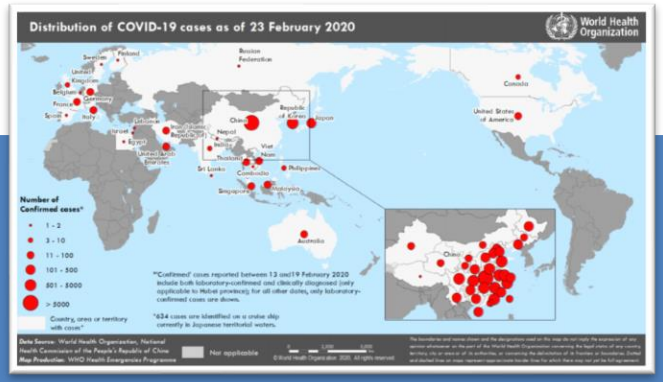
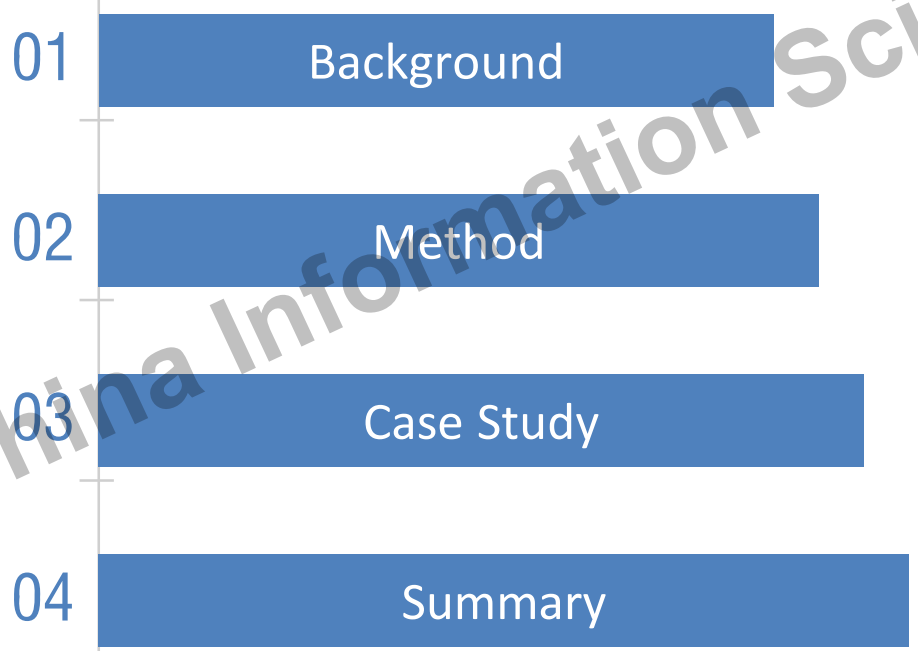


Visualization of Coronavirus Disease 2019 Spread Based on Spread Index and Extinction Index

Song-Hai Zhang*, Yun Cai, Jian Li

Content



Content

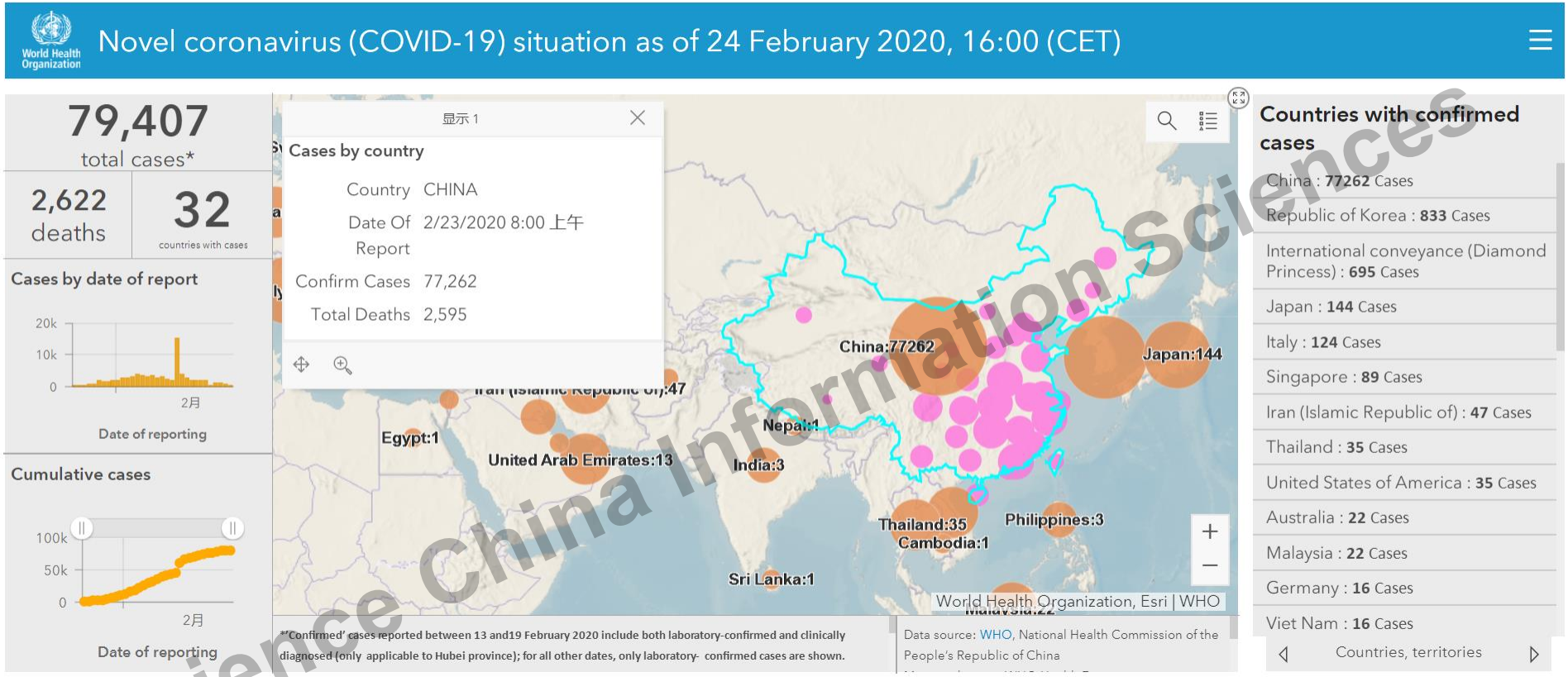
01 Background

02 Method

03 Case Study

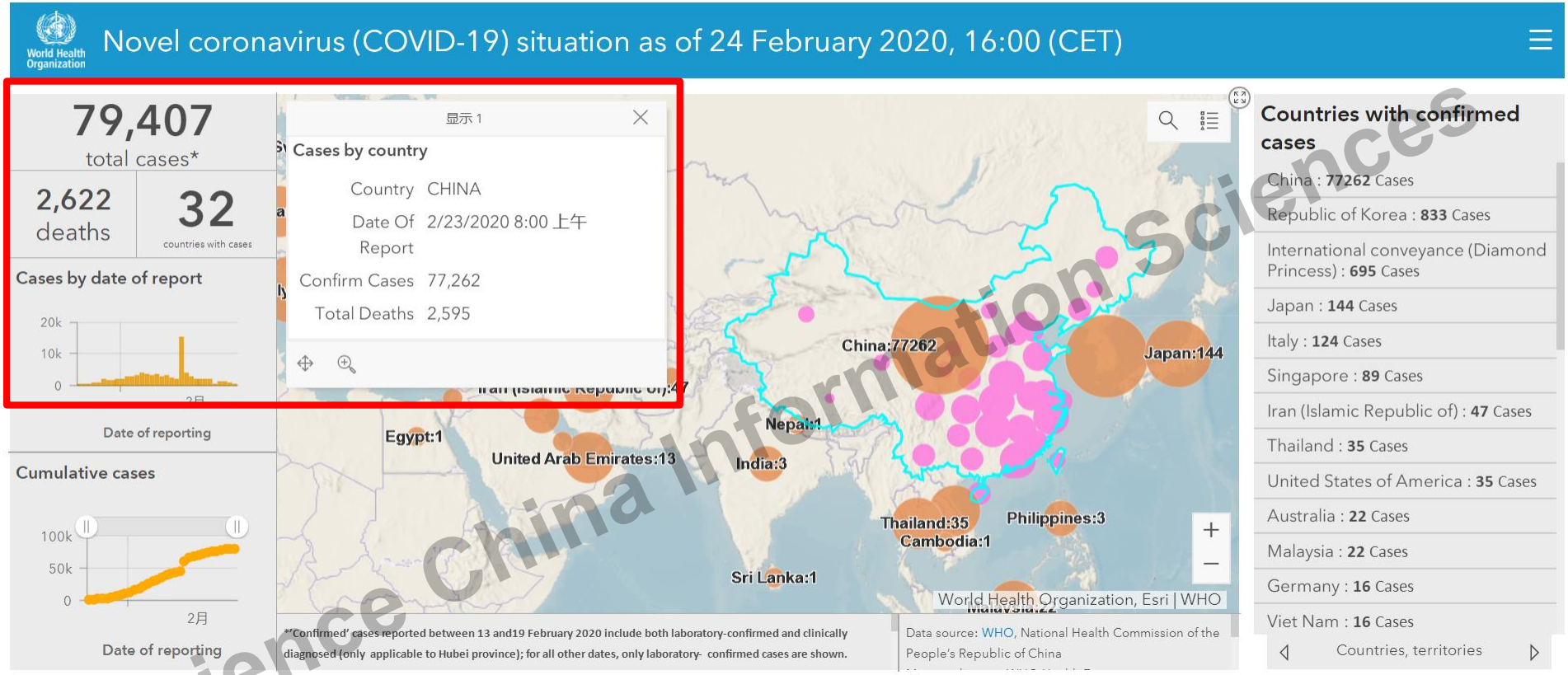
04 Summary

01 Background



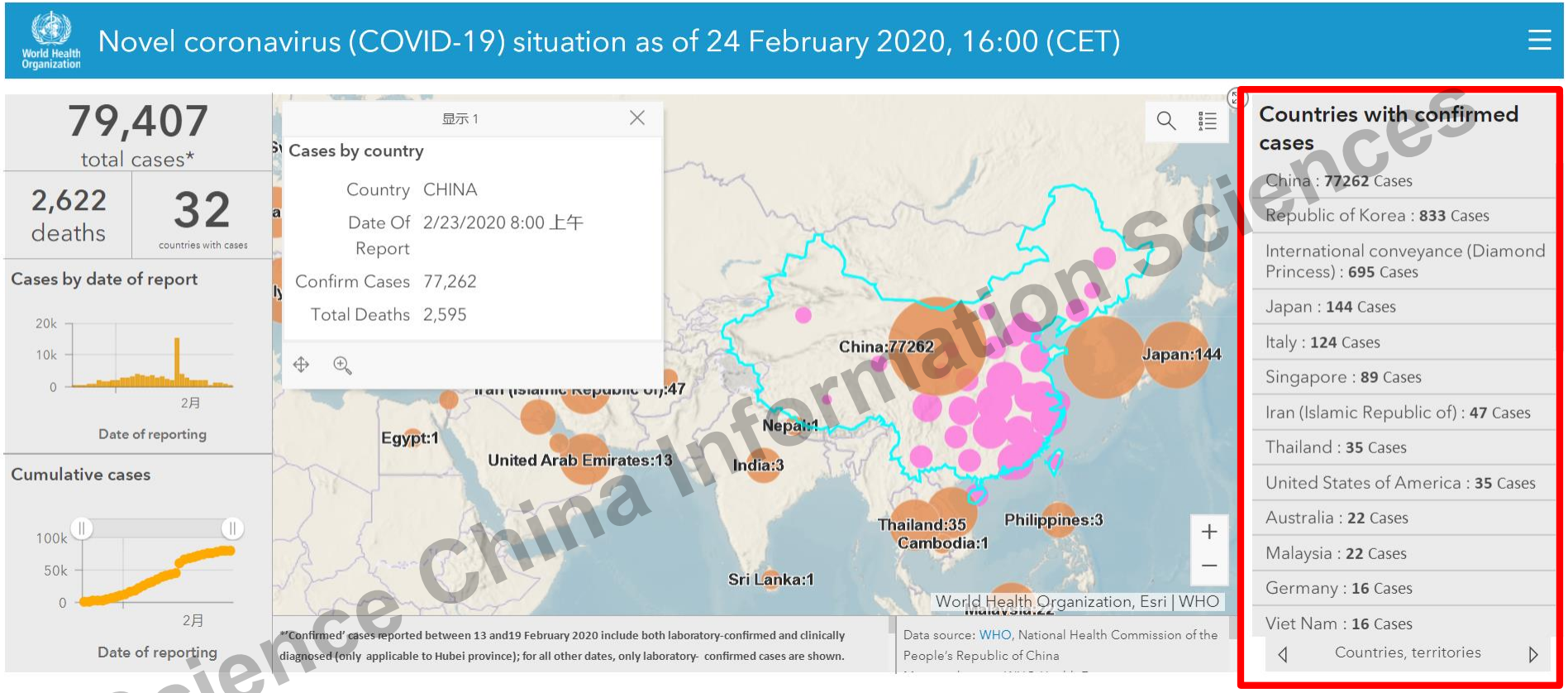
In the winter of 2019, a serious public health event occurred, which was later recognized as a new virus outbreak by WHO and named **Coronavirus Disease 2019** (COVID-19)

01 Background



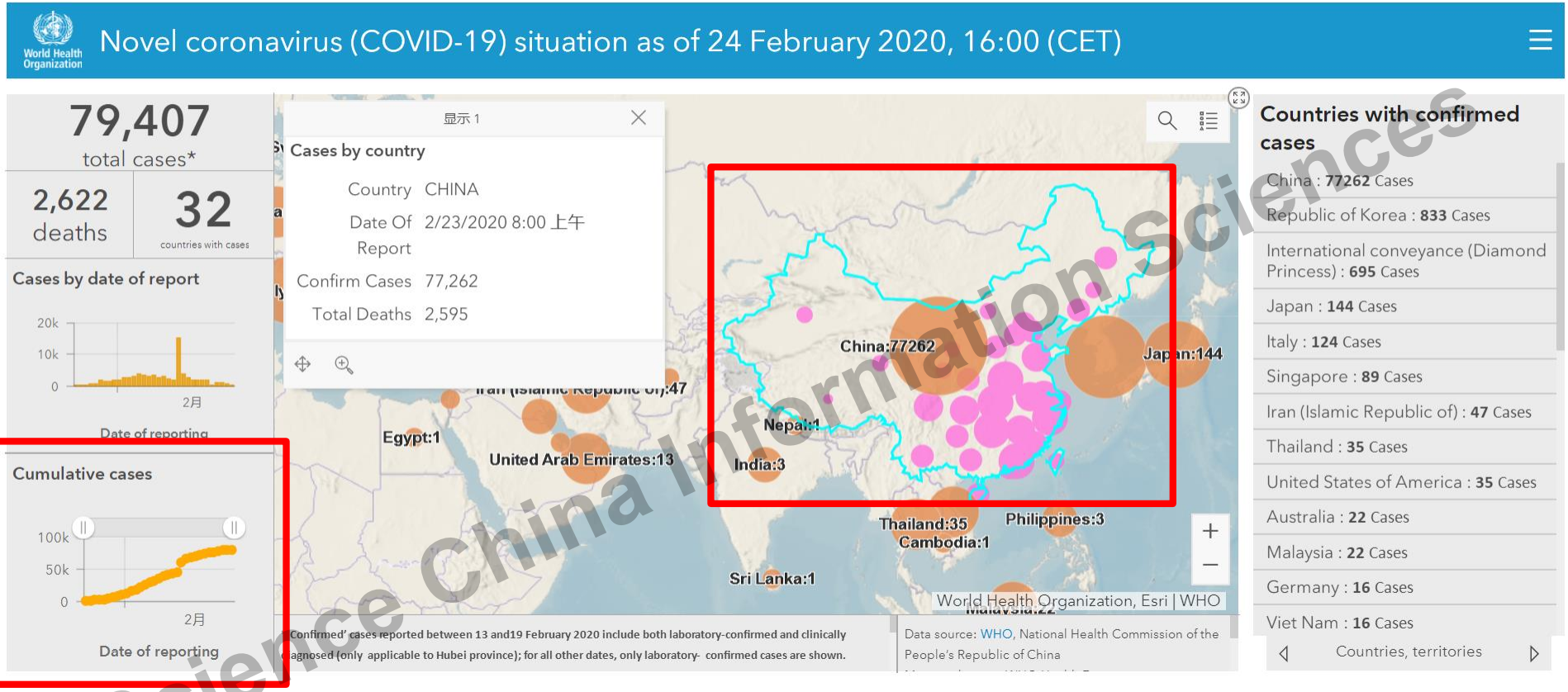
So far more than 70,000 people have been infected, and more than 2,000 have died.

01 Background



Moreover, COVID-19 has already spread to 28 countries, and is causing new outbreaks in certain countries, such as Japan, Korea, Iran and Italy.

01 Background



The influence of COVID-19 has already exceeded that of SARS in 2003. Its spread is **rapid** and extremely **unbalanced**, spanning **four orders of magnitude** in the number of infections in different cities.

01 Background

While classical epidemiological modeling is clearly important, the spread of COVID-19 has been influenced by several factors such models do not necessarily account for

- travel from Wuhan to other cities during the Spring Festival
- airborne transmission without contact
- blockade policies of governments

武汉迁出目的地

文字解读

	名称	比例
1	湖北省	70.67%
2	河南省	6.22%
3	湖南省	3.36%
4	安徽省	2.27%
5	江西省	2.09%
6	广东省	1.66%
7	重庆市	1.27%

Such influences make it quite difficult to predict the spread of COVID-19. One chance event can lead to large consequences.

Content

01 Background

02 Method

03 Case Study

04 Summary

02 Method

We design an intuitive visualization system which allows unprofessional members of the public to grasp the key ideas at a glance.

End User	Collected Data
➢ The public not expert in data analysis ➢ Limited time to read the results	➢ Source: Official release from Health Commission and Bureau of Statistics ➢ Type: the total number of and daily increasing in confirmed cases, the number cured, and the number who have died ➢ the resident population, area…

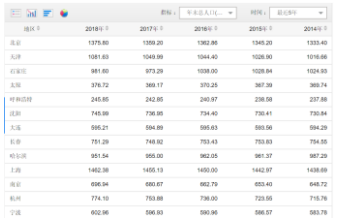



中华人民共和国国家卫生健康委员会
National Health Commission of the People´s Republic of China

国家统计局
National Bureau of Statistics

湖北省卫生健康委员会
Health Commission of Hubei Province

湖北省统计局
Hubei Provincial Bureau of Statistics



02 Method

We design an intuitive visualization system which allows unprofessional members of the public to grasp the key ideas at a glance.

End User

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- Limited time to read the results

Collected Data

- Source: Official release from Health Commission and Bureau of Statistics
- Type: the total number of and daily increasing in confirmed cases, the number cured, and the number who have died
- the resident population, area…

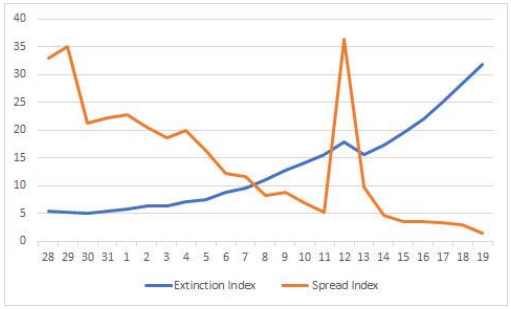
Visualization System

- Some indices are proposed which reveal the essence from the raw data
- Basic statistical charts, ThemeRiver, and bubble charts with no more than 4 visual channels are used, coping well with high dynamic range data varying over 4 orders of magnitude
- The need for interaction should be avoided

02 Method

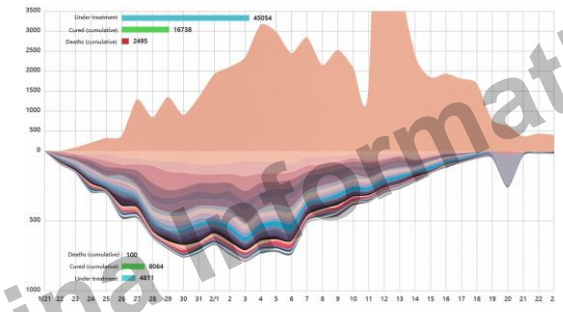
We design an intuitive visualization system which allows unprofessional members of the public to grasp the key ideas at a glance.

Line charts



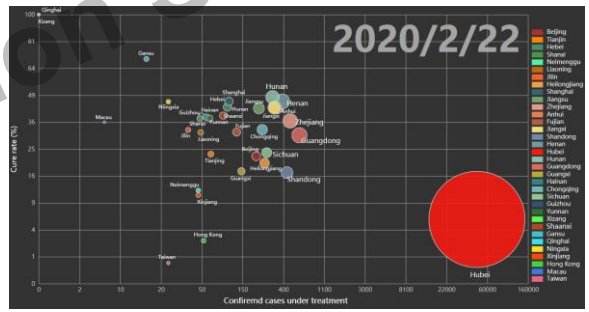
Spread Index and Extinction Index

ThemeRiver



Feb 22

Bubble charts



Hubei: 63889 vs. Xizang: 1

Visualization System

- Some indices are proposed which reveal the essence from the raw data
- Basic statistical charts, ThemeRiver, and bubble charts with no more than 4 visual channels are used, coping well with high dynamic range data varying over 4 orders of magnitude
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02 Method

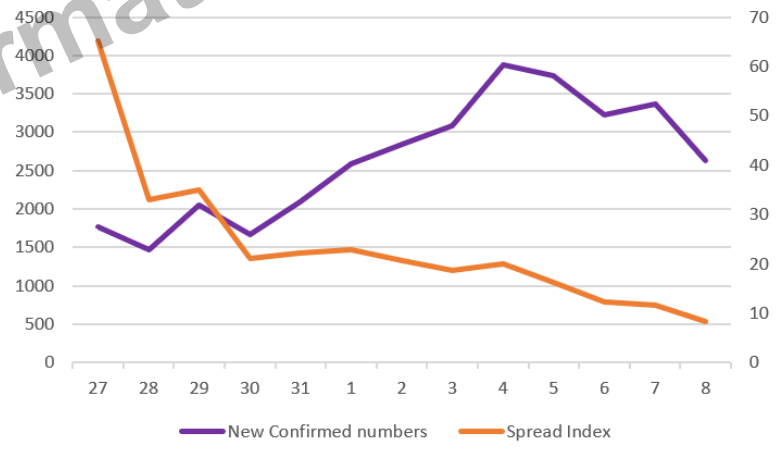
1. Spread Index and Extinction Index

In the early part of the an epidemic spread model, the number of people infected $I(t)$ follows exponential growth.

If $I(t) = ba^t$ in a local domain

Spread Index: $F_s = \frac{I'}{I} = \ln(a)$

Discretely, $F_s(i) = \frac{I(i)}{I_t(i-1)}$ for day i



$I_t(i)$: the number of confirmed cases under treatment

$I_s(i)$: the total number of confirmed cases

$I(i)$: the number of new confirmed cases

$C(i)$ and $D(i)$: increasing in number of persons having been cured and having died

02 Method

1. Spread Index and Extinction Index

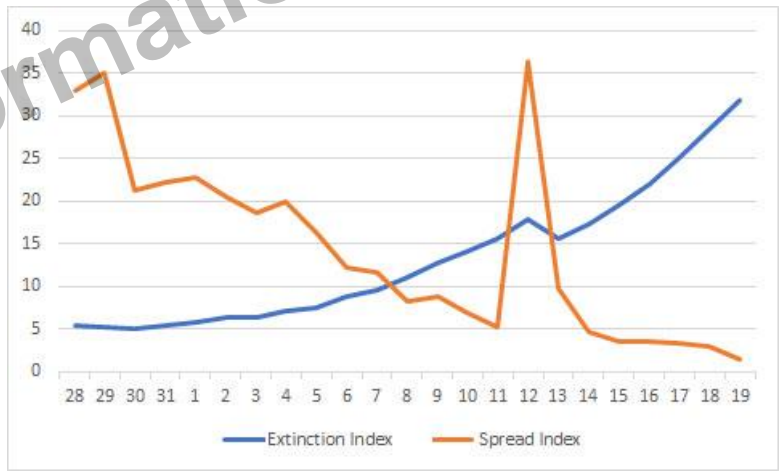
In the early part of the an epidemic spread model, the number of people infected $I(t)$ follows exponential growth.

Spread Index: $F_s(i) = \frac{I(i)}{I_t(i-1)}$

Extinction Index:

$$F_e(i) = \frac{C(i)+D(i)}{I_t(i-1)}$$

for day i



$I_t(i)$: the number of confirmed cases under treatment

$I_s(i)$: the total number of confirmed cases

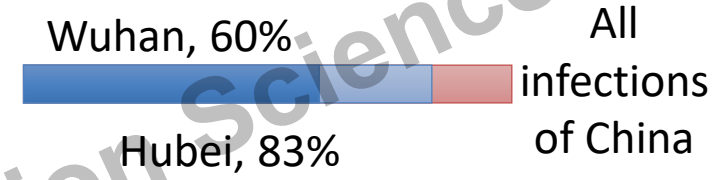
$I(i)$: the number of new confirmed cases

$C(i)$ and $D(i)$: increasing in number of persons having been cured and having died

02 Method

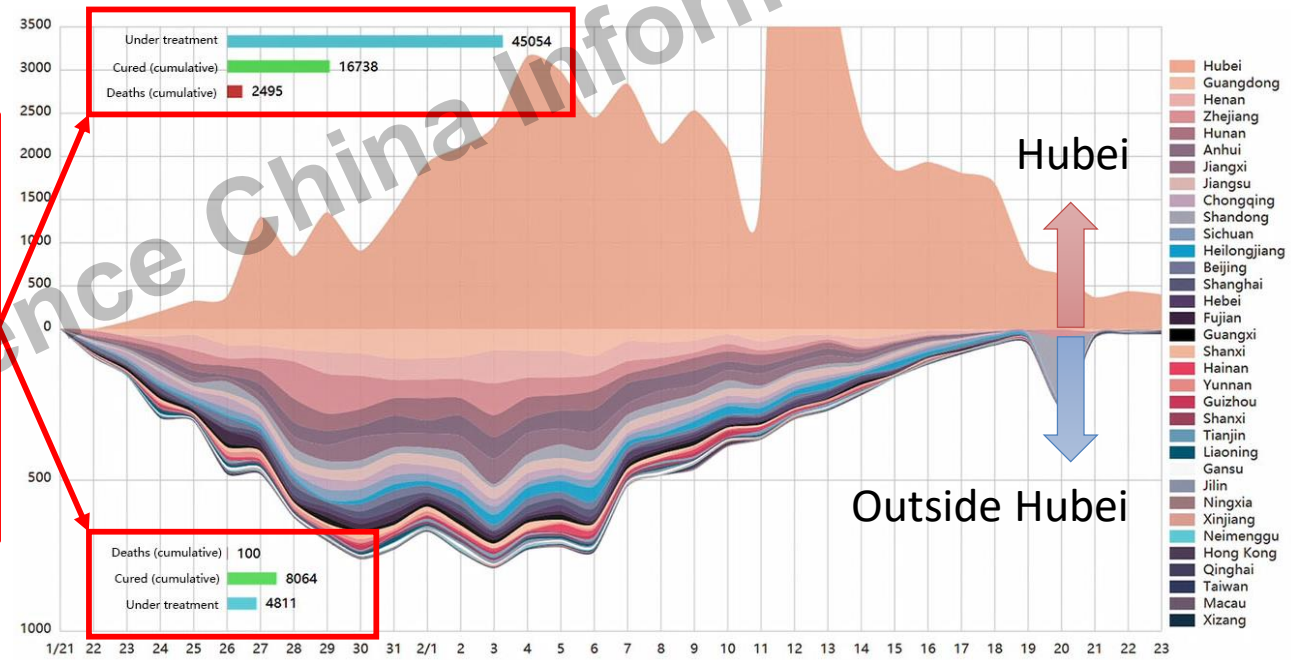
2. ThemeRiver

As noted, the distribution of COVID-19 is extremely unbalanced



We redesign ThemeRiver in three approaches.

Bar charts of the number of confirmed cases under treatment, cured and having died

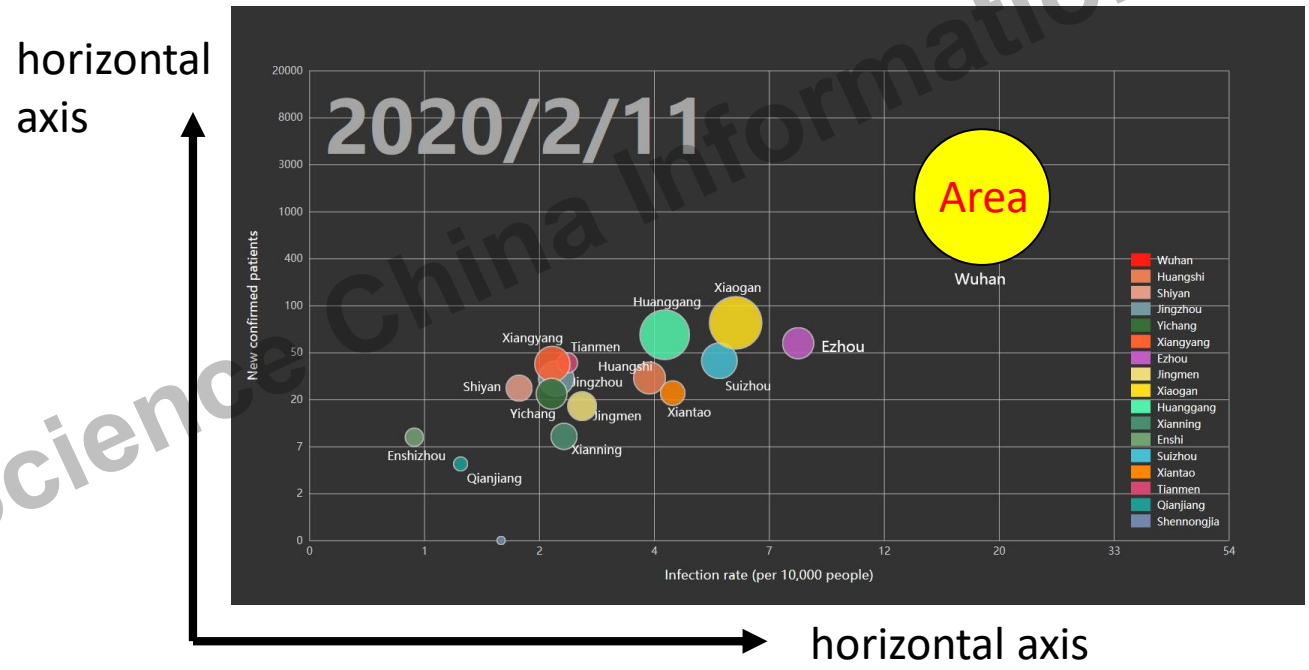


sort in descending order by I_s

02 Method

3. Bubble chart

We use bubble chart animations with only four visual channels: horizontal axis, vertical axis, color and bubble area.



Logarithmic coordinates are used for the two axes and area of the bubble, to handle high dynamic range data.

Content

01 Background

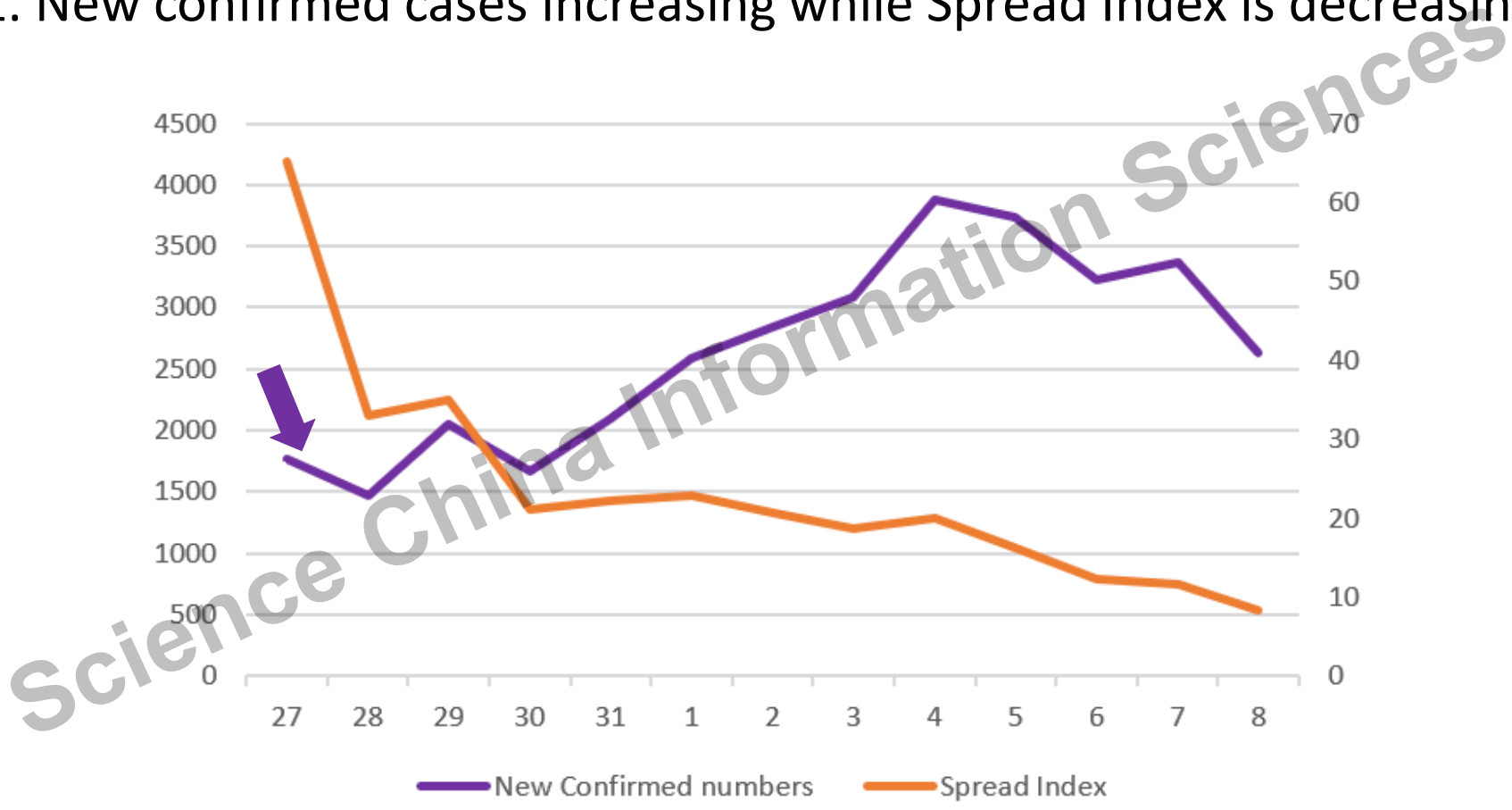
02 Method

03 **Case Study**

04 Summary

03 Case Study

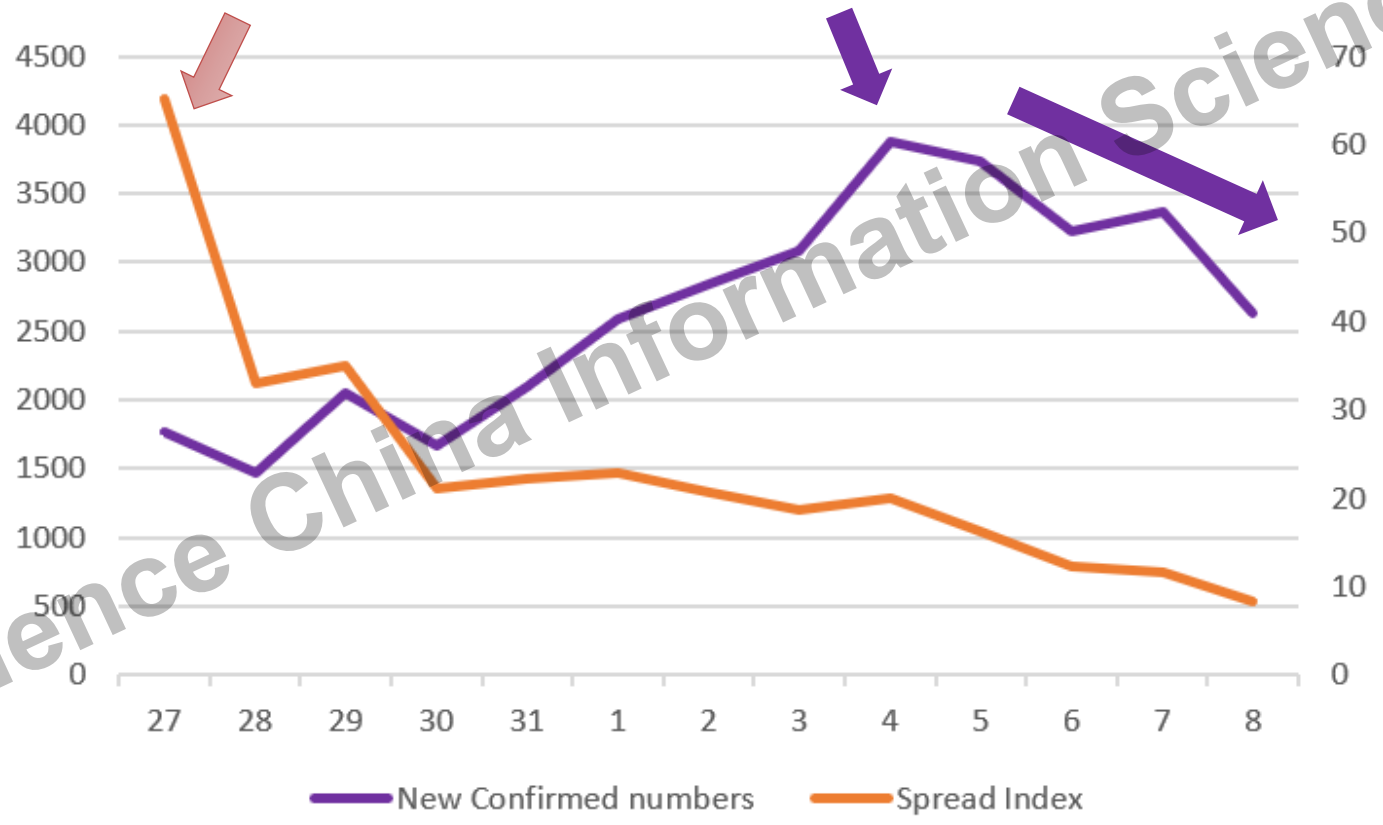
1. New confirmed cases increasing while Spread Index is decreasing



Before 5 February, the number of new confirmed cases across the whole of China was increasing rapidly, causing public anxiety.

03 Case Study

1. New confirmed cases increasing while Spread Index is decreasing



However, the number of new confirmed cases has been increasing, showing that the epidemic was spreading slower and slower.

However, the Spread Index has been decreasing, showing that the epidemic was spreading slower and slower.

03 Case Study

2. Balancing point of Spread Index and Extinction Index

The Spread Index curve is descending while the Extinction Index curve is ascending over time.

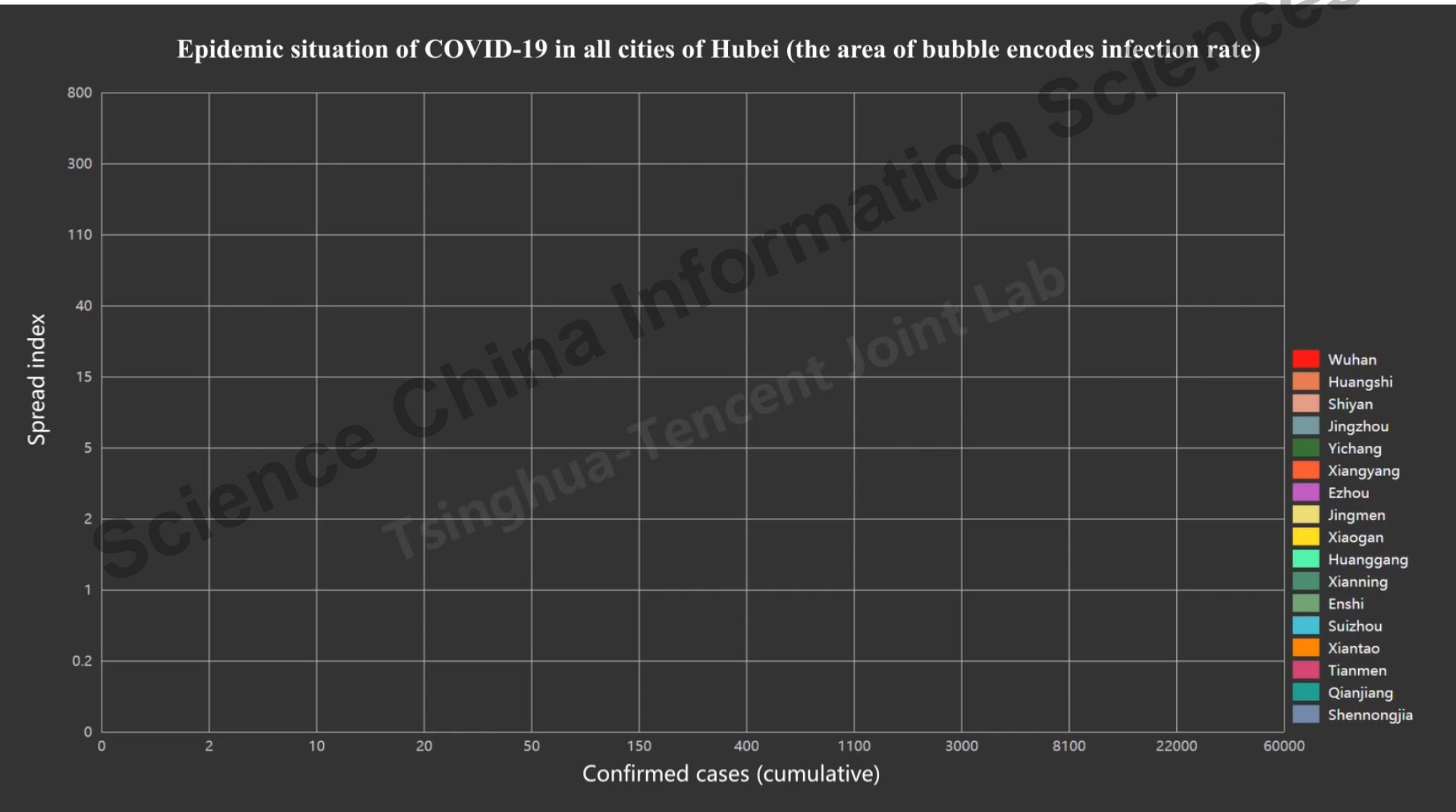
03 Case Study

2. Balancing point of Spread Index and Extinction Index

The balancing point was reached on 7th February. Since that, the number of confirmed cases under treatment has been decreasing.

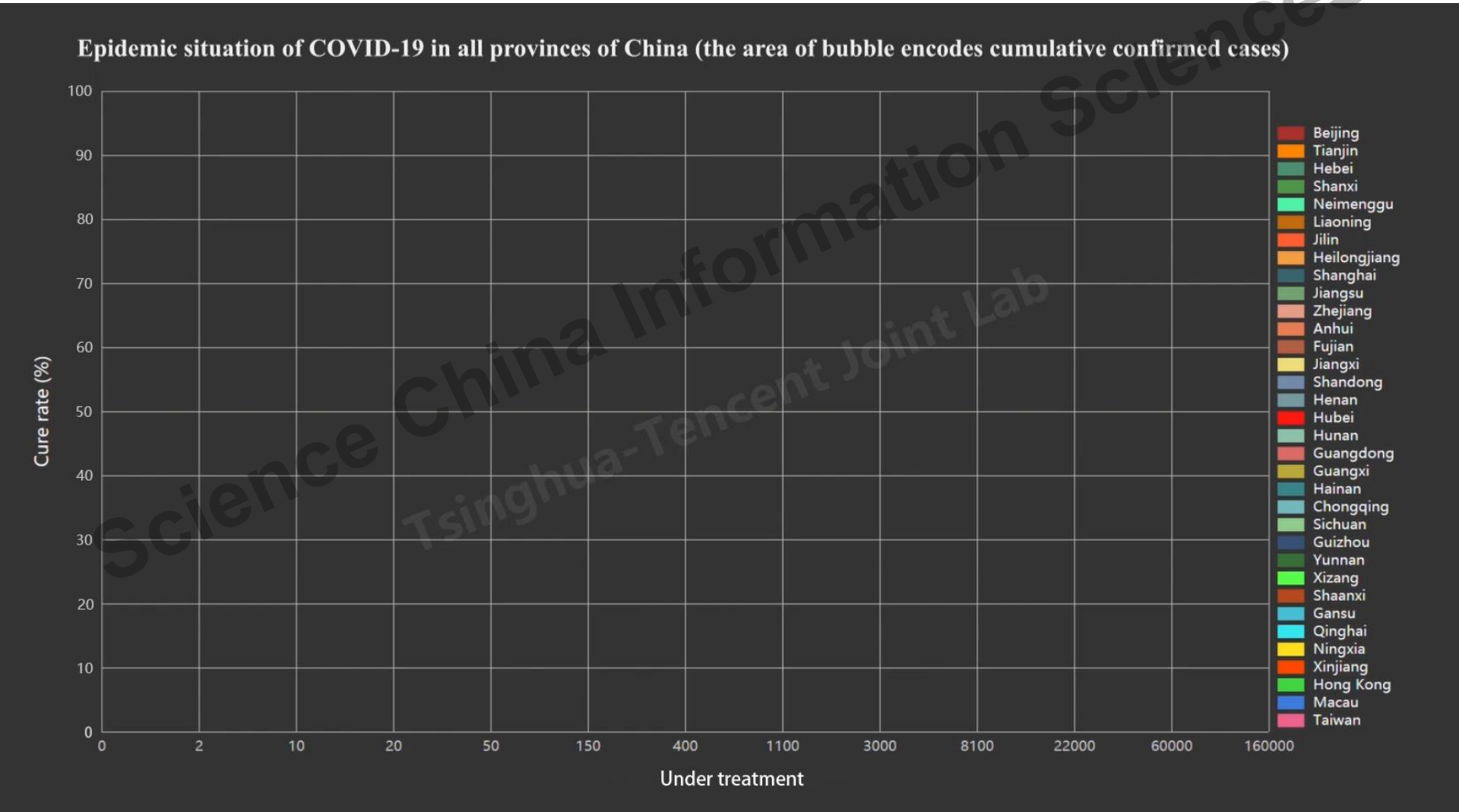
03 Case Study

3. High risk of Ezhou from the bubble chart



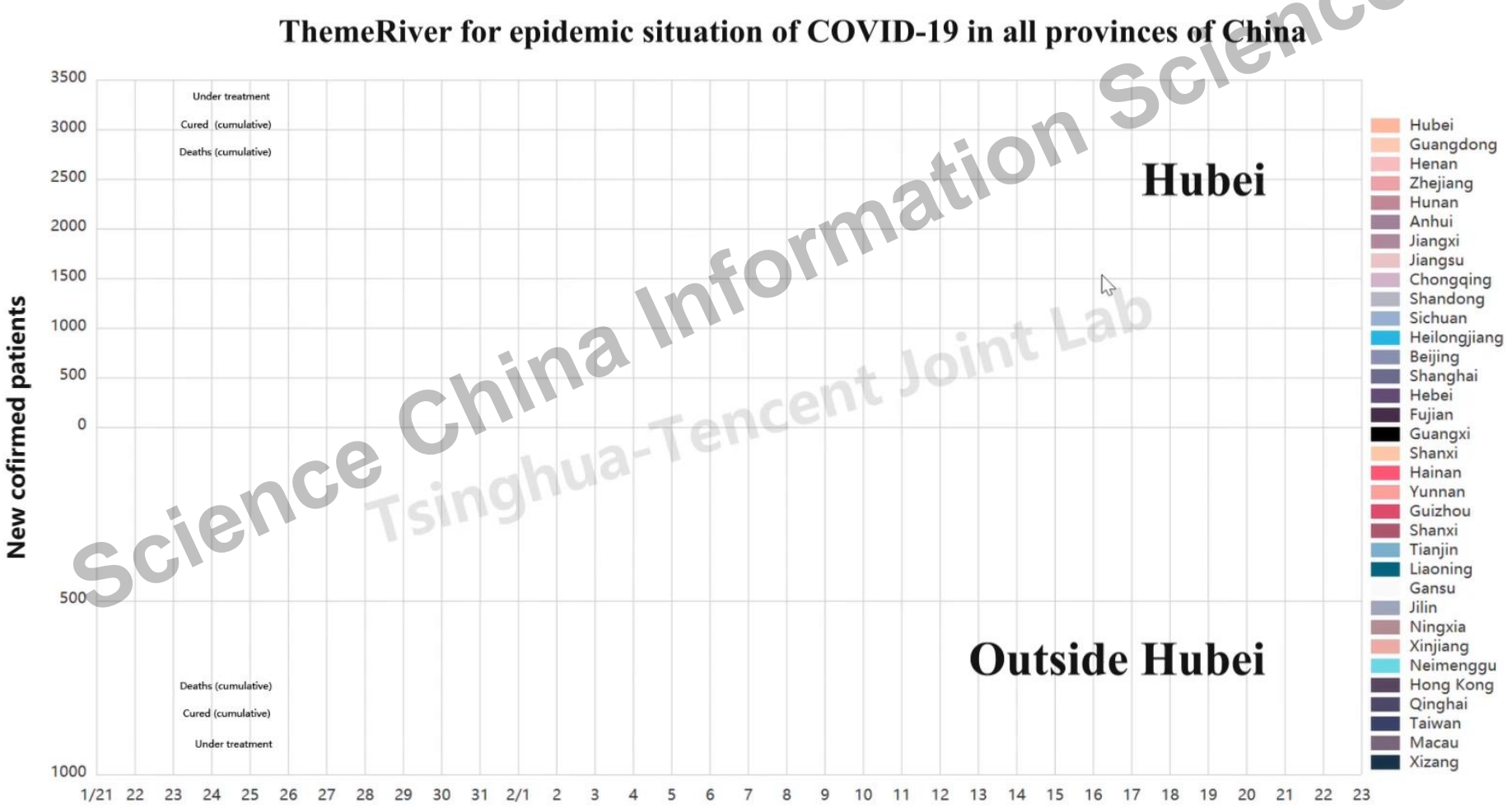
03 Case Study

4. The evolution of the epidemic is on the descending phase



03 Case Study

5. Comparison of Hubei and outside Hubei by ThemeRiver



Content

01 Background

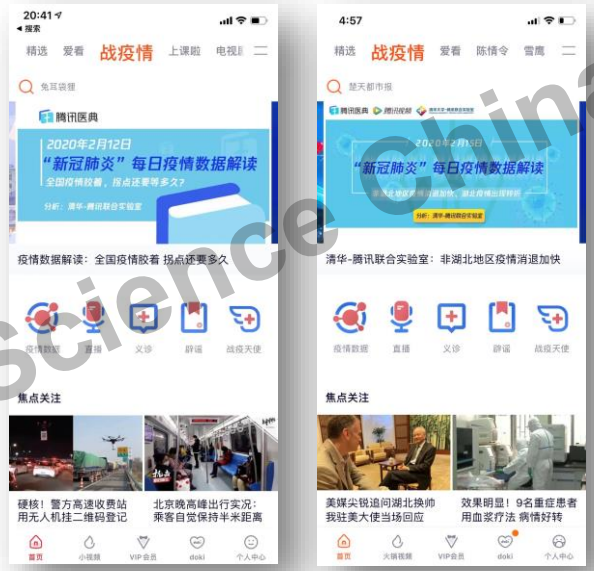
02 Method

03 Case Study

04 **Summary**

04 Summary

- This study introduced a system to analyze and visualize the COVID-19 epidemic situation.
- Using this system, daily reports have been published on the Tencent platforms, gaining high public attention with more than 10 million page views (PV).



Animations are recommended on the main page of TencenVideo

Positive comments on the daily reports

THANKS

武汉加油！ | 中国加油！