

# Temporal and Spatial Characteristics of Government Microblog Response to COVID-19 Epidemic in Hubei Province

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**Abstract:** Taking the government microblog data of various states and cities in Hubei Province from January 1 to March 25, 2020 as the sample, this paper uses LDA topic model and spatial analysis method to mine the implicit semantics and analyze the temporal and spatial characteristics. The results show that: (1) there is a significant positive correlation between the response of government microblog and the development of the epidemic. During the epidemic, government microblog is an important channel for the governments of various states and cities to communicate with the people; (2) The government microblog mainly includes seven implied themes, which reflect the positive actions of the government in promoting covid-19 epidemic control from the theme frequency; (3) In response to major public health emergencies, the media response of Hubei provincial government is relatively fast and the topic management is properly selected.

**Keywords:** government microblog, COVID-19, LDA, text mining, spatiotemporal characteristics

## 1. Introduction

The outbreak of New Coronavirus pneumonia (COVID-19) is a worldwide public health event. As of March 25, 2020, the Hubei health authority website announced 61201 cases of cumulative confirmed cases. During the outbreak of Hubei, COVID-19 epidemic has caused significant spread effect in the Internet society. A large number of netizens have gathered around the platform of WeChat tiktok, micro-blog and jitter to discuss the COVID-19 epidemic events, effectively promoting the spread of related topics.

Since the source of disease was identified as New Coronavirus in January 9, 2020, governments at all levels in the country have taken prompt measures. The communication between the government and the public is a very important link in epidemic prevention and control, which plays a direct role in dispelling rumors, stabilizing public sentiment and mobilizing the people to fight the epidemic together. In the official media response to the covid-19 epidemic, the release of government microblog is the most timely and interactive, and actively responds to the government objectives and people's needs. Take @ Wuhan as an example to respond to important public opinions at the first time during the epidemic period, such as the closure of South China seafood market, the release of confirmed data, etc. As the most serious area of COVID-19 in 2020, what kind of government communication role does Hubei municipal government micro-blog play? What are the temporal and spatial characteristics of media response? Based on this, this paper takes the administrative micro-blog texts of 17 cities in Hubei Province as samples, and conducts thematic mining and spatio-temporal analysis to explore the temporal and spatial characteristics of micro-blog's response to COVID-19 administration in Hubei province.

## 2. Literature review

The development of government microblog is closely related to the rise of microblog and is an important channel to promote public participation in politics [1-2]. In November 2009, after the first

domestic government microblog "Weibo Yunnan" was produced on Sina Weibo, governments at all levels successively registered government accounts and published microblogs to promote the process of government communication on microblog [3]. The report "people's daily • government affairs index microblog influence report in the first quarter of 2018" jointly released by the public opinion monitoring office of people's network and Sina Weibo pointed out that as of March 31, 2018, there had been more than 175000 government microblogs on Sina Weibo [4]. The research on government microblog is usually placed under the theoretical framework of e-government, showing many research topics such as media response [5], crisis expression [6], communication mechanism [7]. The crisis events involved in the study include stampede on the Bund of Shanghai, catastrophic fire and explosion accident in Tianjin port and other social and public events.

The main research methods used in the literature are discourse analysis, including content analysis based on manual coding and text mining based on natural language processing. Among them, many scholars used semi quantitative content analysis methods, such as Yin liangen and Huang Min (2016) studied the characteristics of government microblog in the public domain and wuetal. Studied the interaction mechanism of government microblog in the Tianjin big bang [8]. In the discourse research of government microblog, natural language processing is another new research method. The hidden semantic features in government microblog can be mined through naming topic recognition and topic modeling.

At present, the media response of covid-19 has attracted much attention, but the previous literature lacks text analysis from the perspective of government microblog. Therefore, this paper hopes to understand the microblog response characteristics of the government in response to crisis events by analyzing the temporal and spatial evolution of the implied theme of the government microblog text in Hubei Province during the epidemic.

### **3. Data and methods**

#### **3.1 Data source**

Sina Weibo is one of the most widely used social media platforms for Chinese Internet users, and it is also the main platform for government communication. From January 1 to March 25, 2020, the epidemic of covid-19 in Hubei Province is hot, and a large number of government microblogs have been released in various states and cities. In this paper, the train collector is used to collect the text data of government microblog in 17 provinces of Hubei Province, and a total of 18559 original data are obtained. 15032 valid samples were obtained after data cleaning. The sample information includes user name, user ID, microblog text, geographical location, publishing time and other attribute fields.

#### **3.2 Research methods**

The topic modeling software used in this paper is Python 3.7, and the research method is text mining based on natural language processing. The method flow chart of the paper is shown in Figure 1. Firstly, the obtained data is cleaned, word segmentation and stop words are removed. The word segmentation program is Jieba thesaurus; Secondly, the implicit Dirichlet allocation (LDA) is used to quantify the samples into the low-dimensional representation of the topic space through parameter estimation, and further label the maximum probability topic of each article, so as to analyze the temporal and spatial characteristics of the government microblog topics in various states and cities of Hubei Province.

The determination of the optimal number of topics is related to the efficiency of implicit topic extraction, so it is necessary to judge the optimal number of topics. This paper adopts the discrimination method of the combination of perplexity and coherence. When using confusion degree for evaluation, the more topics, the greater the calculation cost of LDA model, and the value of confusion degree will gradually decrease. When using consistency for evaluation, the higher the index, the better the performance of the model. In order to avoid over fitting of the model, this paper selects the number of topics with less confusion and greater consistency as the optimal number of LDA model training through empirical discrimination.

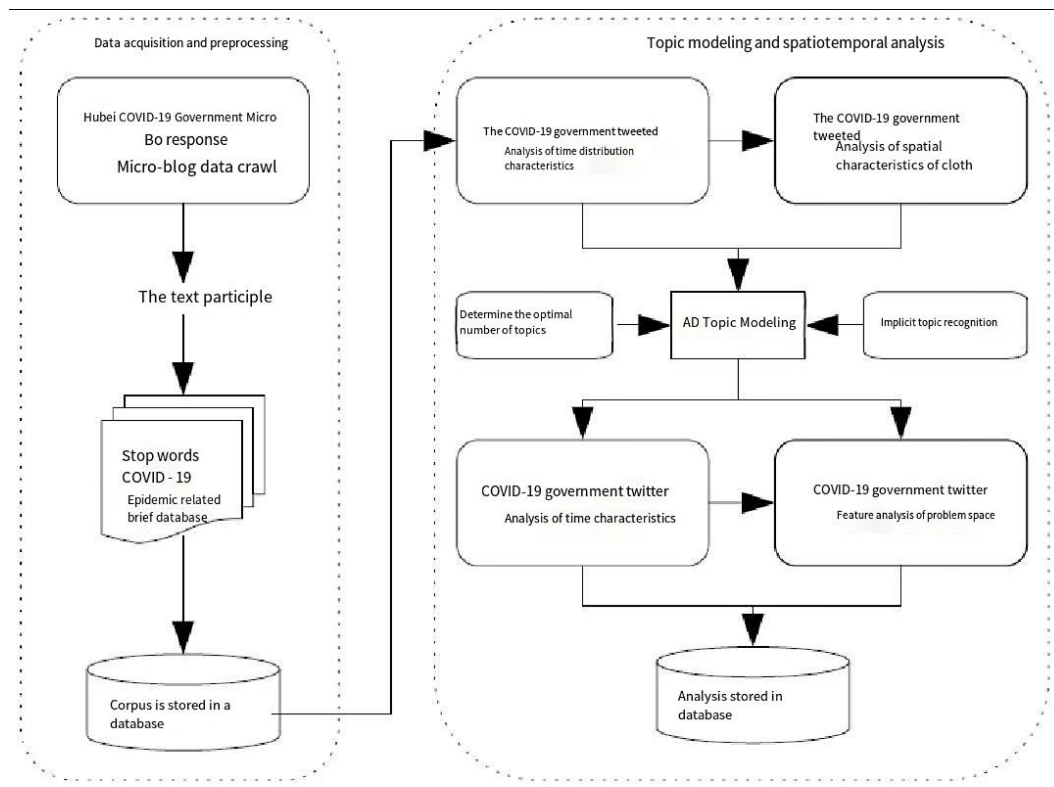


Figure.1 Flow chart of research method

## 4. Result analysis

### 4.1 Temporal and spatial characteristics of microblog Publishing

#### 4.1.1 Characteristic analysis of release time

During the covid-19 epidemic, the time series of government microblogs released by various states and cities in Hubei Province is shown in Figure 2. The number of government microblogs showed volatility, and the peak value of microblog release was related to the nodule of epidemic fermentation. From January 1 to March 25, 2020, Hubei government microblog response is divided into three stages. The first phase of government microblog response is from January 1 to January 19. The second phase of government microblog response was from January 20 to March 5. On January 20, the confirmed data were released for the first time. On January 22, the secondary emergency response to public health emergencies was launched. Subsequently, the government microblogs of various states and cities forwarded relevant notices and widely disseminated popular science knowledge of epidemic prevention and control. On the 24th, the first level emergency response to public health emergencies was launched, and various government microblogs successively issued notices on the shutdown of public facilities. On June 27, the general office of the State Council issued the notice on extending the Spring Festival holiday in 2020. On February 2, Huoshen mountain and Leishen mountain hospitals were put into use, and the "epidemic" operation entered the critical stage. At the same time, the government microblog also actively spread love events, which greatly encouraged the morale of the people's war "epidemic". After 22 days, the epidemic slowed down, the number of newly confirmed cases decreased, the cure rate increased, and the response density of government microblog gradually decreased. March 12-25 is the third stage of government microblog response. On the 12th, the new cases in Hubei Province fell to the single digit level for the first time. On the 19th, the new cases in Hubei Province fell to 0. From 0:00 on the 25th, the control of the channel leaving Hubei was lifted outside Wuhan. The government microblog response to covid-19 epidemic in Hubei Province slowed down in fluctuation, and the production and life of the whole province gradually recovered.

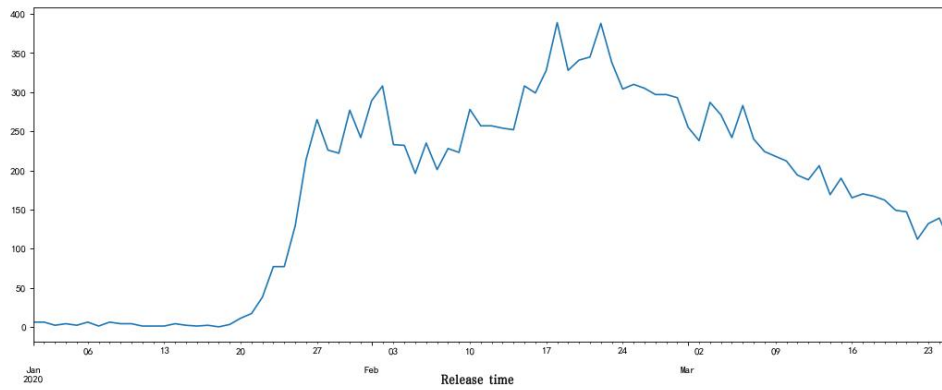


Figure.2 Time series distribution of the number of Weibo

4.1.2. Feature analysis of publishing space

The spatial pattern of covid-19 related government microblogs is shown in Figure 3 (left). In space, it shows the characteristics of a circle centered on Wuhan, extending horizontally to the East and West, and Wuhan, Huangshi, Xiaogan, Huanggang, Qianjiang, Jingzhou, Yichang and other places form a continuous situation. The spatial distribution of covid-19 infection per 10000 people in various states and cities of Hubei Province on March 27, 2020 is shown in Figure 3 (right). The infection density in Wuhan is the highest, with an average of 56.59 people infected with covid-19 per 10000 people, and Enshi has the lowest infection density, 0.63 people / 10000 people. It can be seen from the figure that the number of people infected with covid-19 per 10000 people in Hubei Province shows a significant circle characteristic of Wuhan micro center in space, but the East-West characteristic of the number of government microblogs has a leftward skewness, forming a continuous high infection density area of Wuhan, Ezhou, Huanggang, Huangshi, Xiantao, Xiaogan and Suizhou. The development of covid-19 epidemic shows the spatial characteristics of outward diffusion from Wuhan. The epidemic intensity in the East is significantly higher than that in the west, but the response of government microblog does not have such obvious characteristics.

It can be seen that although the government microblog is closely related to the development of the epidemic, it also has heterogeneity, reflecting the absence of issue management in individual urban areas of Hubei Province. In contrast, government microblogs are used more in the South and southwest of Hubei Province, and the government has carried out more epidemic prevention and control work through social media.

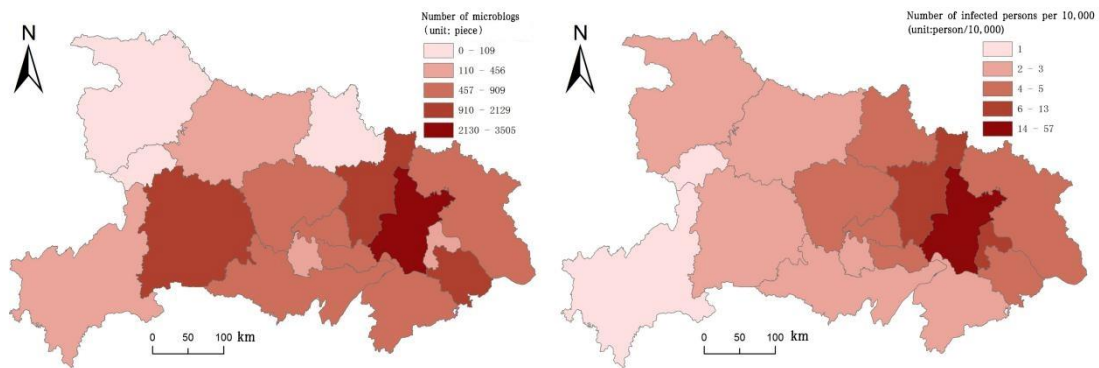


Figure. 3 The number of Weibo and the spatial distribution of COVID-19 infection per 10,000 people

In general, the release time of government microblogs in various states and cities in Hubei Province has a strong correlation with the important nodes of epidemic development. Government microblogs at all levels can actively voice in the fermentation process of major public health events and actively respond to the public, which reflects that the government follows the basic principles of effective emergency management and meets the public’s right to know. However, the release time of government microblogs in various states and cities showed obvious fluctuation, indicating that the government microblogs initially failed to give early warning to the judgment of sudden epidemic situation and development, and the government microblogs in various states and cities failed to build an ideal governance system for collaborative response to the crisis.

4.2 Identification and temporal and spatial characteristics of microblog topics

4.2.1 LDA subject identification

4.2.1.1 Selection of the number of topics

In this paper, according to the formula of confusion and consistency, the confusion and consistency values of the number of different topics in the interval 2 to 21 (the interval is 1) are calculated, and the analysis is shown in Figure 4 (the left figure is the complexity topic broken line diagram, and the right figure is the coherence topic broken line diagram).The horizontal axis is the number of topics and the vertical axis is the discrimination index. It can be seen from the figure that the degree of confusion and consistency fluctuate with the increase of the number of topics.

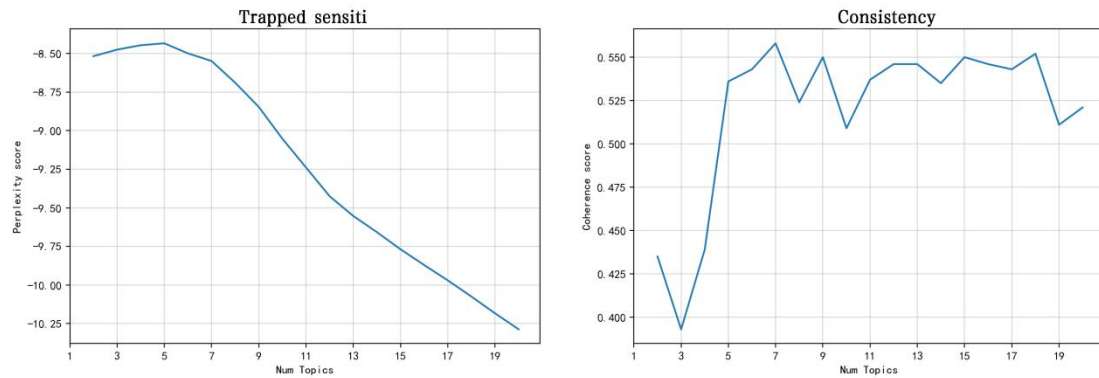


Figure.4 Perplexity-Coherence-Topic line chart

4.2.1.2 Subject classification results

After determining the optimal number of topics, the data after word segmentation is used for LDA model training, and finally the document topic distribution and topic word distribution are obtained. In this paper, the obtained LDA document topic and topic vocabulary probability distribution are used as the deep semantic features of government microblog text. The results of 7 topics trained by LDA model are shown in Table 1, and 5 words are selected for each topic. Further, through manual definition, seven themes (as shown in Table 1) can be determined: War "epidemic" action, resumption of work and childbirth, community prevention and control, material donation, patient admission, community supply and diagnosis data. War "epidemic" action includes air defense, command, management and other main information; resumption of work and production includes enterprise, resumption of work and other main information; community prevention and control includes community, prevention and control, masses and other main information; material donation includes donation, funds, materials and other main information; patient admission includes hospital, patient, medical and other main information; community supply includes community, materials, masks love and other main information. The confirmed data includes case, confirmed, new and other main information.

Table 1: Keyword distribution

Theme	Word form probability				
Fight disease action	Prevention and control(0.021)	Work(0.011)	Headquarters(0.006)	Crew(0.006)	Protect(0.006)
Recovery industry	Crew (0.020)	Prevention and control(0.020)	Enterprise(0.015)	Work resumption(0.009)	Health(0.009)
Community control	Prevention and control(0.044)	Work(0.031)	Community(0.011)	Resolute(0.007)	People(0.006)
Material donations	Donate(0.033)	Prevention and control(0.022)	Wan Yuan(0.017)	Fund(0.016)	Supplies(0.015)
Treated patients	Hospital(0.024)	Patient(0.014)	Wu Han(0.014)	Huang Shi(0.012)	Medical treatment(0.007)
Community supply	Community(0.023)	Supplies(0.019)	Mask(0.013)	People(0.011)	Neighbourhood(0.010)
Confirm the data	Case (0.039)	Confirmed(0.028)	Increases(0.024)	Discharge(0.020)	COVID-19(0.019)

In short, these themes include multi-level contents such as releasing government information, communicating with the people and serving the people. According to the probability words under the

theme, prevention and control and community appear most. It can be seen that all cities, prefectures and districts of Hubei Province pay attention to people's livelihood in epidemic prevention and control during the epidemic period. At the same time, Wuhan and Huangshi are more place names, and there are more microblog perception and government microblog response in the two places, which is consistent with the actual epidemic situation in the two places. It can be seen that the government microblog effectively promoted the progress of epidemic prevention and control in Hubei Province during the epidemic period.

#### 4.2.1.3 Subject distribution

On the basis of determining the theme, get in gesim is used\_document the topics function generates the topic probability distribution of each text, makes statistics on the sample data of the topic, and obtains the pie chart of 7 topic distributions (as shown in Figure 5). It can be seen that among the seven main themes of government microblog response to covid-19 epidemic in various states and cities of Hubei Province, the highest proportion is the admission of patients, accounting for 32.39%; The second is the war "epidemic" action, with a proportion of 15.20%; Among them, the two themes of community prevention and control and community supply related to the community account for 22.76%, which highlights that the community is a powerful promoter of epidemic prevention and control in the context of cities as the main epidemic field; In addition, the confirmed data accounted for 12.71%, and the return to work accounted for 12.27%; The smallest proportion is material donation, which is 4.66%. Donation is usually a public welfare behavior, but there is relatively little attention at the media response level of the government. In conclusion, the theme of government microblog release in urban areas of Hubei Province can construct discourse content from the main topics of public concern according to the development needs of the epidemic situation. Government microblog obtains public recognition and emotional stability with an open attitude. This strategy of crisis construction is an important reference to deal with public crisis events.

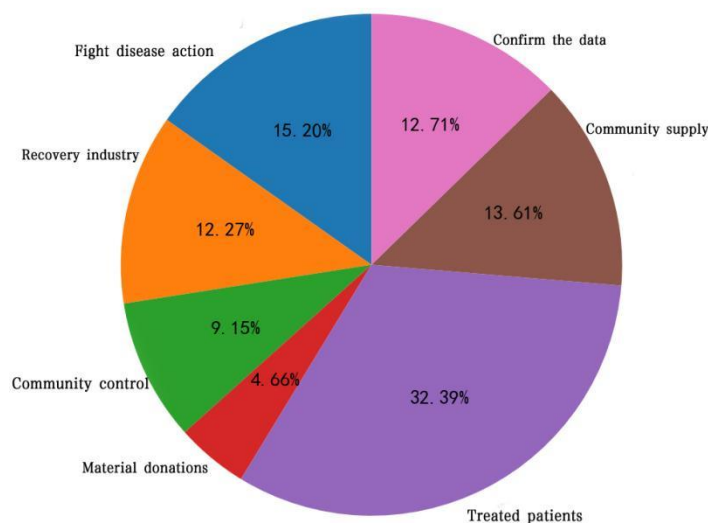


Figure.5 The proportion of seven themes

#### 4.2.2 Analysis of time characteristics of microblog theme

The time series distribution diagram of the hidden themes (as shown in Figure 6) shows that on the whole, each theme has the time series characteristics similar to the number of government microblog releases as a whole, that is, the number of subjects is large after January 23, and began to decline in mid March. In terms of themes, the most prominent theme with the largest proportion is the war "epidemic" action. It gradually increased from January 20 to the first peak on January 23, followed by a wave dynamic potential, and tended to decline after March. According to the development timeline of the epidemic, January 20 to 24 is the time period for making decisions in response to the epidemic. The confirmed data have been published one after another, and the secondary emergency response and primary emergency response for public health emergencies have been started. Therefore, government microblogs at all levels quickly respond to a series of government decisions in response to crisis events.

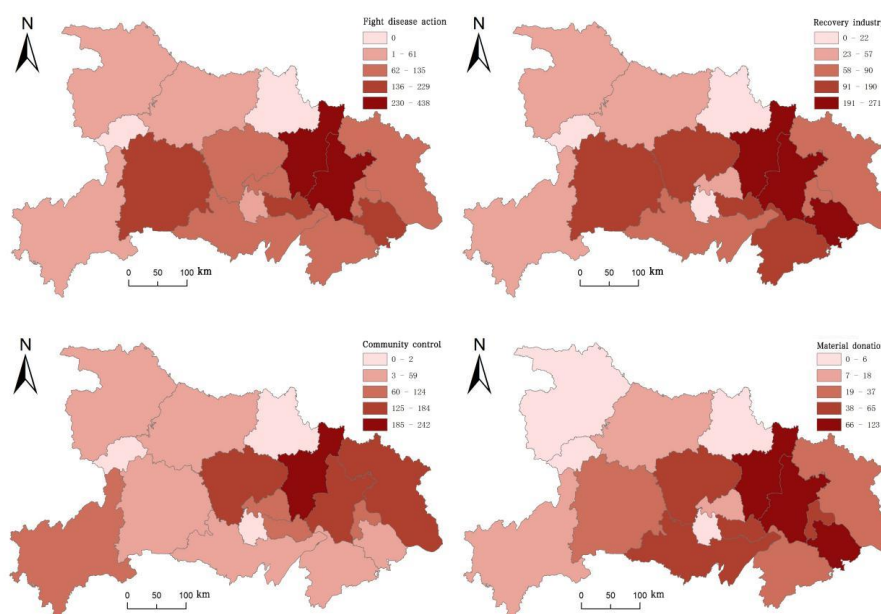
Secondly, the broken line chart of community prevention and control and material donation is obviously different from that of resumption of work and production. The themes of community

prevention and control and material donation were partial normal. From January 24 to early March, when the epidemic was the most serious, people looted goods. Under the community management, once the chaos was changed, the people actively cooperated with the community prevention and control, and the government responded quickly. At this time, the government microblog of relevant topics paid high attention. On January 27, the general office of the State Council issued the notice on extending the Spring Festival holiday in 2020. On January 29, the State Council and Hubei provincial governments began to study the plan for the resumption of work and production of enterprises related to epidemic prevention materials, and the issue of resumption of work and production began to attract the attention of the government and the public. On March 11, the people's government of Hubei Province issued a notice on resumption of work, which planned to promote the resumption of work and production of enterprises in an orderly manner by zoning, classification and time-sharing, and the relevant government microblogs entered the highest intensive stage. In addition, the broken line chart released by the patient admission theme microblog has obvious characteristics of low at both ends and high in the middle. When the patient base is large in the early stage, there is a shortage of medical equipment and venues. After the completion of Raytheon mountain and Huoshen mountain hospitals and assistance from all over the country, there are more media responses to government microblogs on related themes. In the later stage, with the gradual improvement of the epidemic situation, such government microblogs also gradually decreased.

#### 4.2.3 Analysis of spatial characteristics of microblog theme

The spatial distribution of each topic is shown in Figure 6. The spatial distribution of the seven topics of war "epidemic" action, resumption of work and production, community prevention and control, material donation, patient admission, community supply and diagnosis data is similar to the spatial characteristics of the overall government microblog response (see Figure 3). In Wuhan, Xiaogan, Huangshi, Huanggang, Xianning and Xiantao, the government microblog responses form a hot area of high-value agglomeration, and the government microblog responses of Shiyan, Shenglongjia, Enshi, Xiangyang and Suizhou form a relatively low-value agglomeration feature, forming a more significant "center periphery" pattern centered on Wuhan.

In Yichang, which is far away from Wuhan, the response of government microblog is relatively timely. There are many microblogs published on the three themes of war "epidemic" action, patient admission and diagnosis data. The response of government microblog is relatively timely, reflecting the high degree of openness and transparency of government affairs in response to crisis in the region. Qianjiang and Tianmen's Government microblog response is weak, of which Qianjiang is the most prominent. Under each theme, the response of government microblog in the region is at the lowest gradient, forming an "enclave" for government microblog response. Consistent with the epidemic facts, there are fewer people infected with covid-19 per 10000 people in Qianjiang, which also has the characteristics of "enclave".



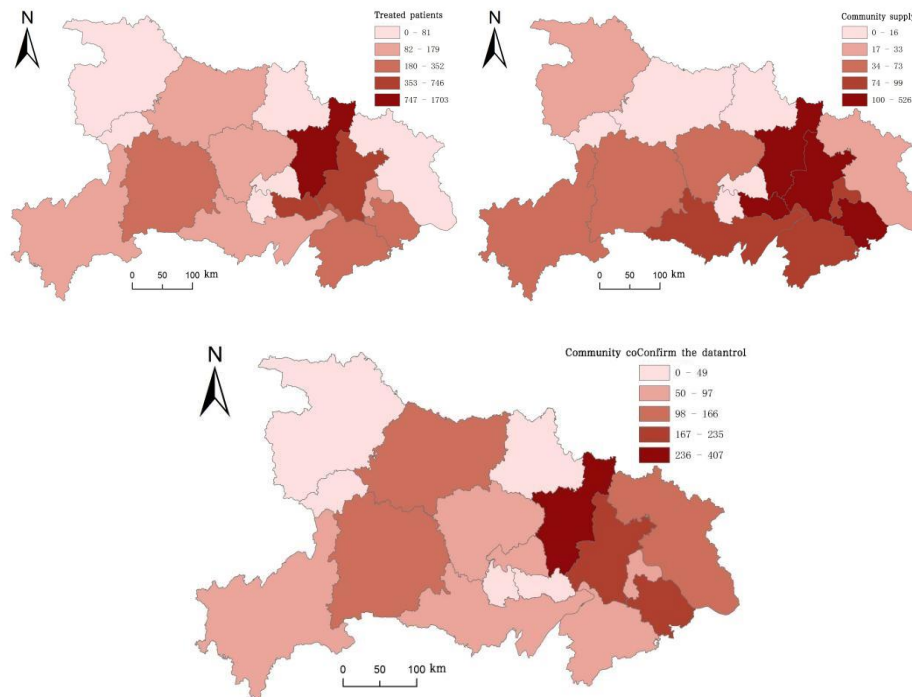


Figure.6 The spatial pattern characteristics of the theme

## 5. Conclusion and discussion

On the basis of reviewing the covid-19 epidemic situation, this paper excavates the implicit meaning of the microblog text of the government microblog response in Hubei Province during the covid-19 epidemic situation. Combined with time and space series, this paper analyzes the temporal and spatial characteristics of government microblog response to public health events in Hubei Province. The results show that:

1) In this paper, the government microblog text mining and topic modeling in various states and urban areas of Hubei Province have achieved good results, which is very consistent with the epidemic facts. In response to covid-19 epidemic prevention and control, there is a significant correlation between the response of government microblog and the degree of epidemic development. On the whole, it presents a spatial pattern of outward diffusion centered on Wuhan. That is, in areas with more serious epidemic, the response density of government microblog is higher, and the communication with the public is more timely and frequent.

2) The main implied themes of government microblog include: War "epidemic" action, resumption of work and production, community prevention and control, material donation, patient admission, community supply and diagnostic data. The topics with high probability are patient admission, war "epidemic" action and community management, which reflects the positive actions of governments at all levels in Hubei Province to promote covid-19 epidemic control.

3) The temporal and spatial characteristics of government microblog in Hubei Province show that the government has a rapid response to the crisis of major public health emergencies and an appropriate choice of issue management. However, in terms of spatial distribution, it reflects that the use of government microblog does not show a local cooperation system, and some urban areas do not make full use of the advantages of microblog to release information and communicate with the people in time. These will be the lessons and reflections of government microblog in response to major public crisis events.

This paper has made some conclusions on the spatio-temporal characteristics of government microblog response, but there are still limitations. The following two aspects are mainly reflected in the following aspects: first, the sample is not fully representative; the channels of government communication include micro-blog tiktok, WeChat and jitter, and other social media platforms. There are different preferences for the media in the choice of the media, which will lead to some errors in the



analysis. The second is the response analysis of government microblog. Compared with the acceptance of the audience, the latter can better reflect the effect of communication between government microblog and the public. There is a deviation in judging the temporal and spatial characteristics of government microblog only from the response. Therefore, in the next research, we will continue to expand the above two aspects.

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