Collaborative System Integrating Technology, Leadership, and Governance

Technical Aspect: Develop a specialized GIS module for emergency broadcasting by creating a "lightweight + highly adaptable" GIS tool, simplifying operational workflows. Pre-set templates such as "Disaster Type(Earthquake/Flood/Typhoon)" and "Broadcast Scenario (Early Warning/Rescue/Reconstruction)" Hosts can generate visualizations by simply inputting key data; Establish a mechanism for "real-time access to multi-source data";Integrate government databases, public feedback information (such as "life-saving documents"), and sensor data (such as water level monitoring data), Ensure the timeliness and comprehensiveness of spatial information. Simultaneously, promote the integration of GIS technology with emergency broadcasting platforms.Develop a "Voice-Map Synchronization" feature that automatically pushes corresponding GIS maps to listeners' mobile devices via keyword triggers during broadcast announcements, achieving complementary "auditory + visual"information delivery.

Hosting Level: Strengthen training in "technical literacy + narrative skills" by integrating GIS fundamentals into emergency broadcasting host training programs. This includes spatial data interpretation and visualization tool operation. Invite GIS experts to collaborate with hosts in simulated broadcasts to enhance technical translation capabilities. Drawing from disaster reporting's "emotional storytelling" approach, guide anchors to integrate humanistic care into spatial narratives. For instance, when reporting "shelter distribution," simultaneously convey details like "a certain shelter has accommodated 200 elderly residents with ample supplies" to enhance the warmth and persuasiveness of information [5]; Add a "Public Sentiment Response" training module to simulate scenarios where the public questions spatial information (e.g., "Why is a closed shelter still listed on the map?"). Train anchors to swiftly verify and clarify such issues to prevent the spread of misinformation.

Governance Level: Promote the development of a "multi-stakeholder collaborative" spatial information network by establishing a GIS data-sharing platform connecting mainstream media, government agencies, rescue teams, and emergency broadcast platforms. For instance, during emergencies, the government can push real-time foundational data on affected areas, rescue teams can update resource allocation information, mainstream media can aggregate public needs, and emergency broadcast platforms can relay feedback from audiences within coverage zones [3]. Presenters can access "one-stop"spatial information through this platform. Introduce "Public Participation GIS" by incorporating"spatial information correction"entry points during broadcasts. Encourage public feedback on map inaccuracies (e.g., "A shelter has relocated, but the map annotation is incorrect"). Presenters can verify and update information in real time, transforming emergency governance from "one-way transmission" to "multi-stakeholder interaction." Establish GIS information channels between short-video platforms and emergency broadcast systems. For instance, synchronize GIS maps from disaster coverage on platforms like Douyin to emergency broadcast databases. Broadcast coverage reaches remote areas, achieving synergistic"online precision dissemination + offline wide-area coverage."

5 Conclusions and Outlook

This study integrates multidisciplinary perspectives including risk communication, mediatized governance, and framing theory,Systematically analyze the application logic and value of GIS technology in emergency broadcasting and hosting. Proposing the practical pathways of "layered spatial information transmission," "3D-based decision-making support," and "collaborative governance empowerment" addresses the shortcomings in existing research where "technological application remains disconnected from decision-making practice."

From a practical perspective, the research findings can directly guide professional emergency broadcasting practices. For instance, they can provide GIS technology adaptation solutions for television stations, new media platforms, and emergency broadcasting agencies, while offering hosts a three-dimensional training curriculum integrating "technology + narrative + public sentiment response." From a governance perspective, it facilitates the transition of emergency information dissemination from "administrative dominance" to "multi-stakeholder collaboration," enhancing the effectiveness of public emergency management. Particularly in remote areas, the integration of GIS technology with emergency broadcasting addresses the "last mile of information delivery" challenge.

Future research may further explore the deep integration of "AI + GIS," such as using AI to automatically generate spatial information broadcast scripts to assist anchors in rapid response; Simultaneously, application strategies for GIS technology can be refined based on the distinct spatial characteristics of different disaster types (e.g., earthquakes, floods, typhoons). By leveraging the dissemination strengths of emergency broadcasts and short-video platforms, this approach will advance the precision and intelligence of emergency broadcasting anchoring. This will provide support for building an emergency information dissemination system that is "all-hazard, end-to-end, and all-stakeholder."

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