BIOFUEL FIELD MAPPING AND GROWTH MONITORING USING PALSAR DATA

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ABSTRACT:

The application technology using PALSAR was developed to extract the distribution of sugarcane fields and to figure out the growth situation of sugarcane. The study area was a whole area of Yagaji island of Nago City, Okinawa. Three objectives are setup. (1) To extract sugarcane fields by analyzing seasonal change of backscatter coefficient of PALSAR. (2) To extract sugarcane fields by analyzing the feature of dual polarization, of PALSAR. (3) To figure out the growth situation of sugarcane based on the backscatter coefficient. The accuracy of extracted fields by analyzing seasonal change of backscatter was over 70%. This shows good possibility of the method based on seasonal change. The accuracy of extracted fields based on the feature of dual polarization was about 65% even though the duration of data collection and timing are not ideal. This shows good potential of the method based on polarimetric feature. To figure out the relation between backscatter coefficient and growth information, the further study is needed.

From these results, the basic knowledge of PALSAR application technology for the figuring out the distribution of biofuel was achieved.

1. INTRODUCTION

The expectation for biofuel has risen as renewable energy following global warming problem. On the other hand, by agricultural products such as sugarcane and corn gain public attention as energy, it has affected seriously supply and demand for foods and environment. Especially, sugarcane is produced mainly in developing countries, therefore it is important for the domestic and international policies about energies and environments, foods that multi-temporal monitoring about figuring out distribution and value of fields, changing to farmland, expansion situation of fields.

Because of these factors, using satellite remote sensing is expected as the extensive monitoring method to establish the system to figure out fields and the multi-temporal changing for global biofuel. Especially, using satellite-mounted Synthetic Aperture Rader which is not subject to weather condition is suitable, because there are a lot of countries produced biofuel in tropics which is cloudy area.

Therefore in this study, we examined the following three points by using ALOS/PALSAR data about the method of figuring out to extract sugarcane fields and growth situation of sugarcane fields which is produced more in developing countries.

1. To extract sugarcane fields by analyzing seasonal change of backscatter coefficient of PALSAR
2. To extract sugarcane fields by analyzing the feature of dual polarization of PALSAR
3. To figure out the growth situation of sugarcane based on the backscatter coefficient

2. STUDY AREA AND DATA USED

We examined the domestic area produced sugarcane where is easy to get land use information and field verification to achieve basic knowledge of the analytical method. As a result, a whole area of Yagaji island of Nago City, Okinawa was selected for study area. There are many farmers actively produced sugarcane. The production volumes has increased, even though the production volumes in the northern part of Okinawa island has faltered, and the crop yields per unit area are more than the average of the northern part of Okinawa island.

Study area is about 7.7km². Major land use is sugarcane fields, the others are mixed of other crops fields and villages, forests (Figure 1). Land uses other than sugarcane fields are forests and weeds fields, other crops fields, abandoned cultivated lands, bares, plastic greenhouses, black steel frame houses, pigsties, bridges, steel towers, water, etc. Other crops are pineapples and flowers, turmeric, potatoes, aloes, etc.

Figure 1. Study area

In this study, we used ALOS/PALSAR high-resolution image (FBS mode) of 5 scenes (2008) and high-resolution image (FBD mode) of 2 scenes (2008) (Table 1).
We got training data for analyzing and verification data by field survey. Field surveys are conducted on July and October 2008 were synchronized with the observation by PALSAR. The survey contents are confirmation of sugarcane crop calendar by hearing survey, to figure out the distribution of sugarcane fields and the other land uses, measurement of the growth situation of sugarcane. We got training data of 34 samples for sugarcane fields and 53 samples for the other land uses by rural settlements.

In addition, we conducted the verification of cultivated field boundary and kinds of cultivation (spring-planting / summer-planting / rotting), measurement of the growth situation (stem length, density, diameter, number of leaves, etc.) The measurement of the growth situation was conducted by following the survey items and methods of the survey for growth which has been conducted every month by local agency (Northern Part District of Sugarcane Production and Promotion Advisory Council) between July and December. In addition, we used QuickBird and ALOS (PRISM and AVNIR-2) images as ancillary data for field survey to confirm last field situation, and used digital map of numeric map 25000 as base map.

3. METHODS

3.1 To extract sugarcane fields by analyzing seasonal change of backscatter coefficient of PALSAR

We examined the method for extraction of sugarcane fields based on seasonal change of backscatter coefficient of PALSAR was observed by PALSAR high-resolution image (FBS mode) on different seasons of 2008. We ordered features of seasonal change of backscatter coefficient on sugarcane fields by comparing the result of field survey and multi-temporal data of PALSAR, and extracted sugarcane fields by developing a rule of discrimination from the other land uses.

3.2 To extract sugarcane fields by analyzing the feature of dual polarization of PALSAR

We analyzed the polarimetric information of PALSAR data was observed by high-resolution image (FBD mode) on September and October of 2008, and ordered effective polarimetric features for extraction of sugarcane fields. We examined method for extraction of sugarcane fields based on the ordered polarimetric features, and extracted sugarcane fields based on dual polarimetric features.

3.3 To figure out the growth situation of sugarcane based on the backscatter coefficient

We analyzed relationship between PALSAR data and the information about growth situation which are sugarcane of stem length and density, diameter, number of leaves, etc. measured by fields survey, and examined relationship between the growth situation and the backscatter coefficient. We ordered extractable information about the growth situation, and developed the method for figuring out growth situation.

4. RESULTS AND DISCUSSION

4.1 To extract sugarcane fields by analyzing seasonal change of backscatter coefficient of PALSAR

As a result of analyzing seasonal change of PALSAR backscatter coefficient observed multi-temporally, there was the feature of decrease by cutting between January and April and large increase on growth season between June and July in sugarcane fields. The distribution of extracted sugarcane fields based on decision tree analysis (Figure 2) developed by using the feature is shown in Figure 3.

As a result of accuracy evaluation, the accuracy of extraction of sugarcane fields was over 70%, and this showed good possibility of extraction of sugarcane fields by using the monitoring ability which is one of features of PALSAR (Table 2).
Figure 3. Extraction result of sugarcane fields based on multi-temporal change of backscatter coefficient

Figure 4. Extraction result of sugarcane fields based on dual polarization features
The distribution of sugarcane fields extracted by object classification used this feature is shown in Figure 4. As a result of accuracy evaluation, the accuracy of extraction of sugarcane fields was about 65% (Table 3). This showed good possibility of extraction of sugarcane fields based on polarization feature, even though under severe conditions, compared to polarization data, are low spatial resolution and short observation of duration, to occur tumbling down on one of periods.

4.3 To figure out the growth situation of sugarcane based on the backscatter coefficient

We analyzed relationship between backscatter coefficient of PALSAR and growth information (stem length and density, volume, etc.) measured by fields survey on July and October (Table 4). As a result, while it showed poor correlation between the density of sugarcane and backscatter coefficient, we could not find relationship between backscatter coefficient and stem length, volume index about the data of July. About the data of October, the structure of stem length and density became complex because of influence of tumbling down by typhoon, therefore the coefficient of correlation was low value. Because sugarcane is cultivated mainly in tropics, we consider that the influence of tumbling down by typhoon or heavy rainfall is important issue. As a solution, we consider that it is important to order effective full-polarimetry feature for tumbling down by estimation of stem length and analyzing with complex of scattering in mind by three-component decomposition using quadruple-polarization data.

5.2 To extract sugarcane fields by analyzing the feature of dual polarization of PALSAR

While the accuracy of extraction sugarcane fields was about 65% by using the feature of dual polarization data (HH+HV) on two periods, it remained an issue to discriminate from land uses which are similar to sugarcane fields like a abandoned cultivated lands as well as the method based on seasonal change. However, this showed good possibility of extraction of sugarcane fields based on polarization feature, because the certain accuracy of extraction was achieved, even though under severe conditions, compared to polarization data, are low spatial resolution and short observation duration, to occur tumbling down on one of periods.

5.3 To figure out the growth situation of sugarcane based on the backscatter coefficient

As a result of analyzing relationship between backscatter coefficient of PALSAR and growth information (stem length and density, volume, etc.), it showed poor correlation between the density of sugarcane and backscatter coefficient. However, deeper examination included surrounding environments (temperature, rainfall, soil moisture, etc.) is necessary to figure out relationship between backscatter coefficient and growth situation. In addition, we consider that it is important issue to estimate stem length and analyze with complex of scattering in mind by three-component decomposition using quadruple-polarization data.

From these results of this study, the basic knowledge about figuring out the distribution of sugarcane fields by using PALSAR data was achieved. We will examine further about discrimination from land uses discriminated hardly by using just seasonal change and the features of dual polarization, and about figuring out effective backscatter coefficient for sugarcane of tumbling down, and about application for in international large production areas.

References from Journals:


Table 3. Classification accuracy assessment based on the method of dual polarization features in the model development points

Table 4 Correlation between growth situation of sugarcane and backscatter coefficient of PALSAR

5. CONCLUSION

5.1 To extract sugarcane fields by analyzing seasonal change of backscatter coefficient of PALSAR

While the accuracy of extraction of sugarcane fields was over 70% by using the feature of seasonal change of backscatter coefficient of PALSAR observed multi-temporally, it remained an issue to discriminate from land uses which are similar to sugarcane fields like a abandoned cultivated lands. However, this showed good possibility of extraction of sugarcane fields by using the monitoring ability is one of features of PALSAR.