Analysis on Spatial Heterogeneity of H1N1 Flu based on GIS Spatial Analysis Technology

CAO Jian-rong[1,2.3,4]
1.Yantai Institute of Coastal Zone Research,Chinese Academy of Sciences, Yantai 264003, China
2.the First Institute of Oceanography, SOA Tsingdao 266061, China
3. College of Environment and Planning, Liaocheng University, Liaocheng 252059, China
4.Graduate University of the Chinese Academy of Sciences, Beijing 100049, China line
Email:caojianrong@fio.org.cn

LIU Yan-jun
College of Environment and Planning, Liaocheng University, Liaocheng 252059, China
email:liuyanjun@lcu.edu.cn

Abstract: The spatial distribution of disease epidemiology has always been the hotspot and difficulty, information technology and GIS technology have been widely applied in epidemiological studies, along with the continuous deepening of the disease spatial analysis development. In this paper taking H1N1 flu as the research object, given that China and Shandong Province, the number of infections and deaths' data was used in geographic information system software and the statistical software for the spatial analysis. The results showed that: the number of infections and deaths in coastal areas is larger than that in inland multi-region, geographic distribution showed a change distribution trend from south to north and from east to west.

Keywords: H1N1 Flu, spatial analysis, geo-statistical analysis, trend

1 INTRODUCTION

The spatial analysis is the most valuable methods in geography about the application of analytical techniques; it also has a wide range of practical value, such as land cover (LUCC), urban planning , environmental assessments and services. And the application of maps and spatial analysis in epidemiology has a long history. In 1854 in London Broad Street John's investigation that cholera outbreak caused by contaminated wells in the epidemiological is an example of the earliest. According to the statistics, 80 percent of the epidemiology has a spatial attribute which disease outbreaks and the geographical location, geographical features are closely related. Therefore, it is significantly important for spatial analysis of geographic information system (GIS) to carry out epidemiological studies.

GIS can achieve the production of various types of epidemics maps, to determine the impact of spatial and temporal distribution patterns of the disease by superposition of multi-factors analysis, and even monitor and evaluate the dynamic changes through the establishment of a database real-time, dynamically disease database. In this article a study of disease distribution, trends, etc. were done by utilizing A H1N1 influenza information in spatial analysis.

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2 SOURCE OF INFORMATION AND DATA PROCESSING

2.1 H1N1 Influenza Source

A H1N1 Influenza in 34 provinces or municipalities, the number of confirmed cases and deaths is from The People's Republic of China Ministry of Health Web site, the cut-off date is February 2010; A H1N1 influenza, Shandong Province, the coastal cities that confirmed influenza cases and deaths is from the Inspection and Quarantine Bureau of Shandong Province Health Department, the cut-off date for data is February 2010. It is showed in Table 1.

Table 1 Data source of H1N1 Influenza

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Items	Area	Source	Start-stop time
The number of Confirmed cases	34 provinces or municipalities	Ministry of Health of P.R China	April 2009 February 2010
The number of deaths	34 provinces or municipalities	Ministry of Health of P.R China	April 2009 February 2010
The number of Confirmed cases	the coastal cities in Shandong Province	Inspection and Quarantine Bureau of Shandong Province	April 2009 February 2010
The number of deaths	the coastal cities in Shandong Province	Inspection and Quarantine Bureau of Shandong Province	April 2009 February 2010

2.2 Digital Map Source

Electronic Chinese map(1:100) of the provincial boundaries was obtained from the national fundamental geographic informationsystem database http://nfgis.nsdi.gov.cn) to. Shandong Province of digital map intercepted from the national map.

2.3 Other data Source

The population of 34 provinces and cities are from 2008 China Statistical Yearbook and the 2008 Statistical Yearbook of Shandong Province.

2.4 Data processing

2.4.1Data pre-processing

To begin with, we established the Influenza H1N1 confirmed the monthly summary of the number and the number of deaths summary database in national 34 provinces and municipalities and along the coast to the city in Shandong Province from April 2009 until February 2010; Taking the ratio of population to former data as the ratio value library ,it will eventually import from Arcgis9.3 software as .Shp file form.

2.4.2Data transformation

Kriging analysis of the difference will meet the normal distribution of data needs. Therefore, after using QQ Figure validation data it was showed a skewed distribution as we found, and after a logarithmic transformation the data was normally distributed, and transformed data on the number of data and processing the ratio of libraries to be updated. Before and after transformation QQ shown in Figure 1a, b, through which the transformed data was normally distributed be carried out correlation analysis.

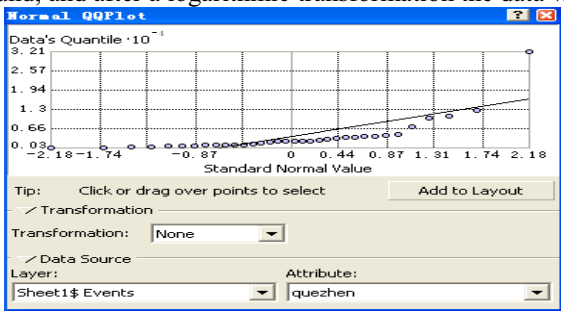

Fig1a The QQ map before data transformation

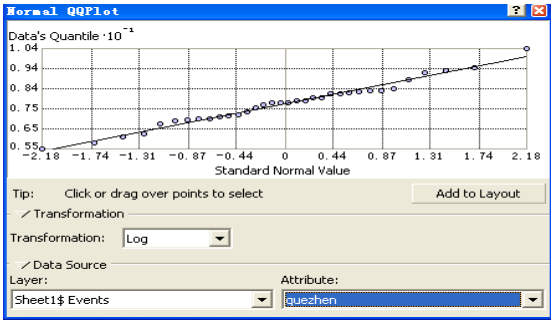

Fig1b The QQ map after log transformation

2.4.3 Kriging Interpolation prediction analysis

Data interpolation refers to the value based on known sample points to estimate the unknown point values. Spatial interpolation is based on the similarity of adjacent samples to generate the principle of the surface, that is, the value of the measured samples is generated on the surface to predict the entire study area, the value of each position and to assess the prediction error and variability of the surface. Spatial interpolation in the field of public health has a large significance, but as a disease of space sample points is relatively limited. So, how to understand the overall situation from the sample points of the entire study area and the value of the limited space to is a difficult one. Margin forecast for the Kriging method provides a solution.

Kriging interpolation is a surface fitting method as following: description of information, and exploration the data, fitting models, diagnostic models, comparison model five steps, finally interpolation maps. With the GIS software development and continuous innovation in the ArcGIS9.3 it is relatively easy to implement.

But spatial data points is relatively less here, so the first step is software Surfer8.0 by ordinary kriging method of grid formed by the difference data and saved as.dat file, and then through ArcGIS9.3 difference Kriging prediction software is more satisfactory.

2.4.4 Data analysis

A H1N1 influenza related trend analysis and forecast maps were completed in software ArcGIS9.3. The disease variant functions in statistical finished by Professional Software GS + (Geo-statistics Software for the Agricultural and Biological Sciences); kriging interpolation forecast results were achieved through software ArcGIS 9.3.

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3 RESULT AND DISCUSSION

3.1 Spatial distribution and trend analysis

Using ordinary Kringing difference based on software Surfer to pre-process grid data, then we carried out IDW analysis through Arcgis9.3. The results showed that there was heterogeneity in spatial distribution, the number of H1N1 influenza confirmed cases and deaths, which was showed in Figure 2a, b. The results showed that the spatial distribution of infection and death there was difference between from East to West and North to South, East and West differences reflected in the distribution of density along the coast than inland, while the south was relatively bigger than the north. This results corresponded to the trend based on ArcGIS9.3 statistical analysis tools to analyze the followings Figure 3.

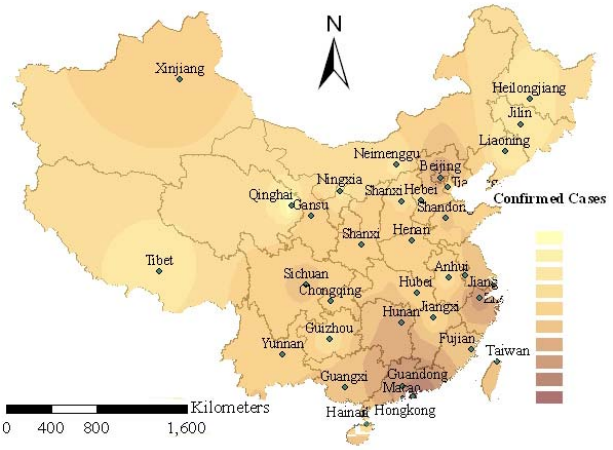

Fig2a Percentage of H1N1 influenza confirmed cases

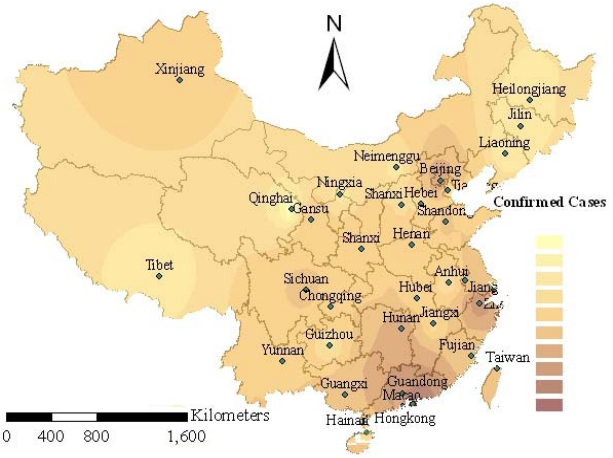

Fig2b Percentage of H1N1 influenza deaths

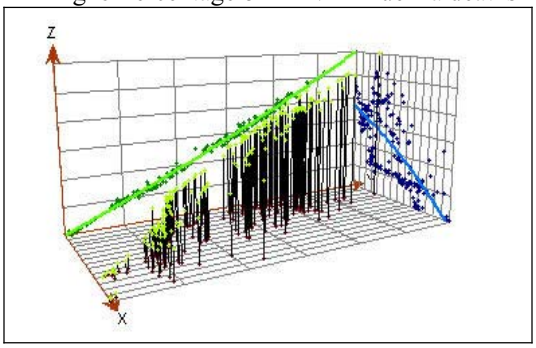

Fig3 three-dimensioned image of H1N1 Influenza confirmed cases

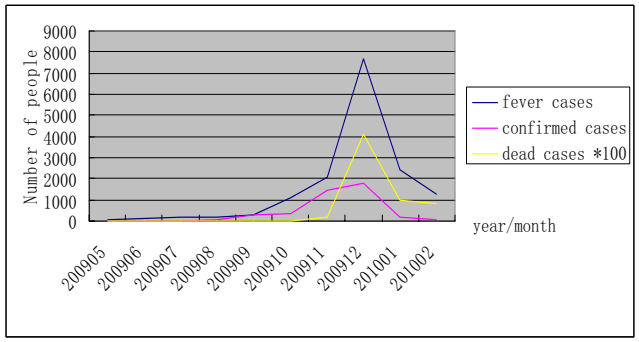

Fig4 Every H1N1 Influenza cases distribution in Shandong Province

In addition, according to the number of infections geographical distribution, Chinese economically developed Yangtze River Delta region, the Pearl River Delta (including Hong Kong and Macao) and the Bohai Economic Rim (including Beijing) ,all the distribution density and the number of deaths are highly relevant to the level of economic development and the population mobility. As to Shandong Entry-Exit Inspection and Quarantine of the relevant data (see Table 2, Figure 4), In Shandong Province, the proportion of infections and deaths in coastal areas is larger than the interior, and input more cases mainly through the civil aviation and the port. The peak of H1N1 influenza appeared in December 2009. The time period is the high rate of ordinary flu, A H1N1 influenza is also a peak; in 2010, after then entering a steady decline period.

Table 2 H1N1 Influenza cases in Shandong Province

Area	Confirmed cases	Deaths	Input cases (transportation vehicles)
Coastal area(%)	71%	69%	77（civil aviation, passengers ships）
Non-coastal area(%)	29%	31%	23%（civil aviation,motors）

3.2 Trend prediction and analysis

Statistical analysis tools adopted software ArcGIS9.3 used in Kriging margin prediction to analysis the H1N1 influenza all over the country's distribution and trend prediction in China. Specific infection rates and deaths using the ratio derived by multiplying the arithmetic average value of 10,000, and the difference between the results using surfer, after using the GS + tool to find the variation of the function, and then ArcGIS9.3 difference between the statistical analysis tools kriging prediction tools can be achieved. The prediction result was showed in figure 5.

Based on the prediction result, it seems the H1N1 influenza focused on Chinese coastal areas, such as Jiangsu Zhejiang Province, and Guangdong Province; Beijing City is also a high incidence area. The specific reasons are highly relevant to good economic development and high population movement.

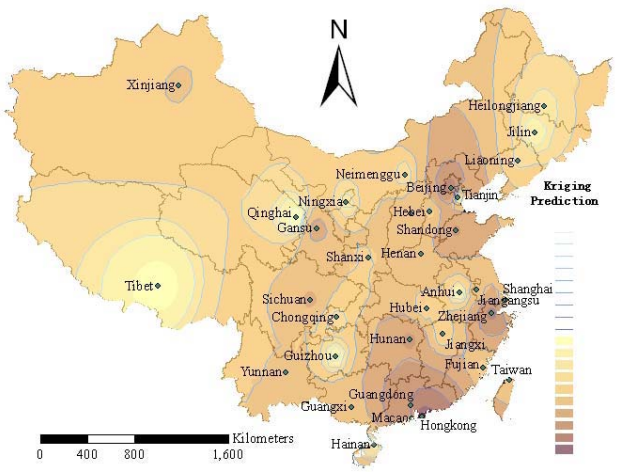

Fig5 Kriging prediction of Percentage of H1N1 influenza deaths

4 CONCLUSION

(1)GIS spatial analysis techniques can be used for Influenza A H1N1 influenza-related spatial distribution, trend analysis and margin forecast and so on.

(2)Based on the research, the spatial distribution trend of Chinese H1N1 influenza are from the coast to inland, from south to north and there is clear trend in the number of infections and deaths more concentrated in the economically developed coastal regions, Taiwan area is more concentrated, This may be related to economic development and high population movement.

(3)Based on the research, the spatial distribution trend of Chinese H1N1 influenza are from the coast to inland, from south to north and there is a clear trend in the number of infections and deaths more concentrated in the economically developed coastal regions, Taiwan area is more concentrated, This may be related to economic development and high population movement.

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