Status on the Research on "Retrieval of biophysical parameters using remotely sensed data"

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Abstract

To retrieve biophysical parameters for wet-land rice fields, ALOS PALSAR images were acquired and crop growth parameters were collected in study areas located at Suwon and Dangjin-gun, South Korea. According to the preliminary results from previous studies in 2006 using a ground polarimetric scatterometer system(C- and L-band, fully-polarimetric) at an experimental plot of National Institute of Agricultural Science and Technology (NIAST), a new on-the-ground SAR system was set up including X-band with full polarimetry and the correlation between the observation and the measured rice growth parameters for each polarization, frequency, and incidence angle from 20 to 60 degrees. Furthermore, all eight pairs of ALOS images were calibrated to calculate backscattering coefficients and compared with the results from RADARSAT-1.

Keywords: ground scatterometer, PALSAR, rice

1. INTRODUCTION

Rice, a primary crop in South Korea and the knowledge on the amount and spatial distribution of cultivation has been perceived as so critical to natural resources management as well as the policy making in agriculture. Under the condition of monsoon climate, using radar-based remote sensing data is known as a strongly practical approach for nationwide mapping of rice fields and identifying of the growing cycles [1], and different studies have been conducted to classify paddy rice fields and estimate the growth using different polarized SAR images such as RADARSAT, ENVISAT, ERS, and so on [2][3][4]. The final goals of this study were never different from what has been done in paddy rice cultivation countries. This study was begun to understand the temporal growth variation of each rice type and to investigate model making to estimate the growth status using ALOS PALSAR images, a representative of L-band SAR data. Several PALSAR images were collected and calibrated for backscattering coefficients, and the feasibility for monitoring rice growth was investigated. Furthermore, to make general rules for growth estimation, an on-the-ground SAR system was operated at a fixed paddy field.

2. STUDY SITE AND MEASUREMENT

2.1. Study sites

Two sites were selected for the measurement of rice growth parameters and backscattering coefficients. One was designed for on-the-ground SAR monitoring at an experimental plot of NIAST shown in Fig. 1, and the other was chosen at Yedang irrigated plain, Dangjin-gun, about 65 km on highway far from Seoul, for the growth monitoring using satellite-based SAR images.

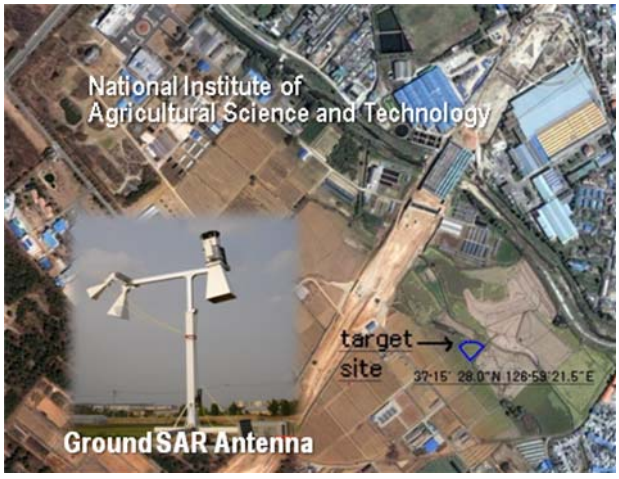

Figure 1. A study plot for on-the-ground SAR monitoring

2.2. Field measurement

Regarding previous studies in 2006 using a ground polarimetric scatterometer system(C- and L-band, fully-polarimetric) at the same experimental plot of NIAST, seven growth parameters were measured at both study sites including NDVI, LAI(leaf area index), plant height, fresh and dry biomass, water content in grain and in plant from May to October in 2007. To discriminate early maturing rice from medium-late maturing rice, all 50 parcels of

paddy rice land were selected: 23 parcels for early maturing rice and 27 for other varieties.

3. IMAGE COLLECTION AND PROCESSING

As for the period of growing season in 2007, all eight pairs of PALSAR images were acquired and the backscattering coefficient was retrieved using the SARscape software respectively (Tab. 1). Fortunately the obtained radar data had shorter recurrence intervals than the designed period, 46 days because the study site places within the area where adjacent paths overlap each other. Fig. 2 demonstrated the temporal change in backscatter coefficients of PALSAR in same path.

Table 1. PALSAR acquired

No	Observation Date	Product Level
1	2007-05-05	1.5
2	2007-05-22	1.1
3	2007-06-20	1.5
4	2007-07-07	1.1
5	2007-08-05	1.5
6	2007-08-22	1.1
7	2007-09-20	1.1
8	2007-10-07	1.1

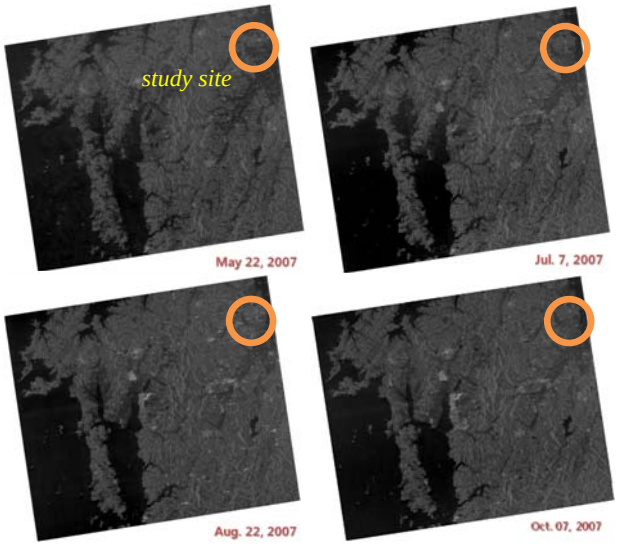

Figure 2. Backscattering coefficients of PALSAR

Through ground SAR monitoring, the correlations between backscattering coefficient and rice growth parameters were analyzed. In case of L-band corresponding to ALOS PALSAR, HV polarization showed better and acceptable correlation than other polarization conditions at the range of incidence angel over 25 degrees.

4. TEMPORAL CHANGE IN BACKSCATTERING COEFFICIENT

The basic statistics of backscattering coefficients were calculated by paddy parcels referring to the Korean Land Information System (KLIS). Fig. 3 shows temporal difference of mean backscattering coefficients between rice varieties. The pattern of temporal change of backscattering coefficients seemed not to be different from previous studies using another SAR images as in [5]. However, the range of the difference between both rice types seemed too small to discriminate early maturing rice from others. It might be because of the characteristics of L-band SAR system, the way of image processing, or data acquisition errors. Further consideration should be given for making better quality of results.

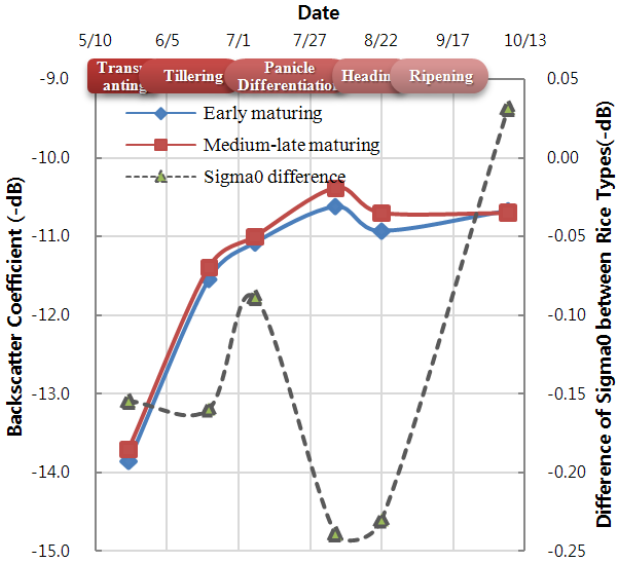

Figure 3. Temporal variation of backscattering coefficient(HH polarization) by rice varieties

5. DISCUSSION AND CONCLUSIONS

Several couples of PALSAR images were calibrated and temporal changes in backscattering coefficients were extracted by the parcel units. The overall pattern was not different from general understanding on SAR responses to rice growth, but it did not show acceptable discrimination for classifying rice varieties. The reasons can be explained in some ways and various possibilities have been examined. In following step, another polarization of PALSAR, HV, will be investigated and we will try to integrate the ground-based SAR backscattering coefficients with those from satellite SAR. Ultimately it is expected to develop a model for estimating crop growth condition by SAR observation.

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