Flood mapping for paddy areas in Thailand and Indonesia using PALSAR data

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Abstract

PALSAR data can be easy to detect the water surface because its wave length is L-band. But it is rather difficult in the paddy areas since usually paddy fields have water surface. Mathematical morphology method is one of the solutions to this conflict. The author carried out the geometric correction to the PALSAR data which had obtained at the last May flood and the last October flood in the Central Plain of Thailand and at the January flood around Jakarta, Indonesia. As preliminary results, the morphological analysis shows good ability to the discrimination of the flood water surface from paddy water.

Keywords: *Flood, Mathematical morphology, KML*

1. OBJECTIVES

There are a lot of flood disaster of agricultural fields and irrigation facilities every year somewhere in the world. The farmers who live in the region also suffer from such floods. By using satellite data, the flood extent spread out large areas will be estimated and it reflects the evaluation of the agricultural damage or the recovery plan of irrigation facilities.

2. STATUS

2.1 Three floods analysis

The author chose three floods, the last May northern part of the Central plain of Thailand, the last October Central plain of Thailand and the this January Jakarta flood of Indonesia. The mathematical morphology method is applied to the PALSAR data and the likely flood extents were obtained. And this processing method requires very short time to calculate it. Especially as for the flood of the northern part of Central Plain of Thailand, the ALOS/PALSAR data between two days shows the down flow of the flood-inundated water. But it is rather difficult for the author to obtain the maps around Jakarta. Therefore the flood damage estimation is delayed because of unknown land use in the area for the author. The author plans to go to the ground truth for those areas in 2008.

2.2 Processing the method of the result of the analysis open to the public [4]

It is very important that the results of flood extent estimation are handed to the people concerning to disaster aid or reduction. Therefore many kinds of global platform for disaster risk reduction on the Internet are proposed. The author converted the result of this Thailand flood analysis into KML format files and superimposed those files on the “Google earth”. The KML is similar to the international Geospatial Information System standard, GML (Geography markup language) of ISO (International Organization for Standardization). And The GML is a kind of data format for GIS data exchange and distribution using the Internet web, what we call, “GEOWEB”.

2.3 Polarimetric data analysis

Some PALSAR data have full radar polarimetry. It is probable that target decomposition method in radar polarimetry will discriminate between the flood damaged crops and non-damaged crops. Because sometimes lodging will occur after flood inundating and it means that rice stems lay down for the horizontal direction from usually vertical one in paddy field. The author tries to use the "PolSARpro v3.0" program by esa for analyzing polarimetric target decomposition.

3. EXPECTED RESULTS OF THE RESEARCH

3.1 Research areas and PALSAR data observation dates for the analysis (Fine mode, level 1.5)

Research areas and its data observation dates are (1) the northern part of Central Plain of Thailand: May 25 and May 27, 2006 (2) the lower Chao Phraya river basin in Thailand: October 12,2006 (May 27, 2006) (3) the neighborhood of Jakarta: January 31, 2007 and February 5,2007. The processing level of each PALSAR data is level 1.5.

3.2 Northern Central Plain of Thailand

The mathematical morphology procedure is the followings. (1) The region under DN=2200 is considered as the water surface including paddy field and flood inundated areas. (2) 2 times morphological dilations at 3 by 3 size (3) morphological open operation at 12 by 12 size. The last procedure is for sieving out the minute polygons. The flood-inundated water seems to flow downstream during the two days. If it was the fact, it was estimated that the rice plants were slightly damaged because the end of May in this region is the beginning of rainy season. The dominant land use in this region is paddy rice fields and because of two or three times cultivation of rice plants, the major rice should be just seeded or transplanted and the flood inundated damage for the young rice plants will be light. Fig.4 is shows this is possible.

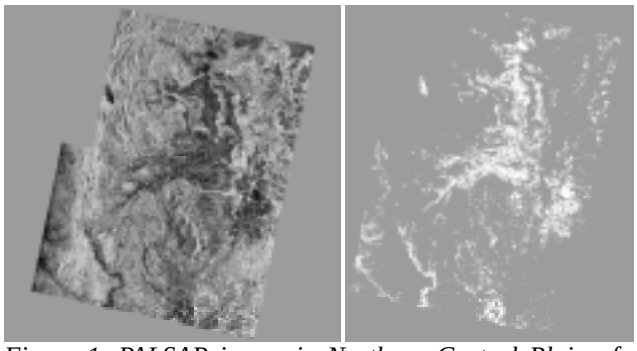

Figure 1. PALSAR image in Northern Central Plain of Thailand on May25, 2006 (left) and mathematical morphology operated image (right: white color)

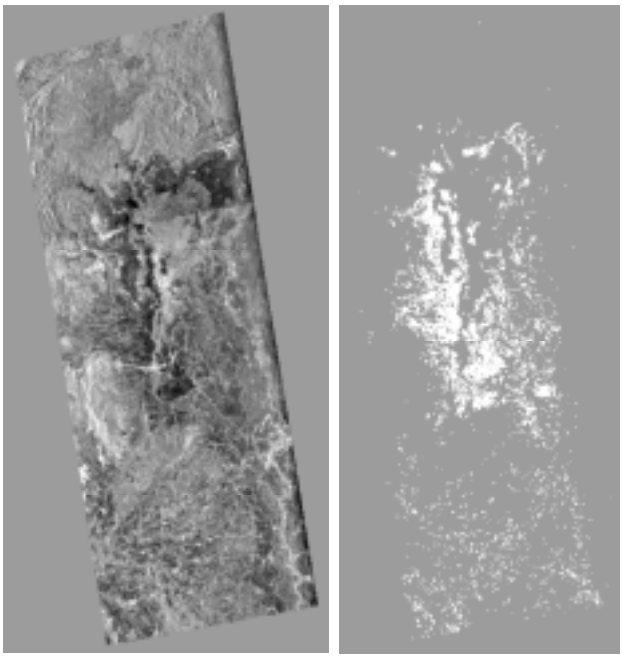

Figure 2. PALSAR image in Northern Central Plain of Thailand on May27, 2006 (left) and mathematical morphology operated image (right: white color)

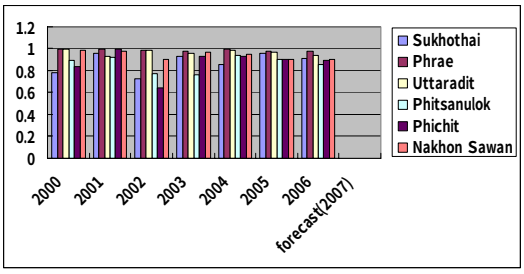

Figure 3. major rice harvested areas divided by the beginning planted areas in every province (FAOSTAT)

3.3 The entire Chao Phraya river basin

The entire Chao Phraya river basin between Nakhon Sawan and Bangkok metropolis often suffer from flood at the end of every rainy season. Fig. 4 shows last October flood and the beginning of rainy season, May. Major paddy rice will be planted at the beginning of rainy season. Fig.5 means the result of mathematical morphology applied to the last October PALSAR image. Fig. 5 shows that the paddy field areas neighboring Ayuthaya city is just like the retarding basin to Bangkok metropolis.

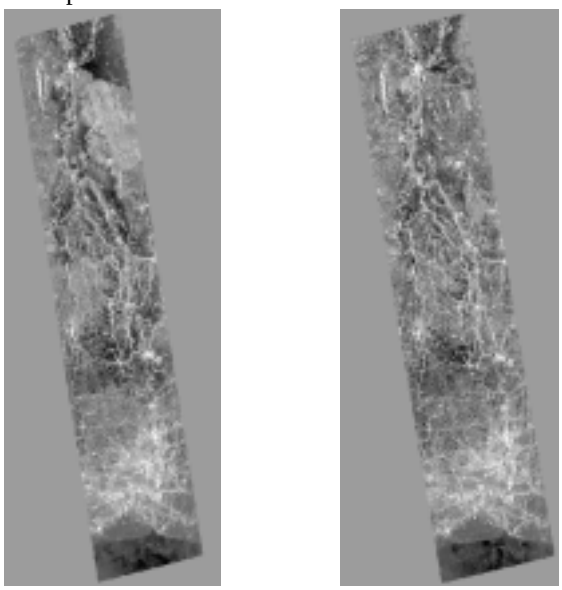

Figure 4. PALSAR images in the entire Chao Phraya river observed on October 12, 2006 (left) and on May 27, 2006 (right).

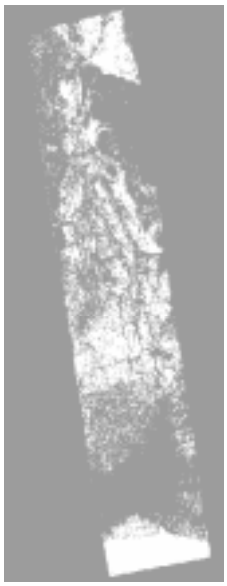

Figure 5. The result of morphological analysis for October 12, 2006 PALSAR image.

3.4 Geo-morphological survey map and flood

The author superimposed the result of morphological analysis as the flood possibility areas over the geo-morphological survey map. Though the surface land use is changed by farm land consolidation, the possibility flood areas coincide with back marsh and delta category avoiding natural levees. The geo-morphological survey map was made by the late professor Masahiko Ohya and his successor professor Shigeko Haruyama. Its map represents the micro-topography and it reflects the process of formation of geographical features. As the flood time is the sediment procedure, the flood inundated areas should coincide with the geo-morphological survey map, if the surface land use was changed. Therefore this kind of micro-topography map can be used for the purpose of flood disaster reduction strategy.

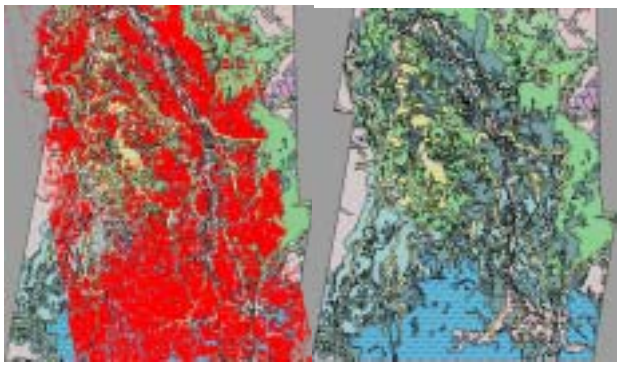

Figure 6. Geo-morphlogical survey map [5] (right) and the superimposed flood possible areas calculated by mathematical morphology operation from PALSAR image. (left: red color)

3.5 Global platform for disaster risk reduction on the Internet

The author converted the result of this Thailand flood analysis into KML format files and superimposed those files on the “Google earth”

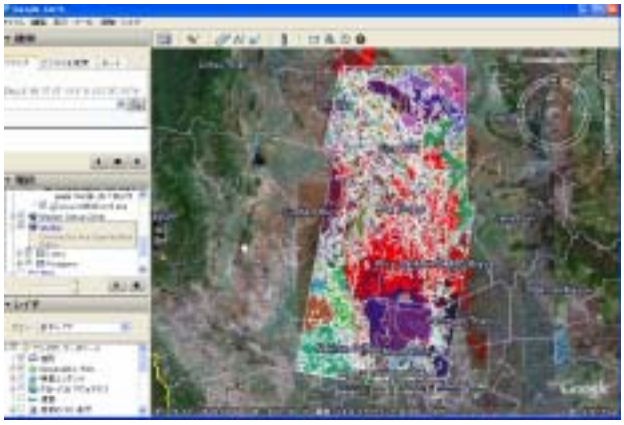

Figure 7. Google earth browser image and geo-morphological survey map and the calculated flood possible areas on it.

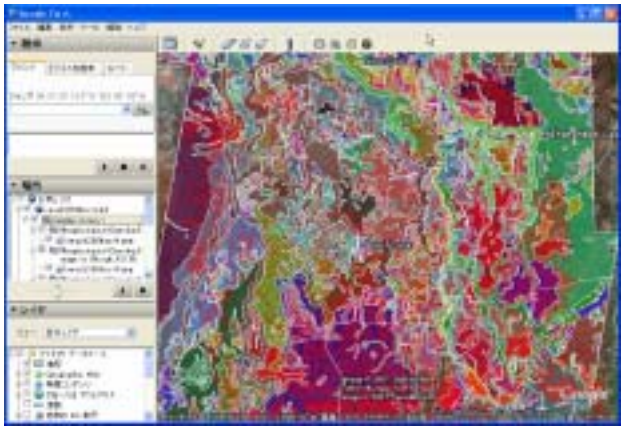

Figure 8. Magnified images of Fig.7 (only geo-morphological survey map and google earth image)

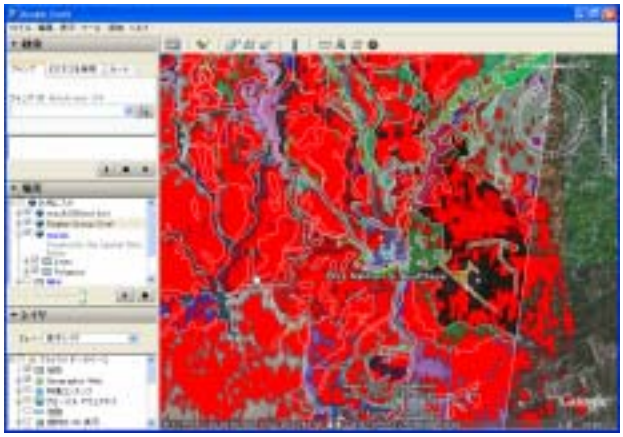

Figure 9. Magnified images of Fig.7 (the red color shows flood areas.)

This kind of web based GIS images is very useful for making a global platform for disaster risk reduction on the Internet. If every organization related to the disaster reduction adopts GML or KML, such kind of international standard data format, those organizations work in close cooperation with publishing its disaster information on the line in the near future.

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