Detail Estimation of Snow Covered Area from NOAA AVHRR data with New Extracting Method of Pixel Inside Information

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ABSTRUCT:
It is already possible to extract the details of a snow coverd aarea by using LANDSAT data. But obtaining unclouded LANDSAT data is not so easy in the winter season of Japan. On the other hand, it is possible to obtain unclouded NOAA AVHRR data, because the NOAA satellite covers the same area two times a day. But spatial resolution of AVHRR data is very low, compared with LANDSAT MSS and TM. This study aimes to develop the methodology and procedures on how to extract details of snow coverd area from NOAA AVHRR data.

1.INTRODUCTION

Remote sensing techniques have effectively been used for snow covered area observation, and estimation of water resources with snow quantity. NOAA and LANDSAT data are main data sources for snow coverd area analysis. These two kind of sources have each advantage and disadvantage points. NOAA data is recieved twice a day, then it has more chance to obtain unclouded data,but ground resolution (IFOV) is low ;about 1.1km. On the other hand, LANDSAT data is recieved every 16 days, then it is hard to obtain unclouded data in winter or early spring seasons of Japan. But ground resolution is rather high ;about 30m. The authours propose to develope the algorithm and systems to estimate the detals of snow covered area from NOAA AVHRR data, and check the accuracy by LANDSAT TM data which is acquired in same day of NOAA data.

2.SPECIFICATION OF RESEARCH

(1) Data

NOAA AVHRR data
LANDSAT TM data (Path-107,Row-32) (Fig.2)
Both data were observed at 26th APR.1984

(2) Test Site

The mountains area around Morioka City which is located north-east part of Japan. (Fig.3)

North lat.: 39deg.30min.00sec.-- 40deg.10min.00sec.
East long.: 140deg.45min.00sec.-- 141deg.37min.30sec.

3.HOW TO GET PIXEL INSIDE INFORMATION

Algorithm of Analysis shows fig.1. At first, the subjects area were classified primary. Then classified pixels as snow covered area were regarded as 100% snow covered area. On the otherhands, no snow area were regarded as 0 % snow covered area. Fig.1b shows that same snow covered pattern exsample of 3 x 3 pixels window. Fig.1c shows that average parcentage of occupation in 3 x 3 pixels window. If it is regarded that 3 x 3 pixels area are large one pixel from macro point of view. The average parcentage value means that pixel inside infomation of

snow covered area as macro one pixel. Fig.1d shows the average of AVHRR row data or mahalanobis generalized distance data in 3 x 3 pixels window. Then it is possible to make regression model between fig.1c data and fig.1d data. This model is named "MACRO PIXEL MODEL or MPM" by us. MPM regression model is useful for each pixels to estimate snow covered rate for each pixel inside.

4.PROCEDURE OF ANALYSIS

The procedures of analysis are below.

a. Geometric corrections of NOAA AVHRR data and LANDSAT TM data are operated with general purpose computer(FACOM M360).
b. The primary classificatin of snow covered area.
c. Snow covered area are regarded as 100% snow covered ,and no snow area are regarded as 0 % area.
d. Account parcentage of snow coverd area in each 3x3 pixels window from primary classified results.
e. Account average of AVHRR row data or mahalanobis generalized distance from snow covered area in each 3x3 pixels window.
f. Setting up of data sets between the parcentage data and the average data for regression analysis.
g. Obtaining the coefficients of regression analysis, and setting up the estimation model of pixel inside information.
h. Calculate the snow coverd area estimation map for each pixels with model formula.
i. Verificate the accuracy of estimation with LANDSAT TM data of same date.

4.RESULTS OF ANALYSIS

The results of M.P.M. estimated maps are shown in fig.4. And M.P.M. estimated residual map is shown in fig.5. The results of M.P.M. regression is shown in table.1.

Table.1 Results of M.P.M. regression

	ITEM	BAND1	BAND2	BAND4
MPM SNOW COV.%	Coef.of Corr	0.920	0.914	0.819
	Mean Sq.Err	13%	13%	14%

5.CONCLUSION

a. Cause of errors

Most of errors are depend on the accracy of primary classification. The causes of miss-classification were these two items. These were topographical condition and sun angle factor, and spectral characteristics of no snow area.

b. Problem for the future

This study regard that primary classified snow area is 100% covered and no snow area is 0 % . But this postulate is generous. Especially border area does not correspond with this postulate. Then it is studied next posutlate boder snow area is regarded 50% covered. Border area is estimaed by mahalanobis generaized distance.

This model does not consider the contents of no snow area. Specially vegitation area has high refrection at IR-band in spring season. It is necessary to consider about these factors.

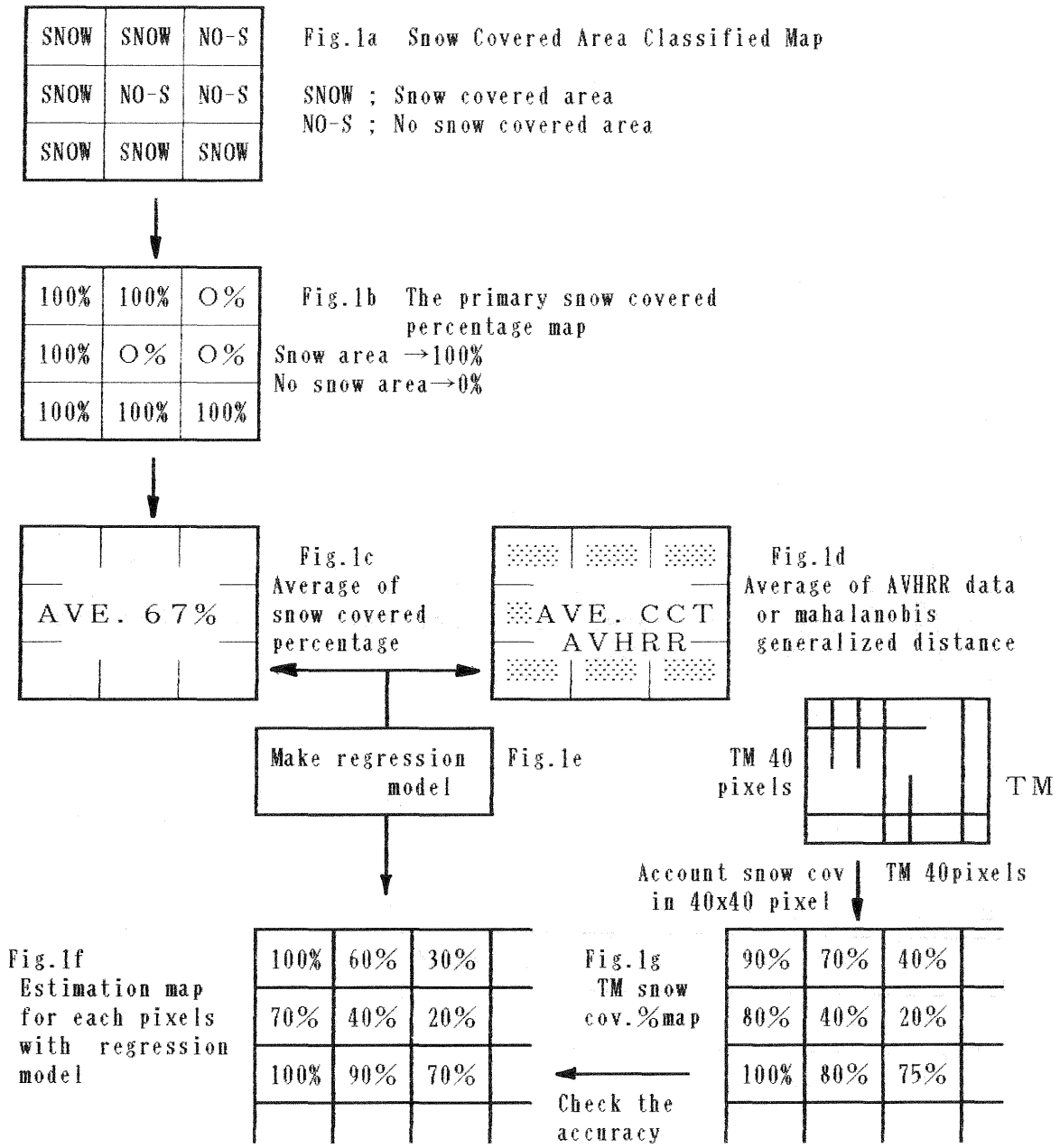


Fig.1 How to get the information of pixel inside

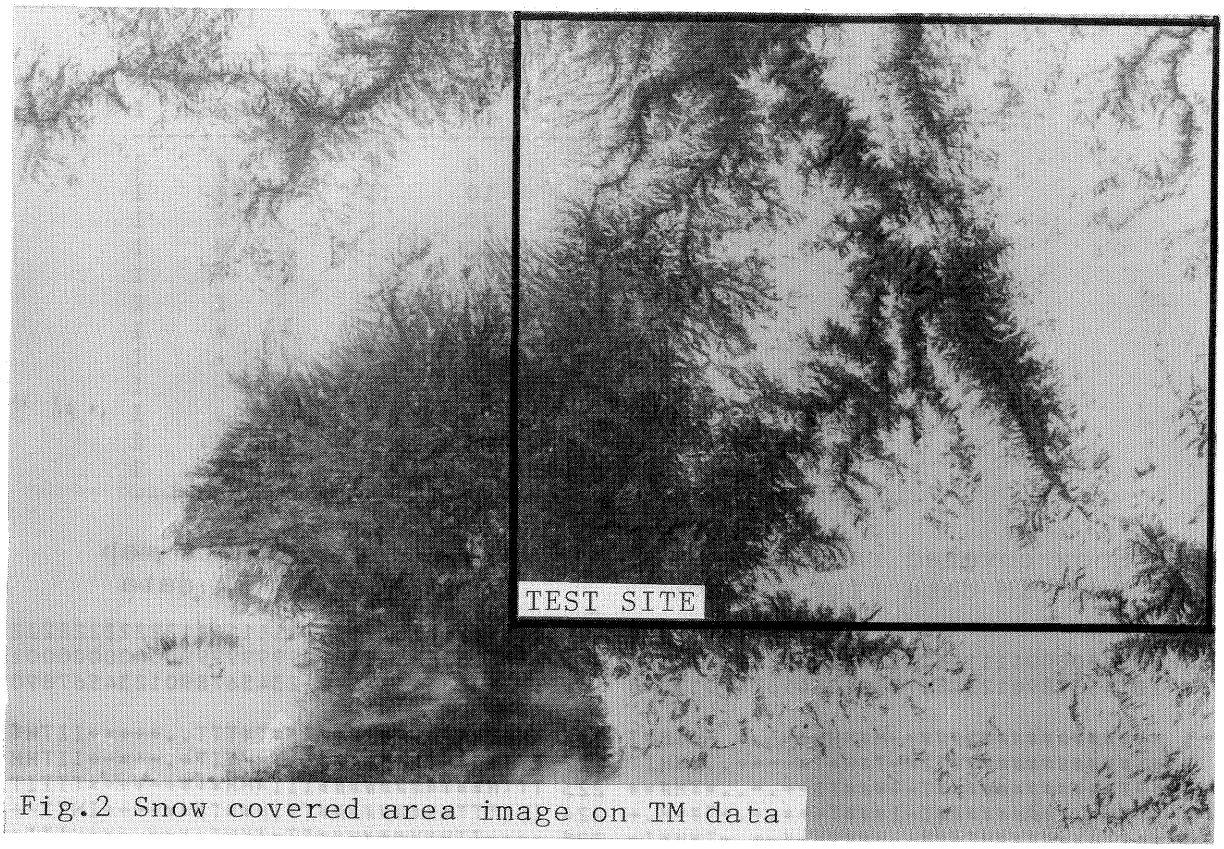


Fig.2 Snow covered area image on TM data

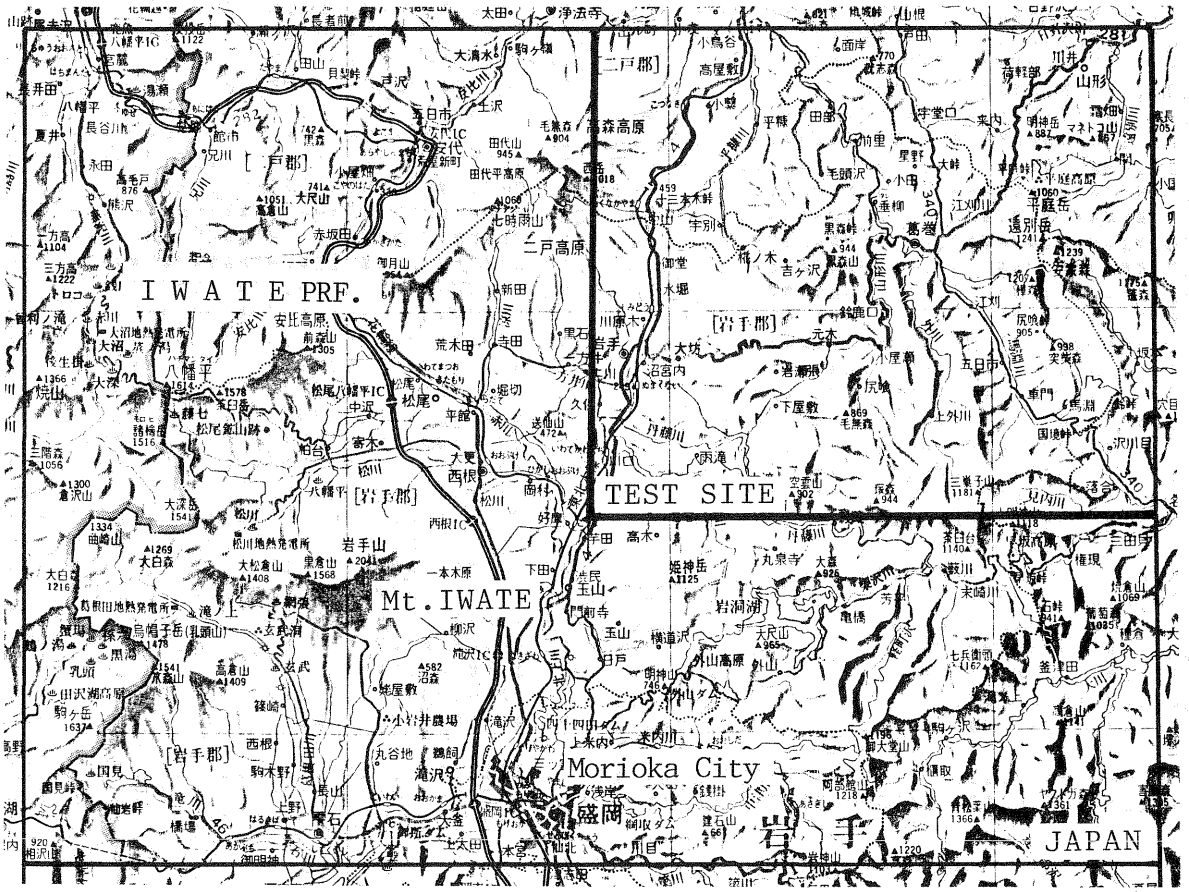
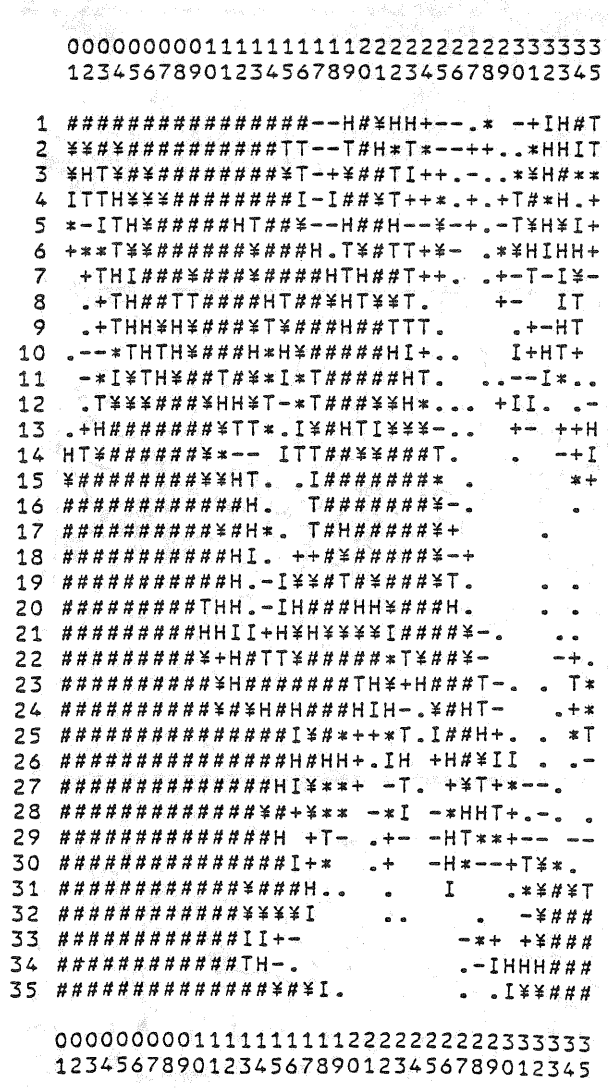


Fig.3 The map of test area Scale 1:500,000

LEGEND

Snow covered percentage (%)	CHARACTER ASSIGNED
- 0	#
1 - 10	#
11 - 20	¥
21 - 30	H
31 - 40	T
41 - 50	I
51 - 60	*
61 - 70	+
71 - 80	-
81 - 90	.
91 - 100	BLANK
101 -	BLANK

Snow covered rate map
from TM data (for check)



Snow covered rate map
from NOAA AVHRR data

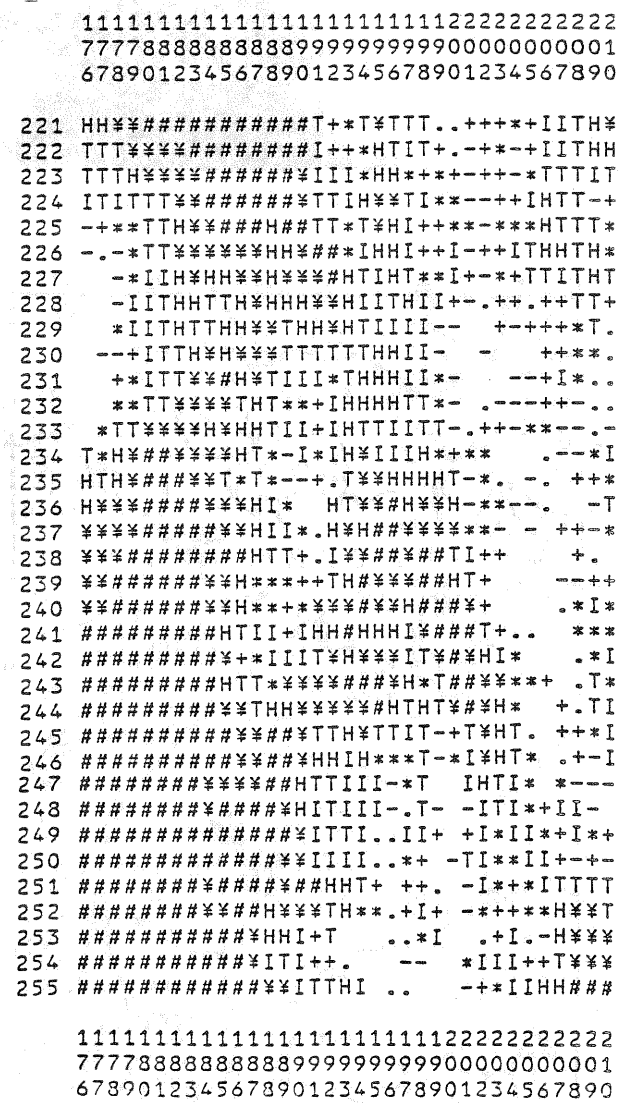


Fig.4 M.P.M. Estimated Map

LEGEND

Residual percentage (%)	CHARACTER ASSIGNED
0 - 19	BLANK
20 - 39	,
40 - 40	*
41 -	I

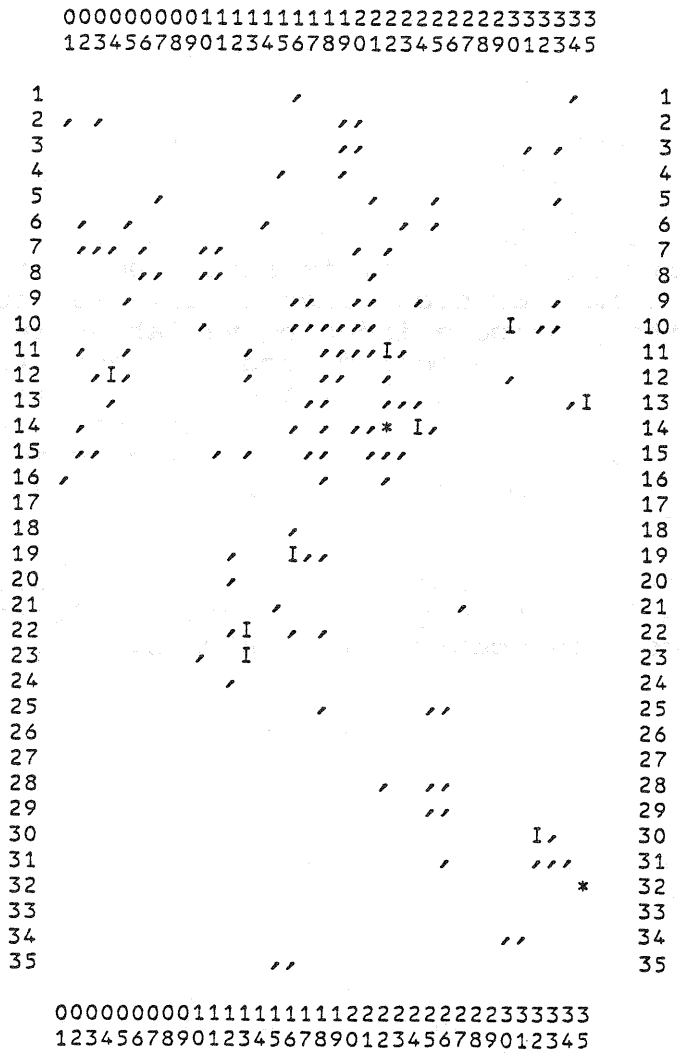


Fig.5 M.P.M. Estimated Residual Map
(TM data and AVHRR data)