

# The GIS Technology Application for the Forest and Grassland Fire Monitoring by Using Meteorological Satellite Data

XuZhe, LiuCheng

National Meteorological Satellite Center

No.46 ZhongGuanCun South Street 100081, Beijing, China

[xu2j@nsmc.cma.gov.cn](mailto:xu2j@nsmc.cma.gov.cn)

**Abstract:** Owing to the higher temporal resolution, meteorological satellite data is widely used to monitor the disasters happened on the earth's surface. However, the precision of identifying disaster information is limited by the poor spatial resolution. As known, GIS technology is good at processing and analyzing the geographic information. The result shows, integrating with GIS technology, the ability of monitoring forest fire using meteorological satellite data has been greatly improved.

**Key words:** GIS technology, Forest Fire Monitoring, Meteorological Satellite

## 1. Introduction

It is known that fires are the worst hazard for forest resources. It not only causes the losses of forest and property, but also severely destroys ecological environment. In order to monitor and control the forest fire disaster early, we have actively developed and applied the forest fire monitoring techniques using meteorological satellite data in China, which has played an important role in fire fighting. Obviously, meteorological satellite data applied in forest fire monitoring has demonstrated advantages of high sensitiveness, time-effectiveness and low cost. However, the precision of identifying disaster information is limited by its poor spatial resolution. As known, GIS technology is good at processing and analyzing the geographic information. Therefore, integrating with GIS technology, the result of monitoring forest fire using meteorological satellite data will be greatly improved.

## 2. GIS Technology

Geographic information refers to all number, letters, images and graphics described the quantity, quality, distribution, relationship and regularity of elements and materials in the geographic environment. Obviously, geographic information is not only correlated with the spatial location but also temporal dimension, i.e. spatial-temporal characteristic, which distinguish geographic information from other information. Hence it is necessary to collect, update geographic information in time and keep them credible, or else we will not make correct decision and forecast. GIS is an integrated technology system to process and analysis the spatial data.

## 3. Application of GIS in Monitoring Forest Fire using Meteorological Satellite Data

### 1) Establishment of Basic Geodatabase

In order to meet the needs of monitoring forest fire using meteorological satellite data, we have established many basic geodatabases, which include:

The administration map of China in the scale of 1:1,000,000, including the boundary of country, province and county, the location of residential area of city and county seat

Land utilization map of China in the scale of 1:1,000,000 and 1:4,000,000 are used to identify the type of land use on the fire spot and display and output image respectively.

### 2) Collection of other Useful Data

Considering the demands of forest fire monitoring, we have also collected the crop phenology information of different growth period in China, which has played an important role in monitoring forest fire in the autumn of 2002.

The Chinese crop phenology grid map was scanned into computer, and then by registration it was georeferenced with the basic geodatabases, finally, it was digitized into vector layer manually, which can make us carry out overlay analysis with fire-spots data.

### 3) Overlay Analysis of Meteorological Satellite Data and the Geographic data

Convert the longitude-latitude location of fire-spots to a point layer, overlaid with the administration map and land-use map, and create distribution map and land-use map of fire-spots respectively. Then based on geographic information, fire-spots information can be classified and analyzed to create different statistical charts, such as charts described the number of fire-spot in each province or each land use class, and so on..

### 4) Mapping the Thematic Map

Select the area of interest from distribution map and land-use map of fire-spots, add some annotations, title, legend and scale on it, and create different scale thematic map. Moreover, we grade the fire-spots based on the number of pixel and then annotated by different size of a symbol on the Chinese administration map. Hence, we can get the thematic map of fire danger class, which well display the location and the number of pixel of each fire-spot.

## 4. Examples

Presently, we can provide a few undermentioned products on monitoring forest fire by GIS technology, which will be of great benefit to weather and fire department.

### 1) Local Hot Spot Distribution Map

Fire-spot data can be accessed from the database of server by telnet, then geocoded with the geographic information, so we can easily identify the fire-spot location from the obtained fire-spot distribution map (Figure 1). We can provide better service for forest fire prevention offices. At present, all these work can be finished automatically, and Internet can issue the products in real time. The fire-spot information was obtained and mapped on the administration map, as shown in Figure 1, the red spot in the map represent the location of fire-spots.



Fig.1. Local Hot Spot Distribution Map

### 2) Hot Spot Statistic Map of Whole Country

The forest fire prevention offices often need to contrast and analyze the historical fire danger information to obtain the spatial-temporal rules of fire occurrence. There are data of 1999, 2000, 2001 in our database of fire monitoring, which can be continuously updated in real-time. Moreover, on the basic map, we could use different color to map fire-spots which happened in the same period of different year, and then by analysis of spatial clustering statistic, the result can be clearly described by histogram, which could make us well understand the fire-happening spatial-temporal rules (figure 2).

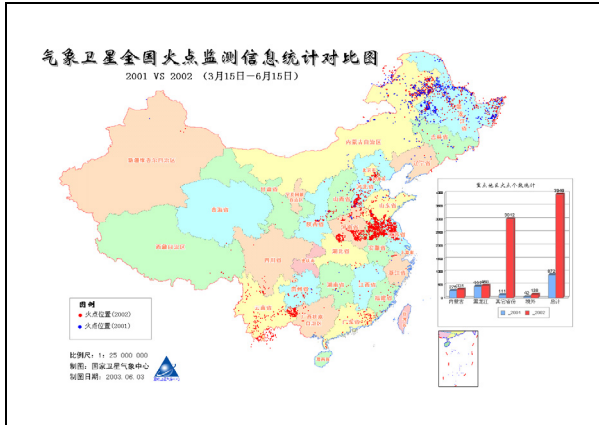


Fig.2. Hot Spot Statistic Map of Whole Country

### 3) Hot Spot Class Map of Whole Country

We can also provide the fire-spot class map, which is necessary and important for fire prevention offices to make decision. For instance, Figure 3 shows the fire-spot class distribution in the range of the whole country. Based on the number of pixel covered, 1-5, 5-25 and 25-50 pixels, fire-spots were divided into three classes. Each class was presented by point of different diameter, the shorter the diameter is the fewer pixels one fire-spot includes, and therefore, we can know the location and distribution of hot spots.



Fig.3. Hot Spot Class Map of Whole Country

### 4) Integrated Analysis with other Useful Geographic Information

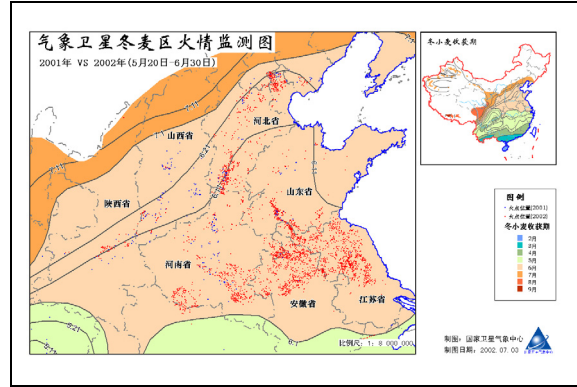


Fig.4. Hot Spot Caused by Burning Dried Wheat Stems

During the detection of fire with meteorological satellite data, weather condition, surface condition and the underlying surface characteristic should be taken into account besides the state of satellite. Obviously, GIS is a good tool to process and analysis these data. In this spring, crop phenology information was firstly introduced to analysis the underlying surface characteristic of fire-spots, which lead to a satisfying result.

Between the later ten days of May and June in 2002, The National Satellite Meteorological Center (NSMC) found that fire-spots happened continually in the north of China, where is mainly covered by farming field. Combined the data analysis of winter wheat phenology during harvest time, it was found that all these fire-spots located in the winter wheat area(Fig.4) and the fires were caused by firing the wheat stems, which was proved by field survey with GPS.

## 5. Conclusions

By using GIS technology, the result of monitoring forest and grassland fire using meteorological satellite data has greatly improved. We can statistic and mapping the hot spot information to find fire-happening spatial-temporal rules.