EXTRACTION OF HYDROGICAL AND METEOROLOGICAL INFORMATION UEING NOAA AVHRR DATA WITH GEOGRAPHICAL INFORMATION

Kazuhiko Okuyama, Takafumi Konno, Sei-ichi Saitoh, Kunio Akatsu, and Rikuyo Morimoto
Japan Weather Association
4-5, koujimachi, Chiyoda-ku, Tokyo 102
Japan
Commission VII

INTRODUCTION

Estimation of snow distribution is important and essential for utilization of water resources. In order to estimate snowmelt-runoff in the snow melting season, it is necessary to know the amount of snow cover in the mountain regions. The past research of snow cover is carring out by the method of snow survey with hard effort in field operations. In this study, using NOAA Advanced Very High Resolution Radiometer (AVHRR) data, we focus to develop and establish a method for estimating the snow cover in the snow melting season. This study will promise to advance for accuracy of prediction of runoff in the period.

DATA PROCESSING

Japan Weather Association (JWA) has been distributing NOAA AVHRR digital images through floppy disk on daily basis since November 1984. We attempt to estimate snow cover with difinition of distinction condition in combination NOAA AVHRR data with snow observation data by Japan Meteorological Agency (JMA). The procedure of this study is shown in Fig. 1.

Study area is chosen from heavy snowfall region in Japan (Fig. 2). This area is surrounded by mountains of medeum height from 1500m to 2000m from the three direction with east, south, and north. There are 19 snow observation stations in this study area. It is also possible to obtain snow depth data.

Study period is determined in April and May, 1984. In this period, we could obtain five could free AVHRR images as follows:

April 2, 1984
April 14, 1984
April 24, 1984
May 7, 1984
May 19, 1984

To difine the discriminate condition, we used three data of April 2, May 7, and May 19. By useing the relationship between two

channels of AVHRR1 to AVHRR4. Location of snow observation stations is fitting to the position in the AVHRR images. Radicance and temperature in the images is averaged by 3 lines by 3 columns with consideration of the error in location.

RESULTS AND VERIFICATION

Relationships between AVHRR1 and AVHRR2, and between AVHRR3 and AVHRR4 is shown in Fig. 3. The difinition of distinction condition is summerized in Table 1. In the relationship of Fig. (a), correlation is 0.97 in only snow coverd points and 0.95 in whole points.

Two AVHRR data set on April 14 and April 24 is applied to verification using observation data. The results of verification is summerized in Table 2. From this results, it is possible to calculated an adaptation ratio(AR) by following expression:

$$AR = \frac{11 + 7 + 12 + 4}{37}$$

AR is calculated as 92%. This is enough to apply the result to estimate snow covered area.

The condition of snow cover is shown in Fig. 4 using verified distinction condition as 3-Dimentional display. It is clear to grasp the decreasing of snow covered area. For example, the trend of the decreasing of snow cover around Mt. Asahi with 1600 square kilometer is shown in Fig. 5. Between April 14 and April 24, decreasing ratio is maximum in the study period.

REMARKS

This is first step to develop a method of estimation of snow cover with application NOAA AVHRR data. We must consider an effect of incidence angle of solar lays in slope. In this study, we used only cloud free images, but cloud contermination problem must be considered when using various data.

REFERENCES

1. Lauritson L., Nelson G.J., and Porto F.W., NOAA Techical Memorandom NESS 107(1979), 83pp.
2. Tozawa Y., Iisaka J., Saitoh S., Muneyama K., and Sasaki Y., Tokyo Scientific Center Report G318-1556(1981), IBM Japan, 14pp.

Table 1 Distinction condition of snow covered area

Relation	Distinction condition	Points
AVHRR1-AVHRR2	AVHRR1 - 1.2 * AVHRR2 > -11	2
	-11> AVHRR1 - 1.2 * AVHRR2 > -20	1
	-20> AVHRR1 - 1.2 * AVHRR2	0
AVHRR3-AVHRR4	AVHRR3 > 10 °C and AVHRR4 > 5 °C	-2
	AVHRR3 > 10 °C and AVHRR4 < 5 °C	0
	AVHRR3 < 10 °C and AVHRR4 > 5 °C	1
	AVHRR3 < 10 °C and 5 °C> AVHRR4 > 0 °C	3
	AVHRR3 < 10 °C AND AVHRR4 < 0 °C	5

Table 2 Results of verification

Calculation	Observation		Total
	Snow	No snow	
Snow	11	2	13
Snow in part	7	12	19
No snow	1	4	5
Total	19	18	37

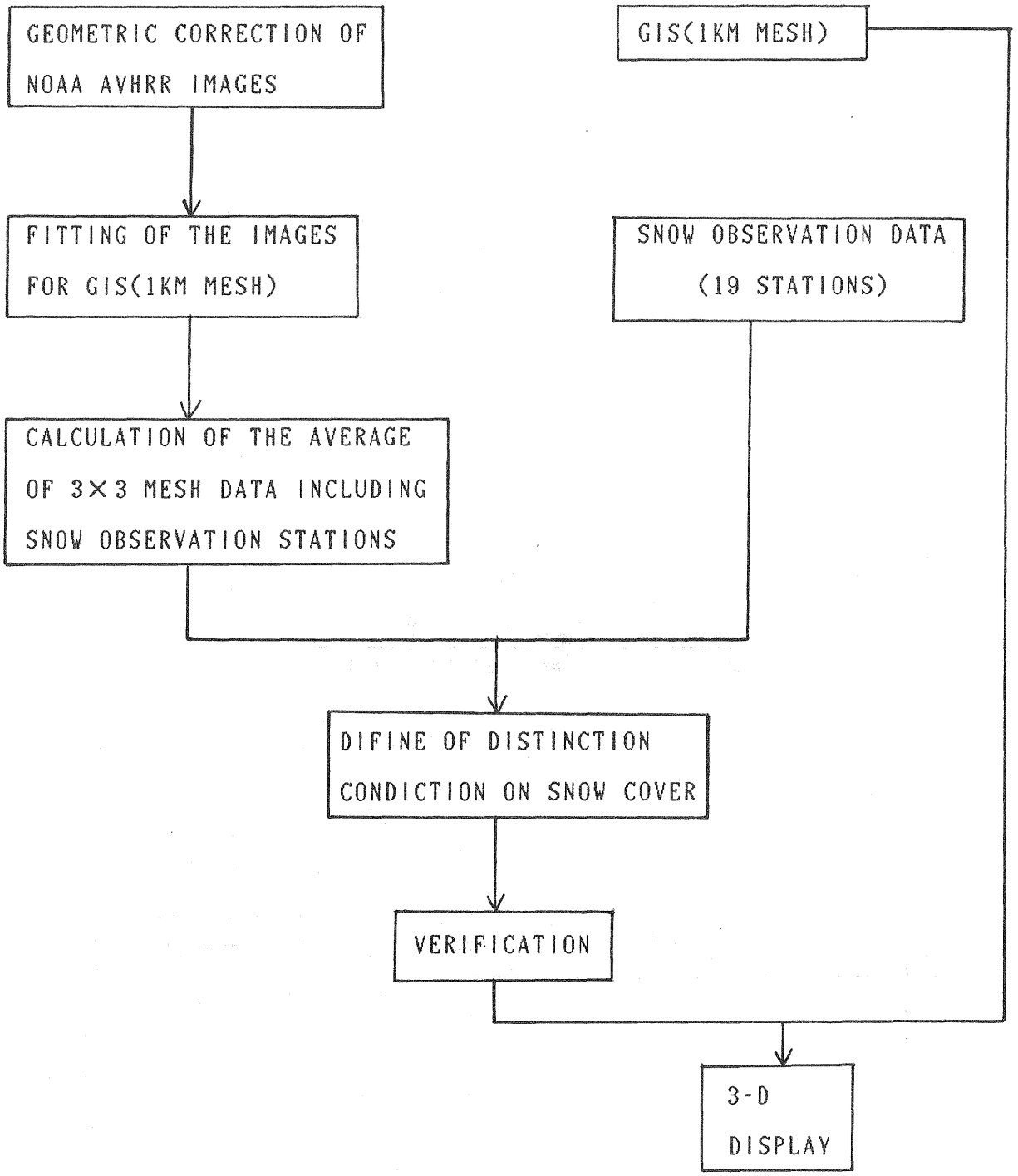


Fig. 1 Flow chart of the procedure of this study.

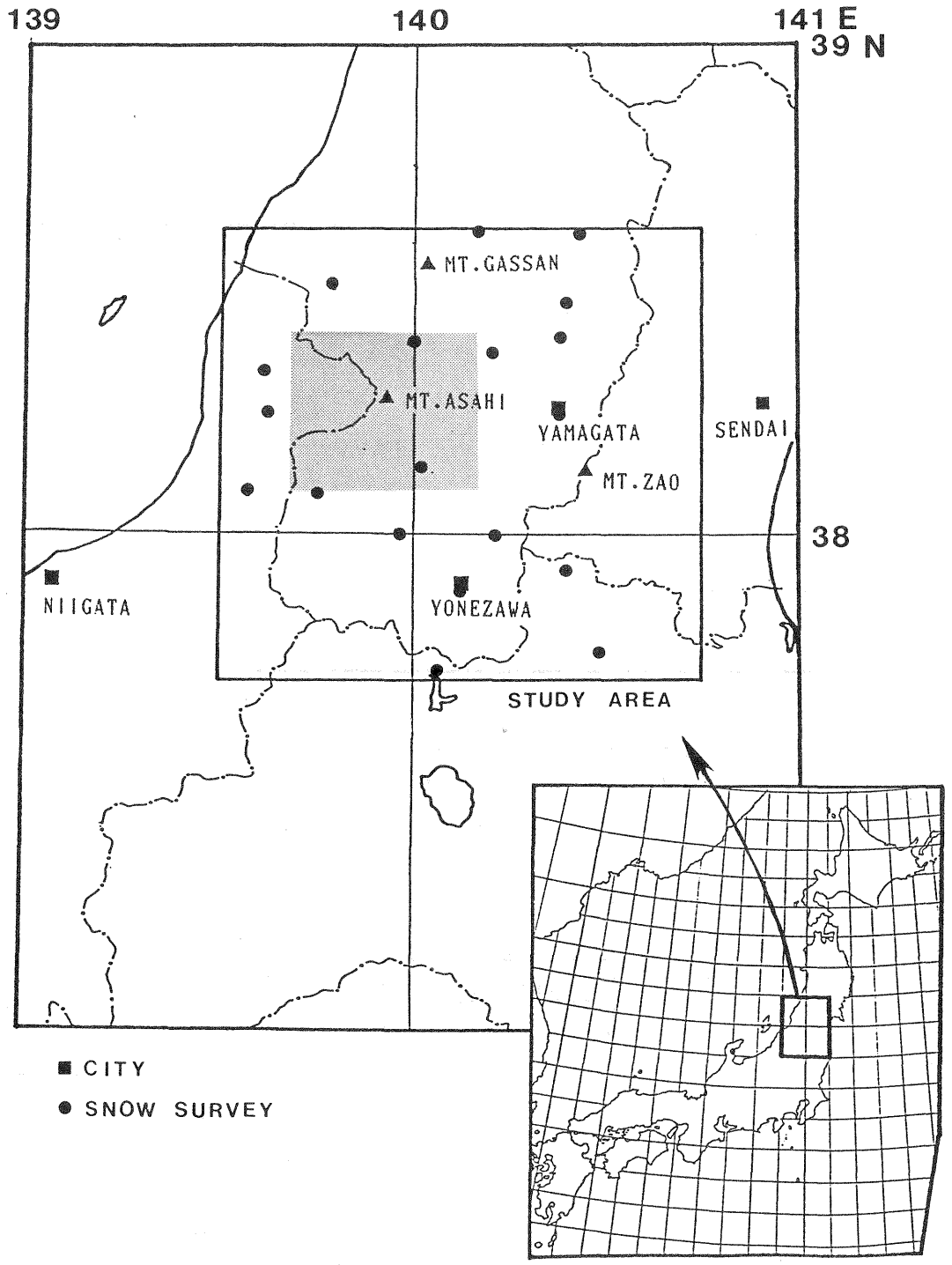


Fig. 2 Map of study area. There are 19 snow observation stations (●). Shadded area indicates the area which is calculated on the snow covering area.

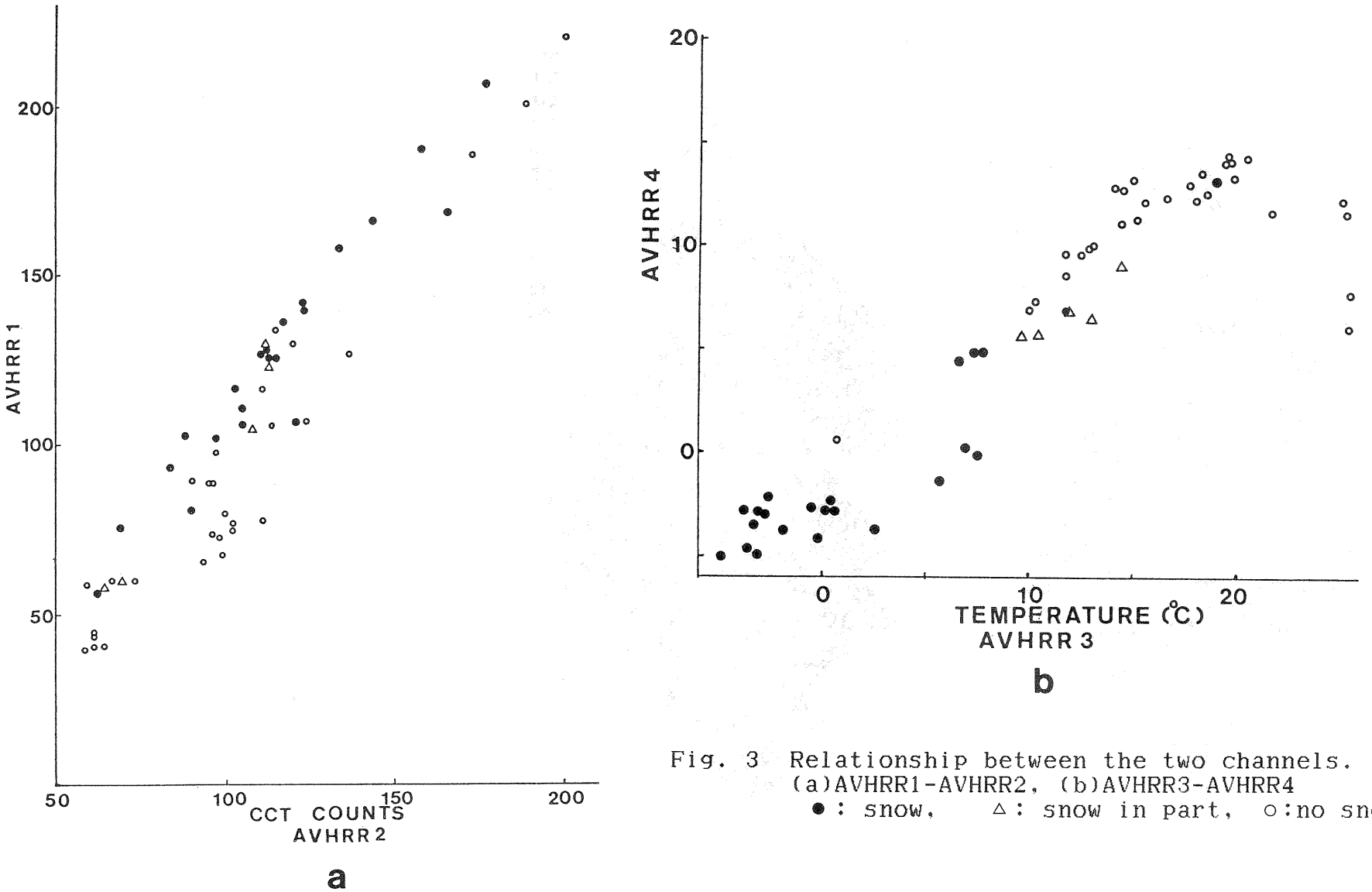
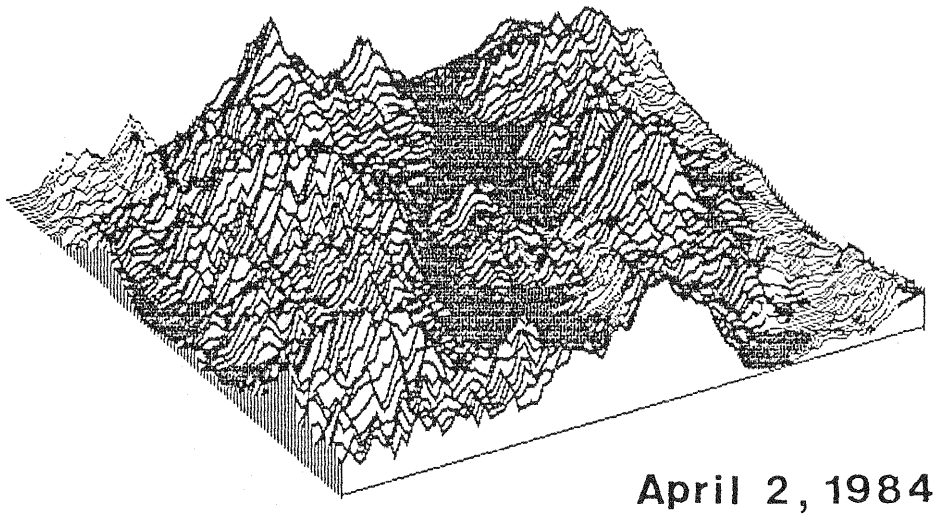
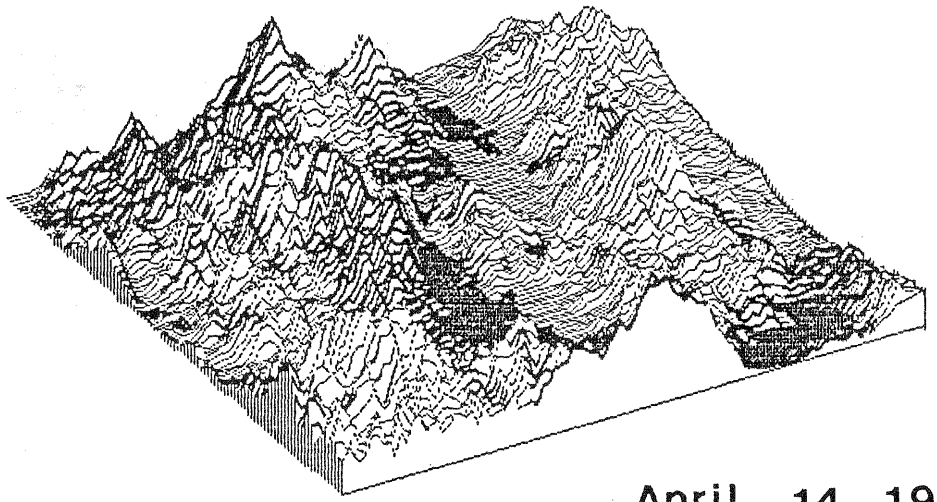


Fig. 3 Relationship between the two channels.
(a)AVHRR1-AVHRR2, (b)AVHRR3-AVHRR4
● : snow, △ : snow in part, ○ :no snow



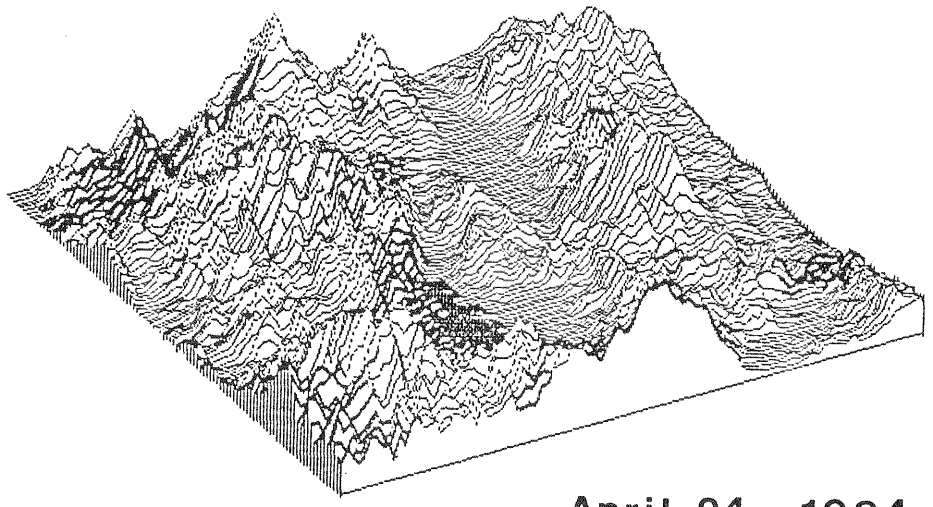
April 2, 1984



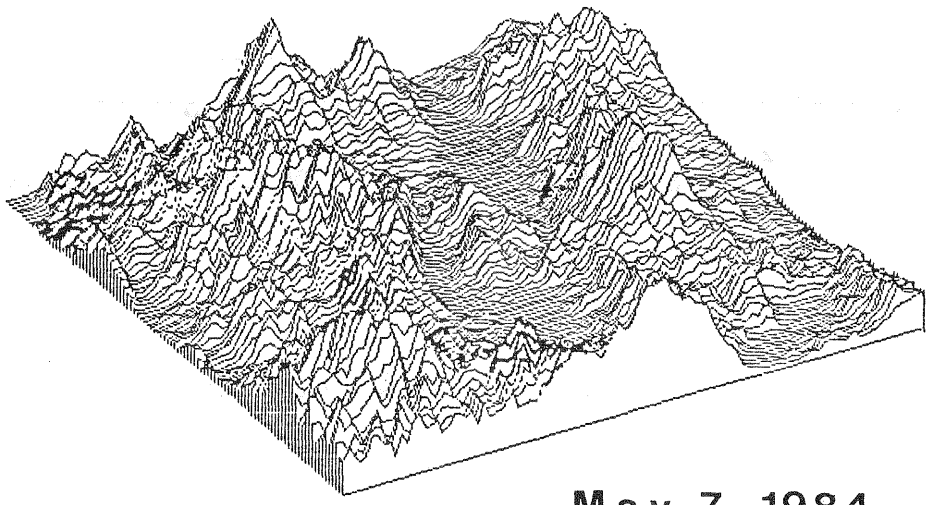
April 14, 1984

Fig. 4 Results of snow cover mapping with 3-D display.

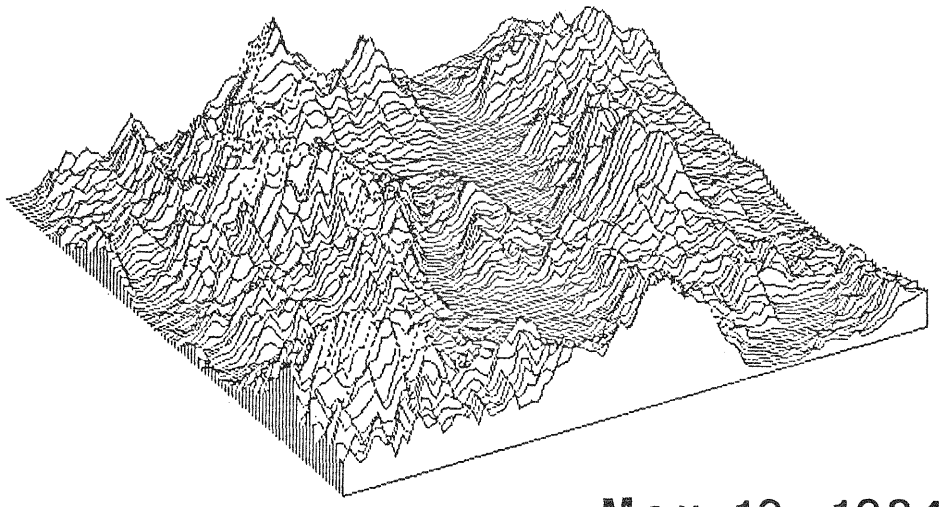
——— : snow
- - - - - - - - : snow in part
——— : no snow



April 24, 1984



May 7, 1984



May 19, 1984

Fig. 4 continued.

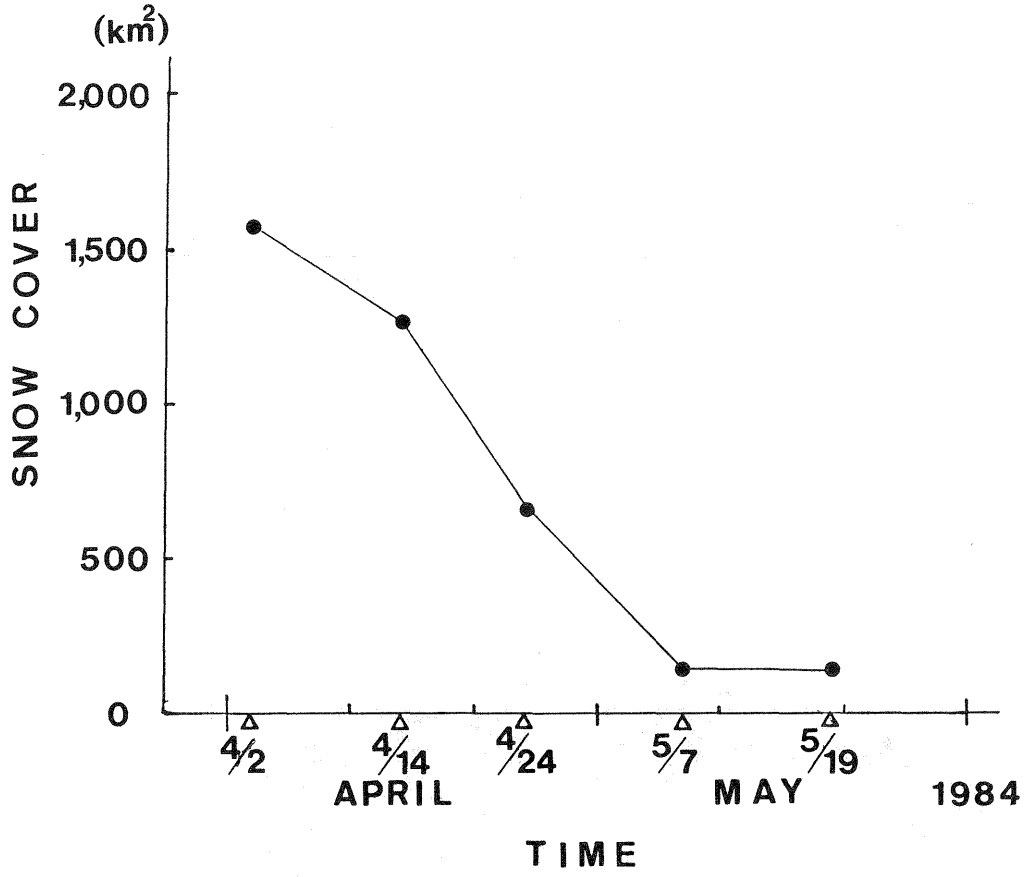


Fig. 5 Trend of decreasing of snow cover around Mt. Asahi.