The Research of an Investigation on Landside Areas of Forest

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Keywords: Landslide, GIS, UAV

Abstract. Due to the rapid climate change, earthquakes, typhoons, torrential rain and the other disasters, the landslide events occur quite often in the mountains. As the inconvenient traffic in the area around the forest, it's difficult to get the instant information about the local situation of these events, which making us couldn't do any appropriate move immediately and the following movement. This study used UAV and FORMOSAT-2 to receive images of the most landslide potential areas of the designated mountains, coupled with the use of GIS to explicitly analyze and locate these landslide areas. The whole study was separated into three stages, each of six months, overlapping images by each other to analyze and quantify to result for the future post-disaster treatment and pre-disaster prevention.

1. Preface

Natural disasters, including earthquakes, typhoons, etc., have been the most popular issues recently, imposing an unignorable influence in Taiwan. Mountainous areas, mostly located on the upstream of watershed, are featured by steep terrains, more fragile geology, and inconvenient traffic, which led to many serious collapses of forest slopes [1]. Therefore, it is vital to grasp first-hand slope image data. By combing UAV images, Satellite images and GIS-technology-based tracking analysis, we could learn the geological changes of the forest slopes. The tracking continued for three phases, with each phase lasting for half a year, where overlapping cross analysis was conducted for major collapses and new exposed facets, with landslide area being quantified to facilitate subsequent tracking.

Overlay analysis for UAV images, satellite images (FORMASA-2) and spatial data, which, together with the Geographic Information System (GIS) [2], were used to assess images of landslide area.

2. Research method

The field of research in this study falls within the forest area of Nanoau Township of Yilan County. Geographic information was analyzed based on two categories. Category 1 refers to UAV-based orthophoto image, the clarity of which was based on the scale of aerial photography of 1:5000. With a spatial phase relationship, the images could be integrated and stacked with the images from the current digital topographic map (DEM), topographic map, aerial photos, orthophoto maps and satellite images. Category 2 refers to FORMOSA-2 satellite images, with cloud cover below 20%. FORMOSA-2 satellite images were used to make a preliminary assessment, and the "UAV-based orthophoto images" of category 1 would be employed if a more precise assessment is required [3].

The ArcGIS software, developed by ESRI, was employed in this study. Landslide area was judged mainly using the maximum likelihood method, which, referencing colors of the various types of images in the business district, classified images into nine categories: water, green, building, road, cloud, shadow, bare, landslip, and doubt. Doubt was defined as the likely shadow block under

shadow and white cloud". Learning area was established in the ArcGIS, where RGB color was taken for each category of images. The degree of similarity was then compared using each pixel of the geographic information images. Images with the highest degree of similarity would be put in the learning area where they would be automatically classified to produce classification images.

3. Analysis result of landslide area

The analysis was divided into three phases, with phase 1, phase 2 and phase 3 beginning in Oct. 2014, Feb. 2015 and Sep. 2015, respectively. Landslide areas of Taiping Mountain of Yilan County with areas larger than 0.2 hectares were selected and cross-analyzed. Because the doubt concept did not gradually mature until phase 2 of 2015 (phase 3), the range of suspicious landslide area was not included for the first 2 phases.

Analysis results of the landslide area in the three phases are exhibited in Figs. 1. and 2. and Table 1.

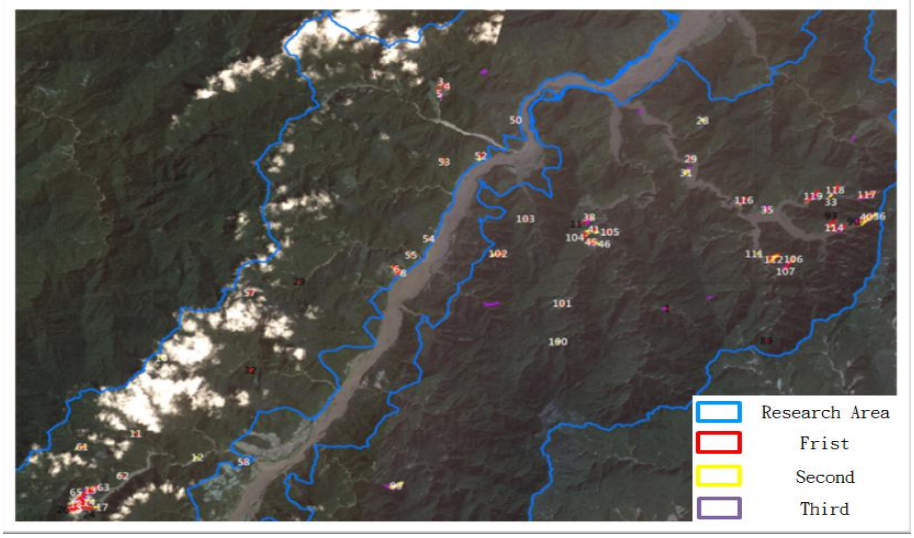

Fig. 1. Analysis results of the landslide area in the three phases

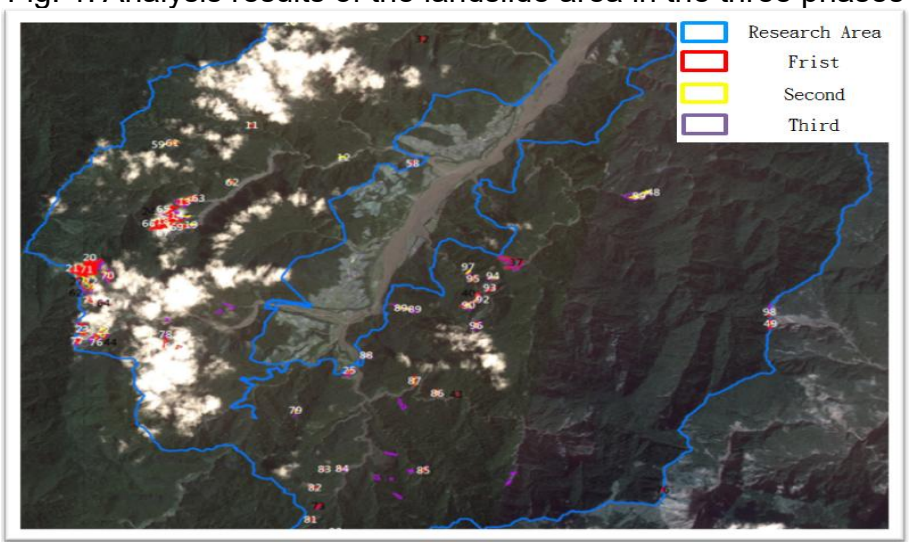

Fig. 2. Analysis results of the landslide area in the three phases

Table 1. Analysis results of the landslide area in the three phases

Summation	Times		
	First	Second	Third
Quantity	72	52	105
Hectares	121.8943	30.0245	113.9184

4. Conclusion

4-1 The comparison of variation analysis results of the first collapse and the second analysis suggested that both the number and areas of landslide area tended to decrease, which might be due to reforestation and low rainfall in winter. Additionally, the second and third analyses indicated that both the number and areas of landslide area of Taiping Mountain tended to increase. This might be due to the fact that the reforested trees still had not thrived at that time, which, together with the invasion of typhoons Soudelor and Dujuan that brought in a lot of rain and strong wind, caused large-area collapses in which trees were toppled and soil and rock became loose.

4-2 Analysis results of the collapses were overlapped for comparison with analysis of Taiping Mountain-based potential maps from the Disaster Prevention Center of National Cheng Gong University [4]. The latter suggested that Hatonozawa is located in a low-risk area based on the potential maps. However, this study indicated that Hatonozawa is located on landslide area. UAV images could be used to identify the problems such as whether the analysis was wrong, whether the geographic Information images were wrong and whether there were new exposed surfaces. Fig. 3. obviously indicates that Hatonozawa, mostly belonging to the category of “cloud doubt” and fluvial bare land, is not located on landslide area. Fig. 4. shows the UAV-based field images, with 704 images covering 12.2 square kilometer of geographic information area [5]. The figure obviously indicates that the region below the “cloud doubt” does not tend to collapse, suggesting that, because there were more clouds in Hatonozawa, and the spectrum of bare land is closer to that of the landslide area, the Formosa-2 images were erroneous.

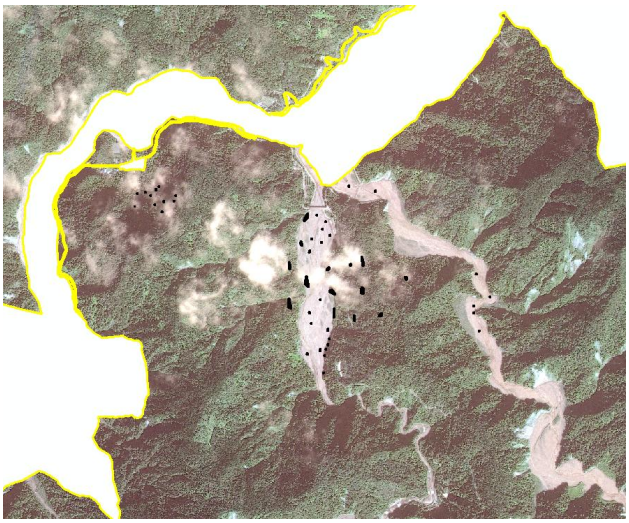

Fig. 3. The landscape in Hatonozawa with FORMOSA-2

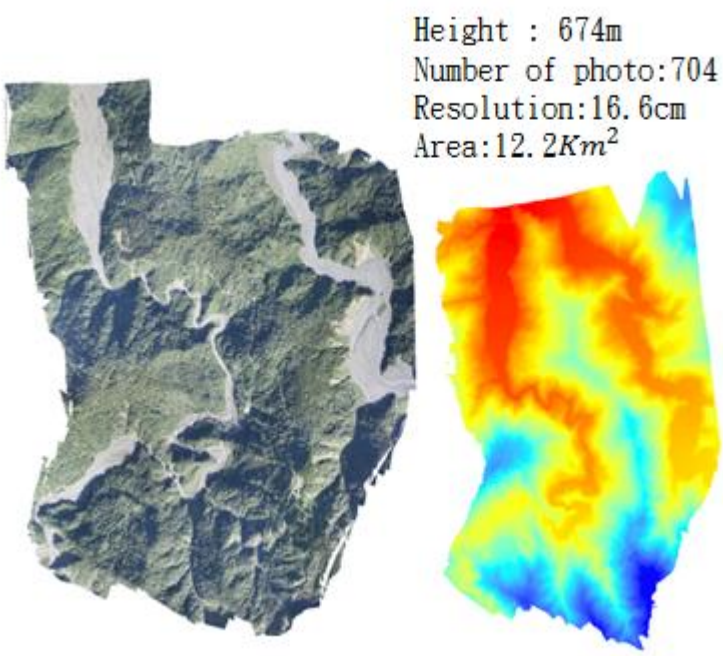

Fig. 4. UAV-based field images

4-3 Collapses are a natural disaster that is highly discussed in Taiwan. Large and small-scale collapses occurred one after the other. In 2010, a collapse occurred on national highway, marking the most serious collapse event in national highway history, where 20 tons of earth and rock collapsed and covered the Chitu section of Formosa Freeway. Thus it is necessary for engineers to investigate whether slopes are stable, and propose solutions in response to lower the risk of disasters. Moreover, it is possible that mountain slopes may change with external environment. Hence we should continue to observe, as well as plot potential collapse maps and landslide area distribution of mountainous areas to classify the categories and determine the prevention area,

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