Monitoring Flood Disaster Using Remote Sensing Data

Zhang Chengcai[1] Chen Xiuwan[2] Zhu Gaolong[2] Zhang Wenjiang[2] Sun ChunPeng[3]

(1.School of Remote Sensing Information Engineering, Wuhan University, HuBei WuHan, 430079)

(2.The Institute of Remote Sensing and Geographical Information System, Peking University, Beijing, 100871)

(3.Bureau of Hydrology, Ministry of Water Resources, Beijing, 100053, China)

Abstracts

Flood is the main natural disaster mostly in the world. It is a care problem to prevent flood disaster generally. The frequency of flood disaster is high and the distributing field is wide, the 50 percent population and 70 percent properties distribute at the threaten field of flood disaster in China. Flood disaster has caused a huge amount of economical losses and these losses have an increasing trend. Along with the development of reducing natural disaster action, it has become one of the most attentive problems for monitoring flood, preventing flood and forecasting flood efficiently. Remote sensing has the characteristics of large spatial observing areas, wide spectrum ranges, and imaging far away from the targets, imaging capabilities all weather. Spatial remote sensing information, which records the full, processes of the disaster's occurrence and development in real-time. It is a scientific basis for management, planning and decision-making. Through systemic analyzing the RS monitoring theory, based on compounding RS information, the technology and method of monitoring flood disaster are studied.

Keywords: Remote Sensing, Geographical Information System, Flood Disaster, Digital Elevation Model

1. Introduction

Flood disaster is an outburst natural disaster. According to report, the economical losses caused by flood disaster are the most grave in fifteen disasters in the world. In china, the occurring frequency of flood disaster is high and the distributing region is wide. About 50 percent population and 70 percent estates are in the flood of threatening region. The economical losses caused by flood are very largeness annually and the losses are increasing.

The surveillance of flood disaster using remote sensing, it may provide much information about the background and condition of the natural disaster's occurring, this helps to define the region, time and harm degree of this disaster before the disaster occurring. The necessary measures will be taken, in order to reduce the natural disaster losses. In the disaster occurring, the process and state of disaster are monitored constantly, the information is transmitted to the all levels fight disaster command organ. This helps them effectual organize fight disaster. After the disaster, the disaster status is widely find out immediately accurately in order to organizing

save, resume production and rebuild homestead.

2. *The theory of flood surveillance using remote sensing*

For every substance, its characters of spectrum are different, due to their construction and component. The whole reflectivity of water is low. It is relative high at wavelength 0.5 to 0.7 μm, its reflectivity is very low after wavelength 0.7 μm, because the water absorbs the infrared. At wavelength 1.00 to 1.06 μm, water has a intensity absorbing apex. These spectral characteristics are any water body possessing, due to the statuses are different, and the whole reflectivity is different. In natural environment, water can almost absorb all the incident energy at the near infrared and far infrared, so its reflectivity is low. The water reflectivity is lower than plant and soil at the infrared wavelength, the water bound can be identified, and the area of submerge can be calculated farther.

Interpretation recognized of water body is based on hue and shape. On image of remote sensing, because of the deep, the case of water fondues, the muddy degree is different, so the images are different too. When the water is shallow and sandiness quantity is more, the hue is tint, thus on the image, the water bound is not distinctness. On near infrared image, water hue is black, because water absorbs near infrared intensively, thus water bound is clear. For the line body such as river, as its wide is larger then certain threshold, it can be distinguish on the satellite image.

Many studies indicate that a good measure to study water body changing using the satellite image. As every image shows the water body instantaneous record, this remedies shortcoming such as the slow of common survey method, the bigness of water level changing, the real-time changing of water status. As satellite image is period imaging, it may reflect water dynamic changing and monitoring the changing of flood areas.

3 The action of using different remote sensing information in the flood monitoring

As the flood monitoring, NOAA data is high temporality resolution but the spatial resolution is lower, which having ability to obtain information day and night and record the course of flood occurring and developing. It is the ideal datum of dynamic monitoring of flood. SPOT image or TM image possesses the properties of many wave bands and temporality, and the resolution is moderate. They can effectively obtain that the land cover information and flood information, and are effective data of the flood submerges losses and the simulation analysis. The side-looking radar on board can capture the flood dynamic information all-weather, and is the optimum information of flood peak tracking and real time monitoring. The geometry capability of aerial photograph is good, the resolution is high .It can provide the most detailed land information. It can raise the flood monitoring precision greatly, for making compound information have the merit.

The super short-term aerospace remote sensing

datum of the meteorological satellite is used the flood monitoring to have much the latent capacity. During the rainstorm, the sky mostly for the cloud covers, monitoring flood has some difficulties with the remote sensing plane. The monitoring period using land satellite is long and the cloud layer cover, so it is impossible. Applying the meteorological satellite plus the radar net to monitor flood, it is good method. TM data period are 16 days. They can get certain flood information constantly, in spite of such period can not reflect the dynamic status of flood, comparing meteorological satellite, the land resolution of TM image is higher, reaching 30 meters, the image scope is covered 185KMxl85KM. It can gain synchronizing information greatly, provides the flood condition of a disaster. If compound the TM and NOAA image, with the NOAA time resolution and TM space resolution, the use value as the dynamic information of NOAA image can be raised.

Many researches of home and abroad prove that the remote sensing information of near infrared is one kind of effective technology of definite water body. According to the test of abroad scholar, the ideal wavelength that recognition water body is between 1.5--1.8μm, since at this wave band, sun intensity is enough. It can't only shine the background body, but also can increase to identify the conditions of water body closed by water plant.

4 The study of remote sensing information compounded analyze

Compound is a match between remote sensing information and the remote sensing information or between the remote sensing information and no remote sensing information in the same region. It has two aspects. One is location match and another is content compound. That forms one team of new space information and one kind of new composite image under the unified geographical coordinates system. The compound purpose of information is protruding special useful subject information, to improve the image environment of target discrimination. The compound source of information can be a remote sensing and other means gained. The compound is not several kinds of information adding simply, often can get new information that original can't provide. So the compound method of information possesses the practical meaning, it is the major aspect of the remote sensing application at present.

As for protruding flood information of high Sediment River, it can be selected land satellite MSS4 and MSS5 wave band reflecting the strongest to the water body to be compounded. Namely MSS4 and MSS5 wave band in the same time, according to their reflection characteristics, then select the public region on two wave bands as the classified region. These is imported the computer, and draws the close pixel information as the classified result.

Multi-temporality compound is the important method of assessed losses to the flood. Based on the time effect of the spectrum characteristic on the ground, Multi-temporality remote sensing data compound has two purposes. One is to improve the ability of recognition and classify precision, according to consider the land cover of recognizing spectrum at the different time and changing rule of space characteristic, to select necessary remote sensing information. Another purpose is to gain the changing information of ground target (calamity and environment), using different temporality remote sensing information, to mate compound, in order to carry on the dynamic analysis. Like the research forest and the change of land and grassland resources, climate, reservoir, lakes and law of river, the extension condition of city, and the better effect are gained.

TM image can gain the synchronizing wide scope information, and provide the flood condition with fixed precision, such as land utilization and crop growing trend etc. The monochromatic wave band is 20 meters to the ground resolution of SPOT satellite image, the panchromatic wave band is 10 meters, it can provide information such as more accurate flood boundary, vegetation, resident ground and river system etc. As for the ground resolution of side-looking radar image, internal has two kinds at present, one is 3 meters, other is 15 meters, it can reflect distinctly the levee, the ditch and the road, breached and the flood.

5 The application of remote sensing technology in flood monitoring

5.1 Using many kinds of image data to investigate the situation of a disaster

The on board synthetic aperture radar with all-weather monitoring ability plays the important role in the monitoring flood, but it is usually used when the flood water level is high and submerged scope is wide. Because so, the flood submerges on the image can reflect the disaster circumstances and distribution basically. The flood appears black on the radar image markedly, because of the relation of regular mirror reflection. So the boundary line between the land and the water is very clear. It can not only easily interpret, but also cross the water border fairly accurately. After defining submerging scope, a submerged loss can be investigated further. The data of submerge is inputted into the computer, we can inquire the loss of submerging very fast, under the support of GIS.

The utilization of the synthesizing aperture radar on board to investigate the condition of a disaster often suffers the limit of image scope, though it can catch hold of the chief condition of the disaster at main district, but it can not investigate all conditions of the disaster. Therefore, it can't offer the data of disaster to authority as administrative region. It happens that the disaster data according to deciding the administrative area of the nation can't be compared to the data from remote sensing image investigation. So, in an administrative unit and a watershed unit, the land lacking the images from

synthesizing aperture radar on board, it is important to collect the TM and NOAA images of land satellite utmost, then to define flood submerges scope and chief submerges items and flood submerges quantity. The disaster data gained from TM image can not modify generally, and add to the disaster data from the investigating data of synthesizing aperture radar on board, then the disaster data of a complete administration cell or the complete watershed can be gotten. But using NOAA meteorological satellite data for filling a vacancy, we will not only draw submerge water body area, but also use the same administrative area or the watershed that the synthesizing aperture radar image and submerge water area of NOAA meteorological satellite image, then the comparison is carried on. NOAA image as for the influence of low resolution on ground, produces the error coefficient to compare with radar image, then to revise submerge water body area , adds to with the data of radar again , in order to gain the disaster data of a complete administration cell and watershed.

5.2 The method of estimating flood submerge scope using remote sensing

The process of estimating flood-submerging scope using remote sensing is as follows:

5.2.1 the obtaining and processing of image data

In the course of studying the flood submerging scope, NOAA satellite image of two temporal can be choose and regarded as the original material: (1) The remote sensing image before the flood occurs, this image regarded as normal water level, absorbing background water body information. (2) The remote sensing image after the flood occurs, according to the temporal image, the most high flood water level be resumed, the flood information can be extracted.

The image-processing scheme is the first, AVHRR image of NOAA satellite has done network correction of equidistant projection of the longitude and latitude respectively before the flood occurring. The second, the man-machine dialog method is used to delineate out the rivers and lakes scope to this two images respectively. The third, the density partition is carried on respective to this two image for the water body recognition, and endowing with the color to the water body, removes other information at the same time. The 4th selected several points, which have the same name in the rivers and lakes above two images respective, use quadratic multinomial to register, and the error of registration is less than 1 pixel generally. The 5th, color synthesis is carried on to these two images, in order to recognize background water body and submerge water body.

5.2.2 Estimating flood submerge scope

(1) Identifying water body

In different particular periods, solar radiation condition, atmosphere condition and ground condition are all not identical, therefore the characteristics of water body information on images are different in different temporal, so the same standard can not be used to recognize the water body on the different temporal

images. Therefore, the water body brightness value, which is AVHRR image of NOAA satellite, will be graded. The water body before the flood is endowed with the green, the water body that the flood occurred is endowed with red, then carrying on color synthesis. According to the color synthesis principle, the submerge water body is redness; the background water body is yellow (green plus red) on the composite image. The hue of other part more dark, the soil humidity are bigger, according to the hue, the flood submerge scope can be recovered clearly, thereby the flood status can be interpreted.

(2) Estimating areas

AVHRR image of NOAA satellite does sampling newly, after the changing of equidistant projection, calculating the land surface area F that one pixel correspond. The surface of the water area before occurring of flood is the arithmetic product of F and pixel number. At the same reason, the surface of the water area after occurring of flood is the arithmetic product that F and pixel number that the flood occurred, this two parts subtract each other, the submerge area of this flood is educed.

Figure 1 shows the monitoring image of flood situation 25/5,1998 in the DongTing lake Hunan province using NOAA/AVHRR. The blue represents the water body.

Figure 2, the monitoring NOAA/AVHRR image of flood situation 6/7,1998, in compared with the image of flood situation 25/5,1998, the around water body of the DongTing lake enlarges obviously, according to calculation, the area of enlarging water body is about 2364square Kilometers (red).

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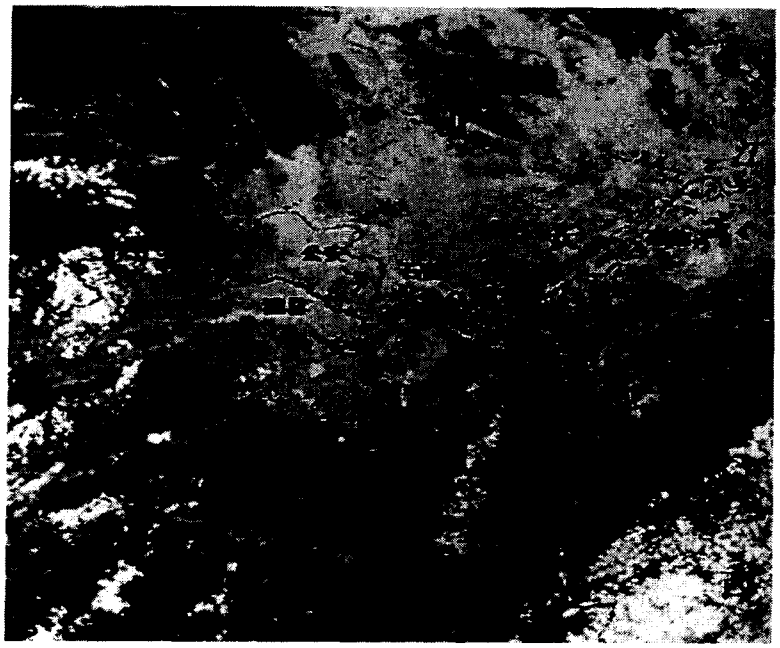

Figure 1 the monitoring image of flood situation, 25/5,1998 in the DongTing Lake

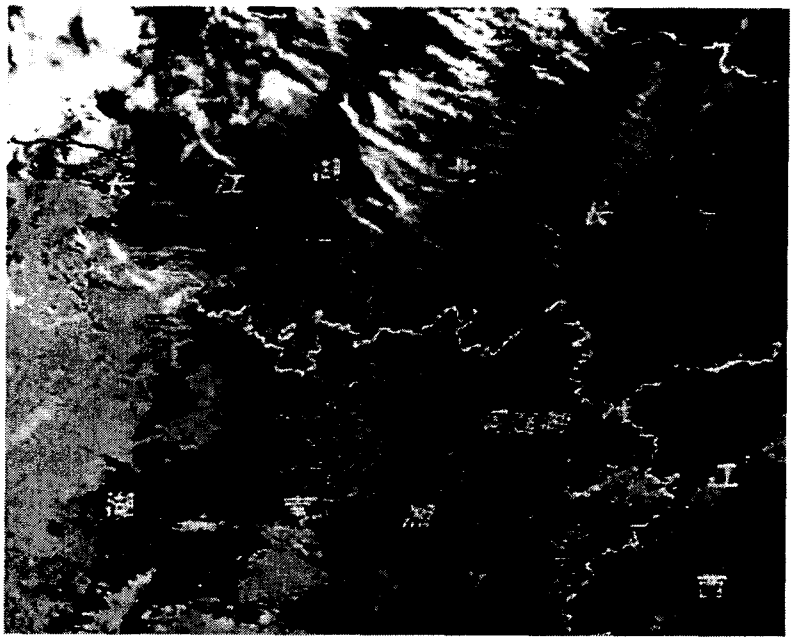

Figure 2 the monitoring image of flood situation, 6/7,1998 in the DongTing lake