BREAK-UP CHARACTERISTICS OF CHENA RIVER BASIN

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July 31, 1973

Second Semi-Annual Technical Report, February-July, 1973
NASA Contract NAS5-21833
ERTS Project 110-5

Prepared for:

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
Goddard Space Flight Center
Greenbelt, Maryland 20771

Original photography may be purchased from:
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10th and Dakota Avenue
Sioux Falls, SD 57198

TECHNICAL REPORT STANDARD TITLE PAGE

1. Report No. 6	2. Government Accession No.	3. Recipient's Catalog No.
4. Title and Subtitle: Break-up Characteristics of Chena River Basin		5. Report Date: 31 July 1973 6. Performing Organization Code
7. Author(s): Robert F. Carlson		8. Performing Organization Report No.
9. Performing Organization Name and Address: Institute of Water Resources, University of Alaska, Fairbanks, Alaska 99701		10. Work Unit No. 11. Contract or Grant No. NAS5-21833
12. Sponsoring Agency Name and Address: National Aeronautics & Space Administration, Goddard Space Flight Center, Greenbelt, Maryland 20771, Technical Monitor: Mr. Edward Crump, Code 430		13. Type of Report and Period Covered: Type II, July 1972 - January 1973 14. Sponsoring Agency Code

15. Supplementary Notes

ERTS-1 Project No. 110-5
Robert F. Carlson /UN 596

16. Abstract

ERTS Imagery has been used to monitor the snow melt in Central Alaska. Channel 5 was found to give the best results. The VP-8 analyser was utilized to obtain false color images of grey scales and the built in planimeter with computer was used to obtain quantitative results. It was found, that the snow cover increased at high altitudes from mid February to the beginning of May, while at lower altitudes, there was an increase from 19 Feb. to 27 March, but a decrease to 2 May, as the melting had started.

Two aerial stereo flights were used as "ground truth" measurement of the ERTS imagery. It was found that the snow cover increased with increasing altitude as well as with a northerly exposure, a result to be expected.

17. Key Words (Selected by Author(s))	18. Distribution Statement
ERTS IMAGERY SNOW DISTRIBUTION HYDROLOGY BREAK-UP	

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price*
Unclassified	Unclassified		

TABLE OF CONTENTS

I: INTRODUCTION

This report summarizes the work performed and conclusions reached during the second six months of contract no. NAS5-21833, ERTS-1 project no. 110-5, "Break-up Characteristics of Chena River Basin".

Receipt, logging, and dissemination of the data for this investigation, and for 11 other University of Alaska ERTS-1 projects is carried out under the auspices of ERTS-1 project 110-1. This project functions as the central coordinating facility for all University of Alaska ERTS-1 projects, and is receiving data to cover the entire state (while the test area of the present project probably does not include more than 1/50 the land area of Alaska).

To date, imagery of about 140 scenes of central Alaska have been received by the present project. However, owing to the high amount of cloudiness, and the relatively short time, we are interested in, only four scenes have been analysed in detail. We found, that for monitoring the break-up band 5 is the most suitable.

II: STATUS OF PROJECT

A. Objective

The original purpose of this investigation was to monitor the break-up in the Chena Basin, Interior Alaska. For this purpose the ERTS-1 imagery has been very successful. In the following sections the details will be described.

B. Accomplishments During the Reporting Period

1. Preliminary Investigation

These have been described in the first semi-annual report.

2. Application of ERTS-1 Data to Project Objectives.

The most interesting period for this project was the spring break up period in Central Alaska. During this time, 2 calibration flights (May 11, 1973 and May 20, 1973) were carried out over the Chena- and Poker-Caribou-watershed, and these were compared with the satellite data.

Most helpful in the analyses of the ERTS data was the zoom transfer scope, which allowed the transfer of contour lines from topographic maps to the ERTS imagery. Furthermore, the VP-8 analyser, purchased under ERTS I 110-1 project, was also used. Not only it is easier to analyse color differences than a grey scale, but the planimeter, which is built into this unit, saves very much time, as planimetering areas with a standard planimeter is very time consuming.

3. Results

In Figure 1 and 2, photographs of the color TV display are given. The area, which is located in Central Alaska, can be seen from Figure 3. When studying Figure 1 and 2, and a topographic map one can see, that the higher areas are snow covered, while areas lower in altitude, show a less dense snow cover. However, one has to be somewhat careful, as vegatation is more dominant in the lower areas, and e.g. a spruce forest, where the same amount of snow was deposited as on a bare area, looks darker. When comparing the two ERTS imageries from March 27 and 2 May 1973, the difference, which can be most clearly seen, is that the area with no or hardly any snow has increased substantially by the latter date. Such color displays are good, to make qualitative statements, but for a quantitative analyses, the planimeter, which is built into the VP-8 unit, was utilized (see table). Starting from 19 Feb. 1973, one can see a strong increase in areas with a total snow cover to 27 March 1973. The percentage of a total snow cover stays relatively constant to 2 May. However, the area, which is bare, increases substantially from end of March to the beginning of May. This is caused by the melting which occurs in the lower lying areas, while the total amount of snow at higher altitudes stays about constant. This is verified by observations of the Soil Conservation Service, which measures the amount of water content in the snow cover at different altitudes (Soil Conservation Service 1973). In Figure 4. the water content is given as a function of altitude for 5 points in the Chena Basin. It can be seen from the graph, that the water content of the snow cover steadily increased from 1 March to 1 May 1973. However, for the lower areas, an increase from 1 March to 1 April was observed. However, in April the melting of the snow cover started, and a smaller value was found on 1 May than 1 April 1973. At the lowest point in the basin, the snow had melted altogether by 1 May 1973. These measurements of the Soil Conservation Service verify the data, we have found from the ERTS imagery, and were given in Figure 1 and 2, and the table, respectively.

The snow cover was also investigated as a function of the slope direction for two relatively small watersheds about 20 miles north of Fairbanks for 11 May 1973. The results can be seen in Figure 5. This investigation was done independently of height. One can see, that areas having an amount of snowcover greater than 50% are found much more frequently on slopes with a northerly exposure than on any other. For Basin A, a result is found that was unexpected viz. slopes with easterly or westerly exposure were slightly more snow free than slopes with southerly exposure. However, this must be regarded as an exception, as the result is not found for the second basin or for the mean of both of them.

In Figure 6, the snow conditions are not only given as a function of slope direction, but also of altitude. One can see, that for slopes with southerly, easterly and westerly directions almost all snow had been melted at lower altitudes. Only northward facing slopes for the two basins had in the mean some snow in the lowest (500-1000 ft) altitude range; 70% had a snow cover of more than 10%, and about 10% of more than 50%. With increasing altitudes and with northerly directions the amount of snow normally increased. It is believed, that this is not the place to discuss further details, as these cannot be understood without further description of the topography as well as information on wind velocities and the related snow drifts.

III: NEW TECHNOLOGY

None.

IV: PLANS FOR NEXT REPORTING PERIOD

In the next 2 months, discharge measurements of the Chena Basin will hopefully become available. The melting of the snow cover will be correlated with these discharge measurements and the meteorological data.

In the remaining time of the grant period the data will be prepared for journal publication.

V: CONCLUSIONS

It has been shown under results, that it is possible to monitor the melting of the snow cover qualitatively with ERTS imagery. The snow conditions were described as a function of time as well as a function of altitude and slope direction.

VI: RECOMMENDATIONS

None.

VII: PUBLICATIONS

G. Wendler and R. Carlson: Break-up Characteristics of the Chena River Watershed, Central Alaska. Accepted for presentation at the Interdisciplinary Symposium on Advanced Concepts and Techniques in the Study of Snow and Ice Resources at Asilomar Conference Grounds in Monterey, California, December 2-6, 1973.

VIII: REFERENCES

U.S. Department of Agriculture, Soil Conservation Service, and Alaska Soil Conservation District: Federal-State-Private Cooperative Snow Surveys for Alaska, March, April, May 1973.

APPENDIX A: CHANGE IN STANDING ORDER FORM

None.

APPENDIX B: ERTS DATA REQUEST FORMS

None.

Table

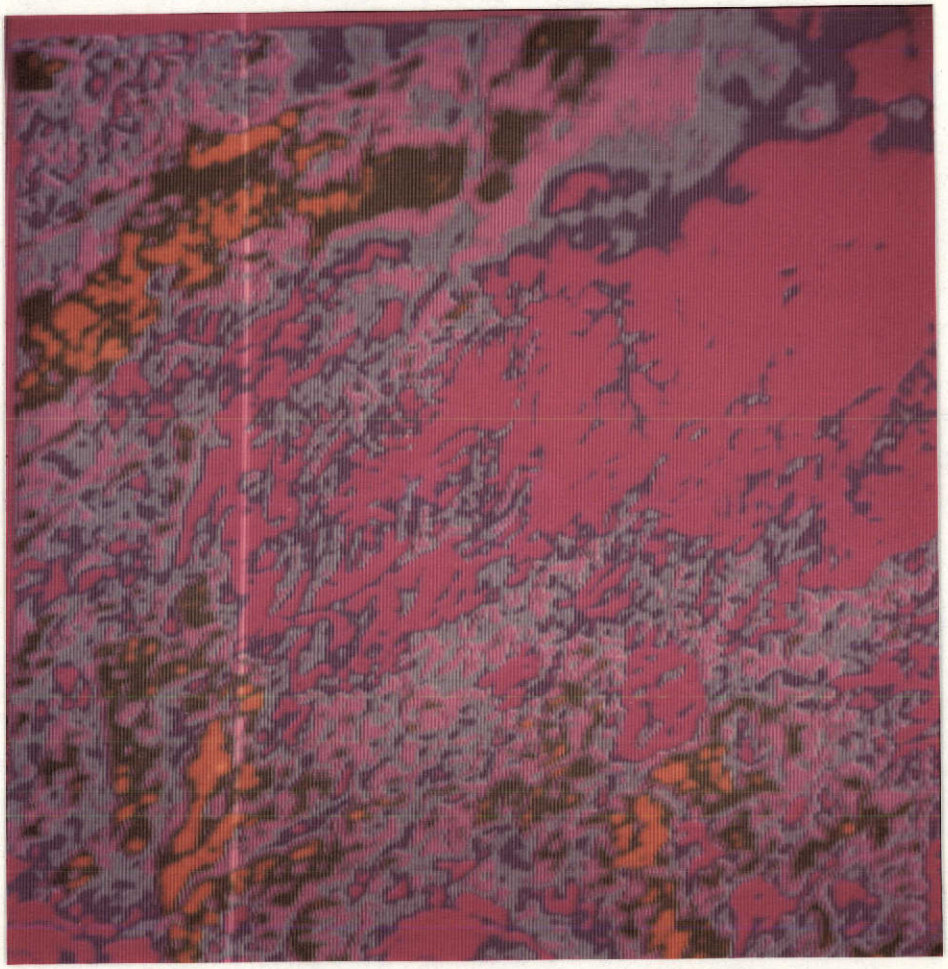
1	2	3	4	5	6	7	
100% snow cover			decreasing snow cover →			no snow	
11	3	24	23	29	6	4*	19 Feb. 73
29	16	20	16	14	3	2	27 Mar. 73
27	13	16	12	14	9	9	2 May 73

Area: 10,000 (nautical miles)^2 or 34,200 km^2. Values given in percent.

* The brightness level for the data of 19 Feb. 1973 was roughly adjusted for the different shadow length.

ERTS Imagery, 27 March 1973, Channel 5, Photo number 1247-20505-5, False color display with VP-8 unit.

Area can be seen from location map

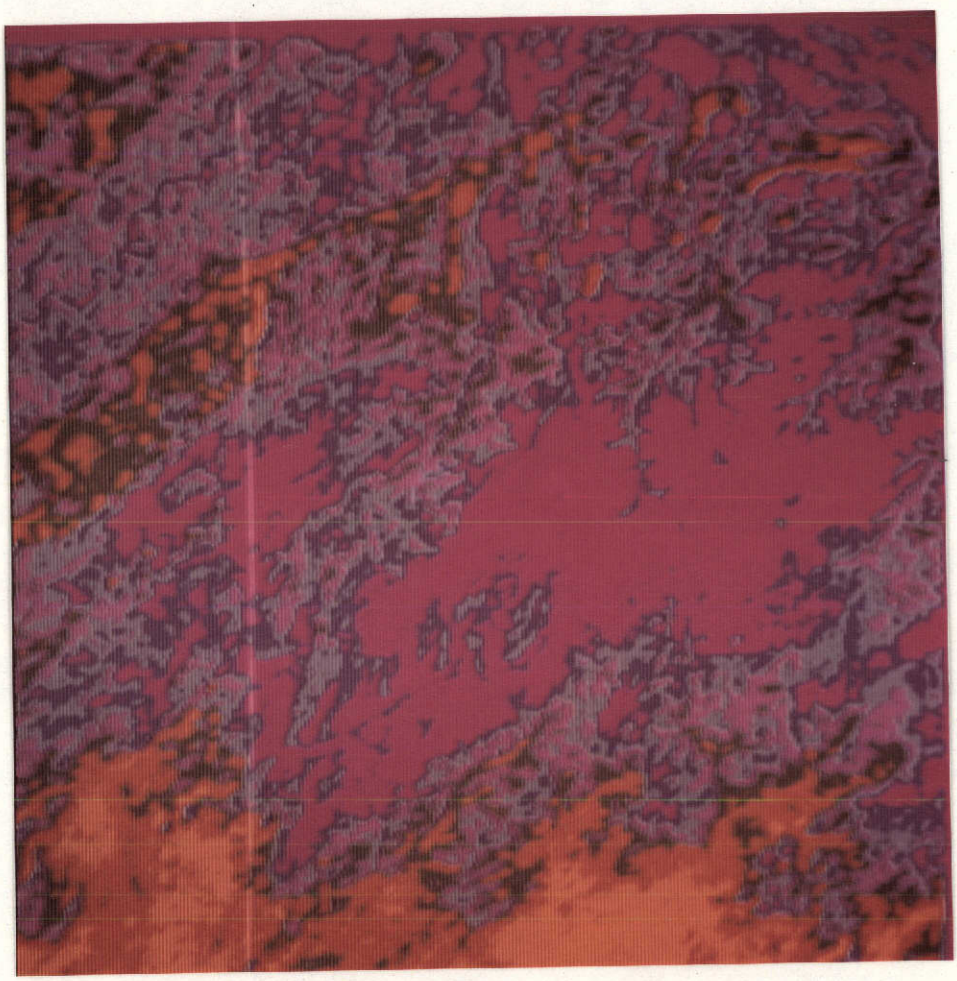


yellow — no snow
orange
green
violet — increasing ↓ snow cover
cyan
blue
magenta — total snow cover

Figure 1.

ERTS Imagery, 2 May 1973, Channel 5, Photo number 1283-20504-5, False color display with VP-8 unit.

Area can be seen from location map



yellow
orange
green
violet
cyan
blue
magenta

no snow

increasing ↓ snow cover

total snow cover

Figure 2.

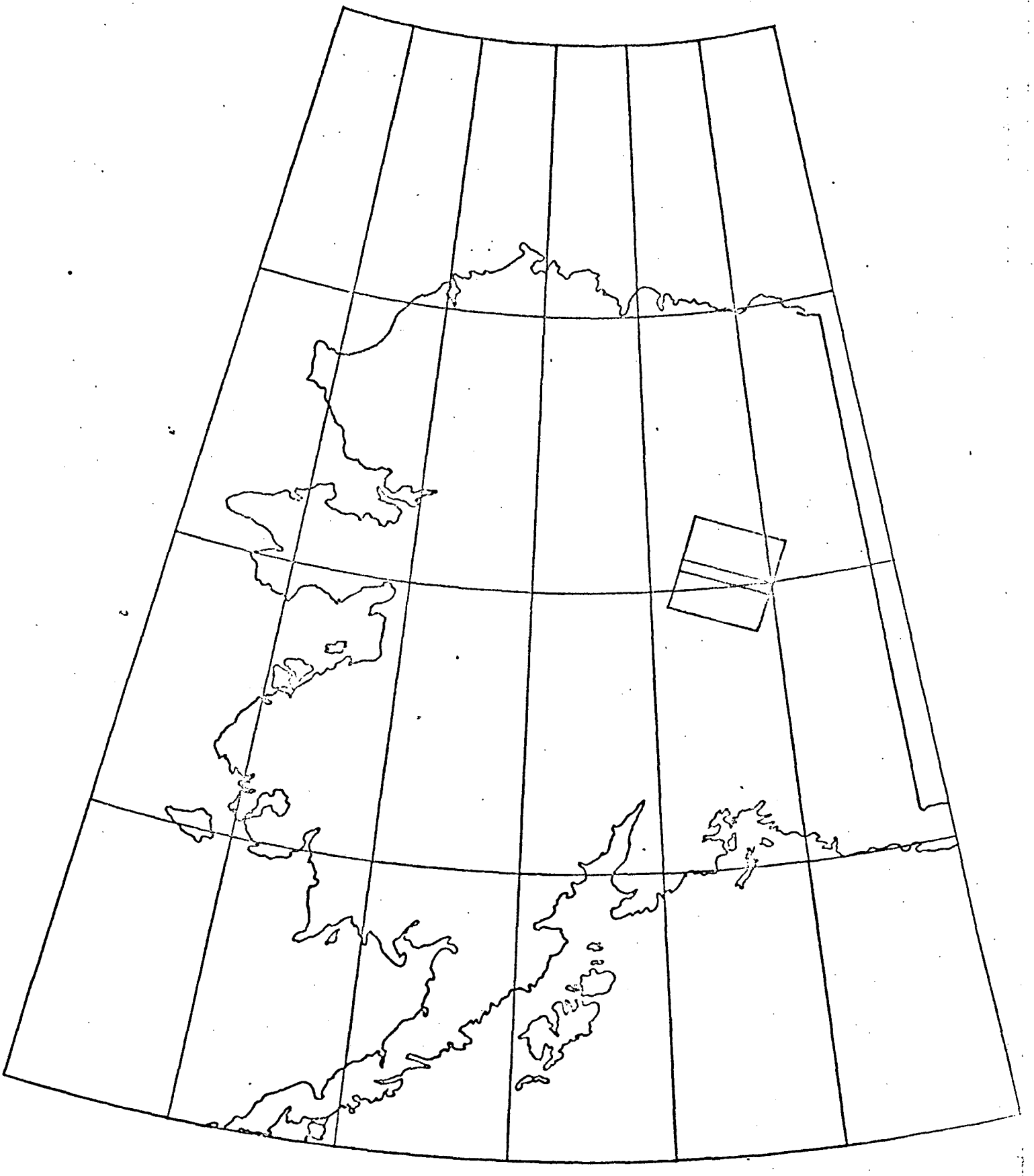


Figure 3. The square represents the test area analysed.

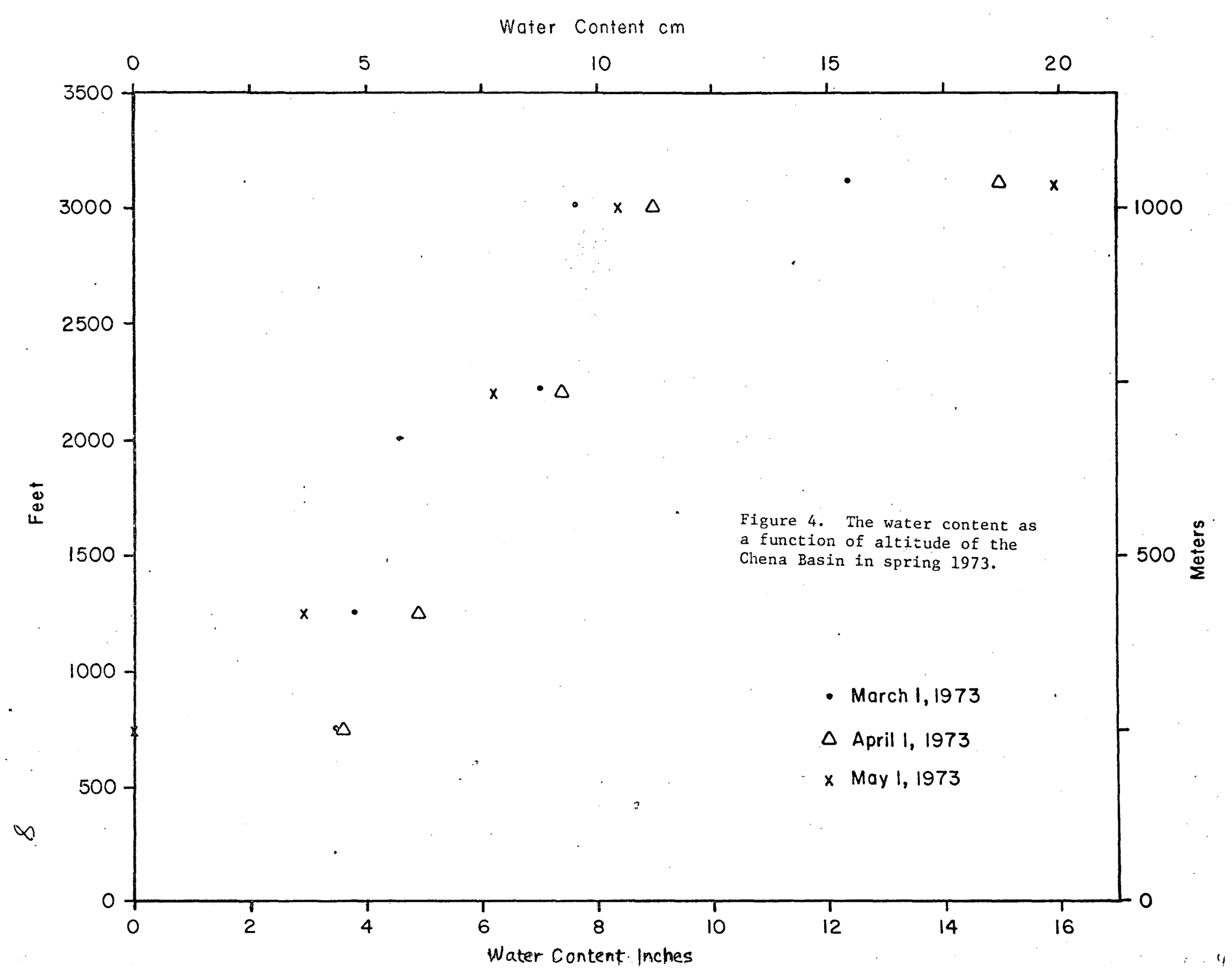


Figure 4. The water content as a function of altitude of the Chena Basin in spring 1973.

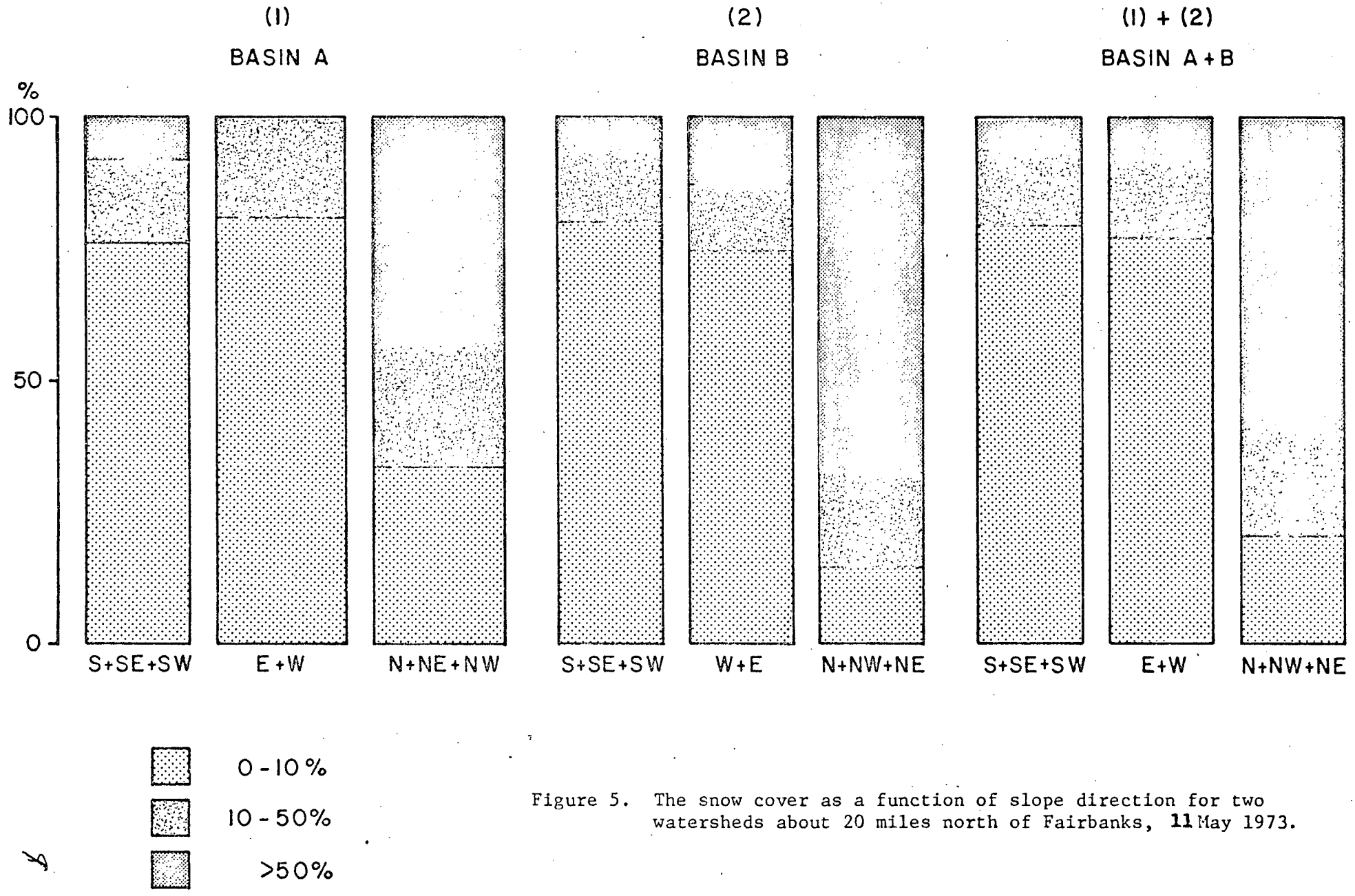


Figure 5. The snow cover as a function of slope direction for two watersheds about 20 miles north of Fairbanks, 11 May 1973.

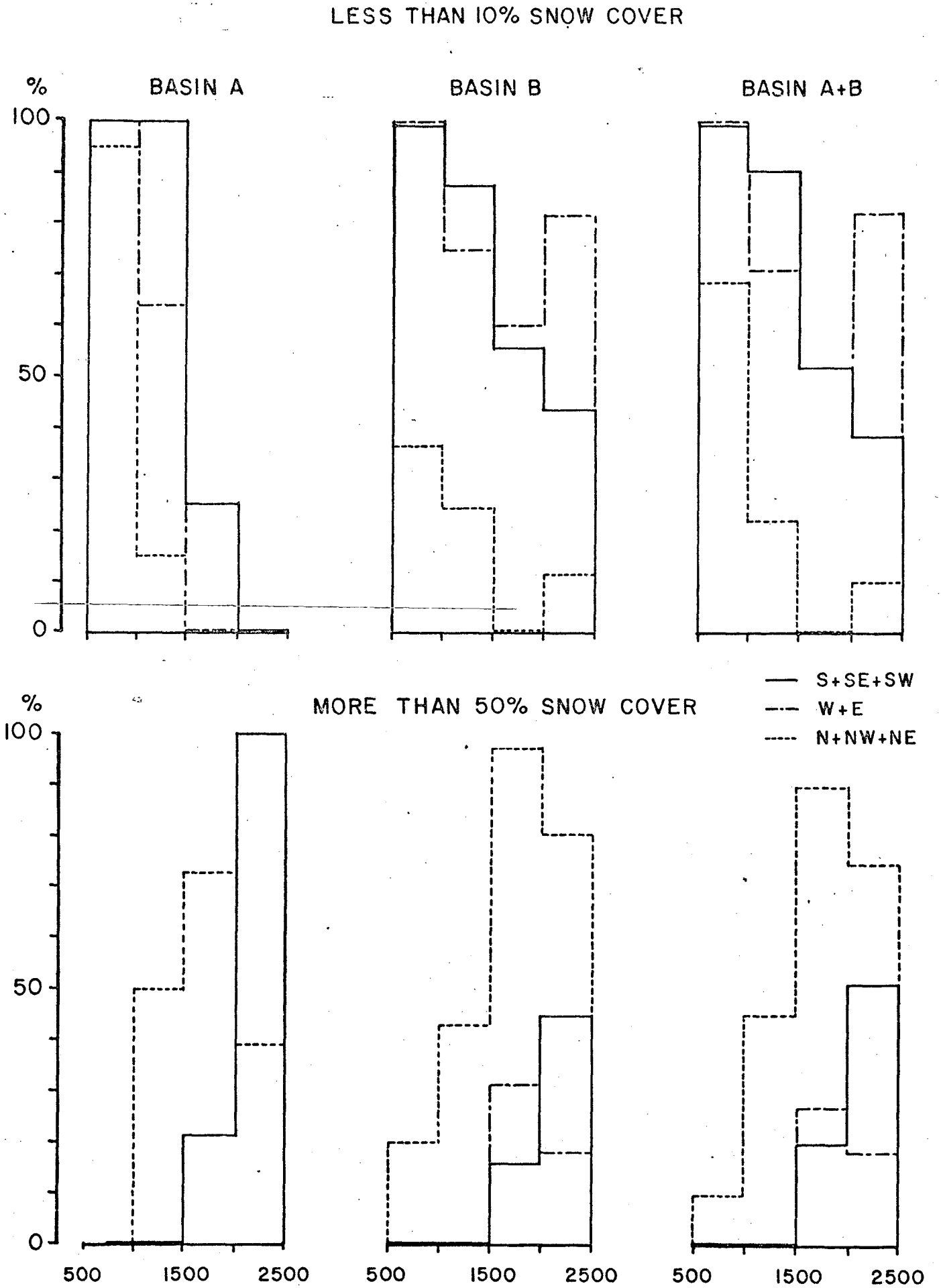


Figure 6. The snow cover as a function of altitude and slope direction for two watersheds north of Fairbanks, 11 May 1973.

APPENDIX C:

ERTS IMAGE DESCRIPTOR FORM

(See Instructions on Back)

NDPF USE ONLY
D
N
ID

DATE July 31, 1973

PRINCIPAL INVESTIGATOR Robert F. Carlson

GSFC UN 596

ORGANIZATION Univ. of Alaska Inst. of Water Resources

PRODUCT ID (INCLUDE BAND AND PRODUCT)	FREQUENTLY USED DESCRIPTORS*			DESCRIPTORS
	Rivers	Mtns.	Valleys	
1211-20504	x	x	x	Thin layer of cloud
1231-21021	x	x	x	Mostly cloud covered
1247-20511	x	x	x	
1262-20340	x	x	x	
1247-20505	x	x	x	
1283-20504	x	x	x	
1284-20562	x	x	x	
1265-20505	x	x	x	
1263-20392	x	x	x	

*FOR DESCRIPTORS WHICH WILL OCCUR FREQUENTLY, WRITE THE DESCRIPTOR TERMS IN THESE COLUMN HEADING SPACES NOW AND USE A CHECK (✓) MARK IN THE APPROPRIATE PRODUCT ID LINES. (FOR OTHER DESCRIPTORS, WRITE THE TERM UNDER THE DESCRIPTORS COLUMN).

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APPENDIX D: SIGNIFICANT RESULTS

PRINCIPAL INVESTIGATOR: Robert F. Carlson

TITLE OF INVESTIGATION: Break-up Characteristics of Chena River Basin.

DISCIPLINE: Hydrology

SUBDISCIPLINE: Meteorology

SUMMARY OF SIGNIFICANT RESULTS:

ERTS Imagery has been used to monitor the snow melt in Central Alaska. Channel 5 was found to give the best results. The VP-8 analyser was utilized to obtain false color images of grey scales and the built in planimeter with computer was used to obtain quantitative results. It was found, that the snow cover increased at high altitudes from mid February to the beginning of May, while at lower altitudes, there was an increase from 19 Feb. to 27 March, but a decrease to 2 May, as the melting had started.

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