Classification using multi temporal MODIS data with Köppen Climate Chart

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Abstract: Rice is a staple crop in Southeast Asia, and the grasp of the production is important. Rice farming is related to not only the food problem but also the problem of demand for water. Therefore, it is important to understand the area of the rice field, and the remote sensing is suitable. However, the rice field distribution in a past land-use map is not accurate. This research has aimed at the development of the making technique of the land-use map that focused to agriculture which is main industry in an Asian region. In this time, the vegetation indices such as NDVI and EVI were calculated from multi temporal MODIS data, in addition, the water indices such as NDWI were combined. Moreover, we developed the technique of the classification which combined climatic zones of Köppen, and made the agricultural land use map. After a homogeneous region had been extracted from wide-ranging object ground by using the climatic zone of Köppen that correspondence with the natural vegetation is good, it was possible to classify it in this technique.
Keywords: MODIS, Rice, Köppen Climate Chart

1.Introducton

The production of food, in a word, agriculture is important for thinking about environmental problems. The main industry in an Asian region is agriculture. Rice is a staple crop in Southeast Asia, and the grasp of the production is important. Rice farming is related to not only the food problem but also the problem of demand for water. Recently, there is an idea of virtual water. This is the one thinking that water which requires it to produce products is bought and sold along with the importing and exporting of the product. In this idea, rice of demand water is 3600m3t/kg while wheat is 2000m3t/kg, and corn is 1900m3t/kg (These estimations are based on eatable part, and if the products cultivate in Japan). Rice needs a large amount of water compared with other main grain. Therefore, it is important to understand the area of the rice paddy field.

However, the distribution of rice paddy field in a past land-use map is not accurate. Especially, distribution of the rice paddy field that is not familiar European and American is not accurate. If some one develop great model of the rice paddy field, accurate total amount can not calculate without accurate distribution. Therefore accurate land use map in Asia is need made by Asian people who well know rice paddy field, and the remote sensing is suitable making land use map that cover large Asian region.

Objective of this research is development of technique to make the land-use map that focused to agriculture which is main industry in an Asian region. Especially, it is accurate distribution of the rice paddy field that has greatly influences an agricultural environment.

2.Study Area and Data Used

This research used Terra and Aqua-MODIS data which is received at Computer Center for Agriculture, Forestry & Fisheries Research in Tsukuba and Asian Institute of Technology (AIT) in Bangkok. These MODIS data ware calculated to MOD09 datasets and MOD09 8days composite datasets.

In this study, data used was extracted from equator to N 30 latitude and from E 75 to E125 longitude from 8day composite data received at AIT in 2002(Fig.1). These 8days composite datasets are 500m spatial resolution including band 1 to 7.

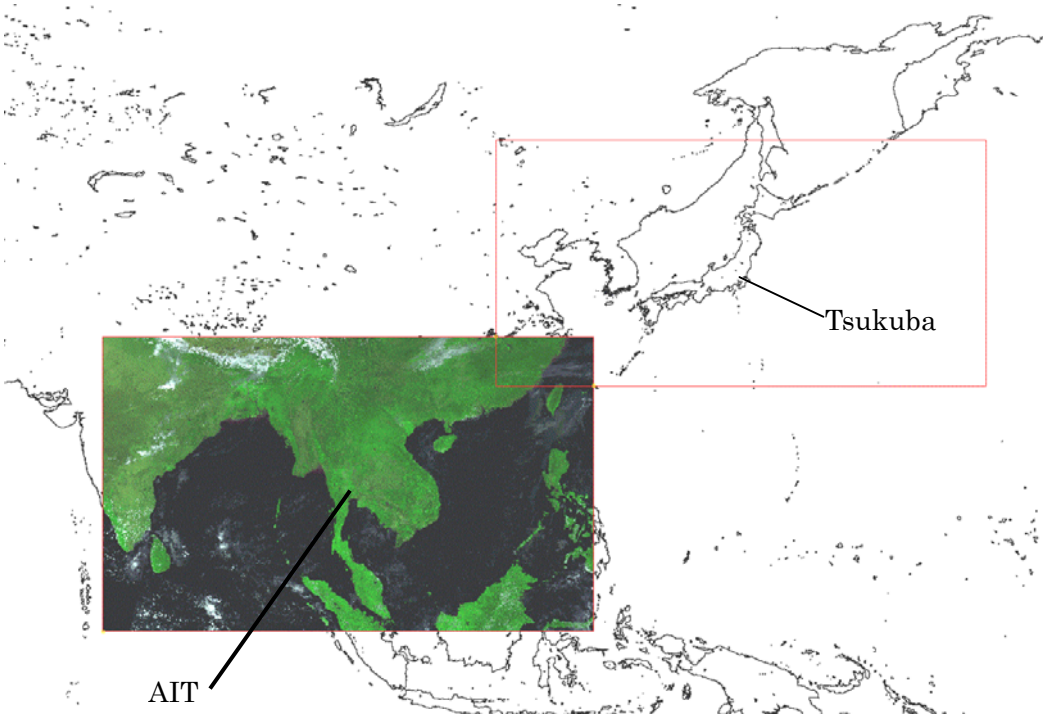


Fig.1 Study Area

8days composite MODIS data (R:G:B=1:2:1)

3.Methods

3.1 Preprocessing

In this study, the vegetation indices such as NDVI and EVI were calculated from multi temporal MODIS data, and, in addition, the water indices such as NDWI were combined. However NDWI is loosely defined equation.

Gao (1996) was defined NDWI as (unit: micrometer)

NDWI = 0.86 - 1.24 / 0.86 + 1.24

McFeeters (1996) was defined NDWI as

NDWI = Green – NIR / green + NIR (Landsat MSS Green:0.5-0.6 NIR:0.9-1.1)

Xiao et al (2002) was defined NDWI as

NDWI = B3 – MIR /B3 + MIR (VEGETATON B3:0.78-0.89 MIR:1.58-1.75)

NSIDC Soil Moisture Experiment 2002 (SMEX02) project was defined NDWI as

NDWI = B4 – B5 / B4 + B5 (Landsat TM/ETM+ B4:0.75-0.9 B5:1.55-1.75)

Hokkaido Institute of Environmental Sciences was defined NDWI as

NDWI = B3 – B5 / B3 + B5 (Landsat TM B3:0.63-0.69 B5: 1.55-1.75)

Finally we choose band combination MODIS B5(1.23-1.25) and B1(0.62-0.67)

3.2 Using Köppen

We developed the technique of the classification which combined climatic zones of Köppen. When it carry out classification large area such as continental scale, you can easily image that it is difficult to classify whole area using same one parameter. Therefore we thought that to classify large area separating some part which is similar condition before classification. After a homogeneous region had been extracted using the climatic zone of Köppen that correspondence with the natural vegetation is good, it was possible to accurate classify in vegetation. Especially we

thought that it is good for distinguish agricultural land and non-agricultural land.

Köppen Climate Chart was made from 0.5 global gridded dataset distributed by CRU (Chromatic Research Unit, UK)(Fig.2).

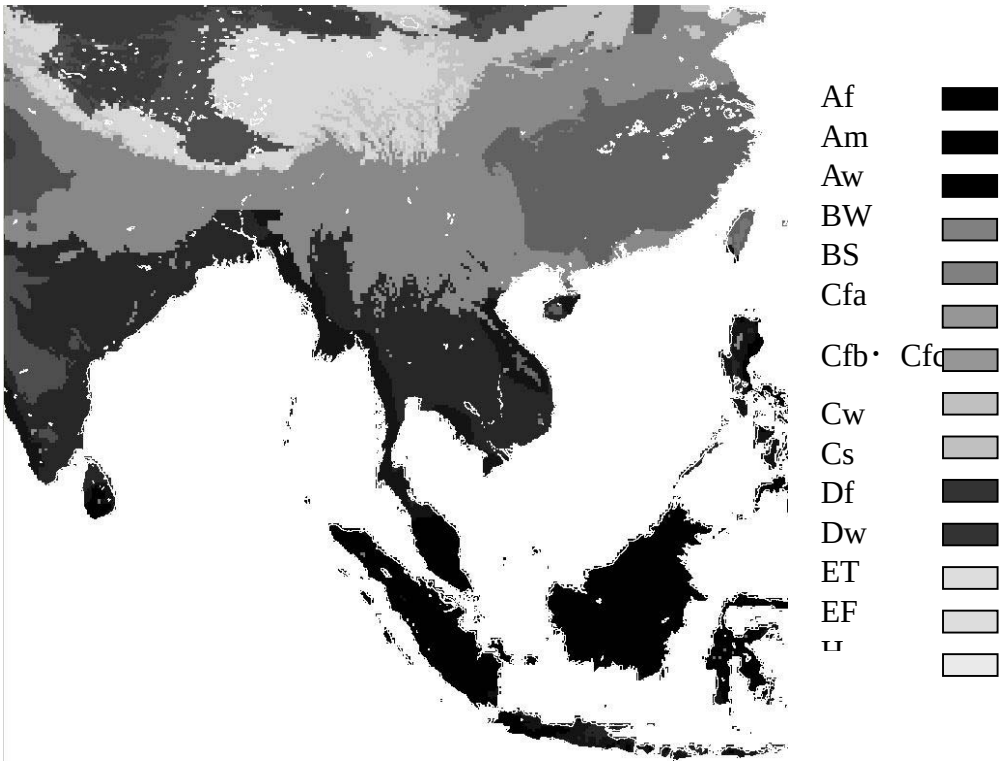


Fig.2 Köppen Climate Chart

3.3Classification

Classification carries out using decision tree method. First, it is separated agricultural and non-agricultural land using vegetation indexes as NDVI or EVI. After that it is distinguish agricultural land as glass land, paddy field, and crop land. Irrigated or rain-fed is estimated that there is or not crop during dry season.

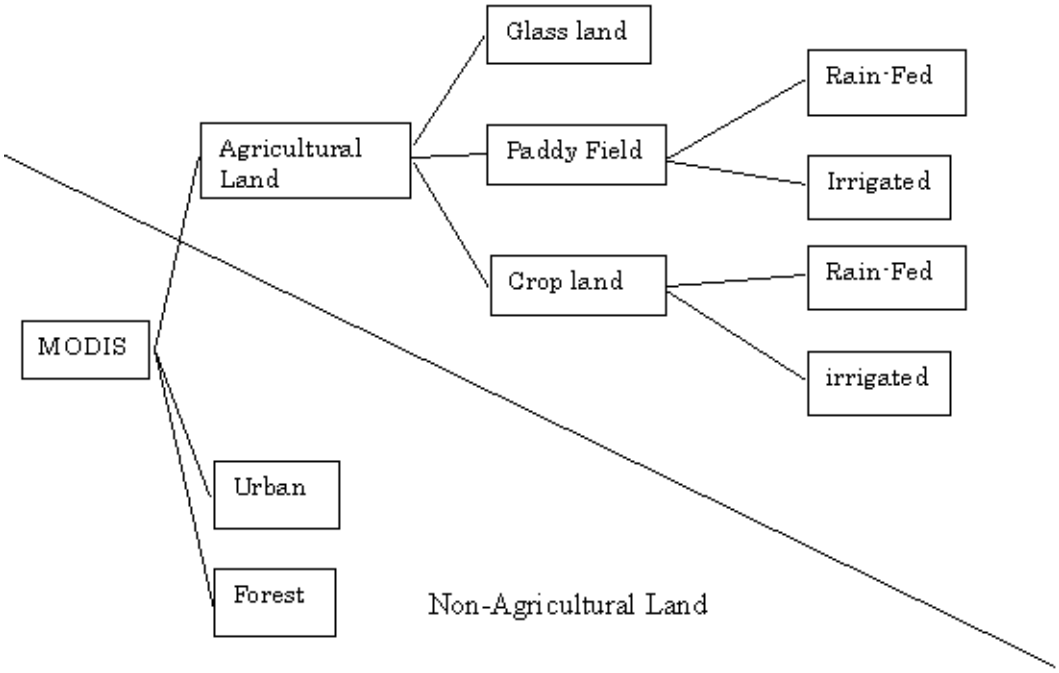


Fig.3 Decision tree

4.Results and discussion

4.1 Effect of Köppen

Fig.4 shows scatter gram between band 1(red) and 2(NIR). Upper one is scatter gram of total area, lowers are scatter gram of each climate zone area. Each climate zone scatter grams are sharper than total area, and slope of soil lines are different. Therefore using Köppen climate chart contribute to get more accurate result than when it is not use.

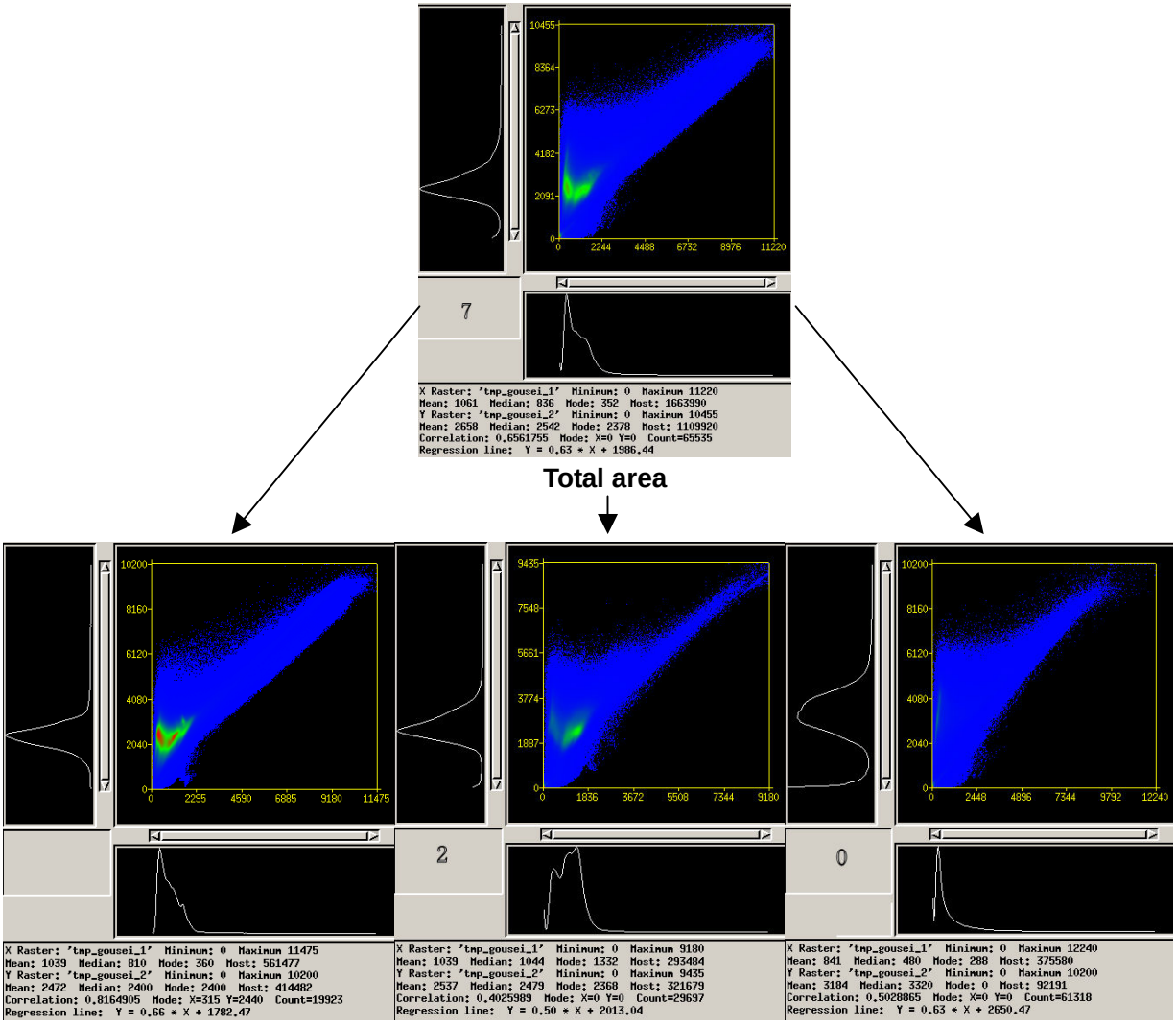


Fig.4 Comparison of scatter gram between total area and each climate zone

4.2 Classification

Now, We are recalculating MODIS data because we met RAID DISK trouble. Therefore we show one of analysis case that detecting rice paddy field.

Fig.5 shows distribution of rice paddy fields in Hokkaido, Japan. In those figures, white part is rice paddy fields. Land use map of AARS can distinguish paddy field in east region. However this area's major land use is crop land, and be in paddy fields little. Land use Map of USGS, this is famous and may be most use in the world, can distinguish rice paddy field west region. This region is primary rice paddy fields in Hokkaido (Ishikari). However. Land use Map of USGS is missed classification in east region same as AARS. The Paddy fields distribution map of Takeuchi is one of good result in present. The paddy fields distribution map that is result of this study appears similar to Takeuchi's result.

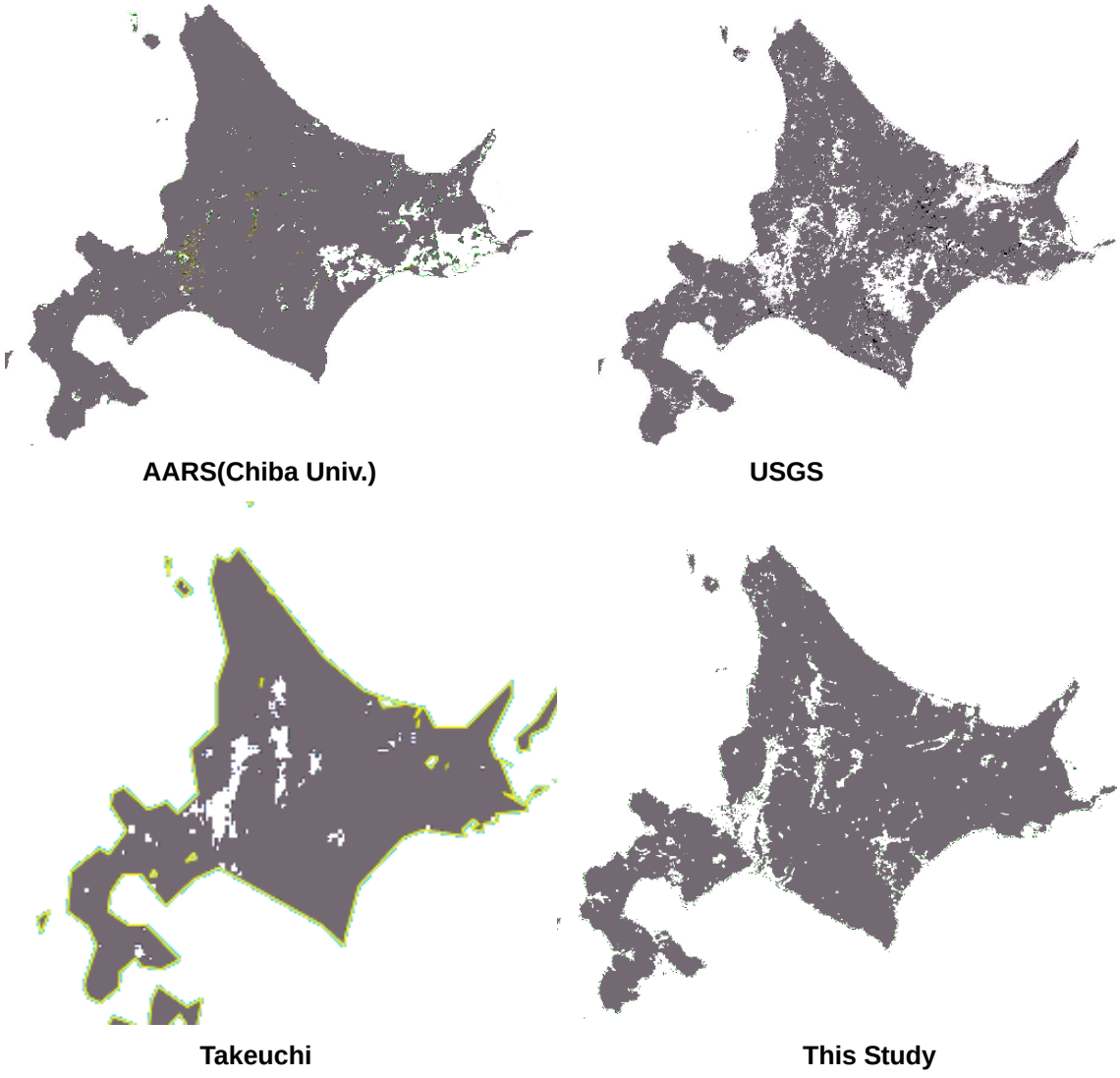
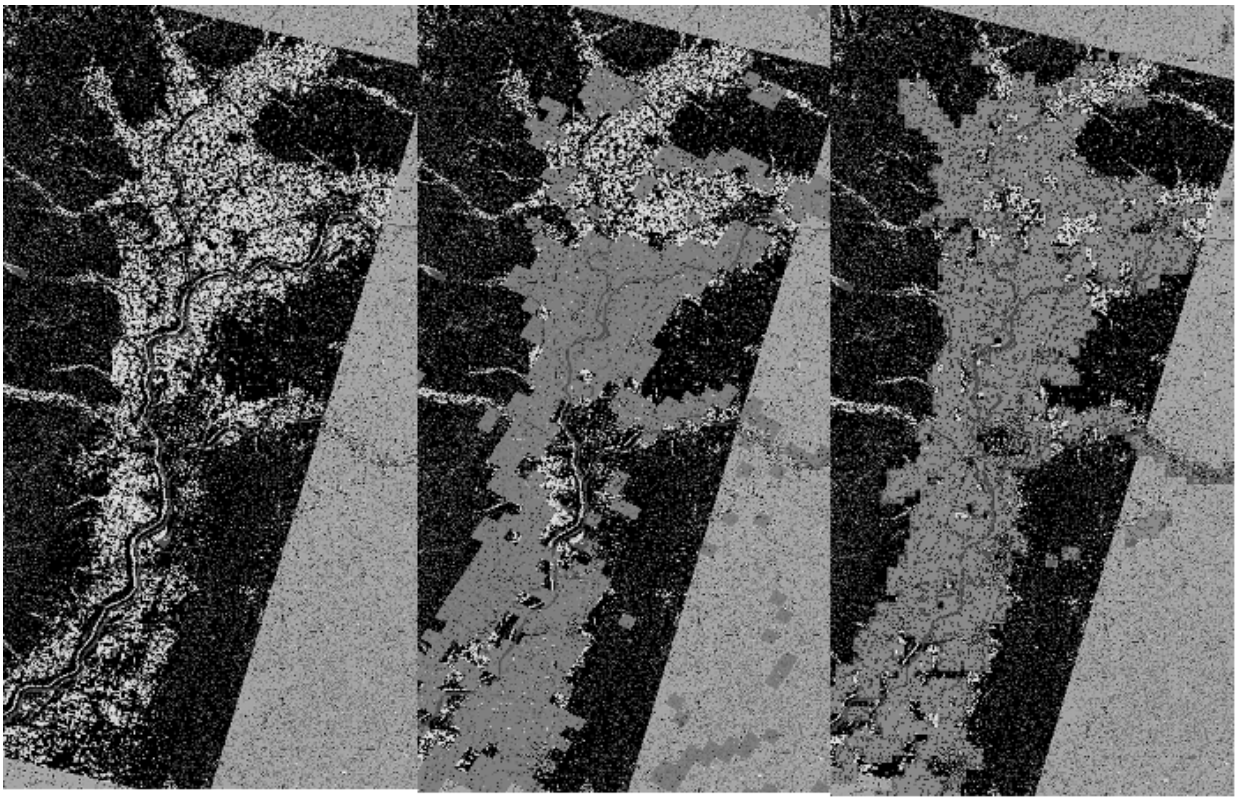


Fig. 5 Distribution map of rice paddy fields in Hokkaido, Japan
White part is detected as rice paddy field

Fig.6 shows Ishikari plains. To validate and compare result, rice paddy field was detected using high spatial resolution satellite image (SPOT5). Left image's white parts are rice paddy field, and center and right image are overlaid USGS and result of this study. USGS is appear white at upper part, it means area of paddy field is smaller than SPOT5. On the other hand, result of this study is almost covered white area. These results conclude that result of this study better than USGS.



SPOT5 USGS MODIS(in this study)

Fig.6 Validation of detection and compare with USGS

White part is detected as rice paddy field using SPOT5 (left). Black part is forest.

Gray color is detected as rice paddy field at USGS map (center) using MODIS (right)

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