THE APPLICATION OF REMOTE SENSING AND GEOGRAPHIC INFORMATION SYSTEM TO BUILD THE FLASH FLOOD DANGER MAP IN DAK LAK PROVINCE

Nguyen Phuc Tham[1], Nguyen Van Nam[2] and Nguyen Phan Tu[3]

[1]ENTEC Environmental Technology Centre
Email: nguyentham07mt@gmail.com
439A9 Phan Van Tri, Go Vap District, HoChiMinh City, Vietnam
[2]Vietnam Institute of Geosciences and Mineral Resources
8 Mac Dinh Chi, District 1, HoChiMinh City, Vietnam
Email: nguyennam.hcmuns@gmail.com
[3]HoChiMinh City Institute of Resources Geography
1 Mac Dinh Chi, District 1, Ho Chi Minh City, Vietnam
Email: nptu89@gmail.com

ABSTRACT

Flash flood is a type of extremely dangerous natural disaster due to the damages and consequences bringing to the human beings. This type of hazard is difficult to predict because of its own characteristics such as always occurring suddenly, quickly developing quickly, composed by many factors,.... Flood hazard occur very popular in the mountainous areas all over the world, especially in the river basin located in the tropical climate zone influenced by monsoons and typhoons. Therefore, the flood forecast has become an urgent and very important job.

In this research, we have combined the remote sensing (RS) and geographic information systems (GIS) technology to study and evaluate the component factors forming the flash flood (rainfall, vegetable coverage, the absorbability of soil, terrain slope, and the density of rivers and streams) to build the geographical data layers of component factors. This article is an introduction of the integration of RS and GIS to build the flash flood hazard map with quantitative information about the potential positions and the dangerous levels in Đăk Lăk Province.

Keywords: *flash flood, RS, GIS, rainfall, vegetable coverage, terrain slope…*

1. INTRODUCTION

Vietnam is a Southeast Asian country located in the tropical climate zone influenced by monsoons and typhoons, and is badly affected by many natural disasters, including flash floods. This type of hazard occurs popularly in the mountainous areas like Cao Bang, Ha Giang, Ha Tinh, Quang Binh, Đăk Lăk…

When the flash flood happens, it brings the serious damage and long-term consequences to human beings. Therefore, the flood forecast has become an has become urgent and crucial job not only in Vietnam but also all over the world. However, despite many efforts to forecast the flash floods, the result in Vietnam is not satisfactory. The reason for this circumstance is the lack of human resources, facilities, specialized researches and documents… in our country. In this article, we introduce the integration of RS and GIS approach to forecast the flash flood hazard. This method has been used quite effectively all over the world.

2. OBJECTIVE & STUDY AREA

2.1. Objectvice

The objective is to build the flash flood hazard map with quantitative information about the potential positions and the dangerous levels in Đăk Lăk Province.

2.2. Study area

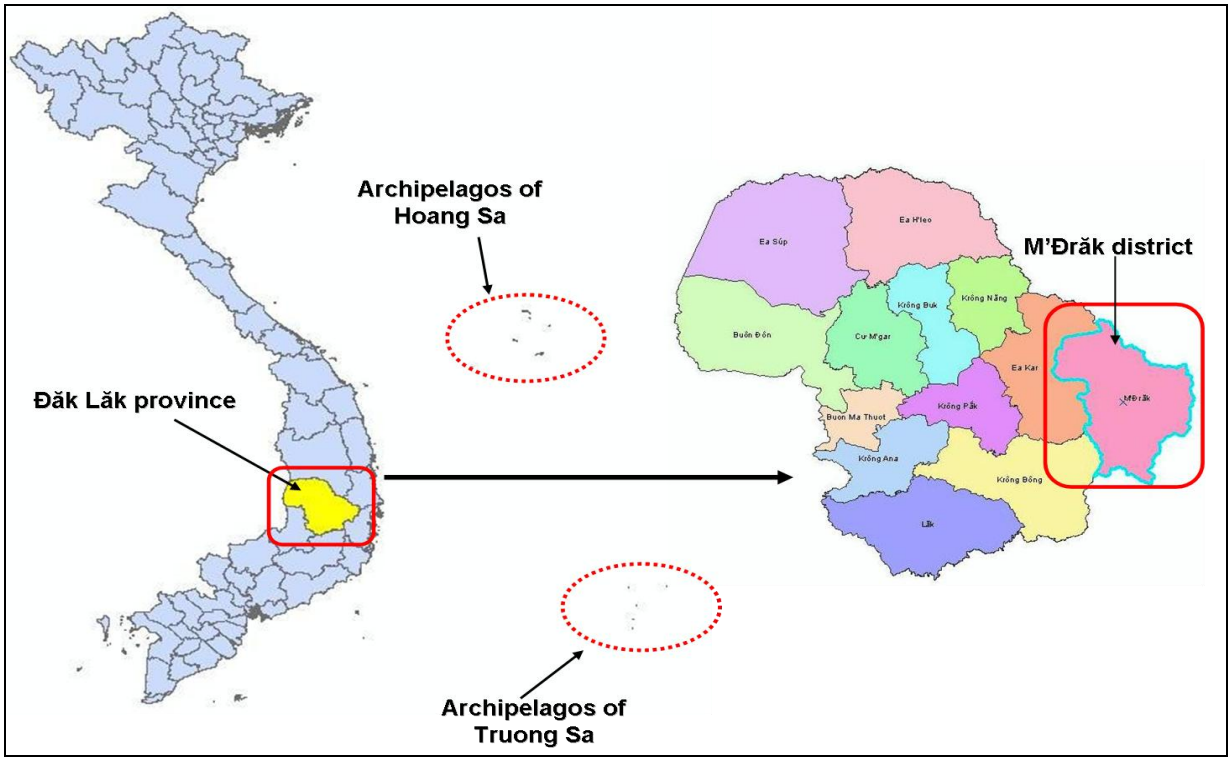

Figure 1. Study area

The study area is a district located in the eastern of Đăk Lăk province, named M'Đrăk district. This is the eastern gateway of Đăk Lăk province, located adjacent to Khanh Hoa and Phu Yen province. This area has a high density of rivers and streams. The terrain here is quite high with the altitude of about 800 m. The average annual rainfall here is about 2500 mm.

The economy is mainly focus on forestry and agriculture. Land is suitable for industrial crops such as coffee, fruits (avocado, durian, jackfruit, lychee…) and farm produce like sugar cane, cereals, corn…The district is also developing in raise the cattle like cows, goats, horses, ostriches…

3. METHODOLOGY

In this article, we used 3 research methods for the building of flash flood hazard map, including: collecting material method, field research method and RS-GIS method.

Based on the information about natural-social conditions, survey data of the study area; domestic and foreign researches and documents about forecast of flash flood hazard; and

relevant data such as administrative map, topographic map, hydro map, rainfall data, soil map, land use map, terrain elevation model… of the study area; there are 5 factors should be the main cause of the formation of flash flood: rainfall, vegetable coverage, the absorbability of soil, terrain slope, and the density of rivers and streams.

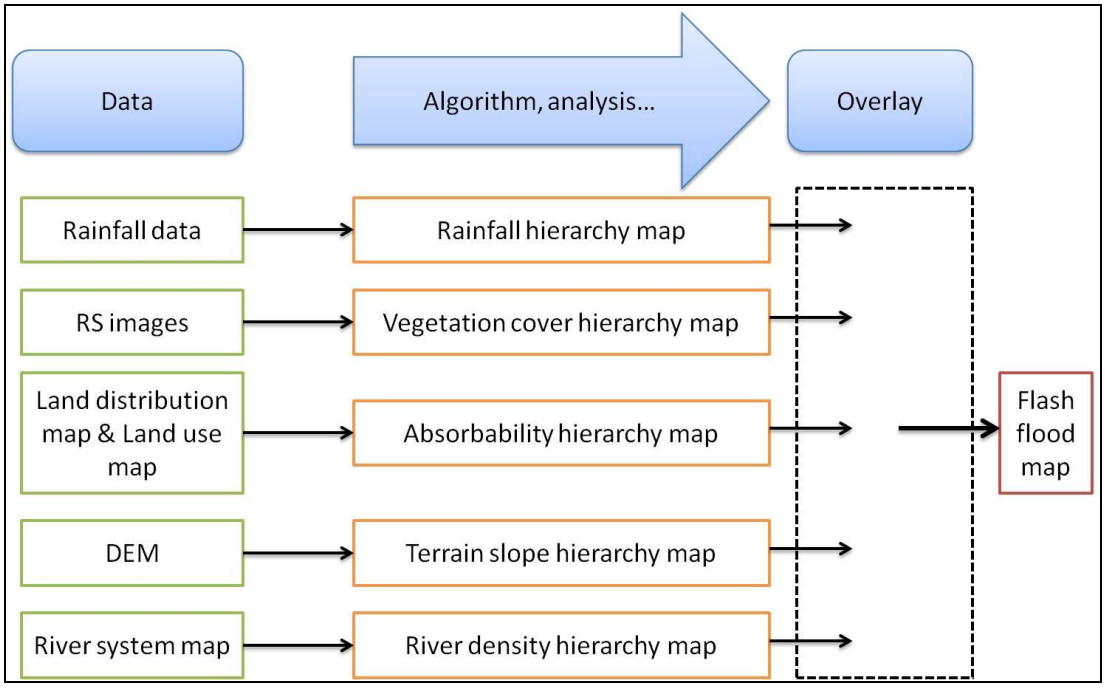

Figure 2. Process of mapping the flash flood map

According to the research documents, the influential level of the component elements to the formation of flash flood are presented in Table 1.

Table 1. The influential level of the component elements to the formation of flash flood

No	Factors	Unit	Low (1)	Average (2)	High (3)	Very high (4)
01	Rainfall (*)	mm	<200	<350	<450	≥450
02	Vegetation cover	NDVI (**)	0,8 – 1	0,5 – 0,8	0,2 – 0,5	-1 – 0,2
03	Absorbability of soil (***)	-	Sand, light sandy soil	Average soil, sand clay	Heavy soil, fine clay	Soil, heavy clay, rock
04	Terrain slope	Degree	0 – 7	7 – 15	15 – 25	25 – 90
05	Rivers density	km/km^2	0 – 1	1 – 2	2 – 4	>4

Notes:

– *: Classification of rainfall with the influential level to the formation of flash flood according to Nguyen Trong Yem.

– **: (NIR – R)/ (NIR + R). NIR is near-infrared channel; R is the visible light range; NDVI is the range of -1 to +1, in which 0.8 – 1 corresponding to the jungle, 0.5 – 0.81 is perennial garden and plantation, 0.2 – 0.41 is the garden soil around the house and harvest crops, -1 – 0.21 is empty land and urban areas…

– ***: Classification of absorbability of soil with the influence level to the formation of flash flood according to Nguyen Trong Yem.

With the influential level from Table 1 and collected data, we used GIS tools to build the component map, each cause of flash floods will be built into a separate digitizing map called a element map.

After that, we overlaid the component maps with the different weight for each elements according to its effective level to the formation of flash flood with the overlay equation (equation 1):

$$\textit{Flash flood map} = \textit{rainfall map}*2 + \textit{NDVI map} * 1.5 + \textit{absorbability map} * 1 + \textit{terrain slope map}*1 + \textit{river density map}*1.5 \quad (1)$$

After having flash flood map in the range of values, we conducted classified into different levels along with the field research to verify the results.

Field research method: using statistics data of flash flood occurred in Dak Lak province to zone the key area. The field research survey also aims to verify the results of the article.

4. RESULTS

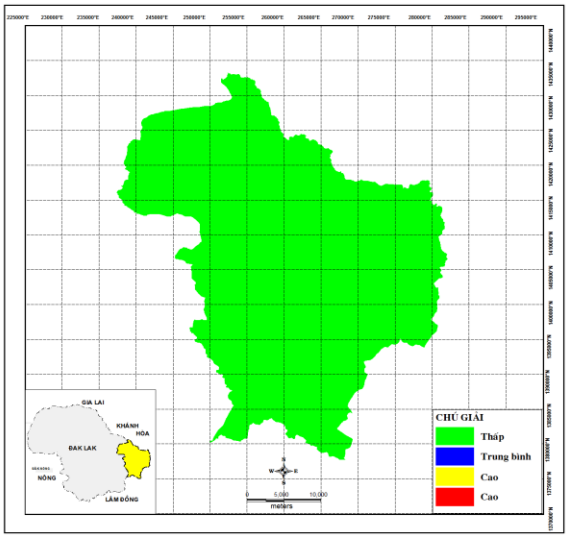

Figure 3. Rainfall hierarchy map

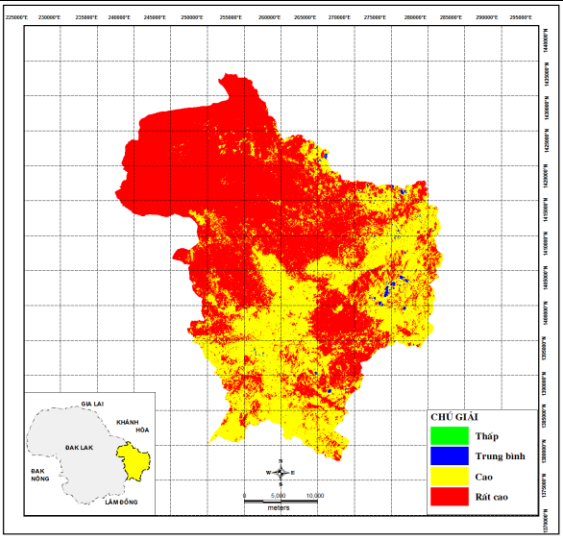

Figure 4. NDVI hierarchy map

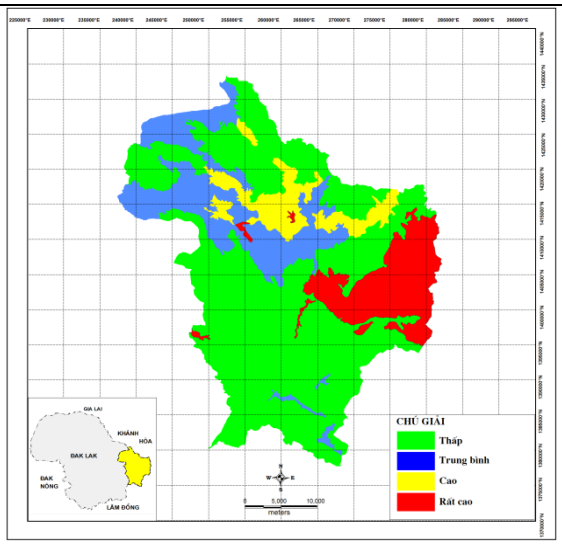

Figure 5. Absorbability hierarchy map

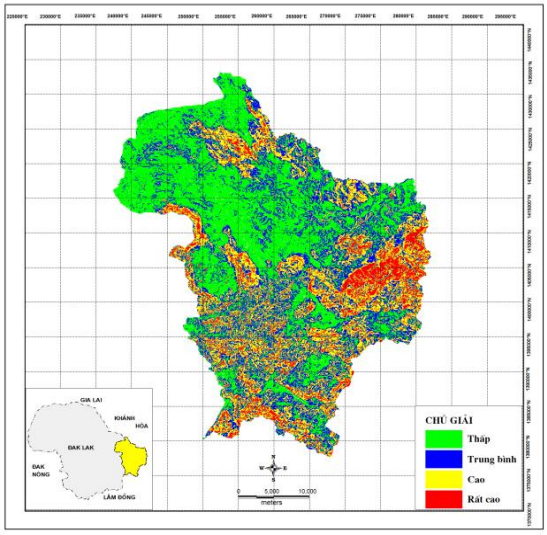

Figure 6. Terrain slope hierarchy map

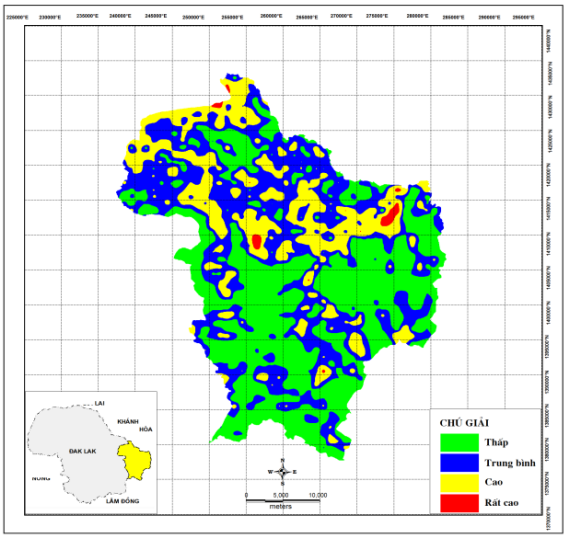

Figure 7. Rivers density hierarchy map

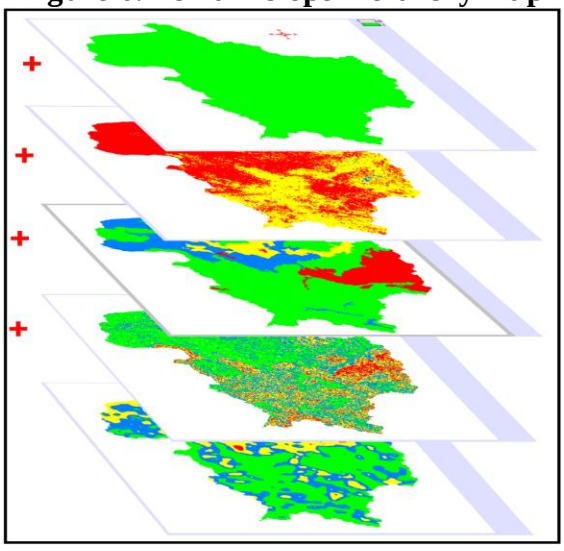

Figure 8. Overley component maps

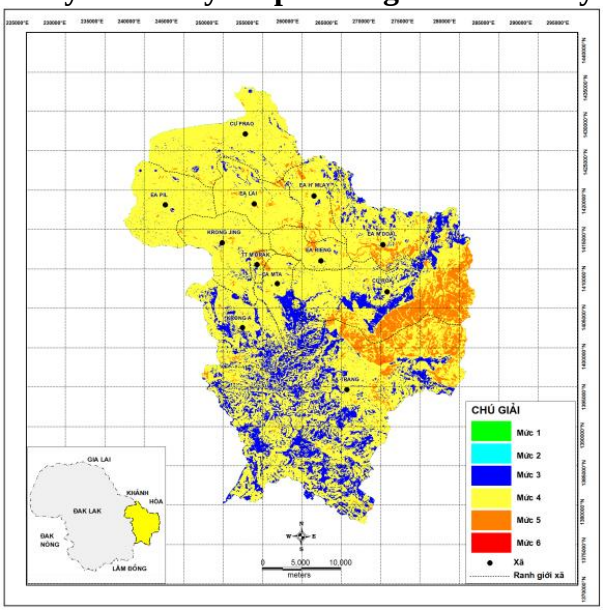

Figure 9. Flash flood map in MĐrăk district – Đak Lak province

5. CONCLUSIONS

This article has develop the flash flood hazard map in M'Đrăk district - Đăk Lăk Province with quantitative information about the dangerous level at specific position.

The RS-GIS approach is an useful method due to its advanced features, such as easy to use, edit and update the data to generate new results, and can be applied for many different scientific researches.

6. REFERENCES

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