Evaluating Flood Risk Area using GIS and RADARSAT Data – A Case Study in Northeast Thailand

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Abstract: The objective of this study is to evaluate flood risk area by integrating GIS and RADARSAT data. The study area, Northeast Thailand, is subject to flood during the rainy season. The main data used in this evaluation included RADARSAT data, landform and topographic map. The evaluation was conducted by overlay operation of flood area in 2001, land form and buffer region beyond the flood areas with the selection criteria defined. Most of the flood risk areas were found in the low lying land form within the buffer region. The cloud penetrating capabilities of SAR is only a source of information for effectively assessment of flood risk area in Northeast Thailand.

Keywords: Flood risk analysis, RADARASAT data

1. Introduction

In Northeast Thailand, flood has the profound impact on the way of living and regional socio-economy. Determination of risk areas is needed not only for flood warning but also for flood development control. A lot of research has been done to determine the flood areas using SAR data in conjunction with other data sources [3,4,5]. In addition, the operational application of MIKE 11 for flood forecasting on flood plains, inaccuracy due to the lack of calibration data was found [1]. To complement the MIKE 11 flood forecasting system the SAR data on flooding for model calibration and validation is needed. In the tropical regions such as the Northeast Thailand, the persistent cloud cover makes optical remote sensing rather difficult particularly the determination of flood area in the rainy season. The capability of remote sensing during the rainy period has been greatly enhanced by RADARSAT equiped with SAR. The SAR images make it possible to identify flooded areas. With the time series of SAR data in combination with hydrological data and quantitative rainfall the flood risk area can be acquired. OEPP(1998)[6] conducted the flood risk area using GIS at 1:250000, lack of validation and calibration data with SAR data was found. In the large area such as Northeast Thailand assessment of flood risk area is needed to provide information on the risk areas for flood protection in advance. The objective of this study was to model the flood risk area with RASARSAT data and terrain information in the Northeast Thailand

2. Study Area

Norheast Thailand, one of the distinct main physiographic features of Thailand, covers about one-third of the total area of the kingdom. It lies between the latitudes of 14° and 19° N and the longitudes of 101°and 106° E (Fig. 1). Average rainfall varies from 1,000 m.m. in the southwest to 2,000 m.m. in the Northeast. The rainfall is unevenly distributed during the rainy season (May to October), with over 80% occuring during August and September. Physiographically, the main area of the Northeast is formed by the so-called Korat plateau and a part of the central highland. The Phu Phan range lies in a Northwest-Southeast direction, dividing the plateau into two basins, the larger Korat basin to the south and the smaller Sakon Nakhorn basin to the North. The two basins are characterized by gently undulating alluvial plain with scattered tree and patches of forest remnants. Flood risk area in the Northeast is a result of large rainfalls, the increased frequency and volume of surface run-off, the rising levels of river bed and human modification of land. The main rivers overflow their banks frequently resulting in devastating floods.

Fig. 1 Study area

3. Methodology

The process of determining flood risk area in the Northeast is based on flood event in 2001 and land form of the areas. The flood event in 2001 can be performed using RADARSAT data. The RADARSAT data used in this study were acquired during the flood events (September 2001) shown in table 1. Preprocessing of the SAR data includes geometric correction, enhancement and mosaicing. The images were produced and used for visual interpretation. Land form map layer was prepared from Landsat data, topographic map and field experiences.

Table 1 RADARSAT data used in this study (C-band, W1-mode)

Images No	Acquisition date	Images No	Acquisition date
450016	2001-09-20	450036	2001-08-13
450017	2001-09-20	450037	2001-08-13
450018	2001-09-20	450105	2001-09-14
450020	2001-07-27	450106	2001-09-14
450029	2001-08-06	450108	2001-09-14
450030	2001-08-06	450205	2001-09-13
450031	2001-08-10	450206	2001-09-13
450032	2001-08-10	450208	2001-09-20
450035	2001-08-13		

The analysis of the flood risk area based on the integration of the flood areas in 2001, land form and buffer zone beyond 1 Km distance of the flood area with the selection criteria as presented in the figure 2.

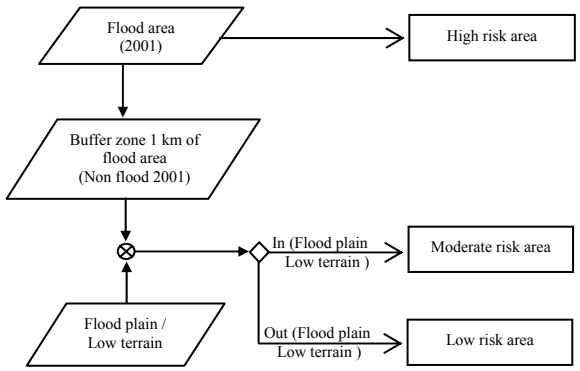

Fig. 2 Selection criteria used for flood risk area.

4. Results and Discussion

The distribution of rainfall in 2001 is illustrated in figure 3. It is evident that the year 2001 provided exceptional high frequency and amount of rainfall during September. A flood risk map of the Northeast based on this analysis was shown in figure 4. The risk areas are summerized in table 2. The high risk areas extend from the river bank to some extent depending the size of the stream. The larger extent of overflow can be found along the main rivers. The land use in the high and moderate risk areas are mainly restricted to paddy field, range land and riverine forest. The study provides an overall insight into the potential flood risk areas and the interaction of drainage pattern, land form and amount of rainfall. The SAR data using in combination with land form proved ideal for regional flood risk assessment. The combination of resolution delivered product that is superior to anything else currently available. The cloud penetrating capabilities of SAR is only a source of informtion for immediate assessment of flooding and flood risk area analysis. This paper represents that we can view the flood from space, to detect reasonably the extent of flood and the assessment of the flood risk areas. With low frequency of hydrological stations, it is not possible to determine the flood area without observation of the flooding as it develops. The SAR data offers best solution for forcasting the flood risk area when using in supplement with terrain and hydrological data.

Table 2 Flood risk area

Flood risk class	Area	
	Sq. Km.	Percentage
High	11882.17	24.82
Moderate	13387.67	7.88
Low	42191.74	6.99
Total	67461.57	39.69

Total NE area = 170,000 Sq. Km.

5. Conclusion

Based on SAR images in conjunction with terrain analysis the assessment of flood risk areas can be effectively conducted. The authorities responsible for flood protection are provided with a excellent tool to manage disasters well in advance

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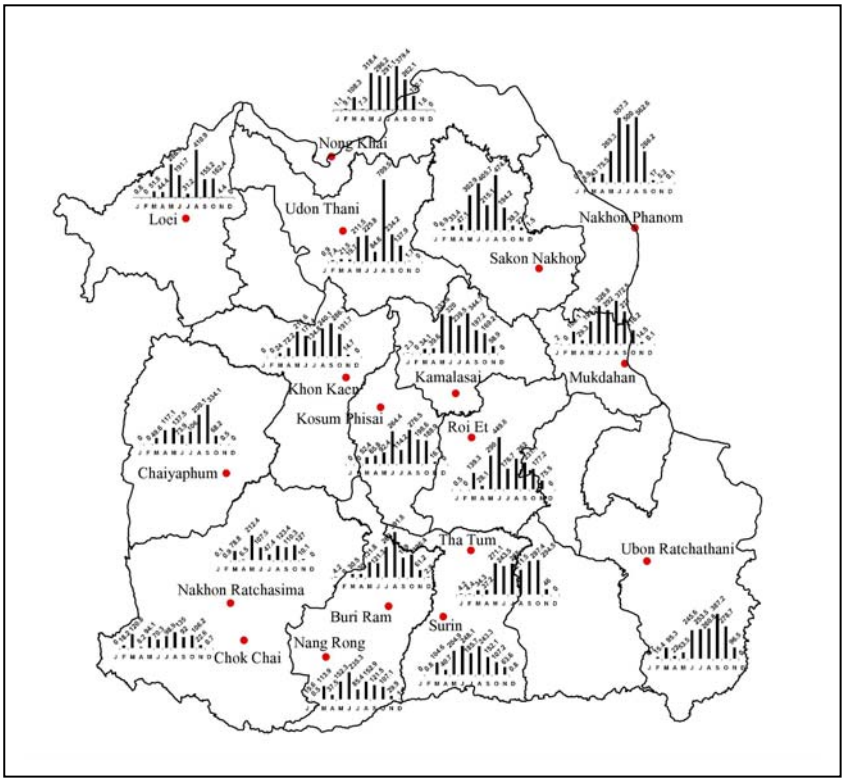

Fig. 3 The distribution of rainfall in 2001

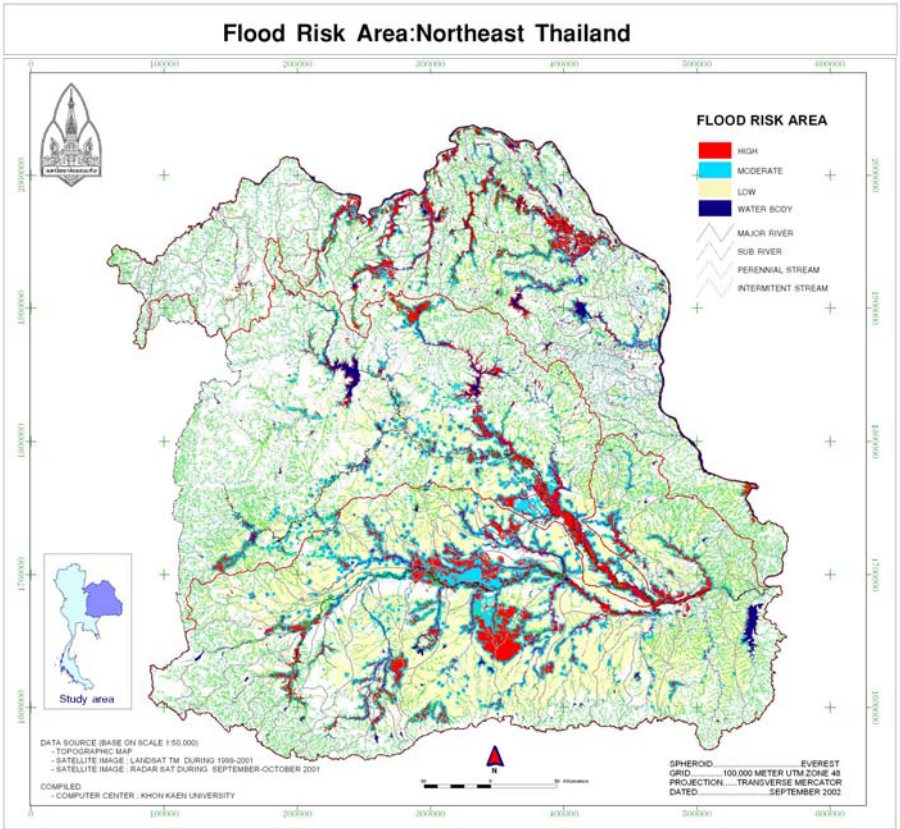

Fig. 4 Flood risk area in Northeast Thailand