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RELATING JERS-1 SAR DATA TO NDVI BY MONITORING VARIOUS FORESTS

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ABSTRACT: Achievement of sound forest management demands the data on plant biomass and stand density from large forest areas, for which SAR data is considered to be promising. Although, SAR data can allow us to get information about plant biomass from vast areas, its availability is not completed yet, and it is thus necessary to extrapolate some relationships between SAR data and other multi spectral sensor complementarily. In this study we show relationship of SAR CCT count and Landsat TM NDVI by monitoring various forests in Kyoto City, Japan. Study areas are consisting of some various forests and green tract of land in Kyoto City (Japan); Kyoto Gyoen, Tadasunomori and two forest compartment in Kamigamo Experimental Forest. The satellite scenes used in this study are Landsat-5 TM and JERS-1 SAR, which are taken in august 1996 to September 1998. NDVI derived from LANDSAT TM of all study sites draw same shape in seasonal change. Whereas SAR CCT counts of Plantation part and Natural part of Kamigamo Experimental Forest showed seasonal change following seasonal change of NDVI. These of Kyoto Gyoen and Tadasunomori show more flat shapes than Kamigamo Experimental Forest and have increasing trends.

1. INTRODUCTION

There are so many needle leaf plantations, which need management caring of plant density. Achievement of sound forest management demands the data on plant biomass and stand density from large forest areas, for which SAR data is considered to be promising. Although, SAR data can allow us to get information about plant biomass from vast areas, its availability is not completed yet, and it is thus necessary to extrapolate some relationships between SAR data and other multi spectral sensor complementarily in order to utilize so many legacy Landsat data in forest density management administrated by satellite SAR data.

SAR backscattering model in forest is proposed by McDonald et al. (1991) and Karam et al. (1991). Because CCT counts appear in satellite image are sum of backscattering from leafs, branches, trunks and grand in forest, density and DBH have close relationship with CCT count: Senoo et al. (1995).

NDVI, the index in popular use, stands for amount and vigor of vegetation at the surface, which has relationship between amount of accumulating biomass. In this way, the relationship between NDVI to SAR CCT count is expected. This study relating SAR data to NDVI by comparison of these two values on seasonal and annual change in some

forest study area.

2. MATERIAL AND METHODS

2.1 Study area and Material

(1) Study area

Japanese cypress plantation and natural forest compartment of the Kamigamo Experimental Forest and two urban forests, Kyoto Gyoen and Tadasunomori, are selected as the study area. Fig. 1 shows location of the study area. The predominant vegetation is evergreen oak in Tadasunomori. Japanese black pine and zelkova are main vegetation in Kyoto Gyoen.

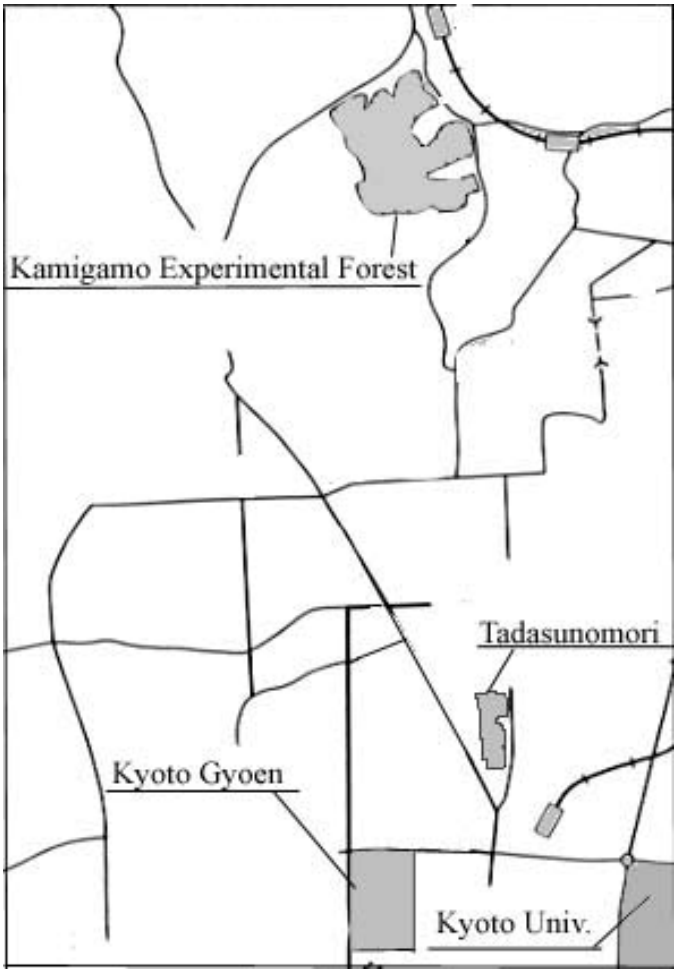

Fig 1. Location of the study area

(2) Material and Tools

Five scenes of LANDSAT TM (acquired on 08/06/96,01/13/97, 08/25/97, 12/15/97, 09/13/98) and also five scenes of JERS-1 data (acquired on 08/30/96, 01/9/97, 12/27/97, 05/8/98, 06/21/98) were selected.

The software used in this study was ERDAS Imagine 8.4 running on PC with Windows 2000.

2.2 Analysis Method

(1) Deriving NDVI image from Landsat TM

NDVI image was derived from each of five Landsat TM scenes. There are some obstructed areas by affection of clouds and shadow of clouds, these area were removed from data for comparison.

(2) Comparing statistic values

Statistic values are computed from both NDVI image and JERS-1 scenes. Mean, minimum, maximum and standard deviations are calculated.

3. RESULTS

Statistical values of NDVI and SAR CCT counts of the study area are showed in Table1 and Table2. Fig. 2 and Fig 3. show seasonal change of mean value of NDVI and SAR CCT counts in each study sites.

Every NDVI generated from LANDSAT TM draw same shape in seasonal change. The Indices increased from spring to summer season, and they decreased toward winter. Annual difference is not appeared in this study. In addition, NDVI of Tadasunomori cannot be observed on the scene acquired on 25-Aug-1997, because of affective obstruction of clouds and shade of clouds.

Whereas SAR CCT counts of Plantation part and Natural part of Kamigamo Experimental Forest showed seasonal change following change of NDVI. These of Kyoto Gyoen and Tadasunomori show more flat shapes than Kamigamo Experimental Forest.

Table 1 Statistical values of NDVI

		06-Aug-96	13-Jan-97	25-Aug-97	15-Dec-97	13-Sep-98
Kyoto Gyoen	mean	0.1230	0.0400	0.1350	-0.1470	0.2540
	min	-0.0891	-0.2258	-0.1803	-0.2558	-0.1429
	max	0.4095	0.2963	0.4909	0.0222	0.5306
	std. deviation	0.1100	0.0950	0.1330	0.0310	0.1350
Tadasunomori	mean	0.2060	0.0020	N/A	0.0200	0.3490
	min	-0.0652	-0.1765	N/A	-0.0741	-0.0682
	max	0.4340	0.2766	N/A	0.1304	0.5102
	std. deviation	0.1470	0.1100	N/A	0.0350	0.1270
Plantation	mean	0.4130	0.2360	0.3330	0.0060	0.4530
	min	0.2039	0.0000	0.0864	-0.1177	0.0323
	max	0.4815	0.4182	0.4528	0.1707	0.5758
	std. deviation	0.0460	0.0930	0.0590	0.0720	0.1070
Natural	mean	0.3950	0.2420	0.2950	0.0210	0.4830
	min	0.2791	-0.1304	0.0741	-0.0667	0.4133
	max	0.5221	0.4386	0.4455	0.1667	0.5446
	std. deviation	0.0640	0.1350	0.0780	0.0440	0.0430

Table 2 Statistical values of SAR CCT count

		30-Aug-96	09-Jan-97	27-Dec-97	08-May-98	21-Jun-98
Kyoto Gyoen	mean	7839.242	8177.604	8203.52	7907.422	8325.258
	min	1902	1712	2172	1949	1511
	max	27098	333957	29646	24527	26358
	std. deviation	2689.836	2907.202	2753.347	2586.732	2914.23
Tadasunomori	mean	8792.462	9643.873	9855.211	7206.096	8094.096
	min	3176	2879	2196	3319	3747
	max	44791	38904	36926	10881	16299
	std. deviation	4691.8	4540.232	4672.254	1982.708	2378.541
Plantation	mean	6666.463	6632.054	8145.85	7985.058	8033.9
	min	2293	2423	2074	2935	2258
	max	17200	15318	24127	22531	16924
	std. deviation	2220.357	2133.055	3444.273	2859.204	2761.573
Natural	mean	5987.248	5448.296	7518.249	6930.399	7328.429
	min	1836	1706	2705	2434	2514
	max	14665	12477	33843	11743	31581
	std. deviation	2425.686	1922.955	3958.552	2048.95	2967.937

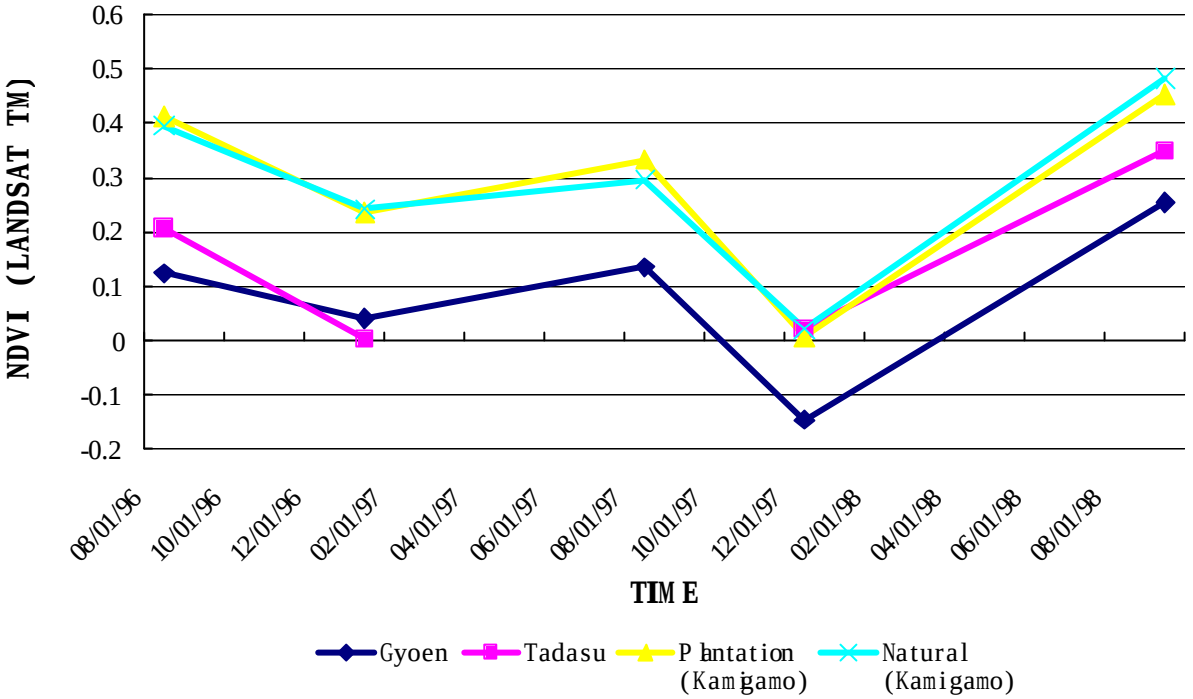

Fig.3 Seasonal change of mean value of NDVI

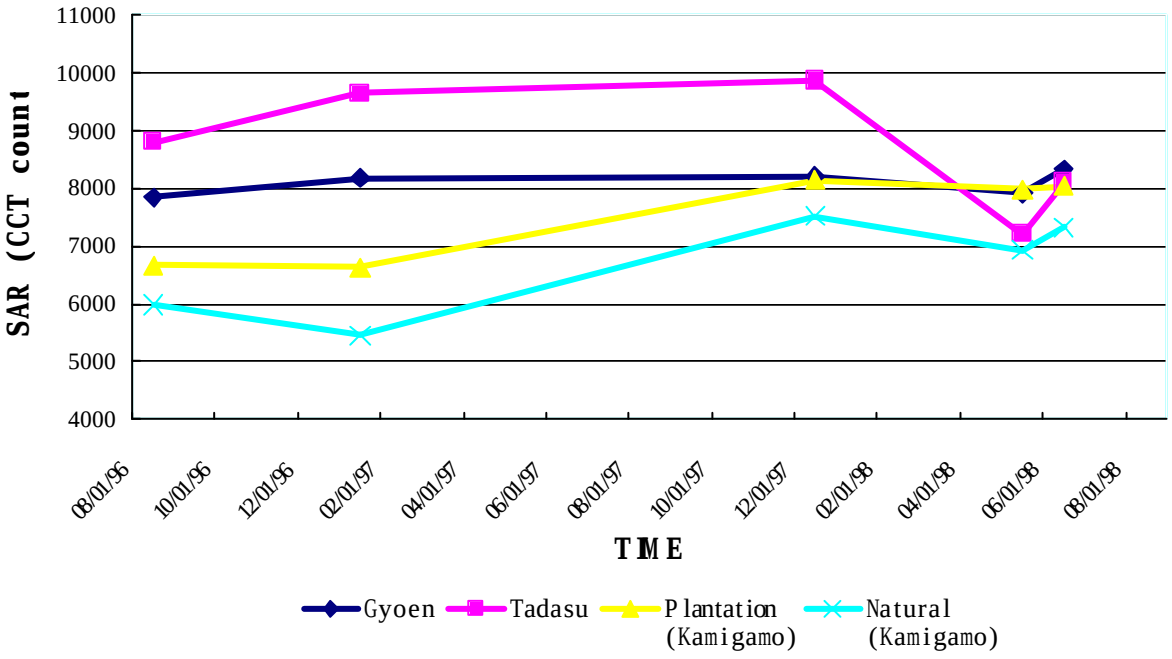

Fig.4 Seasonal change of mean value of SAR CCT counts

4. DISCUSSION

Remarkable seasonal change was not observed in SAR CCT of Kyoto Gyoen and Tadasunomori. The reason is supposed to be that main species is evergreen in there.

This study shows general relationship between NDVI to SAR CCT counts. However more scenes are necessity in order to reveal details of the relationship. Observation of Annual change through five to ten years is supposed to be instructive.

5. CONCLUSION

The following conclusion can be drawn from the results of this study:

- NDVI was increased from spring to summer season, and they decreased toward winter in every forest. Annual difference is not appeared in this study.
- SAR CCT counts of Plantation part and Natural part of Kamigamo Experimental Forest showed seasonal change following change of NDVI.
- SAR CCT counts of Kyoto Gyoen and Tadasunomori show more flat shapes than Kamigamo Experimental Forest does.

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