U.S. DEPARTMENT OF COMMERCE
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RESEARCH LABORATORIES

Research Laboratories Technical Memorandum -ARL 1

PRELIMINARY METEOROLOGICAL DATA SUMMARY

Route 17

July 1966 - June 1967

Robert J. List
Gilbert J. Ferber
A. B. Arnett, Jr.
Terrance R. Palmer
Robert W. Schoner

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This report presents summaries of the meteorological data collected along Route 17 in the Darien region of Panama as part of the Interoceanic Canal Studies to determine the feasibility of constructing a new sea-level canal across the American Isthmus. Surface weather and upper-air wind data are summarized for the period from July 1966 to June 1967.

1.0 INTRODUCTION

In September 1964, Congress authorized a study to determine the feasibility of constructing a sea-level canal across the American Isthmus. The study is to consider converting the present Panama Canal to a sea-level canal by conventional means and the use of nuclear or conventional excavation along two possible routes in remote jungle areas: Route 17 in the Darien region of Panama and Route 25 in northwest Colombia. Within the overall feasibility study, the conduct of safety studies relating to nuclear excavation is assigned to the Nevada Operations Office (NVOO) of the Atomic Energy Commission. The required meteorological studies are being performed for NVOO by the Interoceanic Canal Project of the Environmental Science Services Administration (ESSA). The Interoceanic Canal Project is staffed by personnel from the ESSA Research Laboratories, Air Resources Laboratory and the Weather Bureau, Overseas Operations Division.

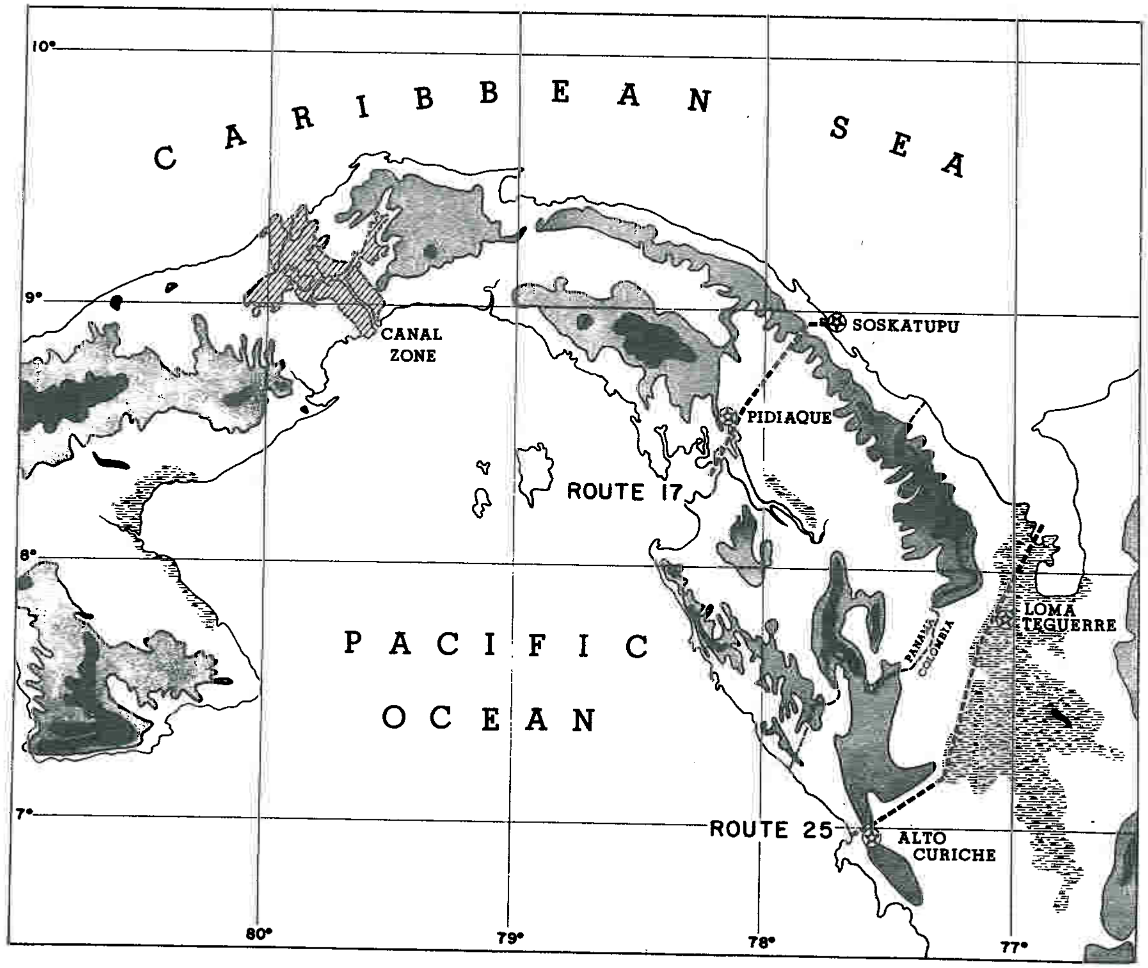
1.1 Objectives

The meteorological program, including 2 years of data collection on Route 17 and Route 25, was designed primarily to answer two basic questions related to radiological safety. First, what is the optimum size and orientation of the area which will have to be evacuated around each proposed canal route in order to insure the safety of the surrounding population? Second, what is the frequency of occurrence of wind and weather situations which would confine the radiation hazard to the evacuated area?

1.2 Data Collection Program

Four manned weather stations, one near each end of each route, have been established to carry out the meteorological observation program. The locations of these stations are shown on the map in figure 1.1. All stations make surface weather observations and radar measurements of winds up to 60,000 feet, four times a day. Observations of the areal distribution of rainfall and the heights to which rain storms extend, are being made by weather radar. These data are needed to evaluate the possible effects of rain scavenging of nuclear debris clouds. Air trajectories at altitudes below 15,000 feet are being studied by radar tracking of constant-volume balloons as they are floated across the isthmus. In addition, three remote instrumented towers have been located along each route to provide a continuous record of wind, precipitation and temperature just above the jungle canopy to aid in studies of the low-level wind circulations.

The manned stations on Route 17 began operations in the summer of 1966; Pidiaque on July 1 and Soskatupu on August 1. The remote towers on this route were installed early in 1967. The manned stations on Route 25 were established at Alto Curiche and Loma Teguerre in July 1967. This report summarizes weather data collected along Route 17 from July 1966 to June 1967. The summaries will be brought up to date and expanded to include Route 25 as the data collection program progresses.



LOCATIONS OF MANNED WEATHER STATIONS

FIGURE 1.1

2.0 SURFACE WEATHER PROGRAM

2.1 Station Locations and Equipment

The meteorological program on Route 17 includes manned stations at Pidiaque and Soskatupu and remote instrumented towers installed at Boca Grande, Summit, and Lagrimas (see fig. 2.1) Table 2.1 lists the location, station elevation, and the date on which data collection started at each site.

Table 2.1

Surface Weather Observation Stations

Station	Location (Lat.-Long.)		Station Elevation (Feet-MSL)	Tower Height (Feet)	Date Observations Began
Soskatupu	8°56'N	77°44'W	7	-	August 1, 1966
Pidiaque	8°36'N	78°8'W	921	-	July 1, 1966
Boca Grande	8°28'N	78°10.1'W	200	60	February 1, 1967
Summit	8°54.9'N	77°50.9'W	1060	120	March 8, 1967
Lagrimas	8°44.2'N	78°4.9'W	274	140	February 8, 1967

The Pidiaque weather station is located on the crest of a 985-foot high ridge which is the northernmost in a line of hills paralleling the Sabana River. In the north and east quadrants from the station, the area is a tropical forest with elevations ranging from 100 to 300 feet above sea level. The Sabana River valley, extending from just west of the station southward to Darien Harbor, is near sea level with tides extending up-river past the station. The area west of the river is also forested and hilly with elevations generally ranging from 300 feet to 1000 feet. The station is approximately 10 miles north of Darien Harbor, but it is 21 miles to the Pacific coast towards the southwest. The Caribbean Sea is 32 miles northeast.

The station was constructed on the cleared ridge whose surface consists of soft rock and clay. Grass and other vegetation is now growing in the area, but bare ground still predominates. The radar is located on the highest point of the ridge which has an elevation of about 985 feet. The office and surface weather observing equipment are located at a lower level with ground elevation of 916 feet. The height of the barometer and official station elevation is 921 feet.

The surface wind equipment consists of a Bendix aerovane mounted on the office building 23 feet above the ground. The data are recorded on a Bendix recorder Model 141. An instrument shelter houses a manually aspirated psychrometer and maximum and minimum thermometers. Precipitation is measured at six-hourly intervals with a standard 8-inch non-recording rain gauge.

Pidiaque also has an M-33 radar system including S-Band (10 cm) and X-Band (3 cm) components used for precipitation observations and upper-air wind measurements respectively. Other instruments on the station are a mercurial barometer, a barograph, and a theodolite used in making upper wind observations when the X-Band radar is not operational.

The other manned station on Route 17 is located on Soskatupu Island, about 1 mile off the Caribbean coast. The island is about one-half mile wide and 2 miles long and parallells the coast. It is only a few feet above sea level except for one hill on which the radar is located. The mainland is forested with terrain rising from 1000 to 2000 feet along the Continental Divide within 5 miles of the coast.

The weather station is located in a palm grove near the beach on the Caribbean side of the island. The ground elevation there is 2 feet and the height of the barometer and official station elevation is 7 feet. The instruments at Soskatupu are identical with those at Pidiaque except that Soskatupu does not have an S-band radar. The height of the hill on which the X-Band radar is located is 145 feet and the height of the radar antenna is 161 feet.

Areas were cleared and instrumented towers were erected at three remote sites as follows:

a. Boca Grande- Ground elevation at this site is 200 feet. The height of the instruments on the tower is 60 feet above ground level. The station is located on the crest of a hill a few hundred feet inland from the northern end of the Darien Harbor.

b. Lagrimas- Ground elevation at Lagrimas is 274 feet and the height of the instruments on the tower is 140 feet above ground. Dense jungle surrounds the Lagrimas tower site with only slight variations in elevation of the terrain.

c. Summit- The ground elevation at this point is 1,060 feet and the height of the instruments is 120 feet above ground. The station is located near the crest of the Continental Divide but there are slightly higher ridges some distance away. Summit is about 5 miles inland from the Caribbean coast.

The equipment at each tower site consists of wind, temperature, and precipitation measuring and recording instruments manufactured by Meteorology Research Incorporated. The wind and temperature instruments have been installed on each tower approximately 20 feet above the top of the jungle canopy. Wind speed is measured by a 3-cup anemometer and the direction with a single blade aluminum vane. The temperature sensor is a spiral bimetallic element. A tipping bucket rain gauge which records rainfall in .01 inch increments in each case is located at the ground approximately 50 feet from the base of the tower. All data are recorded on a battery-wound, spring-driven, strip chart recorder supposedly designed for 60 days unattended operation. The chart recorder is mounted on the tower just below the wind sensing equipment.

2.2 Frequency and Type of Observations

Surface weather observations at the manned stations are made daily at 0100, 0700, 1300, and 1900 local standard time (GMT minus 5 hours). The following measurements are made:

a. Station pressure and sea-level pressure

b. Pressure tendency and 3-hour pressure change

c. Dry-bulb and wet-bulb temperature

d. Relative humidity

e. Maximum and minimum temperature

f. Surface wind direction and speed

g. Visibility

h. Cloud cover (type, percent of sky covered, and cloud height)

i. Significant weather (rain, fog, thunderstorms)

j. Six-hour rainfall amount

k. State of the ground

A "Summary of the Day" record is also kept which lists the beginning and ending time of rain, fog, and thunderstorms, the maximum and minimum daily temperature, and the direction, speed and time of occurrence of the peak wind gust.

The weather data at the tower stations are continuously recorded on a clock-driven chart roll. The data consist of wind speed, wind direction, and temperature at 20 feet above the jungle canopy and rainfall amounts measured at the ground about 50 feet from the base of the tower.

2.3 Data Processing

The surface weather summaries which appear in this memorandum were compiled manually. Current and future observations will be entered on punched cards and summaries will be compiled by computer. The weather observations will be punched onto three types of cards. The six-hourly observations from the manned stations will be entered on standard Weather Bureau card form WBAN I. Card Form 80A will contain the beginning and ending time of rain, fog, or thunderstorms for each manned station. Card Form 80B will contain, for each tower station, the wind direction and speed at 01, 04, 07, 10, 13, 16, 19, and 2200 LST for each day and the hourly and 24-hour rainfall amounts. These card decks will be stored at the National Weather Records Center, Asheville, North Carolina.

The following monthly summaries will be compiled by computer:

A. Soskatupu and Pidiaque

1. Fog and Thunderstorms
   a. Tabulation of occurrences by date and hour.
   b. Number of occurrences each day and each month.
   c. Number of hours or occurrence each day and each month.
   d. Monthly percent frequency of occurrence for each hour of the day.
2. Cloud Ceiling
   a. Monthly percent frequency of various cloud ceiling ranges for 0100, 0700, 1300, and 1900 local time.
3. Visibility
   a. Monthly percent frequency of various visibility ranges for 0100, 0700, 1300 and 1900 local time.
4. Humidity
   a. Monthly mean maximum and minimum relative humidity.
   b. Monthly absolute maximum and minimum relative humidity.

B. <u>All Stations</u>

1. Rainfall

    a. Tabulation of occurrences by date and hour.

    b. Number of occurrences each day (including trace occurrences) and each month.

    c. Number of hours of occurrence each day and sum for the month.

    d. Monthly percent frequency of occurrence for each hour of the day.

    e. Total rainfall for each 6- and 24-hour period and for each month.

2. Surface Wind

    a. Monthly percent frequency of surface winds in direction increments of 10 degrees and various speed categories (increments of 3 to 5 knots).

3. Temperature

    a. Monthly mean maximum and minimum temperature.

    b. Absolute maximum and minimum temperature for each month.

2.4 Surface Weather Data Summaries

Summaries of the surface weather data collected on Route 17 from July 1966 through June 1967 are presented in figures 2.1 through 2.11. Brief explanatory notes appear on the page opposite each figure. Interpretation of these data will be deferred until the data collection program on Route 17 is completed.

Records from the instrumented towers were frequently incomplete due to equipment malfunctions. Table 2.2 lists the number of days of observations obtained per month from each tower.

Table 2.2

Number of Days of Observations

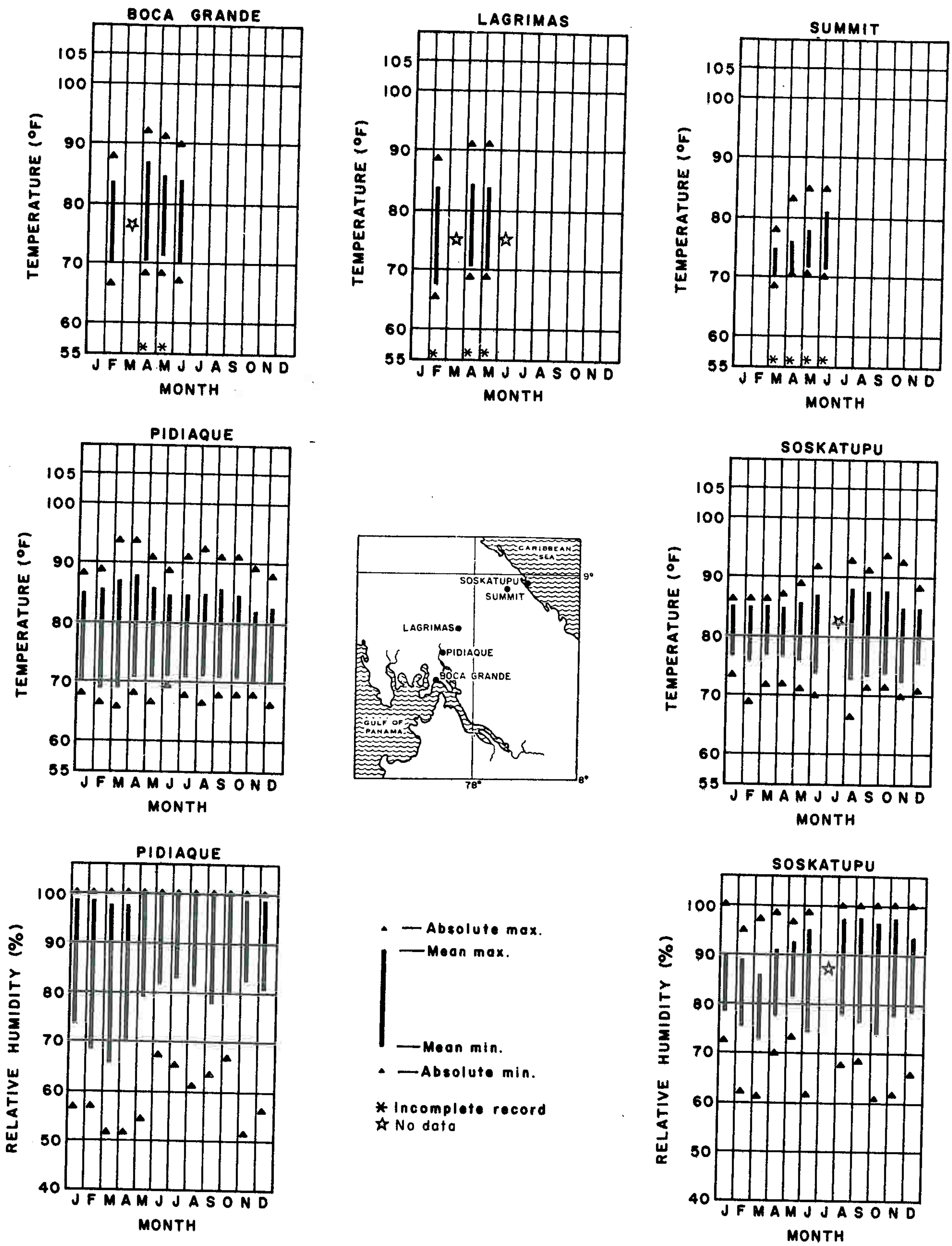
Month (1967)	Feb	Mar	Apr	May	Jun
Boca Grande	28	1	25	30	30
Lagrimas	21	2	25	22	0
Summit	0	24	17	14	28

SURFACE WEATHER

DATA SUMMARIES

Figure 2.1 - Summary of temperature and humidity for Soskatupu and Pidiaque and temperature for the tower stations.

1. The humidity summary for Pidiaque and Soskatupu was made from the observations at 0100, 0700, 1300, and 1900 local time.
2. Data have been entered for months with a period of record greater than 13 days. Months with less than 5 days of observations have been omitted (indicated as "no data"). See Table 2.2.



MONTHLY MAXIMUM AND MINIMUM TEMPERATURES AND HUMIDITIES

FIGURE 2.1

Figure 2.2 - Percent frequency distribution of cloud ceilings for Soskatupu and Pidiaque

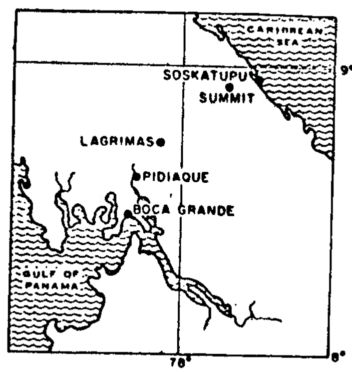
The cloud ceiling observations are summarized for each calendar quarter of the year for each of the 4 observation times. Since Soskatupu did not commence observations until August 1966, the third quarter (July-September) has been indicated as "incomplete record".

SOSKATUPU

LOCAL TIME	0100				0700				1300				1900			
QUARTER	1	2	3*	4	1	2	3*	4	1	2	3*	4	1	2	3*	4
CEILING HEIGHT (HUNDREDS OF FEET)																
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5-7	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
8-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10-14	0	1	0	0	0	2	0	1	0	1	0	0	0	0	0	0
15-19	0	7	0	1	2	8	2	2	3	1	0	3	0	8	0	2
20-29	36	27	10	13	59	33	16	21	31	21	3	20	41	32	16	14
30-49	1	7	5	0	6	10	5	4	1	7	2	1	1	3	3	0
50-95	1	3	2	8	4	8	10	7	1	10	2	8	3	9	0	11
> 95	62	55	83	77	29	40	67	65	64	60	93	69	54	49	81	73

* Incomplete record

Quarter 1 : Jan - Mar
Quarter 2 : Apr - Jun
Quarter 3 : Jul - Sep
Quarter 4 : Oct - Dec



PIDIAQUE

LOCAL TIME	0100				0700				1300				1900			
QUARTER	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
CEILING HEIGHT (HUNDREDS OF FEET)																
0	0	1	7	0	0	1	4	1	0	0	0	0	0	0	1	0
1	0	0	3	1	0	1	8	0	0	0	0	0	0	1	1	2
2	0	4	7	5	0	2	9	5	0	1	0	1	0	1	1	0
3	0	1	2	1	0	7	9	12	0	0	2	0	0	0	2	0
4	0	1	0	0	0	1	2	2	0	0	0	1	0	0	0	1
5-7	0	3	2	2	1	4	5	9	1	1	0	1	0	2	3	3
8-9	0	0	0	2	0	1	2	0	0	1	2	0	0	1	0	0
10-14	0	1	1	4	0	2	4	0	0	7	5	2	0	4	2	5
15-19	0	4	1	2	2	5	1	4	1	7	15	13	1	7	1	2
20-29	1	4	10	3	4	15	4	4	36	43	18	24	6	11	12	8
30-49	1	3	8	1	4	5	2	5	13	10	10	9	3	8	10	7
50-95	6	7	7	3	3	11	12	5	3	5	5	8	1	3	11	11
> 95	92	69	54	74	85	43	37	52	46	26	41	42	89	61	55	61

FREQUENCY DISTRIBUTION OF CLOUD CEILINGS (percent)

FIGURE 2.2

Figure 2.3 - Percent frequency distribution of visibility for Soskatupu and Pidiaque

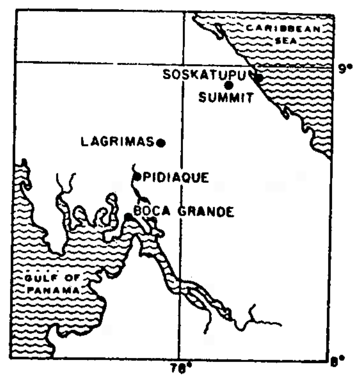
The visibility observations are summarized for each calendar quarter of the year for each of the four observation times. Since Soskatupu did not commence observations until August 1966, the third quarter (July-September) has been indicated as "incomplete record".

SOSKATUPU

LOCAL TIME	0100				0700				1300				1900			
QUARTER	1	2	3*	4	1	2	3*	4	1	2	3*	4	1	2	3*	4
VISIBILITY (MILES) 0-1/8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3/16-3/8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1/2-3/4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1-1 3/4	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	1
2-2 1/2	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0
3-6	0	0	0	0	0	3	0	2	0	1	0	2	0	1	2	0
7-15	73	91	13	20	60	85	26	22	30	67	10	20	50	84	20	23
>15	27	9	87	79	40	10	74	76	70	31	90	78	50	15	79	76

* Incomplete record

Quarter 1 : Jan - Mar
Quarter 2 : Apr - Jun
Quarter 3 : Jul - Sep
Quarter 4 : Oct - Dec



PIDIAQUE

LOCAL TIME	0100				0700				1300				1900			
QUARTER	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
VISIBILITY (MILES) 0-1/8	0	3	12	7	1	8	30	14	0	0	0	0	0	1	1	0
3/16-3/8	0	5	13	7	0	13	18	14	1	0	0	0	0	1	4	4
1/2-3/4	0	3	1	8	0	4	7	9	0	0	0	1	0	2	0	3
1-1 3/4	0	1	1	0	0	4	7	2	0	2	3	2	0	1	0	0
2-2 1/2	1	1	0	0	0	1	0	3	0	0	0	0	0	1	2	0
3-6	2	8	5	8	2	2	1	8	0	3	3	4	1	3	10	3
7-15	69	75	34	46	88	65	18	40	64	84	38	51	84	85	40	50
>15	28	3	33	26	9	2	18	10	34	11	55	41	14	5	42	39

FREQUENCY DISTRIBUTION OF VISIBILITY RANGES (percent)

FIGURE 2.3

Figure 2.4 - Percent frequency distribution of 6- and 24-hour rainfall amounts

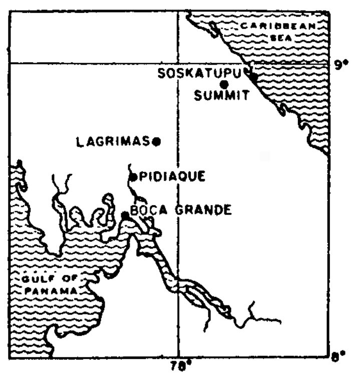
The percent frequency distributions listed for the first quarter at the tower stations are not considered reliable because of the abbreviated period of record. The second quarter statistics are considered more representative although many days of observations were lost as a result of malfunctioning equipment. (See Table 2.2). The summaries show "incomplete record" for these quarters and also for the third quarter at Soskatupu.

A. Percent Frequency of 6-Hour Amounts

LOCATION	BOCA GRANDE				PIDIAQUE				LAGRIMAS				SUMMIT				SOSKATUPU			
QUARTER	1*	2*	3	4	1	2	3	4	1*	2*	3	4	1*	2*	3	4	1	2	3*	4
RAINFALL (INCHES) 0	97	77			89	58	59	57	95	82			78	60			79	59	63	63
T-.01	0	6			7	20	18	18	3	5			7	9			17	21	16	14
.02-.09	2	7			2	12	11	12	.9	5			14	16			3	8	7	7
.1-.24	0	5			1	5	5	7	0	2			0	6			1	4	7	5
.25-.49	0	3			0	2	2	3	0	2			1	3			.3	3	2	5
.50-.99	.8	2			.3	2	4	2	.9	1			0	3			0	3	2	2
1.0-1.99	0	0			.3	.8	1	.3	0	3			0	3			0	.8	2	2
2.0-2.99	0	.3			0	.3	.5	.6	0	0			0	.4			0	.3	.8	1
3.0-5.0	0	0			0	0	0	0	0	0			0	0			0	.5	0	.3
>5.0	0	0			0	0	0	0	0	0			0	0			0	0	0	0

*** Incomplete record**

Quarter 1 : Jan - Mar
Quarter 2 : Apr - Jun
Quarter 3 : Jul - Sep
Quarter 4 : Oct - Dec



B. Percent Frequency of Daily Amounts

LOCATION	BOCA GRANDE				PIDIAQUE				LAGRIMAS				SUMMIT				SOSKATUPU			
QUARTER	1*	2*	3	4	1	2	3	4	1*	2*	3	4	1*	2*	3	4	1	2	3*	4
RAINFALL (INCHES) 0	94	41			71	19	8	22	84	49			55	16			38	17	23	29
T-.01	3	11			18	23	25	22	8	11			0	8			48	29	20	17
.02-.09	0	16			7	21	27	13	4	15			37	27			9	18	7	13
.1-.24	0	11			3	16	11	15	0	4			4	19			3	8	16	7
.25-.49	0	7			0	8	7	15	0	6			4	5			2	9	13	11
.50-.99	0	11			1	8	15	8	4	4			0	12			0	9	11	10
1.0-1.99	3	2			1	4	4	4	0	11			0	8			0	3	7	4
2.0-2.99	0	1			0	1	3	1	0	0			0	3			0	2	3	7
3.0-5.0	0	0			0	0	0	0	0	0			0	2			0	4	0	1
>5.0	0	0			0	0	0	0	0	0			0	0			0	1	0	1

FREQUENCY DISTRIBUTION OF RAINFALL AMOUNTS

FIGURE 2.4

Figure 2.5 - Monthly rainfall amounts at all stations

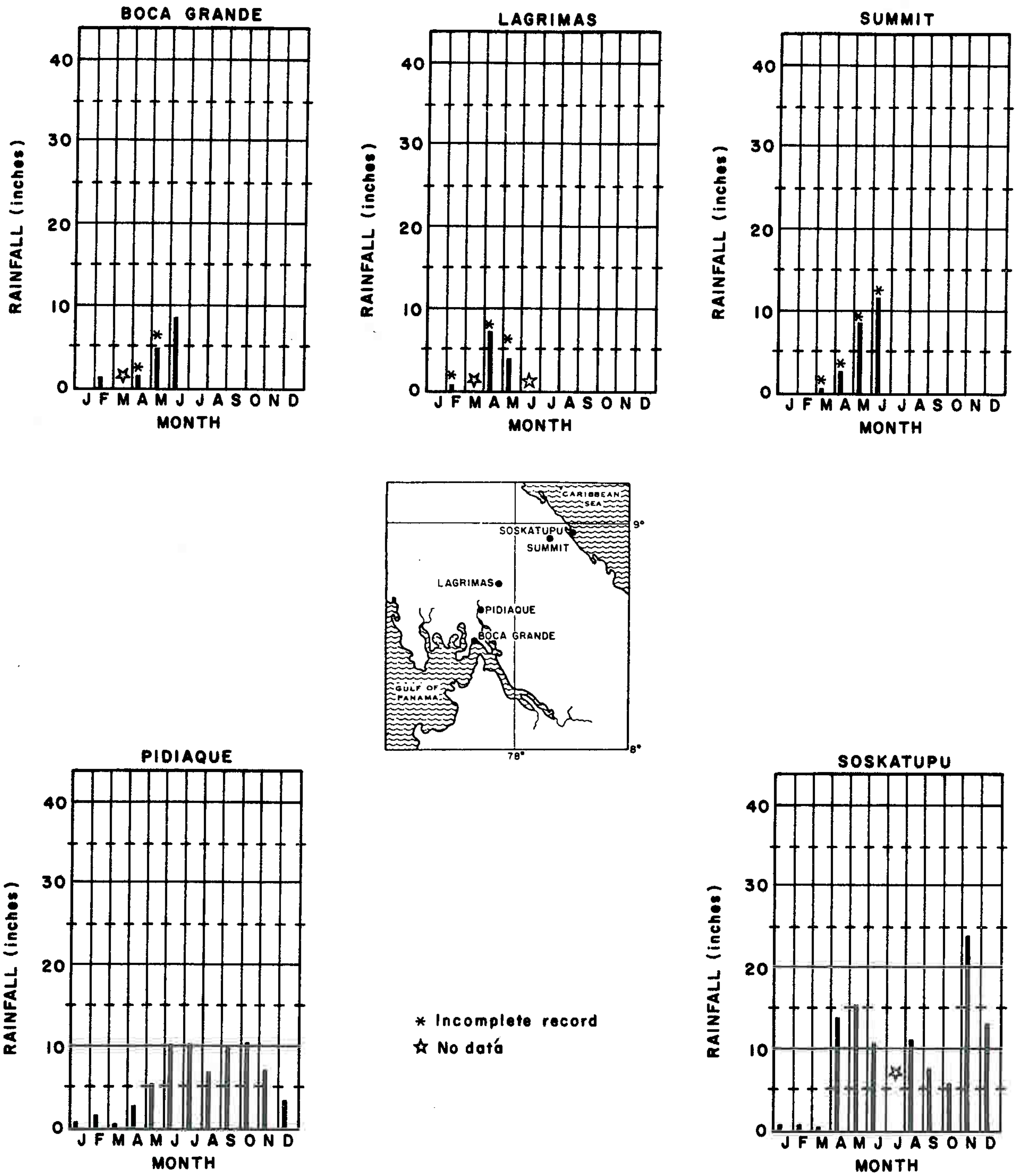
1. Months with a period of record less than 5 days at the tower stations have been omitted from the summary. The number of days of observations for those months with incomplete record are shown in Table 2.2

2. Table 2.3 lists the monthly rainfall amounts for each station. The 12-month total at Pidiaque was 68.34 inches. The 11-month (August 1966-June 1967) total at Soskatupu was 102.05 inches.

Table 2.3

Monthly Rainfall Amounts (Inches)

		Pidiaque	Soskatupu	Boca Grande	Lagrimas	Summit
Jan	1967	1.03	0.63			
Feb		1.70	0.64	1.09	0.98	
Mar		0.42	0.23	-	0	0.97
Apr		2.65	13.64	1.74	6.66	3.28
May		5.16	15.04	4.84	3.91	8.90
Jun		10.02	10.55	8.56	-	11.78
Jul	1966	10.03	No Data			
Aug		7.08	11.01			
Sep		9.68	8.61			
Oct		10.19	5.63			
Nov		7.03	23.75			
Dec		3.35	12.32			



MONTHLY RAINFALL AMOUNTS

FIGURE 2.5

Figure 2.6 - Number of days with rain.

1. This summary presents the number of days of rain including trace occurrences. The trace occurrences are recorded only at the Soskatupu and Pidiaque stations and represent an amount of rain less than 0.01 inch. Table 2.4 lists the number of days per month with rain including trace occurrences and also the number of days with precipitation of 0.01 inch or more.

Table 2.4

Number of Days with Rain

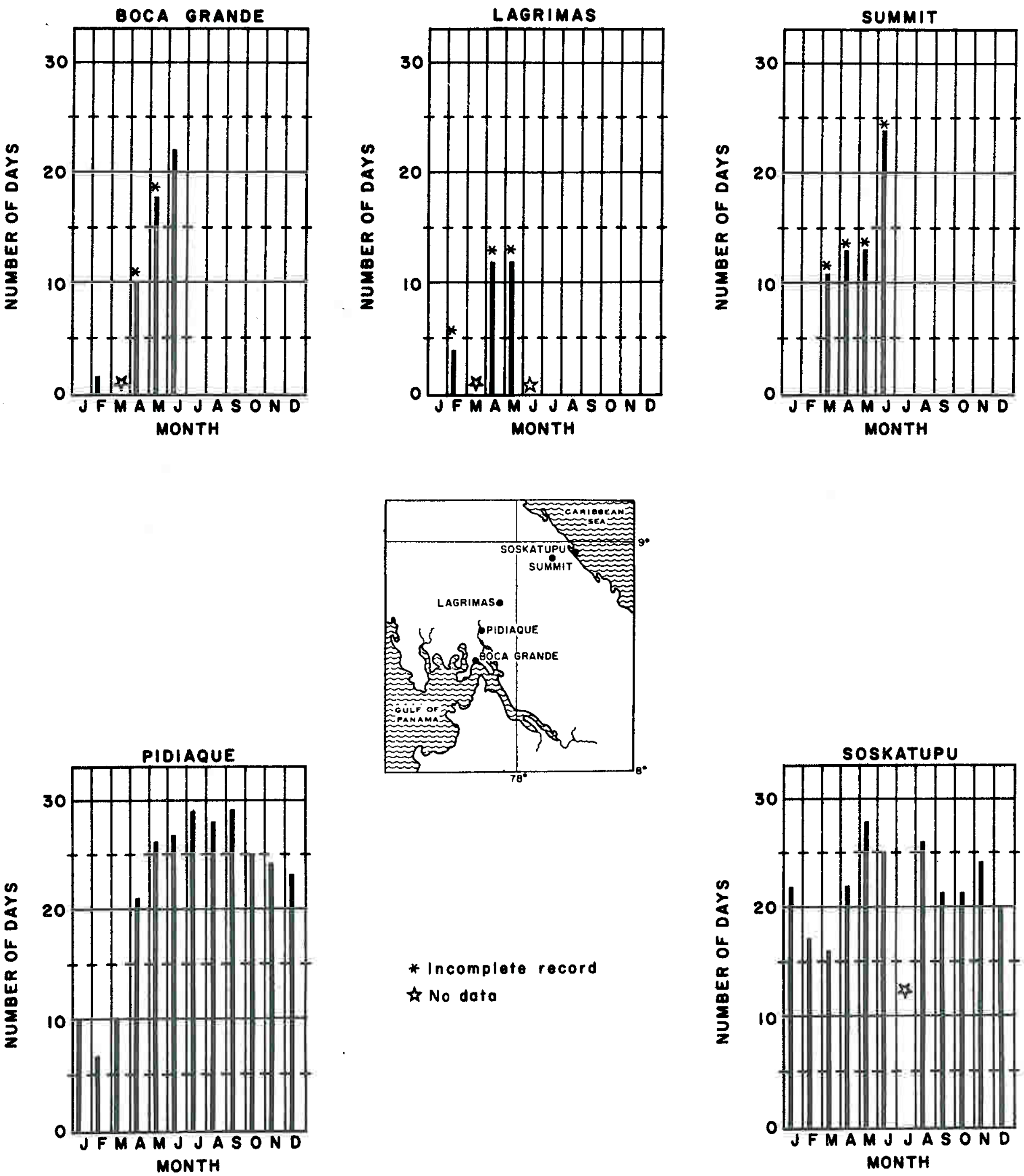
SOSKATUPU

	1967						1966					
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
"Trace" or more	22	17	16	22	28	25		26	21	21	24	20
>0.01 inch	8	8	6	16	18	22		20	17	16	23	16

PIDIAQUE

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
"Trace" or more	10	7	10	21	26	27	29	28	29	25	24	23
>0.01 inch	4	4	4	13	19	26	23	19	25	24	20	17

2. See the comments for Figure 2.5 and Table 2.2 for clarification of the statistics presented for the tower stations.



NUMBER OF DAYS WITH RAIN

FIGURE 2.6

Figure 2.7 - Percent frequency distribution of rain by hour of day and by month for Soskatupu and Pidiaque. The percent frequency listed for any hour represents the period from 30 minutes before to 30 minutes after the hour. A minimum of 5 minutes of continuous rain during this period was established as a criteria for the inclusion of a rain occurrence in the statistic.

SOSKATUPU

Year	Month	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
		HOUR OF DAY (LST)																							
1967	JAN	23	13	0	3	16	26	23	6	10	10	10	10	3	3	0	6	3	3	3	3	3	6	6	13
	FEB	18	7	4	4	0	11	4	7	7	7	11	4	0	7	4	4	4	0	4	7	4	4	0	14
	MAR	16	10	0	0	0	13	10	3	6	0	3	0	3	0	0	3	0	3	0	3	3	6	3	6
	APR	23	27	13	7	3	13	43	30	17	17	17	13	17	13	6	6	3	0	0	3	6	6	3	13
	MAY	*	*	*	*	*	13	19	23	32	42	32	19	10	13	10	3	3	6	10	10	0	3	3	3
	JUN	*	*	*	23	17	23	37	33	30	30	17	10	6	13	10	23	23	27	27	23	13	0	3	13
1966	JUL																								
	AUG	13	19	10	6	13	36	48	45	36	29	13	13	6	6	10	6	6	6	6	3	3	10	19	3
	SEP	20	27	23	13	17	20	20	13	13	23	23	17	13	10	0	3	3	7	7	10	13	17	17	13
	OCT	10	6	3	3	6	6	13	3	10	10	13	16	16	16	23	32	26	26	19	16	6	6	13	13
	NOV	17	20	27	33	37	33	30	43	37	33	33	30	33	33	27	30	23	17	13	10	10	7	20	23
	DEC	16	10	10	10	10	10	19	16	19	16	19	19	13	10	10	13	6	13	6	6	6	6	10	13

* Incomplete record

PIDIAQUE

Year	Month	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
		HOUR OF DAY (LST)																							
1967	JAN	0	0	0	0	0	0	3	6	3	3	3	10	13	6	13	3	0	0	0	0	0	0	0	0
	FEB	0	4	0	0	0	0	0	0	0	0	0	7	11	7	7	4	7	4	4	4	4	4	0	0
	MAR	0	0	0	0	0	3	3	0	0	3	0	3	13	0	6	10	13	0	0	0	0	0	0	0
	APR	0	3	7	3	3	3	3	10	3	0	3	6	17	23	30	23	20	13	10	7	3	3	3	0
	MAY	3	3	6	6	10	13	13	6	6	19	29	32	29	23	10	29	32	23	23	16	10	3	6	6
	JUN	10	17	27	27	37	30	30	20	13	23	23	6	13	20	30	37	43	53	60	60	37	30	23	17
1966	JUL	17	17	13	13	10	13	10	13	10	7	13	10	23	10	10	7	27	30	37	30	13	13	6	10
	AUG	6	3	6	6	10	13	16	13	13	6	16	10	10	16	13	10	16	16	16	26	13	10	3	3
	SEP	20	13	10	17	13	3	7	10	13	6	6	10	20	17	13	27	37	30	13	13	13	17	20	17
	OCT	23	10	10	13	23	23	19	10	10	10	13	23	26	19	19	23	23	29	13	16	13	23	13	16
	NOV	13	17	33	27	23	30	27	27	27	20	33	30	23	23	27	20	10	13	23	13	7	17	7	10
	DEC	10	13	10	6	10	10	13	16	16	19	23	19	29	19	16	13	23	6	6	6	3	13	3	10

FREQUENCY OF OCCURRENCE OF RAIN BY TIME OF DAY (percent)

FIGURE 2.7

Figure 2.8 - Percent frequency distribution of thunderstorms by hour of day and by month for Soskatupu and Pidiaque.

1. The observers recorded an occurrence of a thunderstorm when thunder was heard at the station or overhead lightning was observed whenever the local noise level was such as might prevent hearing thunder.
2. In compiling the statistics, the percent frequency listed for any hour represents the period from 30 minutes before to 30 minutes after the hour. A minimum of 5 minutes of thunderstorm duration within a particular hour was established as the criterion for the recording of a thunderstorm occurrence in that hour.

SOSKATUPU

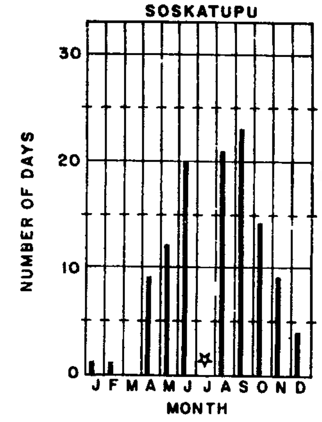
FREQUENCY OF THUNDERSTORMS BY HOUR (PERCENT)

HOUR OF DAY (LST)

		01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
	JAN	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0
	FEB	0	0	0	0	0	0	0	4	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	MAR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1967	APR	3	3	7	7	3	10	13	7	3	6	6	0	6	6	0	3	0	0	3	0	0	0	3	3
	MAY	*	*	3	0	0	6	13	23	23	16	13	6	3	3	3	3	3	0	0	0	0	0	3	6
↓	JUN	*	*	*	27	27	33	33	27	10	10	13	10	6	10	17	13	20	13	6	3	0	0	3	10
↑	JUL																								
	AUG	29	19	19	16	19	29	32	29	26	19	13	3	3	6	0	0	0	3	6	6	3	3	3	13
1966	SEP	30	30	27	23	17	10	20	10	10	10	10	10	10	10	10	3	10	10	17	13	13	13	23	33
	OCT	0	0	0	6	13	13	6	0	0	0	0	0	3	6	10	19	19	13	3	3	3	3	0	3
	NOV	10	7	3	7	10	13	13	3	0	0	0	0	0	3	7	7	3	0	0	0	0	0	0	7
	DEC	3	3	3	3	6	0	3	3	3	3	3	3	3	3	3	0	0	6	3	3	3	3	6	3

* Incomplete record

DAYS WITH THUNDERSTORMS



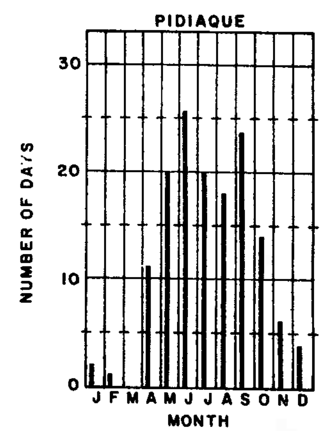
PIDIAQUE

FREQUENCY OF THUNDERSTORMS BY HOUR (PERCENT)

HOUR OF DAY (LST)

		01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
	JAN	0	0	0	0	0	0	0	3	3	3	0	0	0	0	0	3	3	0	0	0	0	0	0	0
	FEB	0	0	0	0	0	0	0	0	0	0	0	0	4	4	4	4	4	0	0	0	0	0	0	0
	MAR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1967	APR	0	0	3	0	0	0	0	0	0	0	3	3	3	13	13	13	13	10	3	3	3	0	0	0
	MAY	3	6	0	6	10	10	10	6	3	3	3	3	13	13	19	26	29	32	32	13	3	3	3	3
↓	JUN	13	13	13	20	20	30	27	17	0	0	3	7	7	20	30	27	47	47	43	30	13	7	10	17
↑	JUL	13	13	10	13	19	19	0	0	0	0	3	0	6	6	6	10	19	23	13	6	3	0	3	3
	AUG	0	3	3	3	6	6	6	3	3	3	3	0	10	0	3	6	10	10	29	10	3	6	3	0
1966	SEP	23	10	3	6	6	3	3	3	0	0	3	6	13	23	30	30	37	23	23	10	7	10	13	27
	OCT	6	3	0	0	3	3	3	3	0	0	0	0	0	3	3	13	23	16	13	6	3	6	6	3
	NOV	0	3	3	0	0	0	0	0	0	0	0	0	0	3	10	3	7	0	0	0	0	0	0	0
	DEC	3	3	6	6	0	0	0	0	0	0	3	3	3	0	0	3	3	3	3	3	0	3	3	0

DAYS WITH THUNDERSTORMS



FREQUENCY OF OCCURRENCE OF THUNDERSTORMS

FIGURE 2.8

Figure 2.9 - Percent frequency distribution of fog by hour of day and by month for Pidiaque.

1. The percent frequency distributions were compiled using the criteria stated in note 2 for figure 2.8.
2. The statistic includes the occurrences of both fog and ground fog. The convention used in reporting these observations is as follows:

   Fog is reported when it reduces the visibility at 6 feet above the ground to less than 5/8 of a mile. Ground Fog is reported when the fog obscures less than 6/10 of the sky and does not extend to the base of any clouds that may be above it.
3. The percent frequency distributions are probably not representative of fog conditions at lower elevations. A cooperative program at the Sante Fe Base Camp in the valley has been initiated to provide supplementary fog observations for daylight hours.
4. A fog summary has not been presented for Soskatupu since only one occurrence was observed during the 11-month period. This occurred on June 14, 1967, between 1730 and 1945 local standard time.

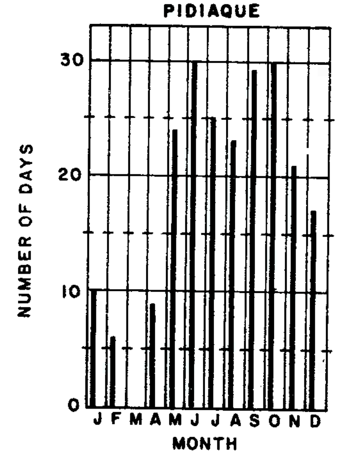
PIDIAQUE

FREQUENCY OF FOG BY HOUR OF THE DAY (PERCENT)

		HOUR OF DAY (LST)																							
		01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1967	JAN	6	3	3	3	6	6	6	6	3	3	3	3	3	3	3	0	0	0	0	0	0	3	3	6
	FEB	4	4	11	14	7	11	14	4	4	0	0	0	0	4	4	4	4	0	4	4	4	4	4	4
	MAR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	APR	7	7	7	10	10	13	20	13	10	7	7	7	3	3	7	10	10	7	7	7	7	10	10	10
	MAY	23	29	10	16	29	42	45	32	23	23	16	3	3	0	0	3	3	3	6	10	10	19	16	19
	JUN	53	53	57	63	63	76	63	86	86	63	20	3	7	10	10	17	20	27	27	23	33	33	43	53
1966	JUL	10	13	26	32	36	58	61	58	45	13	10	3	3	3	3	0	3	3	0	3	3	10	13	19
	AUG	29	26	29	19	32	45	58	29	23	16	6	10	6	10	3	3	3	6	6	10	6	16	13	16
	SEP	53	47	50	17	60	76	73	80	67	17	7	0	0	3	3	7	17	23	20	23	13	20	33	53
	OCT	45	48	48	61	71	84	84	78	52	19	13	3	0	10	10	6	10	13	16	10	13	26	32	29
	NOV	33	33	45	39	53	53	57	53	47	33	27	17	13	13	7	7	7	7	13	17	13	13	7	20
	DEC	19	23	23	23	36	32	39	39	42	23	16	16	13	10	10	6	6	6	3	3	6	6	10	26

DAYS WITH FOG

PIDIAQUE

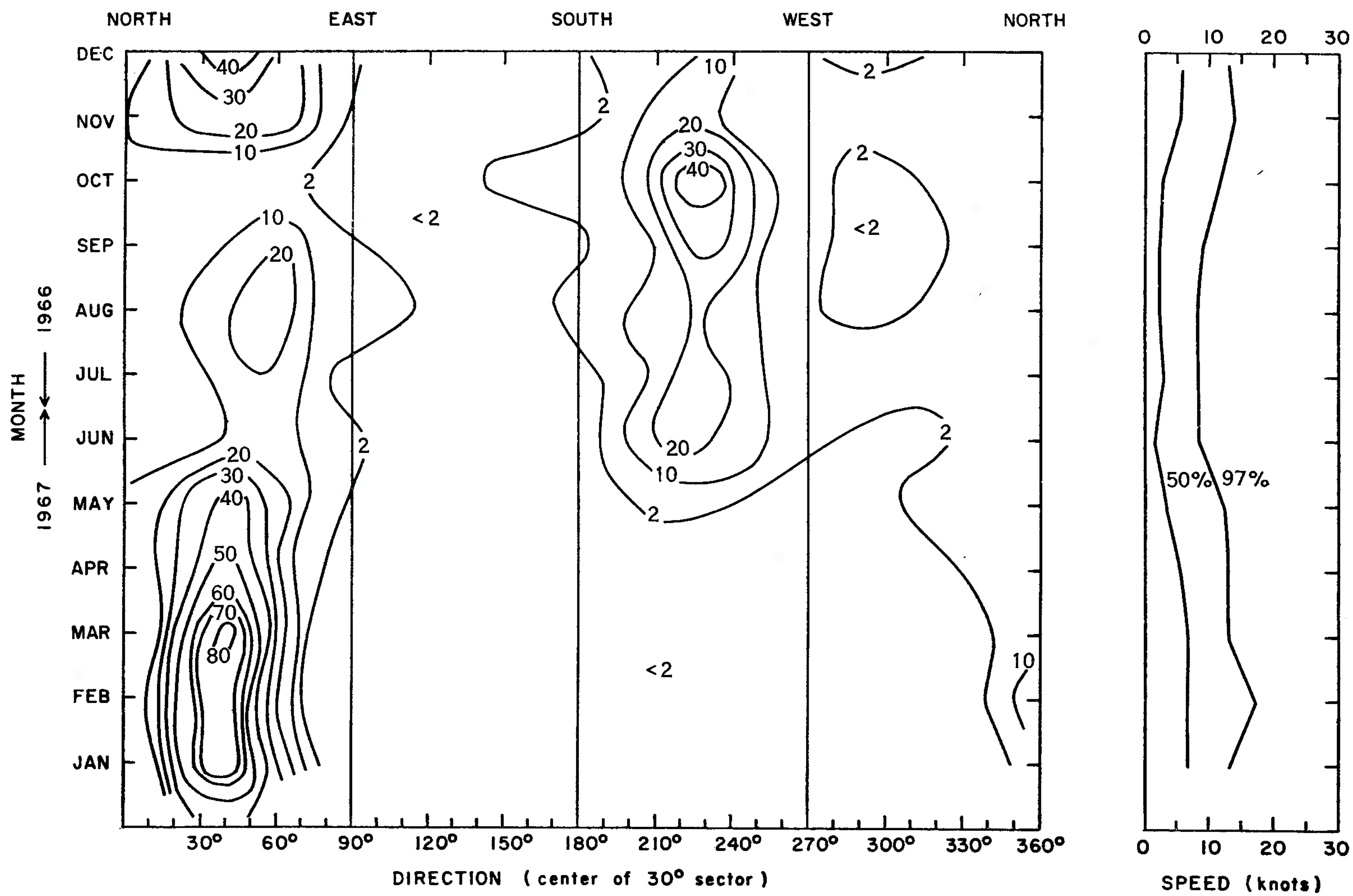


FREQUENCY OF OCCURRENCE OF FOG

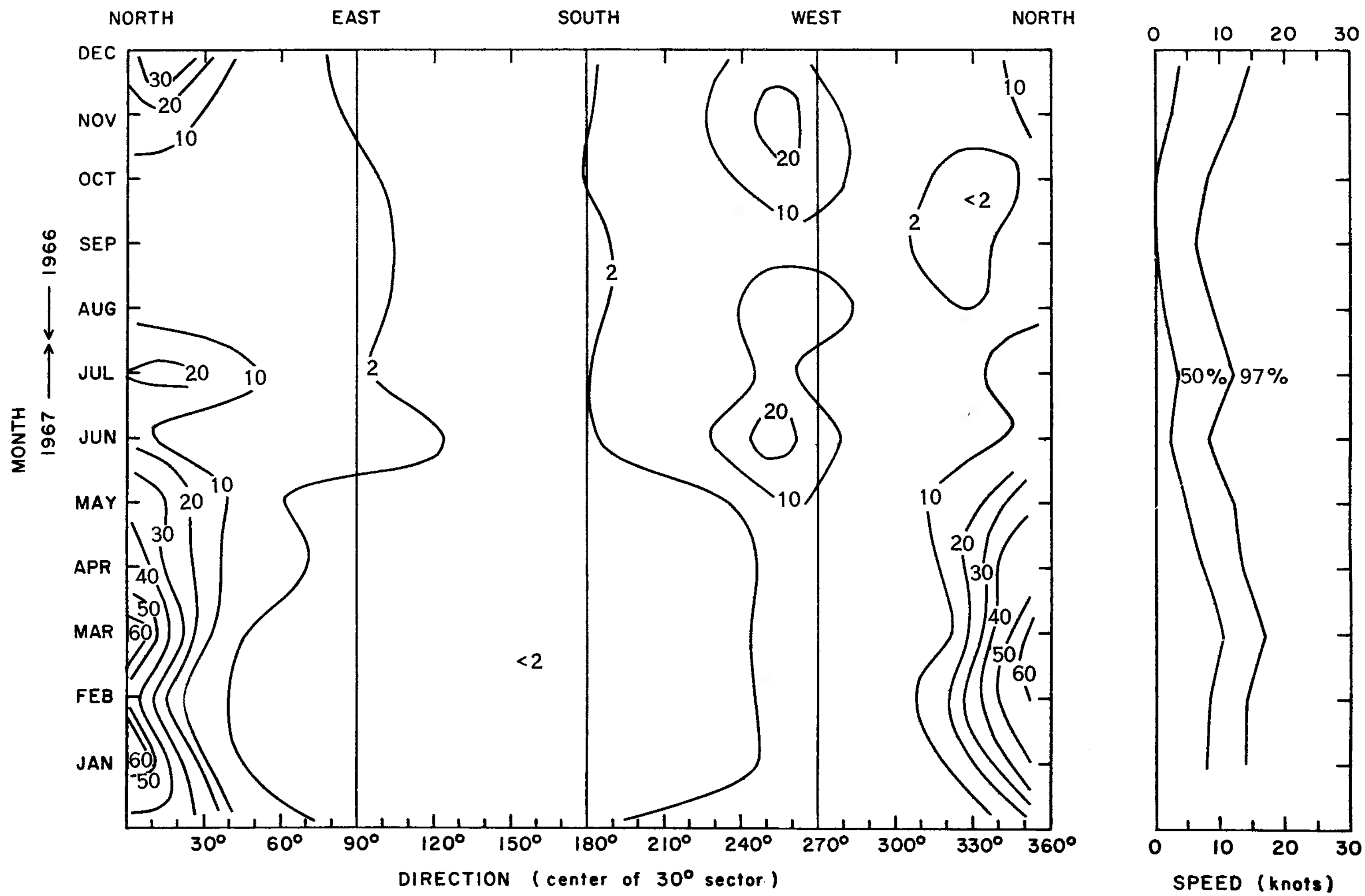
FIGURE 2.9

Figures 2.10 and 2.11 - Percent frequency distribution of surface winds at Soskatupu and Pidiaque.

Each of these diagrams is a composite analysis, by month, of the frequency distribution of surface wind direction and speed. The statistics were compiled from the combined wind observations at 0100, 0700, 1300, and 1900 local standard time. The percent frequency of occurrence of winds in 30-degree sectors centered at the indicated direction (direction is that from which the wind is blowing) is shown. The two curves on the right-hand side of each figure show the wind speeds which include 50 percent and 97 percent of all cases.



FREQUENCY DISTRIBUTION OF SURFACE WINDS (percent)
PIDIAQUE
FIGURE 2.10



FREQUENCY DISTRIBUTION OF SURFACE WINDS (percent)
SOSKATUPU
FIGURE 2.11

3.0 UPPER-AIR WIND PROGRAM

Upper-air winds are measured by means of radar-tracked balloons every 6 hours (0100, 0700, 1300, and 1900 local standard time) at the two manned weather stations on each route. On Route 17 this program began in July 1966 at Pidiaque and in August 1966 at Soskatupu. The basic data from these four-per-day wind soundings have been processed in three different forms; Radar Winds Aloft, Mean Layer Winds and Fallout Vectors.

3.1 Radar Winds Aloft

These data consist of the direction (degrees) and speed (knots) of the winds at specified altitudes above mean sea level. Winds were determined at every 1000 feet up to 20,000 feet; at 23,000 feet, 25,000 feet; and then every 5000 feet up to 60,000 feet. The data are available in the form of punched cards at the National Weather Records Center (NWRC), Asheville, North Carolina. A chronological listing (computer print-out) of the data is available from NWRC or from the ESSA Interoceanic Canal Project, Silver Spring, Md.

3.2 Mean Layer Winds

Mean winds through layers of the atmosphere were also determined directly from the radar-tracked balloon positions. From each wind sounding, mean winds were determined for the layer from the surface to 2000 feet (MSL), 2000-5000 feet and then each 5000-foot layer up to 60,000 feet. These data are easier to use and more representative than the winds aloft data for fall-out deposition calculations. They are available at NWRC on punched cards and in the form of a chronological listing from the card deck.

3.3 Fallout Vector Data

These data, derived from the mean layer wind data from each sounding, indicate the direction <u>along</u> which particles will reach the ground from various altitudes in the atmosphere. The vector speed represents the rate at which fallout deposition will advance along the indicated direction. The fallout vector is obtained from the vector sum of the mean layer winds (weighted according to the relative particle fall rates in each layer) from the ground to the altitude from which the particle falls. Hence, it represents a weighted mean wind from the surface to the indicated altitude. It should be noted that, by convention, wind direction indicates the direction <u>from</u> which the wind blows while fallout vectors indicate the direction toward which the fallout is carried. Fallout vectors are calculated for the following layers: Surface-2000, sfc-5000, sfc-10,000, sfc-15,000, sfc-20,000, sfc-25,000, sfc-30,000, sfc-40,000, sfc-50,000, and sfc-60,000 feet. These data are available at NWRC on punched cards or in the form of a chronological listing.

3.4 Wind Data Summaries

Monthly summaries of the frequency distribution of the mean layer winds and fallout vectors have been computed and stored on magnetic tape. A computer print-out can be readily obtained for any desired altitude layer for any month or combination of months, for any or all observation times. The summaries record the percent frequency of occurrence for each 10-degree sector for various wind speed ranges. Frequencies are also shown for all 30, 50, 70, and 90-degree sectors centered at 10-degree increments.

Monthly summaries of the variability of the fallout vectors are also available on magnetic tape. One set of statistics is being compiled on the directional change of the fallout vectors as a function of initial speed and time (6-, 12-, 18-, and 24-hour intervals). Another set summarizes the directional differences between fallout vectors at Pidiaque and Soskatupu as a function of speed and fallout sector.

These summaries are available at NWRC as Job No. 7648 in the following tabulations:

Table I	Percentage Frequency of Mean Layer Winds
Table II	Percentage Frequency of Fallout Winds
Table III	Percentage Frequency of Fallout Wind Variability (time variability of fallout vectors)
Table IV	Percentage Frequency of Fallout Wind Variability (directional differences between stations)

3.5 Wind Frequency Charts

The monthly summaries of the mean layer wind data and the fallout vector data (NWRC Tables I and II) were used to prepare figures 3.1 to 3.27. These charts were selected to illustrate the frequency distributions of the mean layer winds and fallout vectors at Pidiaque and Soskatupu from August 1966 through July 1967. Data for all four observation times were combined in each chart.

3.5.1 Mean Layer Wind Frequency Charts -- Figures 1 to 14 show the percent frequency of occurrence of winds in 30-degree sectors centered at the directions indicated at the bottom of the charts. The indicated direction is that from which the wind is blowing. In order to smooth the data, the frequencies were determined for overlapping 30-degree sectors taken every 10 degrees. The right-hand side of each chart provides information on the frequency distribution of wind speeds in each layer. The two curves indicate the wind speeds which include 50 percent and 97 percent of all cases.

Figure 3.1 shows the distribution of winds at Pidiaque during August-September 1966. This period is characterized by a strong predominance of easterly winds throughout the troposphere except for the lowest 5000 feet which is influenced by the surface topography. In this layer the winds most frequently veer with altitude from NNE to east. Winds in the surface to 2000 feet layer show a secondary maximum from the WSW.

The upper wind data obtained at Soskatupu during August 1966 are considered to be unreliable due to initial difficulties in the installation and operation of the radar. Therefore figure 3.2 shows the distribution of winds at Soskatupu for September only. The picture is similar to that at Pidiaque with easterlies predominating in all layers above 2000 feet.

Figures 3.3 and 3.4 summarize the wind frequencies at Pidiaque and Soskatupu during October 1966. October is a transitional month when the winds throughout the troposphere generally are more variable than in any other month. There appears to be a greater prevalence of southwesterly winds in the lowest 10,000 feet in October than in other months. Note that at Soskatupu the maximum frequency in the lowest 2000 feet occurs in the sector centered at 210 degrees while at Pidiaque the maximum is centered at 235 degrees. In general, throughout the year, the significant differences between the wind frequencies at Soskatupu and Pidiaque are confined to the layer from the surface to 5000 feet. Within this layer, a clockwise veering of the wind from Soskatupu to Pidiaque is usually in evidence. The extent of the wind shift is generally about 10 to 30 degrees.

Another feature which may be noted on most charts is the tendency for the frequency maxima to be more marked at Pidiaque than at Soskatupu.

Figures 3.5 and 3.6 show the wind frequencies during November-December 1966. Northeasterly winds predominate from the surface to about

30,000 feet. From about 30,000 to 45,000 feet southerly winds predominate while easterly and westerly components occur with about equal frequency. From 45,000 to 55,000 feet westerlies are dominant and in the layer from 55,000 to 60,000 feet, easterlies and westerlies occur with about equal frequency.

The January-February 1967 period (figures 3.7 and 3.8) was similar to November-December 1966 but the regimes of easterlies and westerlies were more sharply defined and the intervening layer of southerlies was no longer in evidence. Both stations show predominant easterlies from 5000 to 30,000 feet, westerlies between 30,000 and 55,000 feet and easterlies above 55,000 feet. In the lowest 5000 feet, northeast winds predominate at Pidiaque; north winds at Soskatupu. Soskatupu shows a much higher frequency of northwest winds than Pidiaque in this layer.

The March-April period (figures 3.9 and 3.10) shows distributions that are very similar to January-February. In the mean, the entire period from November through April which includes the dry season in Panama is characterized by north or northeast winds near the ground, east winds in the lower troposphere, west winds in the upper troposphere reversing to easterlies again near the tropopause.

The wind distributions in May (figures 3.11 and 3.12) begin to show a transition toward the summer wind pattern in the mid-troposphere. The dry-season westerlies have been replaced by southeasterly winds.

The wind distributions during June-July 1967 are very similar to those during August-September 1966. The June-September period is characterized by persistent easterly winds from about 5000 feet to 60,000 feet. However, figures 3.13 and 3.14 show relatively high frequencies of westerly winds at both stations between 45- and 55,000 feet. These occurred in June.

In the layer from the surface to 2000 feet Pidiaque shows predominant NNE winds with a secondary maximum of winds from the southwest. At Soskatupu there is a high frequency of northwest winds in this layer.

3.5.2 Fallout Wind Vector Frequency Charts -- These charts (figures 3.15 to 3.27) indicate the direction toward which fallout from specified altitudes would be deposited. The percentage frequencies are shown for 30-degree sectors centered at the indicated directions. The fallout wind vectors are derived by integrating the effects of all the mean layer winds from the ground to the specified altitude, weighting each wind for the relative amount of time required for a fallout particle to fall through each layer. Thus, the fallout wind vector is the weighted mean wind through the layer from the ground to the specified altitude. The right-hand side of each chart indicates the fallout vector speed which includes 50 percent and 97 percent of all cases.

Figure 3.15 shows the percent frequency distribution of fallout wind vectors at Pidiaque during August-September 1966. This picture is typical of the entire period from June through September which is characterized by predominantly easterly winds above 5000 feet. As a result, fallout particles originating above about 15,000 feet would be deposited toward the west a great percentage of the time. The chart shows a maximum toward the southwest for the layers below 15,000 feet and a secondary maximum toward the northeast below about 5000 feet. Note that the fallout vector speeds on these charts are almost always below 20 knots and more than half of the speeds are below 10 knots.

A chart is not shown for Soskatupu for August-September since reliable data were not obtained until September.

Figures 3.16 and 3.17 show the fallout vector frequency distributions for Pidiaque and Soskatupu for October 1966. Wind variability is greatest during the month of October and both stations show comparatively weak maxima of fallout vectors toward the northeast. The layers extending above 10,000 feet show a second maximum toward the west. Note that the fallout vector speeds are very light and tend to decrease with altitude.

Figures 3.18 and 3.19 show the fallout vector distributions for November-December 1966. Both stations show frequency maxima toward the southwest which are strongest in the lower layers. The vectors extending above about 40,000 feet show a secondary maximum toward the east-northeast.

Figures 3.20 and 3.21 show the January-February 1967 period to be very similar to November-December. The frequency maximum in the southwest sector is even stronger at this time of year. Note that there is a difference of about 20 degrees between the two stations in the direction of the maximum frequencies in the lowest 5000 feet. This characteristic may be seen in most of the charts.

The March-April period (figures 3.22 and 3.23) again shows a strong frequency maximum toward the southwest below 30,000 feet. However, there is a secondary maximum toward the southeast above 20,000 feet, and vectors extending above 35,000 feet show a strong maximum toward the east-northeast. This is due to the relatively strong westerlies in the upper troposphere overcoming the easterlies in the lower layers.

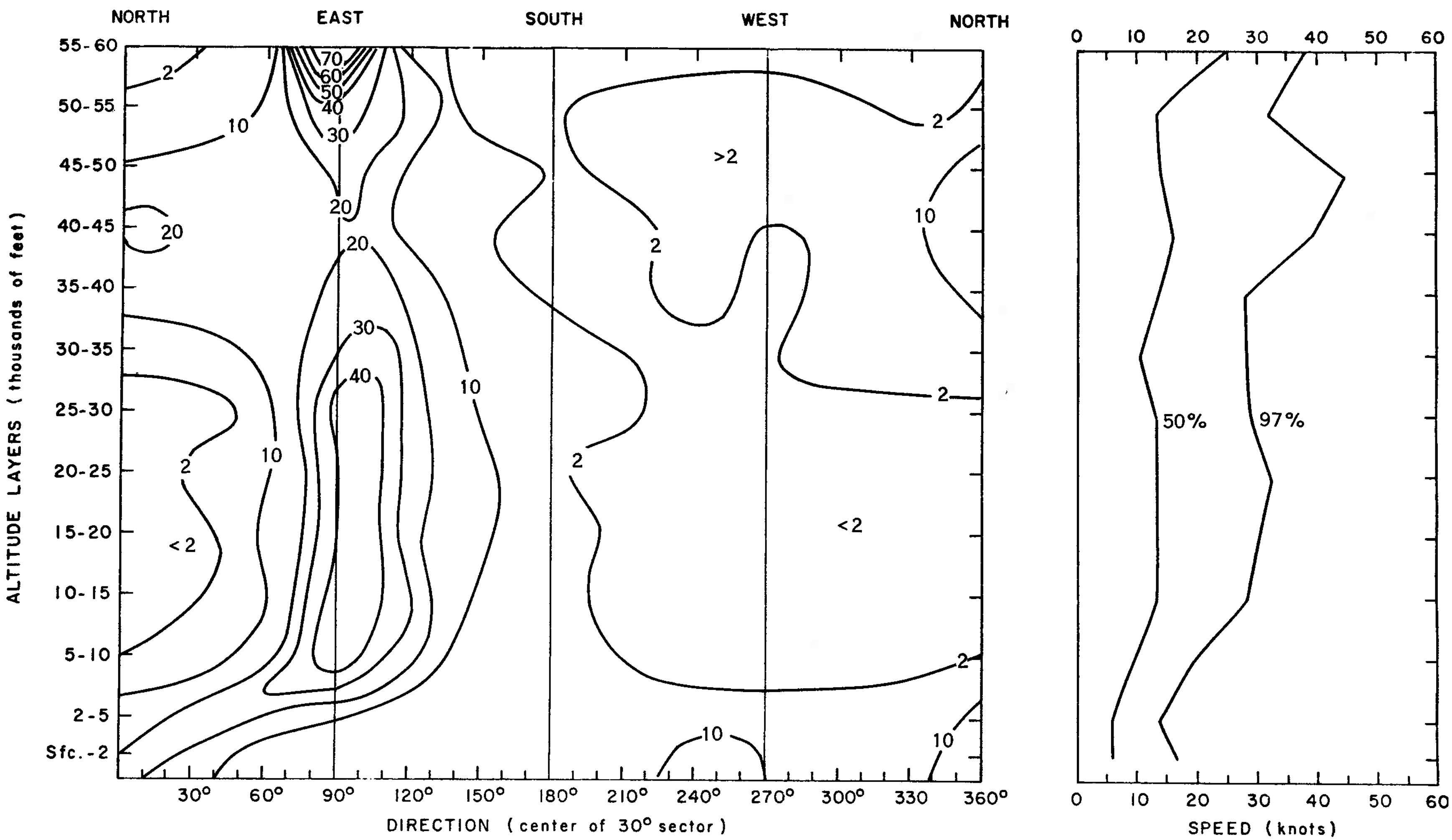
Figures 3.24 and 3.25 show the fallout vector distribution in May 1967. The fallout vectors show a frequency maximum toward the southwest in the lower layers veering to the northwest in the layers extending above 35,000 feet.

Figures 3.26 and 3.27 show the fallout vector frequencies for June-July 1967. Note that the distribution at Pidiaque is almost identical to that for August-September 1966. The distribution above 5000 feet at Soskatupu is very similar to Pidiaque. In the lowest layers, the Soskatupu fallout vectors veer with altitude from south-southeast to southwest.

It must be emphasized that the frequency distributions of fallout vectors do not necessarily reflect the distribution of fallout which would result from nuclear excavations. In practice, detonations would be conducted only under weather conditions which would serve to deposit the fallout patterns in desired sectors. The statistics presented in these charts will be useful in determining the frequency of occurrence of favorable wind conditions.

MEAN LAYER WIND

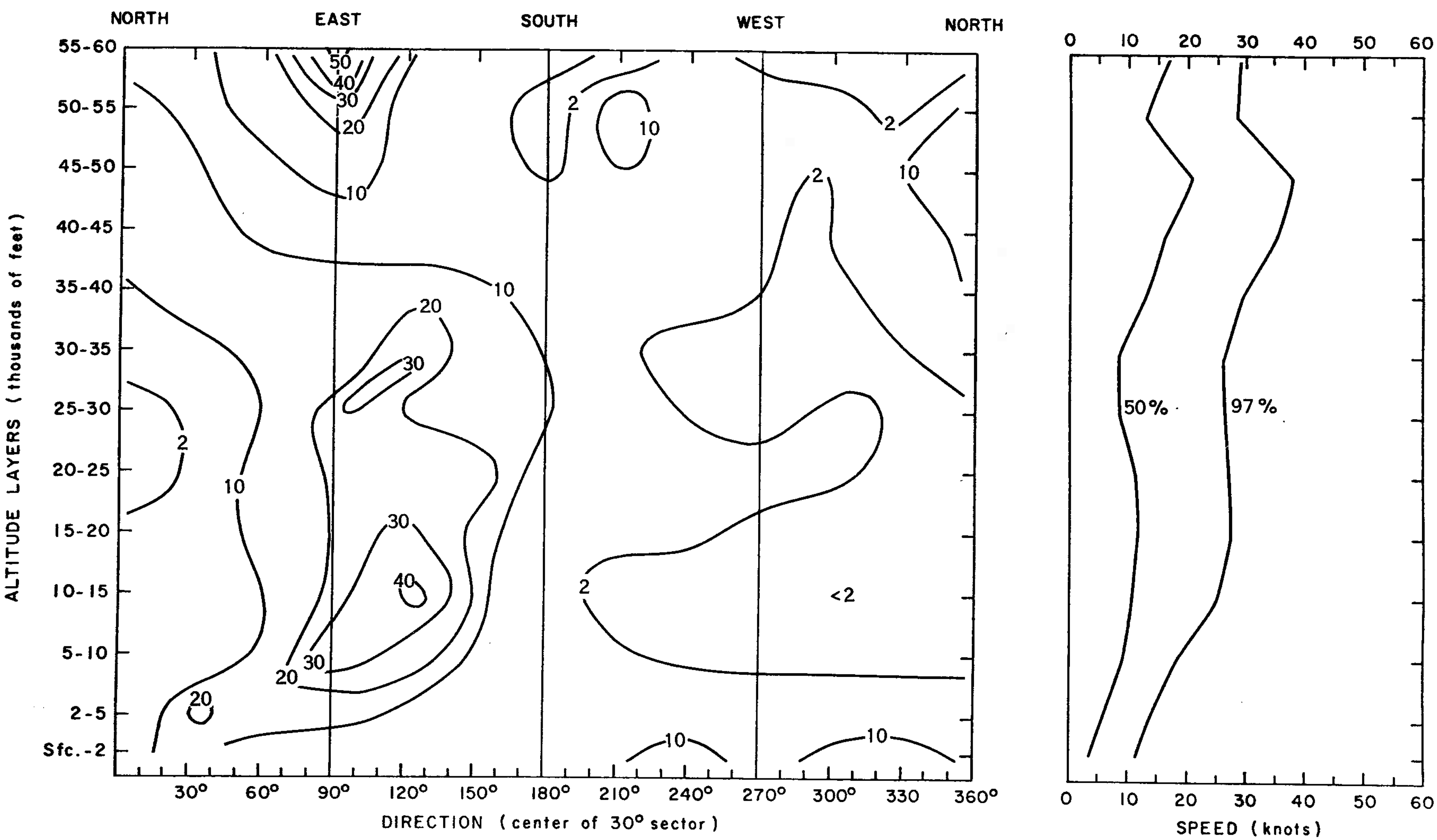
FREQUENCY DISTRIBUTION CHARTS



FREQUENCY DISTRIBUTION OF MEAN LAYER WINDS (percent)

PIDIAQUE AUG-SEP 1966

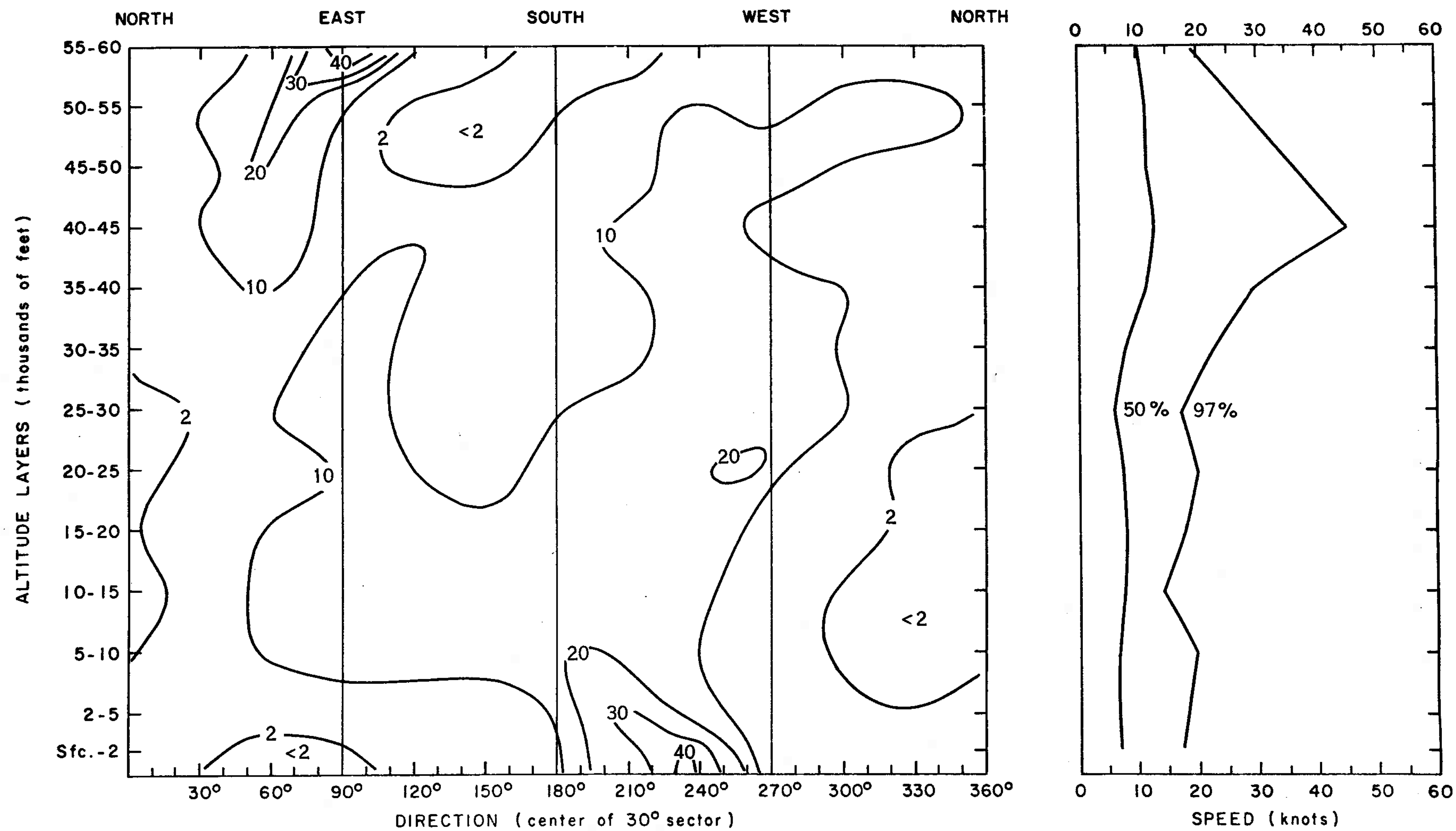
FIGURE 3.1



FREQUENCY DISTRIBUTION OF MEAN LAYER WINDS (percent)

SOSKATUPU SEP 1966

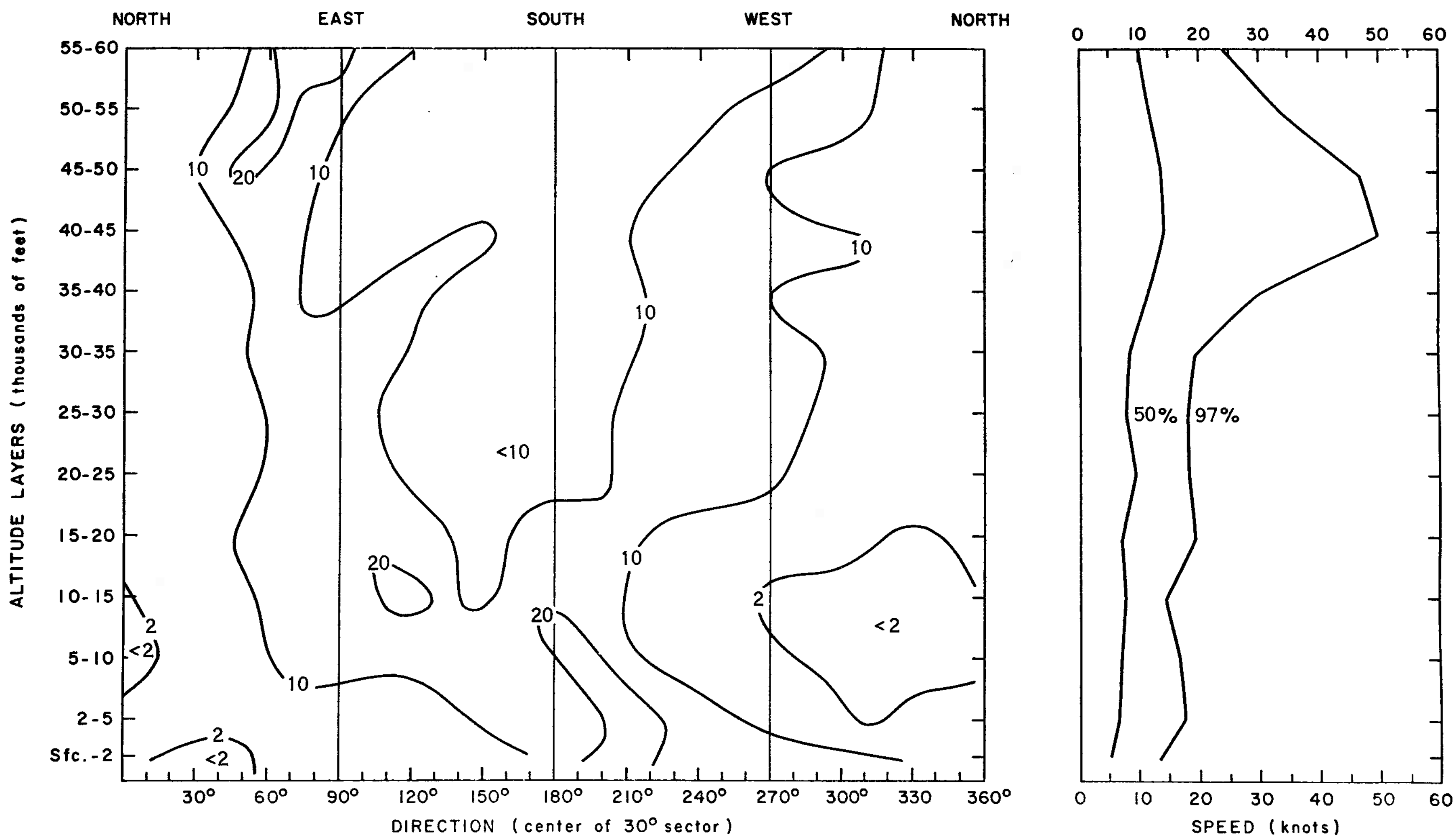
FIGURE 3.2



FREQUENCY DISTRIBUTION OF MEAN LAYER WINDS (percent)

PIDIAQUE OCT 1966

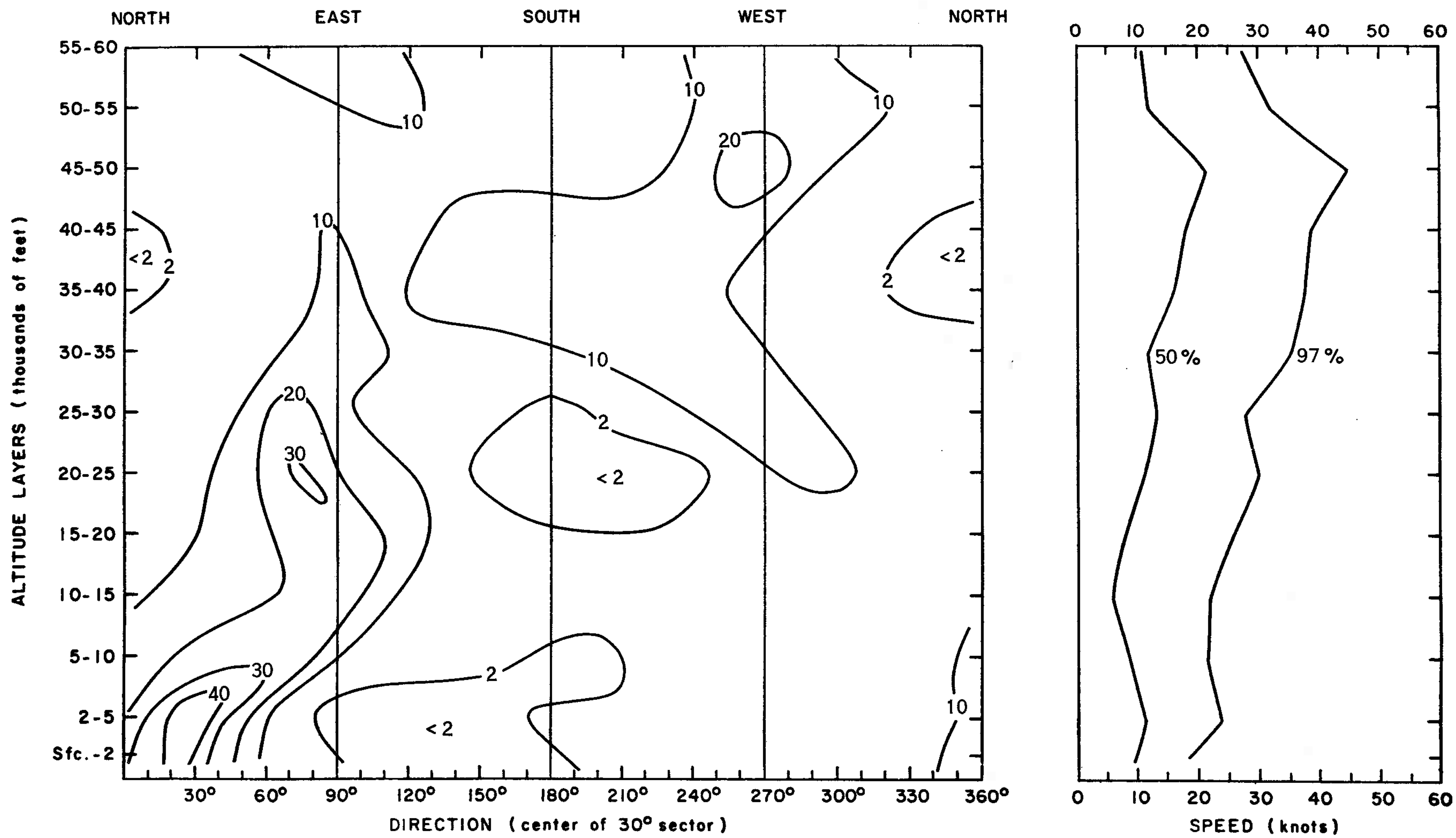
FIGURE 3.3



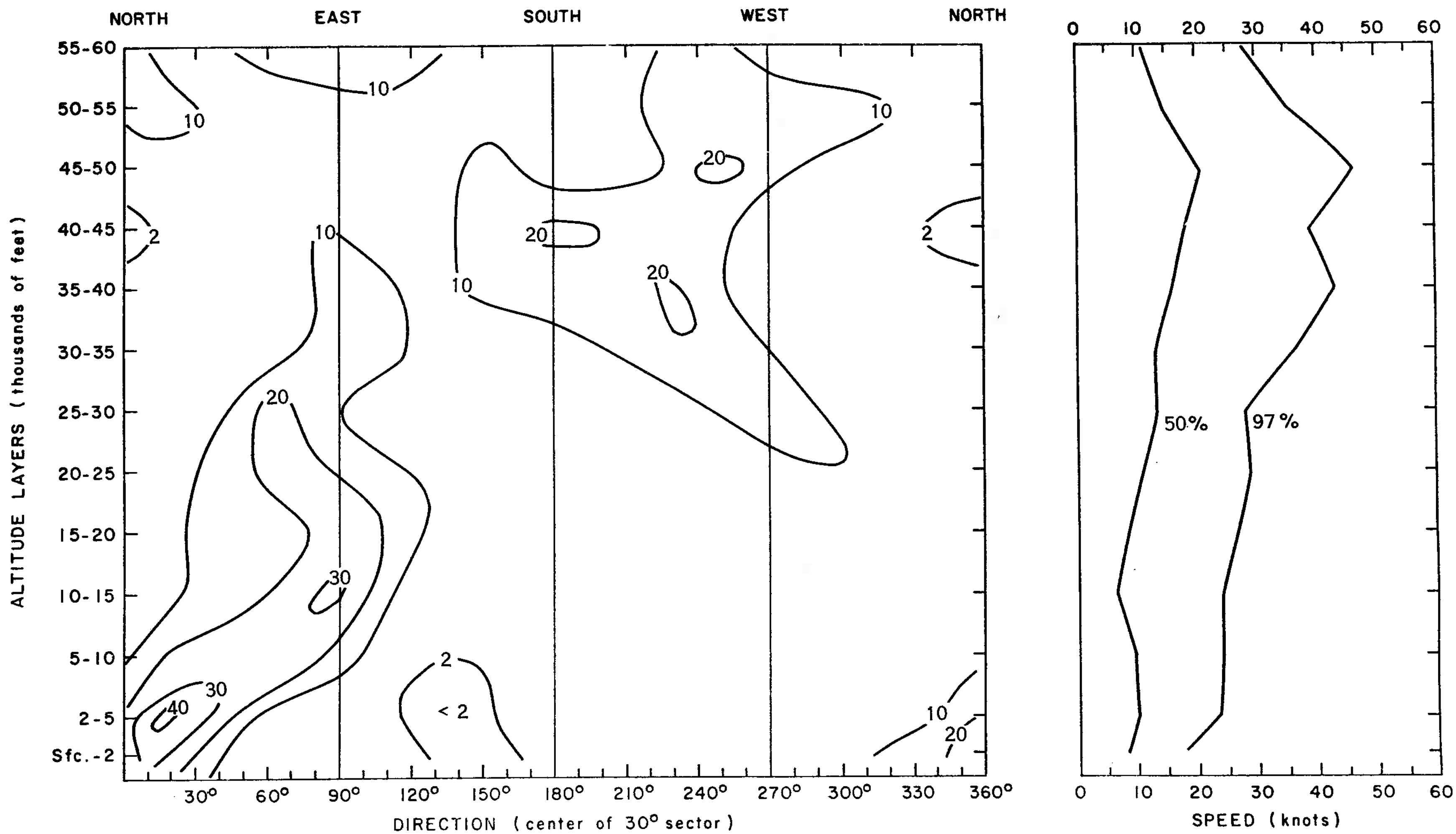
FREQUENCY DISTRIBUTION OF MEAN LAYER WINDS (percent)

SOSKATUPU OCT 1966

FIGURE 3.4



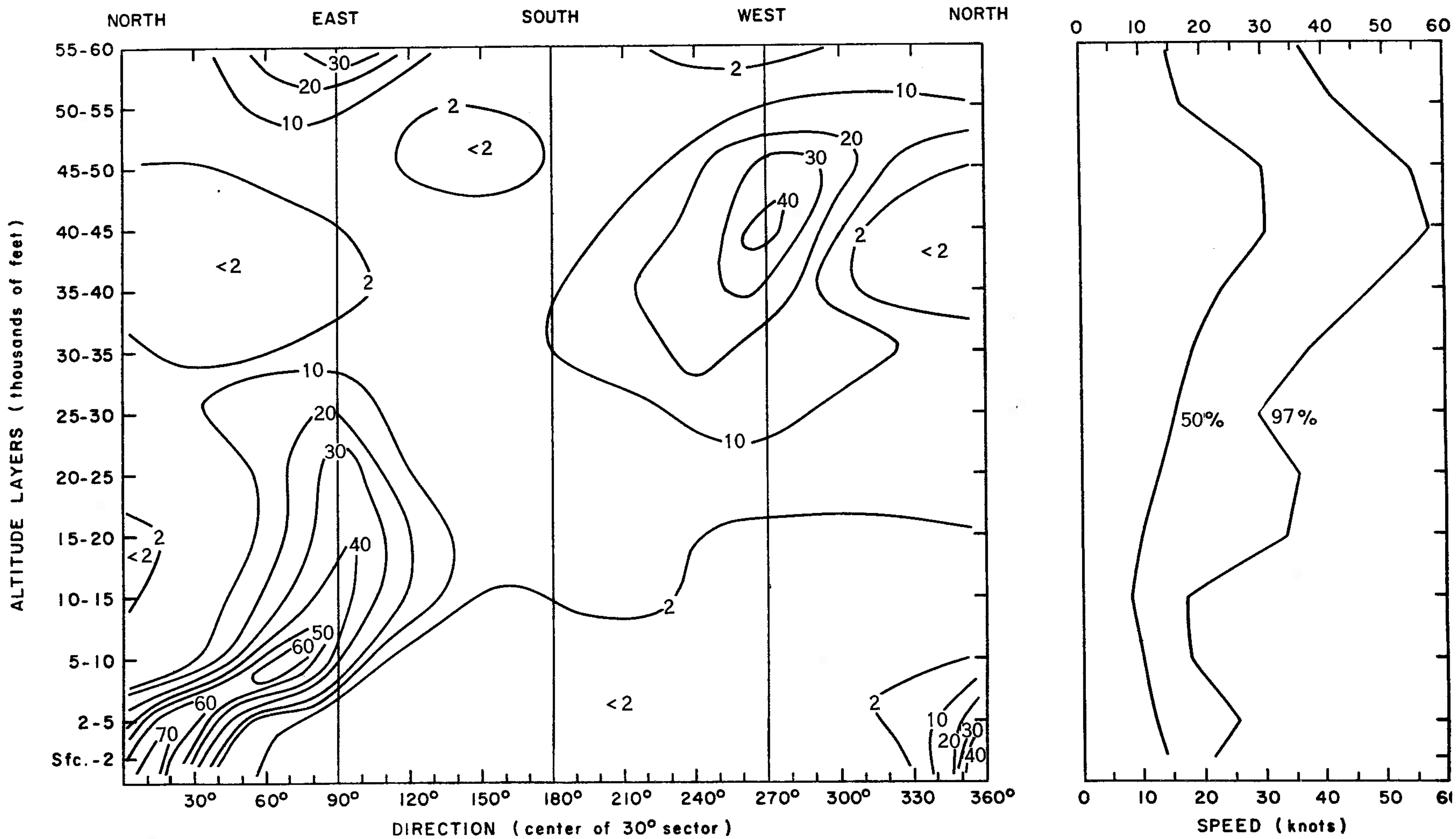
FREQUENCY DISTRIBUTION OF MEAN LAYER WINDS (percent)
PIDIAQUE NOV-DEC 1966
FIGURE 3.5



FREQUENCY DISTRIBUTION OF MEAN LAYER WINDS (percent)

SOSKATUPU NOV-DEC 1966

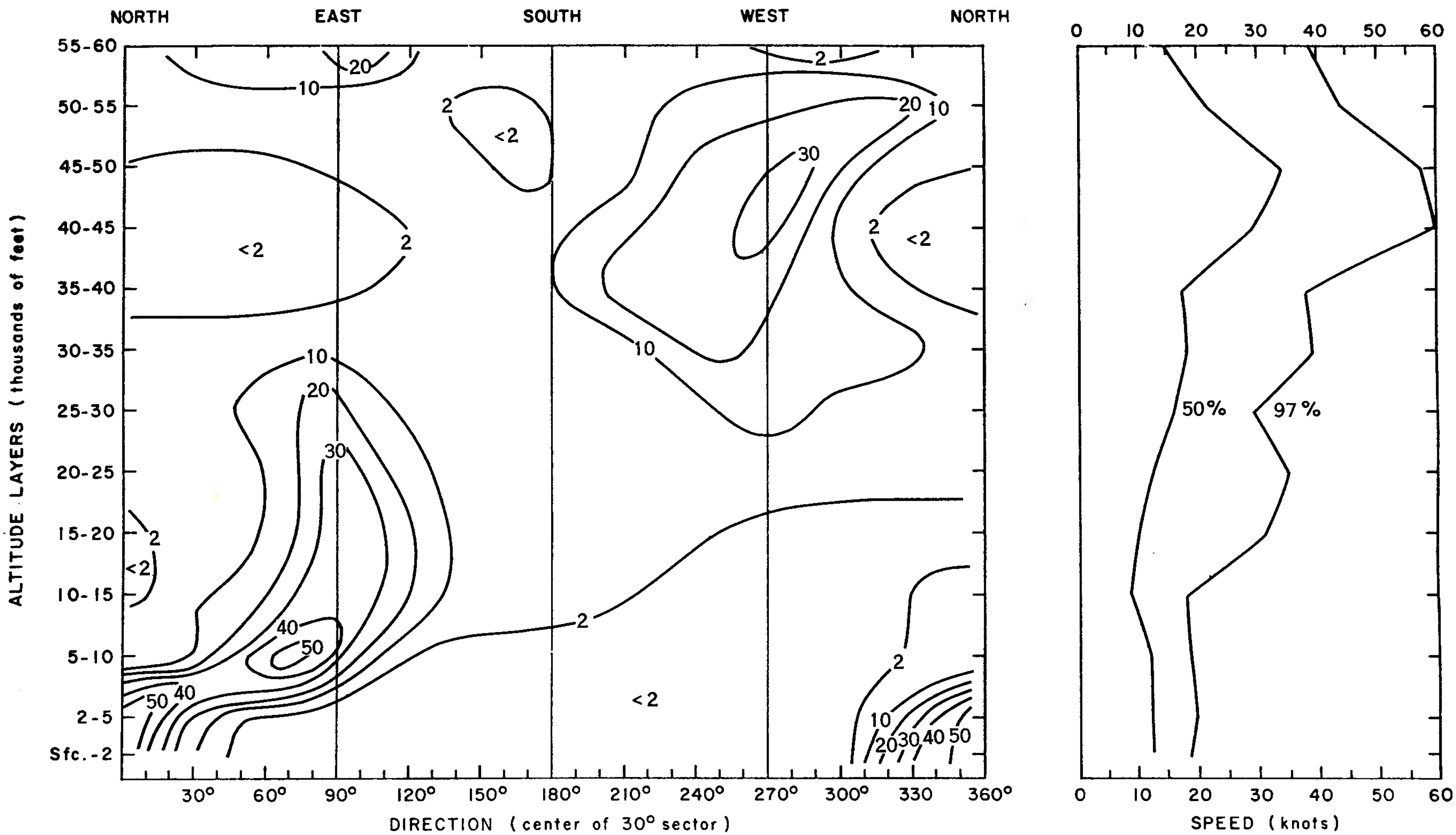
FIGURE 3.6



FREQUENCY DISTRIBUTION OF MEAN LAYER WINDS (percent)

PIDIAQUE JAN-FEB 1967

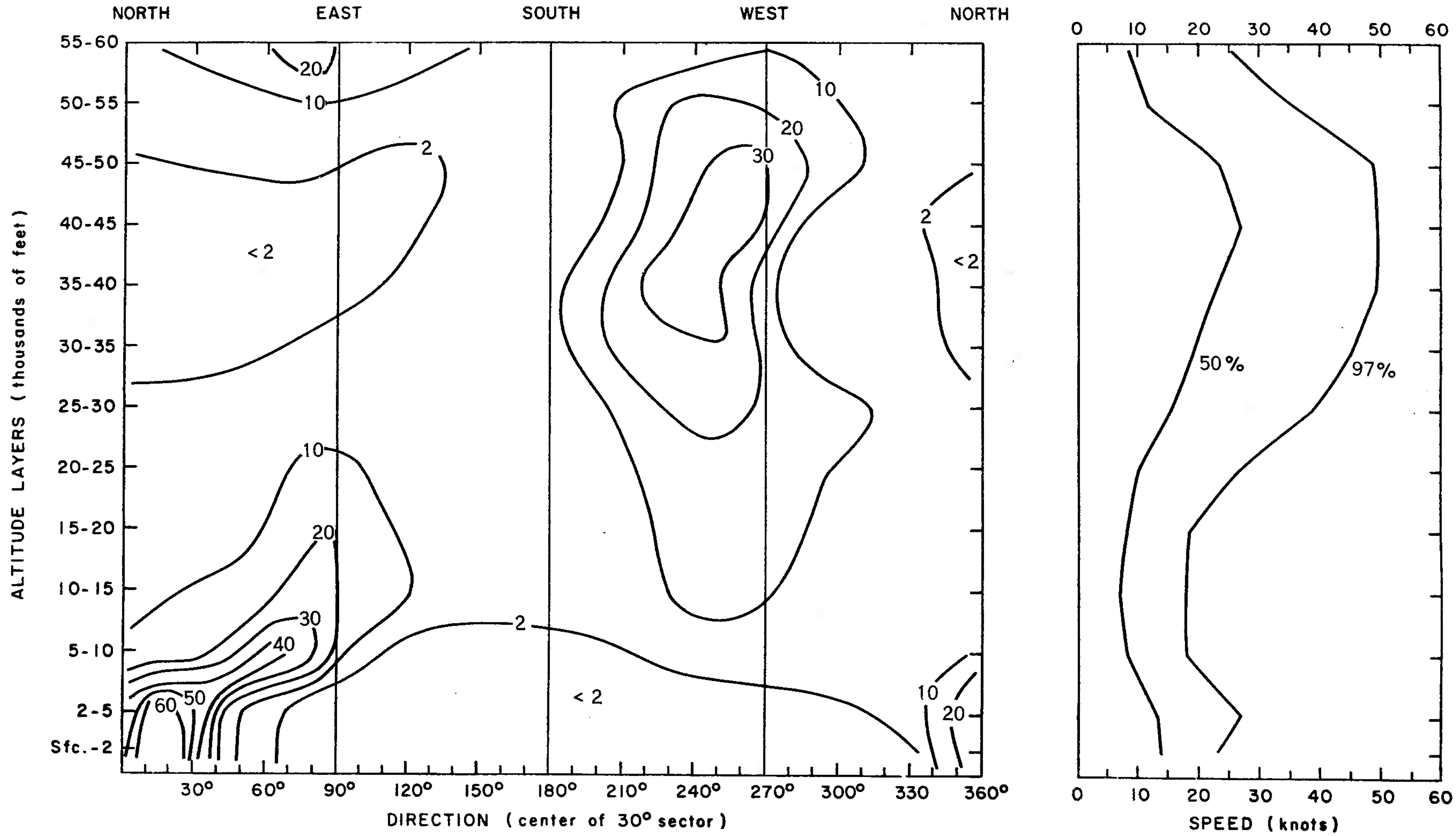
FIGURE 3.7



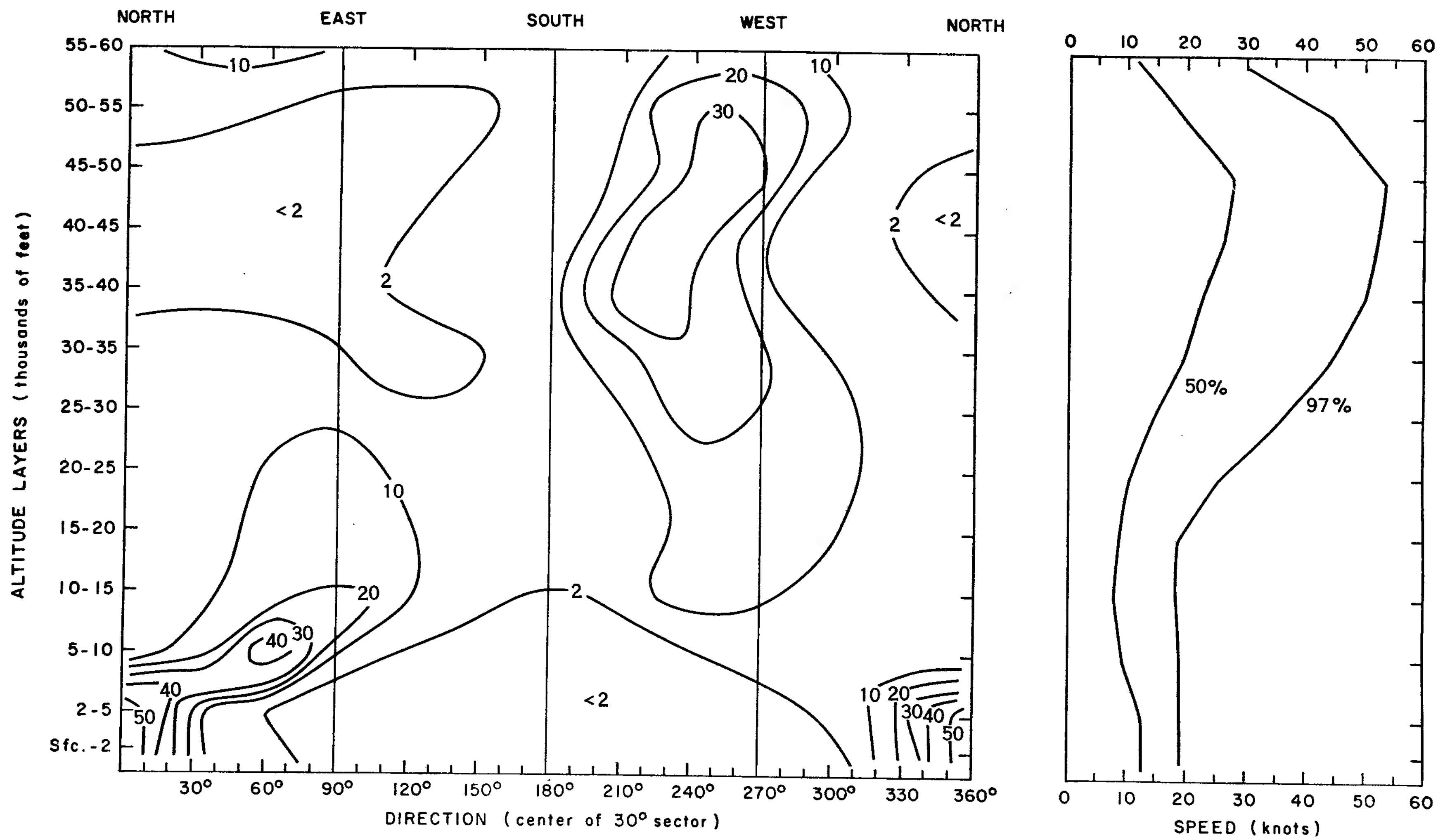
FREQUENCY DISTRIBUTION OF MEAN LAYER WINDS (percent)

SOSKATUPU JAN-FEB 1967

FIGURE 3.8



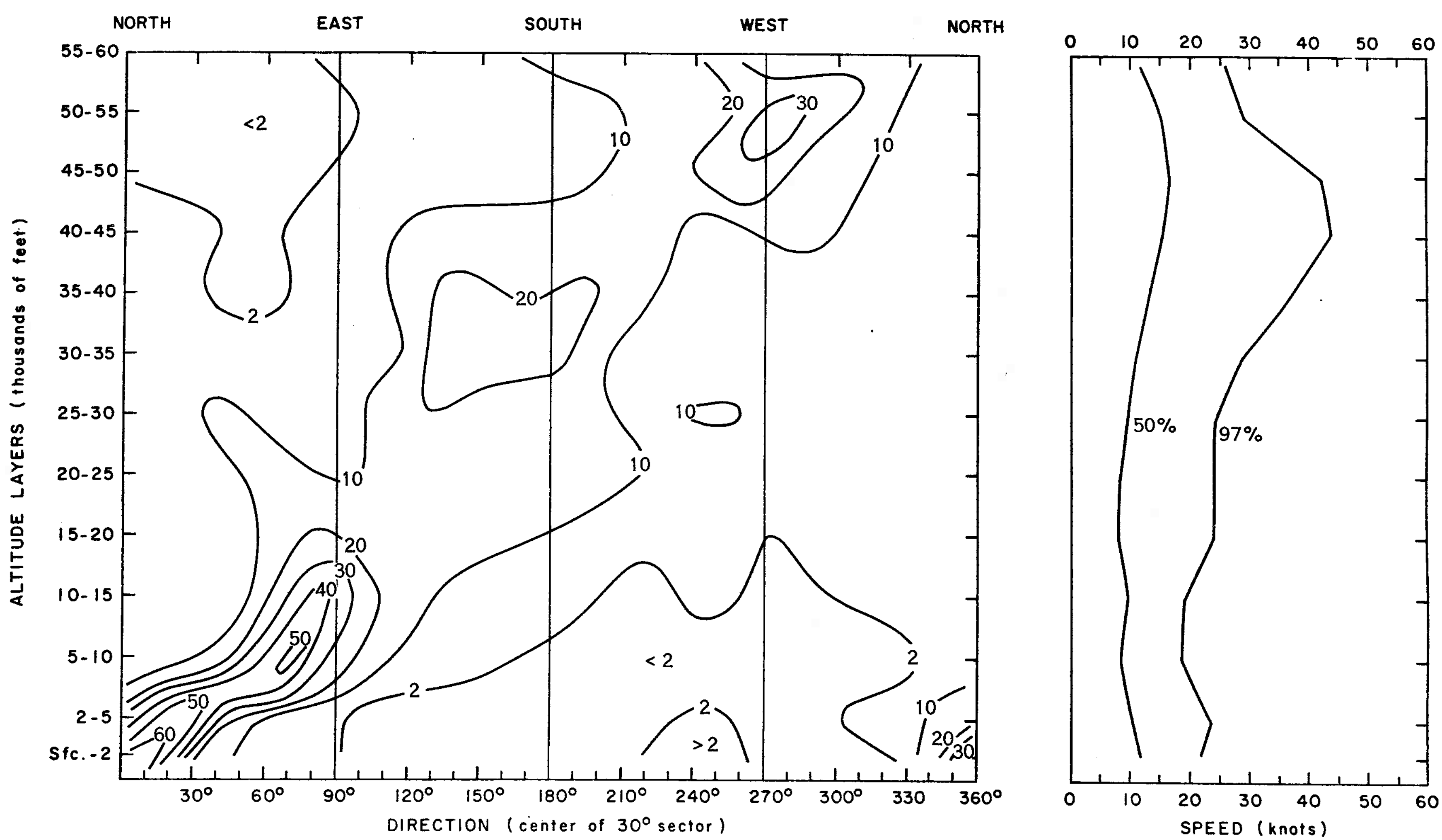
FREQUENCY DISTRIBUTION OF MEAN LAYER WINDS (percent)
PIDIAQUE MAR-APR 1967
FIGURE 3.9



FREQUENCY DISTRIBUTION OF MEAN LAYER WINDS (percent)

SOSKATUPU MAR-APR 1967

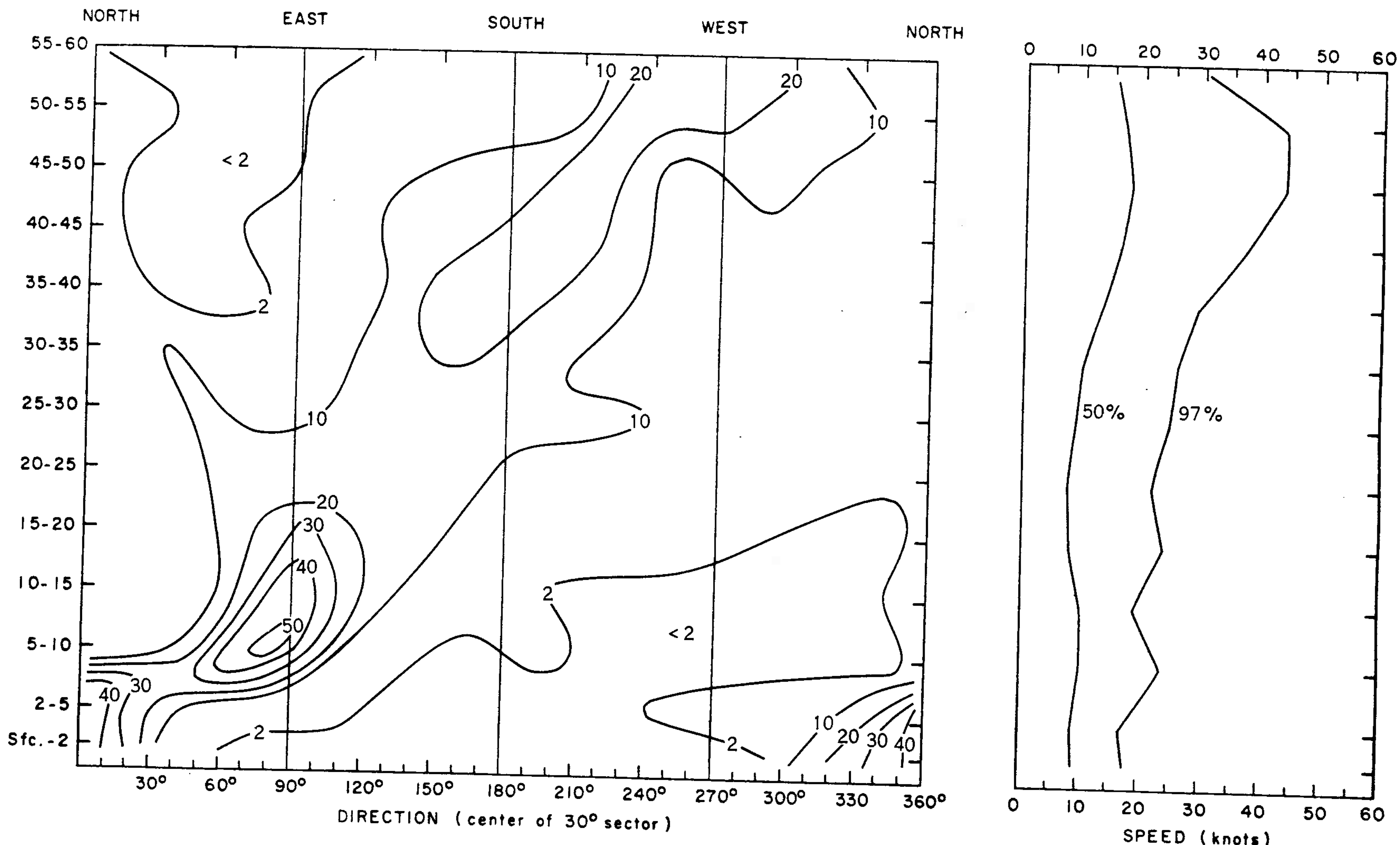
FIGURE 3.10



FREQUENCY DISTRIBUTION OF MEAN LAYER WINDS (percent)

PIDIAQUE MAY 1967

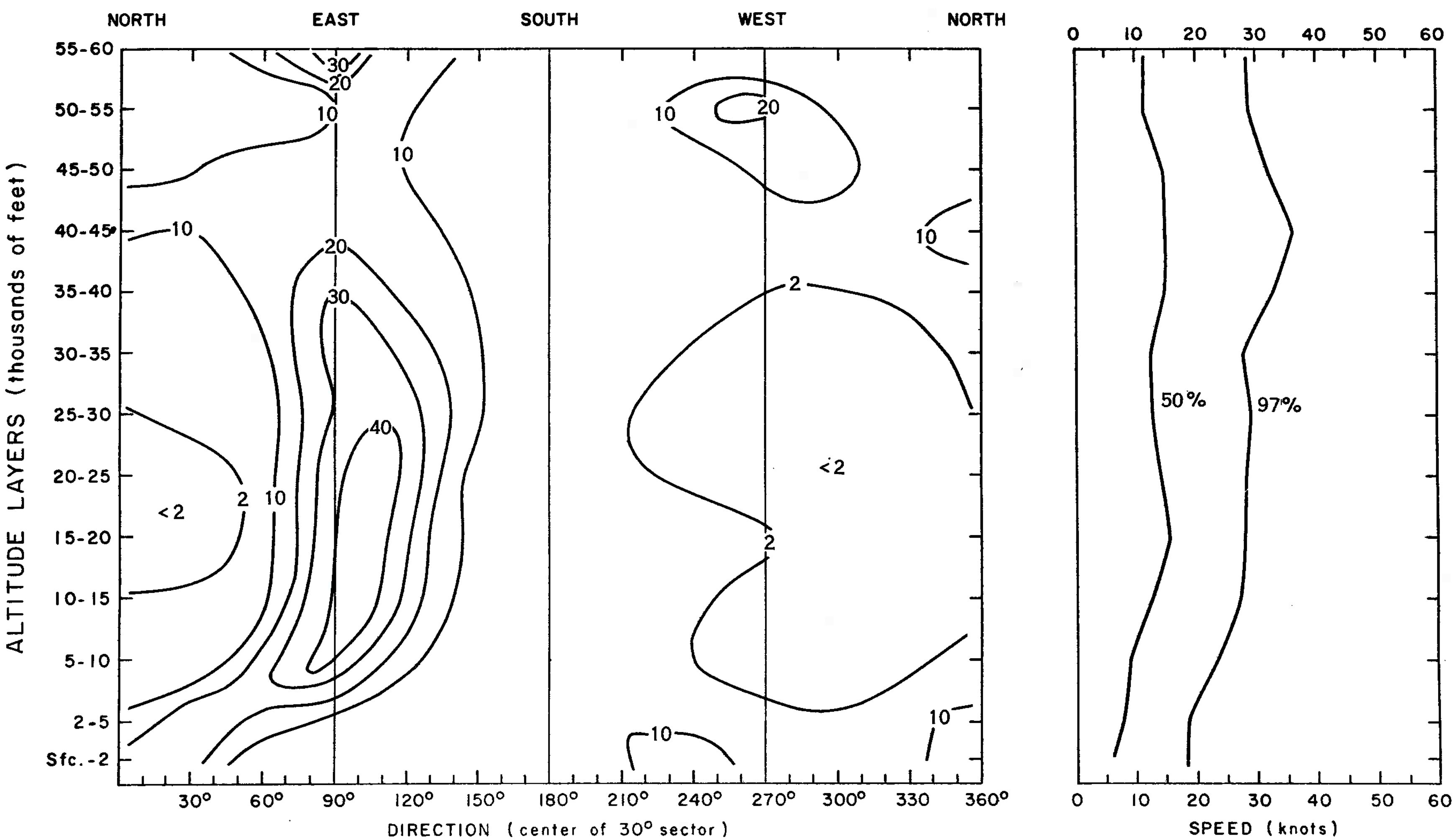
FIGURE 3.11



FREQUENCY DISTRIBUTION OF MEAN LAYER WINDS (percent)

SOSKATUPU MAY 1967

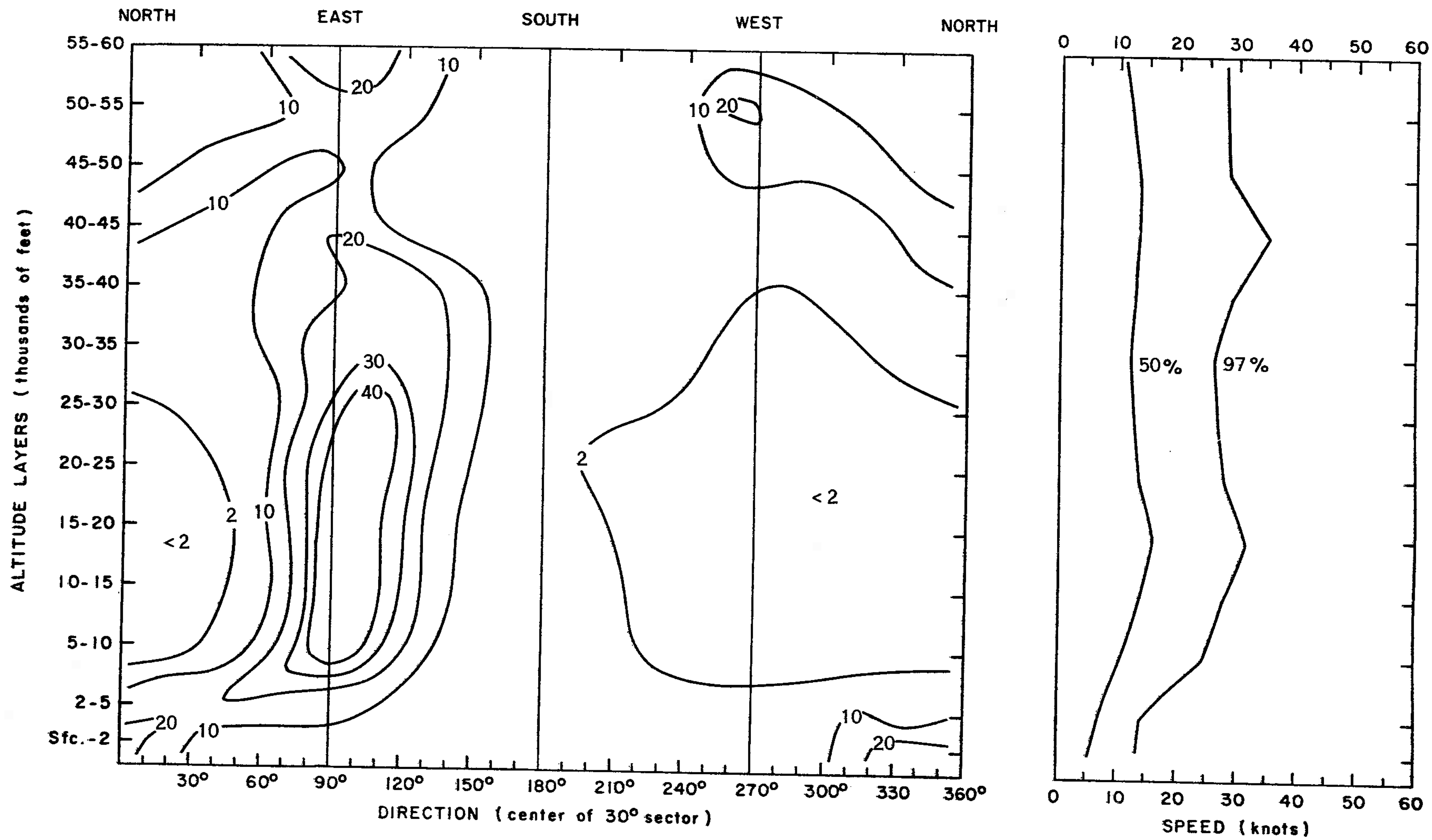
FIGURE 3.12



FREQUENCY DISTRIBUTION OF MEAN LAYER WINDS (percent)

PIDIAQUE JUN-JUL 1967

FIGURE 3.13

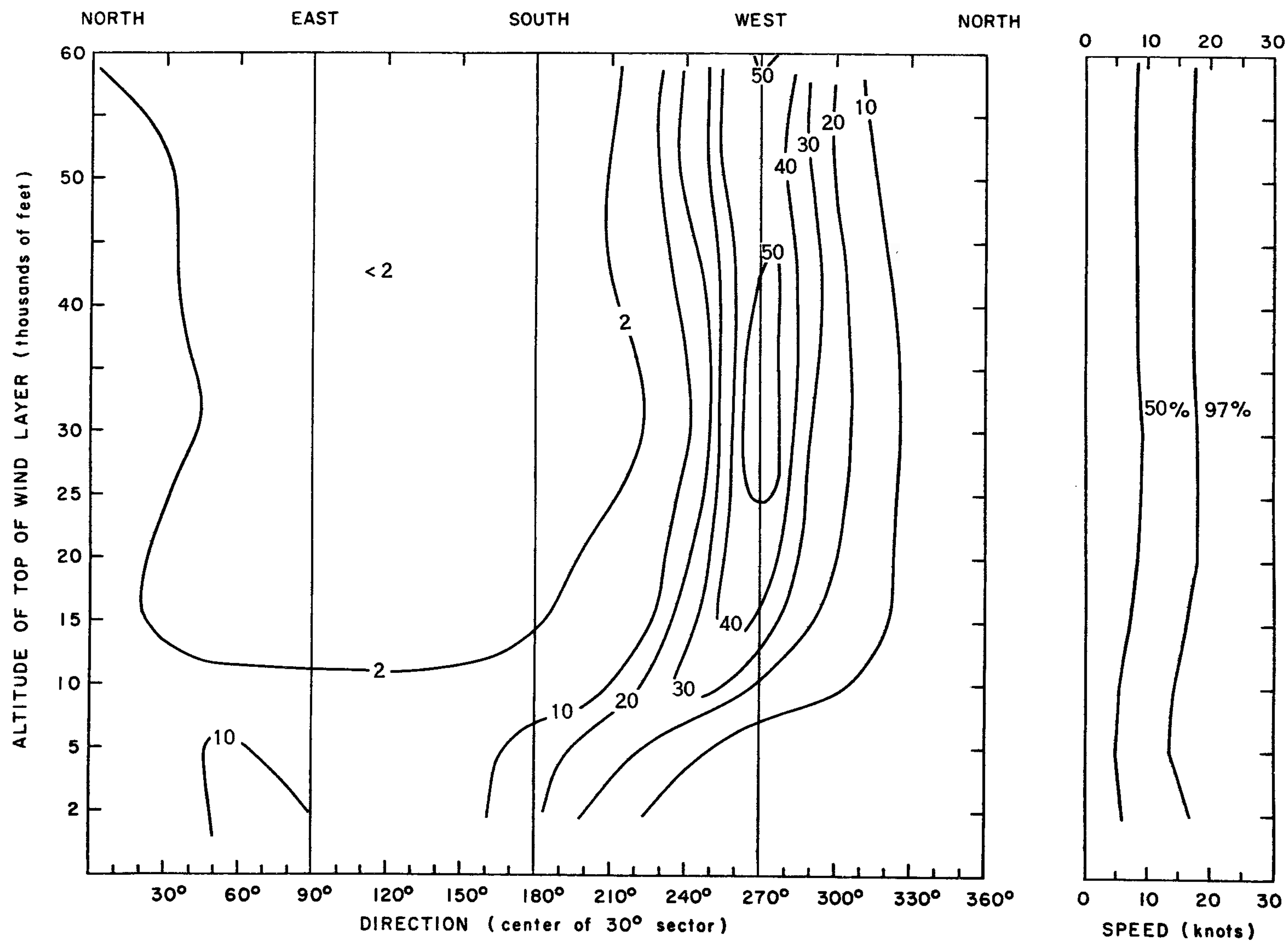


FREQUENCY DISTRIBUTION OF MEAN LAYER WINDS (percent)
SOSKATUPU JUN-JUL 1967

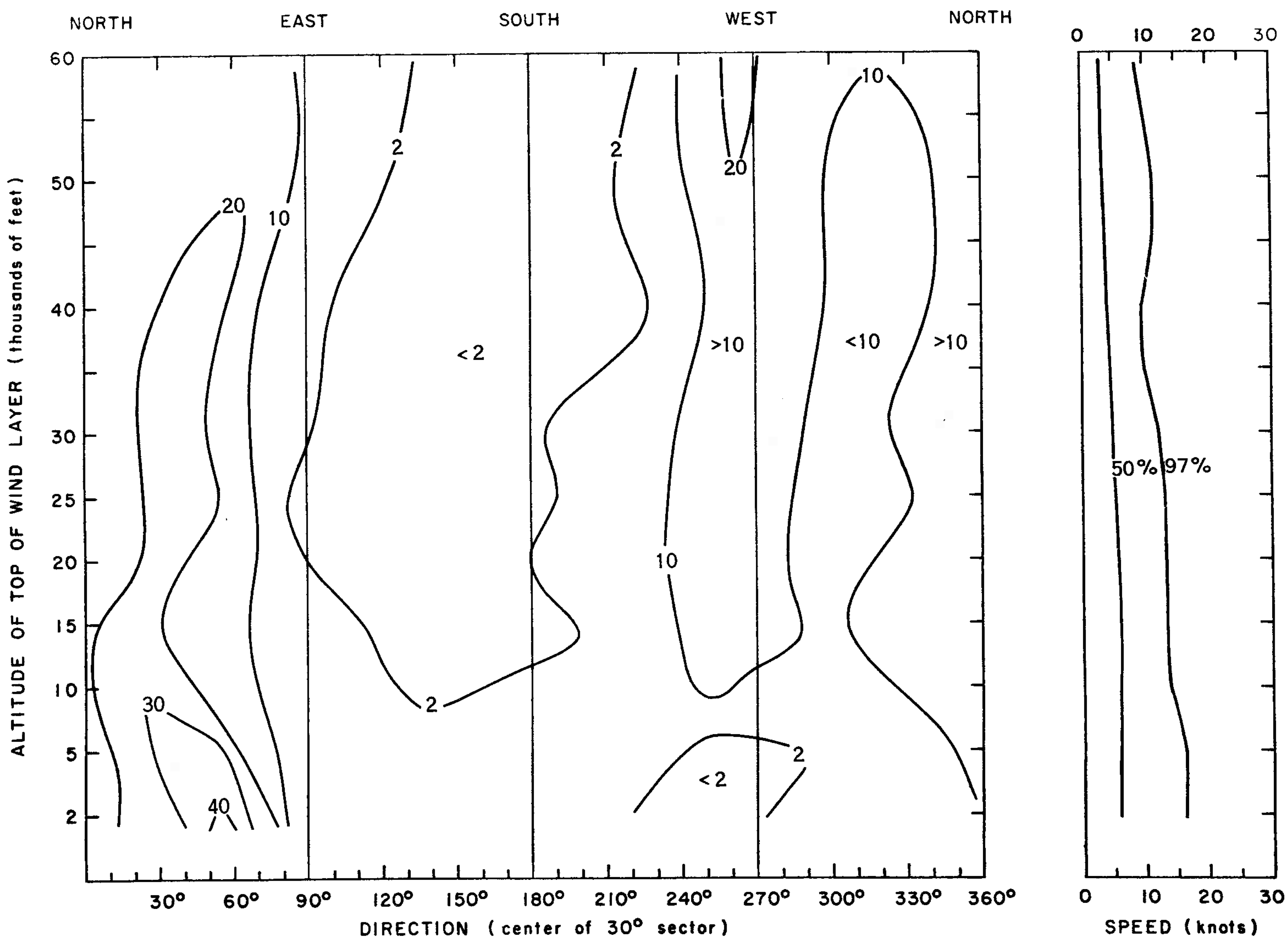
FIGURE 3.14

FALLOUT WIND VECTOR

FREQUENCY DISTRIBUTION CHARTS



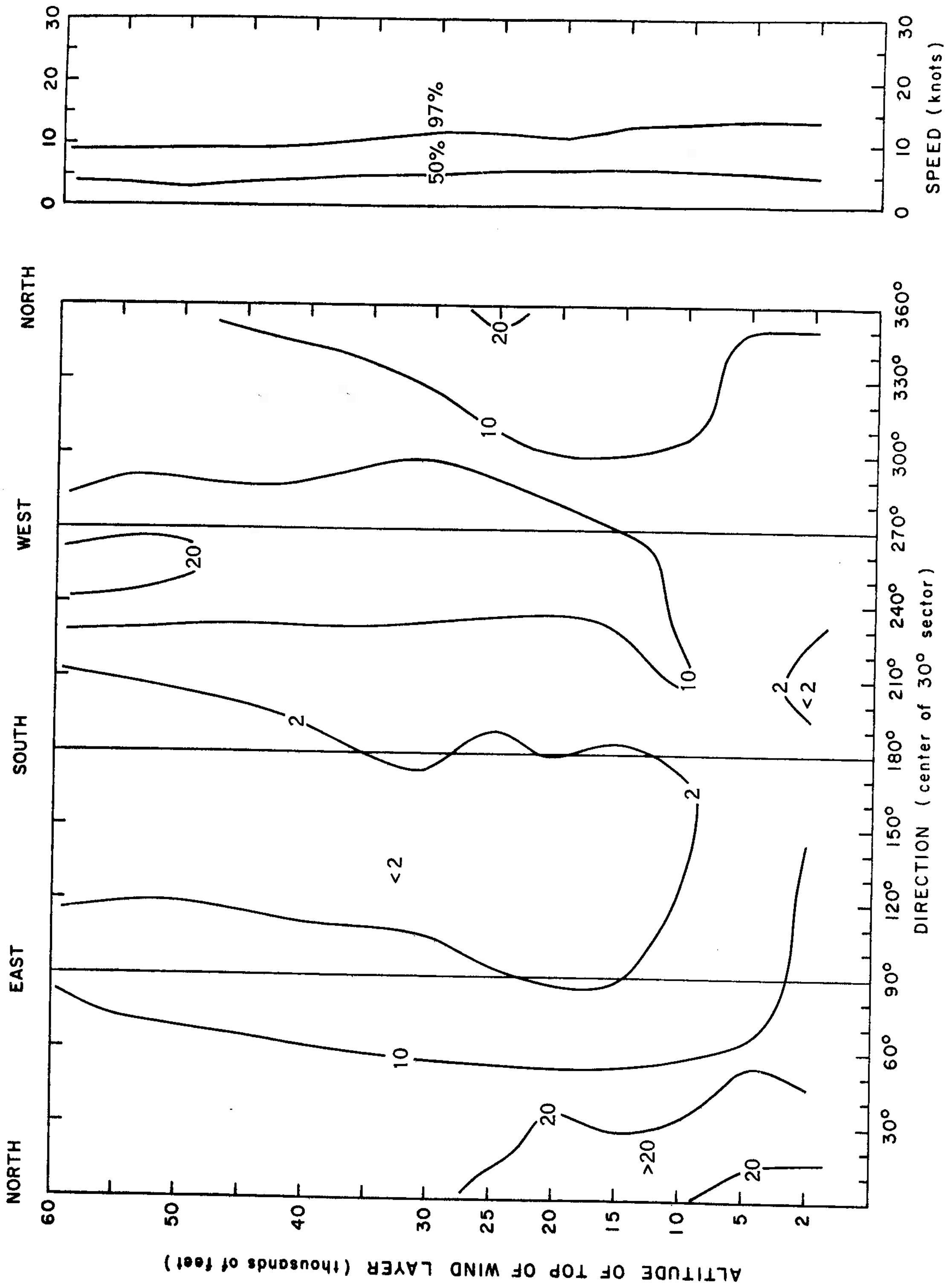
FREQUENCY DISTRIBUTION OF FALLOUT WIND VECTORS (percent)
PIDIAQUE AUG-SEP 1966
FIGURE 3.15



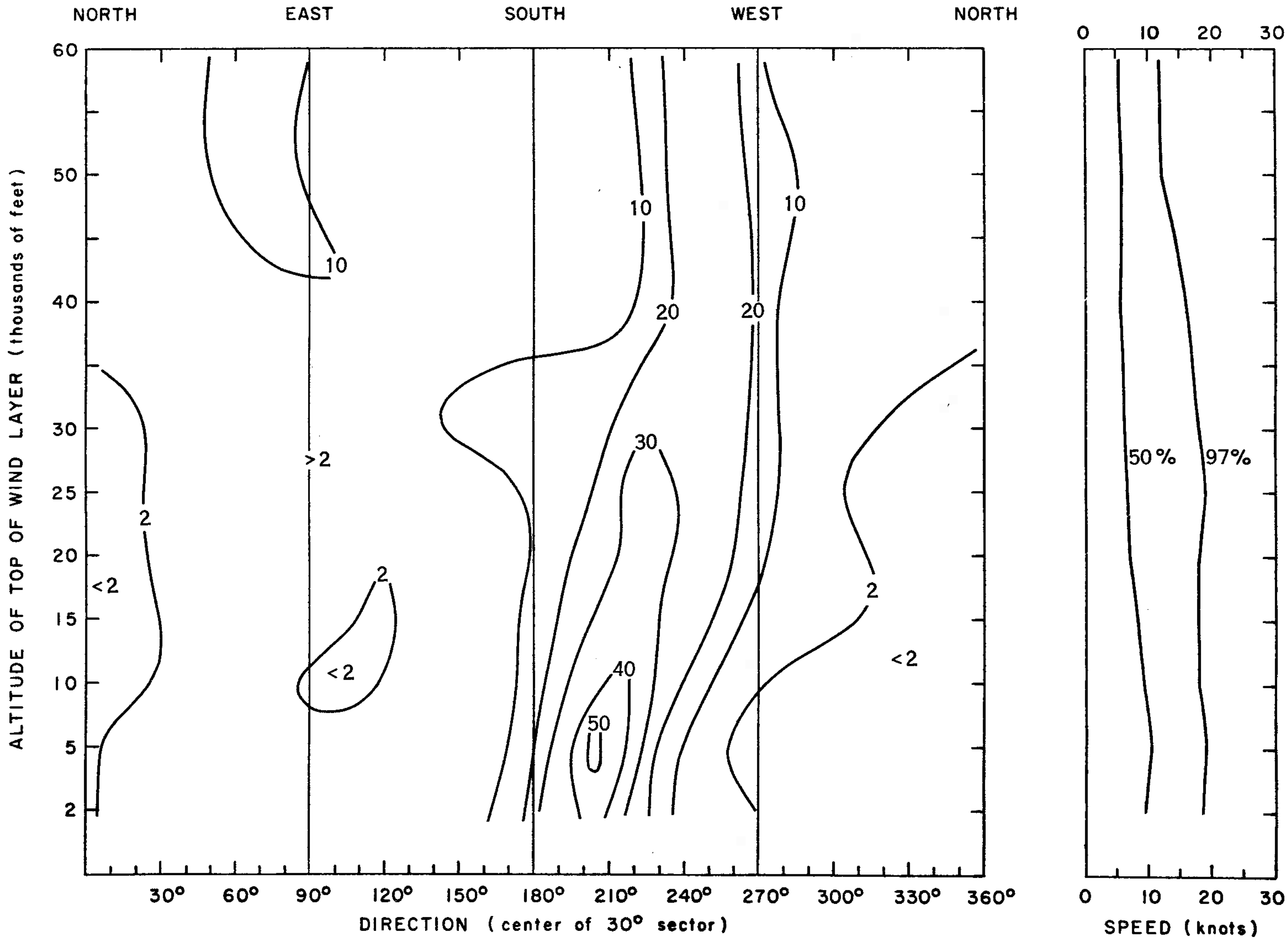
FREQUENCY DISTRIBUTION OF FALLOUT WIND VECTORS (percent)

PIDIAQUE OCT 1966

FIGURE 3.16



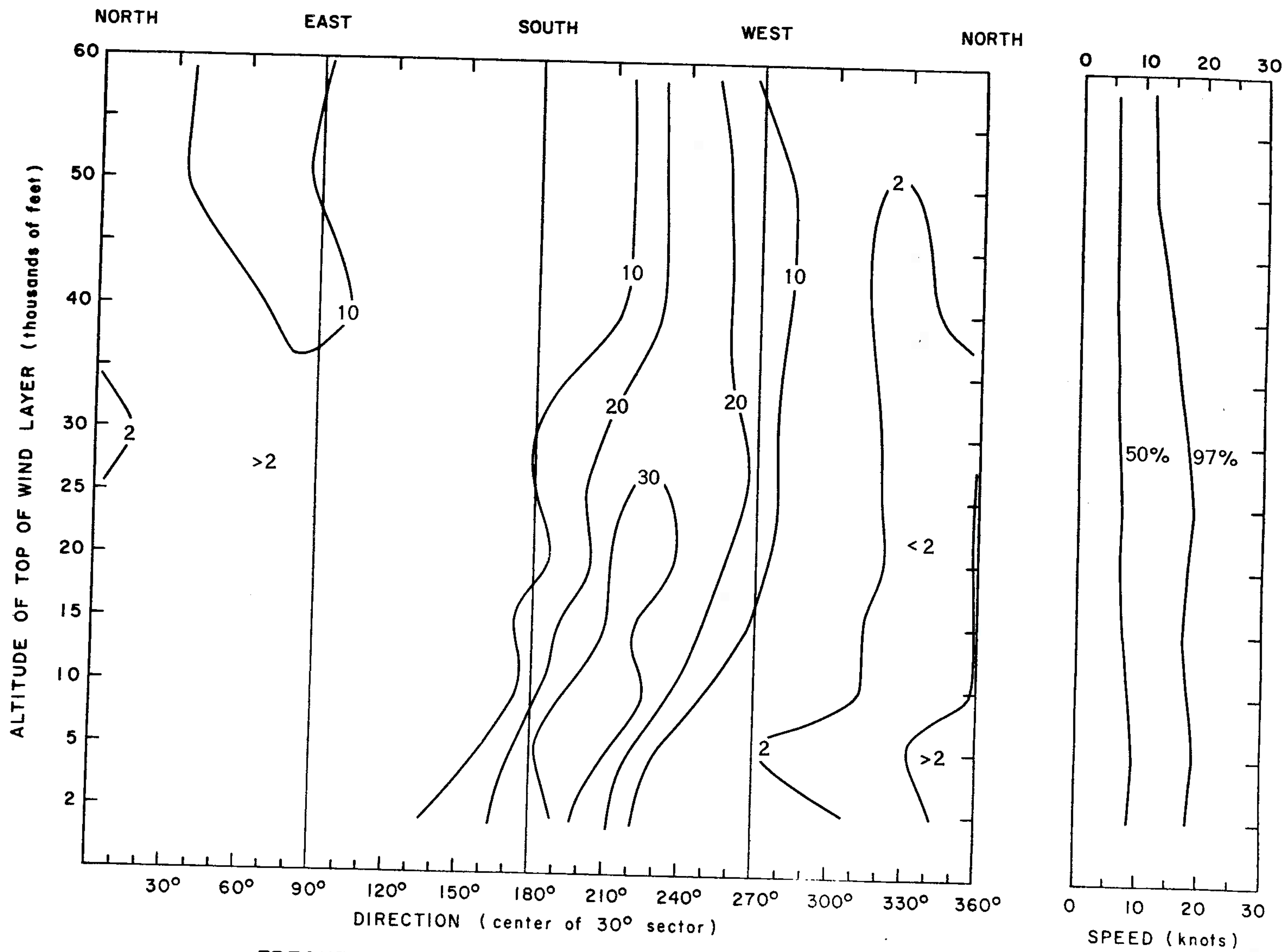
FREQUENCY DISTRIBUTION OF FALLOUT WIND VECTORS (percent)
SOSKATUPU OCT 1966
FIGURE 3.17



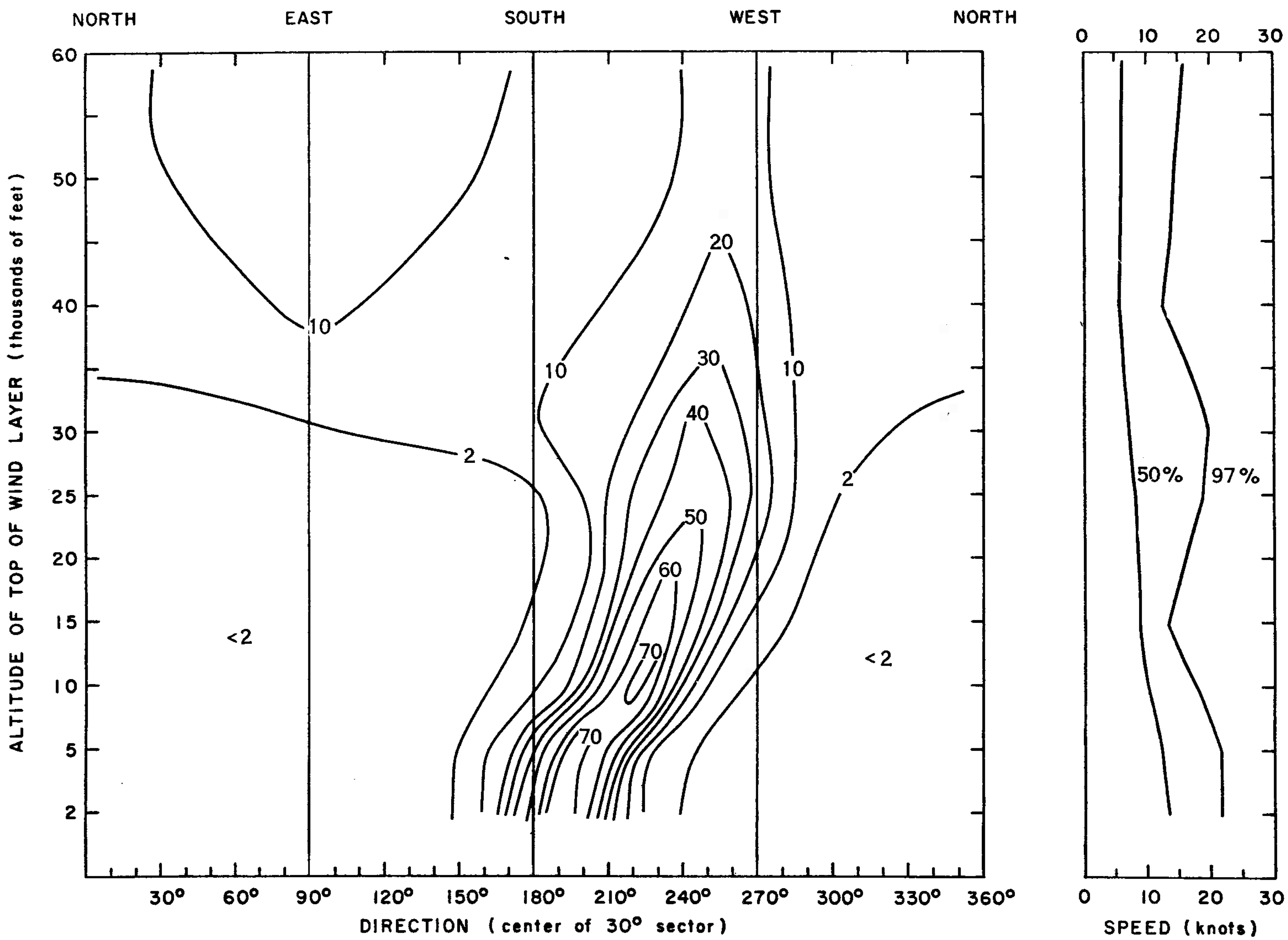
FREQUENCY DISTRIBUTION OF FALLOUT WIND VECTORS (percent)

PIDIAQUE NOV-DEC 1966

FIGURE 3.18



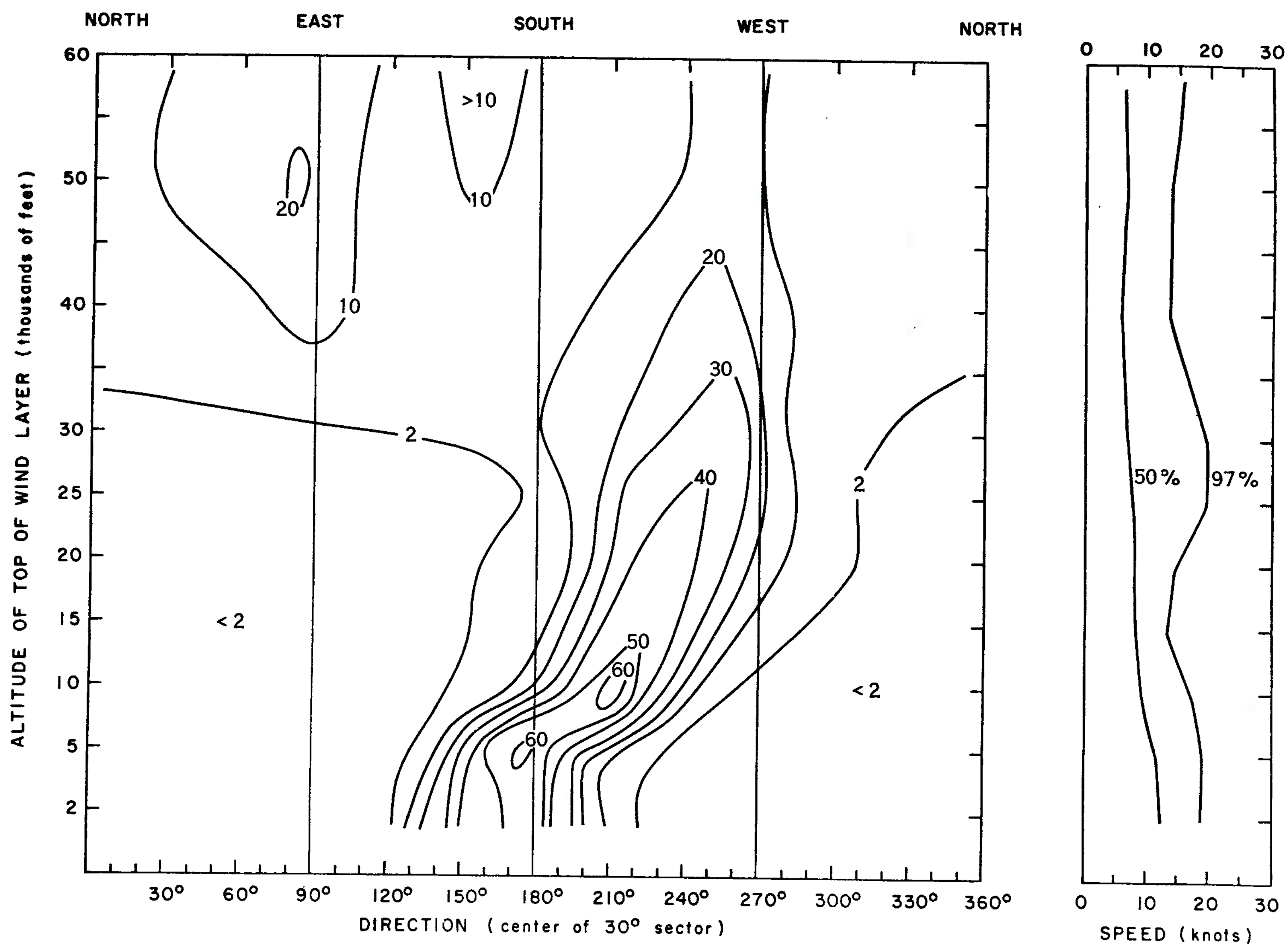
FREQUENCY DISTRIBUTION OF FALLOUT WIND VECTORS (percent)
SOSKATUPU NOV-DEC 1966
FIGURE 3.19



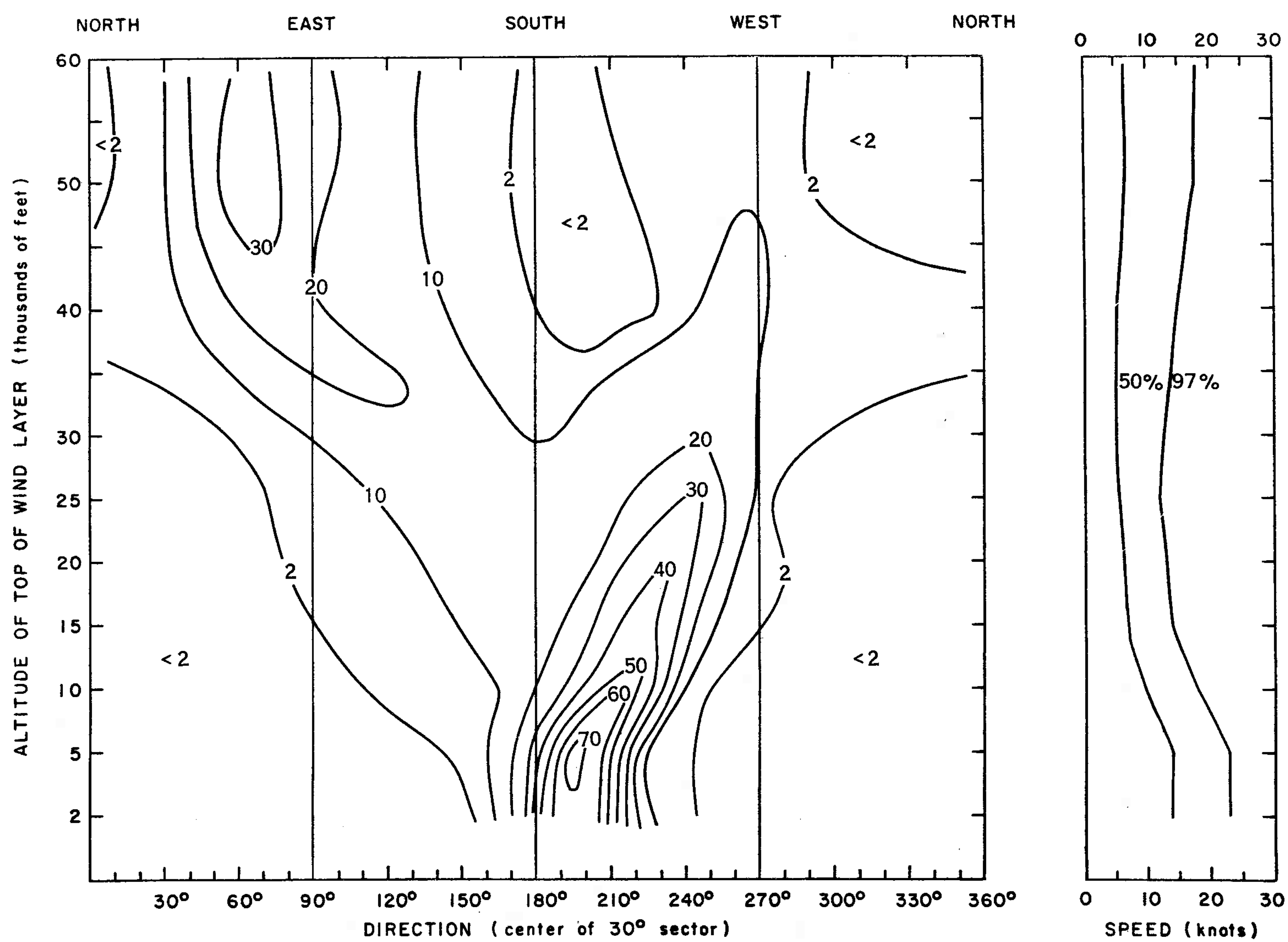
FREQUENCY DISTRIBUTION OF FALLOUT WIND VECTORS (percent)

PIDIAQUE JAN-FEB 1967

FIGURE 3.20



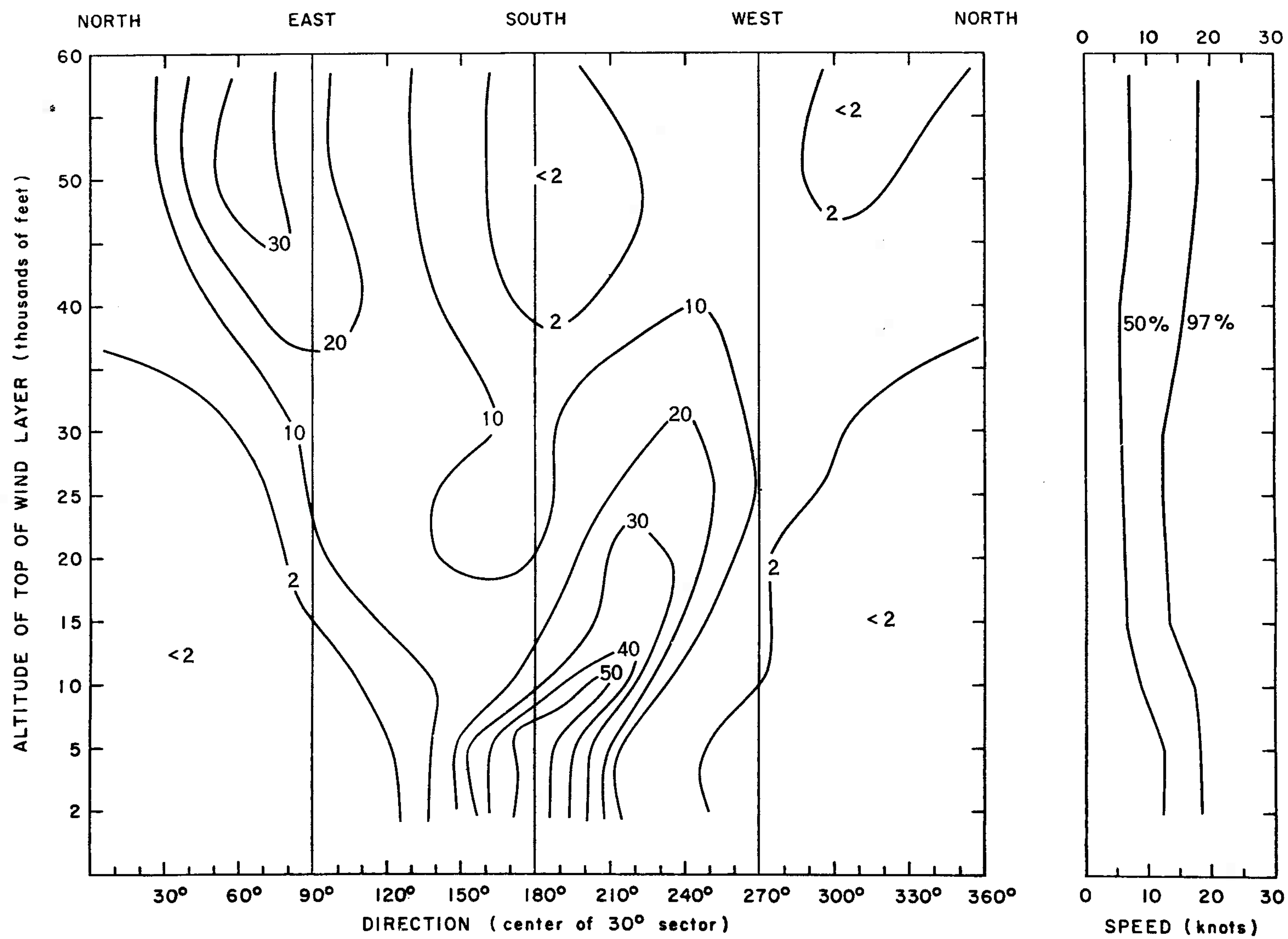
FREQUENCY DISTRIBUTION OF FALLOUT WIND VECTORS (percent)
SOSKATUPU JAN-FEB 1967
FIGURE 3.21



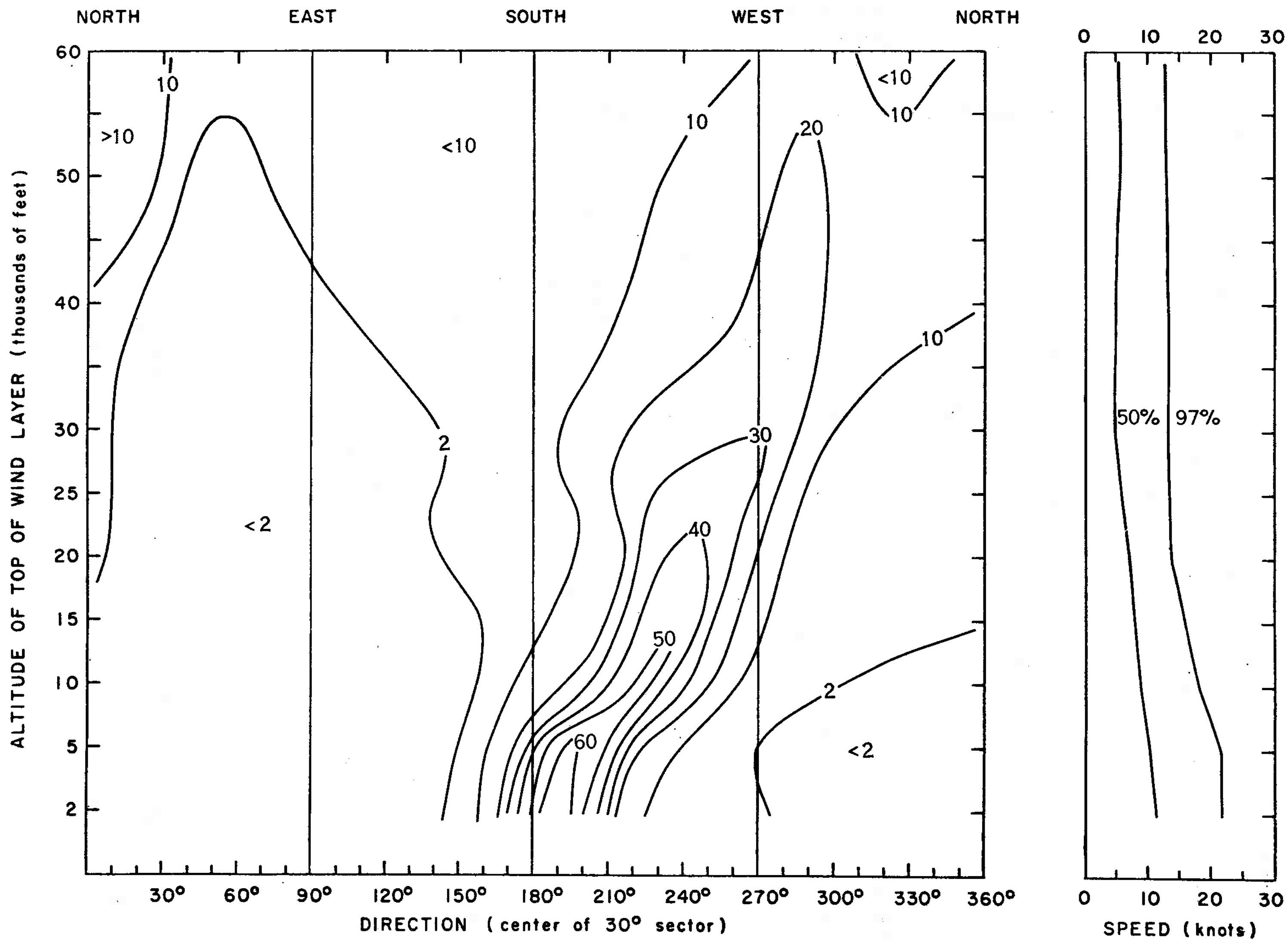
FREQUENCY DISTRIBUTION OF FALLOUT WIND VECTORS (percent)

PIDIAQUE, MAR-APR 1967

FIGURE 3.22



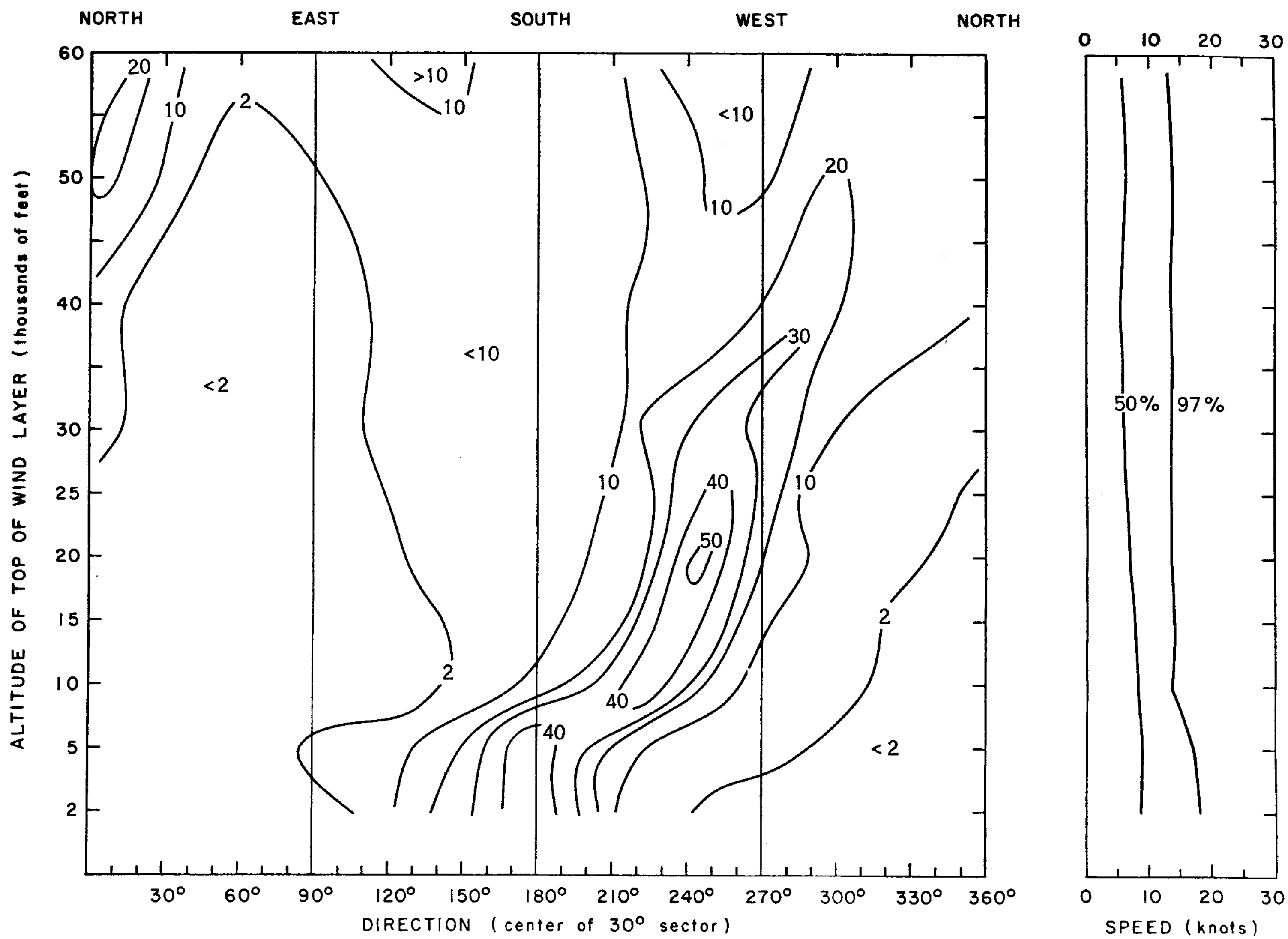
FREQUENCY DISTRIBUTION OF FALLOUT WIND VECTORS (percent)
SOSKATUPU MAR-APR 1967
FIGURE 3.23



FREQUENCY DISTRIBUTION OF FALLOUT WIND VECTORS (percent)

PIDIAQUE MAY 1967

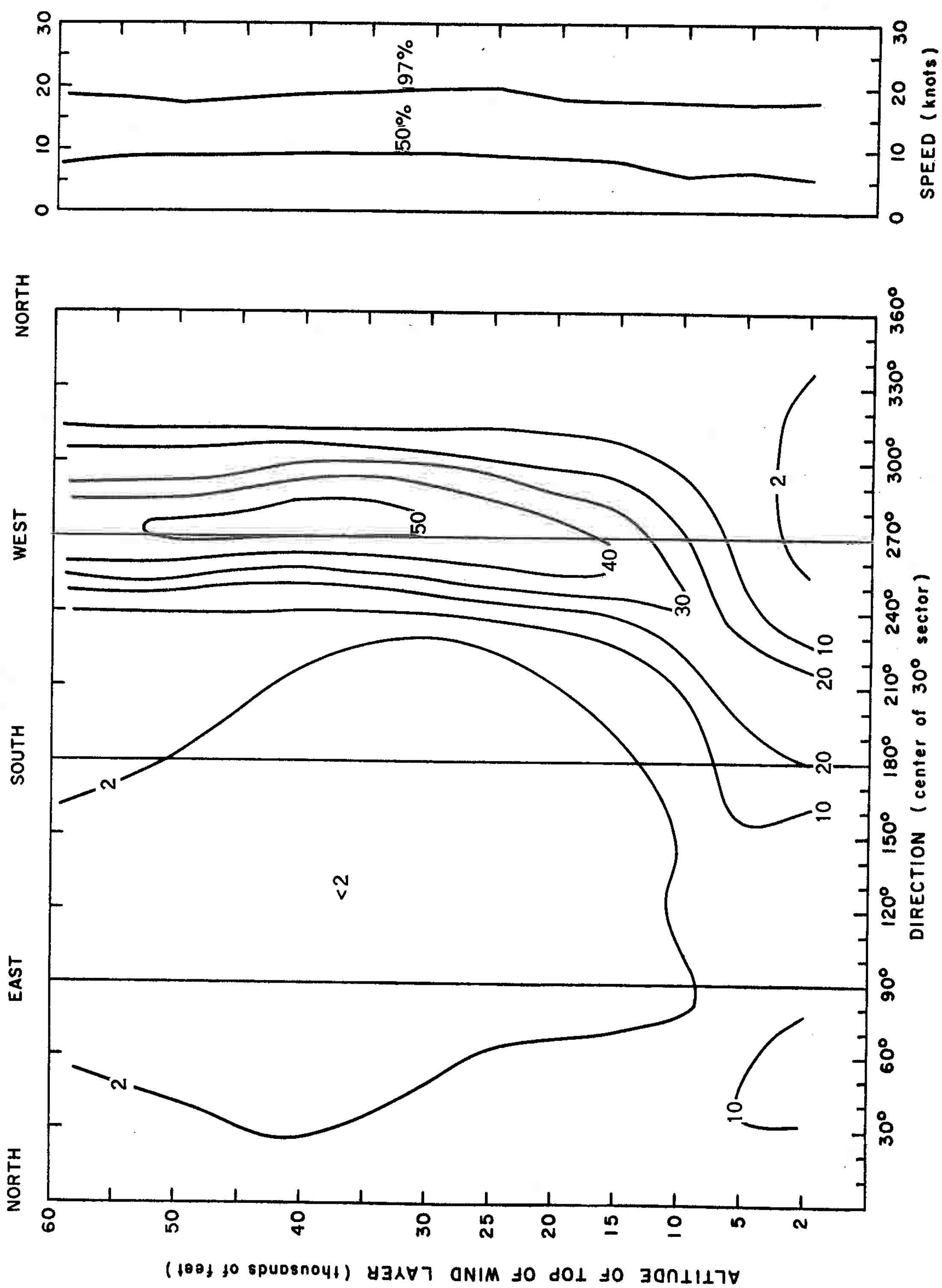
FIGURE 3.24



FREQUENCY DISTRIBUTION OF FALLOUT WIND VECTORS (percent)

SOSKATUPU MAY 1967

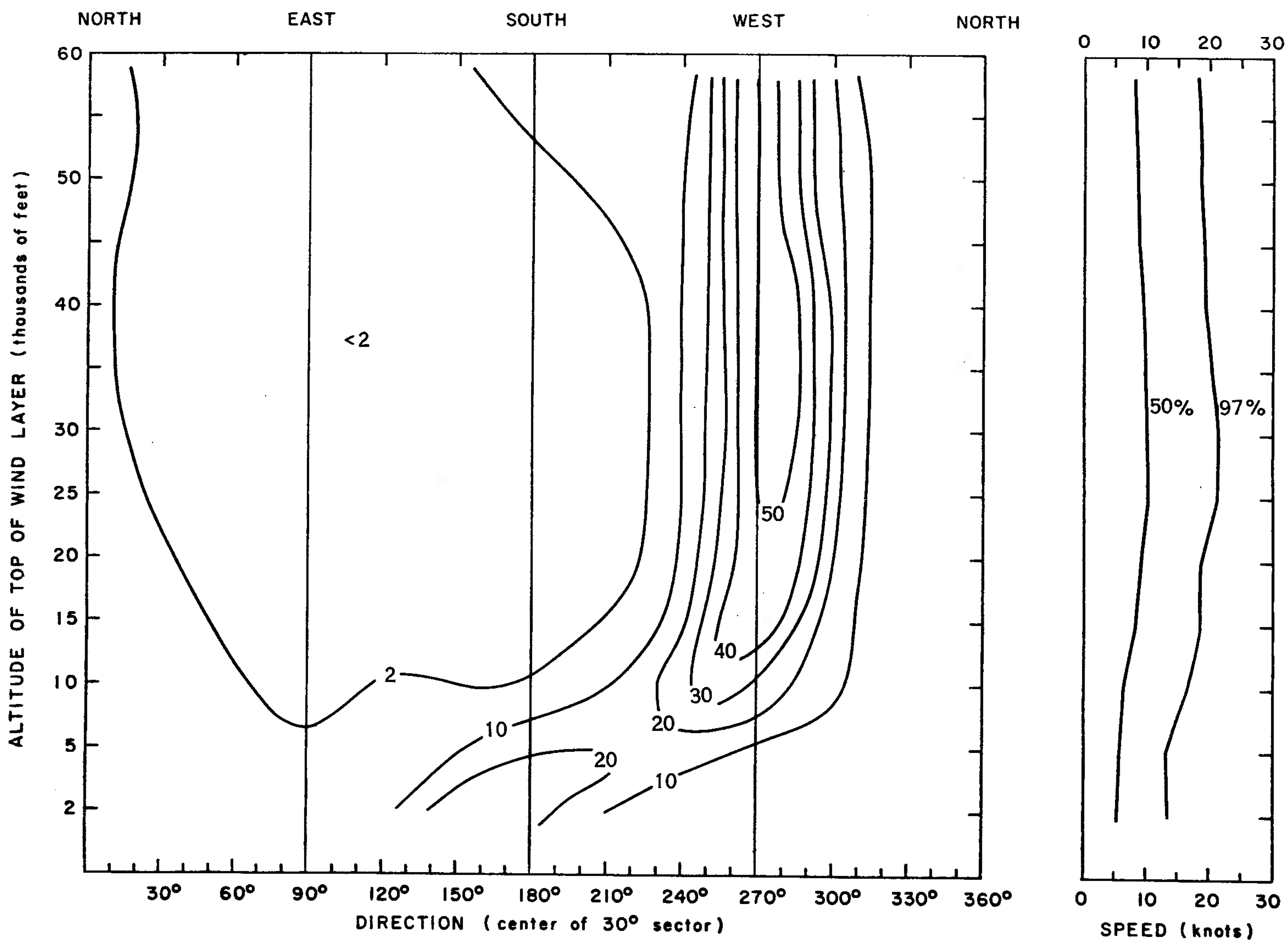
FIGURE 3.25



FREQUENCY DISTRIBUTION OF FALLOUT WIND VECTORS (percent)

PIDIAQUE JUN-JUL 1967

FIGURE 3.26



FREQUENCY DISTRIBUTION OF FALLOUT WIND VECTORS (percent)
SOSKATUPU JUN-JUL 1967
FIGURE 3.27

4.0 WEATHER RADAR PROGRAM

4.1 Objectives

The precipitation data needed for studies of potential rain scavenging of nuclear clouds in the vicinity of Routes 17 and 25 are being obtained by use of both the S-band and X-band components of the M-33 radar system. The S-band (10 cm) acquisition radar is being used to measure areal distribution and intensity of precipitation. The X-band (3 cm) track radar will be used to measure the vertical extend of showers and thunderstorms.

4.2 Route 17 Radar Observations

The S-band acquisition radar at the Pidiaque weather station was installed in July 1966. The radar has a power output of 1000 KW, the pulse width is 1.3 microseconds and the beam width is 1.25 degrees horizontally; 4 degrees vertically. It has a range of 60 nautical miles. A standard antenna elevation angle of 2 degrees is used for all weather radar observations.

An experimental program was followed from July through mid-December 1966 to resolve electronic and "ground clutter" problems. Most of the electronic difficulties were alleviated but "ground clutter" continues to impose a limitation on the data collected at this station.

The term "ground clutter" refers to the pattern of radar echoes caused by terrain features or other obstacles which reflect the radar signal. The clutter tends to hide or confuse the echoes returned from precipitation.

Routine measurements of the areal distribution of precipitation began at Pidiaque during mid-December 1966. These observations are made by manually tracing the precipitation echoes displayed on the radar scope (PPI) onto a plastic overlay. Separate tracings are made for the 0, 10, 20, and 30 db attenuation settings. There are eight daily observations taken at 3-hour intervals for each of the above four attenuation settings. Hourly photographs are made of a repeater radar scope (PPI) using an automatic recording camera. The camera takes a series of pictures each hour of radar echoes at 5-db step intervals for attenuation settings from 0 db to 45 db.

Measurements of the vertical extent of precipitation using the X-band radar at Soskatupu have not yet begun on a routine basis. The program will begin as soon as electronic problems are resolved. The X-band (3 cm) radar has a power output of 250 KW, pulse width of .25 microseconds and antenna beam width of 1.1 degrees. The range is 50 nautical miles.

4.3 Data Analysis

Data obtained with the S-band radar at Pidiaque will yield statistics on the frequency of occurrence of precipitation by region, time of day and season. The X-band radar observations soon to be initiated at Soskatupu will yield statistics on the vertical extent of precipitation by area, time of day, and season.

The radar weather data are being punched on cards for summarization by computer and will be analyzed to determine the probability of rain scavenging of nuclear debris.