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Analysis of the Multi-Dimensional Characteristics of City Weather Forecast Page Views and the Spatiotemporal Characteristics of Meteorological Disaster Warnings in China

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Abstract: In order to provide insights into how various page views are influenced by public engagement with weather information and to shed light on the patterns of warning issuance across different seasons and regions, this study analyzes the multi-dimensional characteristics of city weather forecast page views and the spatiotemporal characteristics of early warning information in China, from 1 March 2020 to 31 August 2023. This is achieved by utilizing the daily page views of city weather forecasts and meteorological warning data, comparing the public's attention to weather during holidays versus regular days, assessing the public's attention to weather under different meteorological warning levels, and performing statistical analysis of the spatiotemporal scale of meteorological disasters. Our analysis shows that compared to weekends and holidays, the public pays more attention to the weather on weekdays, and the difference between weekdays and national statutory holidays is more significant. Due to the widespread impact of heat waves, typhoons, severe convective weather, and geological disasters caused by heavy rainfall, public awareness and participation in flood season weather forecasting have significantly increased. Under red alerts, flash floods, typhoons, and geological risks are the primary concerns. Orange alerts predominantly feature flash floods, rainstorms, typhoons, snowstorms, and cold waves, while sandstorms attract the most attention during yellow alerts. Droughts, however, receive relatively less attention regardless of the warning level. Seasonal patterns in the issuance of meteorological warnings reveal a peak in summer, particularly with typhoons and rainstorms being the main concerns in July, followed by high temperatures and additional typhoon warnings in August. Heavy sea surface wind warnings exhibit a strong seasonal trend, with the majority issued during the winter months. Regionally, southern China experiences the highest frequency of severe convection weather warnings, with provinces such as Jiangxi, Guangxi, and Hunan being the most affected.

Keywords: city weather forecast; page views; meteorological disaster risk warning; public attention; spatial–temporal characteristics

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1. Introduction

Understanding the public's demand for and feedback on meteorological services is crucial to improving service quality. How to establish an effective feedback mechanism to better meet the public's meteorological information needs in China and even globally, as well as how to improve public satisfaction with meteorological services, is an issue that needs to be continuously explored. Analyzing the public's level of attention to city weather forecasts should be an effective approach. City weather forecasting plays a pivotal role in daily life, influencing travel plans, traffic safety, and the smooth operation of various industries [1]. Besides routine weather updates, people's interest in the weather intensifies during significant events and large-scale weather disasters. When such events affect vast

regions, weather-related media reports become even more critical [2,3]. In today's digital landscape, the internet, renowned for its diversity, richness, speed, and globalization, has not only emerged as a mainstream communication medium but is also rapidly evolving as the foremost platform for disseminating meteorological information [4]. Online city weather updates offer numerous advantages: twenty-four seven access to meteorological services; a variety of content formats (text, images, videos, audio) for a more immersive understanding of weather conditions; and timely, widespread information dissemination.

The Chinese government has consistently prioritized the advancement of public meteorological services. It aims to harness the internet's potential to revitalize the meteorological service sector, innovate service models, enhance user engagement and participation, and foster cross-media integration in public meteorological services. Simultaneously, efforts are underway to establish a third-party meteorological service benefit evaluation system to assess the quality of public weather forecasts [5]. To this end, China has established several dedicated websites for meteorological information dissemination, notably the Wentian (www.tq121.com.cn, The website has now been closed now.) by the Central Meteorological Observatory in 2001, providing weather forecasts and daily meteorological indices for over 2000 counties and cities nationwide. Later, in July 2008, China Weather (www.weather.com.cn; accessed on 19 May 2024) was launched as the official website of the China Meteorological Administration, offering comprehensive meteorological services to the public [6]. These platforms serve as vital conduits for the public to access weather forecasts and meteorological warnings, enabling prompt dissemination of critical information. Furthermore, the public can actively subscribe to these warnings, receive regional risk notifications for collaborative response, and make informed risk assessments to mitigate the impact of weather-related disasters.

Effective early warning and preventive measures are essential in dealing with the impact of meteorological disasters, in addition to emergency response and post disaster reconstruction when disasters occur [7]. Given the immense significance of weather forecasting and meteorological warnings, it is imperative to analyze public demand and attention in this domain. Statistical analysis of meteorological website page views emerges as a pivotal tool for both meteorological research and network management. Feng and Dong [8] delved into the browsing patterns related to Jiaxing weather on TikTok, revealing that users engage with content related to early warning information, weather-related topics, and timely weather updates. Furthermore, they tend to express their approval by liking content that offers them critical warning and weather details. By exploring the various meteorological warnings issued across seasons and regions, we can discern which disasters garner the most attention and which ones are relatively overlooked. A nuanced analysis of warning levels, disaster types, and seasonal patterns can profoundly enhance our understanding of the public's perception and response to meteorological risks. This knowledge is invaluable for crafting more targeted and effective disaster communication strategies, ultimately bolstering the public's preparedness for and resilience to weather-related challenges. Examining city weather forecast page views offers valuable insights into society's level of attention toward meteorological risk warnings, which is crucial for implementing effective national disaster prevention and mitigation measures. However, despite the timely and accurate dissemination of meteorological risk warnings nationwide and the comprehensive weather forecast and warning modules available on relevant websites, research focusing on public attention and feedback characteristics remains limited. There is a pressing need for further exploration in this area to better inform and prepare society for the challenges posed by changing weather patterns. Against this backdrop, we seek to quantitatively assess the spatiotemporal characteristics of meteorological risk warnings, contribute to improving their dissemination efficiency, and ultimately enhance public satisfaction with meteorological services.

2. Study Domain and Data

2.1. Study Domain

Due to its monsoon climate and dense disaster-prone regions, China is among the most vulnerable countries in Asia to natural disasters [9,10]. Its complex geographical environment and monsoon climate have led to the uneven spatial distribution of meteorological disasters in China and regional differences in the impact of their impacts [11], such as typhoon disasters in southeastern China [12], heat waves in many parts of northern and southern China [13,14], flood disasters in the Yangtze River Basin and the Pearl River basin, sandstorms in north China [15], and meteorological droughts in southwestern China, the Inner Mongolia Autonomous Region, and Heilongjiang Province. In addition, China also has several meteorological disasters such as low-temperature freezing disasters for agriculture [16,17], geological disasters caused by rainstorm [18]. Given the diversity and severity of meteorological disasters in China, it is imperative to strengthen disaster prevention, mitigation, and response capabilities at both the national and regional levels.

2.2. Data

The observed daily page views of city weather forecasts from 1 March 2020 to 31 August 2023 were obtained from China Weather (www.weather.com.cn). The page views were desensitized. Meteorological warning information, including elements such as accurate hourly warning release time, meteorological risk type, warning level, release status, and warning content, was obtained from the National Early Warning Centre of China (www.pmsc.cn). The warning levels includes four levels: red, yellow, blue, and green. The release status of warning information is divided into three categories: initially released, updated, and released. During 1 March 2020 to 31 August 2023, the National Early Warning Centre of China issued a total of 23 types of meteorological warning information (Table 1). The locations of China and its 23 provinces, 5 autonomous regions, 4 municipalities directly under the central government, and 2 special administrative regions are shown in Figure 1.

Table 1. The types of meteorological risks released by China between 1 March 2020 and 31 August 2023.

No.	Meteorological Risk	No.	Meteorological Risk
1	Agricultural drought	13	Low temperature
2	Cold wave	14	Low-temperature freezing risk
3	Continuously cloudy or rainy weather	15	Meteorological drought
4	Dense fog	16	Rainstorm
5	Dry and hot wind risk for winter wheat	17	Sandstorm
6	Flash flood risk	18	Severe convective weather
7	Geological risk	19	Snowstorm
8	Heavy sea surface wind	20	Strong wind
9	High temperature	21	Typhoon
10	High-risk forest fire	22	Waterlogging for summer corn
11	High-temperature risk for early-season rice	23	Waterlogging risk
12	High-temperature risk for single-season rice		

Firstly, this study was based on the daily page views of city weather forecast data to calculate the average daily page views during the week, as well as the average page views during holidays and non-holidays, in order to analyze the temporal characteristics of city weather forecast page views. Secondly, the daily average page views were calculated to explore their distribution characteristics under different levels of meteorological risk warnings. Finally, the spatial distribution of meteorological warnings in China was studied by counting the number of occurrences of meteorological warnings in different provinces. In this study, the statistical calculations and plotting were all based on Python.

Figure 1. The locations of China and its 23 provinces, 5 autonomous regions, 4 municipalities directly under the central government, and 2 special administrative regions.

3. Results

Throughout the research period, the proportion of city weather forecast page views fluctuated between 24.1% and 93.3% of the total page views (Figure 2). Notably, city weather forecast page views constituted over 50% of the total page views 96% of the time, exceeding 60% 93.7% of the time, and surpassing 80% 39.7% of the time. Evidently, the degree of attention towards city weather forecasts served as a direct indicator of the public's level of interest in weather conditions. Between March 2020 and August 2023, city weather forecast page views fluctuated between 1.74 million units on 29 October 2022 (Saturday) and 13.64 million units on 3 August 2020 (Monday), as depicted in Figure 2. Notably, the lowest number of page views was predominantly observed in October 2022, whereas the peak number of views clustered around August 2020. Mirroring this trend, the overall page views for China weather were also subdued in October 2022. Despite missing data on the total page views for March and April 2020, it is plausible that higher engagement occurred in early August 2020. This surge in public interest in meteorological information can be partially attributed to the influence of Typhoon Hagupit, which made landfall in China during that period. Hagupit exhibited several notable characteristics: its formation occurred less than 1000 km from the coastline, and it progressed from identification to landfall in under three days. Its rapid intensification posed challenges for predicting and mitigating typhoon-related risks and impacts. Furthermore, Hagupit's level 7 wind circle had a radius of less than 300 km before landfall, indicating concentrated energy and a compact rainband structure. These aspects captured significant public attention. Beyond the primary flood season of August 2020, the city weather forecast consistently maintained elevated page views from July through August of 2021 to 2023. This suggests that the prevalence of heat waves, typhoons, severe convective weather, and geological hazards triggered by heavy rainfall during the flood season heighten public awareness and engagement with weather forecasts.

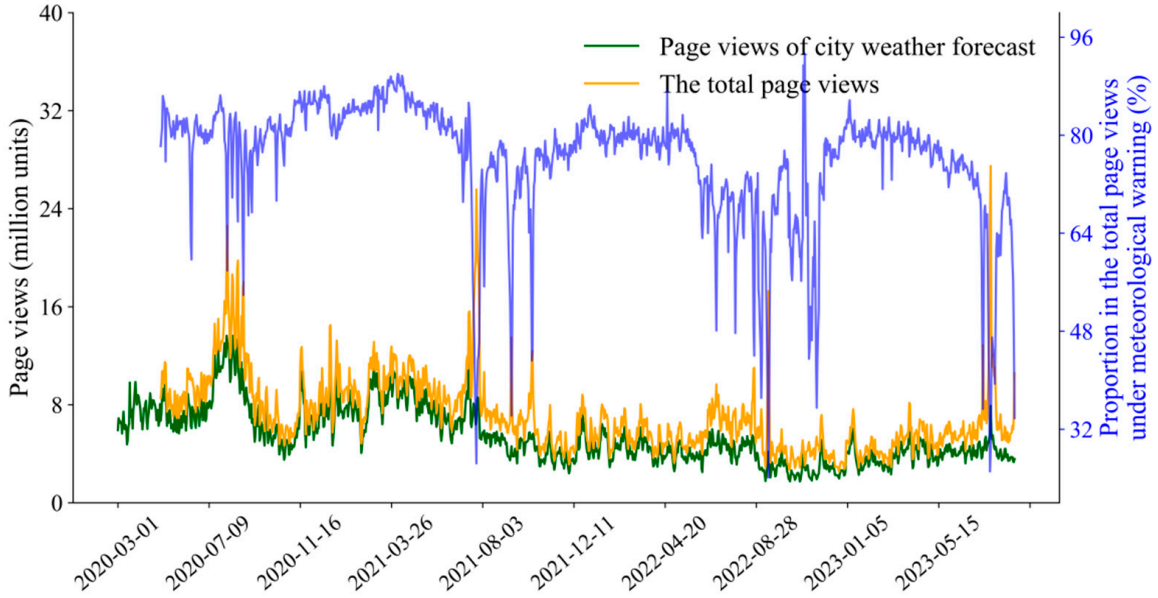

Figure 2. The page views of city weather forecasts and their proportion in the total page views of China Weather (www.weather.com.cn) from March 2020 to August 2023. The green line represents the city weather forecast page views, the orange line represents the total page views, and the blue line represents the proportion of the city weather forecast page views in the total page views.

In contrast to weekends and holidays, weekdays witnessed a heightened focus on weather among the public (Figure 3). Analyzing the weekly distribution of page views reveals a concentration of city weather forecast engagement on Mondays, Tuesdays, and Fridays (Figure 3a). This trend suggests that individuals are more attentive to weather updates at the start of the workweek, likely planning their weekend activities based on Friday's forecast. Notably, Sunday page views surpass those of Saturday, indicating a greater interest in the weather leading into the workweek following a period of rest. As the weekend approaches, particularly on Thursdays and Fridays, the presence of weather warnings prompts increased attention toward city weather forecasts. Conversely, from Sunday to Tuesday, meteorological warnings do not seem to captivate the same level of public interest. This pattern suggests that individuals are primarily concerned with how weather warnings might impact the safety or enjoyment of their leisure time. Additionally, since most weather warnings do not necessitate a change in work schedules, they tend to be less of a concern on Sundays and Mondays unless they pose a significant threat to life and property. The disparity in city weather forecast page views between weekdays and national statutory holidays is even more pronounced (Figure 3b). This reflects a greater emphasis on daily weather updates for planning rest and relaxation. Intriguingly, while holidays with meteorological warnings see a higher peak in page views, the median number of views without such warnings is actually higher than during holidays with warnings. This suggests that in the absence of significant weather events, the public maintains a steady interest in weather updates during time off.

Under various red meteorological disaster warnings in China, the public's primary concerns were flash floods, typhoons, and geological risks, as evident from Figure 4a. In each of these scenarios, the daily average page views exceeded 6.2 million units. Notably, early-season rice's high-temperature risk received the least attention under the red alerts. During orange alerts, flash floods, rainstorms, typhoons, snowstorms, and cold waves dominated the public's attention. In contrast, meteorological droughts and dense fogs garnered less interest. This may be because these they are usually mild and not as violent as rainstorms, snowstorms, or typhoons. In particular, drought disasters are caused by low precipitation for a long time. For yellow alerts, sandstorms were the most notable concern, while meteorological droughts remained relatively unheeded. Under blue alerts, there was

no significant variation in the public's focus across various meteorological disasters, with no particular disaster attracting excessive attention. It was unexpected to see that the public remained relatively unperturbed by the blue warnings for geological risks and strong winds. Comparing across alert levels, Figure 4b reveals that the city weather forecast page views were higher during orange and yellow meteorological alerts than under red alerts. Specifically, the public was more attentive to city weather forecasts when the warnings involved flash floods, sandstorms, rainstorms, typhoons, cold waves, or low-temperature freezing risks, as seen in Figure 4c. Conversely, meteorological drought warnings drew the least interest when it came to the city weather forecasts.

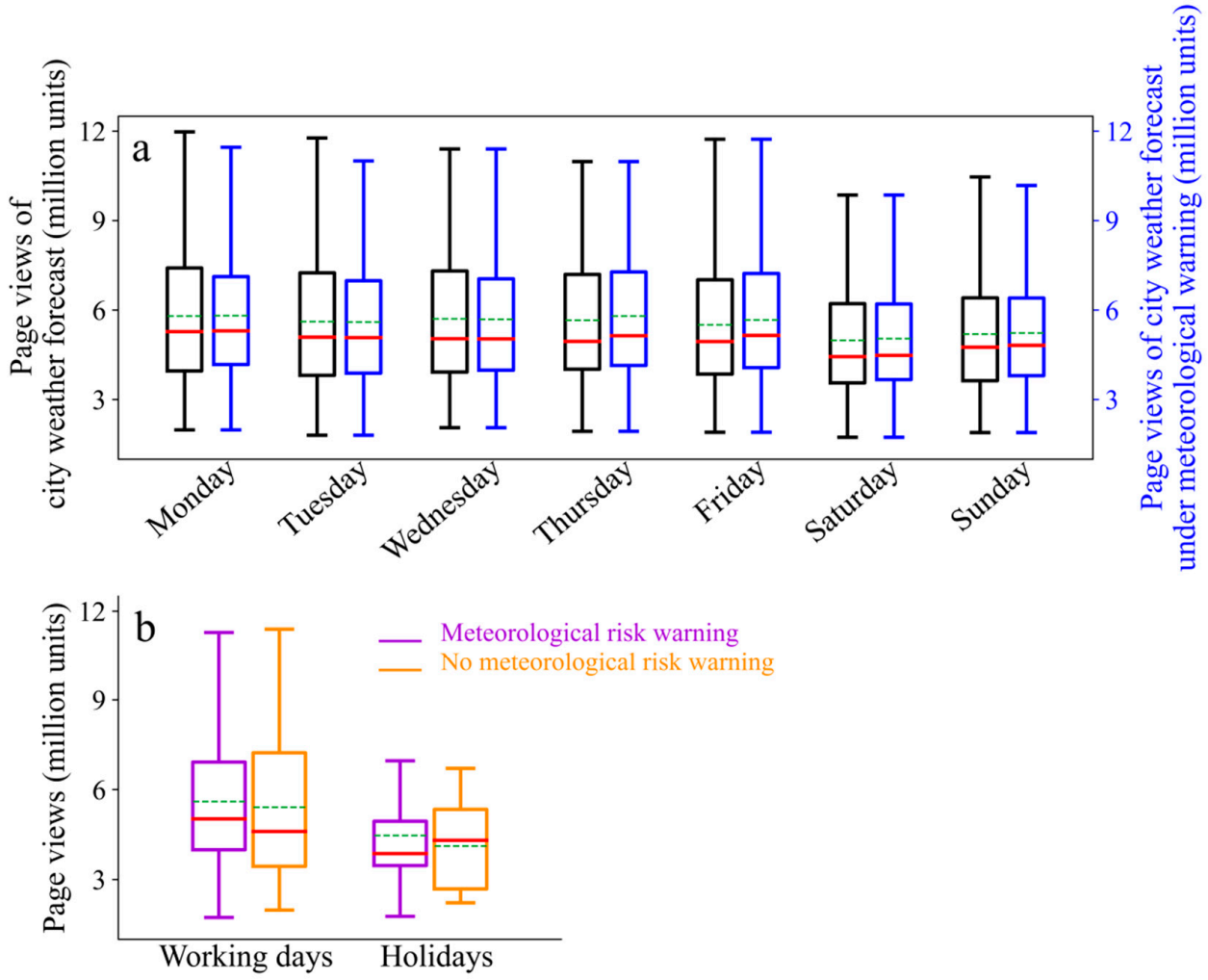

Figure 3. The city weather forecast page views with and without meteorological disaster risk warnings. (**a**) represents the weekly features and (**b**) shows holiday and non holiday features. The red solid line and green dotted line represent the median and mean of page views, respectively. The 25th and 75th percentiles are the bottom and top boundaries of a box; minimum and maximum are the bottom and top whiskers of a box.

The preceding analysis highlights the public's varying levels of attention towards different meteorological disasters under various alert levels. Evidently, certain disasters like flash floods, typhoons, and geological risks garner significant interest during red alerts, while others like meteorological droughts receive less attention. From the above analysis, it can be seen that traffic during the occurrence of meteorological warnings is higher than that during non-warnings (Figure 3). Therefore, it is necessary to conduct a more detailed analysis of the warning information itself. This article mainly analyzes the spatiotemporal characteristics of the warnings.

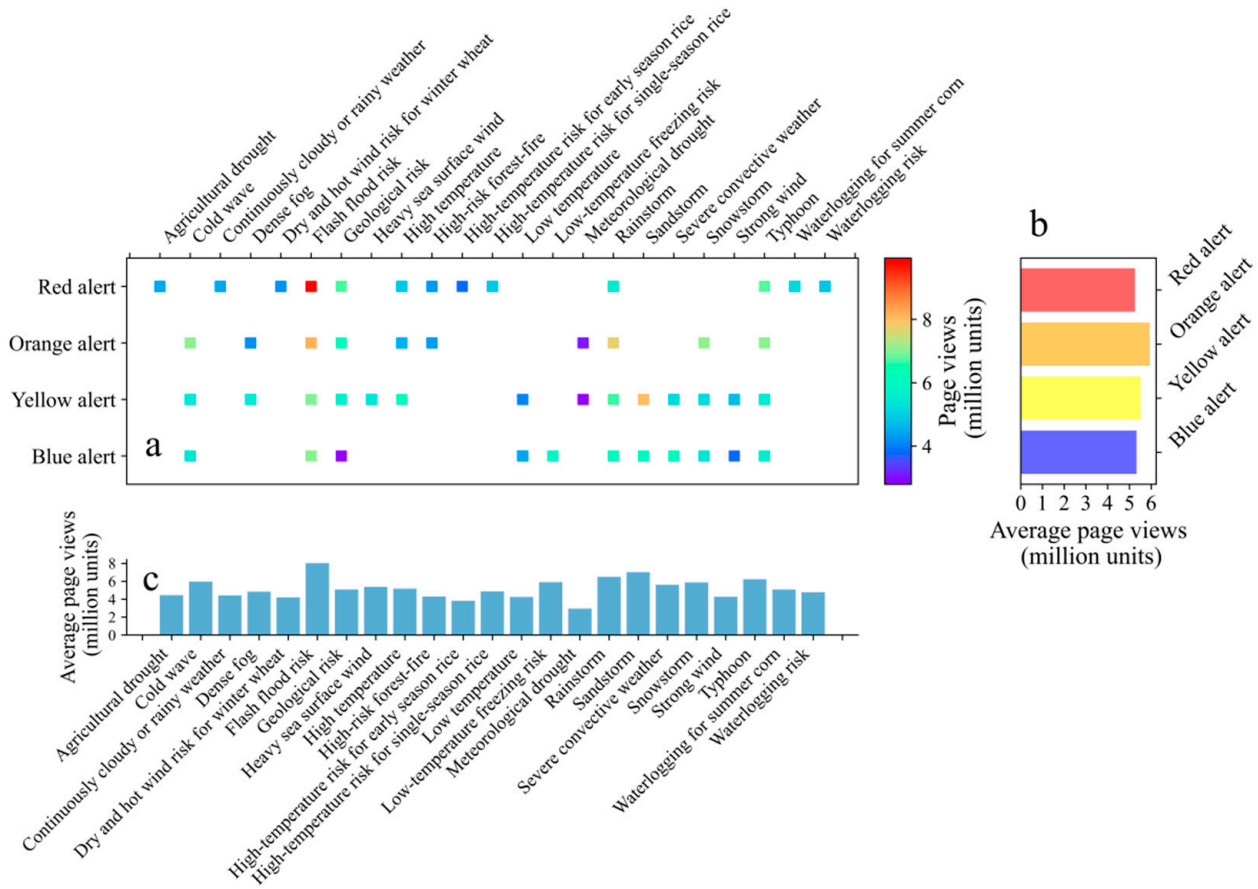

Figure 4. The city weather forecast page views under all meteorological disaster risk warnings that occurred from March 2020 to August 2023 at each warning level. (**a**) shows the daily average page views of city weather forecasts under all meteorological disaster risk warnings at each warning level. (**b**) shows the daily average city weather forecast page views under blue, yellow, orange, and red warning levels. (**c**) shows the daily average city weather forecast page views under the influence of various meteorological disaster risks.

Examining the temporal patterns of meteorological warnings, it becomes evident that summer sees a notably higher issuance of such warnings compared to other seasons (Figure 5). Red meteorological risk warnings, indicating more severe weather events, predominantly occur in July and August. Specifically, typhoons and rainstorms are the primary concerns in July, while August brings warnings on high temperatures and additional typhoons. Orange meteorological warnings, which signify potentially hazardous weather conditions, cover a wider range of events throughout the year. These include cold waves primarily affecting November to January, dense fog in March and December, elevated temperatures spanning June to August, geological risks from May to October, typhoons again from July to September, and meteorological droughts lasting from August to October. Despite fewer red and orange meteorological warnings in spring, blue warnings—indicating less severe but still significant weather events—are more frequent. These warnings often pertain to rainstorms, severe convection, and sandstorms, all of which exhibit distinct seasonal patterns. Additionally, warnings on heavy sea surface winds, another highly seasonal phenomenon, are predominantly issued during winter.

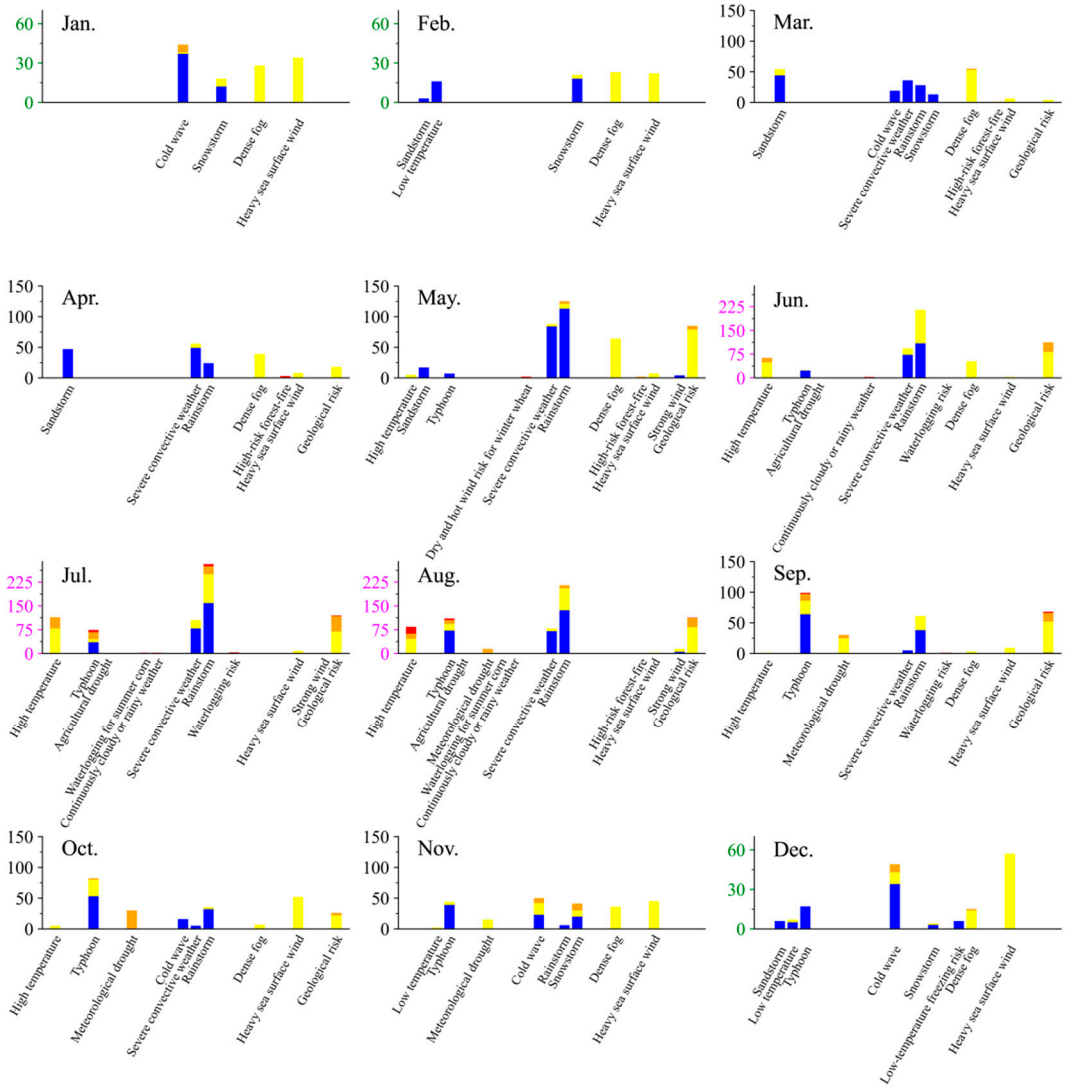

Figure 5. The number of occurrences of meteorological disaster risk warnings in each month. The red, orange, yellow, and blue bar charts represent the number of occurrences of corresponding meteorological risks under the corresponding color warning levels.

During the spring season, spanning from 1 March 2020 to 31 August 2023, a total of 14 distinct meteorological warnings were issued (Figure 6). The most prevalent warnings were directed towards severe convection weather events in southern China, particularly affecting regions such as Jiangxi, Guangxi, and Hunan Province. Additionally, rainstorms along the southeast coast, predominantly in Jiangxi and Guangxi; sandstorms in northern regions, especially in the Xinjiang Uygur Autonomous Region and the Inner Mongolia Autonomous Region; and dense fog along the east coast, notably in Shandong, Zhejiang, and Jiangsu Province, were also frequently warned against. Following these, warnings on flash flood risks, particularly in Jiangxi and Guangxi Province, and geological risks in western and southern China, especially in Jiangxi, Yunnan, and Guangxi Province, were also commonly issued. Typhoon warnings along the southeastern coast were also a significant part of the meteorological warnings during this period. Moving into the summer season, a total of 17 types of meteorological warnings were released (Figure 7). Among these, rainstorms, particularly affecting Jiangxi, Sichuan, and Yunnan Province; severe convection weather events, especially in Hebei, Shandong, Liaoning, Jilin, and Heilongjiang Province; and high temperatures, notably in the Xinjiang Uygur Autonomous Region, Zhejiang, and Jiangxi Province, were the most frequent meteorological disasters. Flash flood risks in

various parts of China, including Sichuan, Yunnan, and Jiangxi Province, and typhoons along the southeast coast of China were also commonly warned about. Additionally, geological risks in southwestern China, especially in Yunnan and Sichuan Province, were a frequent occurrence during the summer season, leading to regular meteorological warnings. During autumn, a total of 13 types of meteorological warnings were issued (Figure 8). The most prevalent meteorological risk warnings included heavy sea surface winds along the southeast coast of China, meteorological droughts in the southern regions, and typhoon warnings, specifically on Hainan Island. Additionally, dense fog warnings, particularly in Shandong and Hebei Province; rainstorm warnings in Sichuan and Shandong Province; and flash flood risks in Sichuan, Shaanxi Province, and the Xizang Autonomous Region, as well as geological risk warnings in the same regions, were also commonly observed in autumn. In contrast to the other three seasons, winter had the fewest meteorological disaster warnings, totaling only eight types (Figure 9). During this period, the primary meteorological risks with the highest number of warnings issued included heavy sea surface winds along the southeastern coast of China; cold waves affecting most parts of the country, especially Guizhou Province, the Inner Mongolia Autonomous Region, Yunnan Province, and the Xinjiang Uygur Autonomous Region; low temperatures in southern China, particularly in Guangxi Province; and dense fog in central and eastern China, with a notable concentration in Hubei Province.

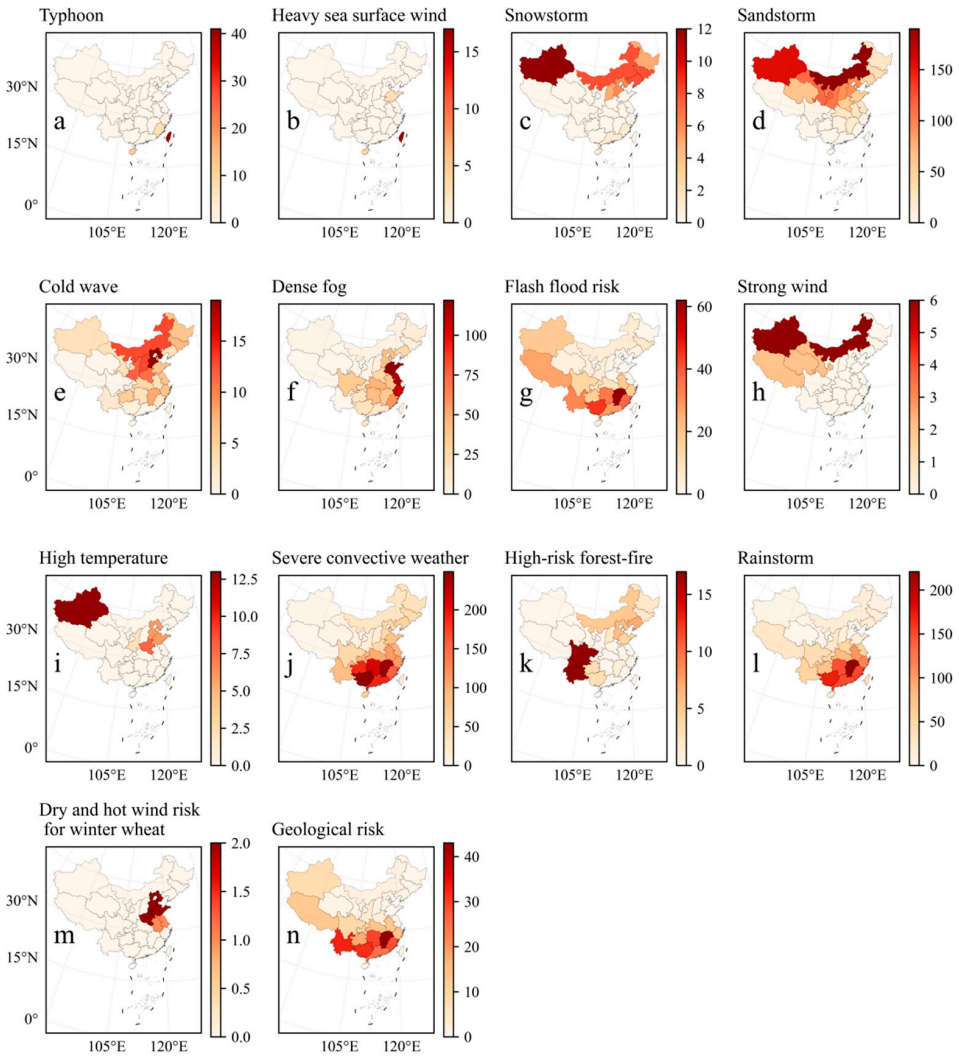

Figure 6. The number of times meteorological disaster risk warnings were issued in various provinces of China in spring from March 2020 to August 2023. Different subgraphs represent different meteorological disaster risks.

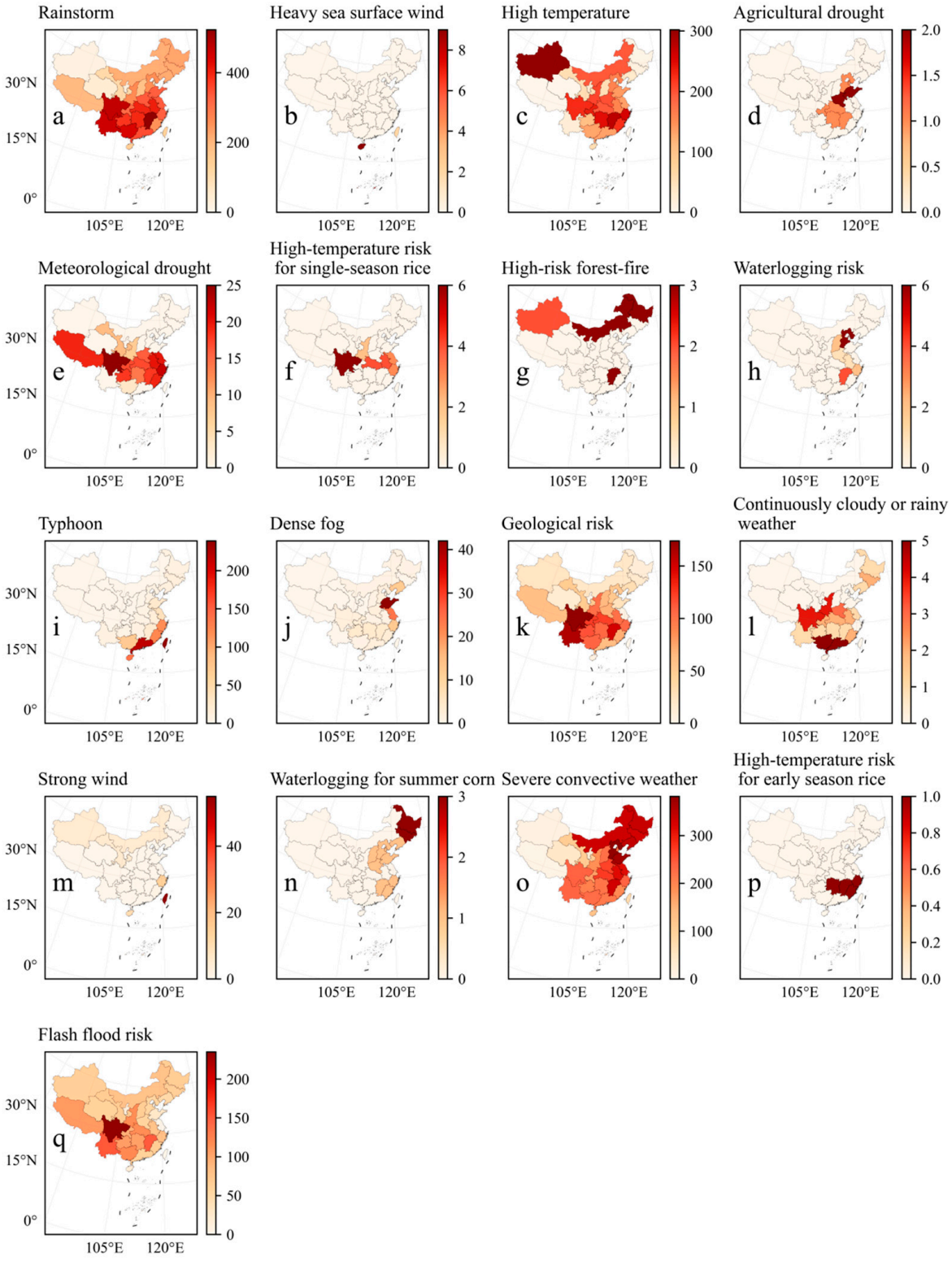

Figure 7. Same as Figure 6 except for issued in summer.

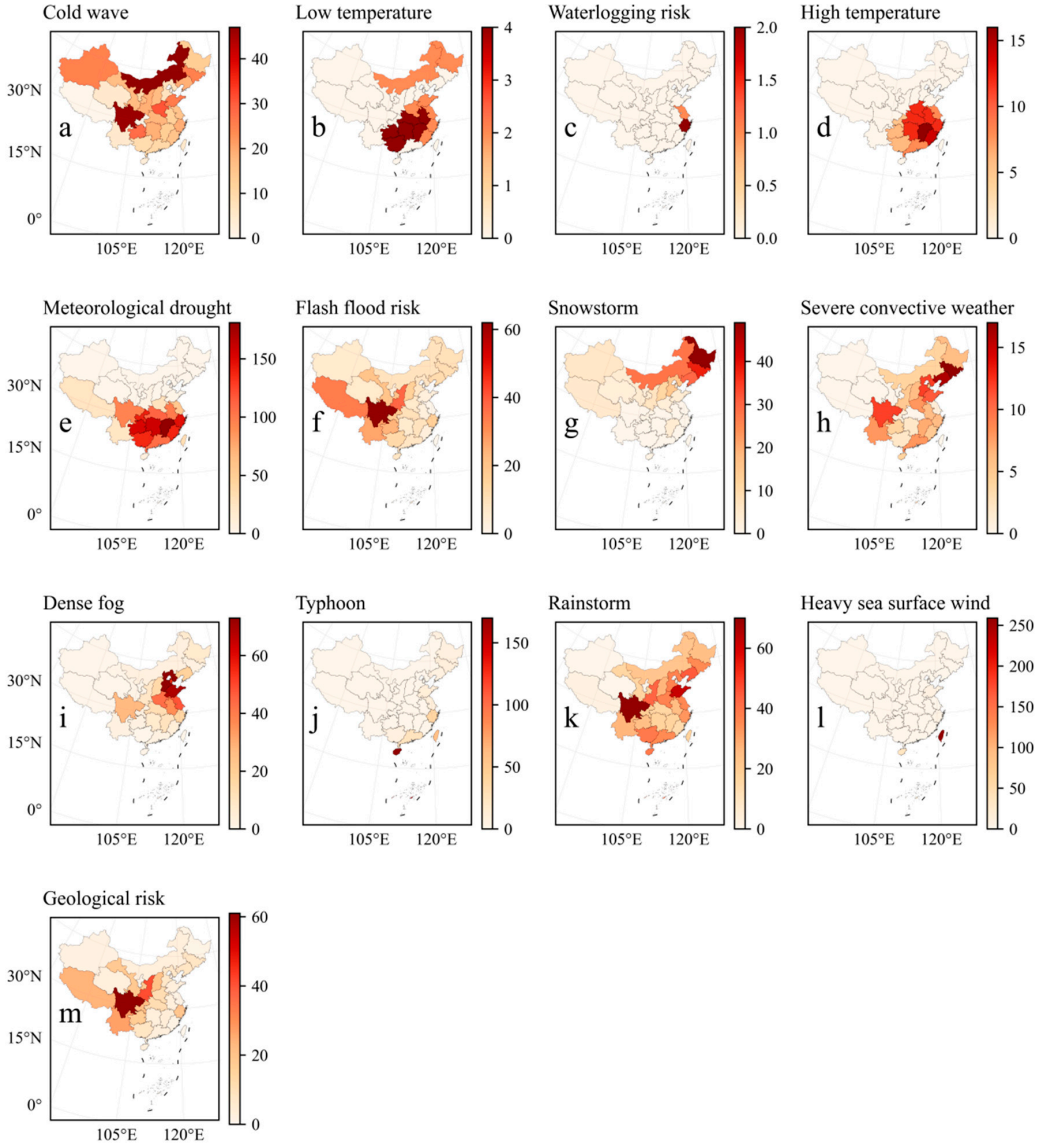

Figure 8. Same as Figure 6 except for issued in autumn.

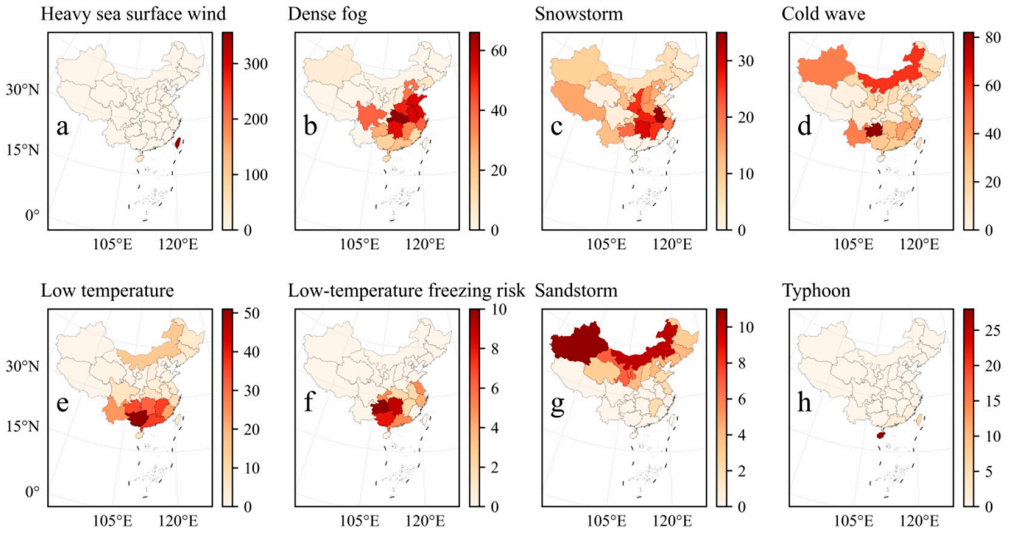

Figure 9. Same as Figure 6 except for issued in winter.

4. Discussions

Compared to weekends and holidays, the public tends to pay keener attention to weather forecasts on weekdays. This trend reflects the diverse and practical nature of people's need for weather information at different times. Primarily, weekdays are typically marked by rigid schedules and demanding work obligations, rendering individuals more susceptible to the vagaries of the weather. When planning travel and daily routines on weekdays, individuals must adhere to stringent timetables for commuting, transporting children to school, attending professional meetings, and more. Consequently, weather conditions become a pivotal factor, influencing decisions like carrying rain gear or allowing extra time to navigate potential traffic delays [19–21]. Hence, staying informed about weekday weather is paramount for efficient trip planning. Moreover, work environments and productivity are also profoundly influenced by the weather. Certain professions, such as those involving outdoor labor or exposure to extreme temperatures, require meticulous monitoring of weather patterns [22–24]. For instance, workers in hot climates must take precautions to avoid heatstroke, while those facing rainy spells may need to adjust their workflows accordingly. Therefore, timely weather updates can greatly assist in maintaining a safe and efficient workplace. As people commute and engage in various outdoor activities during the workweek, they encounter a range of weather-related hazards. From rainstorms and blizzards to heat waves, extreme weather events can pose significant risks to personal safety [25,26]. Hence, staying abreast of the weather forecast allows individuals to take preventive measures, such as avoiding hazardous conditions or selecting safer modes of transportation. Furthermore, weather conditions serve as a valuable reference point for everyday decision-making. Whether it is choosing what to wear, deciding whether to open windows, or scheduling outdoor exercise, weather updates provide valuable insights. Given the fast-paced nature of weekdays, these decisions become more frequent and consequential, making weather forecasts a sought-after source of information. In contrast, weekends and holidays afford greater flexibility and leisure, often involving activities less dependent on the weather. People may opt for indoor pursuits, family gatherings, or travel excursions, reducing their immediate reliance on weather updates. Thus, it is unsurprising that the public tends to prioritize weekday weather forecasts over those for non-working days, reflecting the practicality and relevance of such information in their daily lives.

Geological disaster meteorological risk warning is a key link in geological disaster prevention, which is of great significance for enhancing disaster defense capabilities and transforming passive disaster relief into active disaster prevention and avoidance [27–29]. In the realm of meteorological disaster warnings, alerts of different colors signify distinct levels of urgency and potential impact. The public's attention is often directed towards those disasters that pose an immediate and significant threat to life and property. Firstly, red warnings, a beacon of extreme danger, naturally draw the most concern. It is understandable that flash floods, typhoons, and geological risks occupy the forefront of public worry. These disasters, with their immense destructive capabilities, have the potential to cause catastrophic loss of life and widespread damage to infrastructure. The violent rush of mountain torrents, the ferocious winds and deluges of typhoons, and the unpredictable nature of geological events all contribute to their status as major concerns [30–34]. Secondly, orange warnings, while not as severe as red, still command a significant level of attention. This is due to the fact that disasters such as heavy rainfall, typhoons, snowstorms, and cold waves can cause considerable disruption to daily life. From flooded streets and icy roads to power outages and crop damage, these events have the potential to wreak havoc on communities and critical infrastructure. However, it is interesting to note that in the case of yellow warnings, sandstorms become the focal point. This shift in attention highlights the significant impact that these events can have on daily life, despite the lack of immediate and overwhelming destructiveness seen in other disasters. Sandstorms can engulf entire regions in a cloud of dust and debris, causing respiratory issues, visibility problems, and widespread disruption [15]. Meteorological droughts, on the other hand, often fly under the radar. Their slow-burning nature and gradual impact can make them seem less urgent in comparison

to other, more immediately devastating disasters. However, this does not diminish their long-term significance [35]. Droughts can lead to crippling water shortages, decimated crop yields, and a host of other environmental and socio-economic issues that can have far-reaching consequences.

In conclusion, the public's response to meteorological disaster warnings reflects a balance between the immediacy of the threat and its potential impact on daily life. While some disasters grab headlines and demand immediate action, others, like droughts, require a more nuanced and long-term approach. It is essential that we recognize the importance of all these events and develop comprehensive strategies to mitigate their effects, ensuring the safety and well-being of communities worldwide.

These research findings unequivocally highlight the distinct characteristics of meteorological warnings across seasons and the primary weather events that merit attention. During spring, warnings predominantly center on severe convection, dust storms, and similar weather phenomena. Notably, blue warnings are frequently issued for less severe occurrences. However, as summer approaches, the frequency of warnings escalates, particularly for extreme weather events like typhoons and torrential downpours. This season brings added concerns such as high temperatures and geological hazards like debris flows and landslides, alongside the usual risks of severe convection and heavy rain. Orange warnings, which encompass a broad spectrum of weather events, tend to be more prominent during summer. As autumn commences, the number of warnings may diminish compared to summer, yet vigilance remains crucial for specific weather events. These include strong winds at sea, meteorological droughts, and the occasional typhoon. Despite their infrequency during autumn, typhoons retain the potential for significant impacts and should not be disregarded. Winter brings the fewest warnings, with a focus on cold weather conditions and maritime risks like strong winds, cold waves, low temperatures, and dense fog. This seasonal shift not only illustrates the varying weather patterns unique to each season but also offers invaluable insights for devising tailored prevention and response strategies to address weather-related challenges throughout the year.

China's natural disasters are diverse and widely distributed, and their occurrence is closely related to various factors such as geographical location, climate characteristics, topography, climate change, and human activities. The southern and southeastern regions are close to the ocean and are significantly affected by monsoons, often suffering from severe convective weather events, floods, and typhoons [36–38]. At the same time, the geological risks in these areas cannot be ignored, with frequent disasters such as landslides and mudslides. In contrast, the northern region is more often plagued by sandstorms, high temperatures, and drought, which are related to natural conditions such as arid climates, desertified land, and strong winds [39,40]. In the western region, the terrain is complex and mountainous, and geological disasters such as landslides and debris flows are common [41]. At the same time, floods and rainstorms are also frequent visitors in this region. In addition, the eastern coastal areas also need to address the challenges of heavy fog and marine meteorological disasters [42,43]. The central region may be threatened by multiple disasters, such as rainstorms, heavy fog, and low temperatures. Therefore, it is crucial to develop corresponding prevention and response measures based on the characteristics of disasters in different regions in order to reduce the losses caused by disasters and ensure the safety of people's lives and property.

Although weather forecast websites are very suitable as a medium for delivering weather information, with the development of new communication technologies, some new media platforms allow non-professional (amateur) agents to participate, while other platforms, such as social robots or chatbots, allow for the complete removal of human factors [2]. With the further popularization of these platforms in society, it is crucial to identify individual views in content and media, especially in information that can ultimately help individuals escape danger, such as information about weather risks. In the future, artificial intelligence technology is expected to be further applied in this field.

Despite this study's exploration of public attention towards city weather forecasts and the spatiotemporal patterns of meteorological warning dissemination in China, it bears certain limitations. Firstly, its reliance solely on webpage views may not provide a comprehensive understanding of the public's interest in weather data, as this approach neglects the browsing habits of mobile users, who constitute a significant segment. Secondly, future research endeavors will endeavor to gather additional data on public browsing patterns related to weather forecasts, including factors like forecast duration and user location. This will facilitate a more precise analysis of the public's interest in meteorology and consequently enhance meteorological disaster prevention efforts.

5. Conclusions

In this study, the observed daily page views of city weather forecast and meteorological warning information were employed to analyze the distribution of public attention toward meteorological warning information and the spatiotemporal distribution characteristics of meteorological warning releases from 1 March 2020 to 31 August 2023 in China. The major findings are summarized as follows.

(1) The prevalence of heat waves, typhoons, severe convective weather, and geological hazards triggered by heavy rainfall during the flood season has heightened public awareness and engagement with weather forecasts.
(2) In contrast to weekends and holidays, weekdays witnessed a heightened focus on weather among the public. The disparity in city weather forecast page views between weekdays and national statutory holidays is even more pronounced.
(3) Under various red meteorological disaster warnings, the public's primary concerns were flash floods, typhoons, and geological risks. During orange alerts, flash floods, rainstorms, typhoons, snowstorms, and cold waves dominated the public's attention. For yellow alerts, sandstorms were the most notable concern, while meteorological droughts remained relatively unheeded.
(4) Examining the temporal dimension of meteorological warnings, it becomes evident that summer sees a notably higher issuance of such warnings compared to other seasons. Specifically, typhoons and rainstorms are the primary concerns in July, while August brings warnings for high temperatures and additional typhoons. Additionally, warnings for heavy sea surface winds, another highly seasonal phenomenon, are predominantly issued during winter.
(5) Regionally, the most prevalent warnings were directed towards severe convection weather events in southern China, particularly affecting regions such as Jiangxi, Guangxi, and Hunan Province.

The findings of this study will assist the authorities in gaining a deeper understanding of the public's reaction and attention span when confronted with varying degrees of meteorological disaster warnings. This insight will enable the authorities to refine the timing and approach of warning dissemination, thereby enhancing the public's responsiveness to and the overall effectiveness of such warnings. Furthermore, the results will (1) serve as a guide for authorities to modify their meteorological information release tactics during non-working days, ensuring efficient communication with the public; (2) facilitate more precise formulation and adaptation of disaster mitigation strategies, along with proactive preparation for early warnings and resource allocation; (3) aid in the development of more scientifically grounded policies for meteorological disaster prevention and management, encompassing warning systems, emergency response frameworks, and public educational programs, among others.

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