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SECTION 14

SEA STATE

14.1 Introduction. Natural environment design specifications for all applicable space shuttle activities are given in the appropriate level II (ref. 14.1) or level III (ref. 14.2) program requirement documents. Since those documents are controlled by the program or project manager, it is not appropriate to repeat the design values here. Instead, this section contains the empirical distributions of several natural environment parameters that may be useful in operational analyses, design tradeoff studies or to develop specific design specifications. The National Launch System (NLS) potential recovery areas sea state statistics are also described in this section.

In deep water, sea state is determined by the mean wind speed, the fetch (the distance over which it blows), and the duration of the wind over the open water. A sea state is generally described by significant wave height, which is the average height of the one-third highest waves. Higher waves exist in any given sea state. For example, from the relationship between wind speed and wave height for a fully arisen sea, as shown in figure 14.1, it can be seen that in a code 3 sea state with significant wave heights about 1.4 m, 10 percent of the waves will average about 1.7 m. In other words, a wind speed of 8.2 m s^{-1} (fetch and duration unlimited) will produce a sea with the highest one-third waves averaging about 1.4 m and the highest one-tenth waves about 1.7 m.

Figure 14.1 shows the distribution of wave heights versus wind speed at any given instant. This information is applicable to vehicle water entry. For all other operations (afloat, secure, towback recovery) where some considerable time interval is involved, the exposure period concept must be considered; that is, the longer the exposure period, the greater the probability of encountering a larger wave. Wave heights at the 5-percent risk level for exposure periods from 1 to 100 hours in sea-state codes 3, 4, and 5 are shown in figure 14.2. From 14.2, for example, it can be seen that exposure for 1 hour in sea-state code 4 entails a 5 percent risk of encountering at least one wave greater than 5.3 m. If the exposure time is increased to 48 hours in the same sea-state code 4 condition, the wave height at the 5 percent risk level becomes 6.3 m.

14.2 Sea States. The foregoing paragraphs dealt with general sea-state relationships valid in any deep-water area. This part will present statistical values applicable to aerospace vehicle ocean recovery areas off Kennedy Space Center (KSC) and Vandenberg Air Force Base (VAFB). The wind and wave duration statistics were taken from the "U.S. Navy Hindcast Spectral Ocean Wave Model Climatic Atlas" (ref. 14.3 and 14.4). While these publications contain comprehensive wind and wave descriptions, comparisons with other sources indicate that the Spectral Ocean Wave Model underestimates wind speed and wave height near U.S. east coast areas. For this reason the wind speeds and wave heights (except durations and intervals) from conventional sources (ship observations) are considered more appropriate for planning ocean operations in the Atlantic Ocean areas under discussion. The Spectral Ocean Wave Model is the only known source for duration/interval statistics.

Additional climatic and sea state statistics for these two areas can be found in references 14.5 and 14.6.

The following tables were generated from observations of significant waves ($H_{1/3}$ equals the average height of the one-third highest waves) without regard to fetch or duration (ref. 14.7). In any given sea state there will always be waves higher than the significant heights. Also, exposure time increases the chances of higher waves occurring.

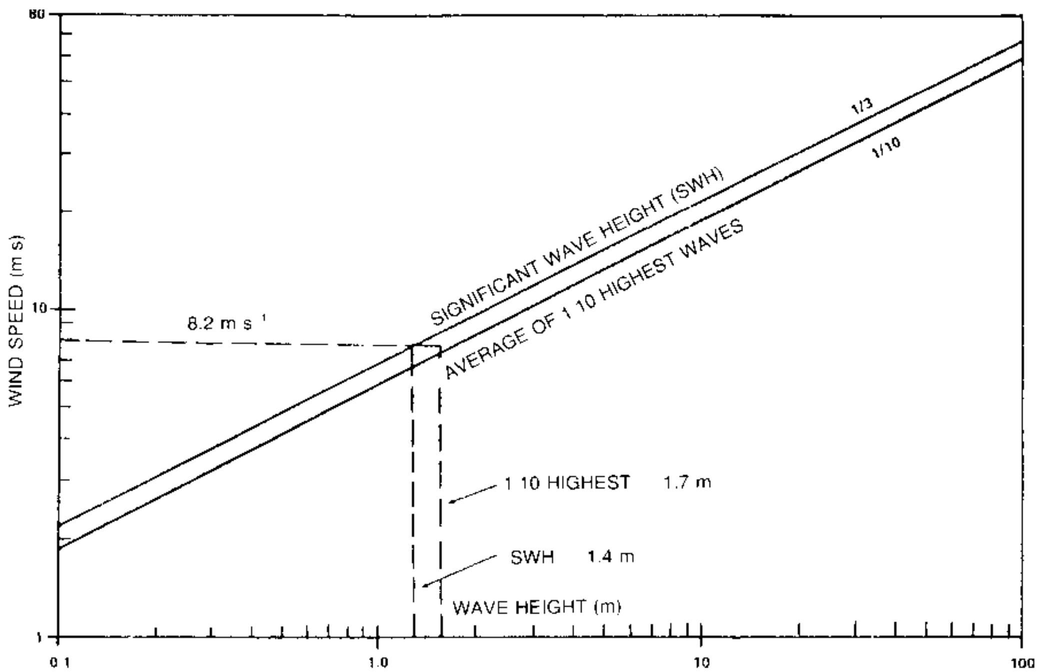


FIGURE 14.1. Relationship Between Wave Height and Wind Speed in a Fully Arisen Sea.

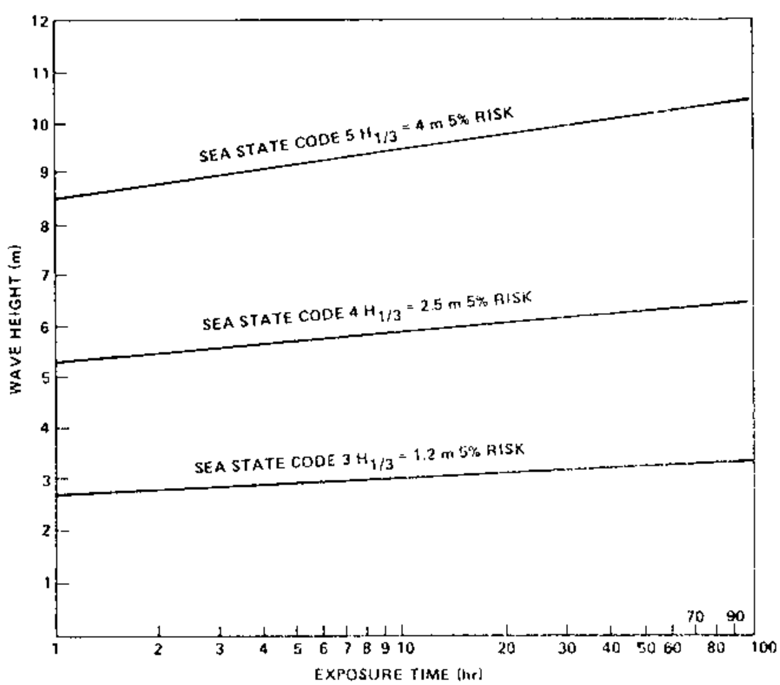


FIGURE 14.2. Five-Percent Risk Wave Height Versus Exposure Time (Assuming Sea-State Category Remains Unchanged for Duration of Exposure Period).

From Table 14.1, there is a 3-percent risk of exceeding sea-state code 5 and a 68-percent risk of exceeding sea-state code 3 in February. Also, in February there is a 95-percent chance that the significant wave height will be $\leq$ 3.7 m and, conversely, a 5-percent chance that it will exceed 3.7 m. On an annual basis, the 95th percentile wave height is 2.9 m in the KSC recovery area versus 2.8 m in the VAFB recovery area (table 14.2). While the annual $H_{1/3}$ values are very similar, some monthly distributions show considerable differences. In general, the KSC area shows a somewhat greater seasonal variation and, consequently, a more severe environment.

Table 14.3 presents the international meteorological codes for the state of the sea (ref. 14.8).

TABLE 14.1. KSC Recovery Area Sea States.
(24° To 32° N. Latitude; 72° To 80° W. Longitude)

Significant Wave Heights, Avg. of 1/3 Highest		Sea State Codes	Percent Probability of Exceeding Indicated Heights												
m	ft		J	F	M	A	M	J	J	A	S	O	N	D	Avg.
0.6	2	2	86	90	84	87	68	70	68	58	82	82	84	84	80
1.2	4	3	60	66	54	50	27	35	30	22	55	58	56	56	50
2.4	8	4	14	20	10	8	5	6	3	2	15	12	13	10	9
4.0	13	5	2	3	1	0.5	0.8	0.8	0.2	0.2	2	1.8	1.2	0.8	1
6.1	20	6	0.2	0.3	0.2	<0.1	0.2	0.2	<0.1	<0.1	0.2	0.3	<0.1	<0.1	0.1
Percentiles			Significant Wave Height (m)												
			J	F	M	A	M	J	J	A	S	O	N	D	Avg.
50th			1.4	1.6	1.4	1.2	0.8	0.9	0.8	0.7	1.3	1.4	1.4	1.4	1.2
95th			3.3	3.7	2.8	2.7	2.4	2.6	2.2	2.1	3.3	3.2	3.0	2.8	2.9

TABLE 14.2. VAFB Recovery Area Sea States.
(25° to 34° N. Latitude; 119° To 124° W. Longitude)

Significant Wave Heights, Avg. of 1/3 Highest		Sea State Codes	Percent Probability of Exceeding Indicated Heights												
m	ft		J	F	M	A	M	J	J	A	S	O	N	D	Avg.
0.6	2	2	74	67	76	78	82	82	81	83	77	58	69	74	76
1.2	4	3	42	38	45	49	50	51	47	45	44	37	34	49	44
2.4	8	4	9	9	10	11	10	9	5	6	6	5	4	13	8
4.0	13	5	1.4	1	1.8	1.8	1.2	0.4	0.2	0.1	0.4	0.4	0.5	3	1
6.1	20	6	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.5	<0.1
Percentiles			Significant Wave Height (m)												
			J	F	M	A	M	J	J	A	S	O	N	D	Avg.
50th			1.0	0.9	1.1	1.2	1.2	1.2	1.1	1.1	1.1	0.7	0.9	1.2	1.1
95th			2.9	3.2	3.2	3.0	3.2	2.8	2.4	2.5	2.6	2.4	2.4	3.5	2.8

TABLE 14.3. International Meteorological Codes, Code 3700, State of Sea.

Code Figure	Descriptive Terms	$H_{1/3}$ of Waves	
		m	ft
0	Calm (Glassy)	0	0
1	Calm (Rippled)	0–0.1	0–0.33
2	Smooth (Wavelets)	0.1–0.5	0.33–1.6
3	Slight	0.5–1.25	1.6–4.1
4	Moderate	1.25–2.5	4.1–8.2
5	Rough	2.5–4	8.2–13.1
6	Very Rough	4–6	13.1–19.7
7	High	6–9	19.7–29.5
8	Very High	9–14	29.5–45.9
9	Phenomenal	Over 14	Over 45.9

Note: Exact bounding height is assigned to lower code; e.g., a height of 4 m is coded 5.

14.3 Surface Currents.

a. KSC Solid Rocket Booster (SRB) Recovery Area. The dominant current, which is south to north, in the KSC SRB recovery area is the Gulf Stream. Although the mean speed and position of the maximum current shows little change from season to season, daily synoptic changes may be rapid and intense (ref. 14.9).

The following means and standard deviations may be applied to all seasons (fig. 14.3):

Area	Mean	Standard Deviation
B	0.4 m s^{-1} (0.8 knots)	0.7 m s^{-1} (1.27 knots)
A	1.3 m s^{-1} (2.5 knots)	0.6 m s^{-1} (1.25 knots)

b. VAFB SRB Recovery Area. While the predominant direction is north to south in all seasons, the currents are generally weak in the VAFB SRB recovery area— less than 1 knot.

The following mean and standard deviation may be used for the entire recovery area for all seasons:

Mean	Standard Deviation
0.3 m s^{-1} (0.54 knots)	0.3 m s^{-1} (0.56 knots)

14.4 Wave Slope. The wave slopes shown in tables 14.4A and 14.4B for Kennedy Space Center and Vandenberg AFB were calculated along the wind direction after assuming a Gaussian distribution in a fully aroused sea. The entire distribution of significant wave heights was used for the calculations.

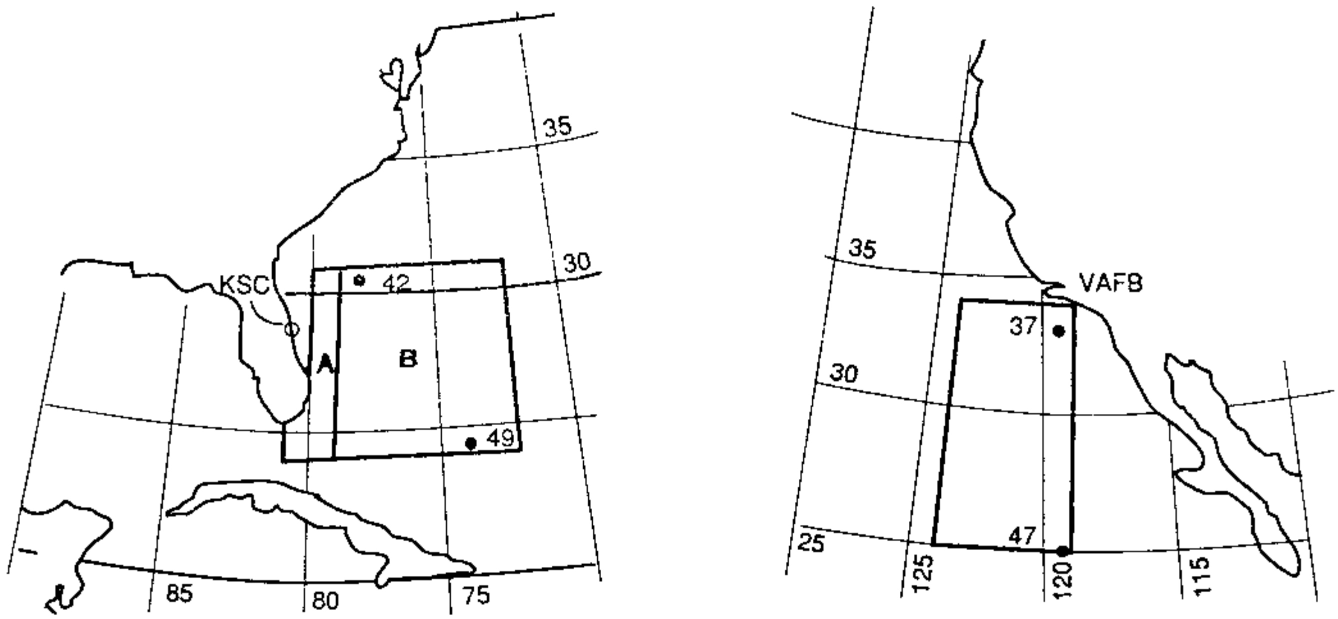


FIGURE 14.3. KSC and VAFB Booster Recovery Areas. Includes Special Gulf Stream Current Areas (A) and Wind Speed Duration Grid Points.

TABLE 14.4A. KSC Recovery Area Wave Slopes (Calculated From Significant Wave Heights).

Risk of Exceeding	J	F	M	A	M	J	J	A	S	O	N	D	Avg.
5%	11°	12°	11°	10°	10°	10°	10°	9°	11°	11°	11°	11°	10°

TABLE 14.4B. VAFB Recovery Area Wave Slopes (Calculated From Significant Wave Heights).

Risk of Exceeding	J	F	M	A	M	J	J	A	S	O	N	D	Avg.
5%	10°	10°	10°	10°	11°	11°	10°	10°	10°	10°	10°	11°	10°

14.5 Ocean Temperatures. Maximum, mean, and minimum water temperatures for 3-month periods from the surface to depths of 50 m for KSC and VAFB booster recovery areas are given in tables 14.5 and 14.6 (ref. 14.10).

14.6 Atmospheric Conditions. Climatological information applicable to KSC and VAFB booster recovery and retrieval areas is given in tables 14.7 and 14.8 (refs. 14.7 and 14.11). These values, developed from observations made at 00, 06, 12, and 18 Z time by ships passing through the area, show the percent frequency of the indicated atmospheric condition. For example, off KSC in January the sky cover was 0, 1/8, or 2/8 (≤ 2/8) on 20.3 percent of the observations. The sky was completely covered (8/8) on 20.8 percent of the observations.

14.7 Wind Speed and Wave Height Durations and Intervals. The following duration and interval tables, taken from the "U.S. Navy Hindcast Spectral Ocean Wave Model Climatic Atlases" (refs. 14.3 and 14.4), are given for two Atlantic Ocean grid points (Nos. 42 and 49) near Cape Canaveral, FL and two Pacific Ocean grid points (Nos. 37 and 47) near Vandenberg AFB, CA (fig. 14.3). Even though the statistics are given at grid points they are representative of surrounding areas. Also, interpolation may be used for areas between grid points. The Atlantic Ocean data base of 20 years was considered large enough to produce reliable monthly statistics. The Pacific Ocean data base of 12.5 years, however, was not large enough for monthly summaries. The statistics were prepared for seasons as follows:

Winter = January, February March
Spring = April, May, June
Summer = July, August, September
Fall = October, November, December

Atlantic Ocean duration and interval tables were published for only 6 months— January, February, April, July, August, October— and a summary table which includes all the hindcasts. These months were chosen to show detail in winter (January and February) and summer (July and August), with only one month for each transition season (April and October). Episodes of durations (continuous hours or days) of events and episodes of intervals (continuous hours or days) between events were tallied for various thresholds. These tables give an indication of how long an episode is likely to last once it has begun. For convenience, the time an episode persisted above a given threshold is arbitrarily referred to as a "duration" of the event. The times in between episodes have been termed "intervals."

14.7.1 Legends For Duration and Interval Tables. Table 14.9 gives the legends for duration and interval tables (tables 14.10 through 14.25).

14.7.2 Applications of Durations and Interval Tables. When answering questions using the duration and interval tables, it is important to distinguish between questions that require the use of the number of episodes and those that require the number of hindcasts. Answers for questions regarding the percentage of time at or above, or below, certain thresholds require the use of the number of hindcasts. On the other hand, questions concerned with the percentage of episodes at or above, or below, certain thresholds demand the use of episode frequencies, where a 1-day episode and a 60-day episode will each count as one episode.

Table 14.5 Ocean tempeatures (°C) in the KSC booster recovery areas.

Months	January to March			April to June			July to September			October to December		
Depth (m)	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean	Min.
0	26	23	16	29	26	21	31	29	27	29	26	19
10	26	23	16	29	26	20	30	29	26	29	26	19
20	26	23	17	29	26	19	30	28	23	29	26	20
30	26	23	16	28	26	17	29	28	21	29	26	21
50	26	23	17	28	25	17	29	27	19	28	26	22

Table 14.6 Ocean temperatures (°C) in the VAFB booster recovery areas.

Months	January to March			April to June			July to September			October to December		
Depth (m)	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean	Min.
0	17	14	12	19	14	11	21	17	13	20	17	13
10	17	14	11	18	14	11	21	17	11	20	17	13
20	17	14	11	17	14	11	20	16	10	20	16	12
30	17	14	11	17	14	10	20	16	10	20	16	11
50	17	14	10	17	13	9	19	14	9	20	14	10

TABLE 14.7. KSC Booster Recovery Area Atmospheric Conditions.

Percent Frequency of Occurrence									
	Visibility		Total Precip.	Sky Cover			Wind Speed (knots)		
Month	≤ 2	≥ 10	(in)	0–2/8	8/8	Mean*	≤ 10	≥ 17	Mean†
J	1.3	89.4	4.0	20.3	20.8	0.62	29.0	35.8	15.2
F	1.9	88.4	4.5	21.3	22.1	0.62	29.9	39.2	15.9
M	0.5	88.6	2.6	26.5	19.2	0.58	30.0	37.9	15.2
A	1.0	89.6	1.3	36.2	9.6	0.47	34.4	30.6	14.0
M	0.9	88.7	2.2	37.5	12.7	0.47	48.2	18.6	11.9
J	2.4	86.2	4.5	24.2	17.2	0.57	49.7	17.8	11.9
J	1.3	92.0	3.8	30.8	12.4	0.52	50.6	14.6	11.5
A	1.1	90.0	4.5	22.5	11.8	0.55	57.6	13.4	11.2
S	2.2	87.3	4.9	25.4	16.2	0.56	50.6	19.1	12.0
O	0.6	90.6	2.3	28.5	13.7	0.53	36.5	28.7	13.6
N	1.1	92.7	3.4	28.7	11.6	0.53	33.8	33.2	14.7
D	0.9	92.7	2.1	29.0	14.3	0.56	41.3	28.6	14.7

TABLE 14.8. VAFB Booster Recovery Area Atmospheric Conditions.

Percent Frequency of Occurrence									
	Visibility		Total Precip.	Sky Cover			Wind Speed (knots)		
Month	≤ 2	≥ 10	(in)	0–2/8	8/8	Mean*	≤ 10	≥ 17	Mean†
J	2.3	76.9	5.1	30.5	25.2	0.59	41.2	27.5	13.1
F	4.6	76.3	4.9	27.8	29.3	0.60	38.6	32.5	13.8
M	0.8	81.0	3.2	30.4	23.9	0.58	35.1	40.4	14.8
A	1.6	75.2	3.0	25.0	30.3	0.63	29.1	43.6	15.7
M	0.3	84.1	2.1	24.0	31.8	0.65	26.5	43.5	15.8
J	1.1	71.5	2.7	21.7	49.2	0.71	28.1	42.4	15.5
J	1.2	74.1	2.3	16.5	60.4	0.79	34.7	34.8	14.0
A	0.8	72.8	1.4	16.1	58.6	0.79	32.9	33.5	13.9
S	0.5	77.0	1.9	26.4	39.4	0.66	35.4	33.3	13.7
O	1.0	79.1	1.3	33.9	33.1	0.58	40.7	30.8	13.4
N	1.9	77.5	3.8	32.9	26.0	0.56	44.2	26.2	12.7
D	1.2	83.3	3.2	32.8	20.5	0.55	46.5	28.2	12.7

*Mean sky cover is expressed in one-hundredths of the sky being covered.
†Mean wind speed values are expressed in knots, not in percent.

The following four examples are provided to illustrate applications of the duration and interval tables.

Question 1: Of all the events with wind speeds (*Ws*) ≥ 22 knots at grid point 42 in January (table 14.10), what percentage had durations of longer than 1 day?

Answer: Consult table 14.10. The number of events (or episodes) of Ws ≥ 22 k (from TE column) is 72. The number of events of wind speeds ≥22 knots lasting more than 1 day is $2 + 1 + 2 + 1 + 1 = 7$. The percentage of events of wind speed =22 knots lasting more than 1 days is then $7 \div 72 \times 100 = 9.7$ percent.

Question 2: What percentage of the time during January at Atlantic grid point No. 42 can waves greater than or equal to 9 ft be expected to persist longer than 24 hours?

Answer: This problem involves computations using hindcasts from the monthly duration table (table 14.14) rather than episodes from the duration table since we are answering a question regarding the percentage of time. The solution can be found by computing the joint percentage as follows: percent of waves ≥ 9 ft times percent of ≥ 9-ft waves that persist longer than 24 hours. Note that the percent of ≥ 9-ft waves that lasted <24 hours plus the percent of ≥ 9-ft waves that lasted ≥ 24 hours is 100 percent so we can compute whichever is easier and subtract from 100 percent if necessary. Percentages are used because of the difference between *T* and *T** caused by missing data.

Step 1, Compute the percent of ≥ 9-ft waves that lasted >24 hours. In this example it will be easier to find the percent for ≤ 24 hours then subtract from 100 percent to obtain the percent we require. This requires the calculation of the total number of hindcasts meeting this criterion.

This procedure is as follows:

Duration	Hindcasts Per Event		Frequency (From Table)		Hindcasts ≤ 9 ft Lasting ≤ 24 hours
6 hours	1	x	8	=	8
12 hours	2	x	10	=	20
18 hours	3	x	5	=	15
24 hours	4	x	3	=	12
			TOTAL:		55

Thus, the percent of ≥ 9-ft waves that lasted ≤ 24 hours is $(55 \div 146) \times 100 = 37.7$ percent. The percent of ≥ 9-ft waves lasting >24 hours is 100 percent – 37.7 percent = 62.3 percent.

Step 2. The percent of waves ≥ 9 ft is (T^*/TH) x 100 or $(146 \div 2.439) \times 100 = 6$ percent.

Step 3. The answer is 62.3 percent x 6 percent = 3.7 percent.

Question 3: Suppose a certain operation to be conducted in February near grid point No. 42 requires that the significant wave height must remain less than 9 ft for at least 24 hours. What is the climatological probability that the operation can be conducted successfully?

Answer: This problem involves the use of the wave height interval tables, since we want intervals between wave height ≥ 9 ft. The number of intervals between events of waves ≥ 9 ft is 74 (from the TI column of the interval table (table 14.16)). The number of intervals between events (episodes) of wave height ≥ 9 ft lasting 24 hours or less is 5 + 6 + 1 + 1 = 13. The percentage of intervals between waves ≥ 9 ft lasting 24 hours or less is thus (13÷74) x 100 = 17.6 percent. In other words, 17.6 percent of all the episodes with waves <9 ft persisted 24 hours or less, and the percentage of <9-ft wave episodes lasting longer than 24 hours is 100 percent –17.6 percent = 82.4 percent. Thus, the climatological probability that the operation can successfully be conducted is 82.4 percent.

Question 4: What percentage of the time can significant wave heights less than 9 ft be expected to persist longer than 2 days in February at Atlantic grid point No. 42?

Answer: This problem requires the use of hindcast frequencies from the interval table (Table 14.16) for February. We proceed following the steps outlined in Question 2.

Step 1. Compute the percent of <9-ft waves that lasted >2 days. This requires estimation of the total number of hindcasts meeting this criterion. Estimation is necessary because beyond 1 day, the 0.25 day resolution of the hindcasts is lost in the summary process, so we must approximate the average number of hindcasts per interval. Since the 1 to 2 day interval includes episodes consisting of 1.25, 1.5, 1.75, and 2 days (that is 5, 6, 7, and 8 hindcasts), the average hindcasts per interval is 6.5. In this example it will be easier and more accurate to find the percent for =2 days then subtract from 100 to obtain the percent we require. The procedure is as follows:

Interval	Hindcasts Per Interval		Frequency (From Table)		Hindcasts ≥ 9 ft Lasting ≤ 2 Days
0.25 day	1	x	5	=	5
0.50 day	2	x	6	=	12
0.75 day	3	x	1	=	3
1 day	4	x	1	=	4
1-2 days	6.5	x	5	=	32.5
			TOTAL		56.5

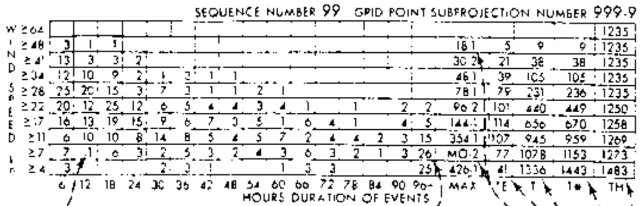
Thus, the percent of <9-ft waves that lasted <2 days is (56.5÷2,565) x 100 = 2.2 percent. The percent of <9-ft waves that lasted >2 days is 100 percent –2.2 percent = 97.8 percent.

Step 2. The percent of waves <9 ft is (*T**/*TH*) x 100 or (2,618÷2,862) x 100 = 91.5 percent.

Step 3. The answer is 97.8 percent x 91.5 percent = 89.5 percent.

TABLE 14.9. Legends For Duration And Interval Tables.

WIND SPEED DURATIONS – MONTHLY SEASONAL



1 Event with wind speeds ≥7 kn. persisted 12 hours, 26 events persisted ≥96 hours.

The longest event with wind speeds ≥7 kn persisted for 1 month or more and it occurred 2 times.

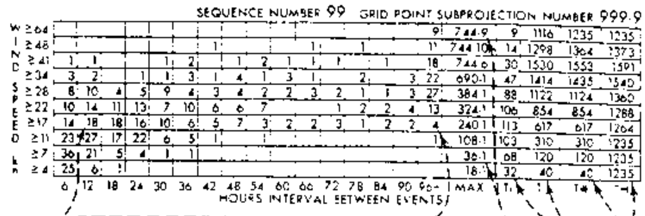
The longest event with wind speeds ≥48 kn. persisted 18 hours and it occurred 1 time.

41 Events had wind speeds ≥4 kn. which comprised a total of 1,336 hindcasts.

1,483 Hindcasts were examined, and 1,443 had wind speeds ≥4 kn.

Durations for a particular month extend from the time the event begins (or the first of the month if already in progress), and terminate when the event ends. Events become undefined if missing data is encountered. Durations lasting a month or more are categorized together. Durations may persist into the next month(s).

WIND SPEED INTERVALS – MONTHLY/SEASONAL



There were 18 12-hour intervals between events of wind speeds ≥17 kn.; 4 intervals persisted 96 hours or more.

The longest interval between events of wind speeds ≥7 kn. was 36 hours and it occurred 1 time.

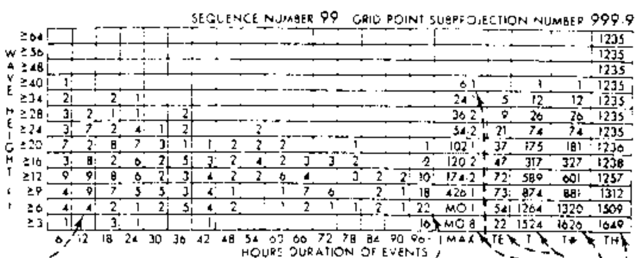
The longest interval between events of wind speeds ≥64 kn was 1 month or more and it occurred 9 times.

There were 32 intervals between events of wind speeds ≥4 kn. which comprised a total of 40 hindcasts.

1,235 Hindcasts were examined, and 40 had wind speeds <4 kn.

Intervals for a particular month extend from the time the event ends (or the first of the month if the event is not in progress), and terminate when the event begins. Intervals become undefined if missing data is encountered. Intervals lasting a month or more are categorized together. Intervals may persist into the next month(s).

WAVE HEIGHT DURATIONS – MONTHLY/SEASONAL



4 Events with wave heights ≥6 ft. (1.8m) persisted 12 hours; 22 events persisted ≥96 hours.

The longest event with wave heights ≥3 ft. (0.9m) persisted 1 month or more and it occurred 8 times.

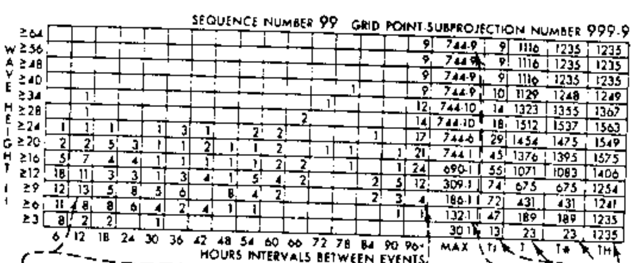
The longest event with wave heights ≥40 ft. (12.2m) persisted for 6 hours and it occurred 1 time.

22 Events had wave heights ≥3 ft. (0.9m) which comprised a total of 1,524 hindcasts.

1,649 Hindcasts were examined, and 1,626 had wave heights ≥3 ft. (0.9m).

Durations for a particular month extend from the time the event begins (or the first of the month if already in progress), and terminate when the event ends. Events become undefined if missing data is encountered. Durations lasting a month or more are categorized together. Durations may persist into the next month(s).

WAVE HEIGHT INTERVALS – MONTHLY/SEASONAL



There were 13 12-hour intervals between events of wave heights ≥9 ft. (2.7m); 4 intervals persisted 96 hours or more.

The longest interval between events of wave heights ≥6 ft. (1.8m) was 132 hours and it occurred 1 time.

The longest interval between events of wave heights ≥64 ft. (19.5m) was 1 month or more and it occurred 9 times.

There were 13 intervals between events of wave heights ≥3 ft. (0.9m) which comprised a total of 23 hindcasts.

1,235 Hindcasts were examined, and 23 had wave heights <3 ft. (0.9m).

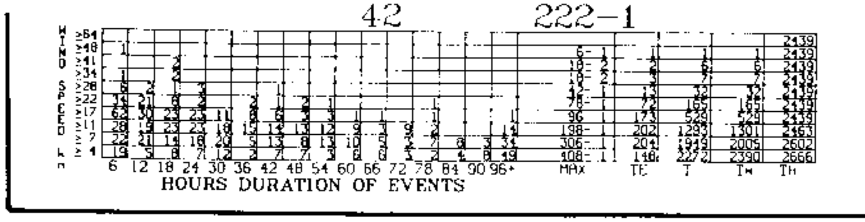
Intervals for a particular month extend from the time the event ends (or the first of the month if the event is not in progress), and terminate when the event begins. Intervals become undefined if missing data is encountered. Intervals lasting a month or more are categorized together. Intervals may persist into the next month(s).

ABBREVIATIONS

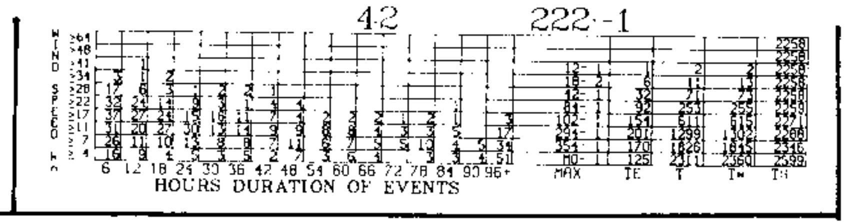
MAX: Maximum duration or interval, followed by the number of occurrences.
TE or TI: Total number of events or intervals.
T: Total number of hindcasts included in TE or TI.
T*: Total number of hindcasts that met the stated criteria
TH: Total number of hindcasts examined
MO: Month
SEA: Season

Table 14.10 Wind speed durations, Atlantic grid point 42, location 30.4 N. latitude, 77.9 W. longitude.

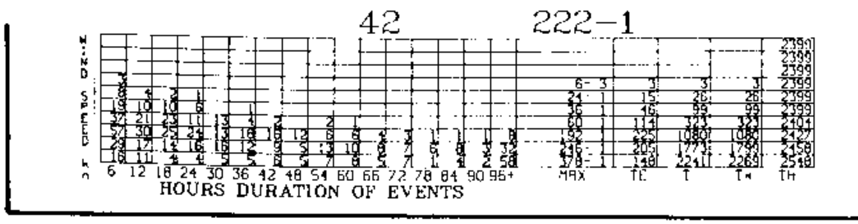
January



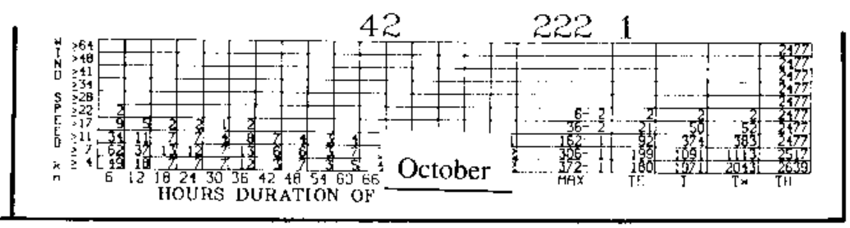
February



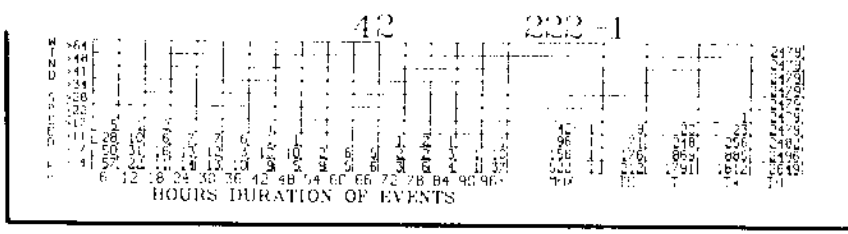
April



July



August



October

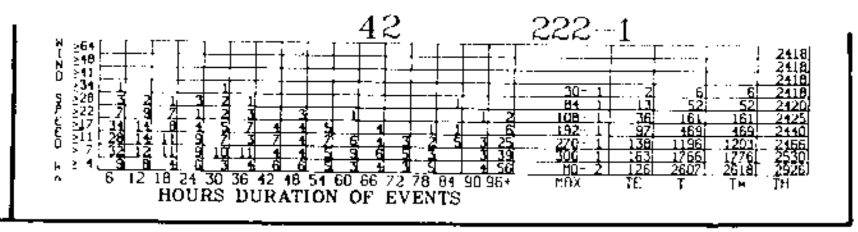
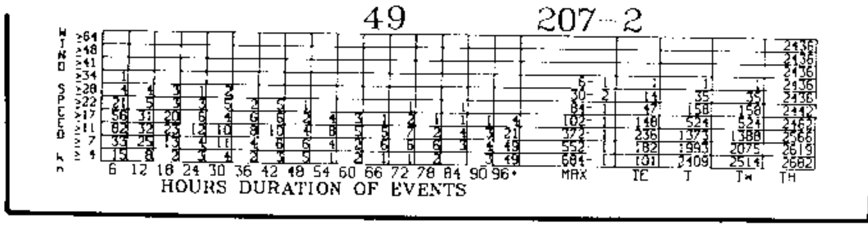
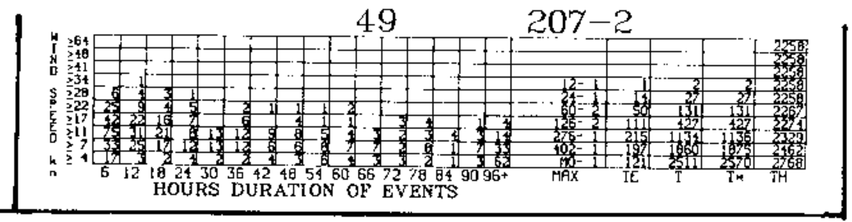


Table 14.11 Wind speed durations, Atlantic grid point 49, location 24.2 N. latitude, 72.9 W. longitude.

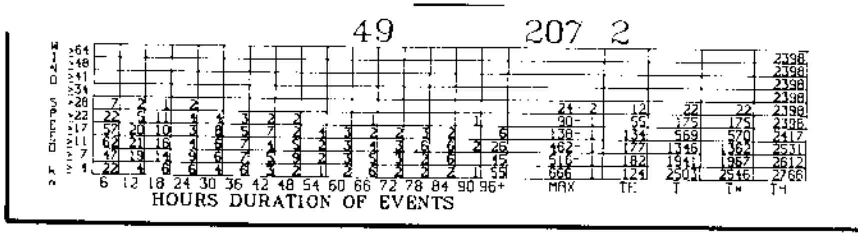
January



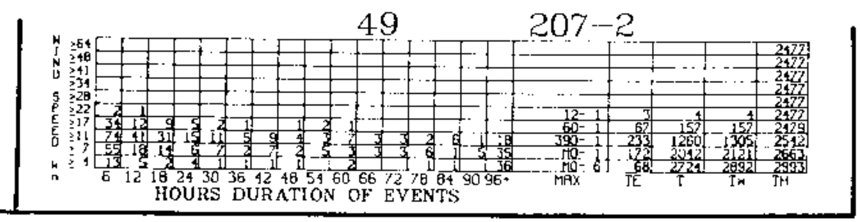
February



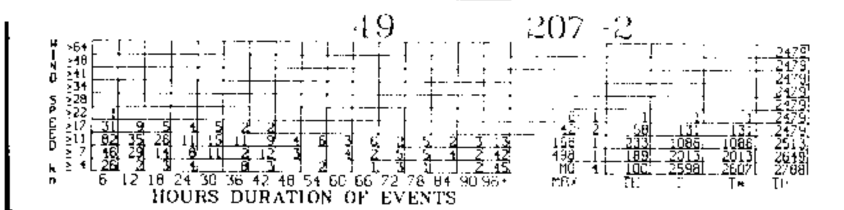
April



July



August



October

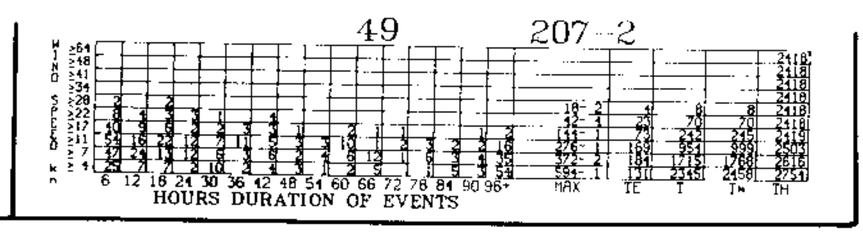
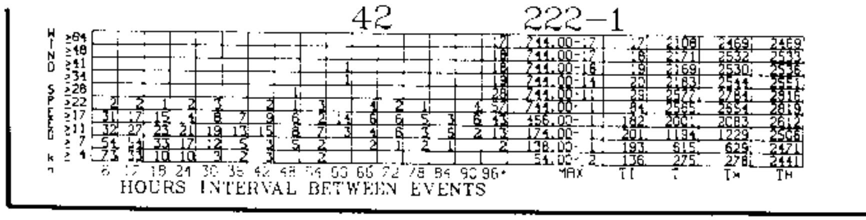
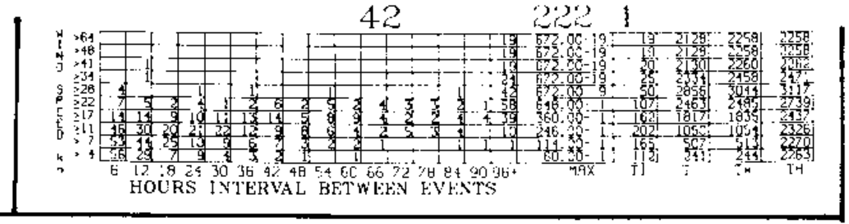


Table 14.12 Wind speed intervals, Atlantic grid point 42, location 30.4 N. latitude, 77.9 W. longitude.

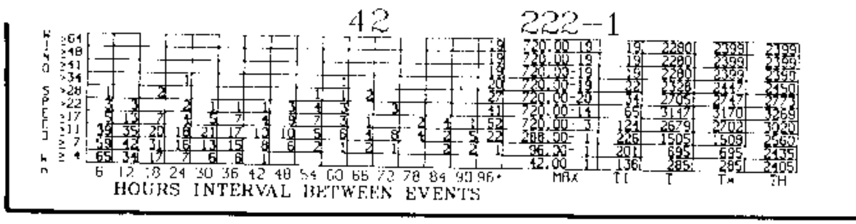
January



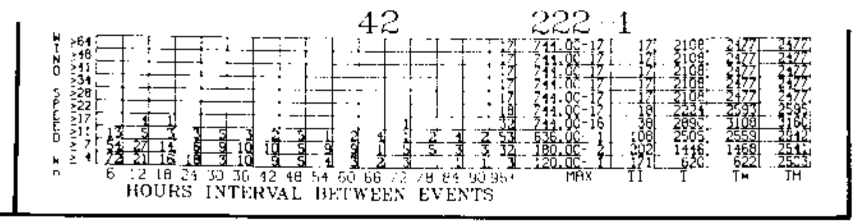
February



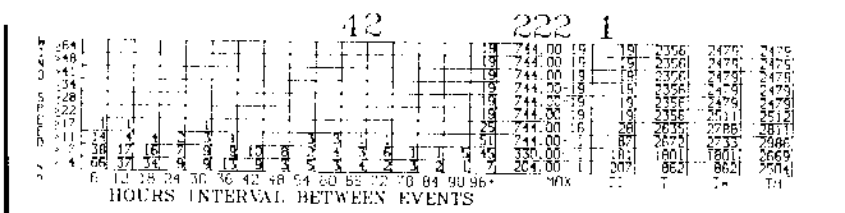
April



July



August



October

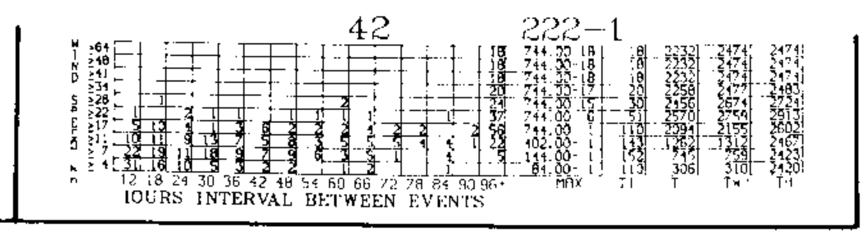
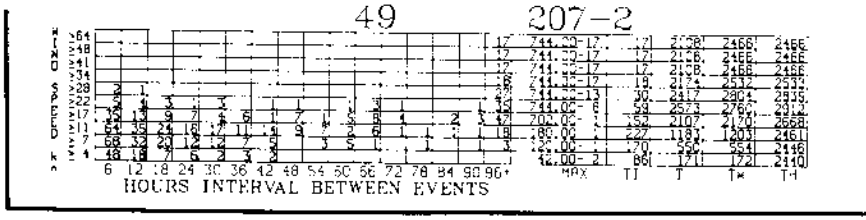
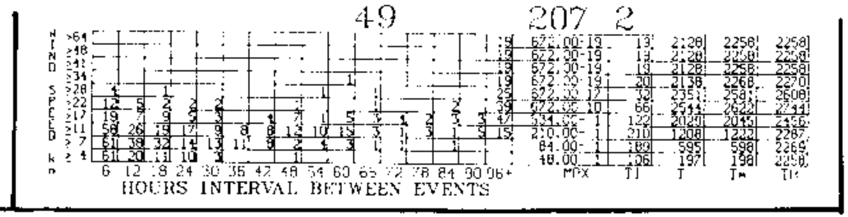


Table 14.13 Wind speed intervals, Atlantic grid point 49, location 24.2 N. latitude, 72.8 W. longitude.

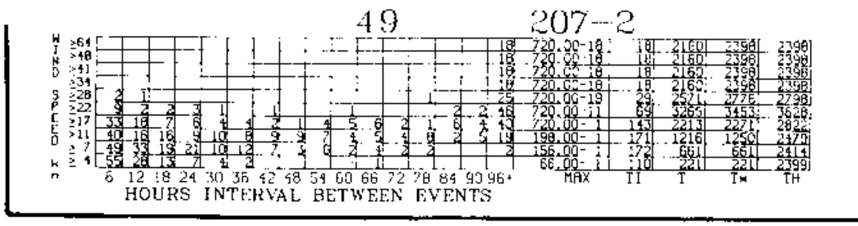
January



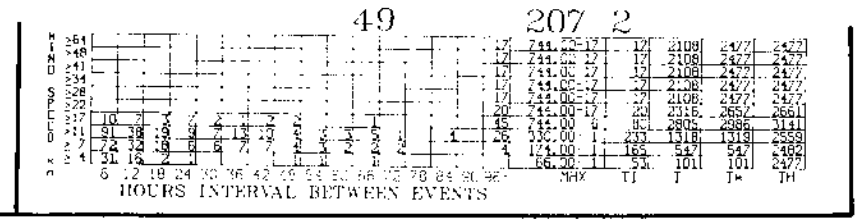
February



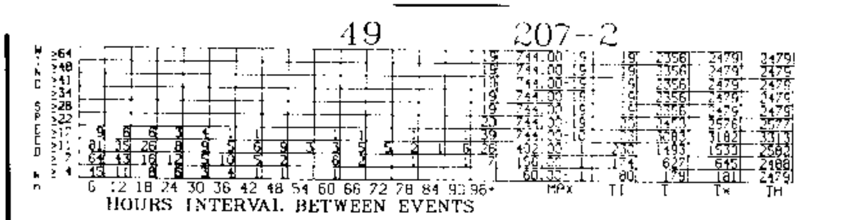
April



July



August



October

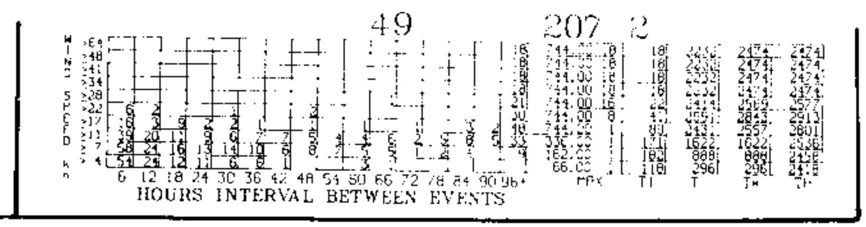
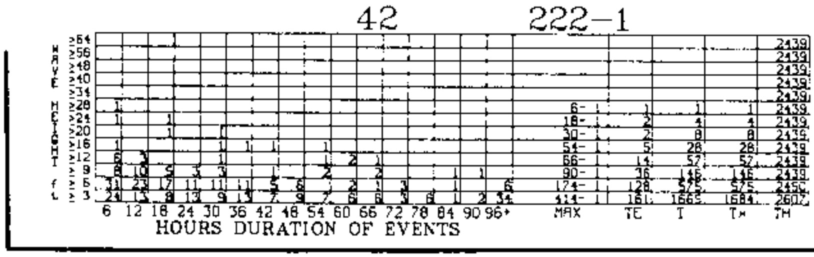
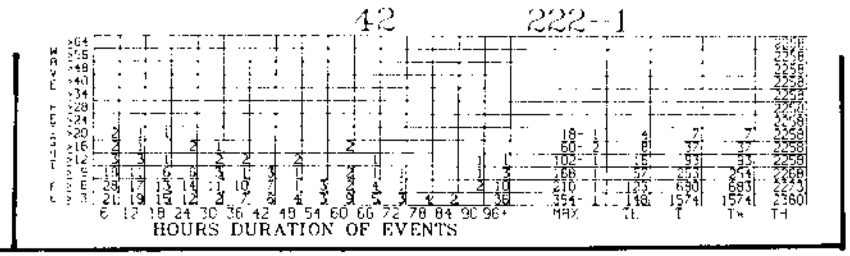


Table 14.14 Wave height duration, Atlantic grid point 42, location 30.4 N. latitude, 77.9 W. longitude.

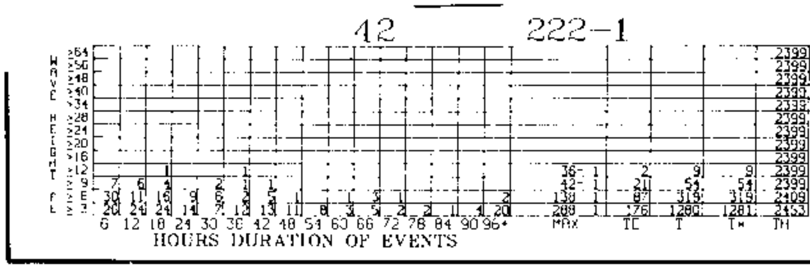
January



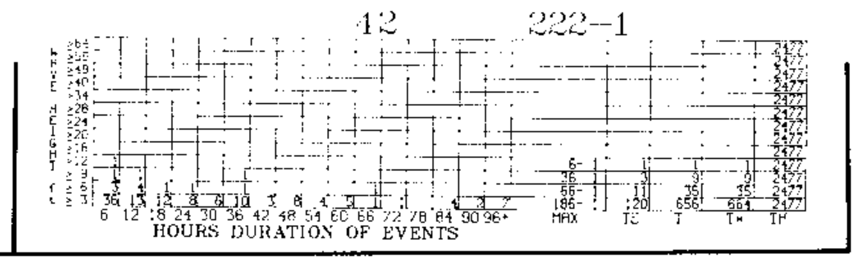
February



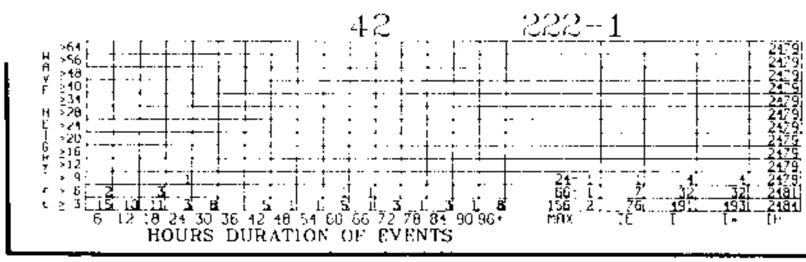
April



July



August



October

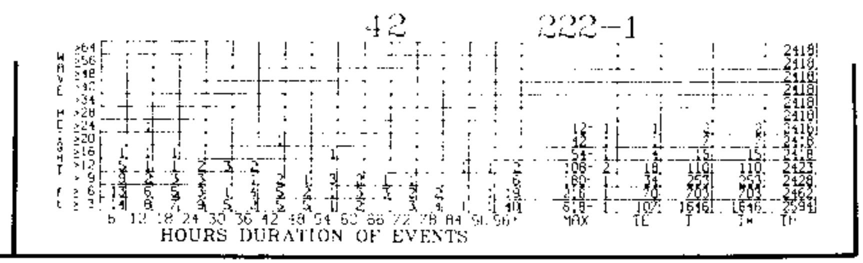
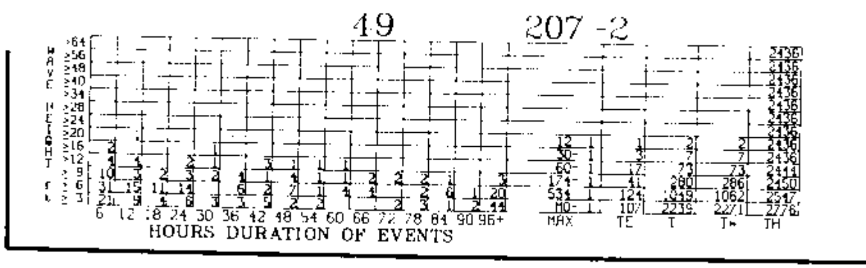
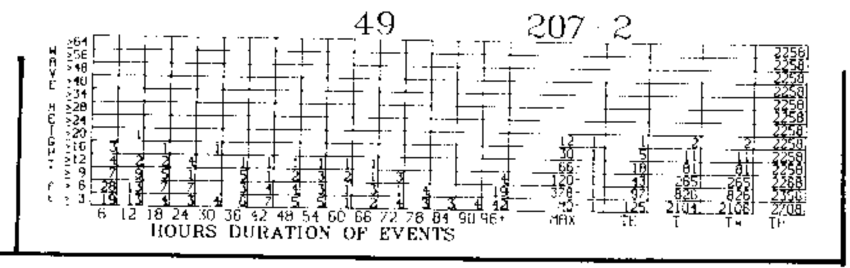


Table 14.15 Wave height duration, Atlantic grid point 49, location 24.2 N. latitude, 72.8 W. longitude.

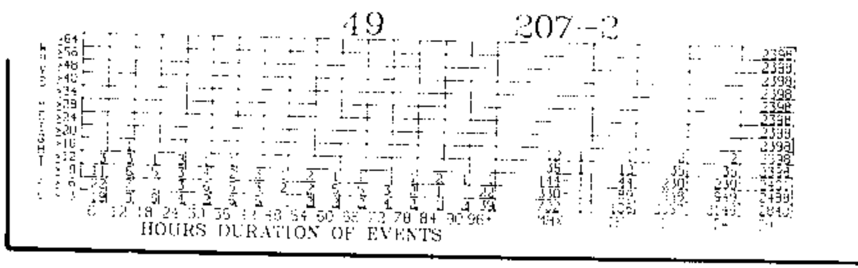
January



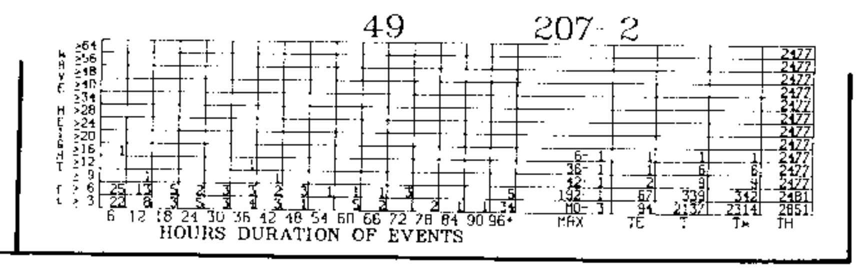
February



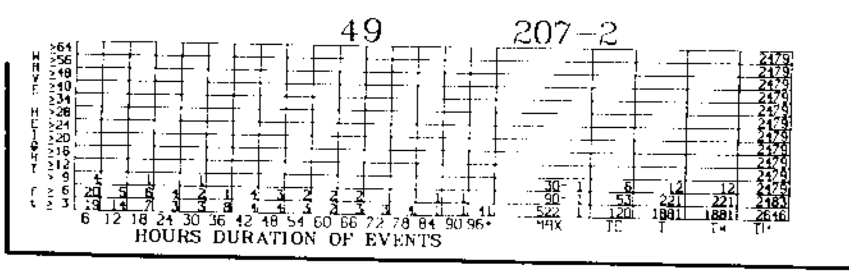
April



July



August



October

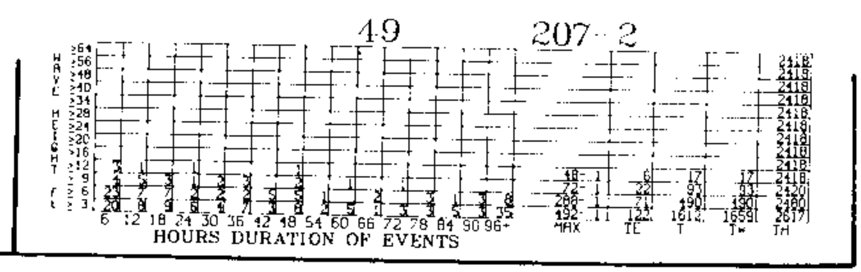
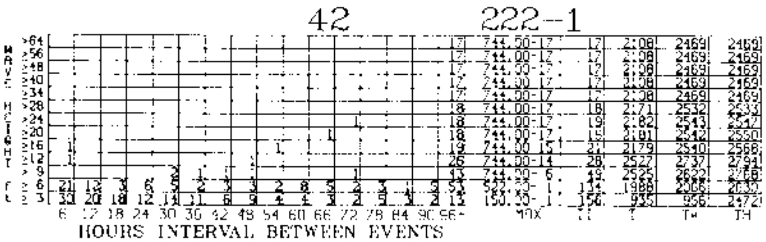
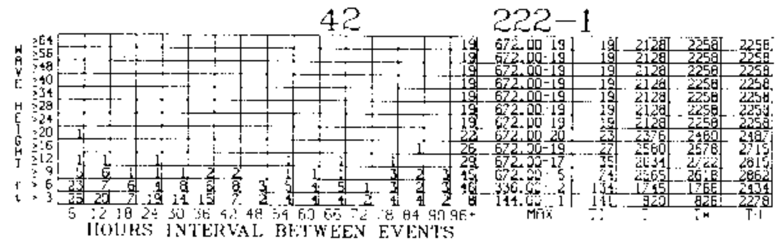


Table 14.16 Wave height intervals, Atlantic grid point 42, location 30.4 N. latitude, 77.9 W. longitude.

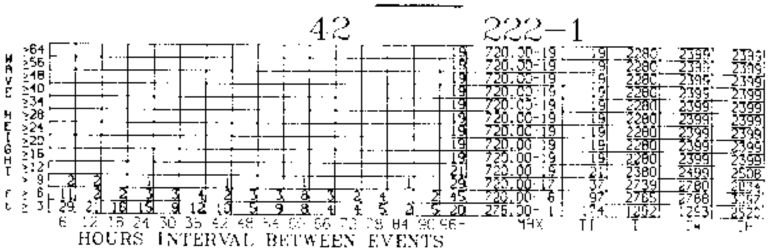
January



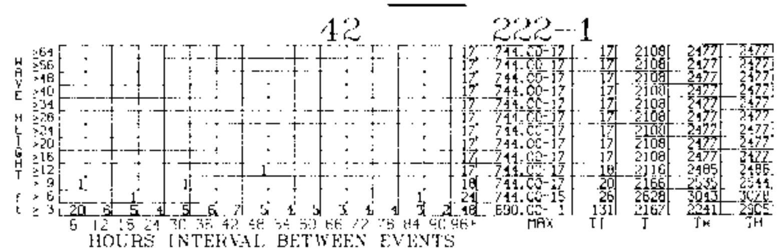
February



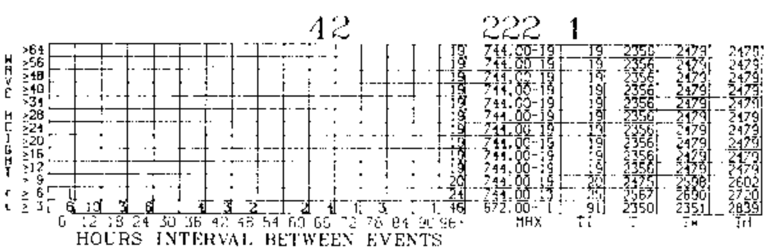
April



July



August



October

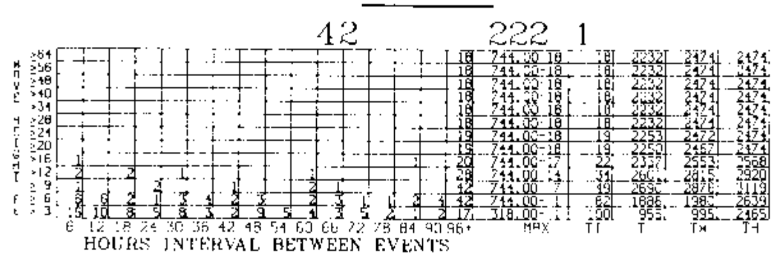
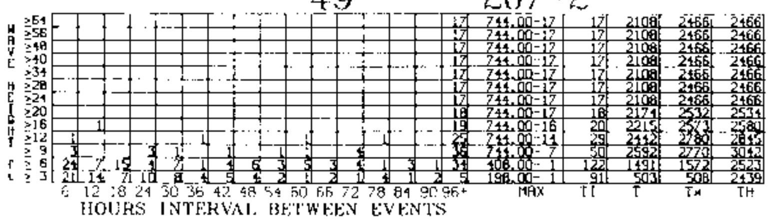
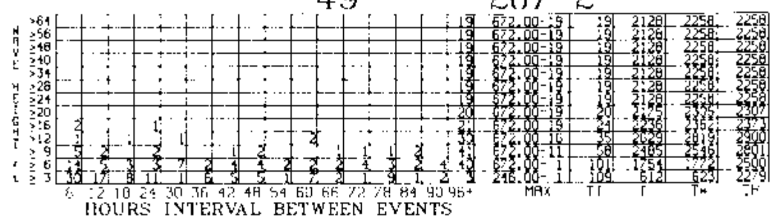


Table 14.17 Wave height intervals, Atlantic grid point 49, location 24.1 N. latitude, 72.8 W. longitude.

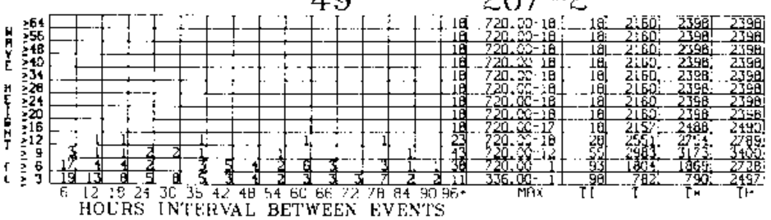
January



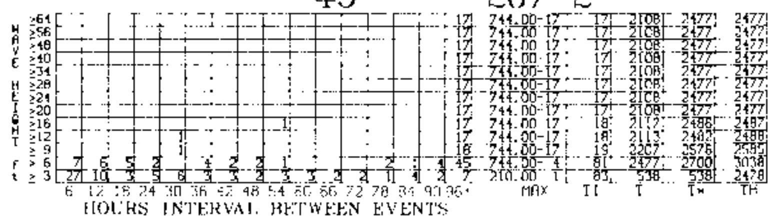
February



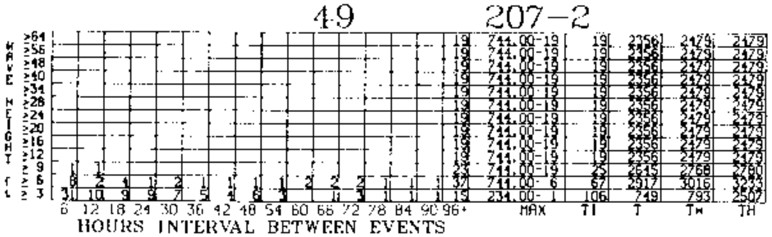
April



July



August



October

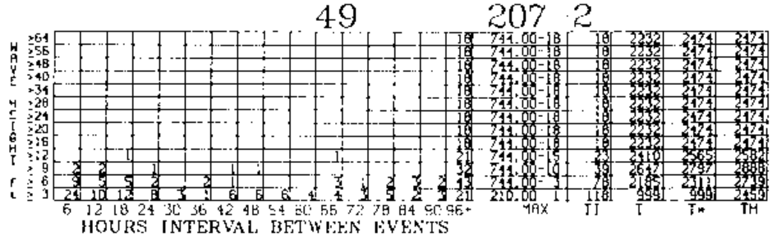


TABLE 14.18 Wind Speed Durations, Pacific Grid Point 37.

Winter — 37 — 32.9 N. Latitude, 119.4 W. Longitude

WIND SPEED kn	6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96+	MAX	TE	T	T*	TH
≥64																					4333
≥48																					4333
≥41																					4333
≥34	2																6–2	2	2	2	4333
≥28	19	9	2	3													24–3	33	55	56	4333
≥22	48	16	11	11	7	1	2	2		2							60–2	100	248	248	4335
≥17	88	43	30	22	11	13	8	4	2	6	1		1	4		2	114–1	235	768	768	4355
≥11	92	51	45	23	27	32	21	9	14	14	12	4	3	7	6	22	306–1	382	2154	2158	4391
≥ 7	90	32	31	12	16	11	13	9	11	12	4	7	6	9	5	74	582–1	342	3350	3395	4458
≥ 4	55	24	16	5	6	8	12	4	9	5	5	5	7		3	76	1218–1	241	3968	4192	4700

HOURS DURATION OF EVENTS

Spring — 37 — 32.9 N. Latitude, 119.4 W. Longitude

WIND SPEED kn	6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96+	MAX	TE	T	T*	TH
≥64																					4241
≥48																					4241
≥41																					4241
≥34			1														18–1	1	3	3	4241
≥28	32	17	3		1												30–1	53	80	80	4241
≥22	103	59	24	5	4	13	10		3	2	2						66–2	225	550	552	4243
≥17	121	70	32	9	19	22	12	5	6	3	9	4	3	7	3	14	228–1	339	1504	1548	4272
≥11	114	44	23	8	10	13	9	5	1	9	12	4	1	8	7	65	552–1	333	3126	3349	4418
≥ 7	27	14	10		2	3	6	1	5	3	3	1	1	2	4	57	1668–1	139	3794	4374	4693
≥ 4	19	4	4		1	2		1	4	1	3				1	42	SEA–1	82	3957	5035	5185

HOURS DURATION OF EVENTS

Summer — 37 — 32.9 N. Latitude, 119.4 W. Longitude

WIND SPEED kn	6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96+	MAX	TE	T	T*	TH
≥64																					4100
≥48																					4100
≥41																					4100
≥34																					4100
≥28	10																6–10	10	10	10	4100
≥22	48	19	1	1			2	1			1						66–1	73	126	126	4100
≥17	144	73	26	5		1	6	1	1	7	4	1		1		2	114–2	272	631	631	4100
≥11	150	100	71	7	10	8	19	5	5	15	8	2	6	3	7	41	324–2	457	2479	2555	4124
≥ 7	40	24	15	4	3	8	5	4	2	2	4		1	3	4	69	1002–1	188	3526	3797	4209
≥ 4	20	11	4	3	2	2	2	2	1	1	2				4	52	1620–1	106	3389	4043	4246

HOURS DURATION OF EVENTS

Fall — 37 — 32.9 N. Latitude, 119.4 W. Longitude

WIND SPEED kn	6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96+	MAX	TE	T	T*	TH
≥64																					4543
≥48																					4543
≥41																					4543
≥34																					4543
≥28	6	2	2														18–2	10	16	16	4543
≥22	30	20	9	4	4	2	2										42–2	71	159	159	4543
≥17	61	37	22	18	10	8	9	3	3	1		1					72–1	173	507	507	4548
≥11	124	58	39	16	19	22	14	10	12	7	8	12	8	5	7	14	180–1	375	1798	1804	4582
≥ 7	117	44	47	12	20	14	23	9	12	8	12	5	8	7	9	68	378–1	415	3344	3422	4742
≥ 4	61	37	27	15	10	8	8	5	10	3	6	6	2	3	4	84	600–1	289	3839	4139	4815

HOURS DURATION OF EVENTS

TABLE 14.19 Wind Speed Durations, Pacific Grid Point 47.

Winter 47 25.0 N. Latitude, 119.4 W. Longitude

W	≥64																				4333
I	≥48																				4333
N	≥41																				4333
D	≥34	1																6–1	1	1	1	4333
	≥28	4																6-4	4	4	4	4333
S	≥22	13	5	3	1		1	1										42–1	24	49	49	4333
P	≥17	75	24	23	13	4	6	3	2	1				1			1	126–1	153	380	388	4335
E	≥11	143	47	38	17	20	12	10	15	13	11	8	7	6	2	4	22	312–1	375	1894	1927	4378
E	≥ 7	86	36	29	19	13	12	8	7	10	8	9	4	4	2	5	74	558–1	326	3197	3288	4478
D	≥ 4	42	14	20	9	9	3	10	4	7	2	3	4	4	2	3	79	1608–1	215	4396	4575	5036
		6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96+	MAX	TE	T	T*	TH

k
n
HOURS DURATION OF EVENTS

Spring 47 25.0 N. Latitude, 119.4 W. Longitude

W	≥64																				4241
I	≥48																				4241
N	≥41																				4241
D	≥34																				4241
	≥28				1													24–1	1	4	4	4243
S	≥22	15	1	2		1												30–1	19	28	29	4244
P	≥17	72	26	18	6	8	4	3	2	3		1						66–1	143	341	345	4248
E	≥11	160	60	35	21	17	9	15	7	6	13	9	6	3	5	5	23	336–1	394	1841	1909	4258
E	≥ 7	68	36	16	9	10	11	12	12	8	9	6	4	6	8	4	74	642–1	293	3250	3446	4336
D	≥ 4	21	8	10	2	2	2	4	3	2	1	3	3	1	1	1	61	1350–1	125	3832	4492	4744
		6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96+	MAX	TE	T	T*	TH

k
n
HOURS DURATION OF EVENTS

Summer 47 25.0 N. Latitude, 119.4 W. Longitude

W	≥64																				4100
I	≥48																				4100
N	≥41																				4100
D	≥34																				4100
	≥28	1	2															12–2	3	5	5	4100
S	≥22	9	2	3		1	1	1										42–1	17	40	41	4100
P	≥17	29	15	3	6	3	2	3	1			1						66–1	63	159	161	4100
E	≥11	155	62	31	22	17	17	13	11	5	9	4	2	3	1	3	9	126–2	364	1286	1314	4124
E	≥ 7	117	42	32	14	16	7	13	13	4	11	9	8	6	4	4	59	450–1	359	2875	2990	4203
D	≥ 4	40	9	16	4	6	5	9	1	3	2	2	2	2	4	3	69	1296–1	177	3870	4163	4476
		6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96+	MAX	TE	T	T*	TH

k
n
HOURS DURATION OF EVENTS

Fall 47 25.0 N. Latitude, 119.4 W. Longitude

W	≥64																				4545
I	≥48																				4545
N	≥41																				4545
D	≥34	1																6–1	1	1	1	4545
	≥28	1																6-1	1	1	1	4545
S	≥22	7	2	1		2												30–2	12	24	24	4548
P	≥17	77	26	12	7	8	3	2	1					1				78–1	137	286	293	4552
E	≥11	172	51	32	29	28	18	13	20	14	10	13	2	6	3	4	19	216–1	434	1941	1993	4599
E	≥ 7	72	34	20	13	8	7	11	13	6	13	6	1	8	4	9	72	582–1	297	3395	3661	4746
D	≥ 4	22	11	10	9	7	1	3	6	4	3	6	4	5	2	5	68	1074–1	166	3812	4492	4890
		6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96+	MAX	TE	T	T*	TH

k
n
HOURS DURATION OF EVENTS

TABLE 14.20 Wind Speed Intervals, Pacific Grid Point 37.

Winter 37 32.9 N. Latitude, 119.4 W. Longitude

W	≥64																8	SEA–8	8	2944	4389	4389
I	≥48																8	SEA–8	8	2944	4389	4389
N	≥41																8	SEA–8	8	2944	4389	4389
D	≥34		1														8	SEA–7	9	2676	4451	4453
	≥28	2	1	3	2	1			2					1	1	2	25	SEA–3	40	3867	4944	4999
S	≥22	13	6	3	2	3	1	3	2	2	1	4	2	2	2	2	57	1296–1	105	3827	4361	4607
P	≥17	41	17	16	11	11	9	7	8	8	9	15	4	2	4	4	70	672–1	236	3325	3679	4425
E	≥11	120	52	33	19	16	21	20	16	14	9	7	7	8	3	4	28	228–1	377	2126	2237	4337
E	≥ 7	131	67	38	21	26	18	6	7	6	2	1	4	2	2		3	102–2	334	1036	1063	4333
D	≥ 4	116	58	22	12	14	4	4	1	1	1							60–1	233	495	508	4333
		6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96+	MAX	TE	T	T*	TH

kn HOURS INTERVAL BETWEEN EVENTS

Spring 37 32.9 N. Latitude, 119.4 W. Longitude

W	≥64																6	SEA–6	6	2208	4265	4265
I	≥48																6	SEA–6	6	2208	4265	4265
N	≥41																6	SEA–6	6	2208	4265	4265
D	≥34																7	SEA–7	7	2576	4330	4333
	≥28	3	3	6		1	4	1			1					2	37	SEA–5	58	4194	5290	5370
S	≥22	48	40	22	1	2	4	7		2	7	9	2	3	1	9	67	SEA–1	224	3882	4689	5239
P	≥17	70	67	44	3	5	11	28	8	5	13	12	6	5	13	6	48	462–1	344	2775	2800	4317
E	≥11	144	54	58	7	11	14	10	5	6	5	5	1	4	1	2	6	132–1	333	1083	1087	4259
E	≥ 7	71	20	21	1	9	8	2	1			1			1			84–1	135	318	319	4241
D	≥ 4	45	11	10	3	4	1	2										42–2	76	149	150	4241
		6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96+	MAX	TE	T	T*	TH

kn HOURS INTERVAL BETWEEN EVENTS

Summer 37 32.9 N. Latitude, 119.4 W. Longitude

W	≥64																6	SEA–6	6	2208	4224	4224
I	≥48																6	SEA–6	6	2208	4224	4224
N	≥41																6	SEA–6	6	2208	4224	4224
D	≥34																6	SEA–6	6	2208	4224	4224
	≥28	2		2													11	SEA–7	15	2811	4657	4667
S	≥22	8	7	15	1	1	3	2		1	2	1	2	1		1	30	SEA–1	75	2635	4111	4237
P	≥17	47	53	46	3	2	11	17	2	2	6	13		4	5	2	54	1602–1	267	3142	3844	4475
E	≥11	166	112	91	3	7	8	23	4	6	4	15	1	2	3	4	11	144–1	460	1566	1609	4140
E	≥ 7	98	51	16	2	5	4	4		1	1	2	1		1		1	114–1	187	419	424	4112
D	≥ 4	54	29	10	2	1	1	2	1	1							1	108–1	102	210	211	4108
		6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96+	MAX	TE	T	T*	TH

kn HOURS INTERVAL BETWEEN EVENTS

Fall 37 32.9 N. Latitude, 119.4 W. Longitude

W	≥64																5	SEA–5	5	1840	4564	4564
I	≥48																5	SEA–5	5	1840	4564	4564
N	≥41																5	SEA–5	5	1840	4564	4564
D	≥34																5	SEA–5	5	1840	4564	4564
	≥28	1															14	SEA–2	15	2840	5230	5246
S	≥22	7	4	3	2		1	1	3		1	3		1	1	2	43	1650–1	72	3058	4714	4873
P	≥17	24	19	11	5	6	5	6	5	7	4	2	3	2	5	3	61	1134–1	168	3279	4251	4753
E	≥11	86	54	31	21	16	15	21	20	10	18	9	4	4	3	7	44	300–1	363	2604	2808	4573
E	≥ 7	175	77	54	23	24	10	12	12	2	7	3	2	3		1	7	120–1	412	1267	1325	4548
D	≥ 4	143	61	35	18	10	8	3	5	3	1	1					1	102–1	289	666	680	4547
		6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96+	MAX	TE	T	T*	TH

kn HOURS INTERVAL BETWEEN EVENTS

TABLE 14.21 Wind Speed Intervals, Pacific Grid Point 47.

Winter — 47 — 25.0 N. Latitude, 119.4 W. Longitude

	WIND SPEED kn	6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96+	MAX	TE	T	T*	TH
W	≥64																8	SEA–8	8	2944	4389	4389
I	≥48																8	SEA–8	8	2944	4389	4389
N	≥41																8	SEA–8	8	2944	4389	4389
D	≥34																8	SEA–8	8	2944	4389	4390
	≥28	1															10	SEA–8	11	3189	4634	4638
S	≥22					1											28	SEA–3	29	3868	5280	5329
P	≥17	36	7	6	4	7	4	8	3	3	5	3			3	2	65	2034–1	156	4039	4550	4936
E	≥11	117	47	39	18	19	17	10	7	15	7	11	7	6	6	3	44	390–1	373	2419	2471	4353
E	≥ 7	121	41	46	27	13	16	16	12	7	6	3		1	1	2	8	156–1	320	1181	1199	4342
D	≥ 4	110	47	22	8	5	5	2	2	2	2	2	1					72–1	208	459	463	4335
k n		6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96+	MAX	TE	T	T*	TH

HOURS INTERVAL BETWEEN EVENTS

Spring — 47 — 25.0 N. Latitude, 119.4 W. Longitude

	WIND SPEED kn	6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96+	MAX	TE	T	T*	TH
W	≥64																6	SEA–6	6	2208	4265	4265
I	≥48																6	SEA–6	6	2208	4265	4265
N	≥41																6	SEA–6	6	2208	4265	4265
D	≥34																6	SEA–6	6	2208	4265	4265
	≥28																6	SEA–6	6	2208	4263	4265
S	≥22																23	SEA–4	23	3526	5042	5068
P	≥17	29	15	9	8	2	1	2	2	1	3	5	1	2		1	68	2052–1	149	4348	4575	4913
E	≥11	132	58	35	20	21	16	15	8	10	7	11	4	10	2	7	40	354–1	396	2447	2463	4355
E	≥ 7	135	58	35	9	15	6	11	2	6	1	4	2	2	2	2	4	150–1	294	898	901	4252
D	≥ 4	67	25	15	4	4	3	2		1			1					72–1	122	251	252	4241
k n		6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96+	MAX	TE	T	T*	TH

HOURS INTERVAL BETWEEN EVENTS

Summer — 47 — 25.0 N. Latitude, 119.4 W. Longitude

	WIND SPEED kn	6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96+	MAX	TE	T	T*	TH
W	≥64																6	SEA–6	6	2208	4224	4224
I	≥48																6	SEA–6	6	2208	4224	4224
N	≥41																6	SEA–6	6	2208	4224	4224
D	≥34																6	SEA–6	6	2208	4224	4224
	≥28																8	SEA–6	8	2610	4483	4488
S	≥22	3		1					1								15	SEA–3	20	2634	4349	4390
P	≥17	7	1	2	2		2	2	2	1		2	2				44	1266–1	67	3161	4291	4452
E	≥11	118	50	39	12	9	10	11	6	4	9	9	10	8	4	13	53	366–1	365	2742	2859	4149
E	≥ 7	151	62	39	15	24	11	11	4	12	9	3	4	4	1	1	4	156–1	355	1198	1227	4114
D	≥ 4	106	35	14	9	6	3	1										42–1	174	309	313	4100
k n		6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96+	MAX	TE	T	T*	TH

HOURS INTERVAL BETWEEN EVENTS

Fall — 47 — 25.0 N. Latitude, 119.4 W. Longitude

	WIND SPEED kn	6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96+	MAX	TE	T	T*	TH
W	≥64																5	SEA–5	5	1840	4566	4566
I	≥48																5	SEA–5	5	1840	4566	4566
N	≥41																5	SEA–5	5	1840	4566	4566
D	≥34	1															5	SEA–5	6	1841	4565	4566
	≥28	1															5	SEA–5	6	1841	4565	4566
S	≥22	1															13	SEA–3	14	2655	5133	5154
P	≥17	25	9	3	7	4	1	3	2	1	1	4	2	4	1	1	69	972–1	137	3035	4436	4722
E	≥11	157	36	49	25	24	15	17	12	7	11	9	5	6	4	9	42	318–1	428	2496	2617	4556
E	≥ 7	125	51	23	18	21	12	9	7	5	5	2	4	1	6		7	126–2	296	1062	1085	4545
D	≥ 4	85	27	24	7	3	5	4	3	1	2		1		1			84–1	164	392	398	4545
k n		6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96+	MAX	TE	T	T*	TH

HOURS INTERVAL BETWEEN EVENTS

TABLE 14.22 Wave Height Durations, Pacific Grid Point 37.

Winter 37 32.9 N. Latitude, 119.4 W. Longitude

W	≥64																					4333
A	≥56																					4333
V	≥48																					4333
E	≥40																					4333
	≥34																					4333
H	≥28																					4333
E	≥24																					4333
I	≥20	1																6–1	1	1	1	4333
G	≥16	6		1	1													24–1	8	13	13	4333
H	≥12	14	4	4	4	2	3	2			1						1	108–1	35	120	120	4333
T	≥ 9	34	7	9	13	6	5	3	4	1	3	2	1				2	150–1	90	354	354	4335
	≥ 6	49	23	18	7	9	12	10	8	8	8	4	2	2	7	1	11	258–1	179	1042	1045	4358
f	≥ 3	55	29	19	14	18	14	16	7	9	5	8	9	4	3	8	47	460–1	265	2518	2569	4386
t		6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96+	MAX	TE	T	T*	TH

HOURS DURATION OF EVENTS

Spring 37 32.9 N. Latitude, 119.4 W. Longitude

W	≥64																					4241
A	≥56																					4241
V	≥48																					4241
E	≥40																					4241
	≥34																					4241
H	≥28																					4241
E	≥24																					4241
I	≥20	1																6–1	1	1	1	4241
G	≥16	2			1													24–1	3	6	6	4241
H	≥12	29	6	6	1	1												30–1	43	66	68	4241
T	≥ 9	75	23	15	4	15	8	6	2	2	1	1						66–1	152	402	402	4241
	≥ 6	86	52	31	12	11	12	20	2	7	5	6	5	3	6	5	13	228–1	276	1360	1413	4261
f	≥ 3	56	27	23	6	4	9	8	3	2	5	5	2	5	7	6	63	1290–1	231	3127	3443	4495
t		6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96+	MAX	TE	T	T*	TH

HOURS DURATION OF EVENTS

Summer 37 32.9 N. Latitude, 119.4 W. Longitude

W	≥64																					4100
A	≥56																					4100
V	≥48																					4100
E	≥40																					4100
	≥34																					4100
H	≥28																					4100
E	≥24																					4100
I	≥20																					4100
G	≥16																					4100
H	≥12	2	2															12–2	4	6	6	4100
T	≥ 9	24	7	1	2		1		1									48–1	36	63	63	4100
	≥ 6	74	32	16	3		5	4	1	1	1	8	1		1	1	1	102–1	149	429	429	4100
f	≥ 3	116	70	57	7	12	8	12	4	5	13	13	1	3	5	6	36	426–1	368	2241	2299	4124
t		6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96+	MAX	TE	T	T*	TH

HOURS DURATION OF EVENTS

Fall 37 32.9 N. Latitude, 119.4 W. Longitude

W	≥64																					4543
A	≥56																					4543
V	≥48																					4543
E	≥40																					4543
	≥34																					4543
H	≥28																					4543
E	≥24																					4543
I	≥20																					4543
G	≥16	1																6–1	1	1	1	4543
H	≥12	4	3	3	2		1	1										42–1	14	40	40	4543
T	≥ 9	25	10	12	5	3	3	2	2				1				1	138–1	64	199	199	4543
	≥ 6	41	23	16	11	14	12	12	7	2	2	3	1	1	4	1	4	174–1	154	709	709	4551
f	≥ 3	52	44	23	15	11	6	17	7	10	12	4	8	4	5	8	38	342–1	264	2106	2157	4611
t		6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96+	MAX	TE	T	T*	TH

HOURS DURATION OF EVENTS

TABLE 14.23 Wave Height Durations, Pacific Grid Point 47.

Winter 47 25.0 N. Latitude, 119.4 W. Longitude

W	≥64																					4333
A	≥56																					4333
V	≥48																					4333
E	≥40																					4333
	≥34																					4333
H	≥28																					4333
E	≥24																					4333
I	≥20																					4333
G	≥16		1															12–1	1	2	2	4333
H	≥12	3		2	1	3	1				1							60–1	11	44	47	4333
T	≥ 9	16	3	5	11	5	3	3	1	2	2			2			1	144–1	54	241	247	4340
	≥ 6	32	16	9	8	11	10	4	9	4	4	7	4			5	16	240–1	139	1012	1051	4347
f	≥ 3	38	22	12	8	11	6	5	9	8	7	5	3	5	4	4	61	1776–1	208	3306	3386	4858
t		6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96+	MAX	TE	T	T*	TH

HOURS DURATION OF EVENTS

Spring 47 25.0 N. Latitude, 119.4 W.
Longitude

W	≥64																					4241
A	≥56																					4241
V	≥48																					4241
E	≥40																					4241
	≥34																					4241
H	≥28																					4241
E	≥24																					4241
I	≥20																					4241
G	≥16			1	1													24–1	2	7	7	4244
H	≥12	2	2	2	1	1	1				1							60–1	10	37	37	4245
T	≥ 9	12	7	3	3	4	6	2	3	3	3	3	4					72–4	53	279	298	4249
	≥ 6	37	11	6	12	12	5	3	10	6	9	6	5	2	5	2	39	486–1	170	1734	1861	4268
f	≥ 3	15	2	3	3	2	1	3		1	2	1	3		2		42	1698–1	80	2965	4391	4838
t		6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96+	MAX	TE	T	T*	TH

HOURS DURATION OF EVENTS

Summer 47 25.0 N. Latitude, 119.4 W.
Longitude

W	≥64																					4100
A	≥56																					4100
V	≥48																					4100
E	≥40																					4100
	≥34																					4100
H	≥28																					4100
E	≥24																					4100
I	≥20	1		1														18–1	2	4	4	4100
G	≥16		1	1		1												30–1	3	10	10	4100
H	≥12	2		1	1			1	1									48–1	6	24	24	4100
T	≥ 9	5		2	1	1	3	1				1	1					72–1	15	68	68	4100
	≥ 6	32	7	11	7	4	6	4	8	3	3	4	4	1	1	1	14	216–1	110	758	785	4105
f	≥ 3	27	6	5	7	3	5	3	3	4	1		3	4	2	2	52	1098–1	127	2961	??05	4225
t		6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96+	MAX	TE	T	T*	TH

HOURS DURATION OF EVENTS

Fall 47 25.0 N. Latitude, 119.4 W. Longitude

W	≥64																					4545
A	≥56																					4545
V	≥48																					4545
E	≥40																					4545
	≥34																					4545
H	≥28																					4545
E	≥24																					4545
I	≥20																					4545
G	≥16	1																6–1	1	1	1	4545
H	≥12	2	2	2		3		2		1								54–1	12	50	50	4548
T	≥ 9	8	4	2		4	1	5		1	2	3	2		1	1		90–1	34	198	198	4554
	≥6	33	23	10	9	6	7	7	6	3	1	6	1	3	2	2	14	174–2	133	810	825	4583
f	≥3	59	20	13	14	4	8	10	10	2	10	5	2	3	3	3	64	840–1	230	2907	3103	4829
t		6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96+	MAX	TE	T	T*	TH

HOURS DURATION OF EVENTS

TABLE 14.24 Wave Height Intervals, Pacific Grid Point 37.

Winter — 37 — 32.9 N. Latitude, 119.4 W. Longitude

W	≥64																8	SEA–8	8	2944	4389	4389
A	≥56																8	SEA–8	8	2944	4389	4389
V	≥48																8	SEA–8	8	2944	4389	4389
E	≥40																8	SEA–8	8	2944	4389	4389
	≥34																8	SEA–8	8	2944	4389	4389
H	≥28																8	SEA–8	8	2944	4389	4389
E	≥24																8	SEA–8	8	2944	4389	4389
I	≥20																9	SEA–8	9	3152	4366	4369
G	≥16	1	1												1		12	SEA–7	15	3424	4066	4879
H	≥12	1	2	3					2		1					3	29	SEA–3	41	3562	4718	4838
T	≥ 9	13	4	1		3	2	3	6	1	2	2	1	3	2	2	51	1254–1	96	3724	4340	4692
	≥ 6	23	18	11	7	9	5	8	4	4	6	8	4	6	3	4	60	918–1	180	3193	3441	4461
f	≥ 3	65	30	26	21	18	8	11	8	9	9	6	8	4	4	5	26	222–2	258	1729	1821	4337
t		6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96+	MAX	TE	T	T*	TH

HOURS INTERVAL BETWEEN EVENTS

Spring — 37 — 32.9 N. Latitude, 119.4 W. Longitude

W	≥64																6	SEA–6	6	2208	4265	4265
A	≥56																6	SEA–6	6	2208	4265	4265
V	≥48																6	SEA–6	6	2208	4265	4265
E	≥40																6	SEA–6	6	2208	4265	4265
	≥34																6	SEA–6	6	2208	4265	4265
H	≥28																6	SEA–6	6	2208	4265	4265
E	≥24																6	SEA–6	6	2208	4265	4265
I	≥20																7	SEA–6	7	2486	4264	4265
G	≥16																9	SEA–7	9	2853	4320	4334
H	≥12	4	2	5	2		1	1					1			1	29	SEA–5	46	40??	5516	5504
T	≥ 9	24	18	18	2	2	1	6	1	2	2	8	1	2		5	61	SEA–3	153	4148	4760	5162
	≥ 6	71	37	28	4	4	7	12	7	9	11	8	5	6	10	6	55	1074–1	280	3019	3065	4458
f	≥ 2	75	44	22	12	11	13	8	6	5	10	8	3	2	2	2	8	234–1	231	1053	1056	4245
t		6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96+	MAX	TE	T	T*	TH

HOURS INTERVAL BETWEEN EVENTS

Summer — 37 — 32.9 N. Latitude, 119.4 W. Longitude

W	≥64																6	SEA–6	6	2208	4224	4224
A	≥56																6	SEA–6	6	2208	4224	4224
V	≥48																6	SEA–6	6	2208	4224	4224
E	≥40																6	SEA–6	6	2208	4224	4224
	≥34																6	SEA–6	6	2208	4224	4224
H	≥28																6	SEA–6	6	2208	4224	4224
E	≥24																6	SEA–6	6	2208	4224	4224
I	≥20																6	SEA–6	6	2208	4224	4224
G	≥16																6	SEA–6	6	2208	4224	4224
H	≥12			1		1											8	SEA–6	10	2534	4471	4477
T	≥ 9	10	3	1	1		1	1					2		1		19	SEA–2	39	2802	4383	4446
	≥ 6	33	19	12	5	4	6	4	4	2	1	2		4	1	3	48	1500–1	148	2829	3899	4328
f	≥ 3	137	75	38	12	16	10	16	2	2	9	8	3	3	3	6	26	306–1	366	1820	1919	4194
t		6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96+	MAX	TE	T	T*	TH

HOURS INTERVAL BETWEEN EVENTS

Fall — 37 — 32.9 N. Latitude, 119.4 W. Longitude

W	≥64																5	SEA–5	5	1840	4564	4564
A	≥56																5	SEA–5	5	1840	4564	4564
V	≥48																5	SEA–5	5	1840	4564	4564
E	≥40																5	SEA–5	5	1840	4564	4564
	≥34																5	SEA–5	5	1840	4564	4564
H	≥28																5	SEA–5	5	1840	4564	4564
E	≥24																5	SEA–5	5	1840	4564	4564
I	≥20																5	SEA–5	5	1840	4564	4564
G	≥16																6	SEA–5	6	2076	4800	4801
H	≥12			1											1		17	SEA–2	19	3168	5503	5543
T	≥ 9	5	2	2		1		1	1	1	1	2	2			1	46	1326–1	65	3069	4754	4953
	≥ 6	14	10	9	7	2	9	6	5	10	1	4	3	2	2	2	65	1050–1	151	3139	4091	4792
f	≥ 3	66	22	22	14	14	15	12	9	8	6	6	2	4	3	1	53	468–1	258	2166	2502	4591
t		6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96+	MAX	TE	T	T*	TH

HOURS INTERVAL BETWEEN EVENTS

TABLE 14.25 Wave Height Intervals, Pacific Grid Point 47.

Winter — 47 — 25.0 N. Latitude, 119.4 W. Longitude

		6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96+	MAX	TE	T	T*	TH
W	≥64																8	SEA–8	8	2944	4389	4389
A	≥56																8	SEA–8	8	2944	4389	4389
V	≥48																8	SEA–8	8	2944	4389	4389
E	≥40																8	SEA–8	8	2944	4389	4389
	≥34																8	SEA–8	8	2944	4389	4389
H	≥28																8	SEA–8	8	2944	4389	4389
E	≥24																8	SEA–8	8	2944	4389	4389
I	≥20																8	SEA–8	8	2944	4389	4389
G	≥16																8	SEA–8	8	2944	4389	4391
H	≥12	1	2		1												13	SEA–5	17	3028	4597	4644
T	≥ 9	3	1	2		2		3	1		1		1			1	43	SEA–2	58	4423	4088	5128
	≥ 6	23	6	9	6	3	4	5	5	1	2	3	3	1	2	3	64	798–1	140	3223	3461	4498
f	≥ 3	43	28	20	10	12	12	8	7	3	10	5	4	5	6	5	18	348–1	196	1378	1474	4335
t		6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96+	MAX	TE	T	T*	TH

HOURS INTERVAL BETWEEN EVENTS

Spring — 47 — 25.0 N. Latitude, 119.4 W. Longitude

		6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96+	MAX	TE	T	T*	TH
W	≥64																6	SEA–6	6	2208	4265	4265
A	≥56																6	SEA–6	6	2208	4265	4265
V	≥48																6	SEA–6	6	2208	4265	4265
E	≥40																6	SEA–6	6	2208	4265	4265
	≥34																6	SEA–6	6	2208	4265	4265
H	≥28																6	SEA–6	6	2208	4265	4265
E	≥24																6	SEA–6	6	2208	4265	4265
I	≥20																6	SEA–6	6	2208	4265	4265
G	≥16																7	SEA–7	7	2576	4335	4339
H	≥12																13	SEA–5	13	2821	4562	4595
T	≥ 9	2	3	1		2	1		2	1		2	1			2	40	SEA–2	57	3600	4241	4531
	≥ 6	20	9	19	14	8	5	7	6	6	6	5	3	6	5	6	49	666–1	174	2429	2519	4353
f	≥ 3	22	12	6	6	6	5	10	2	2	1	1	3	1		1	5	180–1	83	452	452	4246
t		6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96+	MAX	TE	T	T*	TH

HOURS INTERVAL BETWEEN EVENTS

Summer — 47 — 25.0 N. Latitude, 119.4 W. Longitude

		6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96+	MAX	TE	T	T*	TH
W	≥64																6	SEA–6	6	2208	4224	4224
A	≥56																6	SEA–6	6	2208	4224	4224
V	≥48																6	SEA–6	6	2208	4224	4224
E	≥40																6	SEA–6	6	2208	4224	4224
	≥34																6	SEA–6	6	2208	4224	4224
H	≥28																6	SEA–6	6	2208	4224	4224
E	≥24																6	SEA–6	6	2208	4224	4224
I	≥20																7	SEA–6	7	2469	4484	4488
G	≥16																7	SEA–6	7	2468	4479	4489
H	≥12	1															8	SEA–4	9	2323	4463	4487
T	≥ 9								1	1							16	SEA–4	18	2685	4450	4518
	≥ 6	14	7	5	3	1	3	5	5	3	2	1	3	2	3	5	51	954–1	113	3005	3439	4219
f	≥ 3	32	19	19	10	6	3	2	4	3	5	5	4	5	1	1	8	204–2	127	725	759	4139
t		6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96+	MAX	TE	T	T*	TH

HOURS INTERVAL BETWEEN EVENTS

Fall — 47 — 25.0 N. Latitude, 119.4 W. Longitude

		6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96+	MAX	TE	T	T*	TH
W	≥64																5	SEA–5	5	1840	4566	4566
A	≥56																5	SEA–5	5	1840	4566	4566
V	≥48																5	SEA–5	5	1840	4566	4566
E	≥40																5	SEA–5	5	1840	4566	4566
	≥34																5	SEA–5	5	1840	4566	4566
H	≥28																5	SEA–5	5	1840	4566	4566
E	≥24																5	SEA–5	5	1840	4566	4566
I	≥20																5	SEA–5	5	1840	4566	4566
G	≥16																6	SEA–5	6	1866	4565	4566
H	≥12	2						1									12	SEA–3	15	2128	4809	4856
T	≥ 9	2				1		2	2	1	1			2	1		24	2046–1	36	2891	4850	5039
	≥ 6	16	4	6	9	5	2	5	6		4	2	1	4	3	1	58	960–1	126	3248	3983	4770
f	≥ 3	56	22	19	15	19	16	10	10	10	7	3	4	4	4	2	24	240–1	225	1601	1726	4545
t		6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96+	MAX	TE	T	T*	TH

HOURS INTERVAL BETWEEN EVENTS

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