

The scatter characteristic of rice paddy fields using L band multi polarimetric satellite SAR observation

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Abstract

In optical sensor, because it is influenced by the weather, "timely" observation is difficult. "Timely" observation by SAR is expected. Rice is staple food of Asia, and monitoring the area of rice is demanded. The purpose of this research is to clarify the problem and effectiveness when measure the planted acreage of rice paddy fields in the large area using ALOS/PALSAR, which is the first in the world L-band multi polarimetric satellite SAR sensor. However, analysis is on going now. Incidentally, this paper shows the results were already obtained. In Japan, rice paddy fields are several conditions in winter season. The result of this study that it is difficult to distinguish between the puddling and wheat on rice paddy fields in winter using HH polarization PALSAR DN value.

Keywords: L-band, specular reflection, paddy fields

1. INTRODUCTION

In agriculture, the change of the ground is comparatively early and more dynamic compared with the forest. Therefore, it is important that "timely" and "periodic" observations be done in agriculture. Major farm products are harvested at half a year from several months. In optical sensor, because it is influenced by the weather, "timely" observation is difficult. "Timely" observation by SAR is expected. Rice is staple food of Asia, and monitoring the area of rice is demanded.

Until now, the rice paddy fields have been observed by L-band SAR such as AIR-SAR, JERS-1, Pi-SAR, and SIR. However, a "periodic" observation by multi polarimetric L-band SAR is not done. The purpose of the research is to clarify the problem and effectiveness when measure the planted acreage of rice paddy fields in the large area using ALOS/PALSAR, which is the first in the world L-band multi polarimetric satellite SAR sensor.

Specifically, we will compare the multi temporal PALSAR data with the ground survey data of the rice growth, to clarify the difference of the penetration characteristic according to the rice growth stage. In addition, the penetration of the microwave by the difference of polarization will study. Moreover, I will examine the generation condition of the Bragg scattering based on the angle of the range direction and rice paddy fields.

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In Japan, the consumption of the rice is decrease and rice is a surplus. Therefore the government and farmers control amount of products. One of the control methods is planting different crop on the paddy fields, for example wheat, soy beans etc.. In Japan, usually paddy fields in winter season are bare condition. However, if paddy fields are planted wheat for control, these are covered wheat in winter. In this paper, shows results comparison ALOS data with the Japanese paddy fields in winter.

2. METHOD

2.1. Data used and study area

Figure 1 is ALOS/PALSAR image in the vicinity of Aichi Prefecture taken image on February 19, 2007. The observation mode is descending, the HH polarization, and the off nadir angle is 34.3 degrees. Lake Hamana is on an image right edge, there is Chita Peninsula in the left end, and the Atsumi peninsula is seen at the center of the lower side. The Atsumi peninsula is region of agriculture in suburban areas, such as the vegetable (cabbage, Chinese cabbage, broccoli).



Figure 1. ALOS/PALSAR image in the vicinity of Aichi Prefecture on February 19, 2007

2.2. Ground truth

The fields survey is carried out from 20th to 21st in February, the next day of 19 February when PALSAR was

observed, and the ground truth data is taken. The ground truth carried out checking ground state with GPS camera. In this study, I compare ALOS data with ground truth data.

3. RESULTS AND DISCUSSION

Figure 2 is an expansion image, the vicinity of Anjo City, rectangular of Figure 1.

The parts which look bright white are urban area, on the other hand, the parts which look dark are the waters and farmland in Figure 2. In those farmland, the rice field, the conversion field (wheat, soybean), and the fruit tree (fig, Japanese pear) are most.

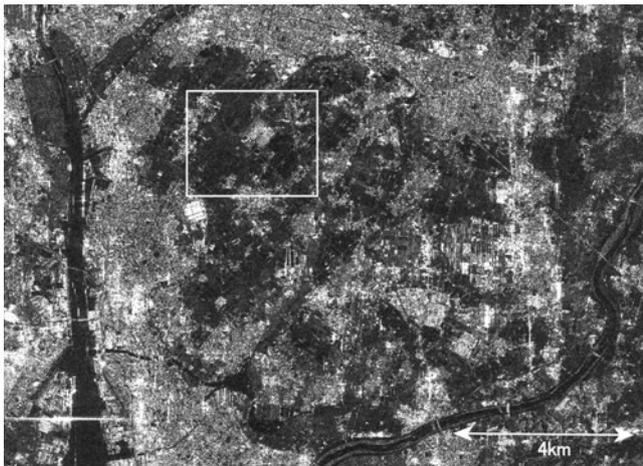


Figure 2. Expansion image rectangular of Figure 1 (vicinity of Anjo City)

The reason why most farmlands look dark is that backscatter is weak. It is known to look dark well in the image so that the microwave may cause the specular reflection when the surface of the water observes with SAR. Usually, neither the rice paddy fields nor the conversion fields are in the state of filled water because this image is winter. However, those are not distinguish the waters such a river and farmlands.

The reason for this is that PALSAR is SAR of L band. The PALSAR of L band SAR is considered smooth even if the roughness somewhat grows compared with RADARSAT etc. of C band SAR sensor. Therefore, bare fields are not so difference with fields filled water, look dark, occur the specular reflection, backscatter is weak.

Figure 3 shows enlarge image of Figure 2. Most of the farmland in this region was paddy fields, and there are a few orchard of the fig tree. The paddy fields where rice will plant in summer are in the state of bare ground. On the other hand, wheat is cropped as for the changing rice paddy fields by reducing acreage, and the bud comes out and it has grown up to about several cm-10cm.

Photo 1 is a picture taken in point , and the rice paddy fields in the state of bare ground. Photo 2 is a picture taken in point and the fields where changing crops wheat is cropped. As for the arrow of the various place point, the direction of taking a picture is indicated. Both fields are

hardly discernible in the PALSAR image. The microwave of L band with long wavelength penetrates the vegetation of such a size. Therefore, scattering is caused with the soil under that. In addition, backscatter becomes small because it can consider smooth ground where the roughness of the ground is small. Therefore the bare fields and the fields where wheat was planted similarly look dark.

Photo 3 is a picture taken in point , and the rice paddy fields filled water. In this region, a new way of farming is experimentally tested. This new way of farming does "puddling in winter". Usually the puddling of rice paddy fields carries out in spring. When taking a picture, "puddling in winter" just done, and paddy fields ware state of filled water or just after "puddling in winter" where has drained water(Refer to photo 4) in the south region from point .

In the PALSAR image, the fields which it went in "puddling in winter" in the south region in point is a state of filled water or a very flat ground. Therefore, the backscatter of those fields are somewhat smaller than the bare fields and the wheat fields, and looks dark little bit. In this PALSAR image, the difference between the waters and the bare land and the wheat fields is small, and as for fields of puddling in winter and other fields in similar, the difference is small. It is conclude that it is difficult to distinguish filled water, puddling field, and other fields clearly from the difference of this backscatter value in the PALSAR image.

4. CONCLUSIONS

There are some issues that observation of rice paddy fields using SAR, for example Ribbes and Toan(1999), Ishitsuka (2002) etc. Those are mostly use RADARSAT that is C-band sensor. If using L-band SAR, the scattering of paddy fields is different C-band SAR, and directly use same method to monitoring rice paddy fields. For example, Ake(1999) shows that some time occur the Bragg resonance scattering observed rice paddy fields using JERS-1/SAR. This Bragg resonance scattering phenomena is discussed in Ouchi et al (2006) and Ishitsuka et al (2004) etc.

In this time, I conclude that it is difficult to distinguish filled water, puddling fields, and other fields clearly from the difference of this backscatter value in the PALSAR image. However, I consider that it is possible to classify though it is a difficult to distinguish state of the ground in this time if PALSAR combines with the SAR image with different wavelength or the optical sensor image.

In this time, PALSAR image used was single HH polarization. I consider that the difference of the backscatter value in the wheat fields etc. somewhat grows, and can be classified if the multi polarization can used. In addition, it is necessary to consider also about the change done by the difference of the incidence angle. I plan to keep experimenting on the microwave-scattered characteristic in the rice paddy fields.

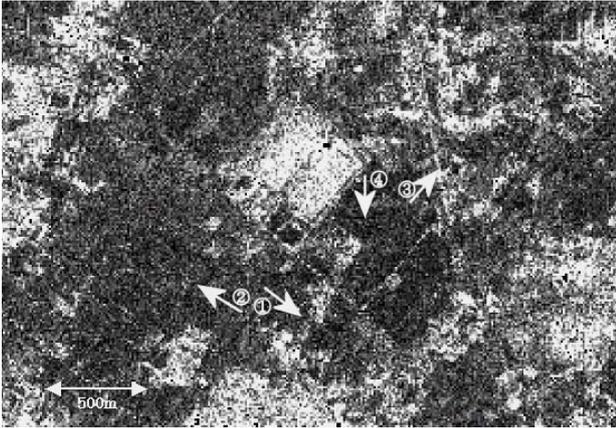


Figure 3. Photo points and direction (Enlarge image of Figure 2)



Photo 3. Just Puddling (filledWater)



Photo 1. Bare



Photo 4. Just after Puddling(draind water)



Photo 2. Wheat

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