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Nevada Nuclear Waste Storage Investigations Project

Meteorological Tower Data for the Yucca Alluvial (YA) Site and Yucca Ridge (YR) Site

July, 1983 – October, 1984
Final Data Report

H. W. Church, D. L. Freeman, K. Boro, R. T. Egami

Prepared by
Sandia National Laboratories
Albuquerque, New Mexico 87185 and Livermore, California 94550
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NEVADA NUCLEAR WASTE STORAGE
INVESTIGATIONS PROJECT

METEOROLOGICAL TOWER DATA FOR THE YUCCA ALLUVIAL (YA) SITE AND YUCCA RIDGE (YR) SITE JULY, 1983 - OCTOBER, 1984 FINAL DATA REPORT

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ABSTRACT

The purpose of the NNWSI meteorological data collection program was to support environmental evaluations of site suitability for a nuclear waste repository. This is the last of a series of data summaries for the NNWSI Alluvial and Ridge Sites in southern Nevada, and covers the sixteen month period of July, 1983 through October, 1984 for both sites.

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METEOROLOGICAL TOWER DATA FOR THE
NEVADA NUCLEAR WASTE STORAGE
INVESTIGATIONS (NNWSI) PROJECT

Final Report, July 1983 - October 1984
Yucca Alluvial (YA) Site
Yucca Ridge (YR) Site

INTRODUCTION

The Nuclear Waste Policy Act of 1982 (PL 97-425) established the frame work for the selection and the timetable for the development of the first two United States repositories for the disposal of high-level radioactive waste. Before final selection of repository locations, potential sites will undergo extensive evaluation to determine their suitability for future repositiory development.

One site under consideration is the Yucca Mountain area in southern Nye County, Nevada, about 140 km northwest of Las Vegas. The U.S. Department of Energy's (DOE) evaluation of the Yucca Mountain site is being conducted by the Nevada Nuclear Waste Storage Investigations (NNWSI) Project under the direction of the Waste Management Project Office (WMPO) of the DOE's Nevada Operations Office. The meteorological data collection described in this report was sponsored by the NNWSI Project to support the evaluation of the Yucca Mountain site.

In 1982, Sandia National Laboratories installed two 10-metre meteorological tower systems. They were located at two sites near Yucca Mountain within the Nevada Test Site: one at site YA (Yucca Alluvial) and one at site YR (Yucca Ridge), shown in Figure 1. Data collection activities began at site YA on June 29, 1982 and at site YR on November 23, 1982. Data acquisition and initial editing were conducted by Sandia. Final processing, editing, and archiving were conducted by the Energy and Environmental Engineering Center (formerly the Atmospheric Sciences Center) of the Desert Research Institute (DRI) in Reno, NV. Data reports for the YA site for the periods July 1982 - September 1982, and October 1982 - June 1983, are contained in SAND83-1912 (Church et al, 1984a), and SAND84-1327 (Church et al, 1984b), respectively, and for the YR site for the period January - June 1983 (Church et al, 1986). This report, the last in this series, presents the results of the monitoring program for the 16 month period of July 1983 - October 1984 (when both installations were closed down by order of WMPO and removed) for both sites.

This report is the first in this series to report wind fluctuation parameters which may be used to gain some insight into the atmosphere's relative capability to disperse tracer material during downwind transport. These parameters are described in the Appendix.

INSTRUMENTATION

The data acquisition unit, consisting of a microprocessor-controlled data logger, signal conditioning circuitry, and digital magnetic tape cassette

recorder, was located near the base of each tower and was supplied with power from a solar collector/battery package. Table 1 is a list of variables monitored, equipment used, and locations on the tower. These variables were supplemented by calculation and recording of squares and cross-products of orthogonal wind components. Wind component variances and correlation coefficients between them were calculated and recorded as an aid in locating values that did not fall within credible limits. In addition, squares and cross-products of orthogonal wind components were used to compute along-wind and cross-wind Intensity of Turbulence, as described in the Appendix.

At each station, each of the 16 channels (12 shown in Table 1, plus four spares) was sampled at 2-second intervals, digitized, and accumulated over 20-minute periods. Wind direction and speed samples were converted to orthogonal (west to east, south to north) components, and data from each channel were averaged and recorded on cassette tapes at the end of each 20-minute period. Besides component squares and products, the maximum individual measured 2-second speed was also recorded for each level, making a total of 24 items recorded during each 20-minute time frame.

Full system calibrations were conducted at each site on a nominal six-month schedule. Transfer standards supplied by both EG&G Energy Measurement Group and Sandia were used to check each sensor channel from transducer to recording.

DATA EDITING, QUALITY CHECKING AND PROCESSING

Twenty minute average data on cassette tapes were transferred to a disk file at Sandia National Labs in Albuquerque for initial quality editing. Data were filtered using a computer algorithm that checked data values against credible limits, shown in Table 2. These limits were established using good meteorological practice and agreed to by both Sandia and DRI. In this process, data were either accepted, flagged for further inspection, or rejected.

After filtering, the 20-minute data were edited manually using the flag codes from the filtering process, as well as time series plots and station logs. Finally, computer tapes containing 20-minute data were shipped to the Desert Research Institute where hourly-average data lists were generated, manually reviewed for reasonableness, and used to prepare tabulated summaries. During this process, wind component data were used to generate vector wind speed and direction data, temperature data were used to prepare WT (10m-3m) data, and squares and cross-products of wind components were used to generate along- and cross-wind Intensities of Turbulence.

Tabulated summaries, including joint frequency distributions of wind speed and direction, are on microfiche contained in a pocket on the back cover of this report. Fully-edited hourly data may be made available to qualified users on 9-track magnetic tape.

DATA RECOVERY

YA Site

Tables 3 and 4 show the percent data recovery (percent of all possible hours for which valid data were recovered) for each parameter for each month at

Site YA. System data recovery (all monitored and calculated variables) was greater than 90% for all months except December, 1983 (77.3%) and July, 1984 (84.5%). System losses in these two months resulted from battery failure.

In addition to these system failures, periodic losses of data for individual variables occurred. Loss of atmospheric pressure data for October 17 through November 8, 1983 resulted from a defective pressure sensor. A loss of relative humidity data in January, 1984, caused by failure of the humidity element in the RH sensor, resulted in relative humidity data capture for that month of only 69.4%. Ground IR radiation data were lost between April 16 and May 9, 1984, as a result of electronic misalignment of the IR channel, which was corrected on May 9. All relative humidity data were deleted between July 2 and September 12, 1984 because of unreasonable (negative) values, a problem subsequently traced to a faulty element in the RH sensor. A new sensor was installed on September 12. It is suspected that the element was damaged by a power failure. Finally, atmospheric pressure data were lost from September 13 to 25, 1984 because of sensor failure, resulting in pressure data capture of 67-.5% for September.

YR Site

Tables 5 and 6 show the percent data recovery for each parameter for each month at site YR. System data recovery exceeded 95% for all months except July, 1983 (80.6%), when system losses resulted from battery failure and possible operator error.

Loss of ground IR radiation data from July 6 to 20, 1983 and from April 10 to 17, 1984 was caused by failure of the PIR (Precision Infrared) sensor battery. This resulted in IR data recovery of 53.6% for July, 1983 and 76.7% for April, 1984. Relative humidity data were lost from August 11 to October 11, 1983, from December 2 to 29, 1983, and from August 1 to September 12, 1984 because of sensor failure. This resulted in low relative humidity data recovery for the months of August and September, 1984. All soil temperature data were lost from April 17, 1984 until the end of the program in October, 1984 because of sensor failure.

WIND DIRECTION DATA AT YA SITE

Beginning December 14, 1983, and through August, 1984, discrepancies were noted between wind directions recorded at 10 m and at 3 m at the YA site. The discrepancy is ~ 30 to 35 degrees for northwest wind directions at 10 m and ~ 15 to 20 degrees for south wind directions at 10 m, with the 3 m wind direction being counterclockwise from the 10 m wind direction. Although the discrepancy may be partly attributable to terrain influences, a review of all wind data during periods of high average wind speeds indicated a possible error in the 3 m wind direction. These data were retained here; however, the user should be aware of this deficiency. After August, 1984, a smaller discrepancy of ~ 10 degrees was noted, with 3 m wind direction being clockwise from the 10 m wind direction.

TEMPERATURE DATA AT YR SITE

Between October 18 and December 22, 1983 and between December 22, 1983 and April 17, 1984, discrepancies were noted in temperature difference (<WT)

values at YR, suggesting that one of the two temperature (10 m or 3 m) measurements was in error. No errors were detected during any of the temperature sensor calibrations however, and it is suspected that the discrepancies in WT may be related to small non-linearities of the calibration curves for the individual temperature sensors. In any case, resulting errors were at most ± 2.0 C. Again, the data user should be aware of this deficiency in any detailed analysis involving these temperatures.

WINDROSES

Figures 2-33 present graphic windroses for the 10-metre level at each site for each month of the period. Directions indicated are the directions from which the wind was blowing. Windroses are shown for all hours and for night and day, to illustrate the diurnal wind pattern.

Tabulated wind frequency distributions for these windroses and for wind monitored at 3 metres at both sites are included on microfiche contained in an envelope at the back of this report.

DESCRIPTION OF TABULATED SUMMARIES

Tabulated data summaries are on microfiche contained in a pocket on the back cover of this report. These summaries were prepared by the Desert Research Institute and show, for each parameter, all of the 1-hour-average values and percent data capture for each month. Missing data are indicated by asterisks. "Hours" refers to sequential hour of the day, e.g., hour 1 is from 0000 to 0100 Pacific Standard Time. A discussion and equations for the wind components and their fluctuations are provided in the Appendix. A description of each summary page follows:

10-metre East-West (U1) Wind Component: Numbers shown are average values in tenths of metres per second, positive from west to east. Daily averages are shown along the right margins and averages for each hour of the day are shown at the bottom. The three highest values for the month are also shown.

10-metre North-South (V1) Wind Component: Same as U1, positive from south to north.

10-metre Vector Wind Speed: Values are in tenths of metres per second and were generated from U1 and V1 components. Calms are indicated by zeros. Daily and hourly averages are shown on the right margin and at the bottom respectively. The three highest values for the month are also shown.

10-metre Vector Wind Direction: Values are in degrees (clockwise from true north) and represent the direction from which the wind was blowing. These were generated from U1 and V1 components. Calms are indicated on these tabulations, and on accompanying microfiche and in hourly data files on magnetic tape, by zeros. Azimuths of due north are indicated by 360 degrees. Daily and hourly averages are shown on the right margin and at the bottom respectively.

10-metre Temperature: Values are in tenths of degrees Celsius. Daily high temperatures are shown on the right margin and monthly averages for hour-of-day are shown at the bottom. The three highest values for the month are also shown.

Soil Temperature: Values are in tenths of degrees Celsius. Daily and hour-of-day averages are shown on the right margin and bottom, respectively.

Barometric Pressure: Values are in tenths of a kPa (kilo-pascal, 1kPa = 10 mb). Daily averages and average by hour-of-day are also shown.

Total Solar Radiation: Values are in Watts/square metre. Daily highs and average by hour-of-day are also shown.

3-metre East-West (U2) Wind Component: Same as U1.

3-metre North-South (V2) Wind Component: Same as V1.

3-metre Vector Wind Speed: Same as 10-metre vector wind speed.

3-metre Vector Wind Direction: Same as 10-metre vector wind direction.

3-metre Temperature: Same as 10-metre temperature.

Precipitation: Values are in tenths of a millimetre. Daily totals and the highest hourly values are also shown.

Relative Humidity: Values are in tenths of percent. Daily and hour-of-day averages and three highest hourly values are also shown.

Ground IR Radiation: Values are in Watts/square metre. Daily and hour-of-day averages are also shown.

10-metre East-West Speed Squared: Values are in tenths of metres squared per second squared and are the averages of squares of instantaneous samples of east-west wind speeds, averaged over one hour. Daily high values and averages by hour-of-day are also shown.

10-metre North-South Speed Squared: Same as 10-metre east-west speed squared but for north-south instantaneous wind speed samples.

10-metre Speed Cross-Product: Values are in tenths of metres squared per second squared and are averages of the products of instantaneous samples of east-west (U1) and north-south (V1) wind speeds, averaged over one hour. Daily high values (absolute magnitude) and averages by hour-of day are also shown. Fields of dashes (----) for hourly averages shown in tabulations indicate negative values too long for the field. However, they are correct on the hourly data files on magnetic tape.

10-metre Maximum Speed: Values are in tenths of a metre per second and represent the maximum 2-second sample for the hour.

3-metre East-West Speed Squared: Same as 10-metre east-west speed squared.

3-metre North-South Speed Squared: Same as 10-metre north-south speed squared.

3-metre Speed Cross-Product: Same as 10-metre cross-product.

3-metre Maximum Speed: Same as 10-metre maximum speed.

10-metre Along-Wind Intensity of Turbulence: Values are in units of hundredths, (dimensionless) and are the along-wind components of intensity of turbulence (IA) as described in the Appendix. Asterisks represent hours of missing wind data or calms. In the latter case IA is undefined.

10-metre Cross-Wind Intensity of Turbulence: Values are in units of hundredths (dimensionless) and are the cross-wind components of intensity of turbulence (IC) as described in the Appendix. Asterisks represent hours of missing wind data or calms. In the latter case IC is undefined.

3-metre Along-Wind Intensity of Turbulence: Same as 10-metre Along-Wind Intensity of Turbulence.

3-metre Cross-Wind Intensity of Turbulence: Same as 10-metre Cross-Wind Intensity of Turbulence.

Temperature Gradient(WT): Values are in hundredths of degrees Celsius per metre and are based on the difference between the 10-metre and 3-metre average temperature for the hour (temperature at 10 metres minus temperature at 3 metres). Averages by hour-of-day are also shown.

Note: These temperature gradient values are not the same as the conventionally-defined WT values, which are usually recorded as a running relative difference of the instantaneous values rather than as an absolute difference between hourly averages. Analysis of the data editing time series plots showed that they are generally consistent, and can be used as qualitative indicators of low-level stability. As mentioned earlier, however, there were periods when some of the temperature difference data were suspect.

References:

Church, H. W., D. L. Freeman, K. Boro, R. T. Egami, 1984a, "Meteorological Tower Data for the Nevada Nuclear Waste Storage Investigations (NNWSI), Quarterly Report, July-September, 1982, Yucca Alluvial (YA) Site," SAND83-1912, Sandia National Laboratories, Albuquerque, NM.

Church, H. W., D. L. Freeman, K. Boro, R. T. Egami, 1984b, "Meteorological Tower Data for the Nevada Nuclear Waste Storage Investigations (NNWSI), Tri-Quarterly Report, October 1982-June 1983, Yucca Alluvial (YA) Site," SAND84-1327, Sandia National Laboratories, Albuquerque, NM.

Church, H. W., D. L. Freeman, K. Boro, R. T. Egami, 1986, "Meteorological Tower Data, Yucca Ridge (YR) Site, January-June 1983," SAND85-1053, Sandia National Laboratories, Albuquerque, NM.

APPENDIX A

CANDIDATE DATE FOR
THE REFERENCE INFORMATION BASE (RIB)

This report contains meteorological date that have not been interpreted. Hence, as such, the data are not candidate material for the RIB. No information was taken from or should be included in the RIB.

APPENDIX B

CANDIDATE DATE FOR THE SITE AND ENGINEERING PROPERTIES DATABASE (SEPDB)

This report contains meteorological data that are candidates for the SEPDB. These data are presented in microfiche form. Microfiche and sample hardcopy sheets were delivered to C. A. Rautman (SNL Org. 6315) on April 22, 1987.

The data are also available on magnetic tape, suitable for computer data processing. The data tapes are available from Hugh Church (SNL Org. 6321) upon request.

APPENDIX C

Calculation of Intensity of Turbulence

Beginning with July, 1983 data, turbulence information was extracted in the form of the Intensity of Turbulence, which Huschke (1959) defines as the ratio of the root-mean-square of the eddy velocities to the mean wind speed,

$$I_A = \frac{\overline{u'^2}^{1/2}}{W} \qquad (1)$$

$$I_C = \frac{\overline{v'^2}^{1/2}}{W} \qquad (2)$$

where u' and v' are the instantaneous along-wind and cross-wind components of the eddy velocity, respectively, W is the mean scalar wind speed, and IA and IC are the along-wind and cross-wind intensities of turbulence, respectively. The overbar denotes a time-average.

The eddy velocity is the difference between the mean velocity of fluid flow and the instantaneous velocity at a point. Thus, for the along-wind components,

$$u' = u - \bar{u} \qquad (3)$$

where u is the instantaneous along-wind velocity and u is the mean velocity. Taking the square and average of equation 3 gives

$$\overline{u'^2} = \overline{u^2} - \bar{u}^2 \qquad (4)$$

where, for N instantaneous measurements (i=1,2,...,N)

$$\overline{u^2} = \frac{1}{N} \sum_{i=1}^{N} u_i^2 \qquad (5)$$

and

$$\bar{u}^2 = \frac{1}{N} \sum_{i=1}^{N} u_i^2 \qquad (6)$$

From equation 4, note that $\overline{u'^2}$ is equivalent to the sample variance, given, for the along-wind component, by

$$\begin{aligned} \sigma_A^2 &= \frac{1}{N} \sum_{i=1}^{N} (u_i - \bar{u})^2 \\ &= \overline{u^2} - \bar{u}^2 \qquad (7) \\ &= \overline{u'^2} \end{aligned}$$

so that equation 1 can be written in terms of the standard deviation of the instantaneous along-wind velocity components, σ_A , as

$$I_A = \frac{\sigma_A}{W} \qquad (8)$$

Similarly, for the cross-wind component,

$$I_C = \frac{\sigma_C}{W} \qquad (9)$$

Each instantaneous wind direction and speed measurement at Yucca Mountain (YA and YR) was resolved into orthogonal east-west (u) and north-south (v) scalar components. The along-wind and cross-wind standards deviations (σ_A and σ_C) were therefore transposed from the east-west and north-south component standard deviations (σ_u and σ_v) for each 20 minute averaging interval. Denoting mean values of the squares and cross-products of instantaneous east-west (u_i) and north-south (v_i) wind speeds, taken at 2-second intervals, by

$$\overline{USQ} = \frac{1}{N} \sum_{i=1}^{N} u_i^2 \qquad (10)$$

$$\overline{VSQ} = \frac{1}{N} \sum_{i=1}^{N} v_i^2 \tag{11}$$

$$\overline{UV} = \frac{1}{N} \sum_{i=1}^{N} u_i v_i \tag{12}$$

and hourly mean east-west and north-south wind speeds U and V by

$$U = \frac{1}{N} \sum_{i=1}^{N} u_i \tag{13}$$

$$V = \frac{1}{N} \sum_{i=1}^{N} v_i \tag{14}$$

gives

$$\sigma_u^2 = \overline{USQ} - U^2 \tag{15}$$

$$\sigma_v^2 = \overline{VSQ} - V^2 \tag{16}$$

$$\sigma_{uv} = \overline{UV} - UV \tag{17}$$

$$\rho_{uv} = \sigma_{uv} / (\sigma_u^2 \, \sigma_v^2)^{1/2} \tag{18}$$

where σ_{uv} is the covariance and ρ_{uv} the correlation coefficient for wind speeds in the east-west and north-south directions. If these are uncorrelated, σ_{uv} and σ_{uv} will both be equal to zero. In the general case, with u and v correlated, σ_A and σ_C can be related to σ_u , σ_v , and σ_{uv} , by

$$\sigma_A^2 = (\sigma_u^2 U^2 + \sigma_v^2 V^2 + 2 UV \sigma_{uv}) / W^2 \tag{19}$$

$$\sigma_C^2 = (\sigma_u^2 V^2 + \sigma_v^2 U^2 - 2 UV \sigma_{uv}) / W^2 \qquad (20)$$

$$W^2 = U^2 + V^2 \qquad (21)$$

Along-wind and cross-wind intensities of turbulence (IA and IC) displayed in the attached summaries on microfiche were calculated by equations 8 and 9 with σ_A, σ_C, and W calculated using equations 19, 20, and 21.

Intensity of turbulence is useful in judging the rate at which tracer material is dispersed as downwind atmospheric transport occurs. However, the interpretation of IA and IC becomes uncertain as mean wind speed approaches zero. Thus, tabulated values larger than unity should be regarded with care.

Reference:

Huschke, R.E. 1959. Glossary of Meteorology, American Meteorological Society, Boston, Massachusetts. Third printing, 1980.

TABLE 1

Variables Monitored, Sensors Used, and Tower Locations

Variable	Height (m)	Manufacturer/Model
Wind Direction	10, 3	Weathermeasure/ W 104
Wind Speed	10, 3	Weathermeasure/ W 103
Barometric Pressure	3	Weathermeasure/ B 242
Temperature	10, 3	Weathermeasure/ TP20
Relative Humidity	3	Weathermeasure/HMP-14U
Solar Radiation	3	Eppley/ PSP
Ground IR Radiation	3	Eppley/ PIR
Precipitation	1	Weathermeasure/ P511E
Soil Temperature	-0.23	Weathermeasure/ TP20

Tower Coordinates, Alluvial Site

Tower Position:	Latitude 36' 50' 34" N Longitude 116' 25' 50" W
Nevada Grid Central Coordinates:	N 761794 feet E 569122 feet
Altitude:	3,751 feet MSL

Tower Coordinates, Ridge Site

Tower Position:	Latitude 36' 50' 51" N Longitude 116' 27' 51" W
Nevada Grid Central Coordinates:	N 763555 feet E 559238 feet
Altitude:	4,818 feet MSL

TABLE 2

Credible Limits Used for
Initial Data Filtering

Variable	Flag Limits	Discard Limits
Orthogonal Wind Components	-40 ; +40 m/s	-50 ; +50 m/s
Maximum Wind Speed	40 m/s	50 m/s
Temperature	-30 ; + 45 C	-50 ; +50 C
Soil Temperature	-10 ; + 35 C	-50 ; +50 C
Barometric Pressure	86.5 ; 90.5 kPa	80 ; 95 kPa
Solar Radiation	-15 ; 1350 W/m^2	-100 ; 1500 W/m^2
Precipitation	0 ; 1000mm/day	100 ; 2500mm/day
Relative Humidity	2 ; 100 %	-10 ; 110 %
Ground IR Radiation	200 ; 700 W/m^2	0 ; 1000 W/m^2
Wind Components Squared	0 ; 400 m^2/s^2	0 ; 1000 m^2/s^2
Cross Products	-400 ; 400 m^2/s^2	-1000 ; 1000 m^2/s^2
Absolute Values of Wind Components	-	< Maximum Speeds
Wind Component Variance	<zero	-
Correlation Coefficient, R	<-1; >+1	-

TABLE 3

Percent Data Recovery, Yucca Alluvial Site
July - December 1983

VARIABLE	JUL	AUG	SEP	OCT	NOV	DEC
Monitored Variables						
U1-10m	99.7	100.0	99.9	99.1	100.0	77.3
V1-10m	99.7	100.0	99.9	98.9	100.0	77.3
Temperature-10m	99.7	100.0	99.9	99.1	100.0	77.2
Soil Temperature	99.7	100.0	99.9	99.1	100.0	77.3
Pressure	99.7	100.0	99.9	53.1	75.1	77.3
Solar Radiation	99.7	100.0	99.9	99.1	100.0	77.0
U2-3m	99.7	100.0	99.9	99.1	100.0	77.3
V2-3m	99.7	100.0	99.9	99.1	100.0	77.3
Temperature-3m	99.7	100.0	99.6	99.1	100.0	77.2
Precipitation	99.6	100.0	99.6	98.7	99.9	77.0
Relative Humidity	99.7	99.9	99.6	99.1	100.0	77.3
Ground IR Radiation	99.7	100.0	99.9	99.1	100.0	77.3
Maximum Speed-10m	99.7	100.0	99.9	99.1	100.0	77.3
Maximum Speed-3m	99.7	100.0	99.9	99.1	100.0	77.3
Calculated Variables						
Vector Wind Speed-10m	99.7	100.0	99.9	98.9	100.0	77.3
Vector Wind Direction-10	99.7	100.0	99.9	98.9	100.0	77.3
Vector Wind Speed-3m	99.7	100.0	99.9	99.1	100.0	77.3
Vector Wind Direction-3m	99.7	100.0	99.9	99.1	100.0	77.3
Along-Wind Turbulence Intensity-10m	99.5	97.2	99.6	97.6	98.9	76.7
Cross-Wind Turbulence Intensity-10m	99.5	97.2	99.6	97.6	98.9	76.7
Along-Wind Turbulence Intensity-3m	98.9	96.8	99.0	97.2	97.8	76.2
Cross-Wind Turbulence Intensity-3m	98.9	96.8	99.0	97.2	97.8	76.2
Temperature Gradient	99.7	100.0	99.6	99.1	100.0	77.2

TABLE 4

Percent Data Recovery, Yucca Alluvial Site
January - October, 1984

VARIABLE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT[a]
Monitored Variables										
U1-10m	91.7	91.7	95.4	99.3	100.0	100.0	84.5	100.0	99.4	95.2
V1-10m	91.7	91.5	95.4	99.3	100.0	100.0	84.5	100.0	99.4	95.2
Temperature-10m	91.7	91.7	95.4	99.3	100.0	100.0	84.4	96.4	99.4	95.2
Soil Temperature	91.7	91.7	95.4	99.3	100.0	100.0	84.5	100.0	99.4	95.2
Pressure	91.7	91.7	95.4	99.3	100.0	100.0	84.5	92.7	67.5	95.2
Solar Radiation	91.7	91.7	95.4	99.3	100.0	100.0	84.5	100.0	99.4	95.2
U2-3m	91.7	91.7	95.4	99.3	100.0	100.0	84.4	100.0	99.4	95.2
V2-3m	91.7	91.7	95.3	99.3	100.0	100.0	84.5	100.0	99.4	95.2
Temperature-3m	91.7	91.7	95.4	99.3	100.0	100.0	84.4	100.0	99.3	95.2
Precipitation	91.3	91.7	95.2	99.0	100.0	100.0	84.1	99.9	99.4	95.2
Relative Humidity	69.4	91.7	95.4	99.3	100.0	100.0	6.0	0.0	58.9	95.2
Ground IR Radiation	91.7	91.7	95.4	51.8	72.6	100.0	81.3	100.0	99.4	95.2
Maximum Speed-10m	91.7	91.7	95.4	99.3	100.0	100.0	84.5	100.0	99.4	95.2
Maximum Speed-3m	91.7	91.7	95.4	99.3	100.0	100.0	84.5	100.0	99.4	95.2
Calculated Variables										
Vector Wind Speed-10m	91.7	91.5	95.4	99.3	100.0	100.0	84.5	100.0	99.4	95.2
Vector Wind Direction-10m	91.7	91.5	95.4	99.3	100.0	100.0	84.5	100.0	99.4	95.2
Vector Wind Speed-3m	91.7	91.7	95.3	99.3	100.0	100.0	84.4	100.0	99.4	95.2
Vector Wind Direction-3m	91.7	91.7	95.3	99.3	100.0	100.0	84.4	100.0	99.4	95.2
Along-Wind Turbulence Intensity-10m	91.0	90.5	94.8	98.1	99.3	98.2	81.3	95.8	97.2	92.9
Cross-wind Turbulence Intensity-10m	91.0	90.5	94.8	98.1	99.3	98.2	81.3	95.8	97.2	92.9
Along-Wind Turbulence Intensity-3m	90.7	90.8	94.8	98.2	98.0	95.6	77.0	90.1	94.7	89.0
Cross-Wind Turbulence Intensity-3m	90.7	90.8	94.8	98.2	98.0	95.6	77.0	90.1	94.7	89.0
Temperature Gradient	91.7	91.7	95.4	99.3	100.0	100.0	84.3	96.4	99.3	95.2

Station shut down on October 30.

TABLE 5

Percent Data Recovery, Yucca Ridge Site
July - December 1983

VARIABLE	JUL	AUG	SEP	OCT	NOV	DEC
Monitored Variables						
U1-10m	80.6	100.0	100.0	98.8	99.7	99.7
V1-10m	80.6	100.0	100.0	98.8	99.7	99.7
Temperature-10m	80.6	100.0	100.0	98.8	99.7	99.7
Soil Temperature	80.6	100.0	100.0	98.8	99.7	99.7
Pressure	80.6	100.0	100.0	98.8	99.7	99.7
Solar Radiation	80.6	100.0	100.0	70.0	99.7	99.7
U2-3m	80.6	100.0	100.0	98.8	99.7	99.7
V2-3m	80.6	100.0	100.0	98.8	99.7	99.7
Temperature-3m	80.6	100.0	100.0	98.8	99.7	99.7
Precipitation	80.5	99.9	100.0	98.3	99.4	99.2
Relative Humidity	80.6	33.5	0.0	65.2	99.7	12.9
Ground IR Radiation	53.6	100.0	100.0	98.8	99.7	99.7
Maximum Speed-10m	80.6	100.0	100.0	98.8	99.7	99.7
Maximum Speed-3m	80.6	100.0	100.0	98.8	99.7	99.7
Calculated Variables						
Vector Wind Speed-10m	80.6	100.0	100.0	98.8	99.7	99.7
Vector Wind Direction-10	80.6	100.0	100.0	98.8	99.7	99.7
Vector Wind Speed-3m	80.6	100.0	100.0	98.8	99.7	99.7
Vector Wind Direction-3m	80.6	100.0	100.0	98.8	99.7	99.7
Along-Wind Turbulence Intensity-10m	80.2	98.9	98.8	96.9	98.5	98.3
Cross-Wind Turbulence Intensity-10m	80.2	98.9	98.8	96.9	98.5	98.3
Along-Wind Turbulence Intensity-3m	79.4	98.4	98.1	95.2	98.2	98.5
Cross-Wind Turbulence Intensity-3m	79.4	98.4	98.1	95.2	98.2	98.5
Temperature Gradient	80.6	100.0	100.0	98.8	99.7	99.7

TABLE 6

Percent Data Recovery, Yucca Ridge Site
January - October, 1984

VARIABLE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT[a]
Monitored Variables										
U1-10m	99.7	100.0	99.9	99.2	99.9	99.9	100.0	99.3	100.0	94.8
V1-10m	99.7	100.0	99.9	99.2	99.9	99.9	100.0	99.5	100.0	94.8
Temperature-10m	99.7	100.0	99.9	99.2	99.9	100.0	100.0	99.5	100.0	94.8
Soil Temperature	99.7	100.0	99.9	54.6	0.0	0.0	0.0	0.0	0.0	0.0
Pressure	99.7	100.0	99.9	99.2	99.9	100.0	100.0	99.5	100.0	94.8
Solar Radiation	99.7	100.0	99.9	99.2	99.9	100.0	100.0	99.5	100.0	94.8
U2-3m	99.7	100.0	99.9	99.2	99.9	100.0	100.0	99.5	100.0	94.8
V2-3m	99.7	100.0	99.9	99.2	99.9	100.0	100.0	99.5	100.0	94.8
Temperature-3m	99.7	100.0	99.9	99.2	99.9	100.0	99.7	99.5	100.0	94.8
Precipitation	99.1	99.7	99.6	98.3	99.6	99.9	99.9	99.2	99.9	94.5
Relative Humidity	99.7	100.0	99.9	99.2	99.9	100.0	99.1	0.0	61.8	94.8
Ground IR Radiation	99.7	100.0	99.9	76.7	99.7	100.0	100.0	99.5	100.0	94.8
Maximum Speed-10m	99.7	100.0	99.9	99.2	99.9	100.0	100.0	99.5	100.0	94.8
Maximum Speed-3m	99.7	100.0	99.9	99.2	99.9	100.0	100.0	99.5	100.0	94.8
Calculated Variables										
Vector Wind Speed-10m	99.7	100.0	99.9	99.2	99.9	99.9	100.0	99.3	100.0	94.8
Vector Wind Direction-10m	99.7	100.0	99.9	99.2	99.9	99.9	100.0	99.3	100.0	94.8
Vector Wind Speed-3m	99.7	100.0	99.9	99.2	99.9	100.0	100.0	99.5	100.0	94.8
Vector Wind Direction-3m	99.7	100.0	99.9	99.2	99.9	100.0	100.0	99.5	100.0	94.8
Along-Wind Turbulence Intensity-10m	97.4	98.4	98.5	98.3	99.3	98.9	98.0	96.4	97.4	92.1
Cross-wind Turbulence Intensity-10m	97.4	98.4	98.5	98.3	99.3	98.9	98.0	96.4	97.4	92.1
Along-Wind Turbulence Intensity-3m	98.3	98.1	98.1	97.9	99.3	99.3	98.3	95.6	96.3	91.4
Cross-Wind Turbulence Intensity-3m	98.3	98.1	98.1	97.9	99.3	99.3	98.3	95.6	96.3	91.4
Temperature Gradient	99.7	100.0	99.9	99.2	99.9	100.0	99.7	99.5	100.0	94.8

[a]Station shut down on October 30.

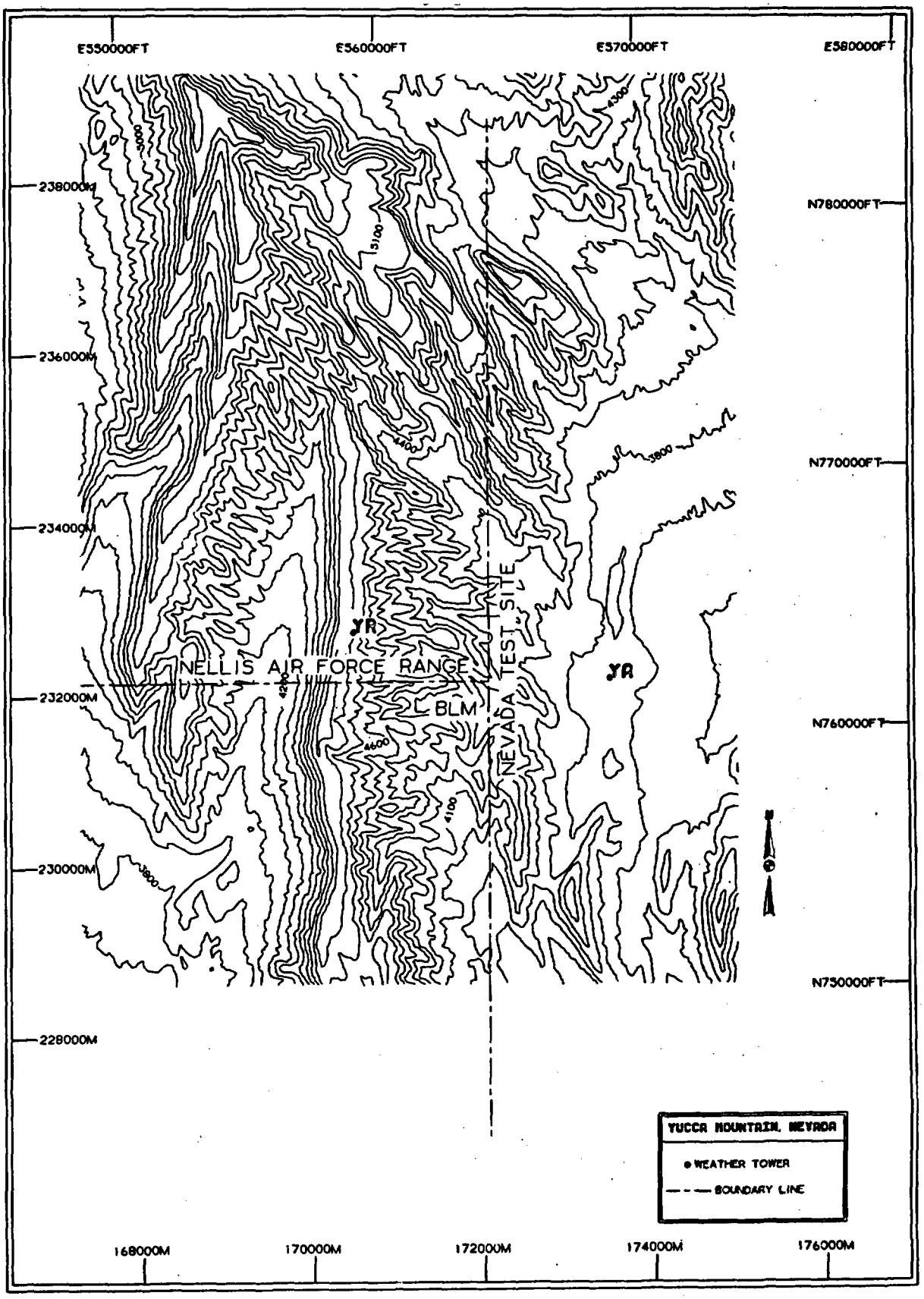


FIGURE 1. Yucca Mountain Contour Map, and Meteorological Tower Locations

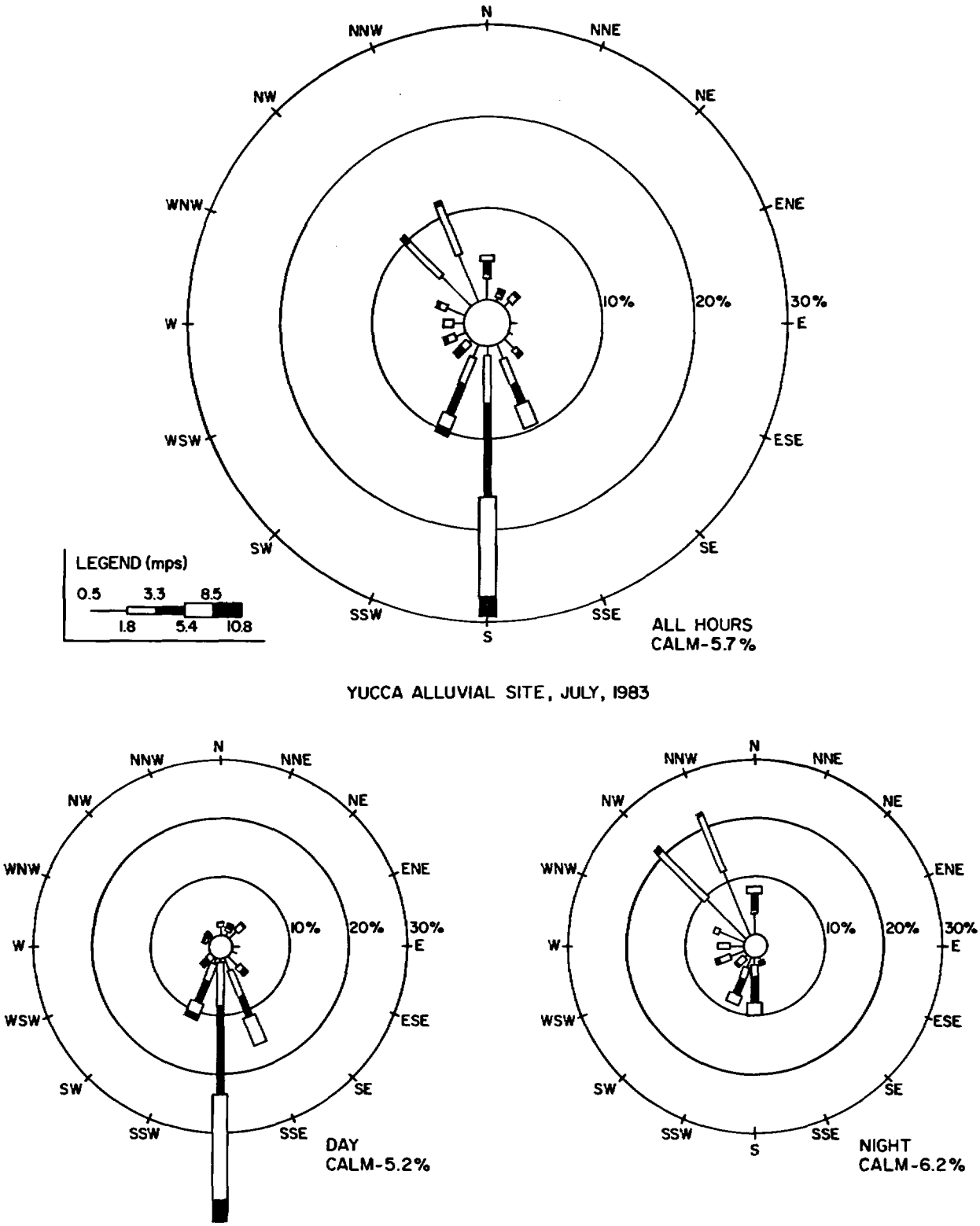
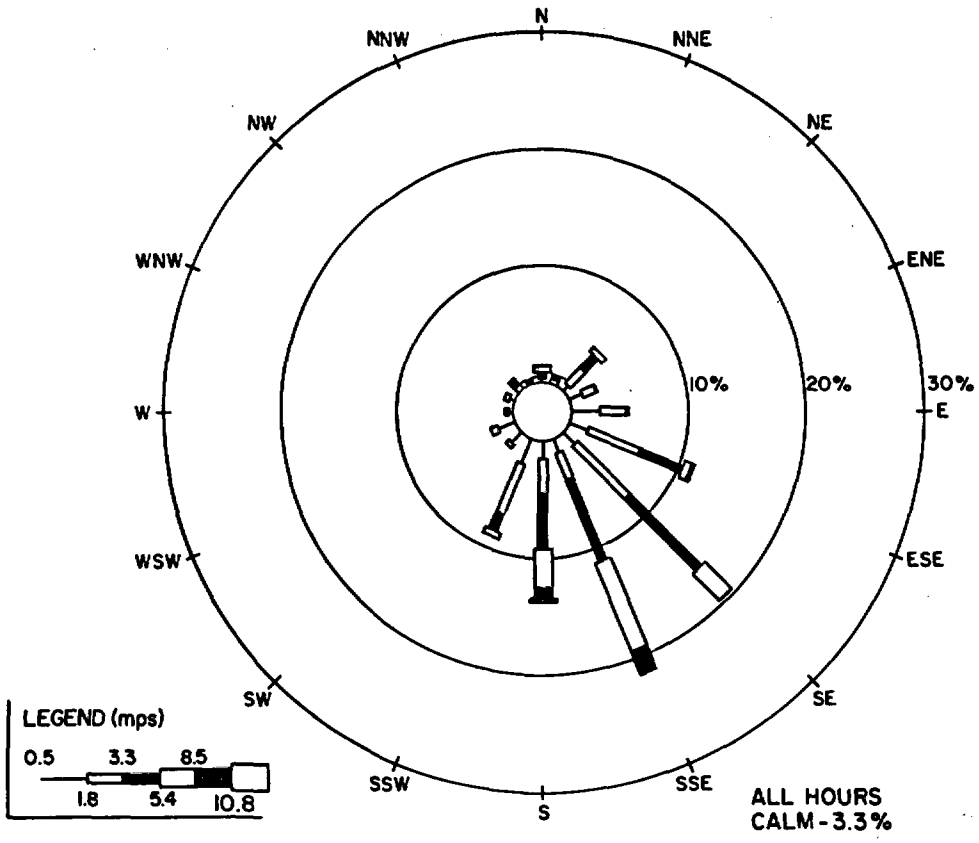
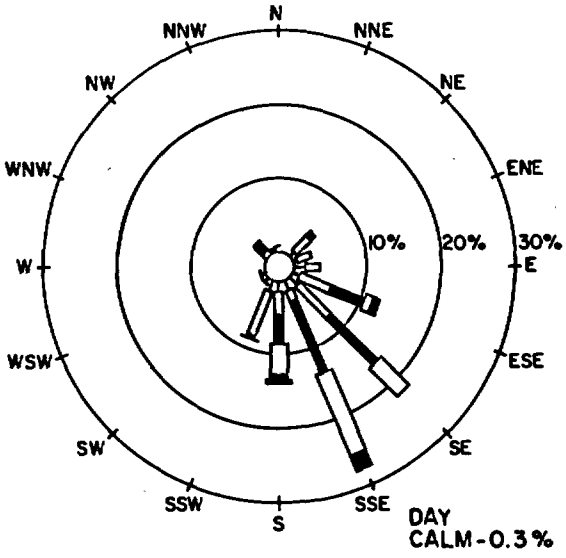


FIGURE 2. Windrose for 10 m Height, Yucca Mountain Alluvial Site, July, 1983



YUCCA RIDGE SITE, JULY, 1983



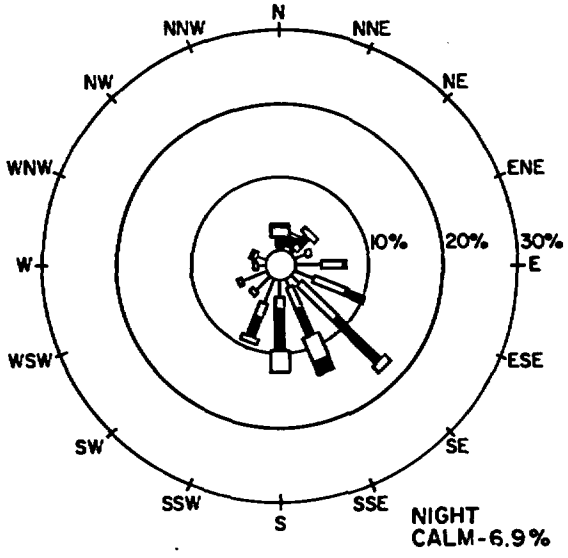


FIGURE 3. Windrose for 10 m Height, Yucca Mountain Ridge Site, July, 1983

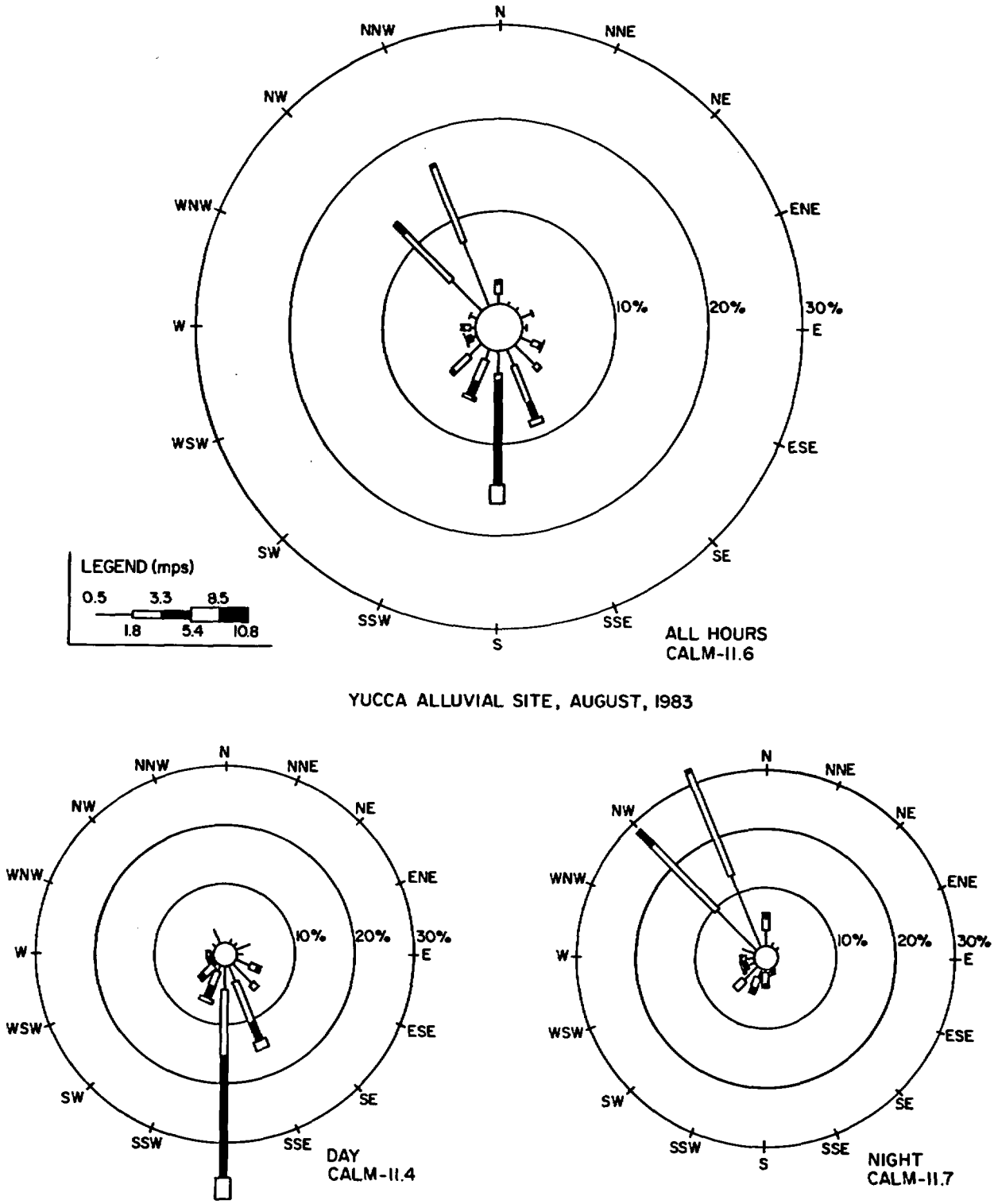
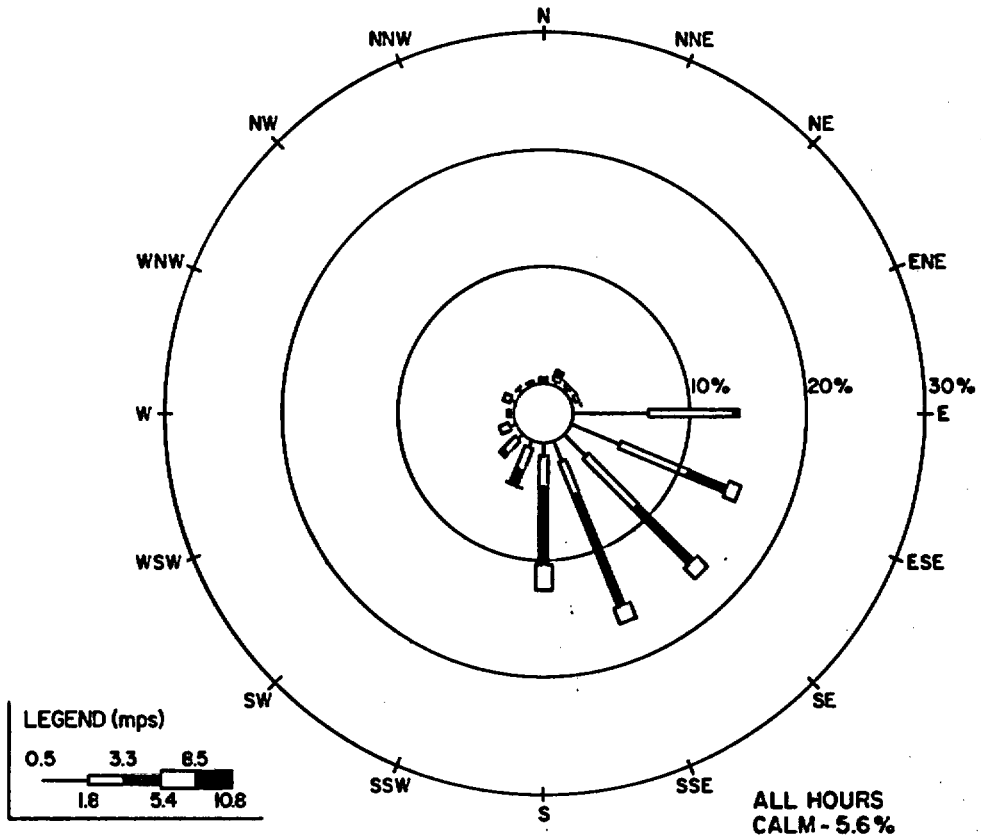
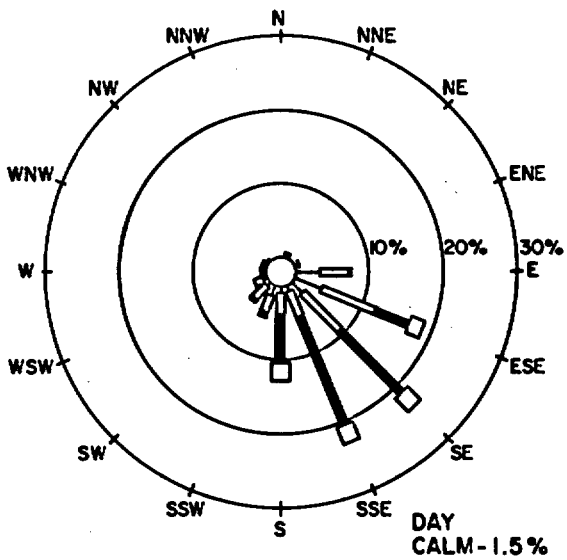


FIGURE 4. Windrose for 10 m Height, Yucca Mountain Alluvial Site, August, 1983



YUCCA RIDGE SITE, AUGUST, 1983



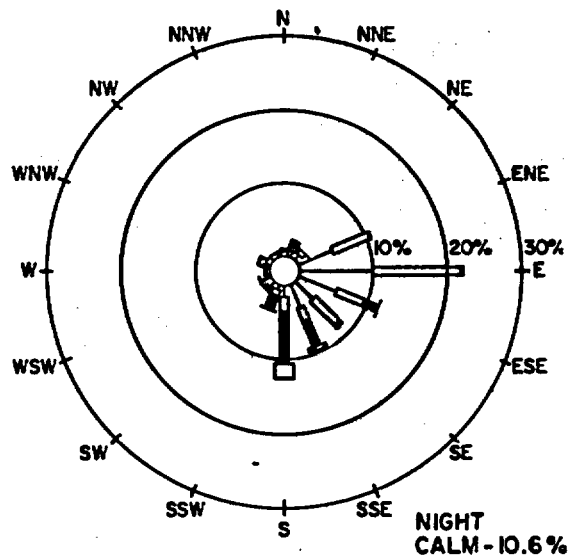


FIGURE 5. Windrose for 10 m Height, Yucca Mountain Ridge Site, August, 1983

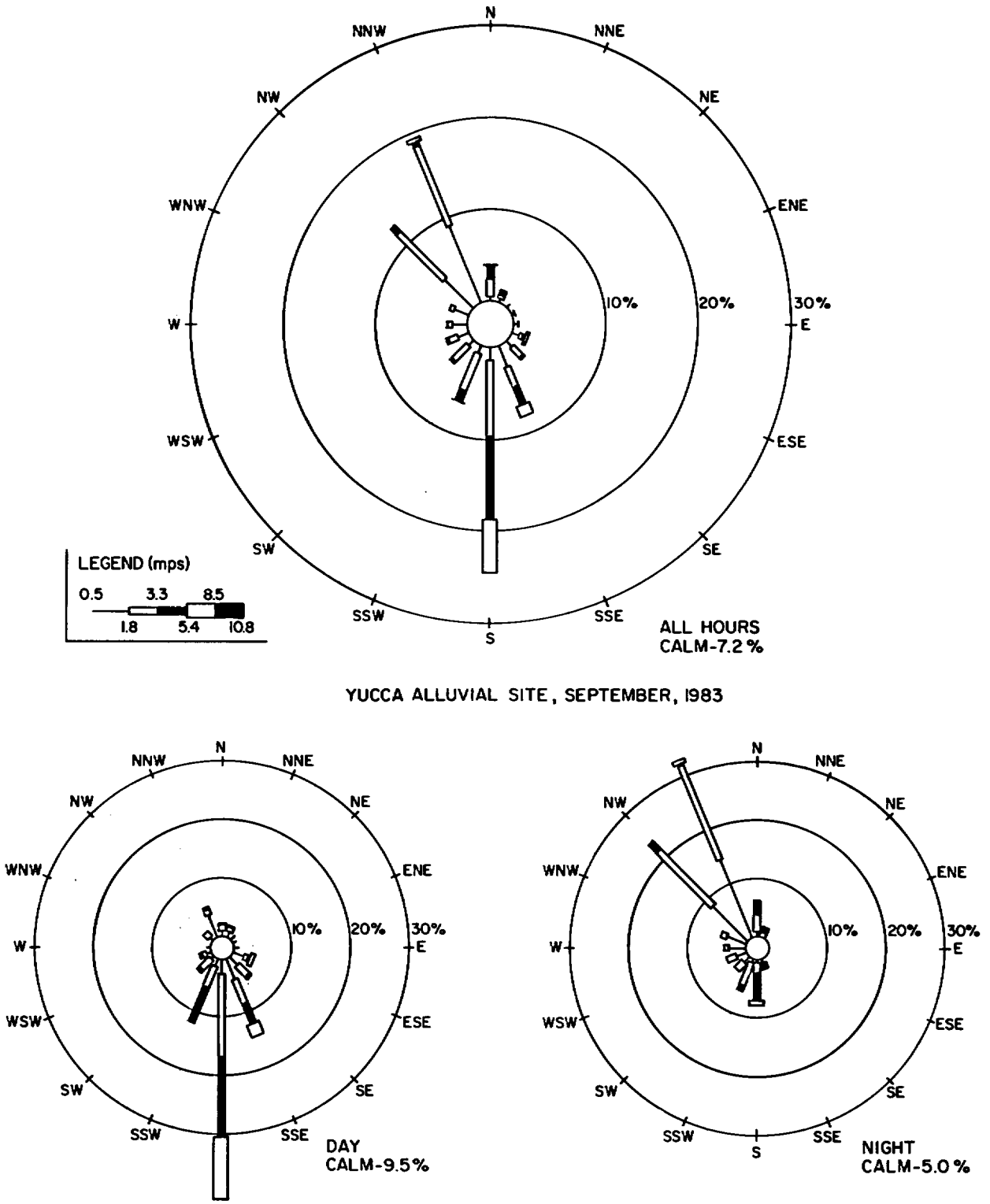


FIGURE 6. Windrose for 10 m Height, Yucca Mountain Alluvial Site, September, 1983

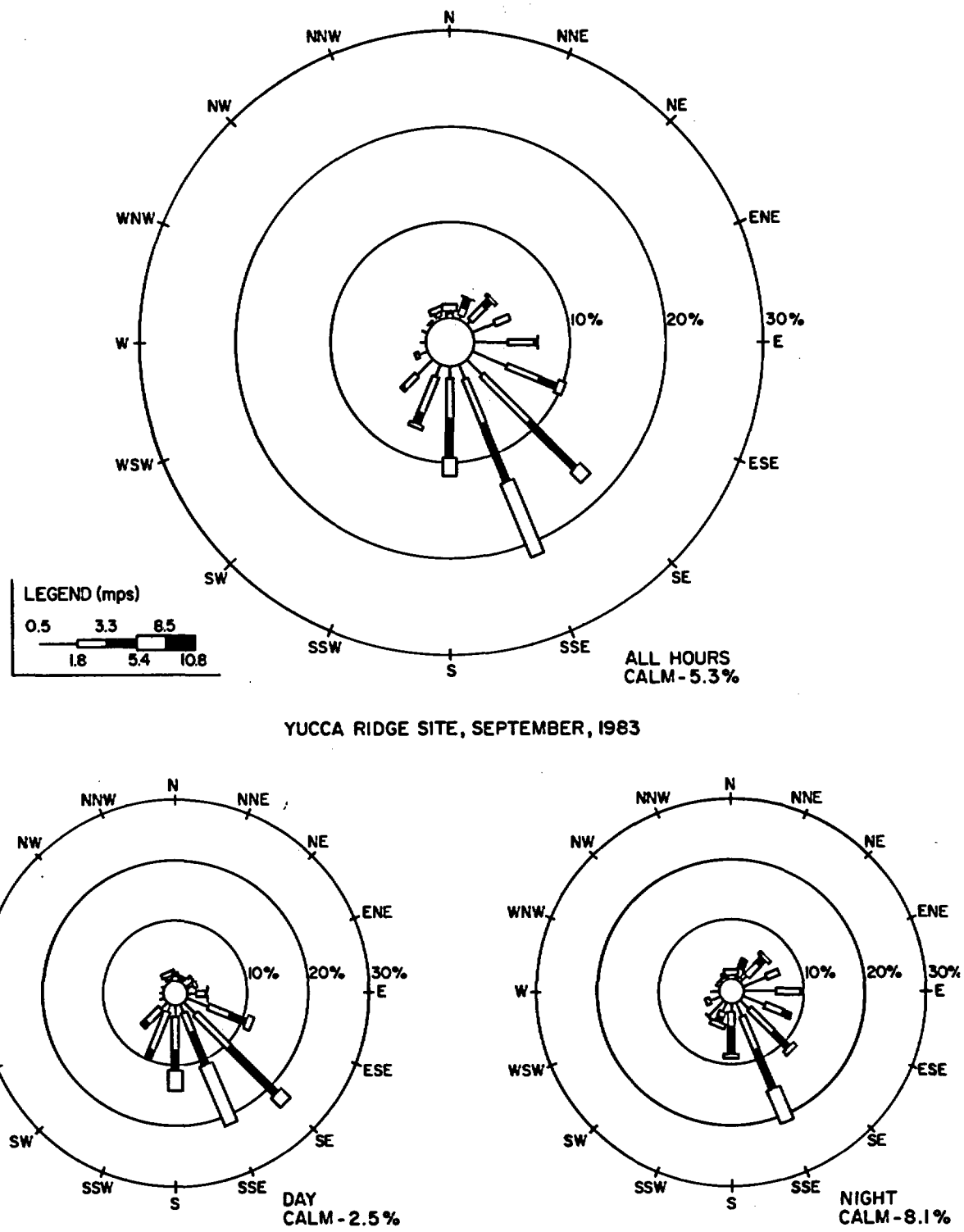


FIGURE 7. Windrose for 10 m Height, Yucca Mountain Ridge Site, September, 1983

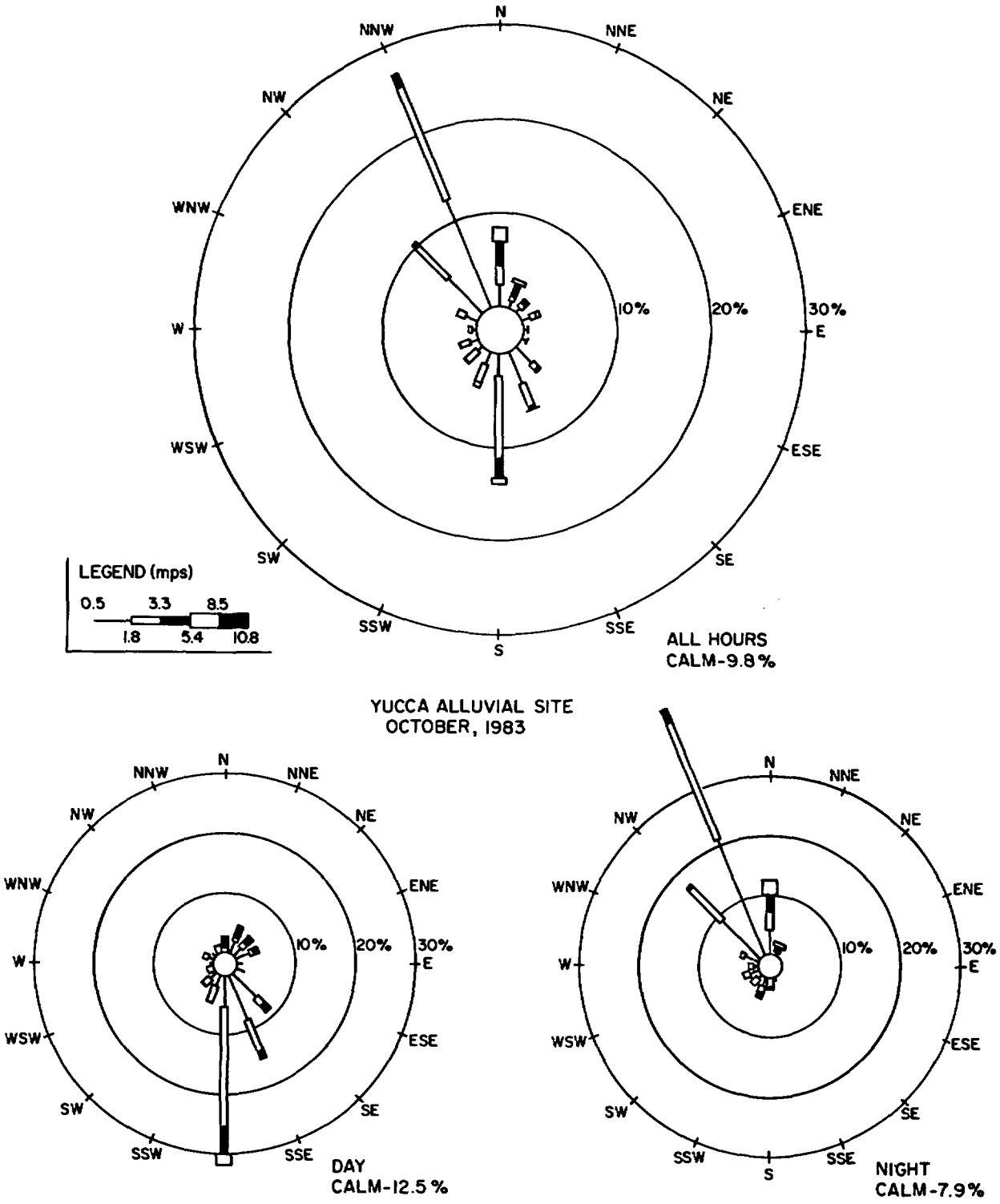


FIGURE 8. Windrose for 10 m Height, Yucca Mountain Alluvial Site, October, 1983

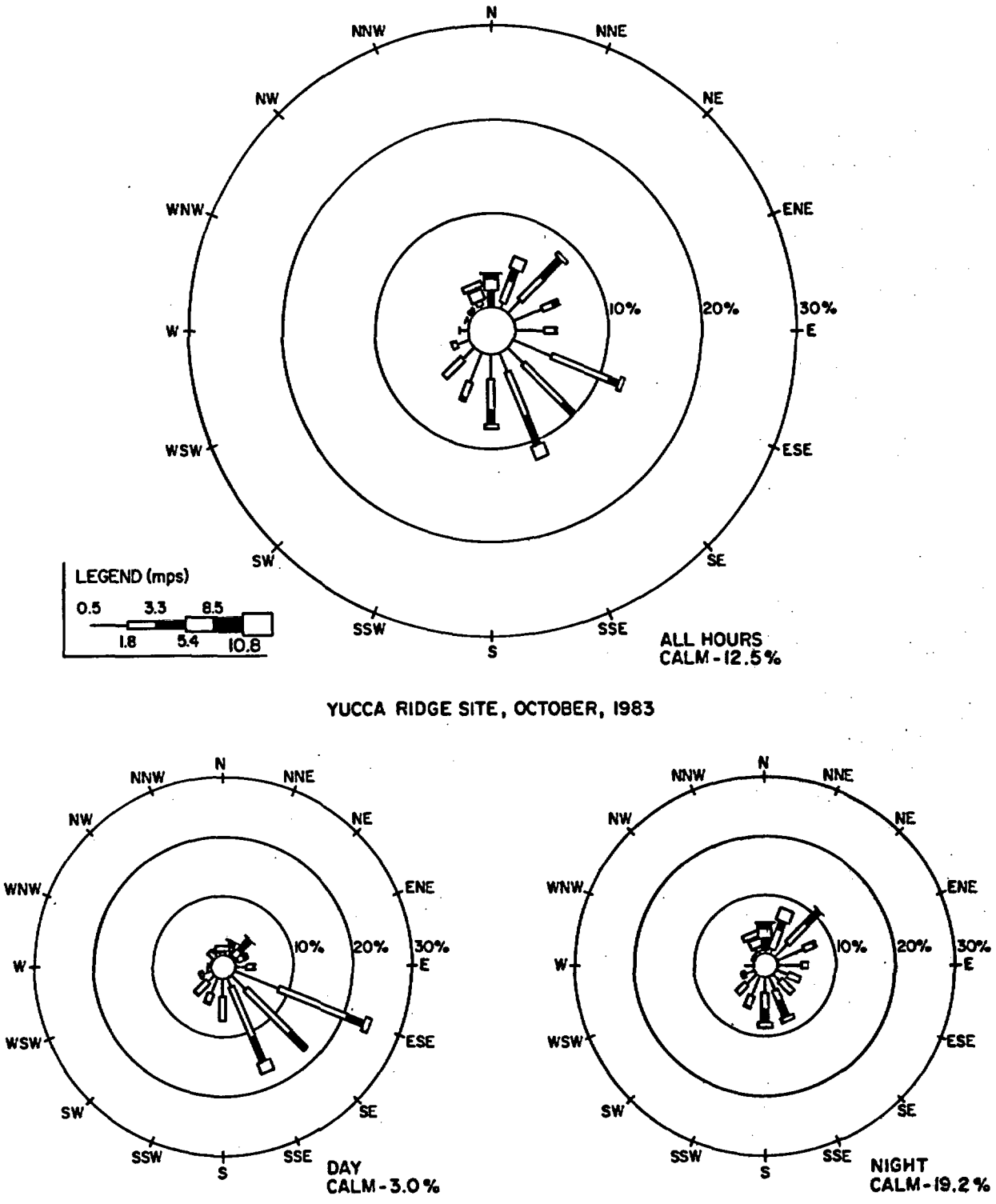


FIGURE 9. Windrose for 10 m Height, Yucca Mountain Ridge Site, October, 1983

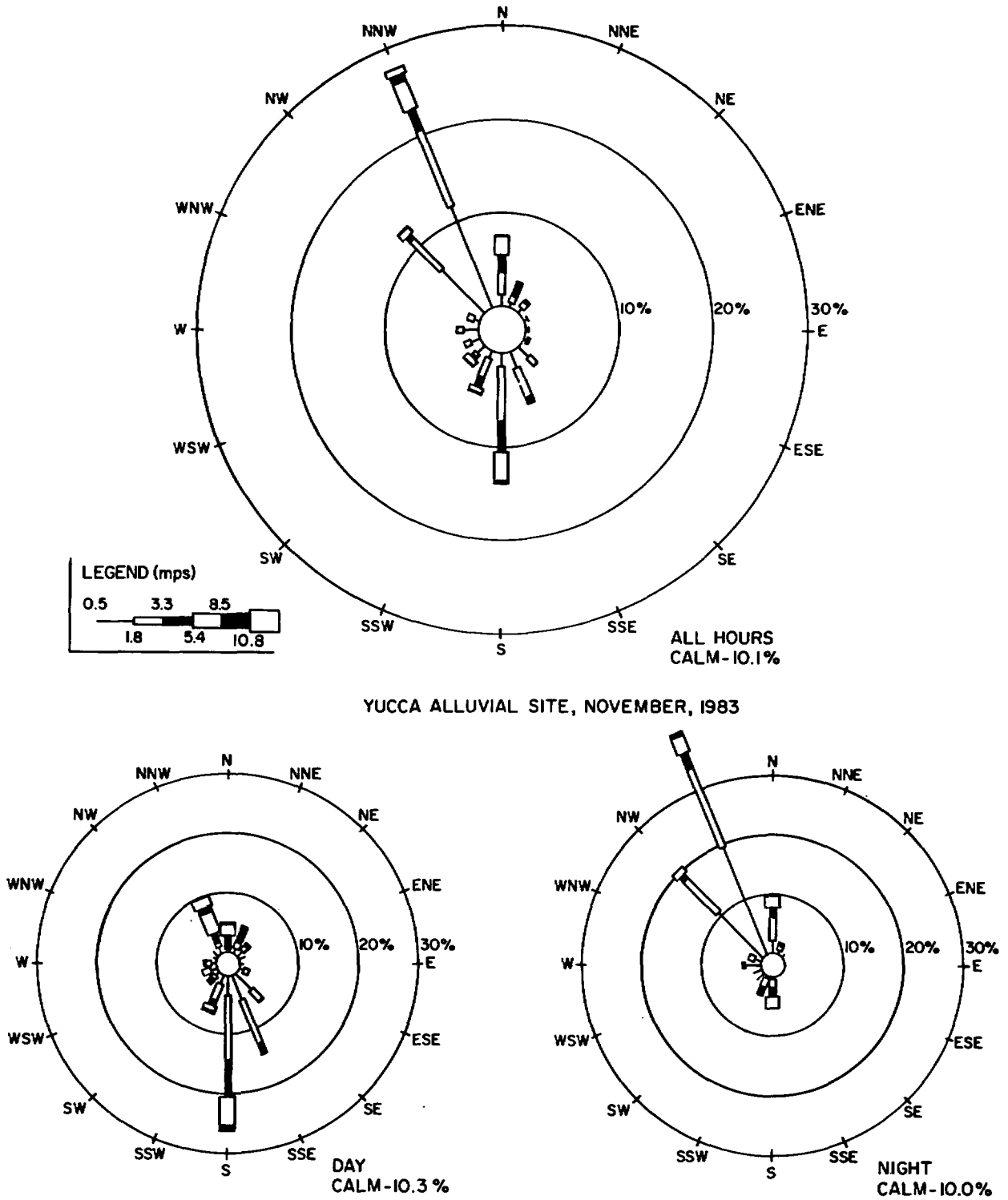
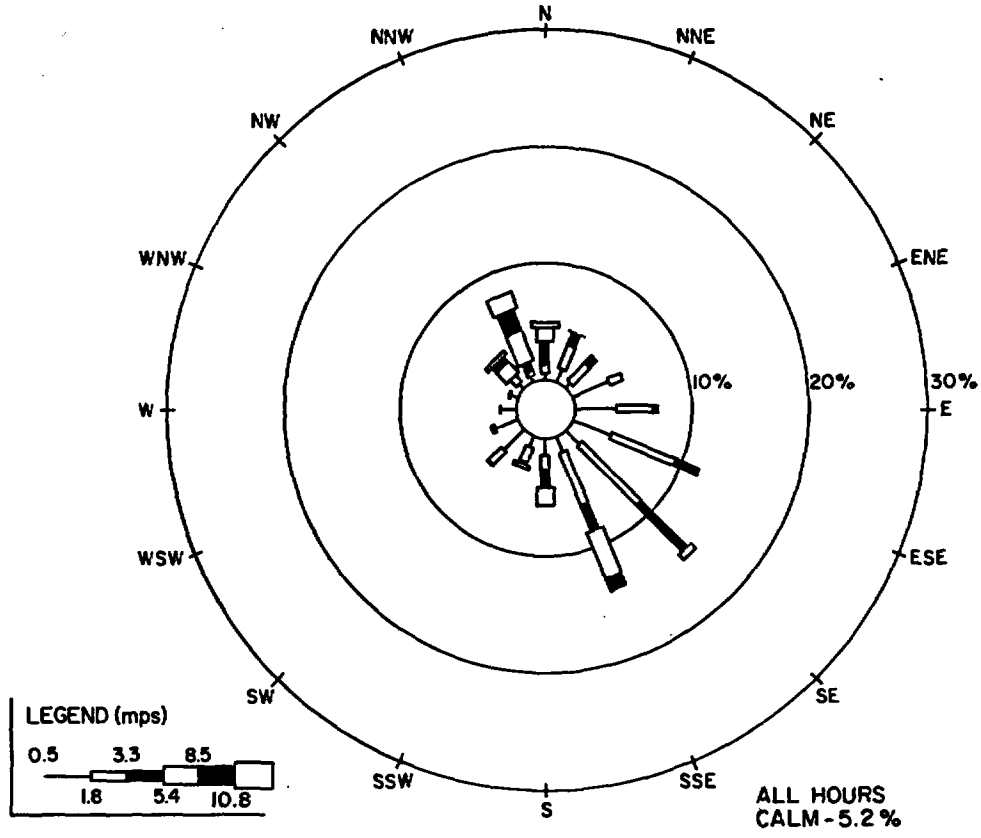
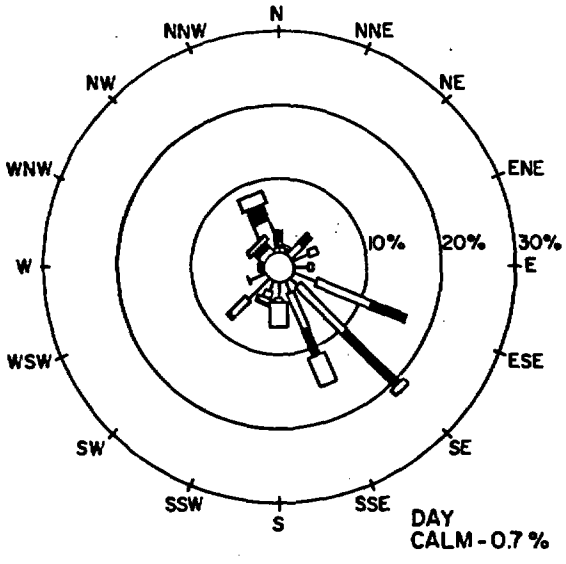


FIGURE 10. Windrose for 10 m Height, Yucca Mountain Alluvial Site, November, 1983



YUCCA RIDGE SITE, NOVEMBER, 1983



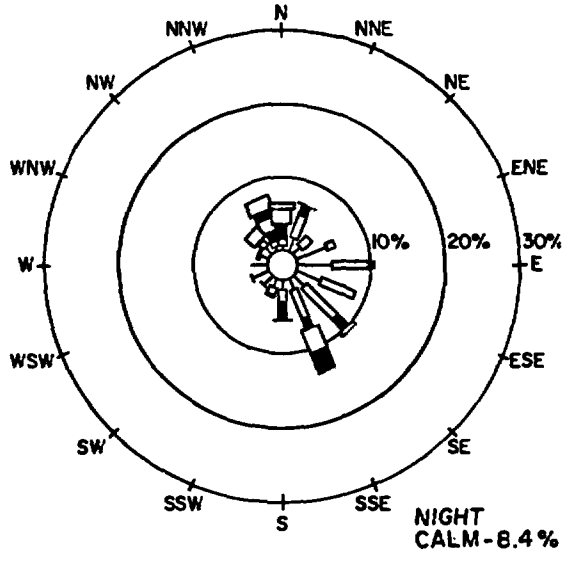


FIGURE 11. Windrose for 10 m Height, Yucca Mountain Ridge Site, November, 1983

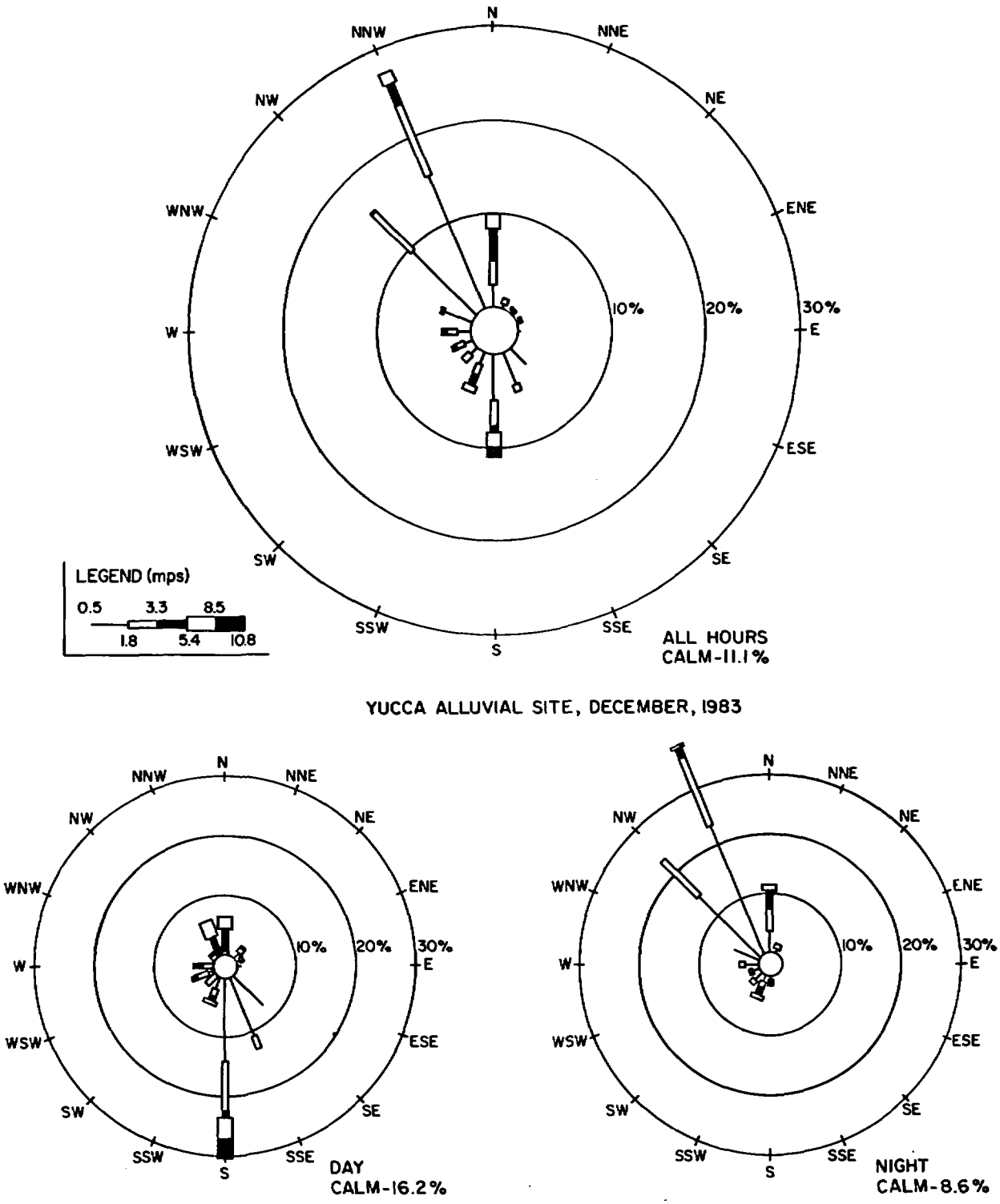


FIGURE 12. Windrose for 10 m Height, Yucca Mountain Alluvial Site, December, 1983

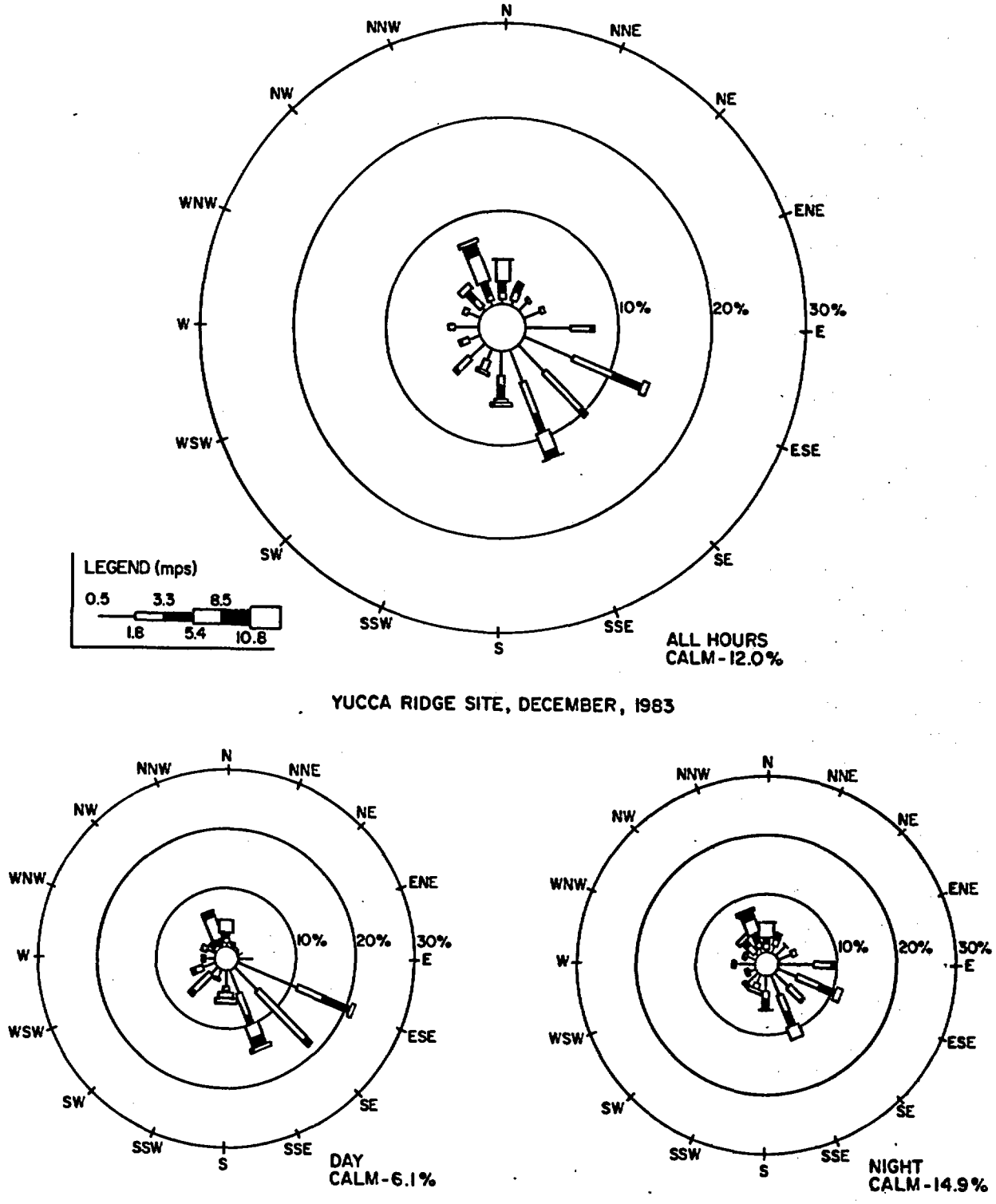


FIGURE 13. Windrose for 10 m Height, Yucca Mountain Ridge Site, December, 1983

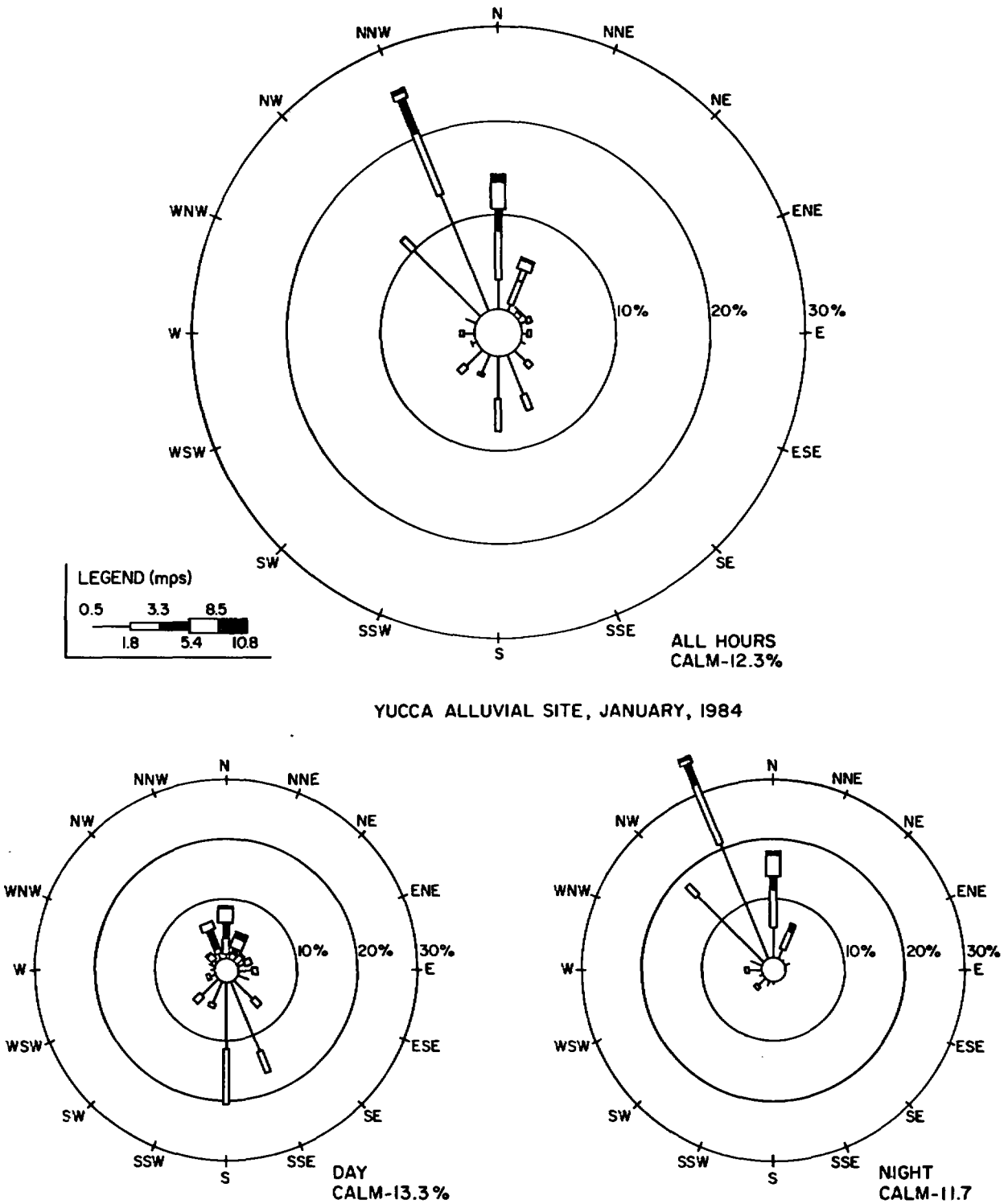


FIGURE 14. Windrose for 10 m Height, Yucca Mountain Alluvial Site, January, 1984

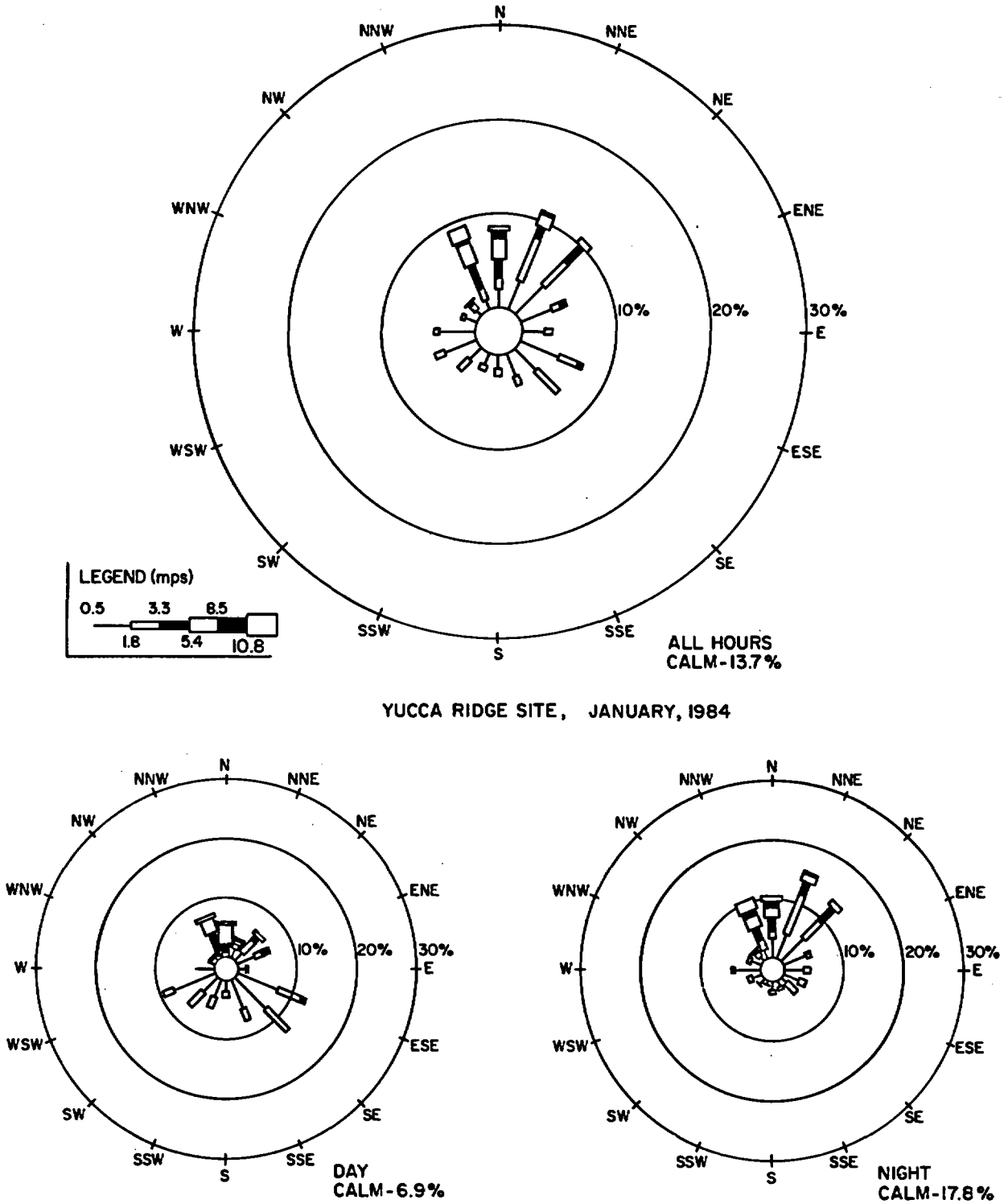


FIGURE 15. Windrose for 10 m Height, Yucca Mountain Ridge Site, January, 1984

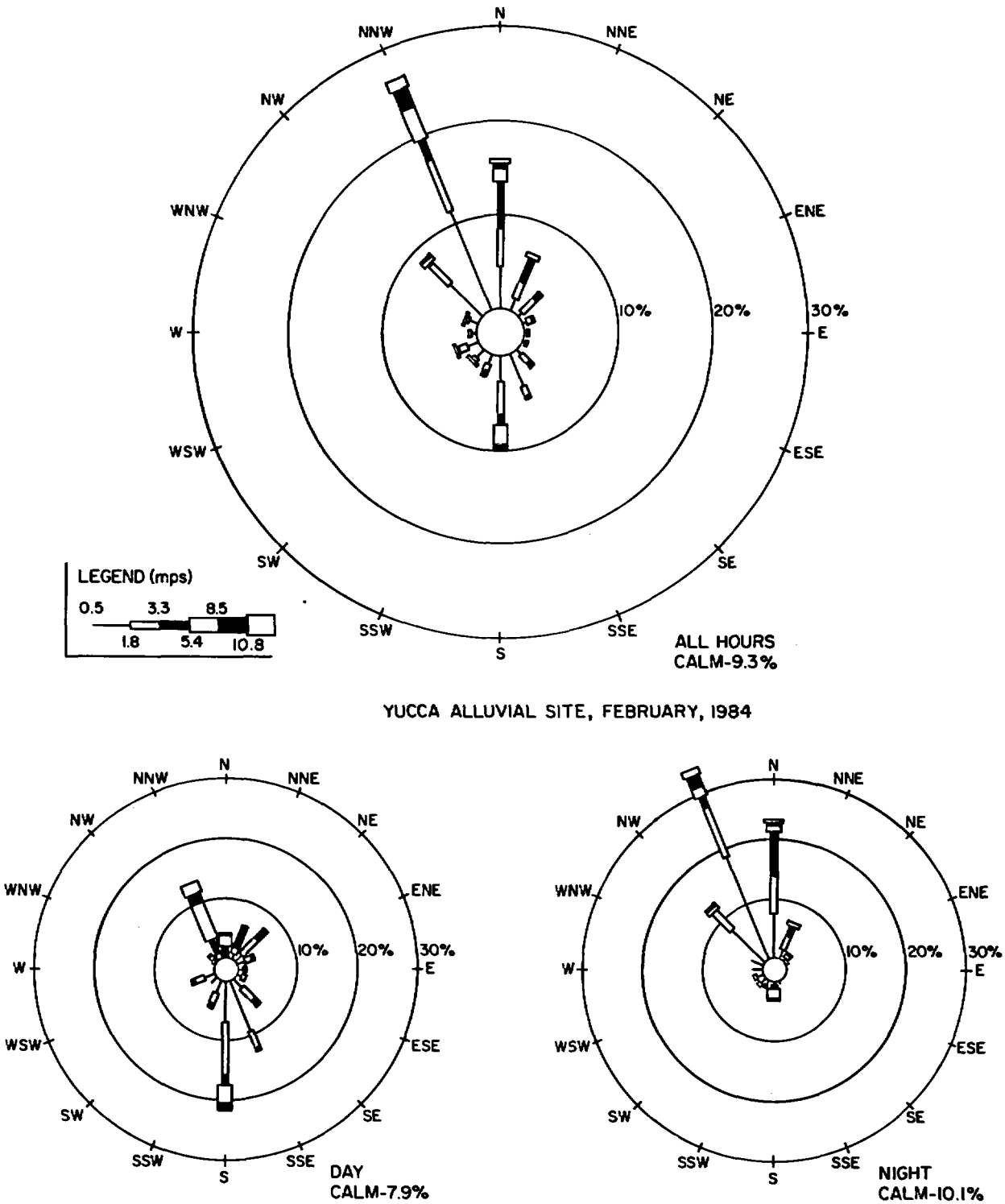


FIGURE 16. Windrose for 10 m Height, Yucca Mountain Alluvial Site, February, 1984

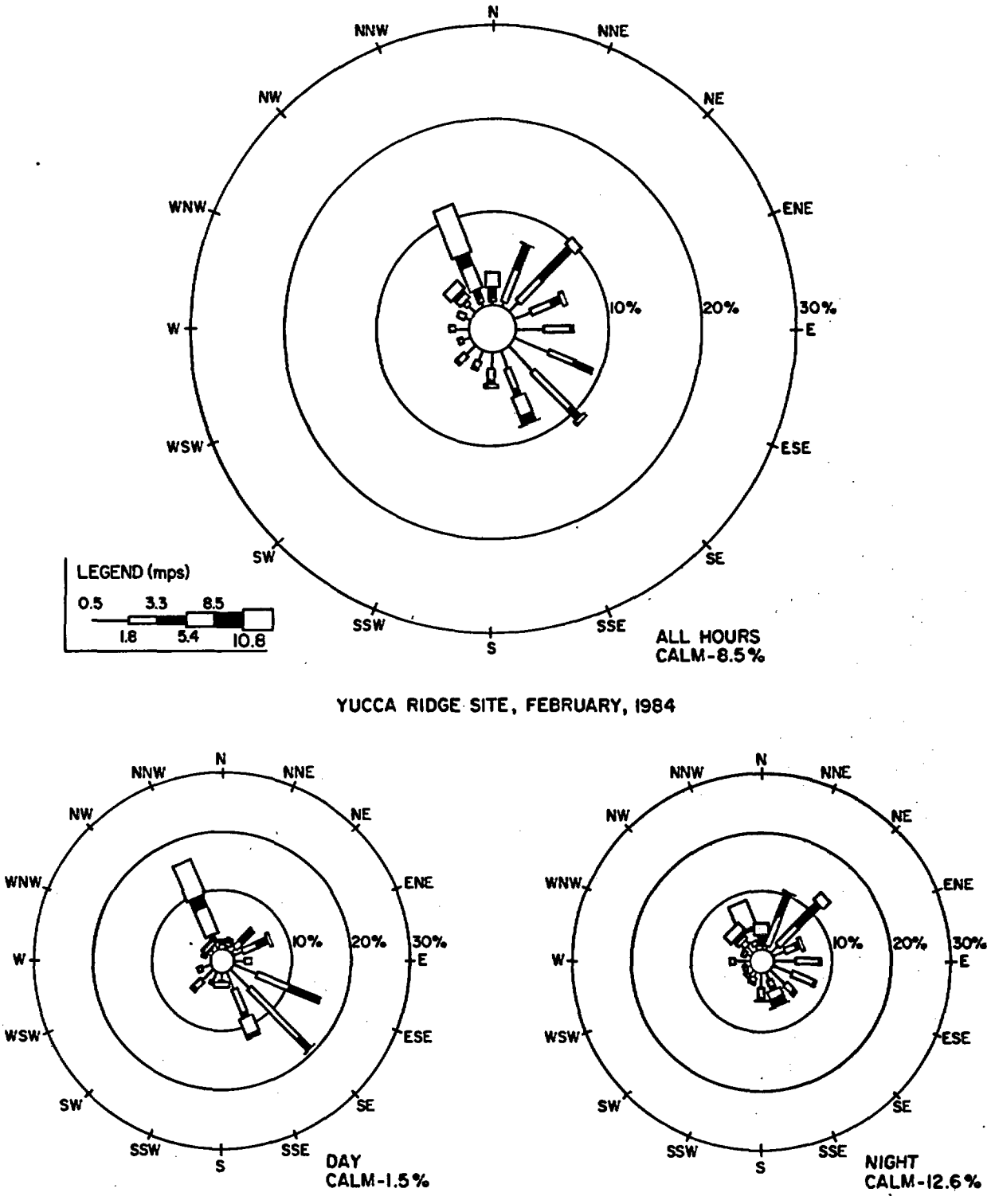


FIGURE 17. Windrose for 10 m Height, Yucca Mountain Ridge Site, February, 1984

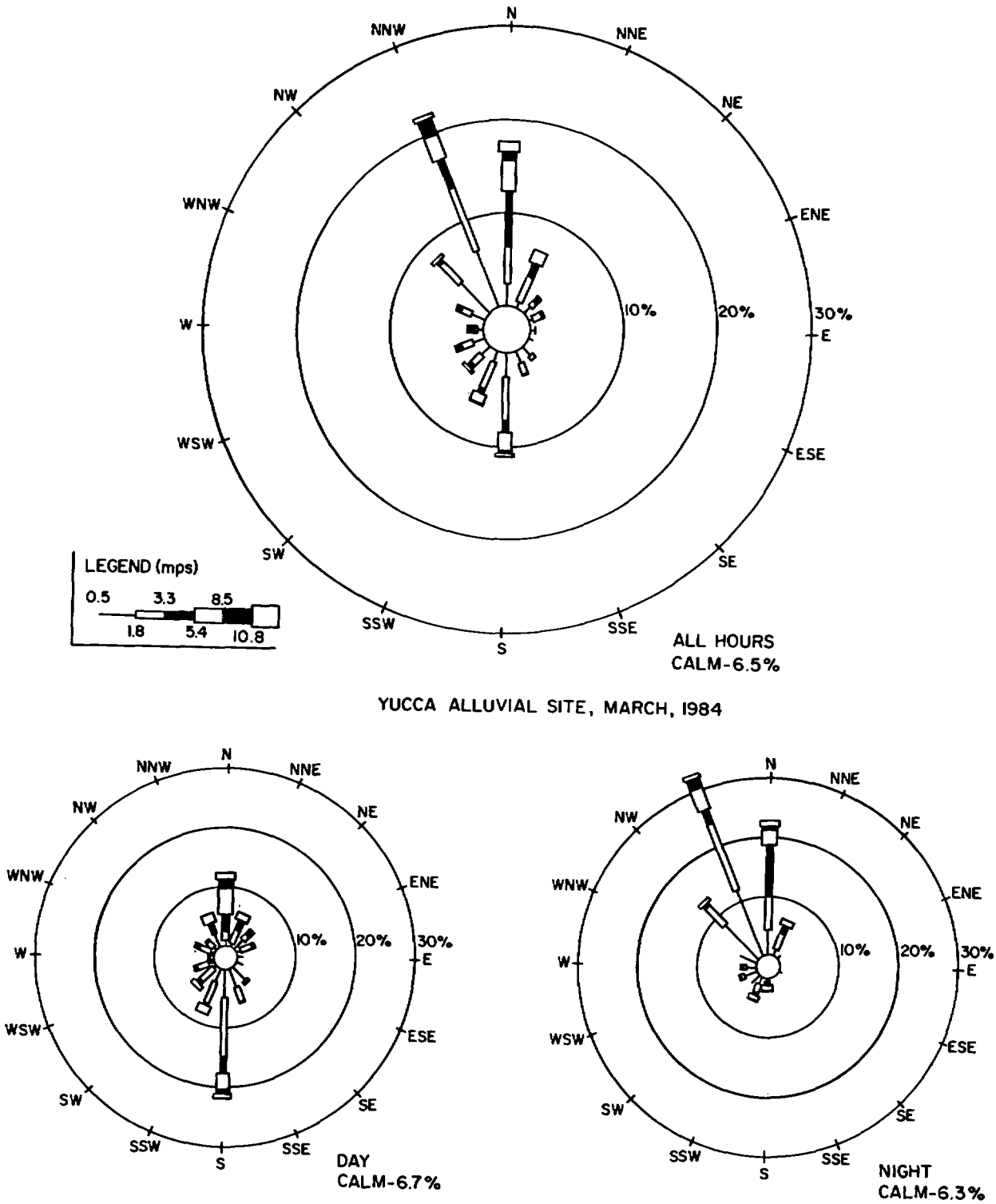


FIGURE 18. Windrose for 10 m Height, Yucca Mountain Alluvial Site, March, 1984

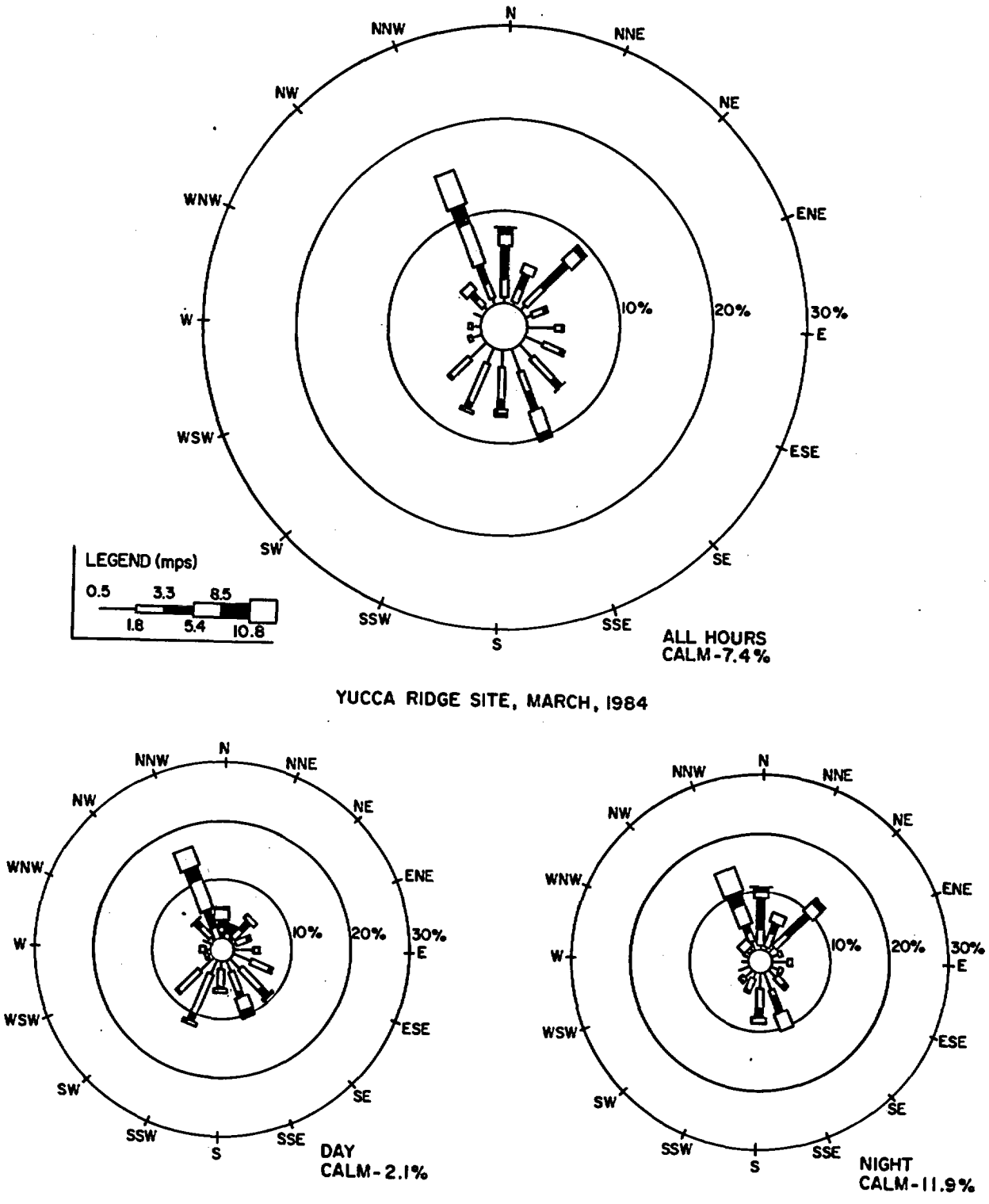


FIGURE 19. Windrose for 10 m Height, Yucca Mountain Ridge Site, March, 1984

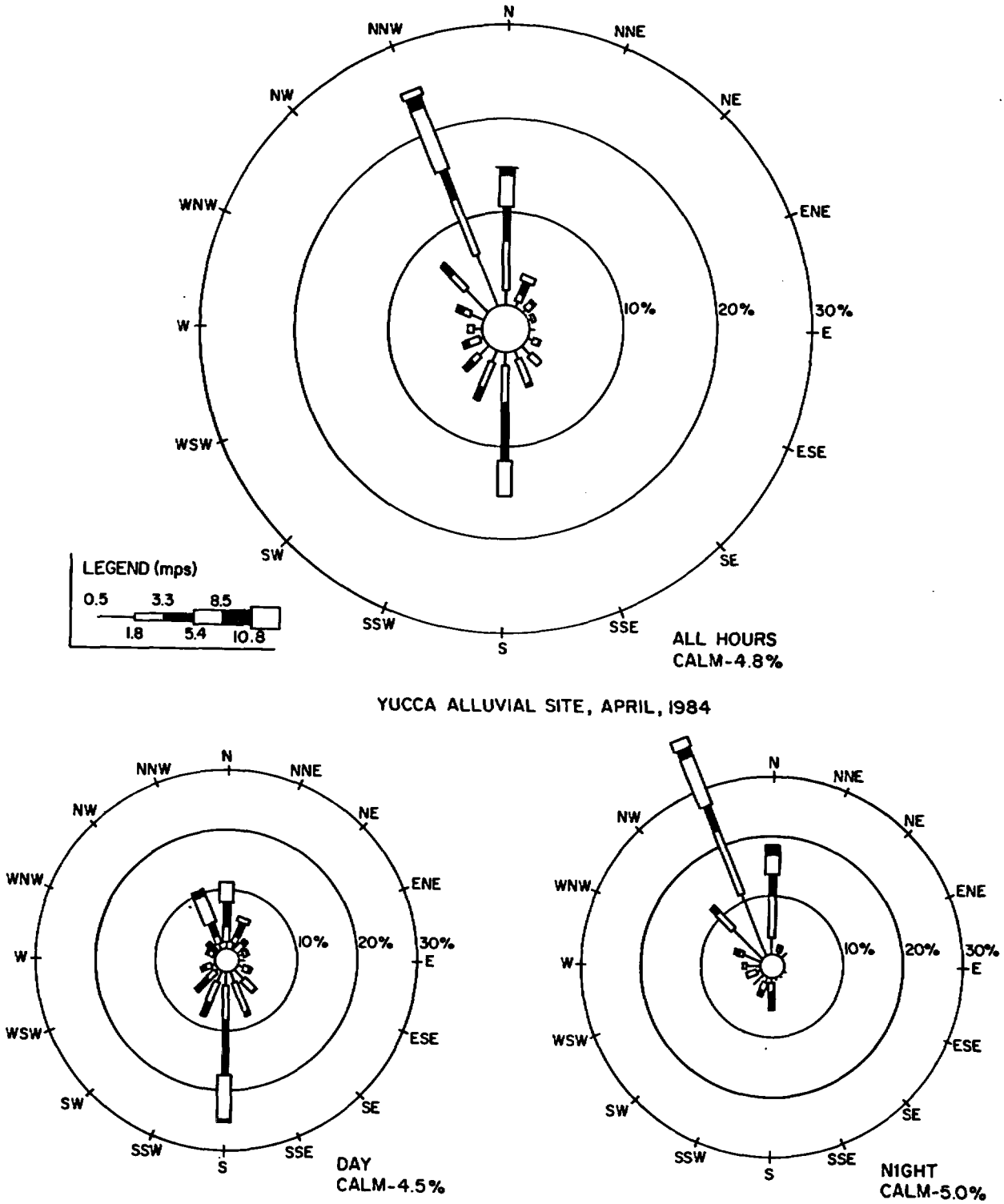


FIGURE 20. Windrose for 10 m Height, Yucca Mountain Alluvial Site, April, 1984

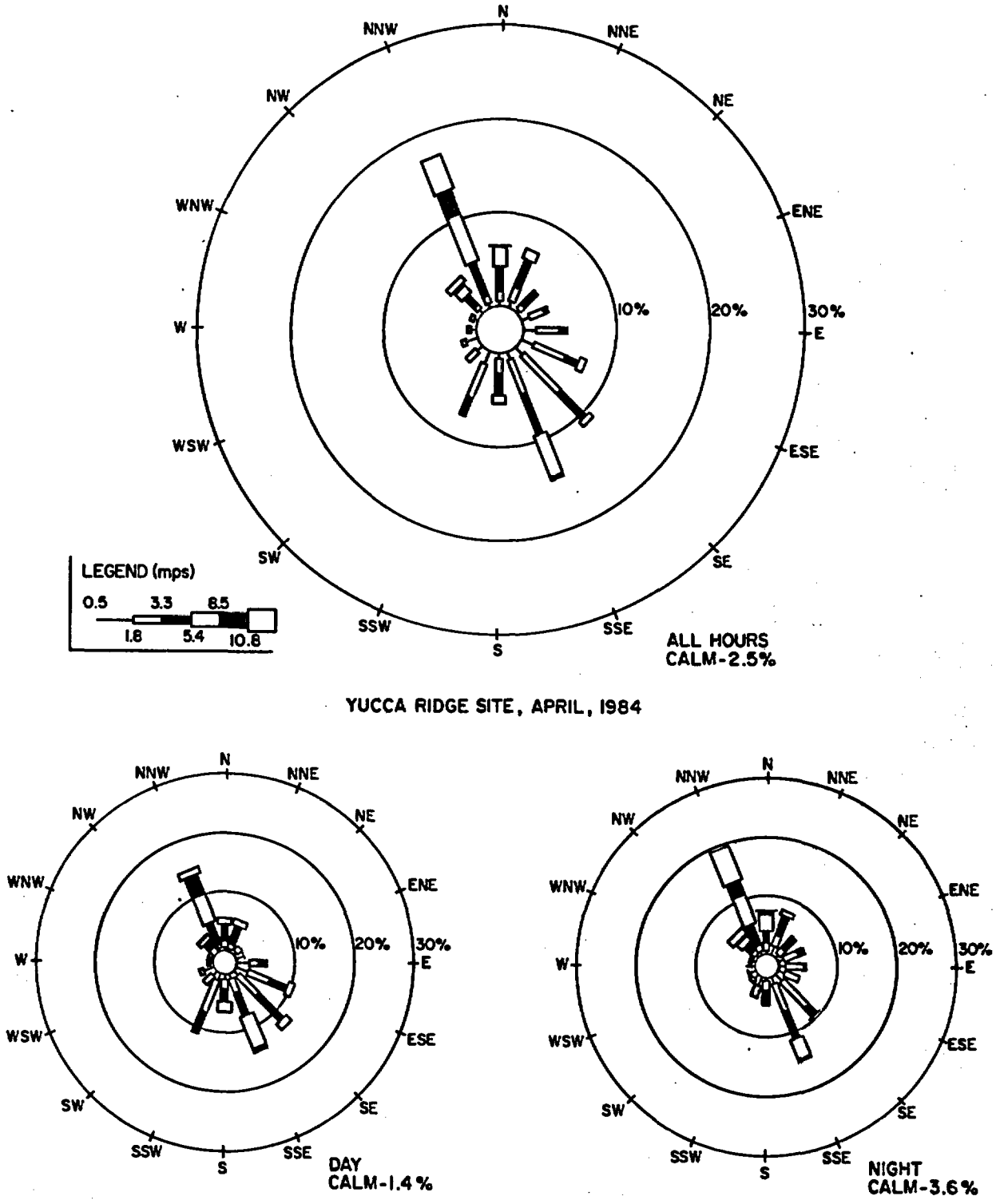


FIGURE 21. Windrose for 10 m Height, Yucca Mountain Ridge Site, April, 1984

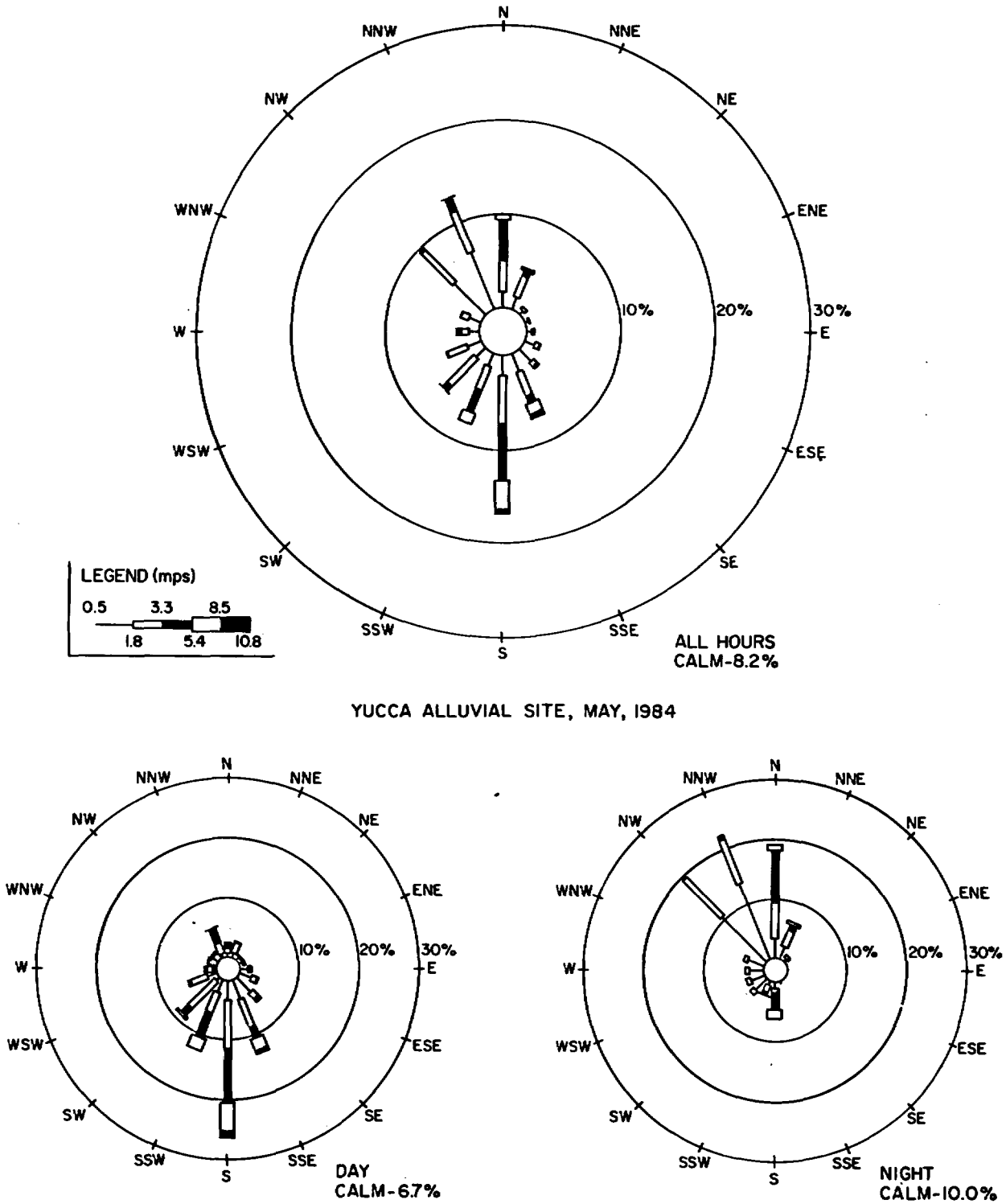


FIGURE 22. Windrose for 10 m Height, Yucca Mountain Alluvial Site, May, 1984

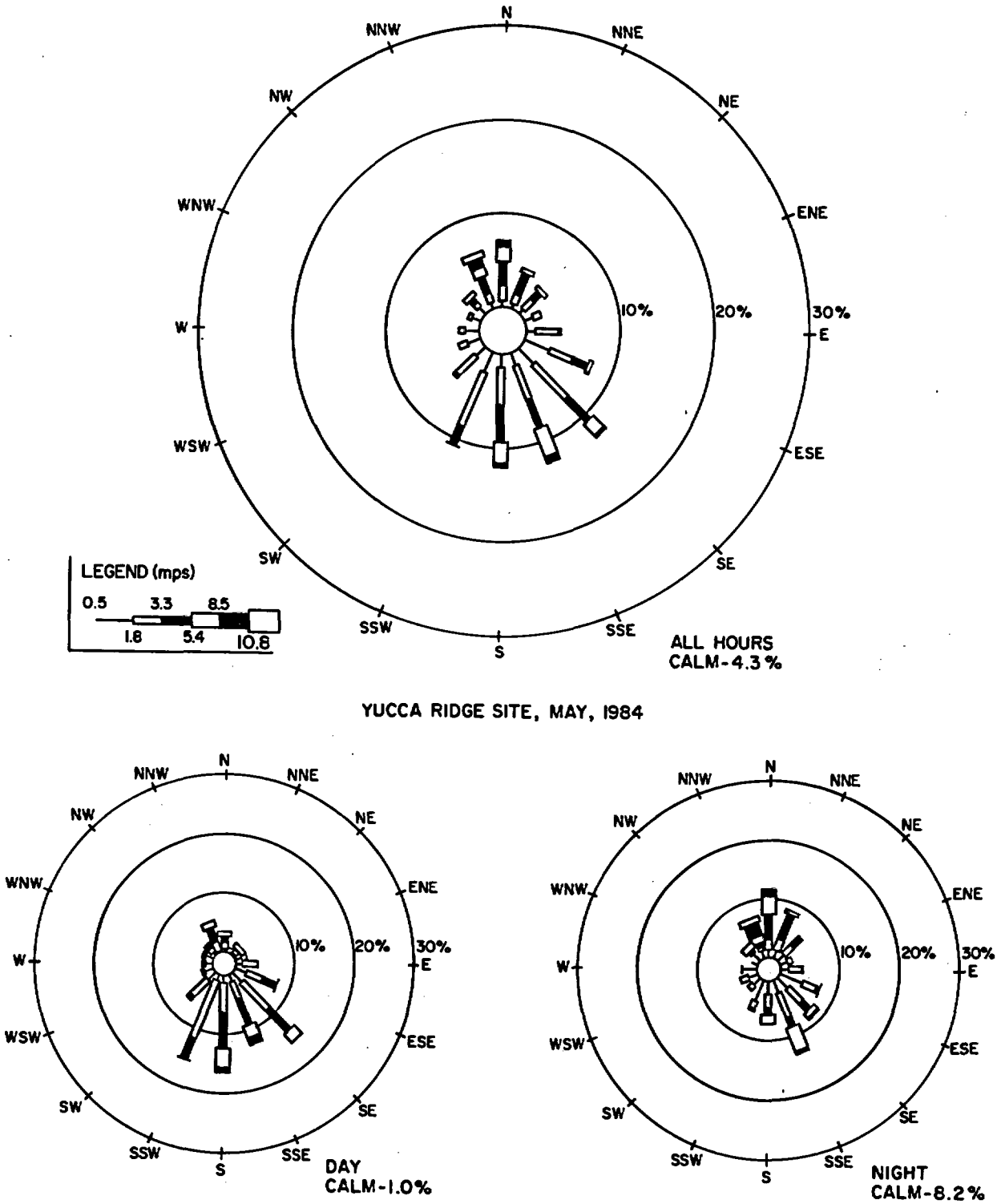


FIGURE 23. Windrose for 10 m Height, Yucca Mountain Ridge Site, May, 1984

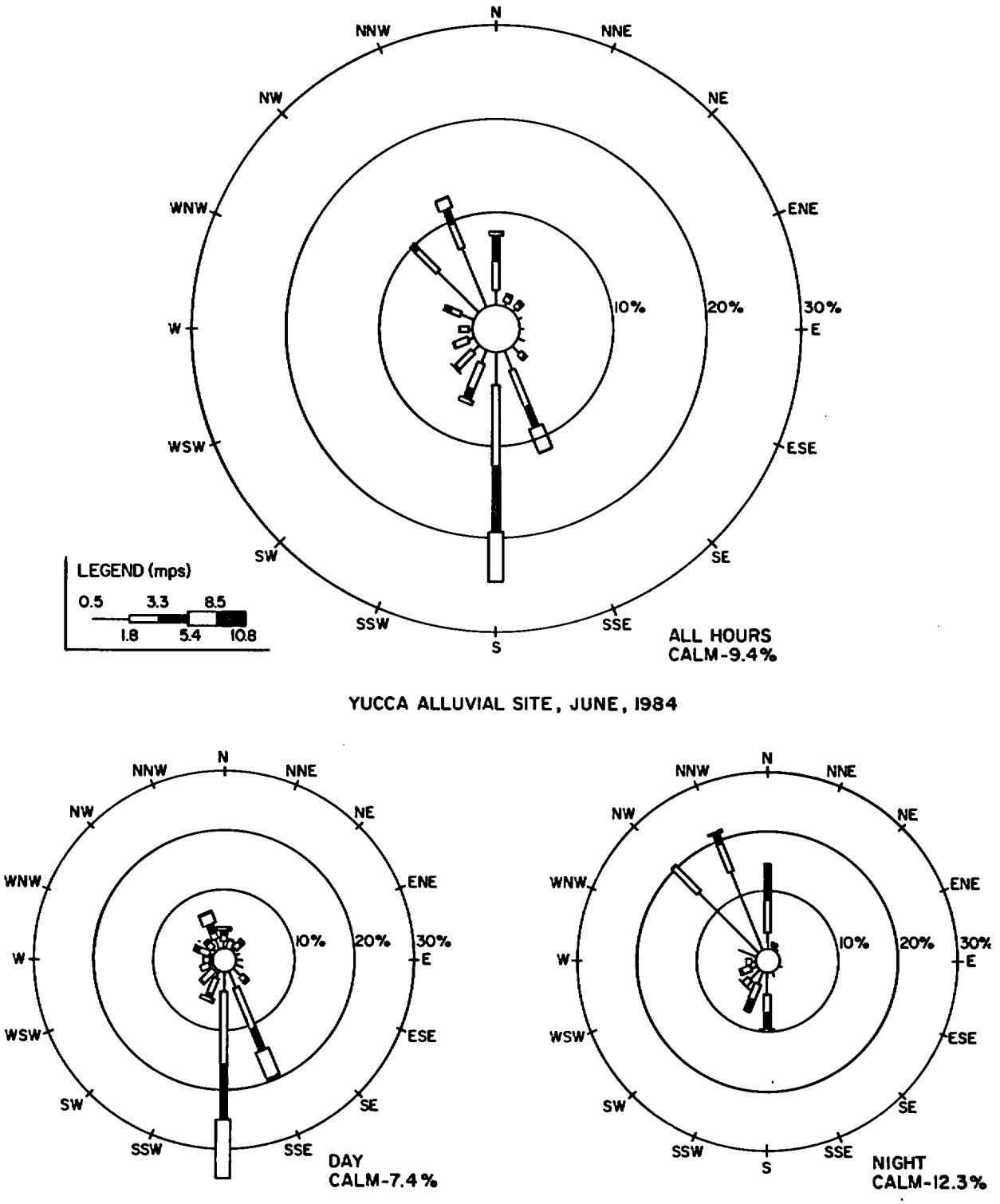
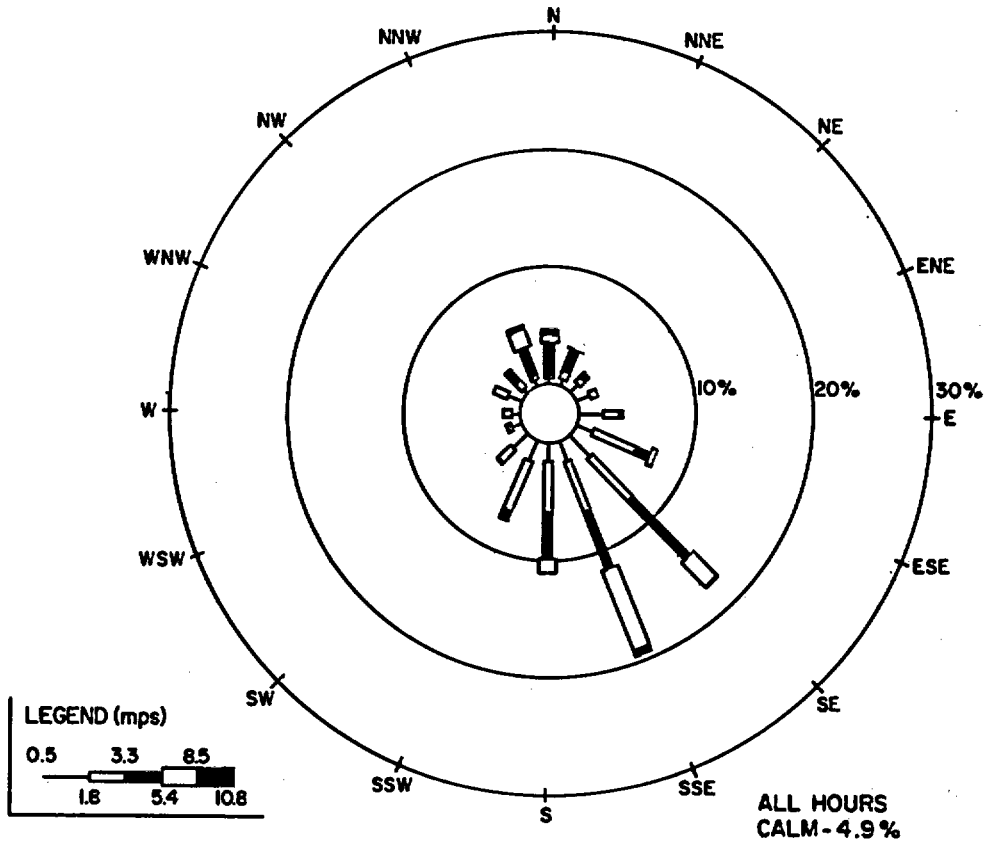
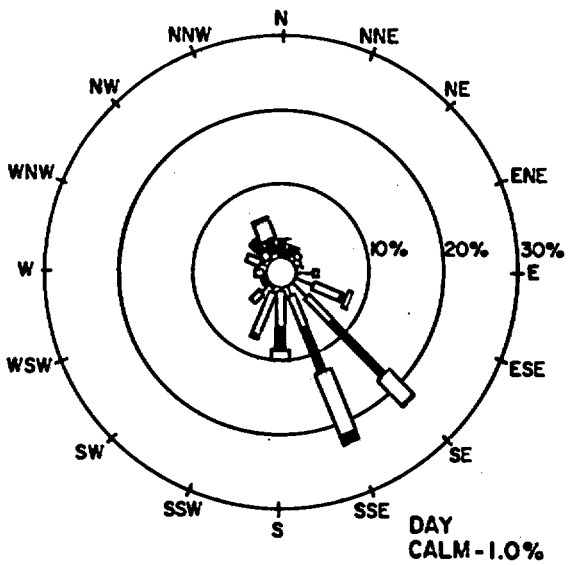


FIGURE 24. Windrose for 10 m Height, Yucca Mountain Alluvial Site, June, 1984



YUCCA RIDGE SITE, JUNE, 1984



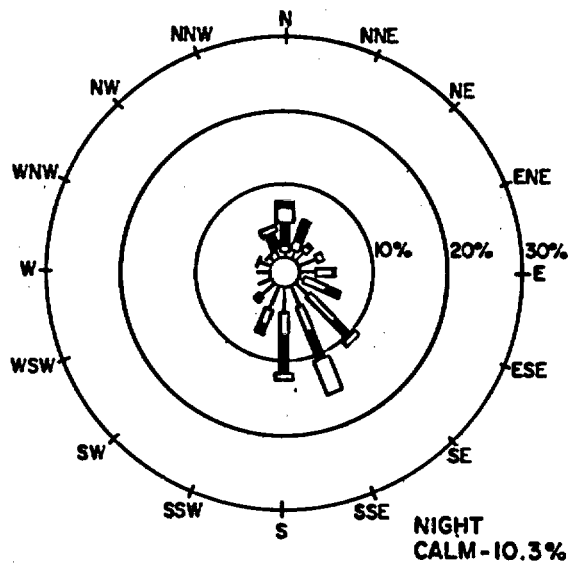
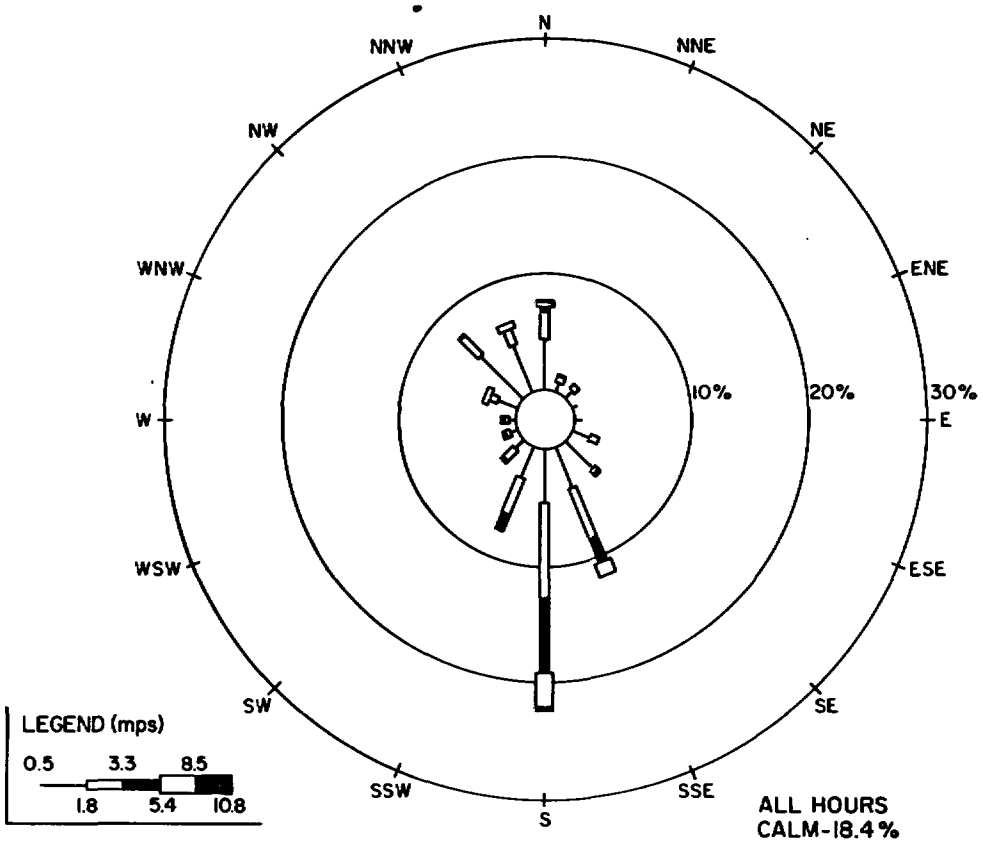
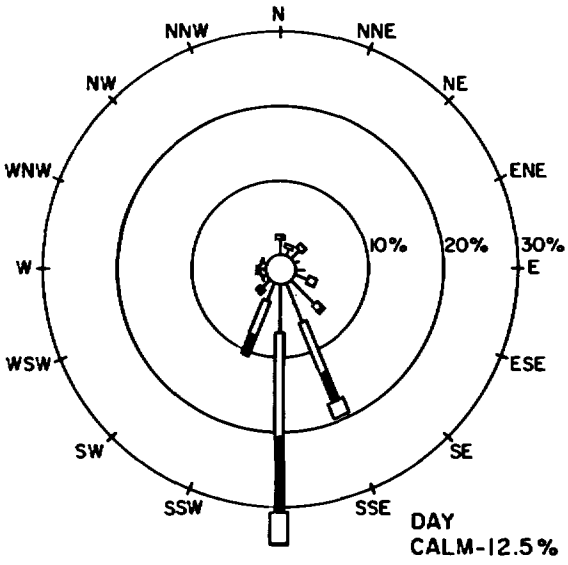


FIGURE 25. Windrose for 10 m Height, Yucca Mountain Ridge Site, June, 1984



YUCCA ALLUVIAL SITE, JULY, 1984



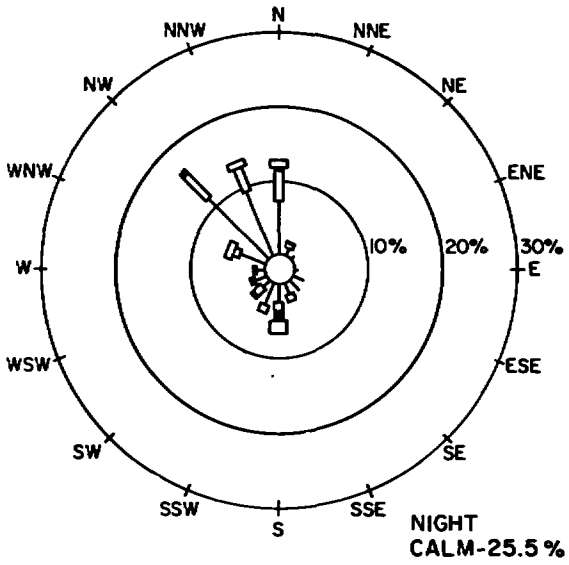
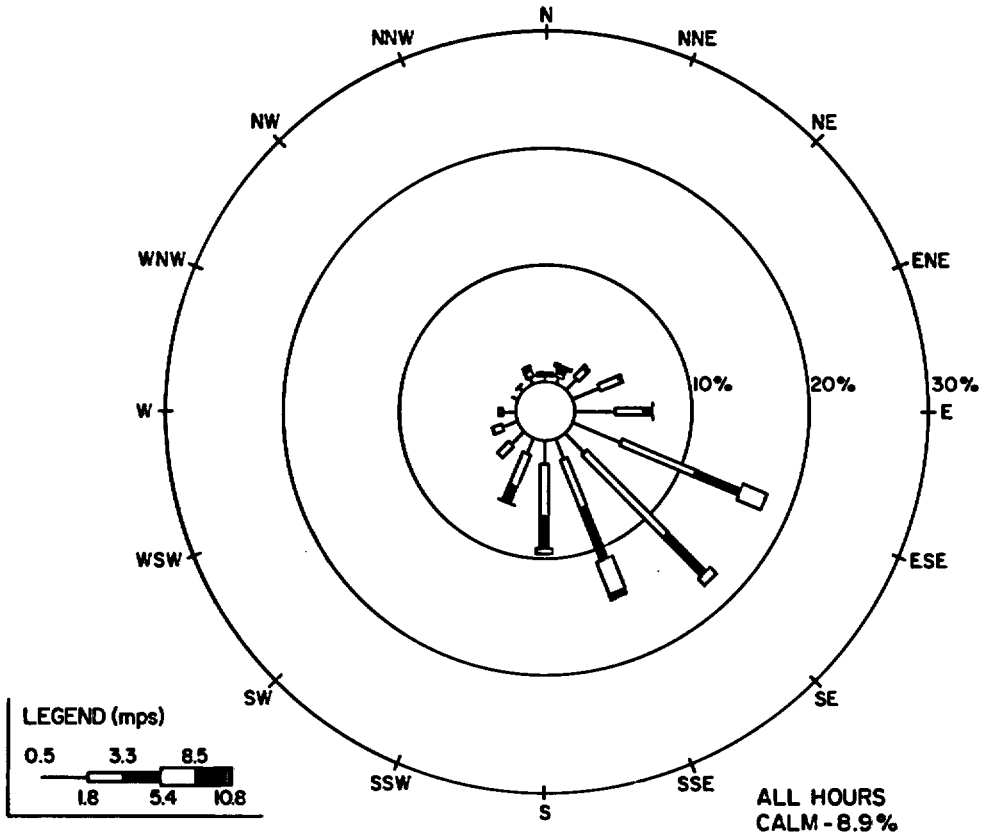


FIGURE 26. Windrose for 10 m Height, Yucca Mountain Alluvial Site, July, 1984



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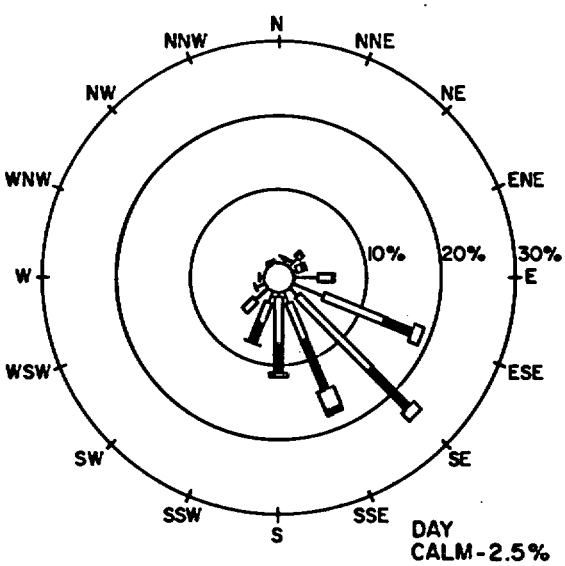


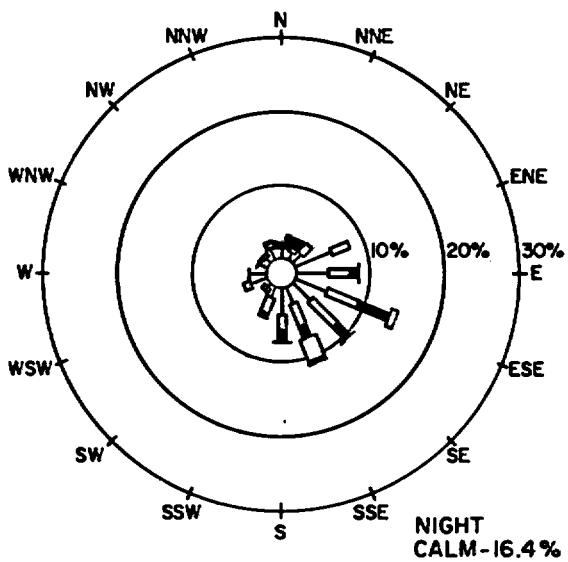


FIGURE 27. Windrose for 10 m Height, Yucca Mountain Ridge Site, July, 1984

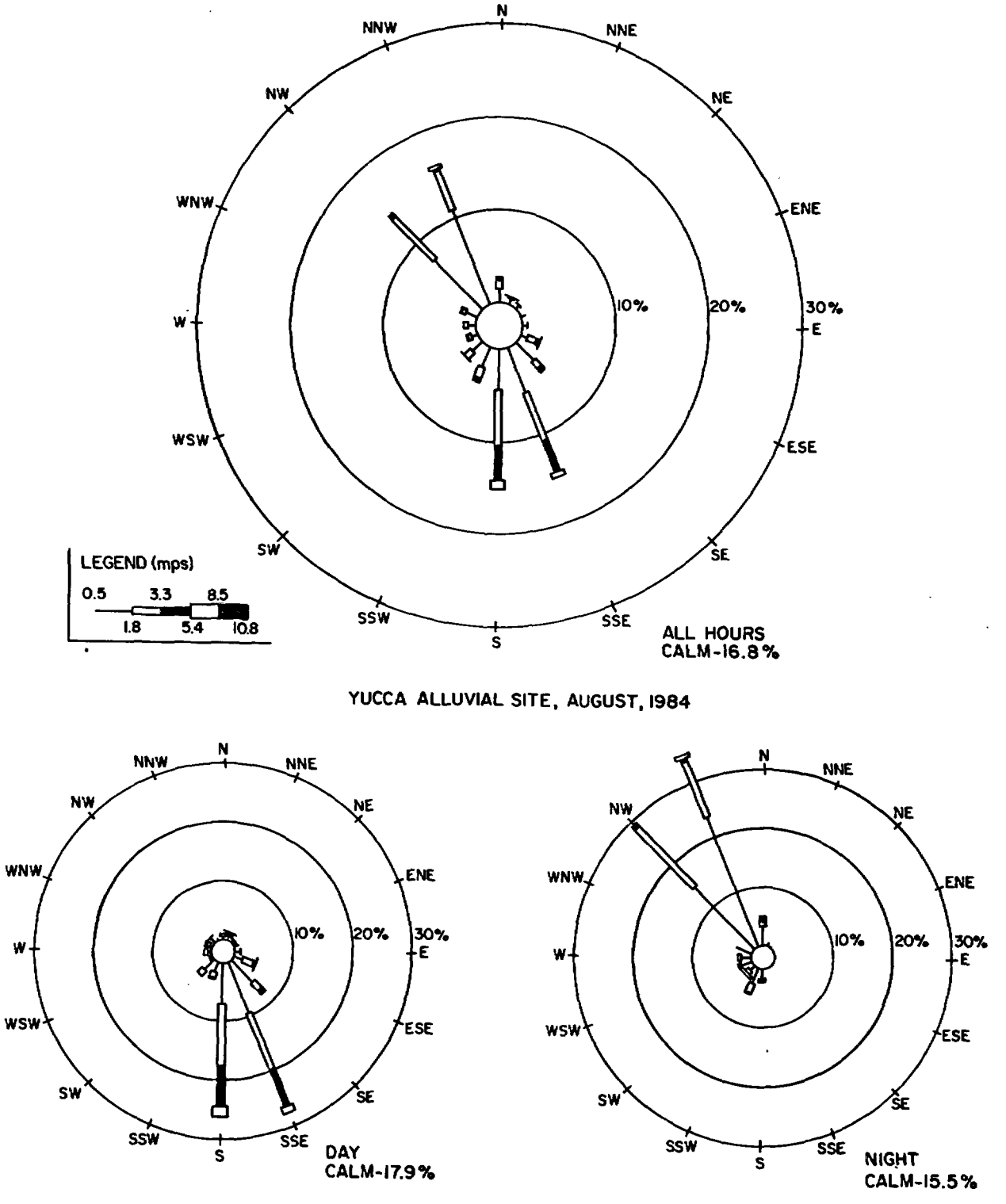
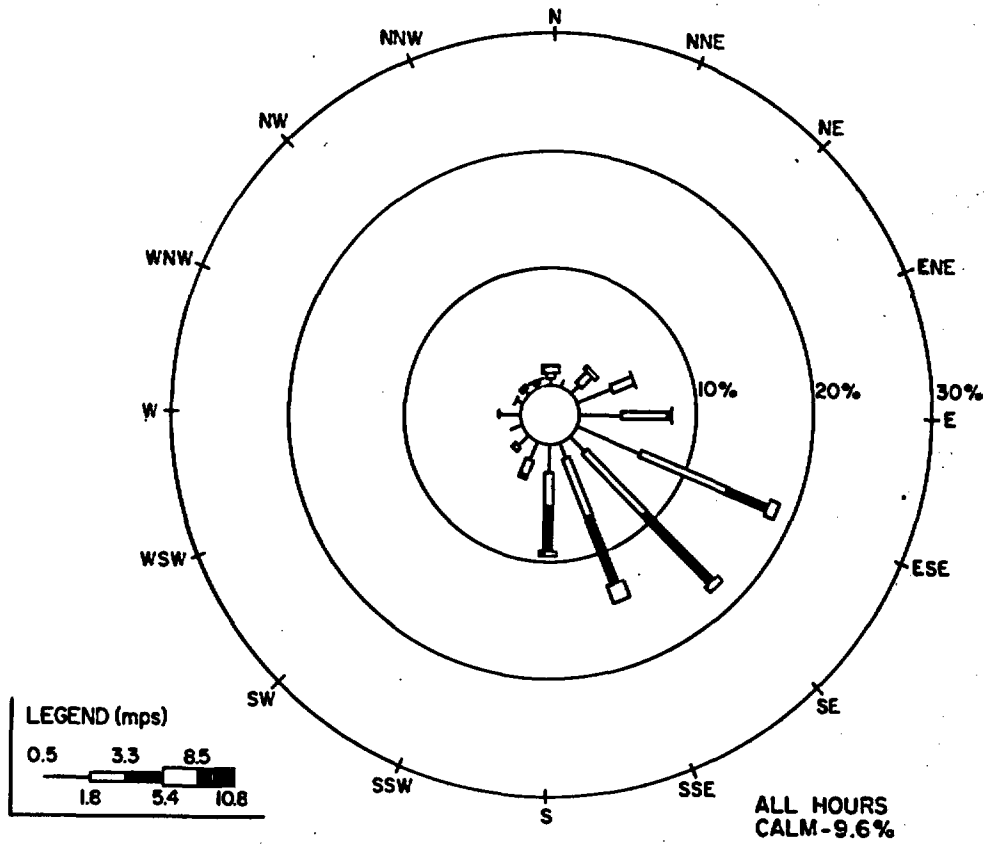
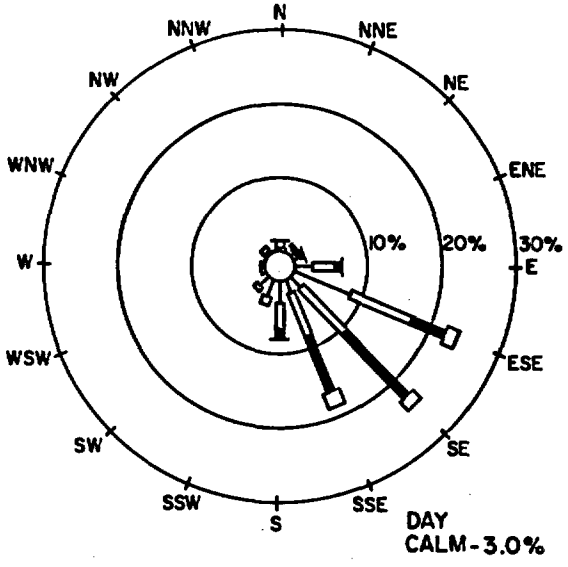


FIGURE 28. Windrose for 10 m Height, Yucca Mountain Alluvial Site, August, 1984



YUCCA RIDGE SITE, AUGUST, 1984



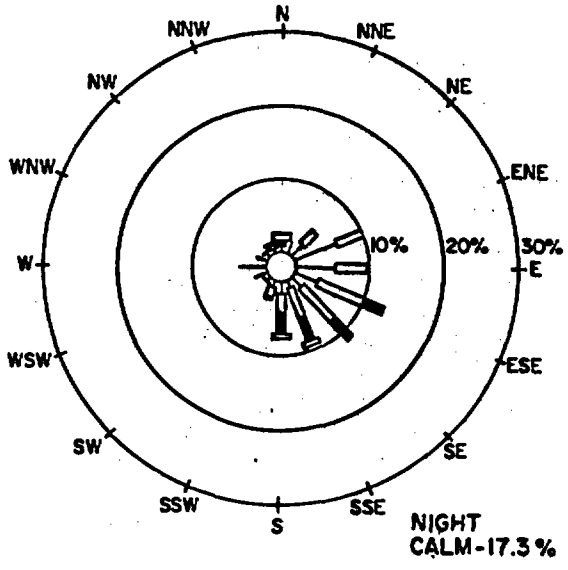
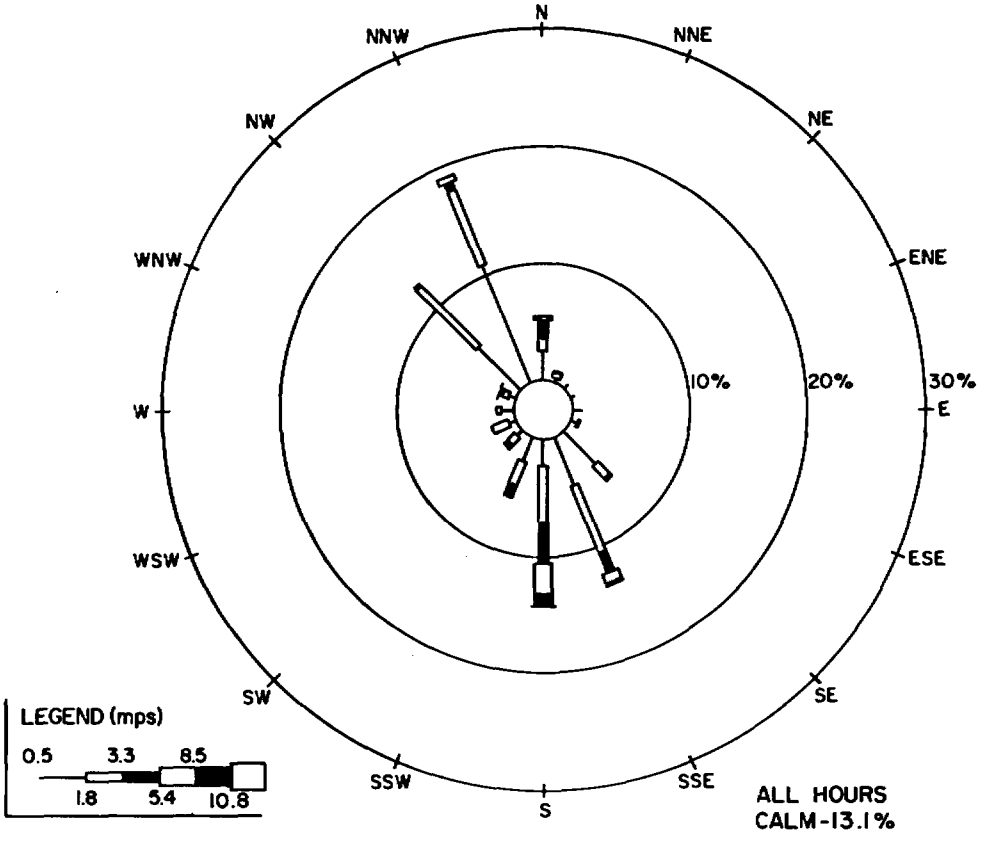


FIGURE 29. Windrose for 10 m Height, Yucca Mountain Ridge Site, August, 1984



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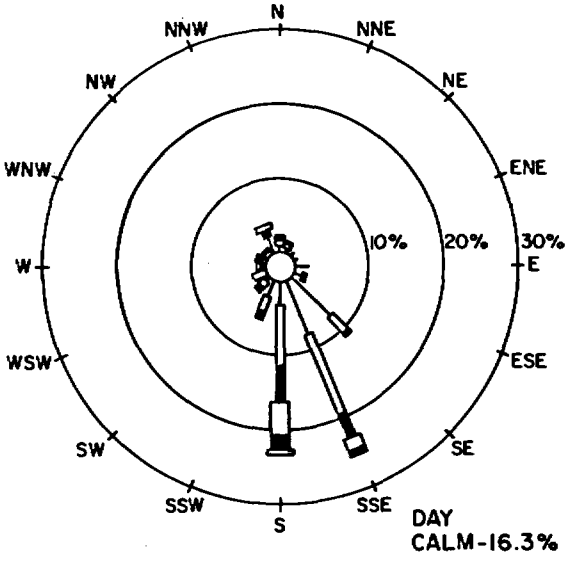


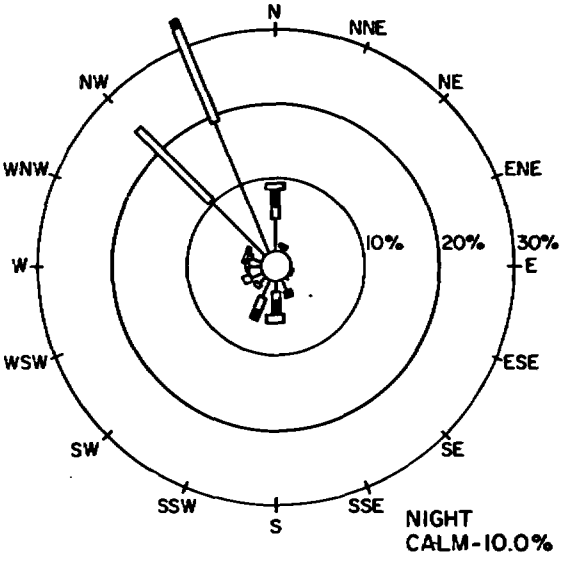
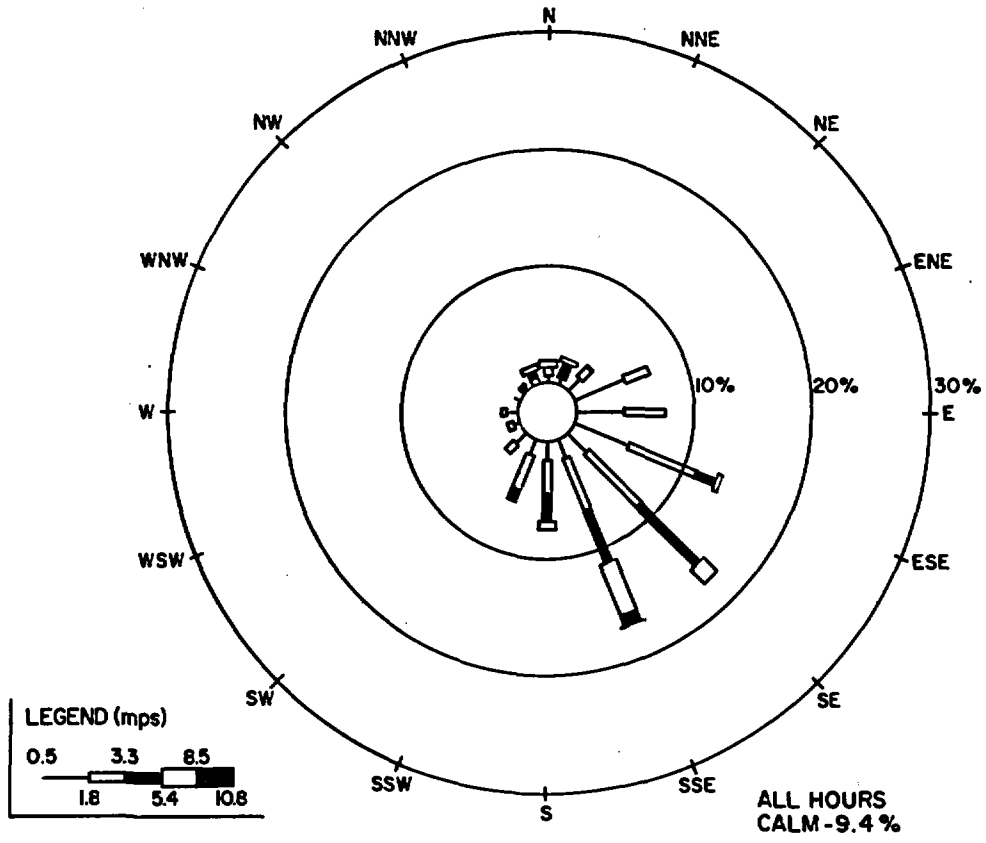


FIGURE 30. Windrose for 10 m Height, Yucca Mountain Alluvial Site, September, 1984



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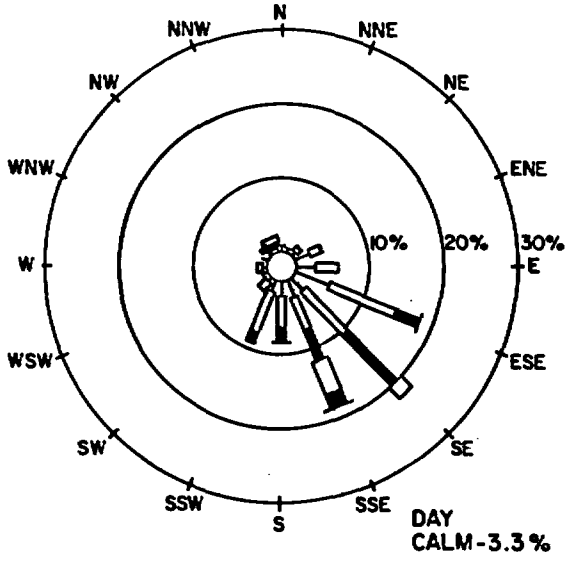


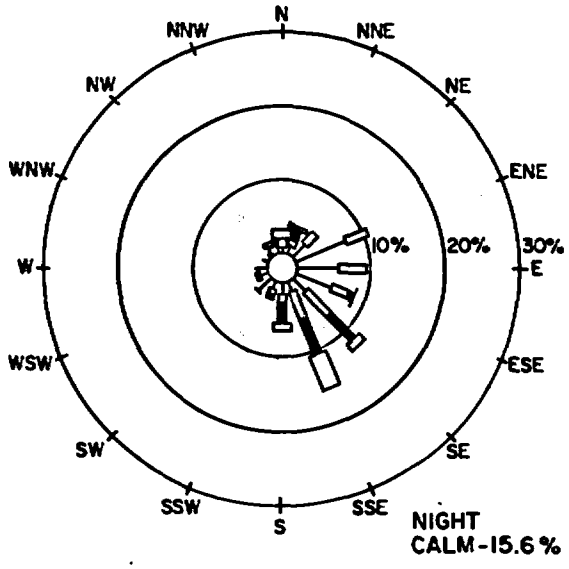
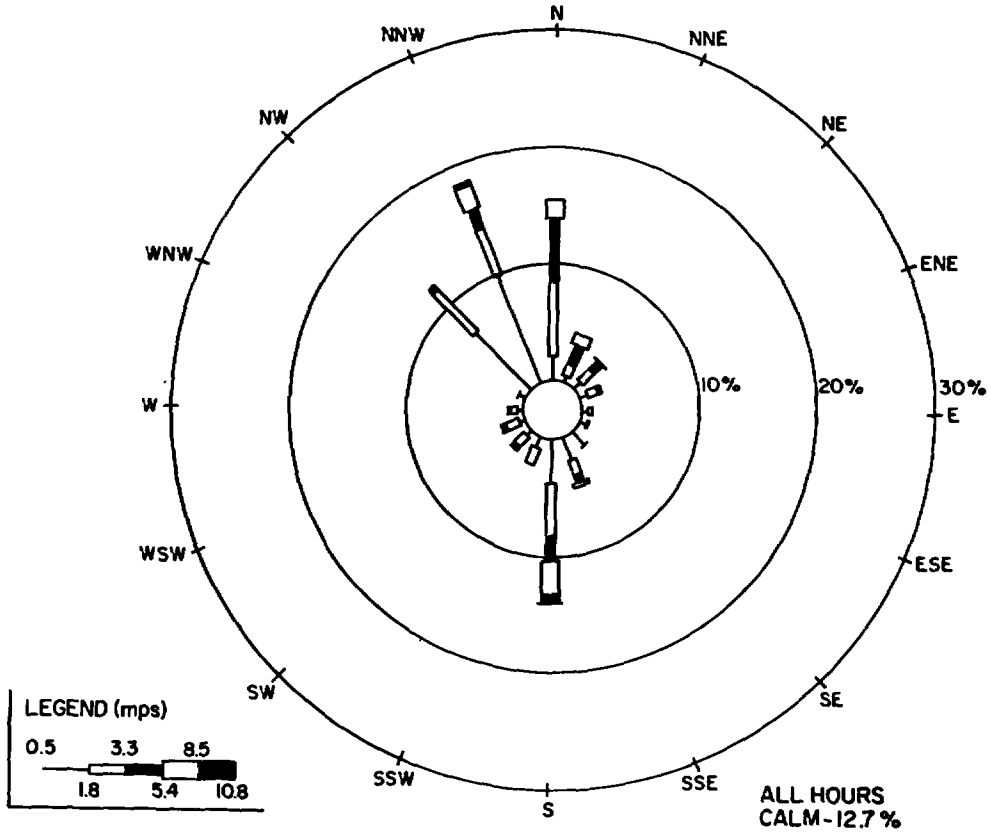
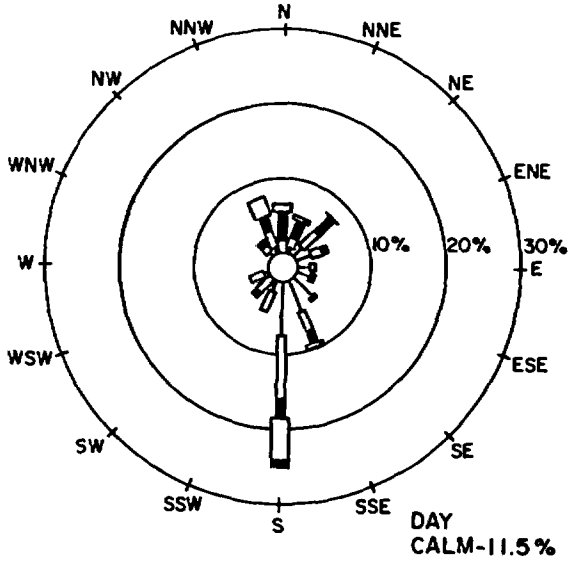


FIGURE 31. Windrose for 10 m Height, Yucca Mountain Ridge Site, September, 1984



YUCCA ALLUVIAL SITE, OCTOBER, 1984



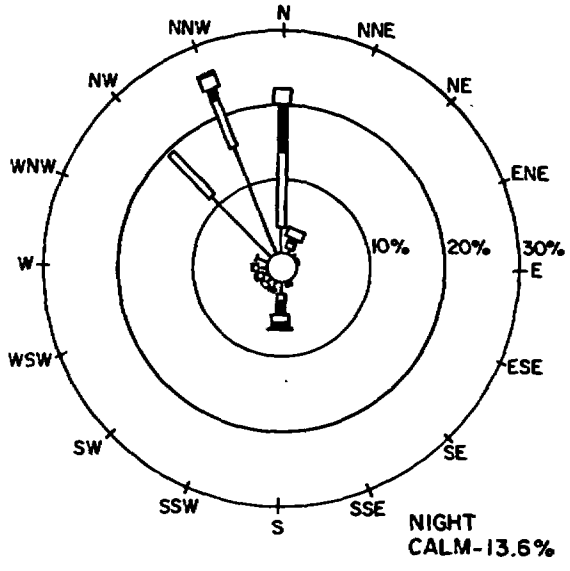
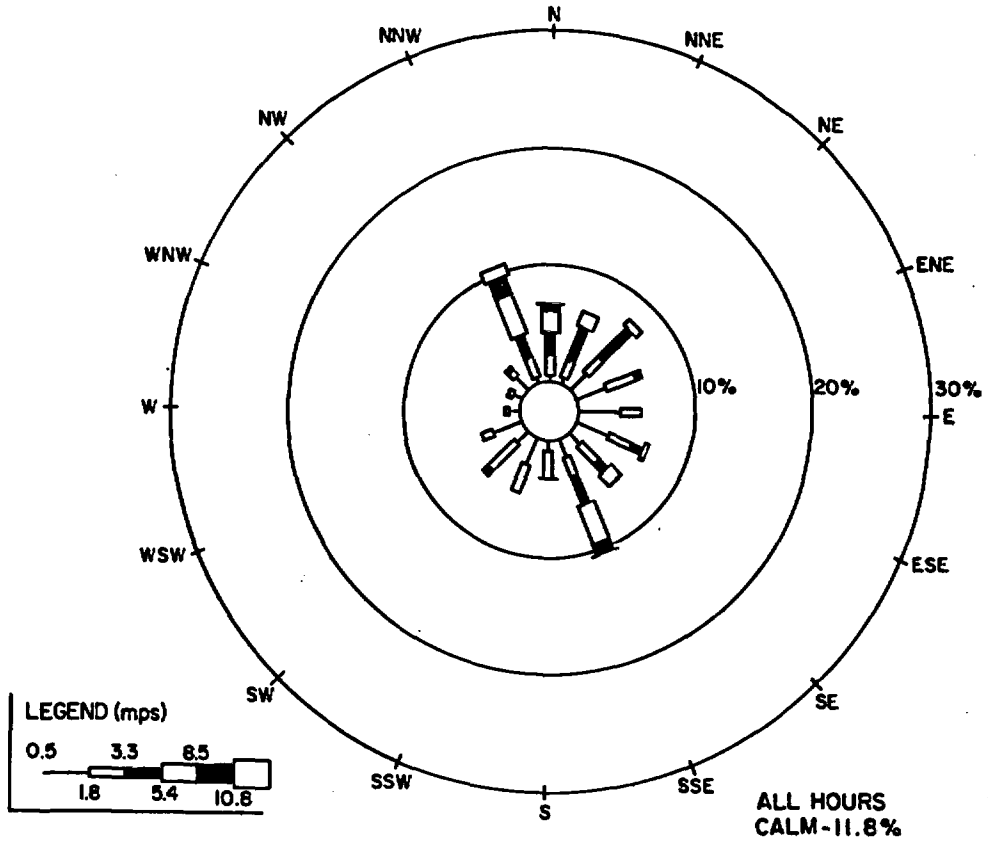


FIGURE 32. Windrose for 10 m Height, Yucca Mountain Alluvial Site, October, 1984



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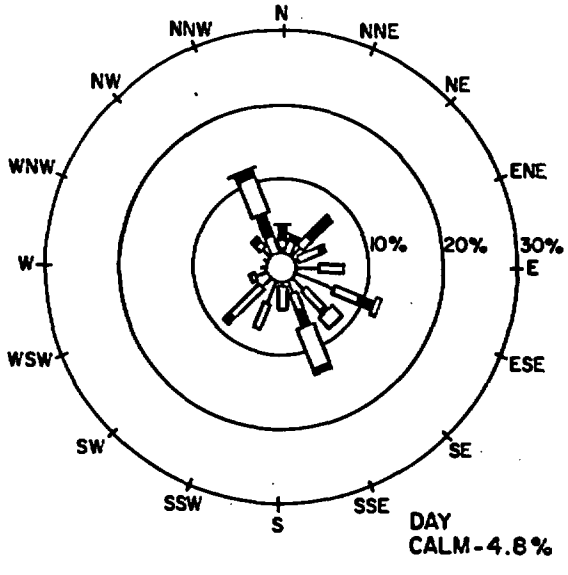

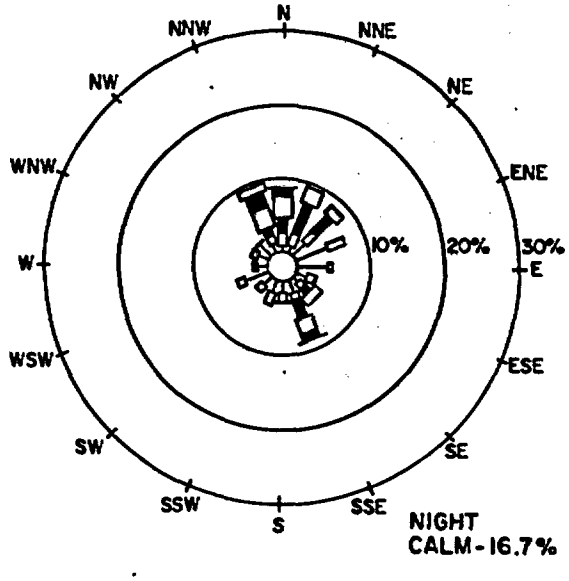

FIGURE 33. Windrose for 10 m Height, Yucca Mountain Ridge Site, October, 1984

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