Estimation of co-seismic uplift at the northwest coast of Andaman Islands by combining stereo-scopic IKONOS and QuickBird imagery

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1. Introduction

Whereas it is very important to estimate the quantities of uplift at Andaman Islands in India, practically few of them have come to light. There is certainly possibility to measure quantity of uplift by comparing ancient shoreline and new shoreline with DSM (Digital Surface Model).

There have been many attempts to generate DSMs through high-resolution satellite imagery. These DSMs are usually made by stereo-images, which are taken from the satellite. However, stereo-images are very difficult to obtain. They take a long time to process and are expensive to order. On the other hand, there are many single-images that already exist from the satellite. Using single-images taken of the aftermath of natural disasters, this paper discusses the method of generating DSMs from different satellites (IKONOS and QuickBird) using different azimuth angles. These DSMs can be generated with a standard deviation of 1.42m.

2. Data and Methods

The research division is located in Nam Khem plain, Thailand. Here, we have the satellite images from IKONOS and QuickBird and here are photos from an airplane. Because the resolutions of the two satellites are different (IKONOS with 1 m and QuickBird with 0.6 m), the images from QuickBird and from IKONOS must first be matched. After this process, we used a program (which is written in C-language) to create DSMs using the two images as input data. At the same time, we also conducted photogrammetry with the photos from the airplane and measured the 3D ground point positioning. Assuming that the results of the 3D ground point positioning are correct, we then measure the differences between the 3D ground point and the DSMs from our research.

IKONOS images and QuickBird images are already corrected for the deflection of the Earth's spherical surface. The IKONOS satellite photographed the image from a height of over 680 km and 12 degrees of off-nadir. Similarly, the QuickBird satellite photographed the image from a height of over 450 km and 26 degrees of off-nadir.The off-nadir angle affects the shape of the images after the height. The direction of the vector is always the same in each image, and the magnitude of the vector increases as the height increases. Whenever the binocular parallax can be measured, magnitude of vectors (which imaged on the satellite images) can also be determined, and consequently height can be determined as well. To measure the binocular parallax, we used the Area-based matching algorism by adopting cross-correlation.

3. Results and Discussion

The difference between the 159 points of the 3D ground point through photogrammetry and our results is considered error of our search. As the result, we could generate DSM with a RMS of 1.42 m. It indicates that even under unfavorable configuration of satellites could be generated DSM with prior RMS. It can predict that DSM can be generated with more high accuracy under more favorable configuration.

4. Estimation of co-seismic uplift at Reef Island

Next, we generated DSM at Reef Island. We have already obtained satellite images, which are better configuration than prior satellites images. We derived the RMS of DSM of Reef Island from RMS of Nam Khem DSM. For this calculation, we used a ratio calculated from the satellites configurations. As a consequence, expectation RMS of DSM of Reef Island is derived as 0.71 m because configuration of satellites is ideal. Comparing ancient shoreline with present shoreline and DSM, we could estimate quantity of uplift as 2.15 m at Reef Island.