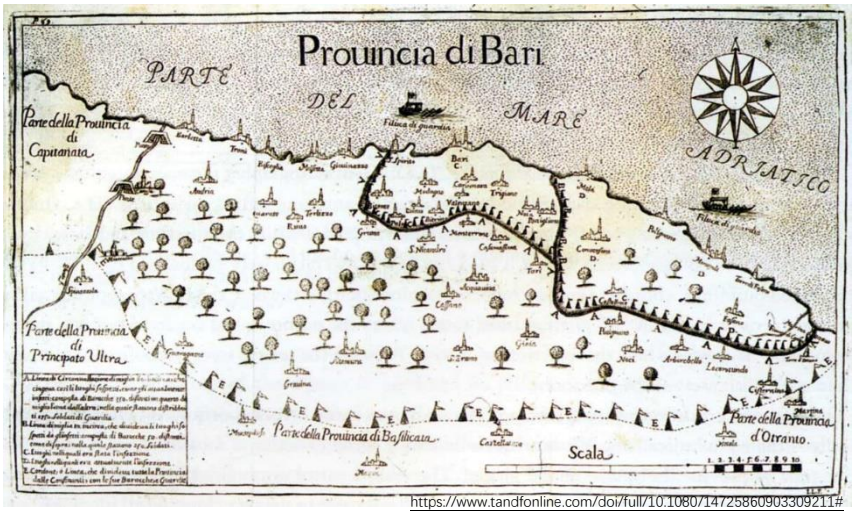
The Role of Visualisations in the Outbreak of 2019 Novel Coronavirus (COVID-19), in China

***Lead and claim**:* In COVID-19, the visualisation of geospatial data helps to show various statistics and predicted data, so that people can more intuitively understand the development of the epidemic through the form of maps. Besides, the visualisations also play a supporting role in tracking and preventing the spread of new coronaviruses. Finally, the visualisations of geospatial data continue to develop, and it will play a more influential role in the future.

The application of visualisations in the field of health can be traced back to the plague control in Italy in 1694 (Wadhwa, 2009). Through map shows the deployment of troops in areas where plague is active and where plague has occurred (Figure 1). Since then, the visualisations of geospatial data have been increasingly used in human health care.



https://www.tandfonline.com/doi/full/10.1080/14725860903309211#

Figure 1. Map of plague containment zones (1690–92) in the province of Bari, Italy, 1694. Tents represent troop deployments on provincial borders, zones of active plague, and those where plague had already occurred. Source: New York Academy of Medicine Library, in Tom Koch, Cartographies of Disease (Wadhwa, 2009).

Today, the visualisation of geospatial data still play a massive role in facing the most infectious novel coronavirus (COVID-19) in history (W.H.O., 2020).

Visualisation of the Cases

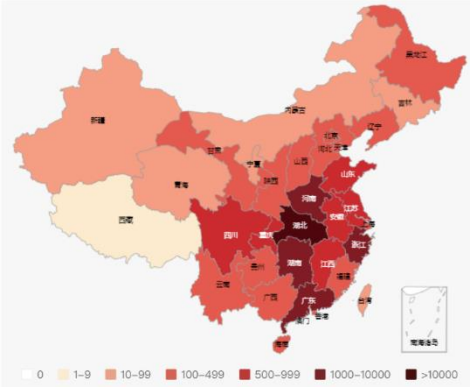


Figure 2. Visualisation of the number of cumulative confirmed cases in China (DXY in China, 2020).

In this epidemic, the main contribution of the visualisations is to show the cases by thematic maps. Whatever static maps or interactive maps or dashboards, every type of visualization plays a role. At the beginning of the development of the outbreak in China, DXY[1] uses the data obtained from the official to make a **choropleth map** per day to indicate the number of confirmed, suspected, death and recovered cases in all provinces of the country (Figure 2). This type of the thematic maps classifies the number of cases in several categories and using gradient colours to represent each category.

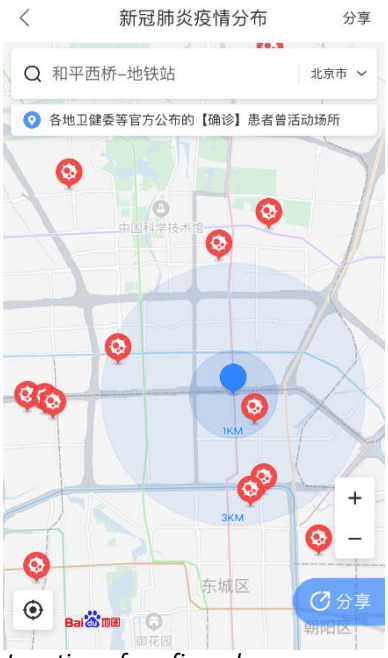


Figure 3. Location of confirmed cases near a subway station. (Red symbol represents the location of cases; blue symbol represents the subway station)

When there are more confirmed patients across the country, Baidu Maps visualised the specific locations of each confirmed patients through **dot density symbol map** (Figure 3). In this map, the patient's personal information will not be disclosed, and each symbol shows one case and its location. Citizens can find nearby cases through this map to avoid passing through the area where has the patients.

In addition, the **dashboard** can contribute to display comprehensive information about the outbreak of COVID-19. Figure 4 shows the dashboard of outbreak progress of COVID-19 in China that made by Mapbox company. This dashboard uses the world map as the background and here using China as the centre location. On the left side of the dashboard, the number of confirmed, deaths, and recovered are shown, and using a stacked bar chart to show these number over time (per day). The time axis at the top right can make the map dynamically show the progress of the virus over time. The middle of right is put a statistical table of the number of confirmed, deaths and recovered in each province. The legend is lying at the bottom of right. This dashboard also integrates different types of thematic maps to represent the number of

[1] DXY is a medical knowledge sharing website, which was founded on July 23, 2000.

cases, including **choropleth**, **proportional symbol**, **diagram** and **heat map** (Figure 4,5).

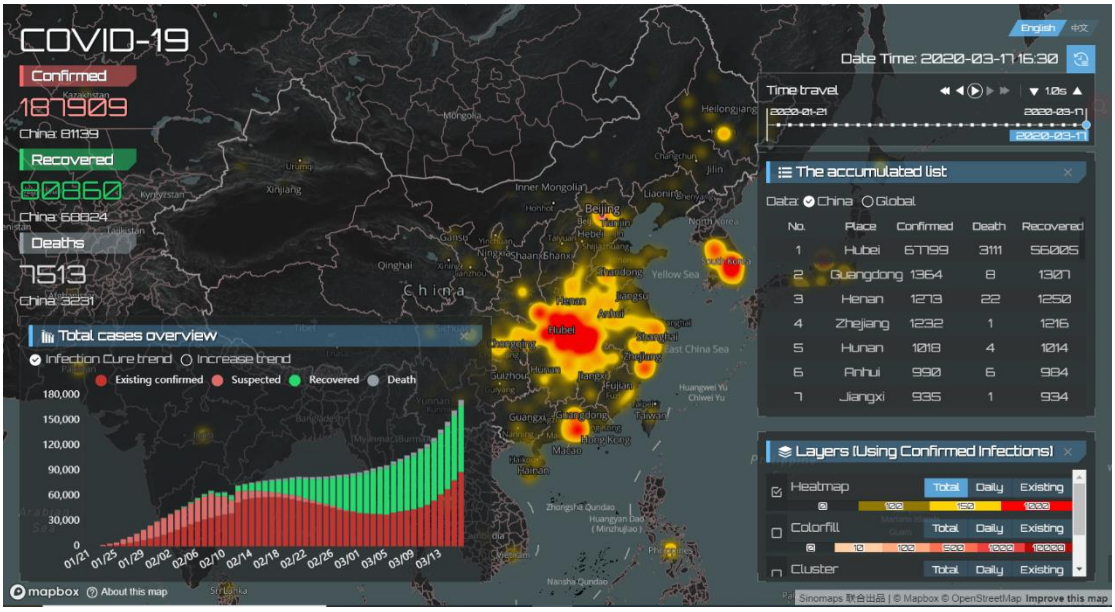


Figure 4. Visualizing the progression of the 2019-nCoV outbreak (Heat map as the background) (Mapbox, 2020)

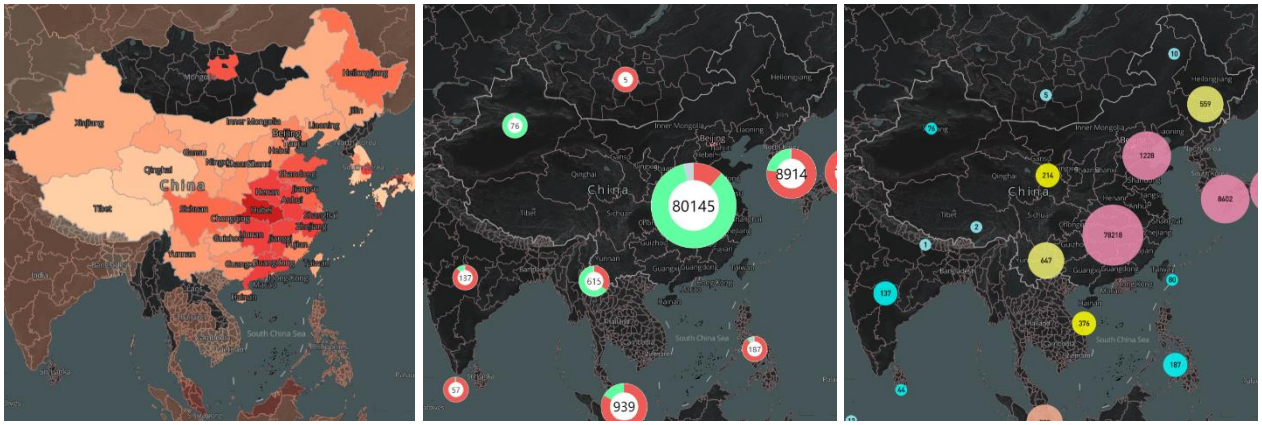


Figure 5. The Types of Thematic Maps using in the Dashboard (choropleth, diagram and proportional symbol map.) (Mapbox, 2020)

Visualise the flow of Potential Patients

Flow maps are also an important type in thematic maps. By visualizing the flights or trains departing Wuhan from the beginning of the epidemic, which countries or areas may be infected can be predicted (Figure 6).

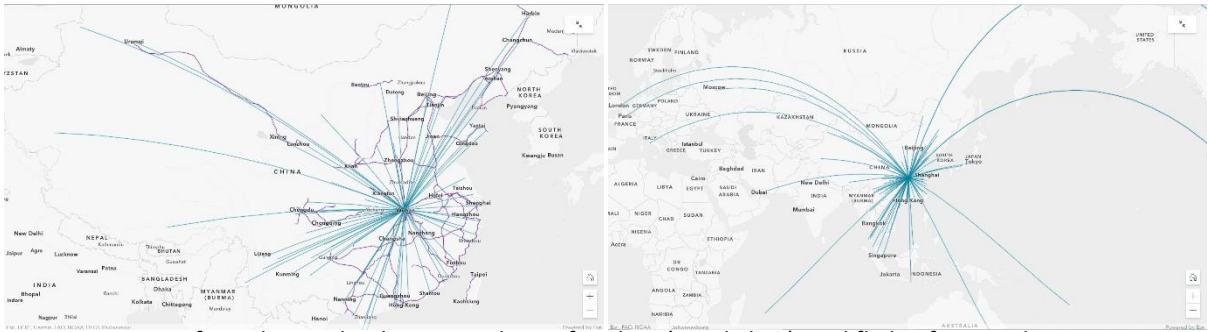


Figure 6. Left: High-speed railway in and out of Wuhan (purple line), and flights from Wuhan to various parts of China. Right: International flights from Wuhan (partial map) (Esir Online, 2020).

“Understanding travel patterns can help health authorities worldwide establish quarantine stations and passenger screening programmes at major international airports” (Boulos and Geraghty, 2020)

Limiting Virus Transmission

The combination of geographic information systems and global positioning systems has also contributed to slowing the spread of the epidemic.

When the epidemic has spread across the country, students were forbidden to return their schools. This rule was issued to prevent students from getting infected on the way back to school, and to prevent students from bringing the virus to school to spread it to others. Most students support the school's decision. However, for some personal reasons, some students returned to the school without applying to the school. To prevent such incidents, the school requires each student to report his or her health condition and geographic information daily through social media platform (WeChat). In this way, the school can manage almost every student, minimizing the infection caused by students returning to school.

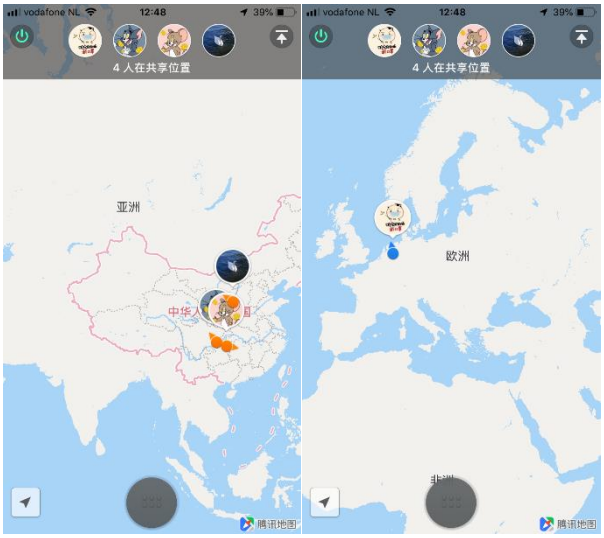


Figure 7. Location Sharing Group. The real-time location sharing feature in the WeChat app allows everyone in the group chat to share location information. In this way, the location information of each student can be recorded every

Nevertheless, obtaining a personal location will involve the issue of location privacy. In fact, people can choose whether to make their location information public on social media. Secondly, in the face of such a severe epidemic, the issue of location privacy may come second. In the future, this problem will be solved automatically when there is no need to constrain people by reporting geographical location.

Conclusion

The visualisation of geospatial data is widely used in this epidemic because of its intuitiveness. Pure text description or table data do not make people feel how severe the outbreak is, nor do they make people realise how close the virus is to themselves. When a person who has no background of visualisation at all just sees these maps, he (or she) can get more information than only text and numbers, and even can compare which type of map performs better.

For some of these visualisations results, the application of cartographic theory needs to be strengthened. For example, the choropleth map is not suitable for express absolute data such

as the number of cases. The proportional symbol and dot density symbol map are the most appropriate types for representing the number of cases. Besides, virus-related symbols or large areas of red should be avoided on the map to avoid panic. These issues that should be noticed in the visualisation can be discussed separately. Whether or not the mapping method is entirely correct, these visualisations have contributed to expressing the number of patients, analysing possible destinations of potential patients, and slowing down the spread of the virus.

Disease will never be avoided, although we don't want this kind of epidemic to happen again. Hope that when the disease comes back, the visualisation of geospatial data can become better weapons to help humans fight the virus!

Reference:

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