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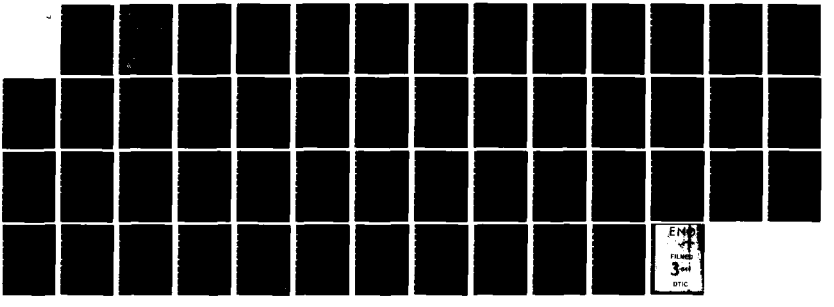

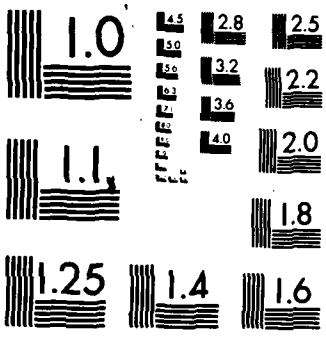

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NAVENVPREDRSCHFAC
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FORECAST AIDS FOR PREDICTING TROPICAL CYCLONE ASSOCIATED GUSTS AND SUSTAINED WINDS FOR AGANA, HONG KONG, KADENA AND MISAWA

Prepared By:

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Tropical cyclone
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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Forecast aids for predicting wind conditions when tropical cyclones pass within 360 n mi of a station are provided for Agana, Hong Kong, Kadena and Misawa. A circle with a 360 n mi radius, which was centered on each station, was divided into 71 equal area segments. Data sets consisting of the ratios of station wind values to tropical cyclone center wind values were developed. Computed ratio wind values were then assigned to the grid areas designated by

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Block 20, Abstract, continued.

the position of the tropical cyclone center. Values of mean and maximum gust ratios for two intensity classifications of the tropical cyclones were analyzed to produce the forecast aids for the stations.

Contents

1. INTRODUCTION

Forecasting wind conditions at a station during the passage of a tropical cyclone is a critical problem for operational environmentalists. The Air Force has produced forecast aids for predicting mean and maximum peak gusts for several western Pacific Air Force Bases (Pettett, 1980) for periods when a typhoon was within 360 n mi of a base. The need for similar forecast aids for Navy sites was recognized and the Naval Environmental Prediction Research Facility (NEPRF), Monterey, California was requested to produce the aids. Science Applications, Inc., under contract to NEPRF has conducted the research and development involved in producing forecast aid reports. Data for Yokosuka, Japan, and Cubi Point, Philippines are provided in separate reports (Jarrell and Englebretson, 1982a; Jarrell and Englebretson, 1982b). Forecast aids are presented in this study for four additional sites: Agana, Guam; Hong Kong; Kadena, Okinawa; and Misawa, Japan. Another use of this type information is to adjust wind probabilities for terrain influence. Appendix A provides a brief description of the use of this information to determine "terrain adjusted" wind probabilities and also provides a sample wind probability message.

2. PRODUCTION OF FORECAST AIDS

The forecast aids are based on available surface wind observations at each site. Length of record and data limitations are discussed in Appendix B. Best track data for the

tropical cyclones were extracted from Joint Typhoon Warning Center (JTWC) records for the periods when a tropical cyclone was within 360 n mi of the station of interest. Aviation hourly observations at three-hour intervals, obtained from the National Climatic Data Center (NCDC), Asheville, NC, were extracted for the periods identified as having a tropical cyclone within 360 n mi of the station.[1] The best track and weather observations were then merged into a new data base. From this data, ratios of station reported sustained winds to storm center winds were determined and assigned to a space on a circular grid containing the storm center position. The 360 n mi radius circle was divided into 71 equal grid spaces (Fig.1).

The ratios identified with each area were summarized and the maximum and mean gust ratios and standard deviations were determined. The gust ratios are based upon the observed maximum sustained wind speed and the calculated mean sustained wind speed, both multiplied by a factor of 1.5. The number of ratios per area (sample size) and cumulative frequency distribution of the ratios were also computed. Gust ratio plots were subjectively analyzed taking into consideration such factors as sample size for the mean gusts and cumulative frequency distribution for the maximum gusts.

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[1]Aviation hourly observations are archived at NCDC for the local times corresponding to 00,03,06,09,12,15,18,21 GMT only.

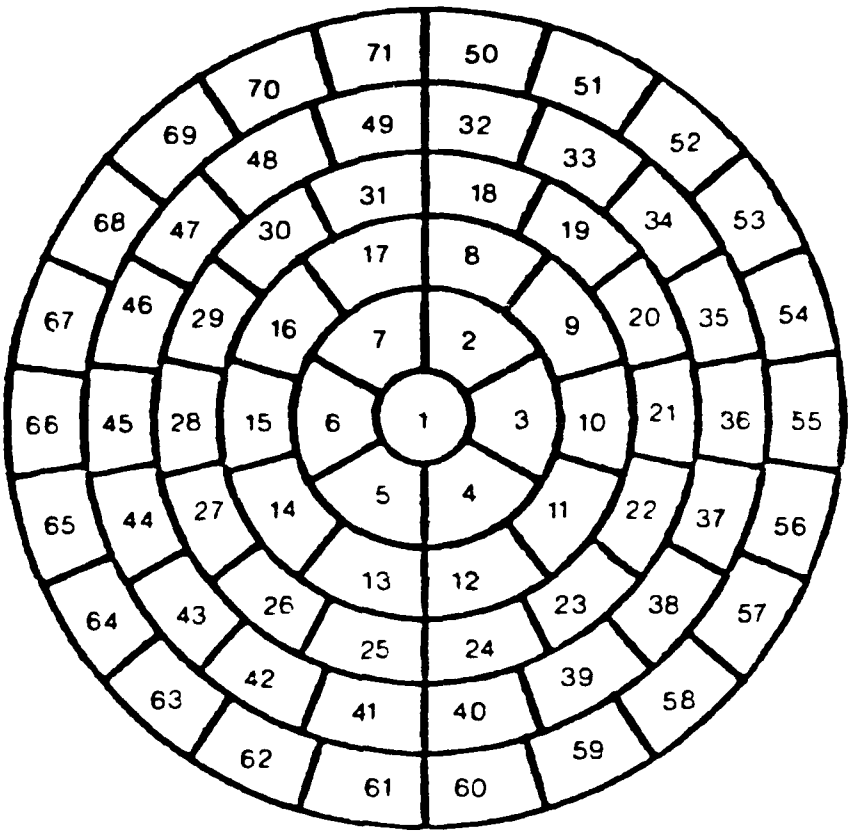

Figure 1. A 360 n mi radius circle divided into 71 equal area (5734.5 n mi^2) segments which can be centered on the station of interest. The circle is comprised of an inner circle and five surrounding rings. The radial thickness of each ring is approximately 60 n mi, but is not a constant. The segments are numbered from the inner circle and spiral outward.

The analyses of the data are presented as isolines which represent the climatological mean or maximum gust to be expected at the station as a percentage of the tropical cyclone center wind. The data base is separated into classification of cyclones, i.e., typhoons and lesser tropical cyclones. The classification is based on the cyclone center wind speed at the time of the station wind observation. Data used to produce the forecast aids are provided in tables 1 to 4.* The data in these tables will assist local reanalysis if desired. To derive the forecast aids for gust values the 1.5 multiplier must be applied.

3. USE OF THE FORECAST AIDS

The forecast aids can be utilized as follows:

1) Locate the actual or forecast tropical cyclone center position on the appropriate forecast aid analysis; 2) determine the maximum (or mean) gust ratio value by interpolating between the contours; and 3) apply this ratio (percentage) to the cyclone center wind value to obtain the maximum (or mean) gust values to be used as an aid in making the wind forecast. For example, if a tropical cyclone has center winds of 100 kt and a ratio of .65 was determined above, then 65% of the center wind gives forecast gusts to 65 kt (.65 X 100 kt) for the station.

Sustained one-minute maximum and average wind values can be found by applying a factor of 2/3 to the gust values.

*Figures & tables, see pp 8-39.

This factor is the inverse of the 1.5 to 1 ratio of gusts to sustained winds that was used in Pettett (1980) and which was substantiated as reasonable by Jarrell and Englebretson (1982a and 1982b).

Figures 2 through 17* are the forecast aid analyses. The contours are labelled as percentages which were derived from the ratios of station winds to tropical cyclone center winds. Note that the maximum contour values on figures 5, 9, 13 and 17 are less than 100 percent. The interpretation of these figures is that the sites have not experienced winds at the official observation point of as great an intensity as the official typhoon center winds during typhoon passages. While these findings are based on a reasonable sample size, caution should be used in applying these results when a typhoon center is expected to pass over or very near the station. It should be noted that extreme wind measurements are frequently lost because of anemometer failure, hence center grid point data may not adequately reflect worst-case conditions.

Inconsistent results will be obtained from the aids when a tropical cyclone center wind change results in a change of cyclone classification and therefore a change of forecast aid. For example, use of Figure 7 for a tropical storm forecast to pass over Hong Kong with 60 kt center winds would indicate mean gusts of about 42 kt. A change in center wind to 65 kt and the use of Figure 9 indicates about 33 kt mean gusts. In cases like this an intermediate value is the likely best guidance.

*Figures & tables, see pp 8-39.

The forecast aids are technically valid only for the reporting station at which wind observations were taken. For example, the Agana data are valid for Naval Air Station, Agana but not for the city of Agana. However, because the data base available for tropical cyclone studies is small, the grid is fairly coarse. It is doubtful that comparabl analysis for the city of Agana, Nimitz Hill or Naval Hospit would have shown substantially different results. Therefor unless there are major differences in exposure between site (e.g., the orientation and elevation of nearby slopes), the forecast aids should provide reasonable estimates of wind gusts over a local area.

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Jarrell, J.D., 1982: Terrain Adjusted Tropical Cyclone Wind Probabilities. NAVENVPREDRSCHFAC Contractor Report CR 82-14.

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Jarrell, J.D., and R.E. Englebretson, 1982b: Forecast Aids for Predicting Tropical Cyclone Associated Gusts and Sustained Winds for Yokosuka, Japan. NAVENVPREDRSCHFAC Contractor Report 82-11.

Pettett, J.E., 1980: Prediction of Typhoon-Induced Peak Winds at Four Pacific Stations. 1WW/TN-80/001.

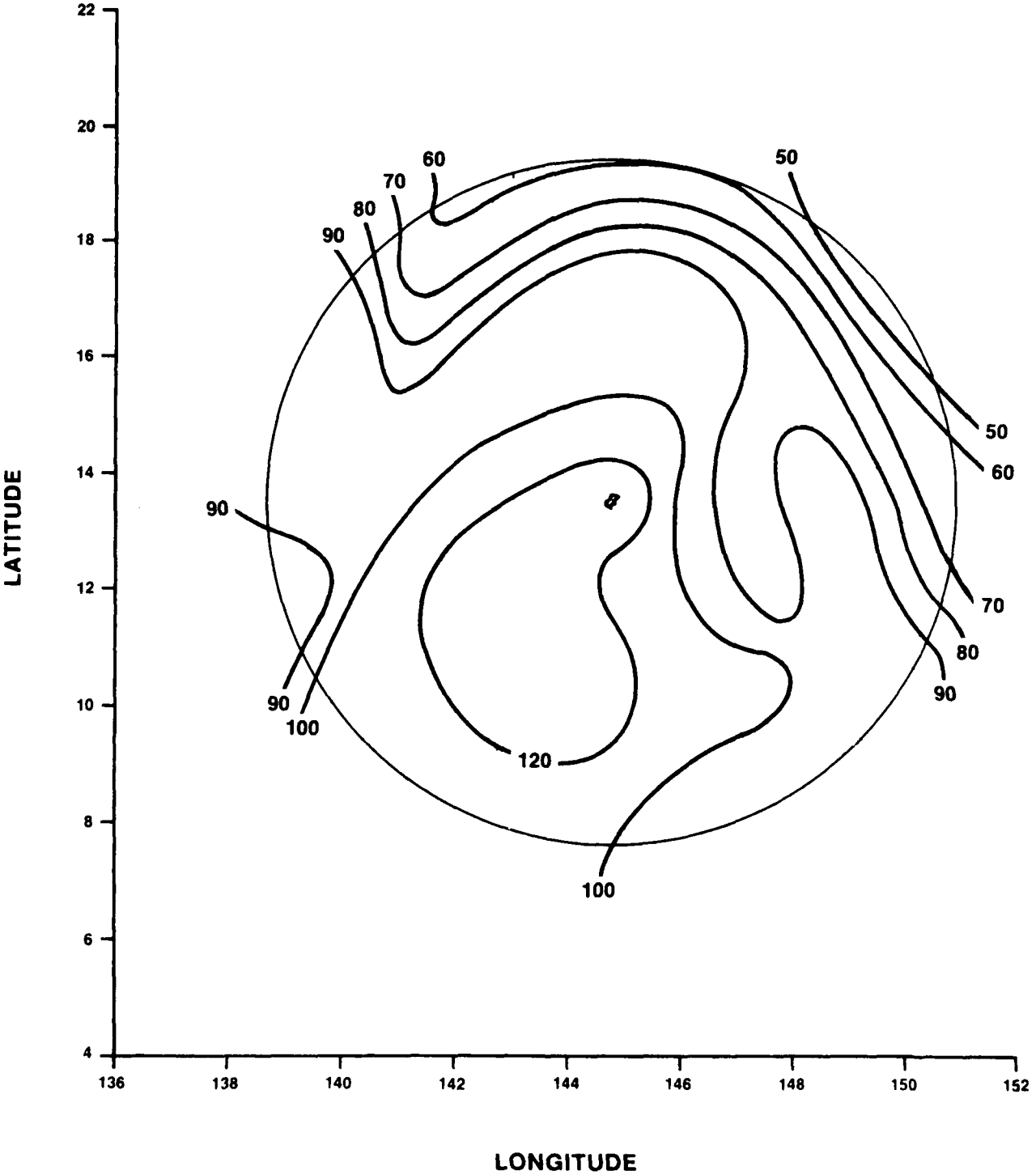

Figure 2. Maximum Gust Ratios (labelled as percentage) for Agana when a tropical cyclone of less than typhoon strength (<64 kt) is centered within 360 n mi of the station. Locate the tropical cyclone center by latitude and longitude and interpolate the ratio (percentage) value. Multiply the tropical cyclone center wind speed by this percentage to get the wind speed value of the maximum gust expected with the given center position and wind speed. Multiply the maximum gust speed by 0.67 to find the maximum one-minute average sustained wind speed.

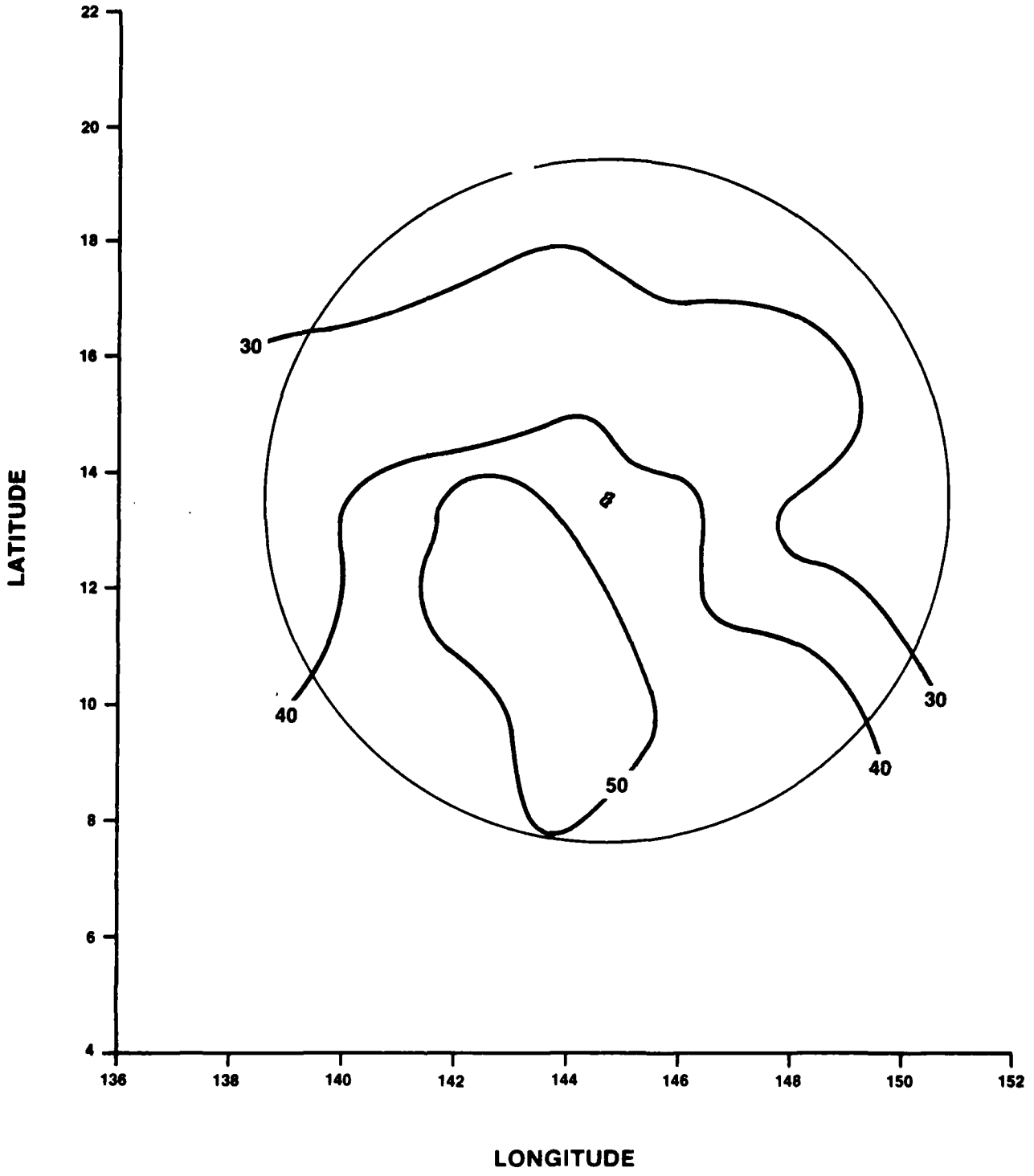

Figure 3. Mean Gust Ratios (labelled as percentage) for Agana when a tropical cyclone of less than typhoon strength (<64 kt) is centered within 360 n mi of the station. Locate the tropical cyclone center by latitude and longitude and interpolate the ratio (percentage) value. Multiply the tropical cyclone center wind speed by this percentage to get the wind speed value of the maximum gust expected with the given center position and wind speed. Multiply the mean gust speed by 0.67 to find the mean one-minute average sustained wind speed.

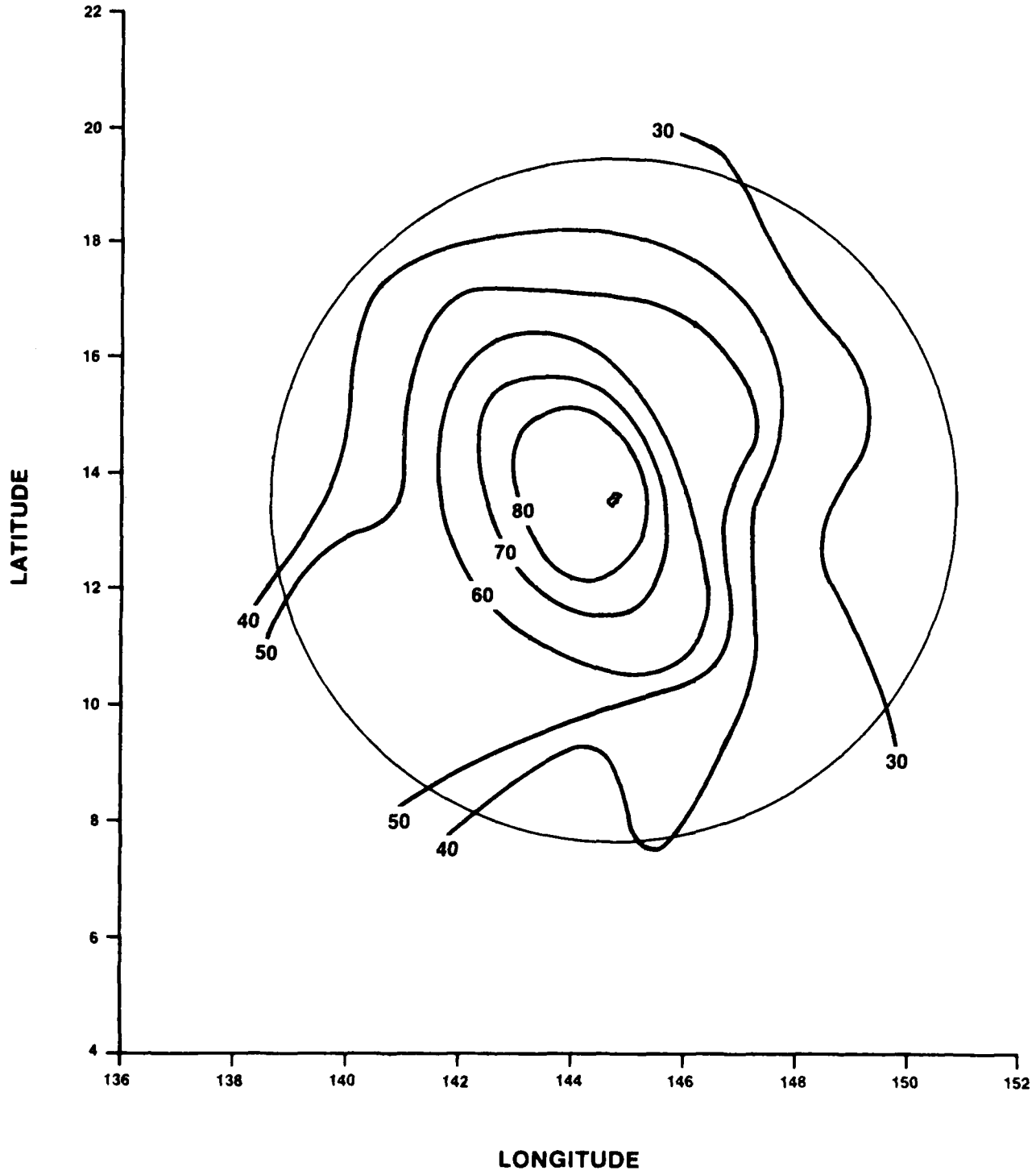

Figure 4. Maximum Gust Ratios (labelled as percentage) for Agana when a tropical cyclone of typhoon strength (≥64 kt) is centered within 360 n mi of the station. Locate the typhoon center by latitude and longitude and interpolate the ratio (percentage) value. Multiply the typhoon center wind speed by this percentage to get the wind speed value of the maximum gust expected with the given center position and wind speed. Multiply the maximum gust speed by 0.67 to find the maximum one-minute average sustained wind speed.

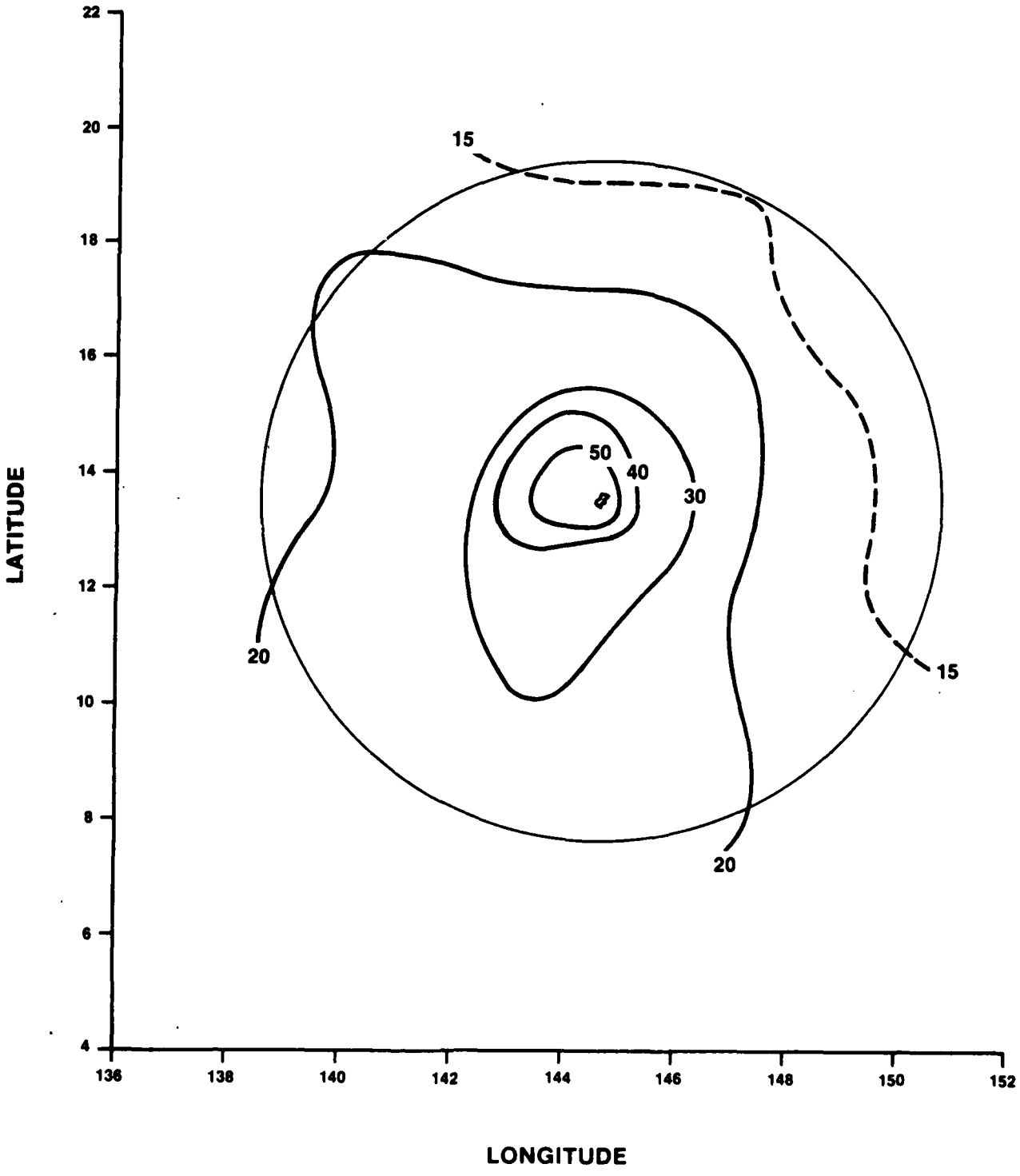

Figure 5. Mean Gust Ratios (labelled as percentage) for Agana when a tropical cyclone of typhoon strength ($\geq$ 64 kt) is centered within 360 n mi of the station. Locate the typhoon center by latitude and longitude and interpolate the ratio (percentage) value. Multiply the typhoon center wind speed by this percentage to get the wind speed value of the mean gust expected with the given center position and wind speed. Multiply the mean gust speed by 0.67 to find the mean one-minute average sustained wind speed.

Table 1. A listing of the data used to produce Figures 2 through 5. Columns represent segment number, latitude and longitude of segment center, maximum ratio, mean ratio, standard deviation of ratios, number of ratios (sample size), and cumulative frequency distribution expressed as the percentage of ratios occurring between 0.0 and 1.0 (in increments of 0.1).

AGANA, GUAM
Tropical cyclones - wind speeds less than 64 knots

CENTER POINT

SEG	LAT	LONG	MAX	MEAN	S.DV.	N	CUM FREQ DISTRN
1	13.5	144.9	1.333	.307	.168	113.	5.33.59.76.91.96.99.99.99.100

RING NUMBER 1

SEG	LAT	LONG	MAX	MEAN	S.DV.	N	CUM FREQ DISTRN
2	14.7	145.5	.636	.251	.154	127.	24.63.84.92.96.98.100100100100
3	13.5	146.2	.600	.312	.155	105.	10.30.51.70.87.100100100100100
4	12.3	145.5	.741	.314	.142	93.	6.29.48.82.88.98.99.100100100
5	12.3	144.0	.720	.359	.133	84.	2.14.32.55.89.93.99.100100100
6	13.5	143.2	.833	.304	.142	109.	6.26.54.80.94.97.99.99.100100
7	14.7	144.0	.706	.273	.145	91.	14.32.64.84.90.97.99.100100100

RING NUMBER 2

SEG	LAT	LONG	MAX	MEAN	S.DV.	N	CUM FREQ DISTRN
8	15.8	145.5	.600	.215	.102	105.	14.51.83.97.97.100100100100100
9	14.9	146.8	.531	.205	.104	84.	18.57.80.96.99.100100100100100
10	13.5	147.3	.455	.198	.104	90.	26.54.82.97.100100100100100100
11	12.1	146.8	.560	.183	.107	66.	32.65.86.97.98.100100100100100
12	11.2	145.5	.767	.320	.161	68.	3.26.53.74.91.93.94.100100100
13	11.2	144.0	.900	.436	.187	81.	1.14.23.48.70.81.90.96.100100
14	12.1	142.7	.833	.385	.154	101.	0.13.33.57.83.90.97.99.100100
15	13.5	142.2	.733	.338	.136	142.	4.14.42.72.90.95.99.100100100
16	14.9	142.7	.429	.195	.089	91.	19.54.89.99.100100100100100100
17	15.8	144.0	.607	.203	.111	95.	19.59.87.94.99.99.100100100100

RING NUMBER 3

SEG	LAT	LONG	MAX	MEAN	S.DV.	N	CUM FREQ DISTRN
18	16.9	145.5	.743	.230	.146	112.	21.49.74.87.96.98.99.100100100
19	16.2	147.0	.640	.207	.108	108.	19.54.81.95.99.99.100100100100
20	15.0	148.0	.750	.200	.144	104.	30.53.82.90.95.98.99.100100100
21	13.5	148.3	.750	.195	.152	79.	41.67.76.91.95.99.99.100100100
22	12.0	148.0	.480	.185	.128	59.	39.64.80.95.100100100100100100
23	10.8	147.0	.750	.270	.138	57.	5.37.68.88.95.96.98.100100100
24	10.1	145.5	.800	.341	.164	67.	3.22.43.64.88.93.96.100100100
25	10.1	144.0	.800	.392	.140	71.	3. 8.21.55.79.96.99.100100100
26	10.8	142.5	.971	.393	.176	92.	1.11.37.61.77.87.95.98.99.100
27	12.0	141.5	.929	.345	.171	105.	7.16.44.74.87.91.95.97.100100
28	13.5	141.2	.739	.299	.131	126.	8.20.53.89.94.96.99.100100100
29	15.0	141.5	.550	.244	.110	104.	12.37.69.94.99.100100100100100
30	16.2	142.5	.714	.222	.119	138.	12.59.79.90.99.99.99.100100100
31	16.9	144.0	.867	.260	.150	67.	10.42.73.93.94.96.97.99.100100

Table 1. continued

RING NUMBER 4

SEG	LAT	LONG	MAX	MEAN	S.DV.	N	CUM FREQ DISTN
32	17.9	145.6	.727	.192	.150	66.	29.68.82.91.92.97.98.100100100
33	17.4	147.1	.583	.254	.124	39.	10.38.69.90.97.100100100100100
34	16.4	148.3	.467	.230	.094	57.	9.40.81.96.100100100100100100
35	15.0	149.1	.500	.215	.118	68.	21.57.72.94.100100100100100100
36	13.5	149.4	.600	.177	.114	73.	30.68.85.97.99.100100100100100
37	12.0	149.1	.600	.201	.129	73.	36.58.79.93.97.100100100100100
38	10.6	148.3	.750	.299	.139	79.	6.28.56.80.94.99.99.100100100
39	9.6	147.1	.700	.279	.117	94.	1.31.62.86.96.99.100100100100
40	9.1	145.6	.667	.317	.136	79.	0.27.54.77.89.95.100100100100
41	9.1	143.9	.806	.385	.148	86.	1.13.29.64.81.91.98.99.100100
42	9.6	142.4	.800	.330	.138	99.	1.19.46.79.87.96.98.100100100
43	10.6	141.2	.750	.313	.148	84.	4.18.60.80.90.94.96.100100100
44	12.0	140.4	.763	.299	.136	77.	4.19.62.81.91.97.99.100100100
45	13.5	140.1	.625	.265	.124	139.	12.35.63.89.96.99.100100100100
46	15.0	140.4	.600	.250	.117	103.	6.49.69.88.98.100100100100100
47	16.4	141.2	.511	.219	.092	89.	9.46.87.96.99.100100100100100
48	17.4	142.4	.522	.204	.099	78.	21.56.82.99.99.100100100100100
49	17.9	143.9	.533	.231	.126	55.	16.42.75.91.98.100100100100100

RING NUMBER 5

SEG	LAT	LONG	MAX	MEAN	S.DV.	N	CUM FREQ DISTN
50	18.9	145.6	.425	.165	.118	38.	42.68.82.95.100100100100100100
51	18.5	147.1	.377	.149	.082	20.	35.85.90.100100100100100100100
52	17.6	148.4	.300	.178	.069	33.	15.64.100100100100100100100100
53	16.5	149.5	.333	.185	.071	36.	14.64.89.100100100100100100100
54	15.0	150.2	.400	.188	.086	44.	18.59.91.100100100100100100100
55	13.5	150.4	.440	.190	.117	60.	30.67.78.95.100100100100100100
56	12.0	150.2	.400	.159	.093	56.	36.68.89.100100100100100100100
57	10.5	149.5	.640	.248	.147	40.	18.48.70.88.98.98.100100100100
58	9.4	148.4	.565	.276	.133	69.	9.39.59.84.94.100100100100100
59	8.5	147.1	.545	.283	.123	68.	3.31.65.79.97.100100100100100
60	8.1	145.6	.640	.422	.133	56.	0. 7.27.45.70.96.100100100100
61	8.1	143.9	.680	.332	.137	71.	0.20.49.80.86.93.100100100100
62	8.5	142.4	.640	.298	.132	71.	3.28.59.83.90.97.100100100100
63	9.4	141.1	.720	.313	.143	80.	4.30.48.76.89.98.98.100100100
64	10.5	140.0	.700	.311	.145	107.	3.23.60.80.86.95.100100100100
65	12.0	139.3	.550	.246	.123	86.	10.43.73.87.98.100100100100100
66	13.5	139.1	.643	.217	.125	105.	17.55.79.90.96.99.100100100100
67	15.0	139.3	.650	.208	.107	85.	14.58.82.96.99.99.100100100100
68	16.5	140.0	.692	.249	.111	52.	8.40.75.96.98.98.100100100100
69	17.6	141.1	.440	.184	.094	65.	23.63.89.98.100100100100100100
70	18.5	142.4	.400	.158	.086	58.	33.74.95.100100100100100100100
71	18.9	143.9	.464	.151	.099	52.	38.67.96.98.100100100100100100

AGANA, GUAM
Tropical cyclones - wind speeds of 64 knots or greater

Table 1. continued

SEG	CENTER POINT LAT	LONG	MAX	MEAN	S.DV.	N	CUM FREQ DIST↑N
1	13.5	144.8	.646	.356	.115	40.	0. 3.33.73.90.95.1001001CC100
	RING NUMBER 1						
SEG	LAT	LONG	MAX	MEAN	S.DV.	N	CUM FREQ DIST↑N
2	14.7	145.5	.354	.226	.068	36.	8.22.86.1001001001001C1C0100
3	13.5	146.2	.320	.203	.048	25.	0.56.92.100100100100100100100
4	12.3	145.5	.453	.227	.084	59.	2.49.80.98.10010010010010010C
5	12.3	144.0	.529	.248	.075	77.	0.23.75.99.99.1001001001C0100
6	13.5	143.3	.522	.278	.075	53.	0.15.60.96.98.100100100100100
7	14.7	144.0	.615	.297	.147	40.	5.35.53.78.90.95.100100100100
	RING NUMBER 2						
SEG	LAT	LONG	MAX	MEAN	S.DV.	N	CUM FREQ DIST↑N
8	15.8	145.5	.347	.112	.064	77.	39.92.99.100100100100100100100
9	14.9	146.8	.371	.163	.085	30.	27.60.97.100100100100100100100
10	13.5	147.3	.208	.159	.036	25.	12.96.1001001001001001C100100
11	12.1	146.8	.267	.148	.055	30.	30.83.1001001001001001C100100
12	11.2	145.5	.427	.147	.078	47.	30.85.94.98.100100100100100100
13	11.2	144.0	.440	.215	.105	49.	12.53.71.94.100100100100100100
14	12.1	142.7	.400	.208	.073	70.	0.54.83.100100100100100100100
15	13.5	142.2	.312	.189	.053	83.	4.63.99.100100100100100100100
16	14.9	142.7	.523	.188	.105	60.	17.69.89.93.97.100100100100100
17	15.8	144.0	.250	.094	.055	68.	63.96.1001001001001001001001100
	RING NUMBER 3						
SEG	LAT	LONG	MAX	MEAN	S.DV.	N	CUM FREQ DIST↑N
18	16.9	145.5	.390	.133	.078	99.	36.80.96.100100100100100100100
19	16.2	147.0	.285	.139	.070	89.	31.75.100100100100100100100100
20	15.C	148.0	.150	.098	.037	16.	50.100100100100100100100100100
21	13.5	148.3	.171	.128	.031	21.	24.1001001001001001001C100100
22	12.0	148.0	.195	.111	.052	24.	29.1001001001001C01001C0100100
23	10.8	147.0	.267	.103	.053	34.	68.94.100100100100100100100100
24	10.1	145.5	.318	.214	.059	26.	4.42.96.100100100100100100100
25	10.1	144.0	.296	.203	.055	49.	6.41.100100100100100100100100
26	10.8	142.5	.277	.193	.048	43.	2.47.1001001001001001001001C0
27	12.0	141.5	.343	.173	.058	58.	12.69.97.100100100100100100100
28	13.5	141.2	.382	.162	.069	124.	18.79.95.100100100100100100100
29	15.0	141.5	.414	.159	.076	111.	17.80.93.99.1001001001CC100100
30	16.2	142.5	.354	.150	.073	69.	28.74.95.1001001001001C0100100
31	16.9	144.0	.400	.135	.086	79.	47.73.95.100100100100100100100

Table 1. continued

RING NUMBER 4

SEG	LAT	LONG	MAX	MEAN	S.DV.	N	CUM FREQ DISTRN
32	17.9	145.6	.329	.107	.056	125.	48.94.99.1001001001001C1CC100
33	17.4	147.1	.204	.110	.045	78.	47.99.1001001001001001C100100
34	16.4	148.3	.314	.097	.069	37.	62.89.97.100100100100100100100
35	15.0	149.1	.241	.111	.065	18.	56.89.100100100100100100100100
36	13.5	149.4	.205	.129	.038	15.	40.93.1001001001C0100100100100
37	12.0	149.1	.174	.120	.035	26.	23.1001001001001001001C0100100
38	10.6	148.3	.200	.098	.051	34.	62.100100100100100100100100100
39	9.6	147.1	.329	.156	.079	27.	33.67.96.1001001001001001001100
40	9.1	145.6	.282	.231	.042	25.	0.32.100100100100100100100100
41	9.1	143.9	.200	.132	.051	15.	47.1001001001C1001001001001100
42	9.6	142.4	.343	.176	.049	23.	0.78.96.1001001001001C0100100
43	10.6	141.2	.368	.190	.075	35.	14.63.91.1001001001001C0100100
44	12.0	140.4	.377	.194	.072	57.	11.60.95.1001001001001001001100
45	13.5	140.1	.294	.151	.050	96.	15.86.100100100100100100100100
46	15.0	140.4	.295	.139	.059	52.	25.90.1001001001001001001100100
47	16.4	141.2	.256	.146	.061	53.	25.75.1001001001001001C100100
48	17.4	142.4	.354	.151	.087	59.	41.66.97.1001001001001001001100
49	17.9	143.9	.220	.104	.049	83.	48.95.1001001001001001001100100

RING NUMBER 5

SEG	LAT	LONG	MAX	MEAN	S.DV.	N	CUM FREQ DISTRN
50	18.9	145.6	.231	.102	.051	91.	53.95.1001001001001001C0100
51	18.5	147.1	.221	.121	.043	49.	24.95.1001001001001001001100100
52	17.6	148.4	.157	.070	.045	26.	65.1001001001001001001001100100
53	16.5	149.5	.144	.059	.039	34.	79.1001001001001001001001C0100
54	15.0	150.2	.131	.058	.029	21.	90.1001001001001001001C100100
55	13.5	150.4	.239	.078	.044	20.	85.95.1001001001001001001100100
56	12.0	150.2	.171	.088	.038	14.	64.1001001001001001001001100100
57	10.5	149.5	.200	.101	.042	34.	47.1001001001001001001001C0100
58	9.4	148.4	.157	.108	.032	22.	50.1001001001001001001001100100
59	8.5	147.1	.231	.136	.051	16.	31.88.1001001001001001001001100
60	8.1	145.6	.259	.141	.048	29.	24.84.1001001001C1001001001001
61	8.1	143.9	.188	.139	.028	12.	8.1001001001001C1001001001001
62	8.5	142.4	.292	.181	.057	12.	0.67.1001001001001001001C100100
63	9.4	141.1	.338	.158	.059	23.	9.83.96.1001001001001001001100
64	10.5	140.0	.329	.158	.054	32.	9.81.94.1001001001001001001100
65	12.0	139.3	.411	.173	.085	55.	18.76.89.96.1001001001001001100
66	13.5	139.1	.243	.127	.046	67.	25.94.1001001001001001001C100100
67	15.0	139.3	.212	.128	.039	55.	22.98.1001001001001001001C100100
68	16.5	140.0	.277	.131	.050	51.	25.90.1001001001001001001001100
69	17.6	141.1	.244	.130	.056	45.	29.91.1001001001001001001001100
70	18.5	142.4	.286	.127	.067	79.	42.89.1001001001001001001001100
71	18.9	143.9	.247	.099	.051	88.	51.97.1001001001001001001001100

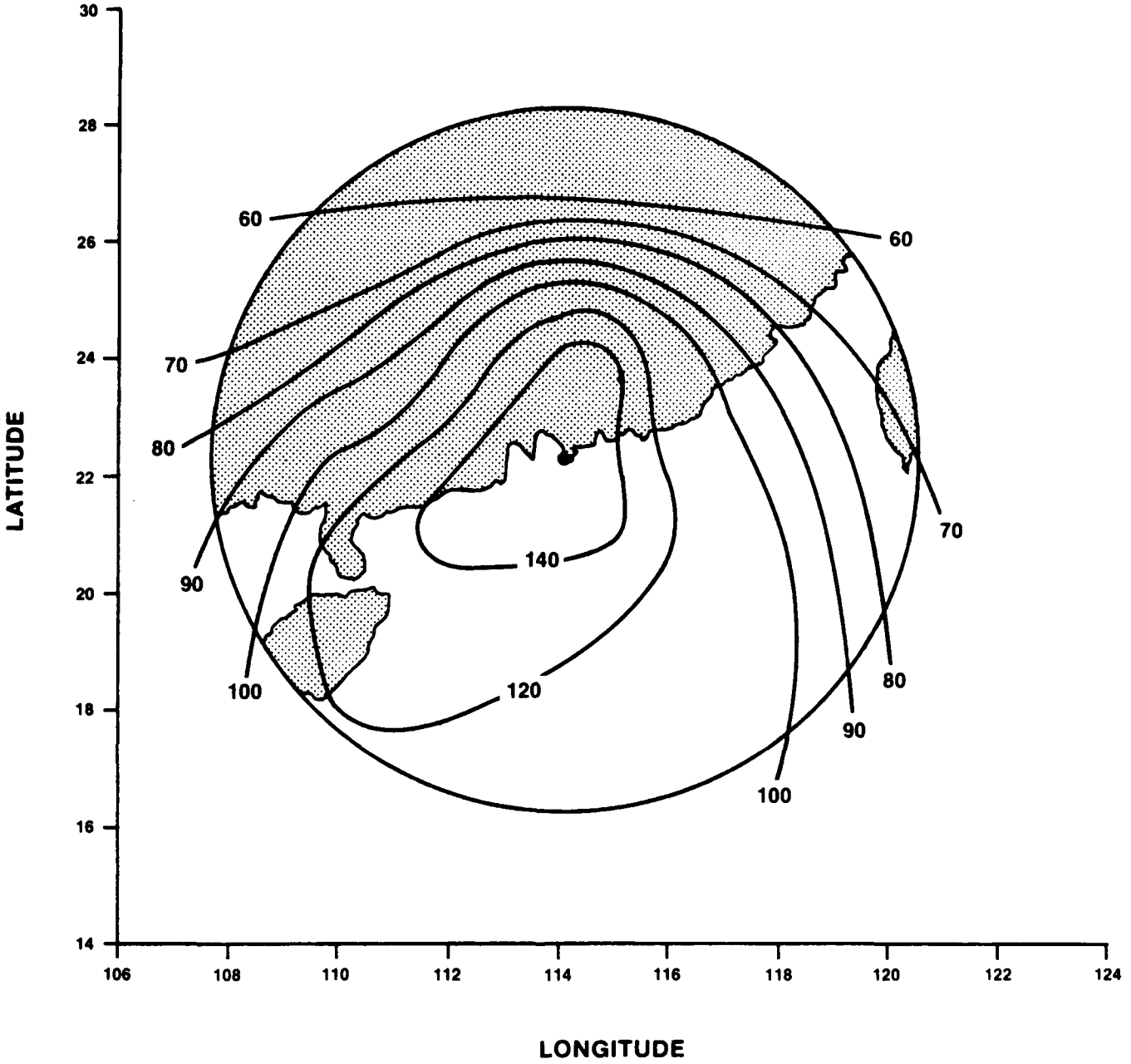

Figure 6. Maximum Gust Ratios (labelled as percentage) for Hong Kong when a tropical cyclone of less than typhoon strength (<64 kt) is centered within 360 n mi of the station. Locate the tropical cyclone center by latitude and longitude and interpolate the ratio (percentage) value. Multiply the tropical cyclone center wind speed by this percentage to get the wind speed value of the maximum gust expected with the given center position and wind speed. Multiply the maximum gust speed by 0.67 to find the maximum one-minute average sustained wind speed.

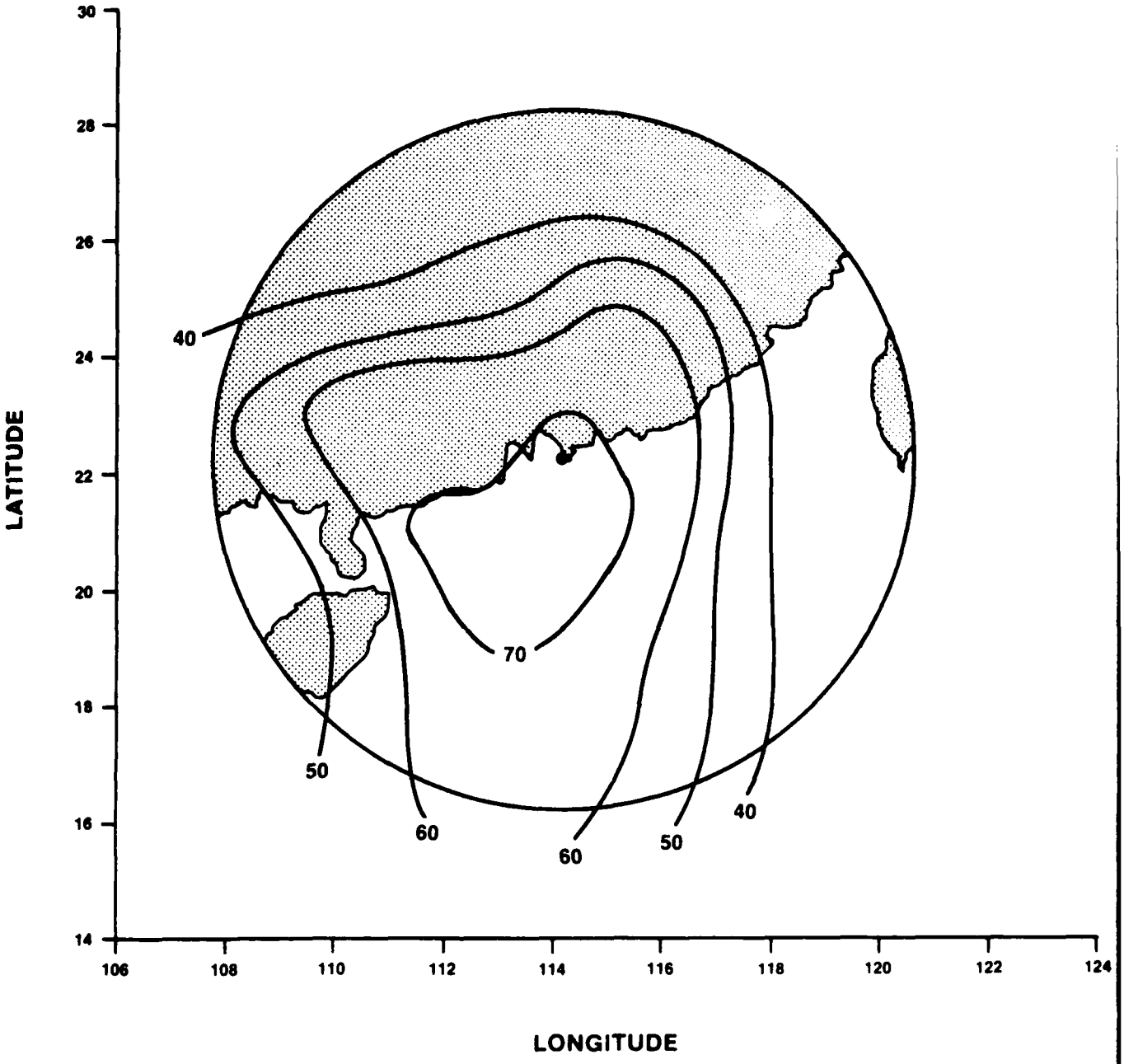

Figure 7. Mean Gust Ratios (labelled as percentage) for Hong Kong when a tropical cyclone of less than typhoon strength (<64 kt) is centered within 360 n mi of the station. Locate the tropical cyclone center by latitude and longitude and interpolate the ratio (percentage) value. Multiply the tropical cyclone center wind speed by this percentage to get the wind speed value of the maximum gust expected with the given center position and wind speed. Multiply the mean gust speed by 0.67 to find the mean one-minute average sustained wind speed.

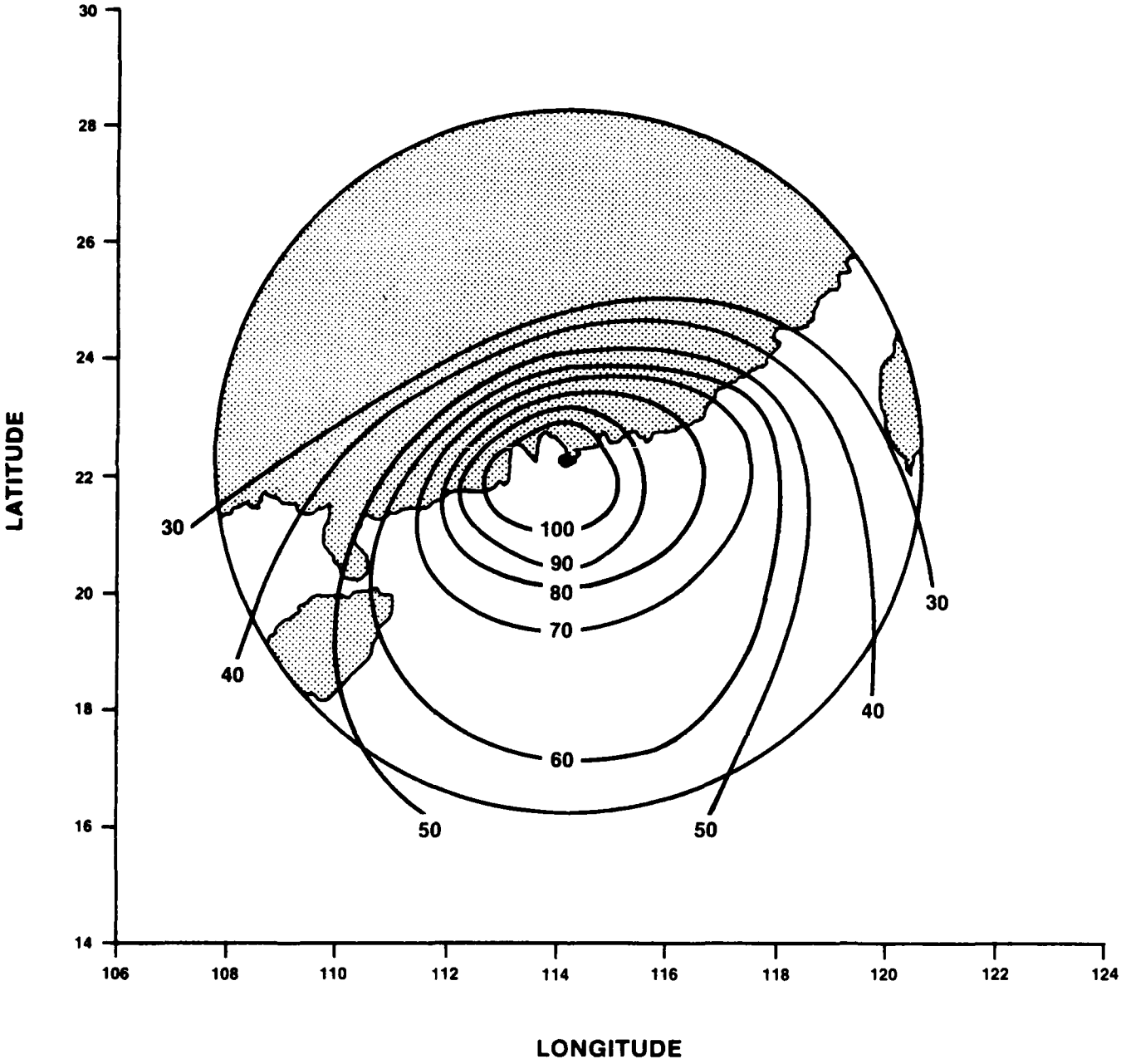

Figure 8. Maximum Gust Ratios (labelled as percentage) for Hong Kong when a tropical cyclone of typhoon strength ($\geq$64 kt) is centered within 360 n mi of the station. Locate the typhoon center by latitude and longitude and interpolate the ratio (percentage) value. Multiply the typhoon center wind speed by this percentage to get the wind speed value of the maximum gust expected with the given center position and wind speed. Multiply the maximum gust speed by 0.67 to find the maximum one-minute average sustained wind speed.

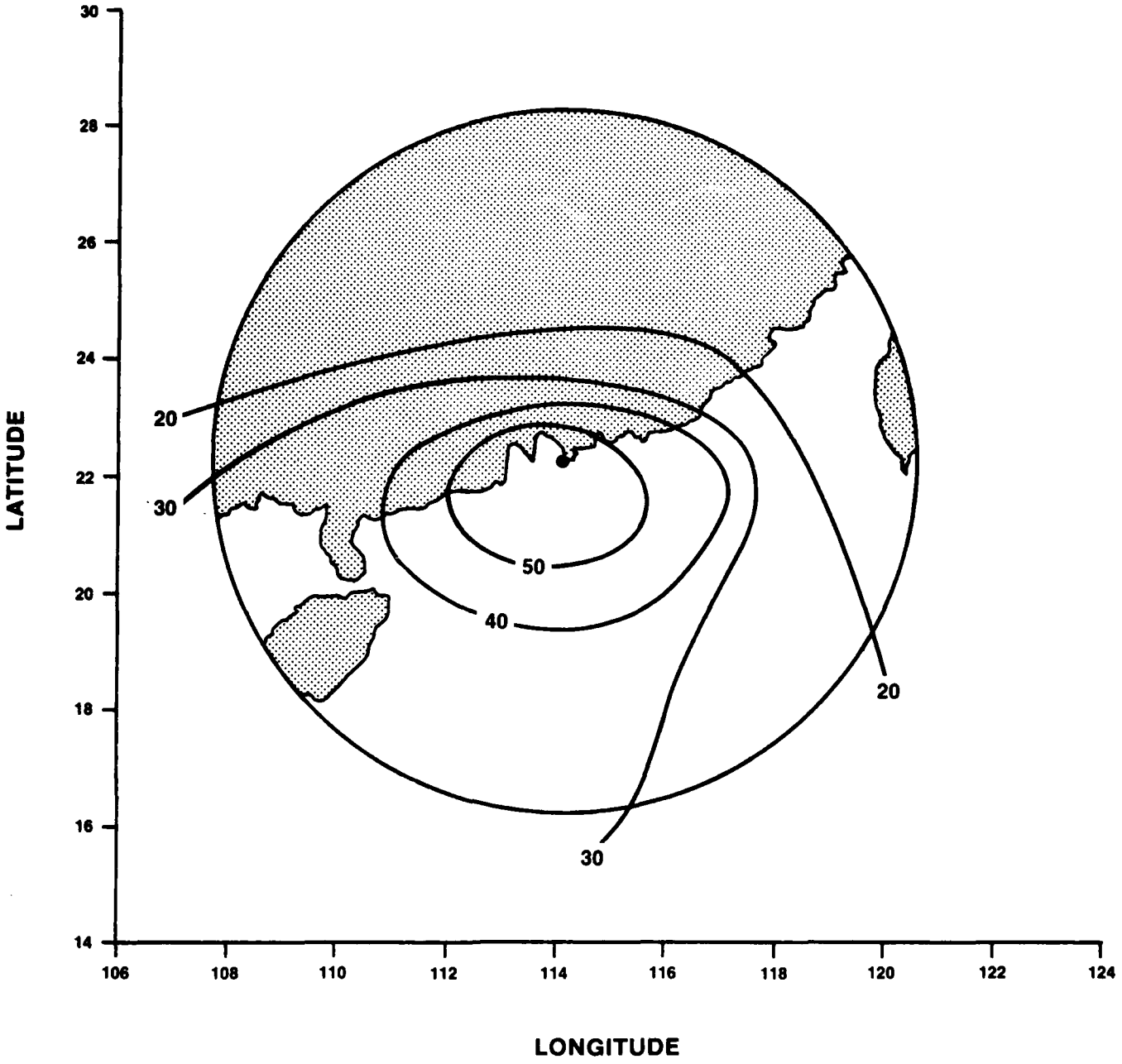

Figure 9. Mean Gust Ratios (labelled as percentage) for Hong Kong when a tropical cyclone of typhoon strength ($\geq$ 64 kt) is centered within 360 n mi of the station. Locate the typhoon center by latitude and longitude and interpolate the ratio (percentage) value. Multiply the typhoon center wind speed by this percentage to get the wind speed value of the mean gust expected with the given center position and wind speed. Multiply the mean gust speed by 0.67 to find the mean one-minute average sustained wind speed.

Table 2. A listing of the data used to produce Figures 6 through 9. Columns represent segment number, latitude and longitude of segment center, maximum ratio, mean ratio, standard deviation of ratios, number of ratios (sample size), and cumulative frequency distribution expressed as the percentage of ratios occurring between 0.0 and 1.0 (in increments of 0.1).

HONG KONG
Tropical cyclones - wind speeds less than 64 knots

SEG	LAT	LONG	MAX	MEAN	S.DV.	N	CUM FREQ DIST*N
CENTER POINT							
1	22.3	114.2	1.371	.486	.226	37.	5. 8.16.35.51.86.92.95.97.100
RING NUMBER 1							
SEG	LAT	LONG	MAX	MEAN	S.DV.	N	CUM FREQ DIST*N
2	23.5	115.0	.900	.381	.219	52.	12.23.42.60.69.85.92.96.100100
3	22.3	115.7	.818	.455	.158	43.	0. 7.14.40.65.81.95.98.100100
4	21.1	115.0	1.026	.534	.198	72.	3. 4.10.29.46.57.75.93.99.100
5	21.1	113.4	1.045	.487	.175	116.	0. 1.11.38.59.81.90.93.96.100
6	22.3	112.7	1.120	.381	.219	53.	11.19.40.57.75.87.92.94.98.100
7	23.5	113.4	.933	.419	.221	9.	0.11.33.56.78.78.89.89.89.100
RING NUMBER 2							
SEG	LAT	LONG	MAX	MEAN	S.DV.	N	CUM FREQ DIST*N
8	24.6	115.0	1.087	.506	.305	14.	14.14.36.43.57.64.71.79.86.100
9	23.7	116.3	.700	.364	.165	46.	9.17.35.61.83.93.100100100100
10	22.3	116.9	.733	.375	.154	40.	5. 8.35.65.78.90.98.100100100
11	20.9	116.3	.913	.404	.179	72.	10.14.25.54.74.86.97.99.99.100
12	20.0	115.0	.875	.433	.155	77.	1. 6.16.51.75.83.94.96.100100
13	20.0	113.4	.840	.510	.147	44.	0. 0. 7.27.45.73.93.95.100100
14	20.9	112.1	1.250	.517	.203	123.	0. 2. 4.33.60.83.85.88.93.100
15	22.3	111.5	.857	.438	.135	30.	0. 0.20.40.77.93.97.97.100100
16	23.7	112.1	.475	.449	.020	3.	0. 0. 0. 0.100100100100100100
17	24.6	113.4	.880	.346	.264	11.	36.45.45.55.64.91.91.91.100100
RING NUMBER 3							
SEG	LAT	LONG	MAX	MEAN	S.DV.	N	CUM FREQ DIST*N
18	25.7	115.0	.600	.197	.184	8.	50.50.75.88.88.100100100100100
19	25.0	116.5	.480	.201	.115	24.	21.58.79.92.100100100100100100
20	23.8	117.6	.633	.252	.114	39.	5.36.67.92.97.97.100100100100
21	22.3	118.0	.514	.217	.116	33.	18.58.73.94.97.100100100100100
22	20.8	117.6	.760	.249	.183	73.	16.55.73.81.89.93.97.100100100
23	19.6	116.5	.617	.298	.136	70.	9.27.49.83.94.99.100100100100
24	18.9	115.0	.862	.397	.174	94.	3.16.38.61.79.86.94.97.100100
25	18.9	113.4	1.150	.520	.198	102.	0. 4.14.29.51.71.88.93.97.100
26	19.6	111.9	.914	.375	.130	73.	1. 5.25.68.90.96.96.99.99.100
27	20.8	110.8	.800	.387	.164	44.	0.11.30.66.82.89.93.100100100
28	22.3	110.4	.800	.396	.124	31.	0. 3.23.52.90.97.97.100100100
29	23.8	110.8	.636	.416	.161	12.	8. 8.33.42.75.92.100100100100
30	25.0	111.9	.700	.542	.134	4.	0. 0. 0.25.25.75.100100100100
31	25.7	113.4	.200	.118	.042	5.	60.100100100100100100100100

Table 2. continued

RING NUMBER 4

SEG	LAT	LONG	MAX	MEAN	S.DV.	N	CUM FREQ DISTRN
32	26.7	115.0	.400	.262	.107	10.	10.30.60.100100100100100100
33	26.2	116.6	.400	.214	.121	10.	20.60.70.100100100100100100
34	25.2	117.9	.600	.239	.167	43.	30.53.67.81.91.100100100100
35	23.8	118.8	.560	.240	.135	43.	14.44.74.86.98.100100100100
36	22.3	119.0	.457	.210	.110	53.	19.57.81.98.100100100100100
37	20.8	118.8	.700	.169	.127	24.	25.83.92.96.96.96.100100100
38	19.4	117.9	.528	.175	.117	52.	31.71.85.96.98.100100100100
39	18.4	116.6	.640	.287	.142	43.	14.33.56.84.93.98.100100100
40	17.9	115.0	.909	.396	.185	71.	3.18.34.61.73.85.94.97.99.100
41	17.9	113.4	.767	.387	.163	123.	5.15.34.51.78.90.98.100100100
42	18.4	111.8	.810	.441	.143	121.	0. 3.21.47.64.88.98.99.100100
43	19.4	110.5	.750	.340	.101	55.	0. 5.27.89.95.96.98.100100100
44	20.8	109.6	.800	.354	.168	52.	2.10.48.79.85.87.96.100100100
45	22.3	109.4	.675	.361	.118	31.	0.10.39.71.87.97.100100100100
46	23.8	109.6	.424	.412	.012	2.	0. 0. 0.50.100100100100100100
47	25.2	110.5	.326	.279	.046	2.	0. 0.50.100100100100100100
48	26.2	111.8	.400	.276	.107	3.	0.33.67.100100100100100100
49	26.7	113.4	.343	.272	.051	4.	0. 0.75.100100100100100100

RING NUMBER 5

SEG	LAT	LONG	MAX	MEAN	S.DV.	N	CUM FREQ DISTRN
50	27.7	115.0	.333	.205	.128	2.	50.50.50.100100100100100100
51	27.3	116.7	.156	.1560	.000	1.	0.100100100100100100100100
52	26.4	118.1	.400	.122	.102	10.	70.80.90.100100100100100100
53	25.3	119.2	.571	.219	.190	16.	38.63.69.81.81.100100100100
54	23.8	119.9	.500	.229	.155	13.	31.46.69.85.100100100100100
55	22.3	120.1	.349	.124	.085	21.	52.81.95.100100100100100100
56	20.8	119.9	.467	.218	.120	34.	24.50.71.94.100100100100100
57	19.3	119.2	.462	.178	.104	46.	33.57.96.98.100100100100100
58	18.2	118.1	.700	.252	.171	78.	28.37.64.81.90.97.100100100
59	17.3	116.7	.780	.368	.178	42.	7.17.45.60.74.90.98.100100100
60	16.9	115.0	.900	.392	.172	92.	0.17.32.65.75.90.96.98.100100
61	16.9	113.4	.750	.383	.213	36.	6.22.53.61.69.75.92.100100100
62	17.3	111.7	.864	.435	.149	122.	0. 7.20.49.69.87.98.99.100100
63	18.2	110.3	.800	.368	.148	99.	1.11.33.69.82.92.98.100100100
64	19.3	109.2	.733	.328	.137	82.	0.17.46.83.89.93.99.100100100
65	20.8	108.5	.571	.307	.110	55.	4.24.45.84.96.100100100100100
66	22.3	108.3	.600	.385	.093	20.	0. 0.25.60.95.100100100100100
67	23.8	108.5	.500	.310	.125	4.	0.50.50.75.100100100100100100
68	25.3	109.2	.218	.122	.097	2.	50.50.100100100100100100100
69	26.4	110.3	.263	.2630	.000	1.	0. 0.100100100100100100100100
70	27.3	111.7	.417	.375	.042	2.	0. 0. 0.50.100100100100100100
71	27.7	113.4	.600	.269	.209	4.	25.50.75.75.75.100100100100100

HONG KONG

Tropical cyclones - wind speeds of 64 knots or greater Table 2. continued

SEG	CENTER POINT LAT	LONG	MAX	MEAN	S.DV.	N	CUM FREQ DIST↑N
1	22.3	114.2	.789	.332	.140	23.	0. 4.65.74.91.96.96.10010C10C
RING NUMBER 1							
SEG	LAT	LONG	MAX	MEAN	S.DV.	N	CUM FREQ DIST↑N
2	23.5	115.0	.265	.220	.044	2.	0.50.1001001001001C1C010C100
3	22.3	115.7	.484	.316	.080	13.	0. 8.38.85.10010010010010010C
4	21.1	115.0	.676	.334	.121	20.	0.15.40.70.95.95.100100100100
5	21.1	113.4	.558	.364	.121	23.	0. 9.35.70.78.96.100100100100
6	22.3	112.7	.714	.338	.159	7.	0. 0.57.86.86.86.86.100100100
7	23.5	113.4	.192	.1920.000		1.	0.100100100100100100100100100
RING NUMBER 2							
SEG	LAT	LONG	MAX	MEAN	S.DV.	N	CUM FREQ DIST↑N
8	24.6	115.0	.222	.118	.104	2.	50.50.1001001001001001C0100100
9	23.7	116.3					
10	22.3	116.9	.527	.290	.109	20.	10.15.45.90.95.10010C1CC100100
11	20.9	116.3	.500	.263	.147	11.	18.36.64.82.100100100100100100
12	20.0	115.0	.492	.242	.081	37.	5.19.86.97.100100100100100100
13	20.0	113.4	.432	.300	.078	42.	0.12.55.90.100100100100100100
14	20.9	112.1	.368	.246	.072	19.	0.42.74.100100100100100100100
15	22.3	111.5	.313	.3130.000		1.	0. 0. 0.100100100100100100100
16	23.7	112.1					
17	24.6	113.4					
RING NUMBER 3							
SEG	LAT	LONG	MAX	MEAN	S.DV.	N	CUM FREQ DIST↑N
18	25.7	115.0					
19	25.0	116.5	.041	.0410.000		1.	100100100100100100100100100100
20	23.8	117.6	.147	.140	.007	2.	0.100100100100100100100C100100
21	22.3	118.0	.348	.163	.086	19.	26.74.95.100100100100100100100
22	20.8	117.6	.312	.141	.077	20.	40.75.95.10010010010010010010C
23	19.6	116.5	.425	.192	.098	31.	23.45.94.97.10010010010C100100
24	18.9	115.0	.375	.195	.093	32.	19.53.81.10010010010010010010C
25	18.9	113.4	.456	.275	.089	48.	0.29.52.92.10010010010C100100
26	19.6	111.9	.414	.257	.066	45.	0.22.76.96.100100100100100100
27	20.8	110.8	.400	.227	.075	8.	0.25.88.100100100100100100100
28	22.3	110.4	.246	.2460.000		1.	0. 0.100100100100100100100100
29	23.8	110.8	.169	.1690.000		1.	0.100100100100100100100100100
30	25.0	111.9					
31	25.7	113.4					

Table 2. continued

1
0 RING NUMBER 4

SEG	LAT	LONG	MAX	MEAN	S.DV.	N	CUM FREQ DIST↑N
32	26.7	115.0					
33	26.2	116.6					
34	25.2	117.9					
35	23.8	118.8	.246	.179	.033	6.	0.83.100100100100100100100100
36	22.3	119.0	.246	.104	.051	36.	44.97.100100100100100100100100
37	20.8	118.8	.224	.147	.052	21.	14.90.100100100100100100100100
38	19.4	117.9	.323	.177	.085	21.	29.62.90.100100100100100100100
39	18.4	116.6	.386	.236	.093	26.	12.31.69.100100100100100100100
40	17.9	115.0	.357	.157	.084	11.	36.82.91.100100100100100100100
41	17.9	113.4	.437	.240	.085	39.	3.41.77.97.100100100100100100
42	18.4	111.8	.338	.247	.049	40.	0.25.83.100100100100100100100
43	19.4	110.5	.400	.247	.075	17.	0.41.71.100100100100100100100
44	20.8	109.6	.286	.256	.017	4.	0. 0.100100100100100100100100
45	22.3	109.4	.323	.3230	.000	1.	0. 0. 0.100100100100100100100
46	23.8	109.6					
47	25.2	110.5					
48	26.2	111.8					
49	26.7	113.4					

0 RING NUMBER 5

SEG	LAT	LONG	MAX	MEAN	S.DV.	N	CUM FREQ DIST↑N
50	27.7	115.0					
51	27.3	116.7	.164	.141	.023	2.	0.100100100100100100100100100
52	26.4	118.1					
53	25.3	119.2	.161	.081	.061	5.	40.100100100100100100100100100
54	23.8	119.9	.163	.108	.056	4.	50.100100100100100100100100100
55	22.3	120.1	.212	.103	.061	13.	46.92.100100100100100100100100
56	20.8	119.9	.300	.140	.071	42.	26.81.100100100100100100100100
57	19.3	119.2	.262	.135	.072	32.	38.75.100100100100100100100100
58	18.2	118.1	.323	.142	.084	30.	33.77.97.100100100100100100100
59	17.3	116.7	.397	.158	.112	15.	47.73.80.100100100100100100100
60	16.9	115.0	.385	.218	.091	31.	6.45.81.100100100100100100100
61	16.9	113.4	.300	.201	.060	57.	9.42.100100100100100100100100
62	17.3	111.7	.260	.192	.038	31.	3.58.100100100100100100100100
63	18.2	110.3	.307	.213	.039	16.	0.50.94.100100100100100100100
64	19.3	109.2	.257	.182	.048	5.	0.60.100100100100100100100100
65	20.8	108.5	.262	.239	.024	4.	0.25.100100100100100100100100
66	22.3	108.3					
67	23.8	108.5					
68	25.3	109.2					
69	26.4	110.3					
70	27.3	111.7					
71	27.7	113.4					

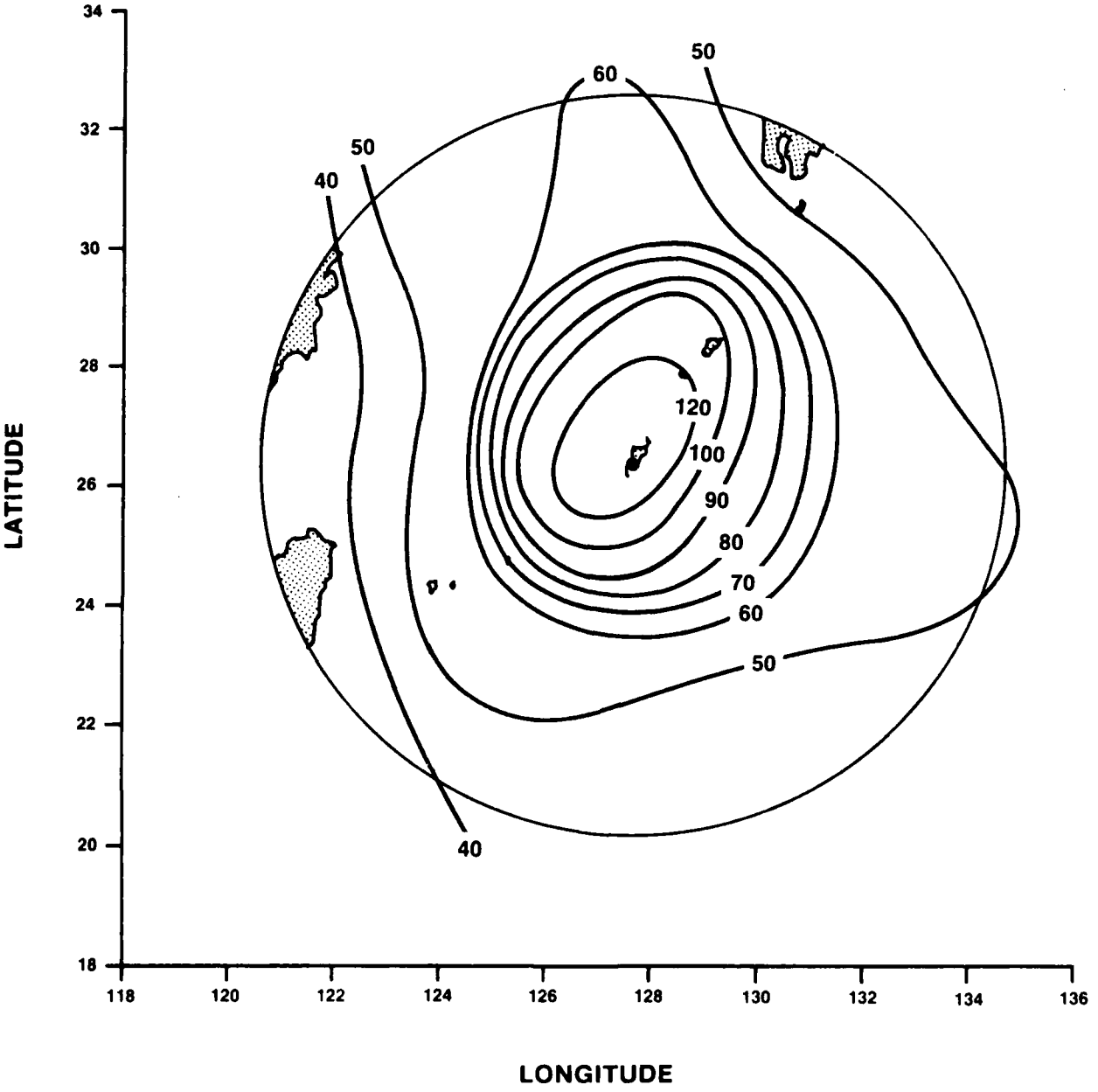

Figure 10. Maximum Gust Ratios (labelled as percentage) for Kadena when a tropical cyclone of less than typhoon strength (<64 kt) is centered within 360 n mi of the station. Locate the tropical cyclone center by latitude and longitude and interpolate the ratio (percentage) value. Multiply the tropical cyclone center wind speed by this percentage to get the wind speed value of the maximum gust expected with the given center position and wind speed. Multiply the maximum gust speed by 0.67 to find the maximum one-minute average sustained wind speed.

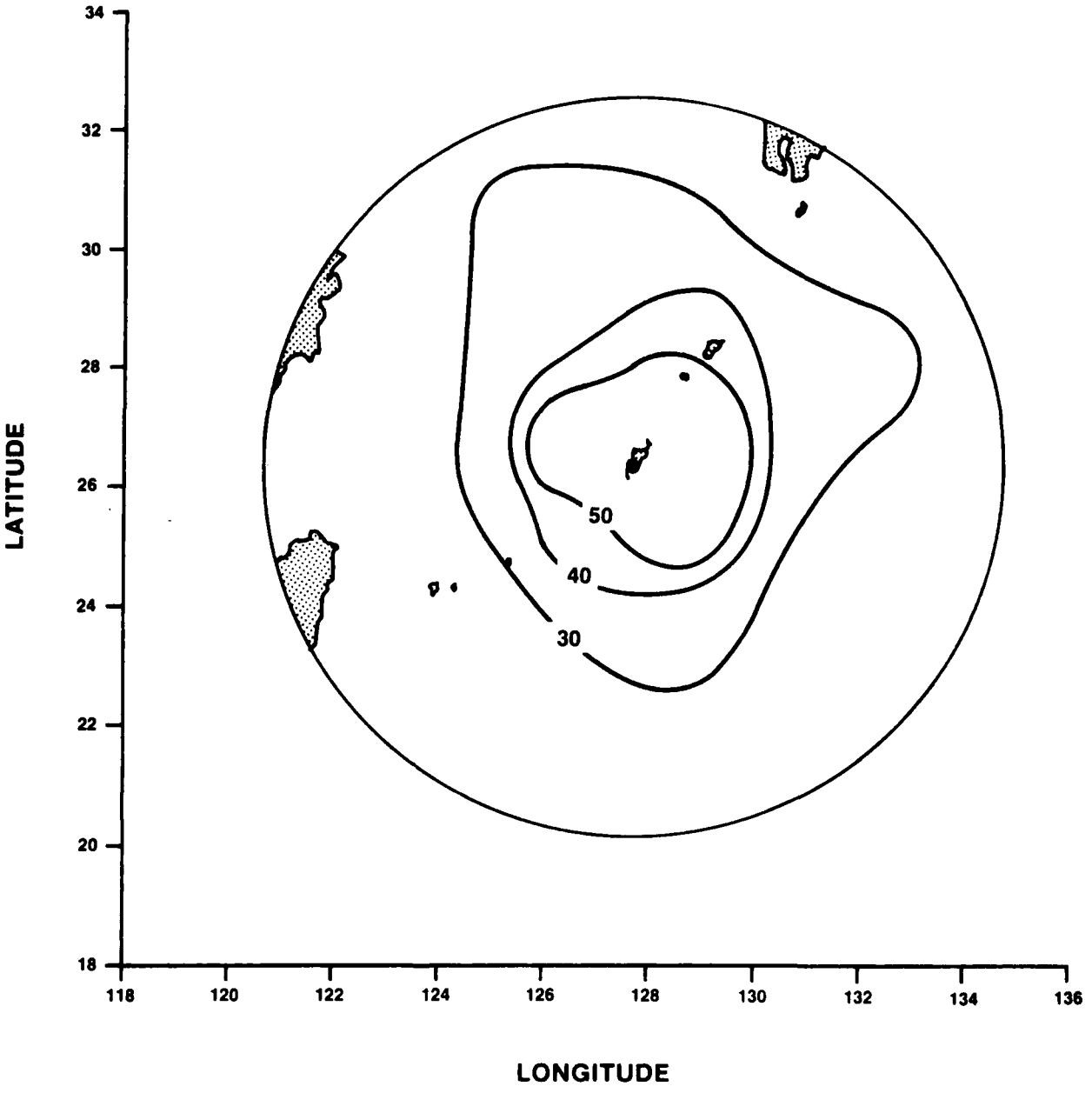

Figure 11. Mean Gust Ratios (labelled as percentage) for Kadena when a tropical cyclone of less than typhoon strength (<64 kt) is centered within 360 n mi of the station. Locate the tropical cyclone center by latitude and longitude and interpolate the ratio (percentage) value. Multiply the tropical cyclone center wind speed by this percentage to get the wind speed value of the maximum gust expected with the given center position and wind speed. Multiply the mean gust speed by 0.67 to find the mean one-minute average sustained wind speed.

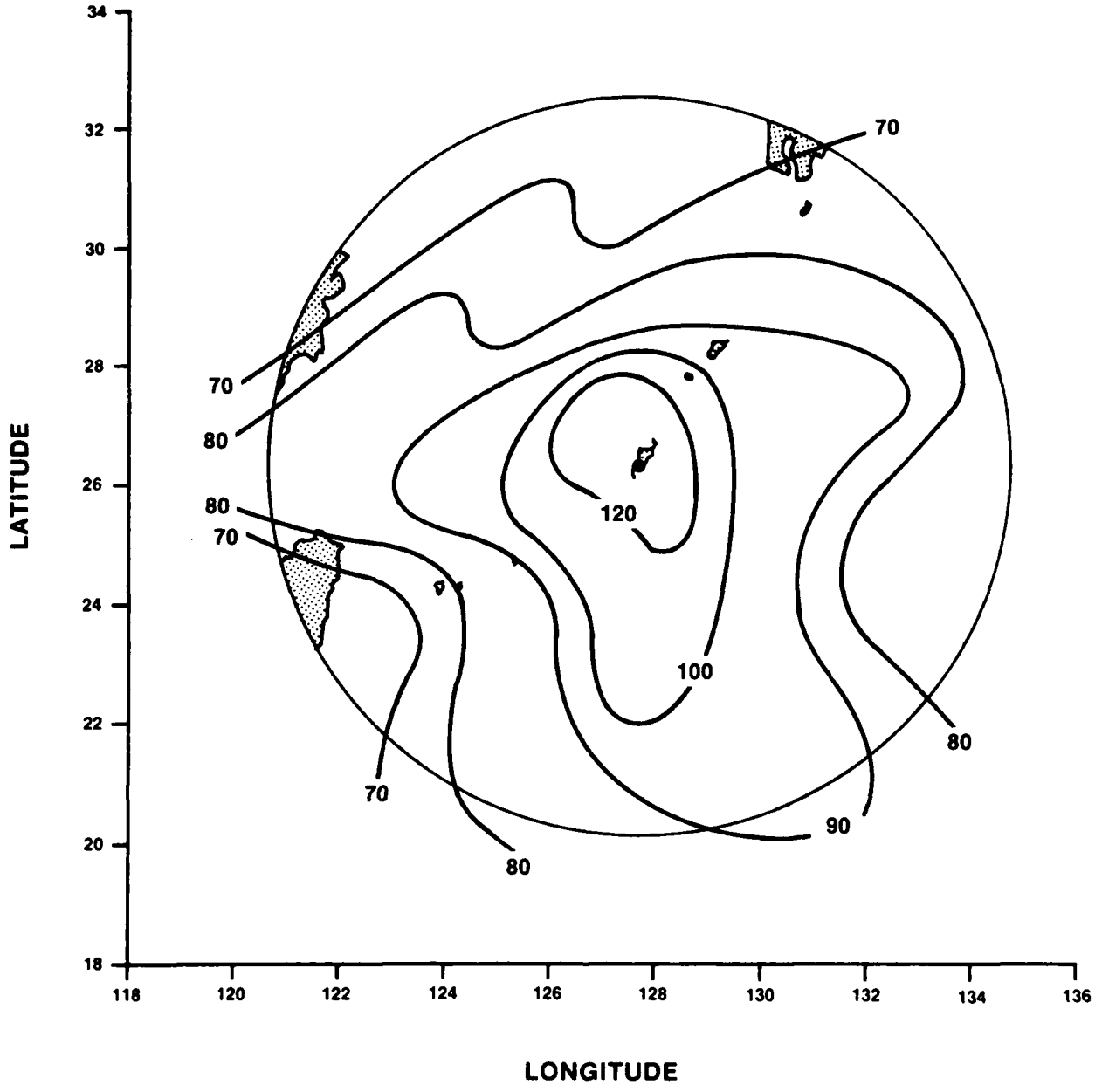

Figure 12. Maximum Gust Ratios (labelled as percentage) for Kadena when a tropical cyclone of typhoon strength ($\geq$64 kt) is centered within 360 n mi of the station. Locate the typhoon center by latitude and longitude and interpolate the ratio (percentage) value. Multiply the typhoon center wind speed by this percentage to get the wind speed value of the maximum gust expected with the given center position and wind speed. Multiply the maximum gust speed by 0.67 to find the maximum one-minute average sustained wind speed.

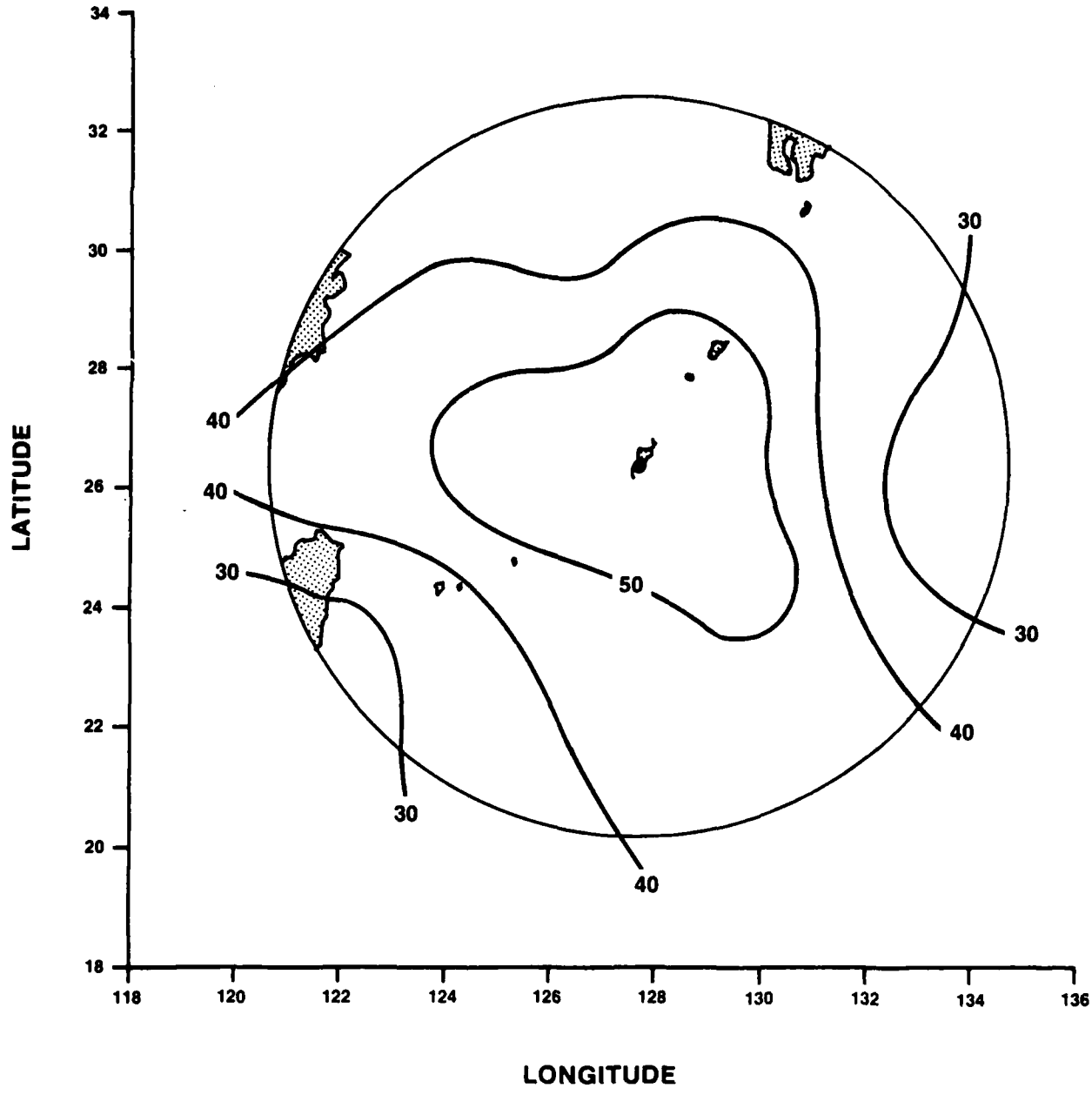

Figure 13. Mean Gust Ratios (labelled as percentage) for Kadena when a tropical cyclone of typhoon strength ($\geq$ 64 kt) is centered within 360 n mi of the station. Locate the typhoon center by latitude and longitude and interpolate the ratio (percentage) value. Multiply the typhoon center wind speed by this percentage to get the wind speed value of the mean gust expected with the given center position and wind speed. Multiply the mean gust speed by 0.67 to find the mean one-minute average sustained wind speed.

Table 3. A listing of the data used to produce Figures 10 through 13. Columns represent segment number, latitude and longitude of segment center, maximum ratio, mean ratio, standard deviation of ratios, number of ratios (sample size), and cumulative frequency distribution expressed as the percentage of ratios occurring between 0.0 and 1.0 (in increments of 0.1).

KADENA, OKINAWA
Tropical cyclones - wind speeds less than 64 knots

CENTER POINT

SEG	LAT	LONG	MAX	MEAN	S.DV.	N	CUM FREQ DIST↑N
1	26.2	127.5	1.013	.411	.199	110.	?.16.38.5?.69.82.91.96.99.100

RING NUMBER 1

SEG	LAT	LONG	MAX	MEAN	S.DV.	N	CUM FREQ DIST↑N
2	27.4	128.3	.974	.370	.178	107.	0.15.51.61.75.87.97.98.99.100
3	26.2	129.1	.584	.333	.138	91.	0.18.51.69.80.100100100100100
4	25.0	128.3	.631	.338	.110	125.	0.13.37.?3.92.98.100100100100
5	25.0	126.7	.743	.305	.114	169.	1.19.48.89.94.97.99.100100100
6	26.2	125.9	.836	.325	.122	111.	?.18.38.76.94.99.99.99.100100
7	27.4	126.7	.783	.340	.130	73.	1. 8.45.74.88.96.99.100100100

RING NUMBER ?

SEG	LAT	LONG	MAX	MEAN	S.DV.	N	CUM FREQ DIST↑N
8	28.5	128.3	.765	.304	.161	112.	1.29.62.76.89.94.96.100100100
9	27.6	129.?	.433	.227	.072	132.	1.40.83.98.100100100100100100
10	26.2	130.2	.547	.242	.095	132.	6.33.75.95.98.100100100100100
11	24.8	129.?	.533	.233	.090	142.	2.42.80.94.99.100100100100100
12	23.9	128.3	.556	.249	.105	177.	5.40.66.95.97.100100100100100
13	23.9	126.?	.418	.193	.067	221.	5.62.92.100100100100100100100
14	24.8	125.3	.421	.186	.078	139.	9.68.88.99.100100100100100100
15	26.2	124.8	.435	.217	.081	79.	9.44.85.99.100100100100100100
16	27.6	125.3	.533	.219	.081	88.	5.43.86.99.99.100100100100100
17	28.5	126.?	.659	.255	.105	65.	0.35.82.89.94.98.100100100100

RING NUMBER 3

SEG	LAT	LONG	MAX	MEAN	S.DV.	N	CUM FREQ DIST↑N
18	29.6	128.4	.441	.217	.094	61.	7.49.79.93.100100100100100100
19	28.9	129.9	.400	.213	.069	80.	1.54.90.100100100100100100100
20	27.7	131.0	.350	.198	.068	125.	8.57.9?.100100100100100100100
21	26.2	131.4	.372	.195	.073	94.	9.61.94.100100100100100100100
22	24.7	131.0	.382	.191	.090	96.	15.70.83.100100100100100100100
23	23.5	129.9	.391	.162	.063	114.	9.78.96.100100100100100100100
24	22.8	128.4	.429	.198	.067	200.	3.56.94.100100100100100100100
25	22.8	126.6	.368	.168	.052	126.	8.71.99.100100100100100100100
26	23.5	125.1	.294	.149	.056	170.	21.86.100100100100100100100
27	24.7	124.0	.341	.176	.067	57.	16.67.95.100100100100100100100
28	26.2	123.6	.350	.145	.075	51.	33.78.94.100100100100100100100
29	27.7	124.0	.308	.190	.053	74.	7.55.97.100100100100100100100
30	28.9	125.1	.347	.189	.074	62.	10.58.95.100100100100100100100
31	29.6	126.6	.558	.289	.129	58.	?.31.59.79.90.100100100100100

Table 3. continued

RING NUMBER 4

SEG	LAT	LONG	MAX	MEAN	S.DV.	N	CUM FREQ DIST↑N
32	30.6	128.4	.388	.242	.090	59.	10.27.68.100100100100100100100
33	30.1	130.0	.356	.181	.054	75.	5.71.99.100100100100100100100
34	29.1	131.3	.350	.183	.075	49.	10.67.94.100100100100100100100
35	27.7	132.2	.363	.222	.066	62.	5.39.92.100100100100100100100
36	26.2	132.5	.313	.173	.072	58.	10.66.95.100100100100100100100
37	24.7	132.2	.333	.156	.062	87.	15.75.99.100100100100100100100
38	23.3	131.3	.329	.137	.067	136.	34.82.98.100100100100100100100
39	22.3	130.0	.323	.158	.065	115.	19.80.97.100100100100100100100
40	21.8	128.4	.320	.160	.069	132.	22.72.98.100100100100100100100
41	21.8	126.6	.368	.153	.058	114.	18.78.99.100100100100100100100
42	22.3	125.0	.329	.147	.059	110.	19.85.99.100100100100100100100
43	23.3	123.7	.300	.132	.042	131.	23.94.100100100100100100100
44	24.7	122.8	.247	.143	.034	84.	11.95.100100100100100100100
45	26.2	122.5	.246	.123	.044	37.	43.89.100100100100100100100
46	27.7	122.8	.265	.158	.052	41.	20.76.100100100100100100100
47	29.1	123.7	.267	.152	.060	47.	21.81.100100100100100100100
48	30.1	125.0	.343	.194	.061	99.	6.58.94.100100100100100100
49	30.6	126.6	.438	.221	.101	41.	17.49.76.93.100100100100100

RING NUMBER 5

SEG	LAT	LONG	MAX	MEAN	S.DV.	N	CUM FREQ DIST↑N
50	31.6	128.4	.462	.183	.109	34.	26.59.88.97.100100100100100
51	31.2	130.0	.282	.187	.055	57.	12.53.100100100100100100100
52	30.3	131.5	.230	.150	.046	28.	21.89.100100100100100100100
53	29.2	132.6	.250	.155	.057	65.	22.75.100100100100100100100
54	27.7	133.4	.313	.142	.071	118.	36.81.97.100100100100100100
55	26.2	133.6	.333	.157	.079	43.	21.79.95.100100100100100100
56	24.7	133.4	.390	.131	.081	70.	41.87.94.100100100100100100
57	23.2	132.6	.296	.131	.062	87.	40.84.100100100100100100100
58	22.1	131.5	.318	.150	.059	99.	18.82.98.100100100100100100
59	21.2	130.0	.279	.152	.057	110.	19.80.100100100100100100100
60	20.8	128.4	.282	.154	.051	134.	16.81.100100100100100100100
61	20.8	126.6	.271	.138	.053	148.	29.86.100100100100100100100
62	21.2	125.0	.257	.148	.043	156.	13.87.100100100100100100100
63	22.1	123.5	.259	.148	.052	115.	18.83.100100100100100100100
64	23.2	122.4	.231	.130	.046	98.	26.89.100100100100100100100
65	24.7	121.6	.259	.140	.059	96.	31.79.100100100100100100100
66	26.2	121.4	.205	.127	.041	46.	43.93.100100100100100100100
67	27.7	121.6	.217	.208	.012	3.	0.33.100100100100100100100
68	29.2	122.4	.231	.151	.045	33.	12.85.100100100100100100
69	30.3	123.5	.343	.174	.047	33.	6.91.97.100100100100100100
70	31.2	125.0	.343	.209	.078	46.	13.46.85.100100100100100100
71	31.6	126.6	.215	.130	.056	15.	40.93.100100100100100100100

Table 3. continued

KADENA, OKINAWA

Tropical cyclones - wind speeds of 64 knots or greater

SEG	LAT	LONG	MAX	MEAN	S.DV.	N	CUM FREQ DIST↑N
CENTER POINT							
1	26.2	127.5	.643	.323	.117	63.	2.19.48.76.94.98.100100100100
RING NUMBER 1							
SEG	LAT	LONG	MAX	MEAN	S.DV.	N	CUM FREQ DIST↑N
2	27.4	128.3	1.150	.430	.160	79.	0. 3.19.53.75.89.96.97.99.100
3	26.2	129.1	.680	.326	.124	96.	3.21.40.74.93.99.100100100100
4	25.0	128.3	1.080	.333	.192	97.	2.25.55.72.88.91.92.96.98.100
5	25.0	126.7	.760	.385	.220	43.	0.30.47.56.72.77.84.100100100
6	26.2	125.9	.967	.386	.168	70.	0.14.40.61.73.89.99.99.99.100
7	27.4	126.7	.967	.357	.172	87.	0.16.44.72.86.91.95.97.99.100
RING NUMBER 2							
SEG	LAT	LONG	MAX	MEAN	S.DV.	N	CUM FREQ DIST↑N
8	28.5	128.3	.667	.332	.130	56.	0.18.46.75.84.98.100100100100
9	27.6	129.7	.652	.332	.108	60.	2. 7.47.85.92.95.100100100100
10	26.2	130.2	.600	.306	.098	81.	0.12.53.85.96.100100100100100
11	24.8	129.7	.640	.396	.130	37.	0. 8.27.68.76.89.100100100100
12	23.9	128.3	.750	.279	.145	75.	4.39.64.85.93.96.99.100100100
13	23.9	126.7	.622	.268	.142	90.	14.40.60.79.94.99.100100100100
14	24.8	125.3	.711	.342	.127	50.	0.12.40.78.86.98.98.100100100
15	26.2	124.8	.650	.309	.130	59.	3.19.61.76.93.97.100100100100
16	27.6	125.3	.520	.342	.089	37.	0. 8.32.73.97.100100100100100
17	28.5	126.7	.560	.244	.082	43.	0.35.84.93.98.100100100100100
RING NUMBER 3							
SEG	LAT	LONG	MAX	MEAN	S.DV.	N	CUM FREQ DIST↑N
18	29.6	128.4	.591	.346	.080	23.	0. 0.35.87.96.100100100100100
19	28.9	129.9	.467	.269	.105	67.	7.28.58.90.100100100100100100
20	27.7	131.0	.645	.248	.126	82.	15.37.72.91.95.99.100100100100
21	26.2	131.4	.500	.222	.099	70.	11.47.81.96.100100100100100100
22	24.7	131.0	.500	.237	.103	63.	8.41.78.97.100100100100100100
23	23.5	129.9	.700	.354	.133	51.	2.18.37.67.88.94.100100100100
24	22.8	128.4	.667	.309	.217	28.	29.50.54.61.75.86.100100100100
25	22.8	126.6	.667	.316	.176	62.	0.39.58.73.81.87.100100100100
26	23.5	125.1	.553	.298	.117	54.	2.24.50.81.94.100100100100100
27	24.7	124.0	.517	.293	.104	37.	5.24.54.86.97.100100100100100
28	26.2	123.6	.667	.331	.125	49.	0.18.49.71.92.98.100100100100
29	27.7	124.0	.533	.240	.126	36.	14.50.72.89.97.100100100100100
30	28.9	125.1	.485	.253	.104	42.	7.33.67.90.100100100100100100
31	29.6	126.6	.458	.258	.064	32.	0.28.78.97.100100100100100100

Table 3. continued

RING NUMBER 4

SEG	LAT	LONG	MAX	MEAN	S.DV.	N	CUM FREQ DISTRN
32	30.6	128.4	.394	.230	.048	42.	0.26.93.100100100100100100100
33	30.1	130.0	.600	.285	.139	95.	16.27.57.79.96.100100100100100
34	29.1	131.3	.500	.228	.115	59.	22.46.75.93.100100100100100100
35	27.7	132.2	.643	.260	.129	51.	12.35.76.86.94.98.100100100100
36	26.2	132.5	.414	.157	.082	43.	23.79.93.98.100100100100100100
37	24.7	132.2	.500	.245	.114	29.	7.55.72.93.100100100100100100
38	23.3	131.3	.560	.243	.114	84.	7.39.75.90.98.100100100100100
39	22.3	130.0	.600	.262	.121	98.	5.42.65.89.98.100100100100100
40	21.8	128.4	.727	.278	.143	81.	6.38.68.84.91.95.99.100100100
41	21.8	126.6	.700	.325	.146	85.	4.20.55.74.87.96.100100100100
42	22.3	125.0	.558	.224	.131	72.	24.49.79.89.96.100100100100100
43	23.3	123.7	.657	.278	.122	57.	4.23.70.84.93.98.100100100100
44	24.7	122.8	.440	.243	.082	48.	0.31.75.96.100100100100100100
45	26.2	122.5	.700	.345	.156	61.	2.23.43.77.84.90.100100100100
46	27.7	122.8	.967	.328	.185	53.	4.30.49.75.87.92.94.96.98.100
47	29.1	123.7	.760	.285	.158	65.	5.35.71.80.91.92.97.100100100
48	30.1	125.0	.700	.266	.163	37.	14.38.70.73.92.97.100100100100
49	30.6	126.6	.636	.282	.104	38.	3.16.71.89.97.97.100100100100

RING NUMBER 5

SEG	LAT	LONG	MAX	MEAN	S.DV.	N	CUM FREQ DISTRN
50	31.6	128.4	.480	.296	.083	59.	5.12.58.90.100100100100100100
51	31.2	130.0	1.050	.319	.174	77.	3.25.57.77.90.92.96.97.99.100
52	30.3	131.5	.609	.197	.112	49.	22.57.86.96.98.98.100100100100
53	29.2	132.6	.500	.217	.119	33.	15.55.73.97.100100100100100100
54	27.7	133.4	.760	.211	.127	85.	14.61.80.95.96.96.99.100100100
55	26.2	133.6	.480	.161	.098	23.	30.87.91.96.100100100100100100
56	24.7	133.4	.343	.200	.068	54.	7.52.91.100100100100100100100
57	23.2	132.6	.700	.252	.141	71.	11.46.70.86.94.99.100100100100
58	22.1	131.5	.800	.280	.196	121.	16.50.70.79.85.90.94.100100100
59	21.2	130.0	.950	.332	.212	115.	5.36.56.76.80.85.95.97.98.100
60	20.8	128.4	.650	.291	.126	62.	2.29.61.87.92.95.100100100100
61	20.8	126.6	.571	.276	.113	149.	1.30.64.87.97.100100100100100
62	21.2	125.0	.567	.255	.130	106.	7.46.69.83.95.100100100100100
63	22.1	123.5	.739	.259	.171	74.	18.51.73.78.86.96.99.100100100
64	23.2	122.4	.417	.192	.097	68.	18.60.82.99.100100100100100100
65	24.7	121.6	.425	.197	.077	64.	8.64.91.98.100100100100100100
66	26.2	121.4	.800	.333	.173	68.	3.28.57.72.87.93.96.100100100
67	27.7	121.6	.600	.283	.117	45.	0.29.62.87.96.100100100100100
68	29.2	122.4	.368	.203	.098	14.	21.64.79.100100100100100100100
69	30.3	123.5	.960	.394	.256	24.	0.13.67.75.75.83.83.83.92.100
70	31.2	125.0	.320	.181	.097	19.	26.47.84.100100100100100100100
71	31.6	126.6	.810	.248	.167	50.	26.46.74.88.94.96.96.98.100100

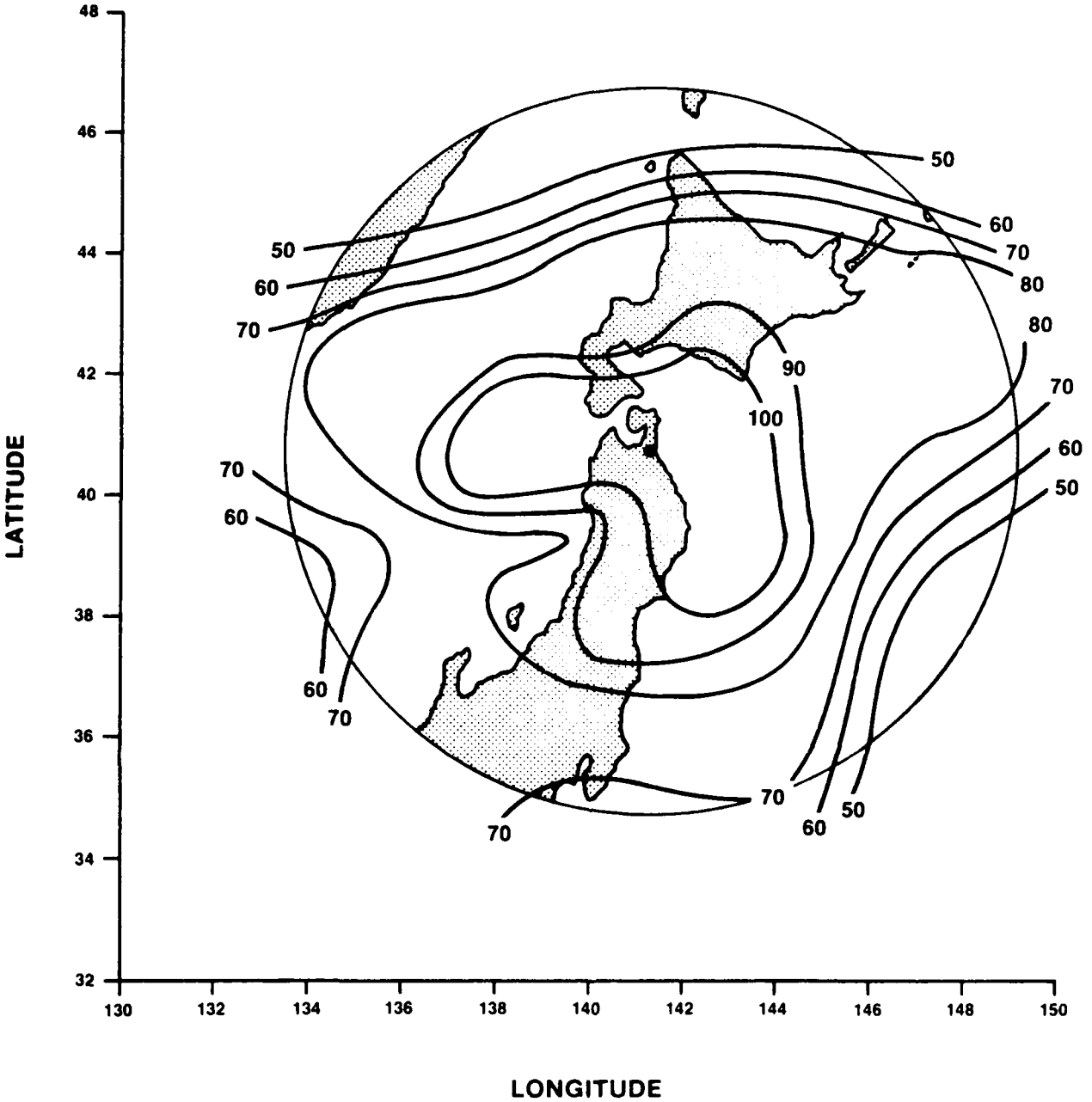

Figure 14. Maximum Gust Ratios (labelled as percentage) for Misawa when a tropical cyclone of less than typhoon strength (<64 kt) is centered within 360 n mi of the station. Locate the tropical cyclone center by latitude and longitude and interpolate the ratio (percentage) value. Multiply the tropical cyclone center wind speed by this percentage to get the wind speed value of the maximum gust expected with the given center position and wind speed. Multiply the maximum gust speed by 0.67 to find the maximum one-minute average sustained wind speed.

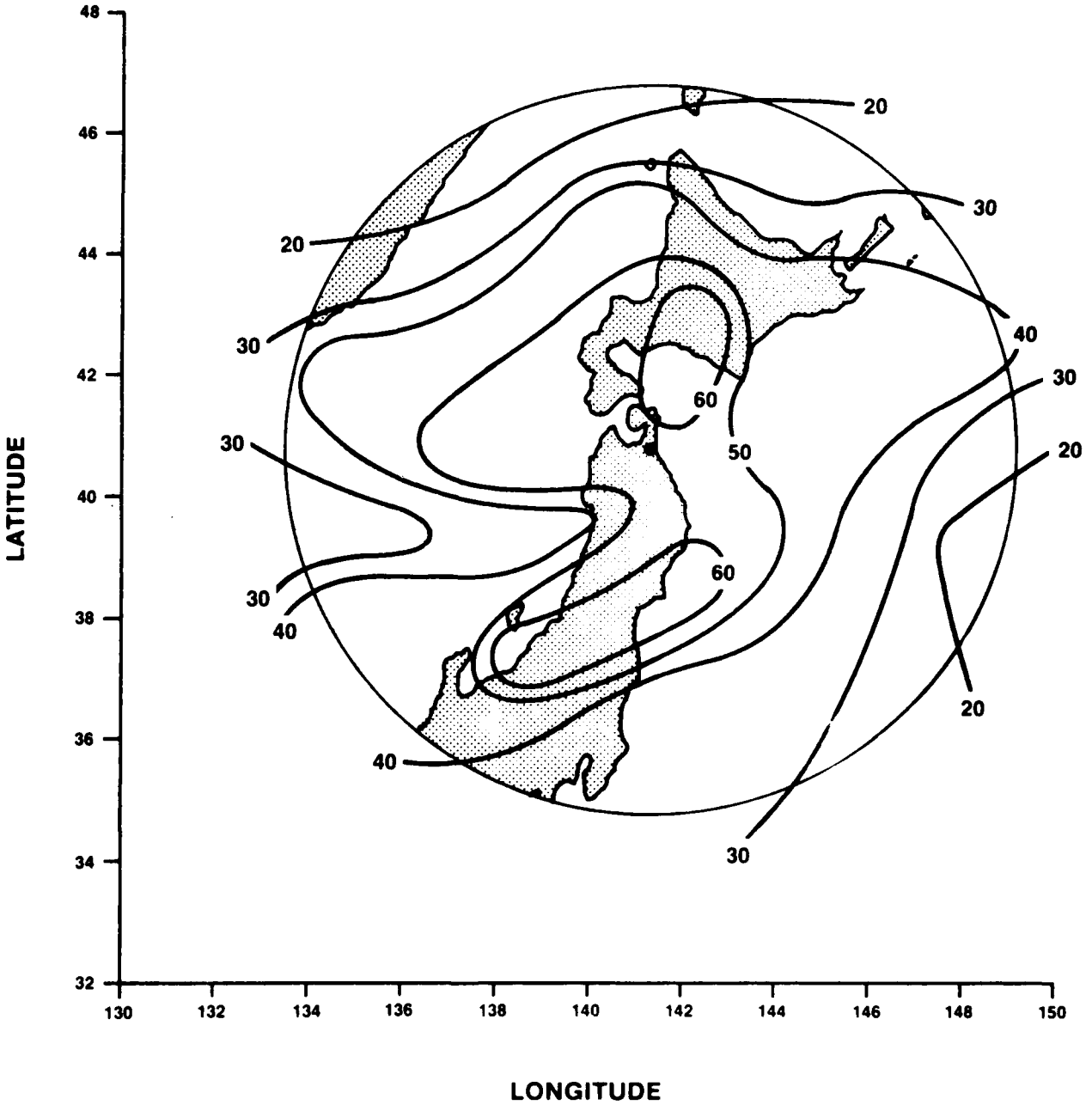

Figure 15. Mean Gust Ratios (labelled as percentage) for Misawa when a tropical cyclone of less than typhoon strength (<64 kt) is centered within 360 n mi of the station. Locate the tropical cyclone center by latitude and longitude and interpolate the ratio (percentage) value. Multiply the tropical cyclone center wind speed by this percentage to get the wind speed value of the maximum gust expected with the given center position and wind speed. Multiply the mean gust speed by 0.67 to find the mean one-minute average sustained wind speed.

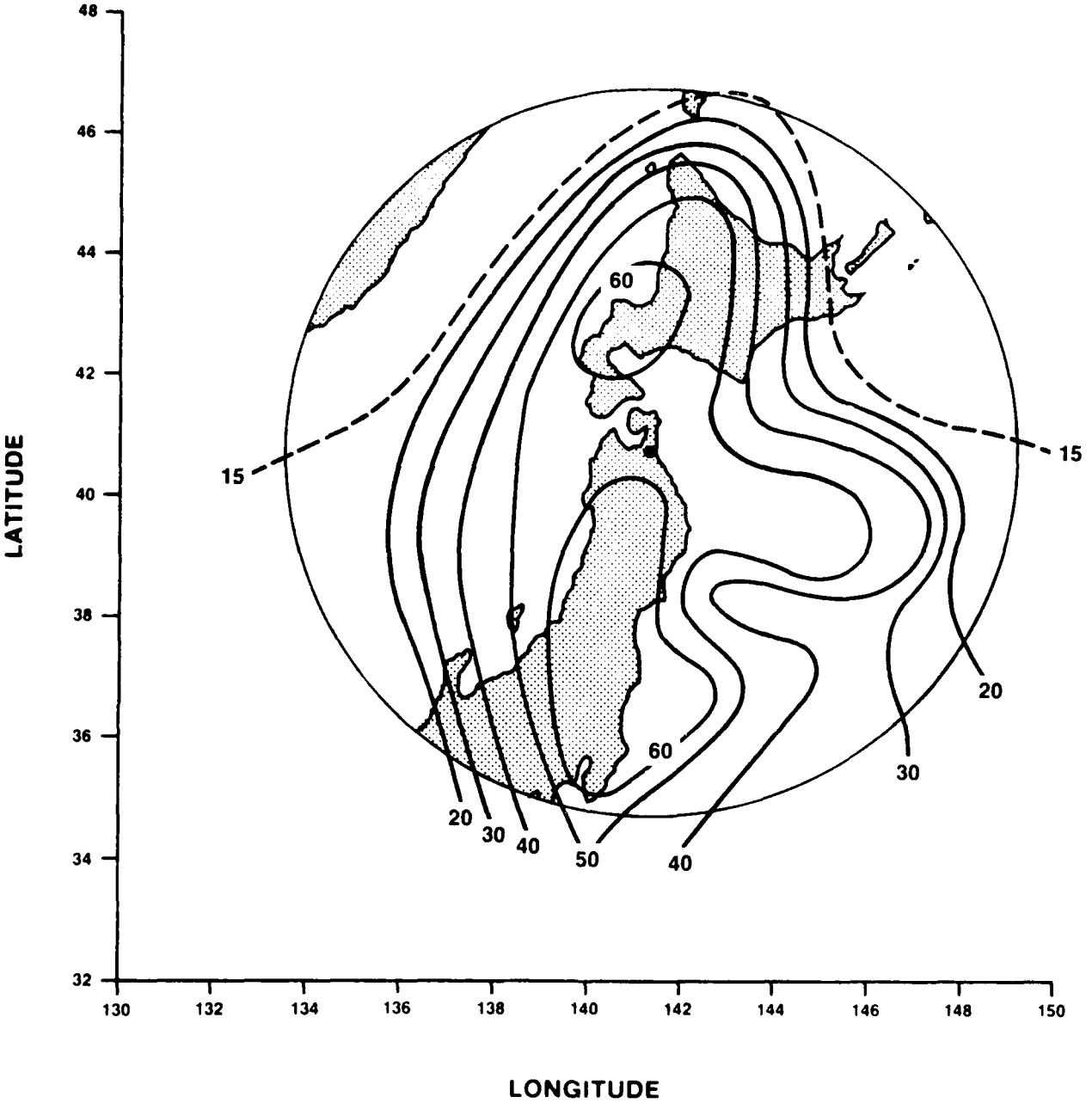

Figure 16. Maximum Gust Ratios (labelled as percentage) for Misawa when a tropical cyclone of typhoon strength ($\geq$64 kt) is centered within 360 n mi of the station. Locate the typhoon center by latitude and longitude and interpolate the ratio (percentage) value. Multiply the typhoon center wind speed by this percentage to get the wind speed value of the maximum gust expected with the given center position and wind speed. Multiply the maximum gust speed by 0.67 to find the maximum one-minute average sustained wind speed.

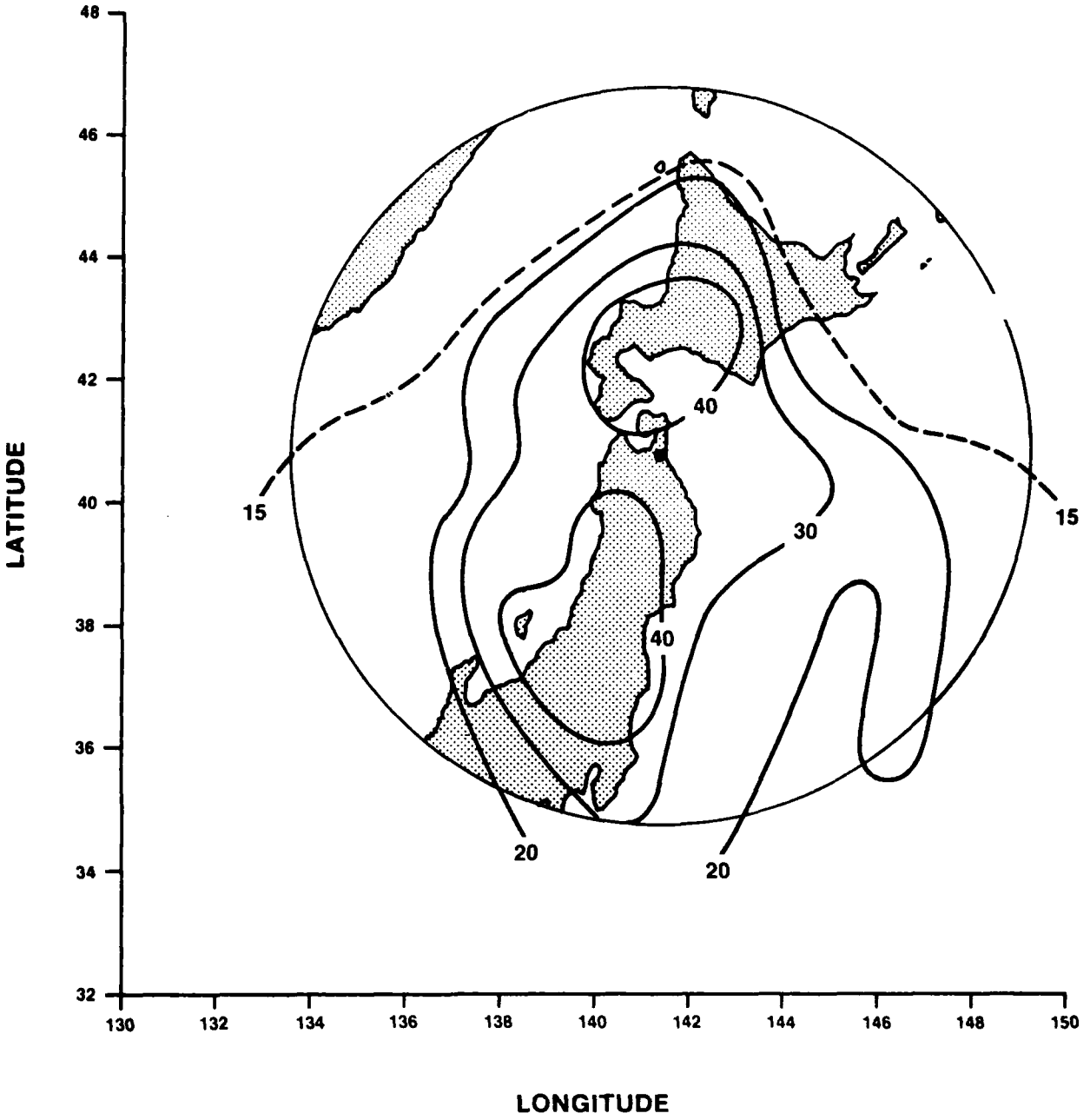

Figure 17. Mean Gust Ratios (labelled as percentage) for Misawa when a tropical cyclone of typhoon strength ($\geq$ 64 kt) is centered within 360 n mi of the station. Locate the typhoon center by latitude and longitude and interpolate the ratio (percentage) value. Multiply the typhoon center wind speed by this percentage to get the wind speed value of the mean gust expected with the given center position and wind speed. Multiply the mean gust speed by 0.67 to find the mean one-minute average sustained wind speed.

Table 4. A listing of the data used to produce Figures 14 through 17. Columns represent segment number, latitude and longitude of segment center, maximum ratio, mean ratio, standard deviation of ratios, number of ratios (sample size), and cumulative frequency distribution expressed as the percentage of ratios occurring between 0.0 and 1.0 (in increments of 0.1).

MISAWA, JAPAN
Tropical cyclones - wind speeds less than 64 knots

CENTER POINT							
SEG	LAT	LONG	MAX	MEAN	S.DV.	N	CUM FREQ DIST↑N
1	40.7	141.4	.750	.301	.189	19.	16.42.53.74.89.95.95.100100100
RING NUMBER 1							
SEG	LAT	LONG	MAX	MEAN	S.DV.	N	CUM FREQ DIST↑N
2	41.9	142.3	.733	.426	.243	8.	13.13.50.50.63.63.75.100100100
3	40.7	143.3	.571	.314	.132	22.	5.23.41.77.91.100100100100100
4	39.5	142.3	.750	.383	.186	19.	11.21.32.53.63.95.95.100100100
5	39.5	140.5	.459	.227	.096	10.	0.40.80.90.100100100100100100
6	40.7	139.5	.750	.303	.149	22.	0.32.55.82.91.95.95.100100100
7	41.9	140.5	.535	.312	.121	11.	0.27.45.73.91.100100100100100
RING NUMBER 2							
SEG	LAT	LONG	MAX	MEAN	S.DV.	N	CUM FREQ DIST↑N
8	43.0	142.4	.575	.411	.133	11.	0. 9.18.36.73.100100100100100
9	42.1	144.0	.517	.326	.125	12.	8. 8.42.75.92.100100100100100
10	40.7	144.6	.519	.266	.103	17.	6.29.65.94.94.100100100100100
11	39.3	144.0	.714	.374	.165	15.	0.13.47.53.80.87.93.100100100
12	38.4	142.4	.698	.413	.186	21.	5.19.29.38.57.90.100100100100
13	38.4	140.4	.575	.340	.155	13.	15.23.38.62.85.100100100100100
14	39.3	138.8	.440	.209	.119	10.	20.60.80.80.100100100100100100
15	40.7	138.2	.733	.374	.171	15.	0.13.33.67.87.87.87.100100100
16	42.1	138.8	.750	.325	.130	15.	0. 7.53.87.93.93.93.100100100
17	43.0	140.4	.523	.347	.110	17.	0. 6.35.65.94.100100100100100
RING NUMBER 3							
SEG	LAT	LONG	MAX	MEAN	S.DV.	N	CUM FREQ DIST↑N
18	44.1	142.4	.676	.530	.124	8.	0. 0. 0.25.25.63.100100100100
19	43.4	144.3	.579	.329	.150	8.	0.25.50.75.75.100100100100100
20	42.2	145.5	.500	.293	.111	27.	0.26.52.74.100100100100100100
21	40.7	146.0	.514	.285	.130	17.	6.29.59.76.88.100100100100100
22	39.2	145.5	.548	.259	.156	28.	11.50.68.79.89.100100100100100
23	38.0	144.3	.854	.260	.186	17.	18.47.71.82.94.94.94.94.100100
24	37.3	142.4	.520	.273	.152	31.	16.45.58.71.94.100100100100100
25	37.3	140.4	.638	.398	.142	16.	0.13.25.50.75.94.100100100100
26	38.0	138.5	.532	.245	.109	10.	0.40.90.90.90.100100100100100
27	39.2	137.3	.375	.204	.099	13.	15.38.85.100100100100100100100
28	40.7	136.8	.733	.363	.169	14.	0. 7.50.64.79.93.93.100100100
29	42.2	137.3	.515	.200	.089	23.	9.65.91.96.96.100100100100100
30	43.4	138.5	.548	.340	.129	9.	0.22.56.67.89.100100100100100
31	44.1	140.4	.533	.318	.152	10.	0.30.50.60.80.100100100100100

Table 4. continued

RING NUMBER 4

SEG	LAT	LONG	MAX	MEAN	S.DV.	N	CUM FREQ DIST*N
32	45.1	142.4	.150	.124	.017	4.	0.100100100100100100100100100
33	44.6	144.4	.632	.433	.132	9.	0. 0.33.44.67.89.100100100100
34	43.6	145.9	.533	.299	.121	18.	17.17.50.89.94.100100100100100
35	42.2	147.0	.571	.268	.123	20.	5.35.60.85.95.100100100100100
36	40.7	147.3	.514	.185	.103	18.	22.67.94.94.94.100100100100100
37	39.2	147.0	.343	.205	.110	6.	17.50.67.100100100100100100100
38	37.8	145.9	.429	.231	.107	17.	6.59.65.94.100100100100100100
39	36.8	144.4	.425	.243	.109	22.	5.50.73.82.100100100100100100
40	36.3	142.4	.518	.217	.130	32.	25.56.72.94.97.100100100100100
41	36.3	140.4	.448	.223	.109	24.	13.50.83.89.100100100100100100
42	36.8	138.4	.526	.422	.069	9.	0. 0. 0.56.89.100100100100100
43	37.8	136.9	.500	.314	.139	13.	15.15.54.69.100100100100100100
44	39.2	135.8	.308	.166	.075	5.	20.80.80.100100100100100100100
45	40.7	135.5	.514	.230	.140	15.	20.53.73.80.93.100100100100100
46	42.2	135.8	.543	.287	.180	6.	0.50.67.67.67.100100100100100
47	43.6	136.9	.559	.219	.157	6.	0.67.83.83.83.100100100100100
48	44.6	138.4	.239	.144	.054	13.	15.85.100100100100100100100100
49	45.1	140.4	.436	.318	.118	2.	0.50.50.50.100100100100100100

RING NUMBER 5

SEG	LAT	LONG	MAX	MEAN	S.DV.	N	CUM FREQ DIST*N
50	46.1	142.4	.222	.2220	.000	1.	0. 0.100100100100100100100100
51	45.7	144.4	.333	.267	.067	2.	0.50.50.100100100100100100100
52	44.8	146.1	.343	.199	.088	8.	13.63.75.100100100100100100100
53	43.7	147.5	.533	.254	.137	18.	11.39.67.83.94.100100100100100
54	42.2	148.3	.606	.277	.182	28.	14.50.68.71.79.96.100100100100
55	40.7	148.6	.343	.149	.084	15.	53.80.87.100100100100100100100
56	39.2	148.3	.180	.106	.037	11.	55.100100100100100100100100100
57	37.7	147.5	.350	.153	.067	30.	23.83.97.100100100100100100100
58	36.6	146.1	.300	.174	.064	23.	13.65.100100100100100100100100
59	35.7	144.4	.500	.202	.163	12.	50.75.75.75.100100100100100100
60	35.3	142.4	.455	.197	.122	25.	28.64.84.92.100100100100100100
61	35.3	140.4	.438	.208	.123	12.	25.58.83.83.100100100100100100
62	35.7	138.4	.473	.291	.087	16.	0.13.56.88.100100100100100100
63	36.6	136.7	.525	.292	.135	15.	7.33.47.80.93.100100100100100
64	37.7	135.3	.500	.335	.126	4.	0. 0.50.50.100100100100100100
65	39.2	134.5	.257	.154	.057	11.	27.82.100100100100100100100100
66	40.7	134.2	.475	.228	.128	10.	10.70.70.80.100100100100100100
67	42.2	134.5	.622	.403	.228	3.	33.33.33.33.67.67.100100100100
68	43.7	135.3					
69	44.8	136.7					
70	45.7	138.4	.115	.099	.013	4.	75.100100100100100100100100100
71	46.1	140.4	.216	.163	.054	2.	0.50.100100100100100100100100

Table 4. continued

MISAWA, JAPAN

Tropical cyclones - wind speeds of 64 knots or greater

SEG	CENTER POINT LAT	LONG	MAX	MEAN	S.DV.	N	CUM FREQ DIST↑N
1	40.7	141.4	.160	.112	.048	2.	50.100100100100100100100100100
	RING NUMBER 1						
SEG	LAT	LONG	MAX	MEAN	S.DV.	N	CUM FREQ DIST↑N
2	41.9	142.3					
3	40.7	143.3	.054	.054	0.000	1.	100100100100100100100100100100
4	39.5	142.3					
5	39.5	140.5	.554	.496	.058	2.	0. 0. 0. 0.50.100100100100100
6	40.7	139.5	.369	.235	.092	6.	17.33.67.100100100100100100100
7	41.9	140.5	.338	.282	.051	4.	0.25.75.100100100100100100100
	RING NUMBER 2						
SEG	LAT	LONG	MAX	MEAN	S.DV.	N	CUM FREQ DIST↑N
8	43.0	142.4	.292	.292	0.000	1.	0. 0.100100100100100100100100
9	42.1	144.0					
10	40.7	144.6	.250	.207	.043	2.	0.50.100100100100100100100100
11	39.3	144.0					
12	38.4	142.4	.123	.123	0.000	1.	0.100100100100100100100100100
13	38.4	140.4	.412	.261	.151	2.	0.50.50.50.100100100100100100
14	39.3	138.8	.308	.193	.089	6.	33.50.83.100100100100100100100
15	40.7	138.2	.197	.117	.058	3.	67.100100100100100100100100100
16	42.1	138.8	.254	.210	.030	4.	0.25.100100100100100100100100
17	43.0	140.4	.585	.317	.120	7.	0. 0.57.86.86.100100100100100
	RING NUMBER 3						
SEG	LAT	LONG	MAX	MEAN	S.DV.	N	CUM FREQ DIST↑N
18	44.1	142.4	.385	.210	.100	6.	0.67.67.100100100100100100100
19	43.4	144.3					
20	42.2	145.5					
21	40.7	146.0	.239	.205	.034	2.	0.50.100100100100100100100100
22	39.2	145.5	.342	.342	0.000	1.	0. 0. 0.100100100100100100100
23	38.0	144.3	.227	.162	.047	3.	0.67.100100100100100100100100
24	37.3	142.4	.206	.158	.034	4.	0.75.100100100100100100100100
25	37.3	140.4	.463	.450	.017	3.	0. 0. 0. 0.100100100100100100
26	38.0	138.5	.369	.283	.084	6.	0.17.50.100100100100100100100
27	39.2	137.3	.290	.203	.082	3.	33.33.100100100100100100100100
28	40.7	136.8	.154	.108	.029	6.	50.100100100100100100100100100
29	42.2	137.3	.164	.164	0.000	1.	0.100100100100100100100100100
30	43.4	138.5					
31	44.1	140.4	.205	.205	0.000	1.	0. 0.100100100100100100100100

Table 4. continued

RING NUMBER 4

SEG	LAT	LONG	MAX	MEAN	S.DV.	N	CUM FREQ DIST↑N
32	45.1	142.4	.338	.135	.094	6.	50.83.83.1001001001001C0100100
33	44.6	144.4					
34	43.6	145.9					
35	42.2	147.0					
36	40.7	147.3	.101	.1010.000		1.	0.1001001001001001001001001001001
37	39.2	147.0	.314	.159	.109	5.	40.60.80.1001001001001001001001001
38	37.8	145.9	.154	.073	.037	7.	86.1001001001001001001001001001001
39	36.8	144.4	.274	.143	.060	26.	31.88.1001001001001001001001C01C0
40	36.3	142.4	.446	.151	.091	22.	32.86.91.95.1001001C1001001001
41	36.3	140.4	.493	.298	.124	6.	0.17.67.83.1001001001001001001
42	36.8	138.4	.292	.217	.059	5.	0.60.1001001001001001001001001
43	37.8	136.9	.200	.121	.046	6.	50.1001001001001001001C1001001
44	39.2	135.8	.118	.101	.013	3.	67.1001001001001001001001001001
45	40.7	135.5	.156	.131	.025	2.	0.1001001001001001001001001001
46	42.2	135.8					
47	43.6	136.9					
48	44.6	138.4					
49	45.1	140.4					

RING NUMBER 5

SEG	LAT	LONG	MAX	MEAN	S.DV.	N	CUM FREQ DIST↑N
50	46.1	142.4	.246	.2460.000		1.	0. 0.1001001001001001001001001
51	45.7	144.4					
52	44.8	146.1					
53	43.7	147.5					
54	42.2	148.3					
55	40.7	148.6	.103	.1030.000		1.	0.1001001001001001001001001001001
56	39.2	148.3	.088	.062	.017	4.	1001001001001001001001001001001
57	37.7	147.5	.143	.111	.042	3.	33.1001001001001001001001001001
58	36.6	146.1	.229	.140	.055	25.	24.84.1001001001001001001001001
59	35.7	144.4	.200	.102	.065	8.	63.1001001001001001001001001001
60	35.3	142.4	.286	.126	.078	26.	42.98.1001001001001001C01C1001
61	35.3	140.4	.569	.221	.151	9.	11.67.78.89.89.1001001001001001
62	35.7	138.4	.231	.139	.054	4.	25.75.1001001001001001001001001
63	36.6	136.7	.046	.0460.000		1.	1001001001001001001001001001001
64	37.7	135.3	.103	.085	.013	4.	75.1001001001001001001001C1001
65	39.2	134.5	.084	.067	.019	4.	1001001001001001001001001C1001
66	40.7	134.2	.103	.1030.000		1.	0.1001001001001001001C1001001
67	42.2	134.5					
68	43.7	135.3					
69	44.8	136.7					
70	45.7	138.4					
71	46.1	140.4					

Appendix A

Terrain Adjusted Wind Probabilities

The present version of the Navy tropical cyclone WIND probability model assumes that winds are over water. For stations located in rough terrain this assumption can cause overestimates of the probabilities of 30 and 50 kt winds. The terrain wind probability program is now used to modify the WINDP output. An example of this modified message is given in Figure 18. Details of the development and testing of the terrain wind probability program can be found in Jarrell (1982).

Strike and Wind Probability Message Before Modification

```
STRIKE AND WIND PROBABILITY FORECASTS
NANCY       080600Z
KADENA AB   00ININ   12ININ   24ININ   36ININ   48ININ   60ININ   72ININ
  50KNOT    00ININ   12ININ   24ININ   36ININ   48ININ   60ININ   72ININ
  30 KNOT   000202   12IN02   24IN02   36IN02   48IN02   60IN02   72IN02
YOKOSUKA    00ININ   12ININ   24ININ   36ININ   48ININ   60ININ   72ININ
  50 KNOT   00ININ   12IN02   24IN02   36IN02   48IN02   60IN02   72IN02
  30 KNOT   001717   121066   24IN68   36IN68   48IN68   60IN68   72IN68
YOKOTA AB   00ININ   12ININ   24ININ   36ININ   48ININ   60ININ   72ININ
  50 KNOT   00ININ   12IN01   24IN01   36IN01   48IN01   60IN01   72IN01
  30 KNOT   001313   120654   24IN55   36IN55   48IN55   60IN55   72IN55
CHEJU-DO    00ININ   12ININ   24ININ   36ININ   48ININ   60ININ   72ININ
  50 KNOT   00ININ   12ININ   24ININ   36ININ   48ININ   60ININ   72ININ
  30 KNOT   000101   12IN01   24IN01   36IN01   48IN01   60IN01   72IN01
MISAWA JA   00ININ   12ININ   24ININ   36ININ   48ININ   60ININ   72ININ
  50 KNOT   00ININ   12ININ   24ININ   36ININ   48ININ   60ININ   72ININ
  30 KNOT   00ININ   12IN02   24IN02   36IN02   48IN02   60IN02   72IN02
```

Strike and Wind Probability Message After Modification

```
STRIKE AND WIND PROBABILITY FORECASTS
   NANCY       080600Z
  +KADENA AB   00ININ   12ININ   24ININ   36ININ   48ININ   60ININ   72ININ
     50 KNOT   00ININ   12ININ   24ININ   36ININ   48ININ   60ININ   72ININ
     30 KNOT   000202   12IN01   24IN01   36IN01   48IN01   60IN01   72IN01
  +YOKOSUKA    00ININ   12ININ   24ININ   36ININ   48ININ   60ININ   72ININ
     50 KNOT   00ININ   12IN01   24IN01   36IN01   48IN01   60IN01   72IN01
     30 KNOT   000202   120235   24IN35   36IN35   48IN35   60IN35   72IN35
   YOKOTA AB   00ININ   12ININ   24ININ   36ININ   48ININ   60ININ   72ININ
     50 KNOT   00ININ   12IN01   24IN01   36IN01   48IN01   60IN01   72IN01
     30 KNOT   001313   120654   24IN55   36IN55   48IN55   60IN55   72IN55
   CHEJU-DO    00ININ   12ININ   24ININ   36ININ   48ININ   60ININ   72ININ
     50 KNOT   00ININ   12ININ   24ININ   36ININ   48ININ   60ININ   72ININ
     30 KNOT   000101   12IN01   24IN01   36IN01   48IN01   60IN01   72IN01
  +MISAWA JA   00ININ   12ININ   24ININ   36ININ   48ININ   60ININ   72ININ
     50 KNOT   00ININ   12ININ   24ININ   36ININ   48ININ   60ININ   72ININ
     30 KNOT   00ININ   12IN01   24IN01   36IN01   48IN01   60IN01   72IN01
  +THESE WIND PROBABILITIES ALLOW FOR TERRAIN.
```

Figure 18. Depiction of a western Pacific wind probability message for Typhoon Nancy, October 1982 before and after the terrain modification. Notice that only the wind probabilities for Kadena, Yokosuka, and Misawa are changed. Had Subic Bay, Hong Kong, or Apra Harbor been significantly threatened, those wind probabilities would also have been terrain modified.

Appendix B

Data Limitations in the Terrain Wind Probability Program

Data sets for the four sites in this study were obtained from the National Climatic Data Center and included records from three files---TDF-14, TDF-13, and TDF-9. Period of record was 36 years for Agana (1945-1980) and 33 years for Misawa (1949-1981). Non-continuous records of 28 years (1949-1968 and 1973-1981) were established for Kadena with 26 years (1946-1962 and 1973-1981) for Hong Kong.

Typhoon data were extrapolated for land areas north (northwest through northeast) of Hong Kong and for grid segments over the island of Honshu, south of Misawa. Two data points were extrapolated for Kadena, none for Agana. These data were interpolated in order to create the file required for terrain adjusted wind probability forecasts for these sites. This is of little consequence since there is little realistic chance of a tropical cyclone retaining typhoon strength in those areas.

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