

Use of Remote Sensing and GIS Technology for Monitoring and Assessment of Flooding Status at the Coastal Zone in the Central Part of Vietnam

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Key words: key words, theme, etc.

SUMMARY

Remote Sensing and GIS technology is a useful tool for following and managing natural resource. Using Remote Sensing and GIS technology to quickly detect changing of environment by time, preventing natural disaster to serve agriculture.

The derivative maps and statistics that take from period images not only help us assess a part of changing trends of nature and environment, but also propose reasonable ways in using resource, protecting environment and stable development.

The flood problem in the Middle of Viet Nam makes managers at many levels pay attention. Under the influences of natural disasters, flood, a lot of roads were destroyed, they also influence on people's living who live near the rivers and coastlands. So using the multi time images, especially recently images, have a great significance of collecting statistics, assessing the state of flood and its trend in the delta near the rivers and coastlands to prepare relevant preventing measures.

SUMMARY (Vietnamese)

Công nghệ viễn thám và Hệ thống tin Địa lý là công cụ hữu ích trong theo dõi và quản lý tài nguyên thiên nhiên. Những bản đồ dẫn xuất và số liệu thống kê lấy từ ảnh đa thời gian giúp ta đánh giá một phần các xu hướng biến động của thiên nhiên và môi trường, đồng thời đề xuất hướng sử dụng hợp lý tài nguyên, bảo vệ môi trường và quy hoạch bền vững.

Vấn đề lũ lụt miền Trung trong thời gian qua thu hút nhiều sự chú ý của các nhà quản lý ở nhiều cấp. Những ảnh hưởng của thiên tai, bão lũ đã gây ra nhiều đoạn đường bị xói lở, lụt lội làm ảnh hưởng đến đời sống dân cư vùng ven sông, ven biển. Như vậy, việc dùng ảnh vệ tinh đa thời kì, nhất là ảnh trong thời gian gần đây có ý nghĩa rất nhiều trong việc nắm bắt số liệu thống kê, đánh giá một phần xu thế diễn biến tình trạng ngập lụt vùng đồng bằng ven sông và biển nhằm chuẩn bị các biện pháp phòng chống thích hợp.

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1. INTRODUCTION

Application of remote sensing and GIS technology to investigate the changing of flooded areas in the flat areas of the Middle coastland.

In general the river valleys and the flat areas near to the river and the sea in the Middle coastland is small and narrow, especially in the Quang Tri area. Because of short rivers with a lot of slopes, the rivers valleys in the region are flooded with serious intensity when heavy rain occurs. The river in the areas originates from areas with high rainfall and the ability of drainage of the estuaries are not good, so this region is usually flooded in the flood season, it can happen several times in a year.

According to statistics of many years, the flood usually happens very serious in some relatively large river valleys. In the Northern Middle coastland area some river valleys is worth paying attention to, such as Ma River (Thanh Hoa Province), Ca River (Nghe An Province), Thach Han River (Quang Tri Province). From Hue city to the Southern Middle coastland area, there are also some rivers such as Huong River (Hue city), Thu Bon River (Quang Nam Province), Tra Khuc River (Quang Ngai Province), Ve River that should be payed attention to. The maximum of the flood in the Northern Middle coastland area usually occurs from September to October, but in the Southern Middle coastland area it usually happen in November and in the first part of December.

Because flooding in the Middle coastland happens several times during a season and the time of flood is short, using satellite pictures to show the flood in real time is very important. Especially because in the years from 1996 up to now, there are many floods in the Southern Middle coastland area that have caused great damages, of which the flood in 1999 is the most important.

2. METHODOLOGY AND METHODS

2.1 Using Multi Time Remote Sensing Materials to Follow Flood through Years

The first pictorial satellite materials used to investigate natural resources and survey environment of the earth was LANDSAT-MSS images of US satellite. It was put to space in 1972. Up to now many generations of satellites are made with high professional function for researching the environmental resources. In the field of flood survey, radar images is used in many cases because it is not influenced by clouds. The pictorial radar material is taken, filter interference (caused by interfere phenomenon) and cover each other by multi-time principle

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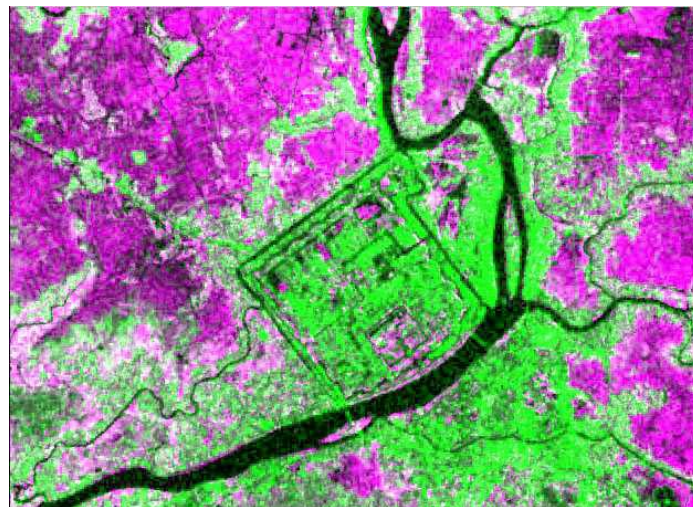
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or cover other multi spectrum images. Because of sensitivity to water, flood area that is received from radar images, is used as a pellicle to cover other images and it reappear very clear (Picture 1,2).



Picture 1: LANDSAT-ETM satellite picture taken in 1/1999 at ancient capital of Hue.



Picture 2: LANDSAT-ETM satellite picture covered by RADARSAT satellite picture that was taken at the time of the flood on November 6th 1999. The dark purple areas represent the flooded areas.

In interpreting multi spectrum picture, water surfaces, wet grounds and swamps usually absorb strongly light wave at the region near infrared with wavelength from 0,7 to 1,1 m. In images at this wavelength, the flooded areas usually have dark grey or black color. The

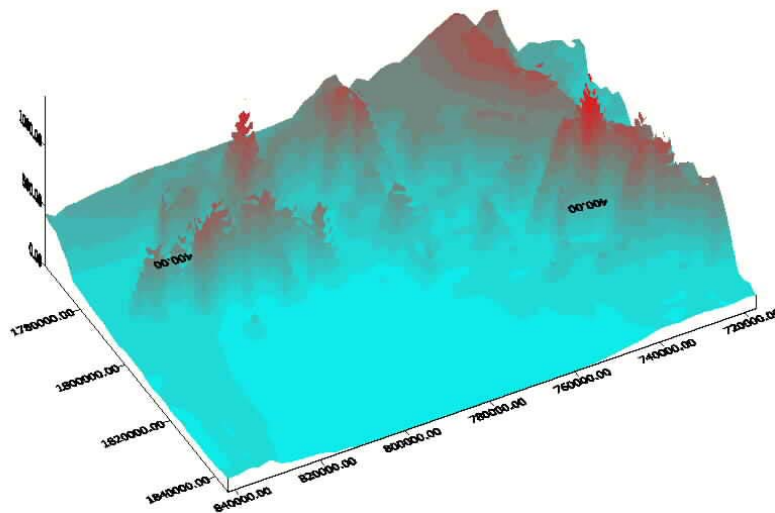
flooded areas are specified and GIS is used to count statistical numbers according to each province. The historically known flood in 1999 is made separate to highlight its specific characteristics (Table 1).

Table 1: The flooded area of 14 near sea provinces in the Middle coastland area.

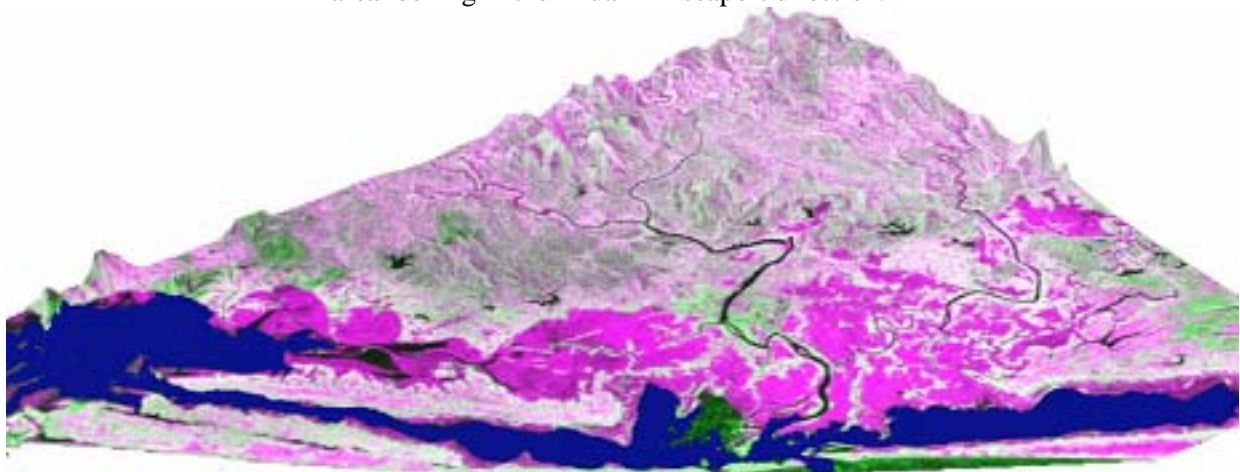
(Based on processing multi time picture 1975-1999)

Province name	Flooded areas in 1999 (ha)	Percent in comparison with whole province (%)
Thanh Hoa		
Nghe An		
Ha Tinh		
Quang Binh		
Quang Tri	33974	5,09
Thua Thien - Hue	51989	12,98
TP Da Nang	75388	8,75
Quang Nam	23472	9,01
Quang Ngai	55526	4,76
Binh Dinh	78419	1,97
Phu Yen	51018	4,76
Khanh Hoa	62101	6,87
Ninh Thuan	62636	9,99
Binh Thuan		

According to the description of the general department of hydrometeorology in hydrometeorology document of 1999, the flood in 1999 is really worth paying attention to when deeply analyse the Middle coastland area. When the researching object is flood, the terrain factor is always important to find out about the surrounding of the researching area. Three dimensional models of the estuary and the river valley are built (Pictures 3 and 4), and then the flooded areas, that are extracted from remote sensing materials, are covered to give the reader a general view.



Picture 3: Three dimensional model of Thua Thien Hue area looking in the Thuan An seaport direction.

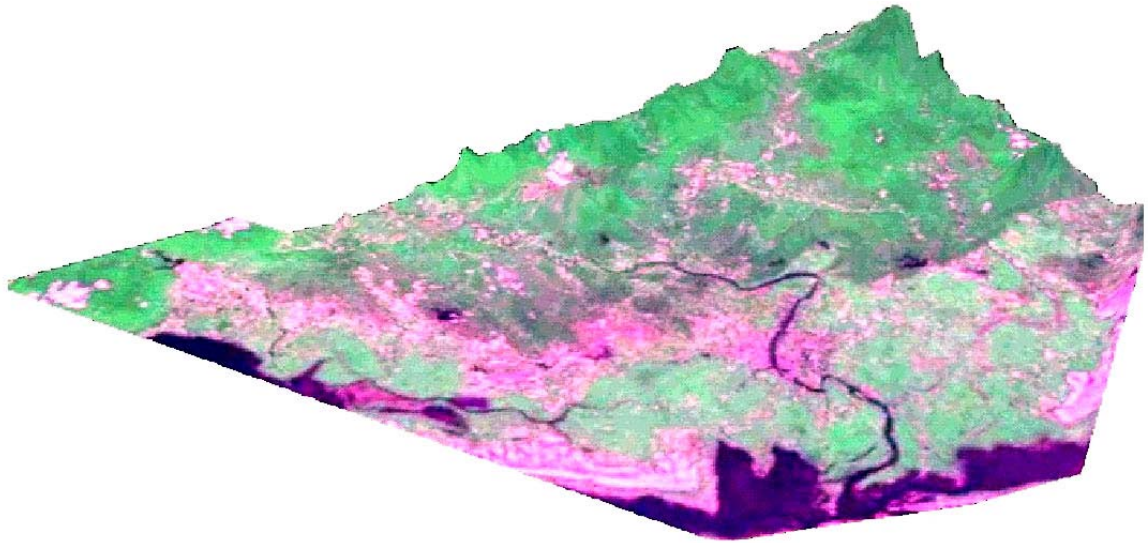


Picture 4: Three dimensional digital model covered by flooded area taken from RADASAT picture at the time of flood in Thua Thien Hue on November 6th 1999. The dark purple areas represent flooded areas.

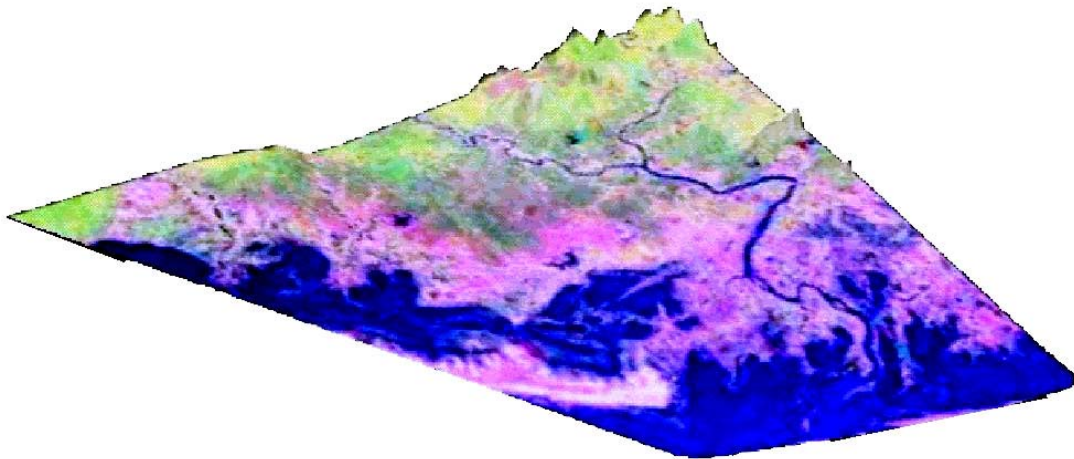
2.2. Researching Flood Situation at some River Valleys

2.2.1. Researching Flood Situation at Huong River Valley

To research the flood situation at Huong river valley in Thua Thien Hue Province, some multi spectrum satellite images and multi time satellite images were used at the same time with RADASAT images that was taken at the time of the flood situation.



Picture 5: Three dimensional model of a digital image at Huong River valley in the dry season. (5/1999)



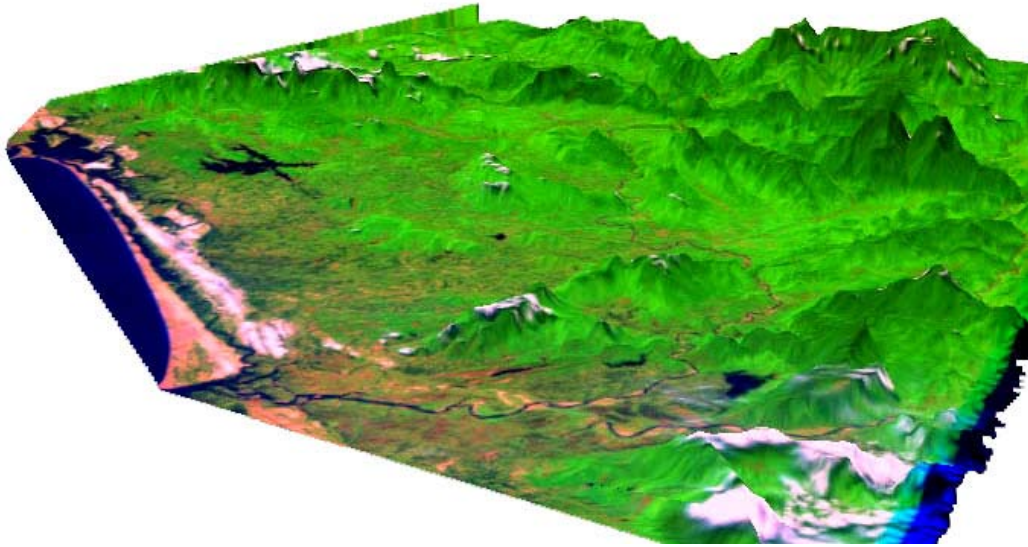
Picture 6: Three dimensional model of digital image at Huong river valley in the rainy season. (28 September 2000)

Table 2: The flooded area of the district at Huong River valley
(Following satellite picture of GIS software)

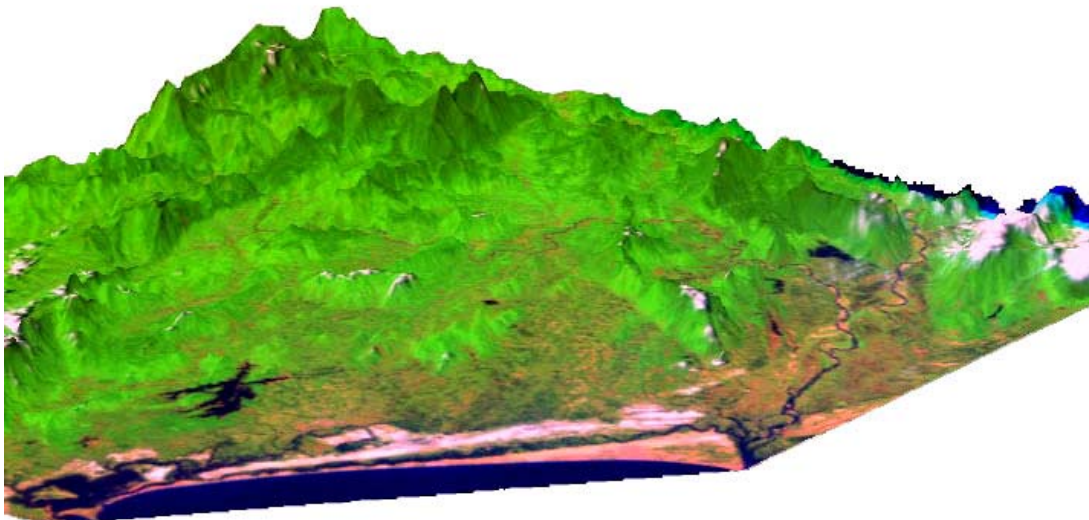
Ordinal number	District name	Area (ha)
1	Quang Dien	4106,57
2	Phong Dien	1565,19
3	Huong Tra	4482,40
4	Phu Vang	3144,10
5	TP Hue	1188,50
6	Huong Thuy	1560,28
7	A Luoi	7,41
8	Nam Dong	0
	Total	16054,57

The total area of Huong river valley is over 280 ha, it mainly consist the area of 7 districts and 1 city of the Thua Thien Hue Province. The flood season lasts from the end of September to the end of November. The high floods of Huong River is usually the end of October and in the first part of November. (October 23rd 1996, November 20th 1998, November 2nd 1999, October 10th 2000). The area that can be flooded is specified by multi spectrum images for many years (from 1986 to 2001) and from RADASAT images that was taken during the time of the flood (from 1998 to 2001). The area that can be flooded is low in comparison with other areas around. It can be marked by using ground mixing with RADASAT image (in dark style) that was taken during the time of flooding. The image is then covered on a digital three dimensional model to specify clearer the inundated ground (Picture 5 and 6). After the area that can be flooded is determined (mainly from radar picture processing), it is intermixed with administrative border that belong to the river valley in order to calculate the area according to administrative unit of GIS (Table 2). Two districts that can have the largest flooded area in the valley are in Quang Dien Province and Huong Tra Province. Phu Vang District can have quite large flooded area too, but it is out of the valley border.

2.2.2. Researching the Flood Situation at the Thu Bon River Valley



Picture 7: Three dimensional model of Thu Bon River valley looking in the North - South direction.



Picture 8: Three dimensional model of the Thu Bon River valley looking in the East - West direction.

3. DISCUSSION

The Thu Bon River valley is wide and it covers the whole Quang Nam Province with over 1100 000 hectares. The flood season of Thu Bon River valley usually is from September to December. The maximum of the floods in the Thu Bon River valley is later than Huong River valley. Usually it occurs in November (November 3rd 1996, November 21st 1998, November 3rd 1999, November 18th 2000).

4. CONCLUSION

The application of satellite image is a useful method to fast collect information to assess the changing of natural objects and natural resources in general. Above is shown the specific case of flooding areas in flat areas near the sea of the Middle coastland district. Simultaneous application of two methods, by eyes and digital processing, can help us exploit all useful capability of remote sensing materials. In addition, it also increase reliability of received information. Beside multi-spectrum satellite image in the seing wave area and in the near infrared, radar image is used as extra complementing part to monitor areas from picture in the time of the flood. In future, information received and known, tecnology will uninterrupted develope the combination between remote sensing and GIS technology. This will help us go ahead with long steps in solving changes in the natural environment problem, preventing natural calamities and managing natural conditions. The natural calamities can happen in a short time in wide areas, and it can cause very serious disasters like the flood in the Middle coastland area. The statistics received from using remote sensing and GIS technology can help us to localize and use reasonably sunken grounds in flat areas near the sea of the Middle coastland area, and hence improve the people's life in such areas.

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