Flood Submerged Area Mapping Using the Integration of SAR /TM Images

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Abstract

Real-time flood submerged area map provides important scientific basis for the decision-making of flood control and relieving disaster. Taking the Wuhan area as an example, this article gives out a image interpretation method under influence of flood, and describes real-time or quasi-real-time flood submerged area map by using the integration of ERS—2 SAR image and LANDSAT TM image in support of remote sensing images process software ERDAS.

Keywords image interpretation, TM, SAR, flood submerged area map

1 Introduction

Flood disaster is natural disaster caused enormous losses on present world. According to statistical data of United Nations, disaster loss caused by flood and water-logging account for 40% of annual various natural disaster losses on the world. Because of historical reasons and influence of physical geographic element, Chinese principal economic flourishing region and agricultural region is mostly situated in the region of mid-lower river basin, so that flood disaster has very serious harm for national economic development and social stability and unity.

Flood monitoring and flood disaster evaluation is principal basis for decision-making of flood control and relieving disaster. With development of society, traditional acquisition way of hydrologic data can not far satisfy the needs for the decision-making of flood control and relieving disaster because of its non-determinacy and non-real-timeliness. But remote sensing technique possessed the characteristics of real-timely and quasi-real-timely collected information can be very will solved above problem.

Multi-spectral remote sensing images (example MSS,TM,SPOT etc.) and Synthetic Aperture Radar (SAR) images all have very important signification in respect of flood disaster monitoring and decision-making of flood control and relieving disaster. This article attempts to take the Wuhan area, Hubei Province as example, and inquire into information extraction method during flood period in respect of image processing, interpretation key and TM image integrated with SAR image by using Landsat TM image and ERS-2 SAR image in support of remote sensing images process software ERDAS, so that real-time and quasi-real-time flood submerged area map is described, and a scientific basis can be

provided for decision-making of flood control and relieving disaster.

2 Survey of test site and image data

The Wuhan Area situated mid-lower basin of Yangtze River is the area where economy is more flourishing and population is more dense. Wuhan City is the most landlocked city in China, also is the area where flood disaster is more serious, so that the city has become key section in respect of flood control . A large basin-wide flood was occurred in mid-lower basin of Yangtze River on June~Sept.,1998. The flood is second only to the disastrous flood on 1954.

TM image has a lower resolution than aerial photograph, but it has the characteristic of multi-temporal, multi-spectral and low cost possessed not aerial photograph, so that it become very important image information in flood monitoring. SAR can all-weather acquire dynamic information of a flood, and has not the limit of various weather situation. SAR image can provide the most detailed ground information according to geometric characteristic clearer and resolution higher, so that it is best information in respect of flood peak tracking and real-time monitoring. Therefore, TM image and SAR image is principal image data in this study. Landsat TM image on Sept.25,1996 is made as image data in normal water period before flood disaster occurrence. ERS-2 SAR image on Aug.13,1998 is made as image data in flood period.

3 Advantage of image integrated and image processing step

SAR image integrated with TM image has as follows two advantage: ① SAR image is more sensitive to dielectric constant which is a index of soil moisture. In addition, the boundary between water and land can be easily distinguished in SAR image. ② SAR image is not affected by weather or day and night changes, so that we can regularly acquire multi-temporal data applied flood monitoring. TM image provides the distribution of land-use type and water body in normal water period before flood disaster occurrence . Applying SAR image in flood period integrated with TM image, we can recognize flood submerged area, analyze land-use type and estimate flood loss.

Various source (remote sensing and non-remote sensing) information are integrated. Integrated information steel keeps up the advantage of each source information, so that accuracy of flood monitoring may have risen greatly. Concrete step of image processing as follows:

(1) TM image in normal water period before flood disaster occurrence is chosen. Background information of water body is extracted in TM image, so that two-state picture respectively expressed water and land is described.

(2) SAR image within one week after flood disaster occurrence is chosen. Flood information is extracted in SAR image, so that flood submerged area picture is described.

(3)Above two pictures are strictly registered and composed, so that flood submerged area map is described.

4 The description of submerged area map

A part of image relative to the Wuhan area on firsthand TM/SAR image is only processed for convenience of the study. In support of remote sensing image processing software ERDAS, first, TM/SAR images are respectively processed; then, two-state pictures of TM/SAR are integrated, so that flood submerged area map is described.

4.1 TM image processing in normal water period

Because TM1 waveband is influenced by atmospheric scattering, and resolution of TM6 waveband is lower, images of TM2,3,4,5,7 waveband are only chosen.

(1) Geometric correction

Applying Ground Control Point (GCP) Editor, some ground control points are chosen in same position of topographic map and TM image under dual pattern, so that geometric correction is accomplished.

(2) Image enhancement

Kauth-Thomas (K-T) transformation is chosen in image enhancement. K-T transformation can achieve data compression and kelp us to interpret and analyze surface features.

Brightness, greenness and humidity three pictures related to surface features may be extracted by means of K-T transformation.

(3) Classification

Applying data of above three pictures as feature vectors ,supervised classification is chosen. Because of only requirement of projecting water body for flood analysis, training sample can be simply divided into water body and land two type in normal water period. Hence ,two-state picture of water area and land is described by means of Parallelepiped Classification Rule. Water area is defined as red in two-state picture.

4.2 SAR image processing in flood period

SAR image is a single-waveband and single-polarization image.

(1) Geometric correction

The purpose of geometric correction is that surface features on SAR image is identical with same surface features on corrected TM image in respect of relative position, so that dynamical analysis of flood disaster is made, and therefore only geometric registration is accomplished. Applying GCP Editor, some ground control points are chosen in same position of TM image and SAR image under dual pattern, so that geometric correction is accomplished.

(2) Despeckle processing

There are speckle noise on SAR image because SAR image is influenced by slop, roughness and vegetal cover of ground. Therefore, despeckle processing is essential to SAR image. Sigma filter is chosen to accomplish despeckle and filtering for SAR image. The results of despeckle processing is better.

(3) Image enhancement

The purpose of image processing is to give

prominence to water body. Luminance inverse, edge detection and texture analysis three processing methods are respectively chosen, so that three relevant pictures are derived from SAR image corrected. Water body is projected on the luminance inverse picture. Water boundary is quite clear on the edge detection picture. The boundary between water area and land is very eye-catching on texture analysis picture.

(4) Classification

Applying data of above three pictures derived from single-waveband and single-polarization SAR image as feature vectors, supervised classification is accomplished in the nature of TM image classification. Hence, two-state picture of water area and land is described in flood period. Water area is defined as green in two-state picture.

4.3 SAR/TM integration— describing flood submerged area map

Above two pictures after classification are integrated, so that flood submerged area map may be obtained, see Figure 1.Submerged area is equal to water area in flood period minas water area in normal water period, it is yellow in Figure 1, and its area is 16.3077 km^2.

5 Conclusion

Imaging time of remote sensing image is often different to the time of the most submerged area in the course of flood. But airborne SAR can break through the obstacle. The test results of this article show that the most submerged area in the course of flood can reconstruct by means of image processing for extracted data from TM image in normal water period and SAR image in flood period, it also is a effective way in the study of flood disaster. The most submerged area etc. can be used to estimate flood loss and evaluate flood disaster.

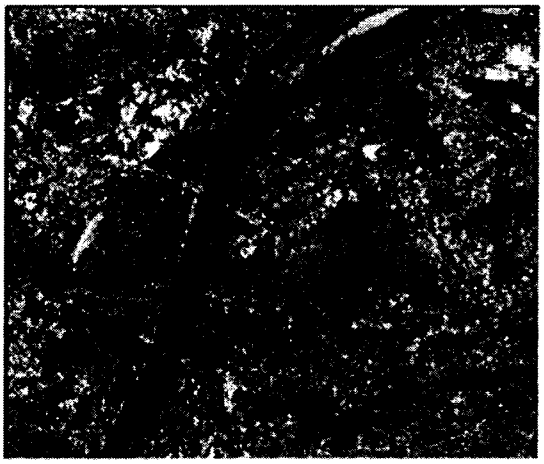

Figure 1 Flood submerged area map in Wuhan city,Hubei province(Aug.13,1998)