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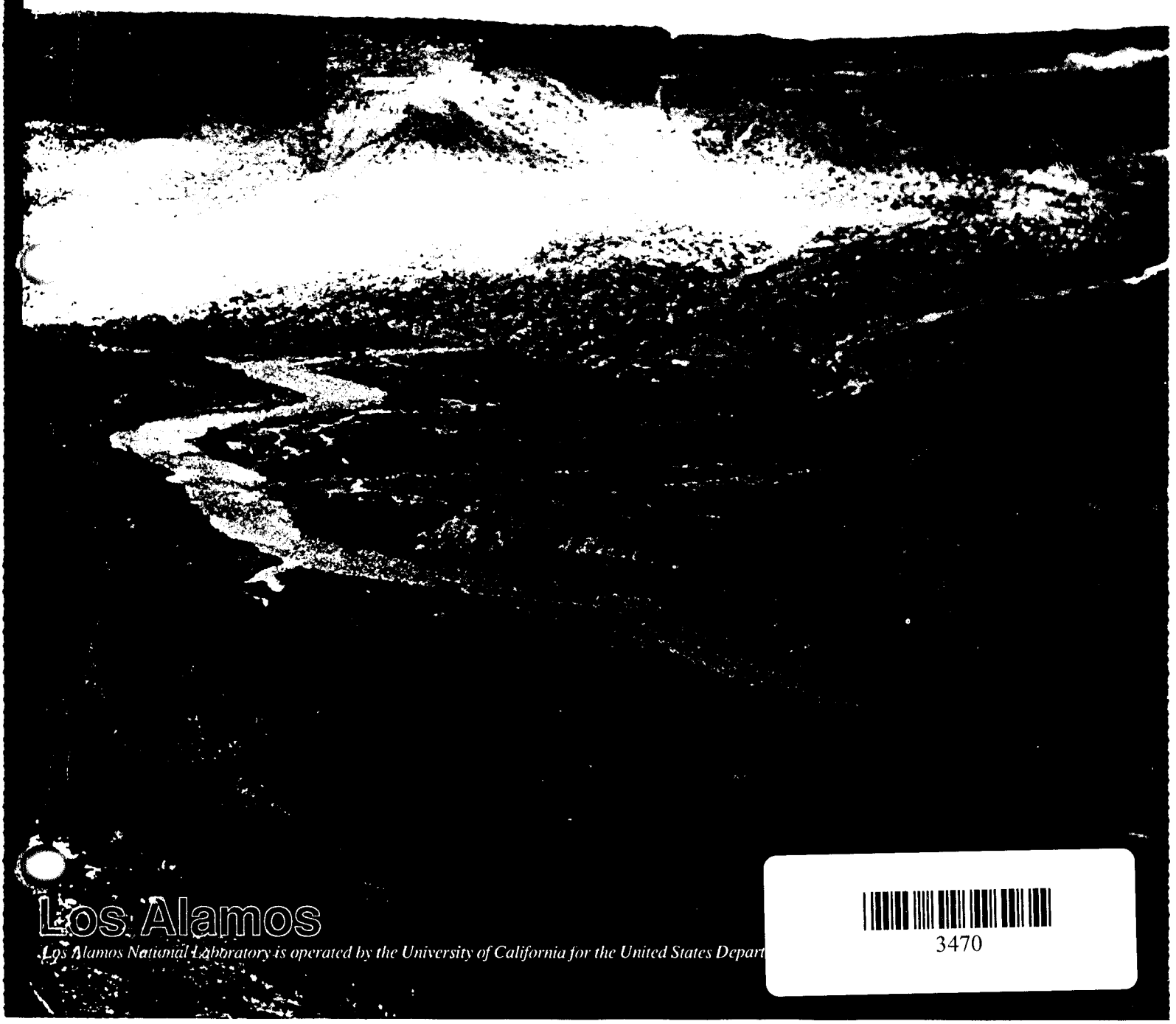
Los Alamos Climatology



Los Alamos

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LA-11735-MS

UC-902
Issued: May 1990

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4.1 Wind Roses

Mean wind-speed and wind-direction frequencies were calculated for daytime, nighttime, and total time (24 hours) at five sites for the months of January, April, July, and October. The frequencies are presented as wind roses, which are circles with spokes extending from the center representing the direction from which the wind blows. The length of each spoke is proportional to the frequency at which the wind blows *from* the indicated direction. Each direction is 1 of 16 primary compass points (N and NNE, for example) and is shown centered on a 22.5° sector of the circle. Each spoke consists of different line widths representing wind-speed classes. The frequency of calm winds (winds having a speed less than 1 mph [0.5 m/s]) is given in the circle's center. Day and night are defined by sunrise and sunset.

The wind roses represent winds at five sites (elevations above sea level [ASL] are in parentheses): TA-59 (7373 ft [2248 m]), TA-50 (7270 ft [2216 m]), Bandelier (7040 ft [2146 m]), East Gate (7019 ft [2140 m]), and Area G (6688 ft [2039 m]). Surface winds were measured at a height of about 39 ft (11–12 m) above ground level (AGL) at all sites except TA-59, where the measuring height is 75 ft (23 m). The TA-59 measuring height is higher because the tower is adjacent to the Laboratory one-story OH-1 building, and the effects of a nearby building on airflow are assumed to be minimal at the 75-ft measuring height. At TA-50, winds were also measured at the 300-ft (92-m) level.

Annual surface wind roses for day, night, and total at TA-50, Bandelier, East Gate, and Area G are shown on maps in Fig. 4.1(a)–(c). Day and night wind roses for the four seasons are shown in Figs. 4.2–4.5. Total (day and night) wind roses for January, April, July, and October are shown in Figs. 4.6–4.9, respectively. Note that the TA-50 (92 m) wind roses are displaced on the maps and are shown far to the right, with an arrow pointing to the TA-50 location. The Bandelier site is located farthest to the south, East Gate is east-northeast of TA-50, and Area G is just west of White Rock.

The TA-50 (upper-left) wind rose (Figs. 4.1–4.9) has been chosen to represent the western Laboratory area; wind roses for TA-59 (not shown on these figures because of space limitation) are shown separately in Figs. 4.10–4.14 at the end of this section. The two sites are located very close to each other, and winds are similar at both sites. Wind data for all these sites were available for the following periods (ending in early 1988): 8 years at TA-59 and Area G, 6 years at East Gate, 3 years at TA-50, and 1 year at Bandelier.

Los Alamos annual surface winds are generally light, with an average speed of nearly 7 mph (3 m/s). Wind speeds greater than 11 mph (5 m/s) occur with frequencies ranging from 10% at TA-50 to 20% or so at East Gate. The S'ly and SW'ly winds tend to be stronger because the Los Alamos Canyon, located just south of East Gate, presents less friction to winds. Many of the strong Los Alamos winds occur during the spring. More than 40% of the surface winds at all sites have speeds less than 5.5 mph (2.5 m/s). The

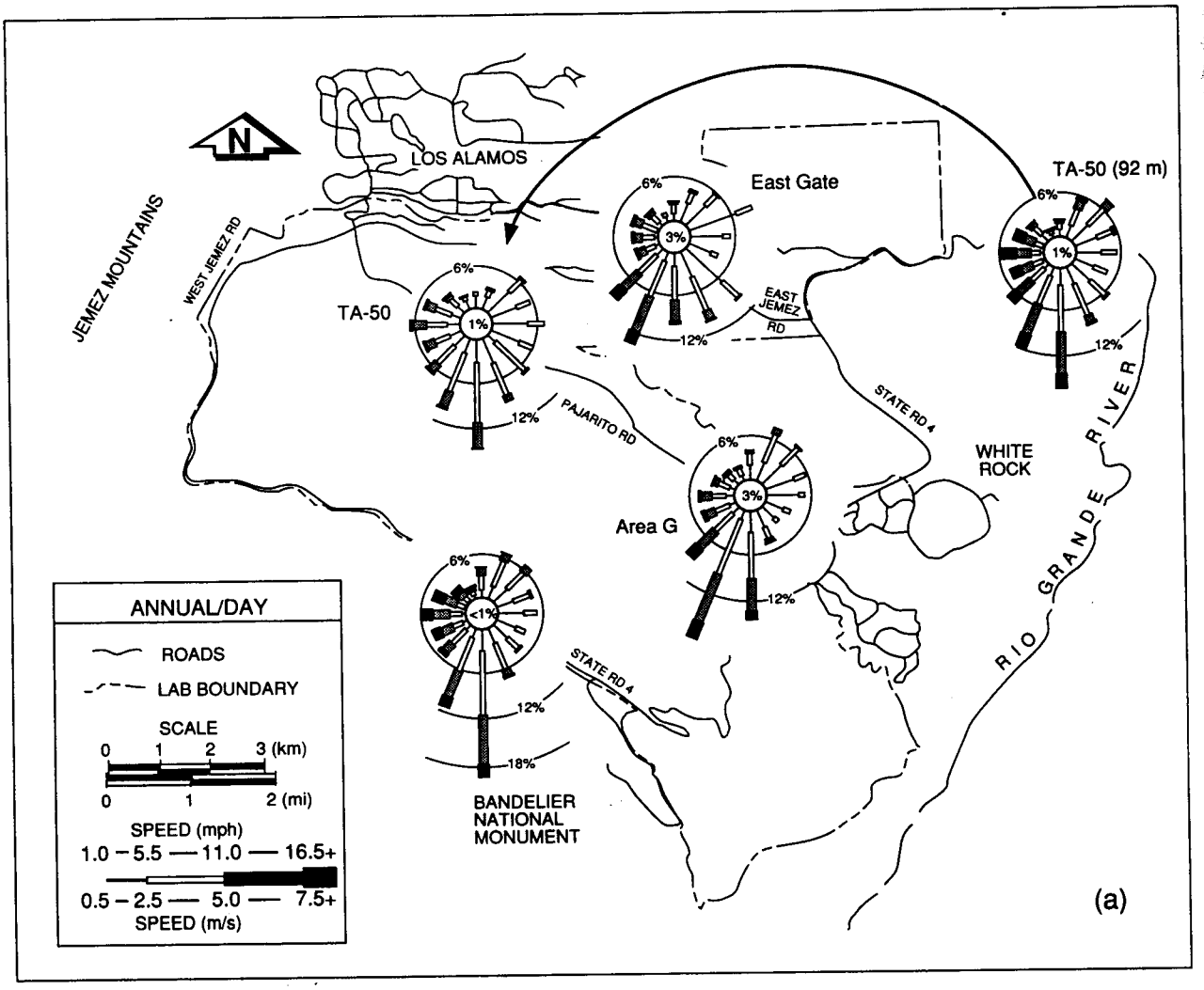

Fig. 4.1(a)–(c). Annual wind roses for (a) daytime, (b) nighttime, and (c) total (day and night) for Los Alamos sites at TA-50, East Gate, Area G, and Bandelier. Winds were measured at a height of about 39 ft (11–12 m) for all the sites and also at the 300-ft (92-m) level at TA-50.

average wind speed increases to over 9 mph (4 m/s) at the TA-50, 300-ft (92-m) level. At this higher level, wind speeds greater than 11 mph (5 m/s) occur one-third of the time, and wind speeds less than 5.5 mph (2.5 m/s) occur almost one-third of the time.

Wind distribution varies with site, height above ground, and time of day, primarily because of the Los Alamos terrain features. On days with sunshine and light, large-scale winds, a deep, thermally driven upslope wind develops over the Pajarito Plateau. Note the high frequency of SE'ly through S'ly winds during the day at TA-50 (both levels) and at East Gate during the year. The upslope wind is even more frequent at TA-59

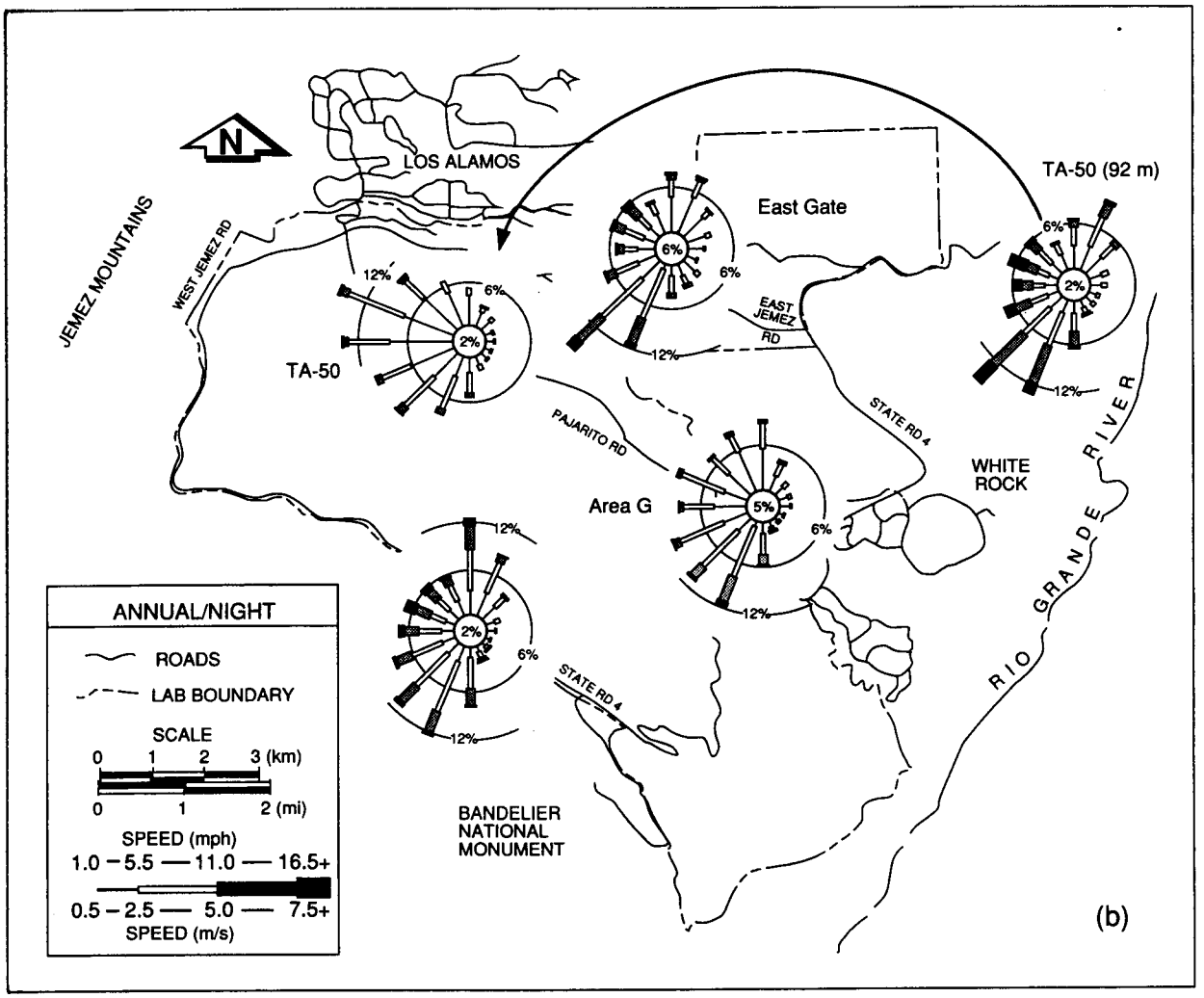

Fig. 4.1 (Continued)
(b) Annual nighttime wind roses at Los Alamos.

(not shown). Upslope winds are generally light, less than 5.5 mph (2.5 m/s). Winds become more SSW'ly at Area G (that is, at lower elevations). The winds here are more affected by the Rio Grande Valley than by the plateau. Regional-scale wind channeling by the valley contributes to the high frequency of SSW'ly and NNE'ly or NE'ly winds. In addition, a thermally driven up-valley wind may cause some of the SSW'ly winds at Area G that are less than 5.5 mph (2.5 m/s).

Winds reverse during the night. A shallow, cold-air drainage wind often forms and flows down the plateau on clear nights along with the light, large-scale winds. Drainage

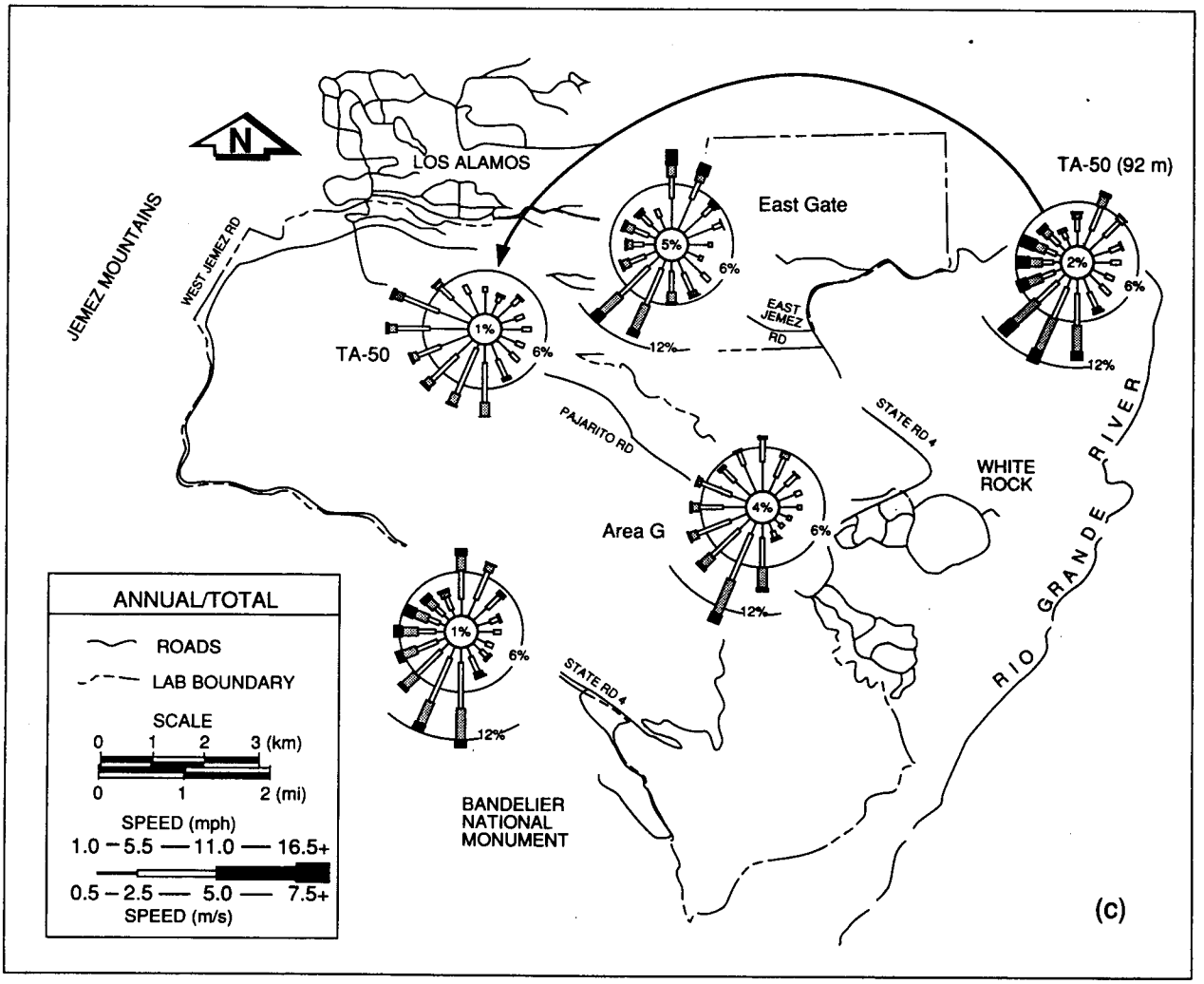

Fig. 4.1 (Continued)
(c) Annual total wind roses at Los Alamos.

winds are generally less than 7 mph (3 m/s). Drainage winds most often occur from the NW through the W at TA-50, whereas the drainage winds at Bandelier and Area G are more evenly distributed from the WNW through the N. Drainage winds are much less frequent at East Gate because the Los Alamos Canyon extends to the west of the site. The nighttime TA-50 wind rose at 300 ft (92 m) shows dramatically different winds from those at the surface, with valley-channeled winds dominating. Up-valley (SW'ly and SSW'ly) and down-valley (N'ly through NE'ly) winds occur with high frequency. Less-frequent channeled winds also occur at the lower sites.

Wind patterns are quite different for different times of the year. More N'ly through NE'ly winds occur during the winter (January, for example, in Fig. 4.2). Large-scale pressure patterns during the winter promote a relatively high frequency of N'ly winds in the lower atmosphere. During the day, NE'ly winds are almost as common as SE'ly winds at TA-50 and East Gate and S-SSW'ly winds at Bandelier and Area G. At night, the NE'ly winds are prominent, especially at the upper level at TA-50. At lower heights, the nighttime drainage flow is important. The data show a dramatic difference in winds between the upper and lower heights at TA-50. The large number of NNW'ly through N'ly winds at Bandelier and Area G indicates that the drainage wind and channeled down-valley wind are equally important, resulting in a compromised wind. However, channeled winds, not drainage winds, predominate at East Gate. This site is situated where drainage winds are not common.

April winds, and spring winds in general, are stronger than winds occurring during other times of the year (Fig. 4.3). Strong storms often track west to east across the southern and central Rockies, thereby causing strong winds in New Mexico. The strong winds are important in limiting local plateau winds (upslope and downslope), as well as, to a lesser extent, channeled winds. Note the scarcity of upslope winds at TA-50 during the day and the increase of W'ly winds at all sites during the day.

Winds are also different in April at night. Note the dramatic decrease in down-valley winds, especially at TA-50 at the upper level, when compared with occurrences in January. The weather pattern for large-scale winds has changed by April, giving fewer large-scale N'ly winds and thereby preventing many channeled NNE-NE'ly winds. Also note the reduction in NNW-N'ly winds at Bandelier and Area G from those occurring in January. The drainage winds for these areas are now more prevalent than the channeled, down-valley winds. At TA-50, the drainage wind is now more W'ly and WNW'ly.

Winds become much weaker by summer. Daytime winds in July (see Fig. 4.4) tend to be S'ly at all sites. The upslope winds are less frequent during July at the upper plateau because of increased humidity and shower activity, which reduce the differential heating. Winds are generally similar in October, with only a slight increase in wind speed (see Fig. 4.5).

In Figs. 4.10–4.14, data show that TA-59, located on a steeper slope than the one at TA-50, has more slope winds. When compared with TA-50 (12 m), TA-59 has more daytime SE-SSE'ly winds and more nighttime drainage winds from the W-NW.

4.2 Mean Wind-Direction Frequencies and Wind Speeds

Although wind roses are useful in showing general day and night wind frequencies, they do not show the short-term features in the wind patterns. Mean wind-direction frequencies and wind speeds were calculated at four sites (including the two levels at TA-50). Frequencies and speeds were calculated for the 16 compass points.

Mean wind-direction frequencies and wind speeds are plotted by hour in Figs. 4.15–4.18 for January, April, July, and October. Data from the upper and lower