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Task 3: Wave Resource Model, Wave Field Measurements and Data Analysis

Wave Power Analysis for Makapu'u Point, O'ahu

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WAVE POWER ANALYSIS FOR MAKAPUU POINT, OAHU

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1.0 Introduction

The CDIP buoy 034 was located off Oahu's eastern most point, Makapu'u. It was relocated several times as indicated in Figure 1 for the period of available data: 1981-1996. The wave flux analysis will be different with different water depths in different locations. Therefore, five different time periods are chosen to compute statistics. Table 1 provides a summary of the buoy locations and data coverage. Each time period is longer than 1 year. All the available buoy measurements are analyzed to demonstrate the wave climate at this site. The annual and monthly wave power fluxes are presented in Section 2.

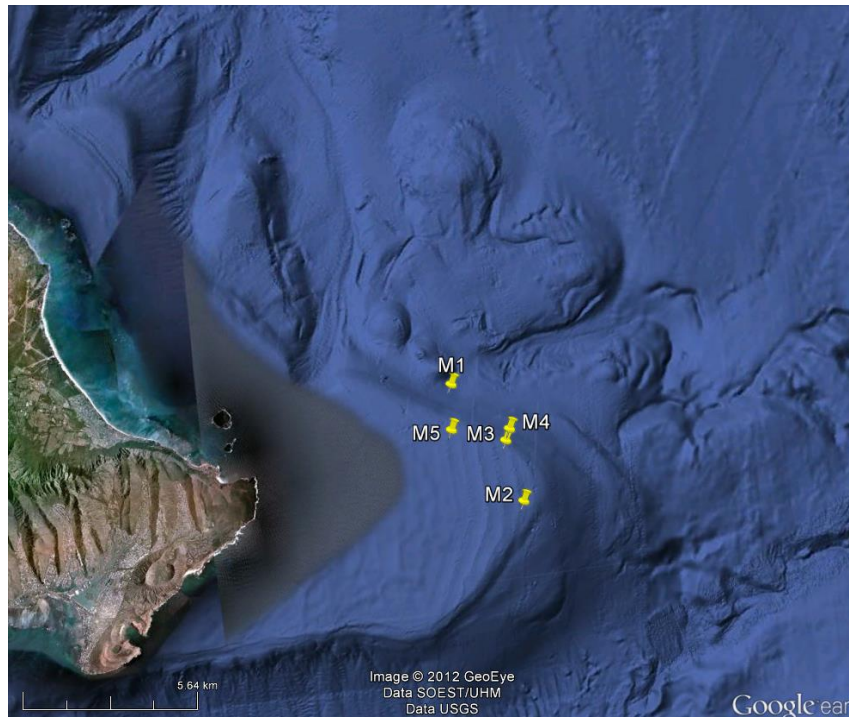


Figure 1 - Locations of Makapuu Point buoy

Table 1 - Locations of Makapuu Point Buoy during 1981-1996

Time Period	Start Date (UTC)	End Date (UTC)	Latitude N	Longitude W	Water Depth (m)
1	08/17/1981	11/22/1982	21°19.7'	157°35.1'	187.0
2	03/24/1983	03/08/1985	21°17.5'	157°34.0'	168.2
2	06/03/1985	06/21/1985	21°17.5'	157°34.0'	168.2
3	11/15/1985	06/21/1987	21°18.6'	157°34.2'	118.9
3	08/07/1987	06/01/1989	21°18.6'	157°34.2'	118.9
4	12/15/1992	12/28/1993	21°18.8'	157°34.1'	128.0
4	03/01/1994	11/16/1994	21°18.8'	157°34.1'	128.0
5	01/19/1995	08/09/1995	21°18.9'	157°35.2'	91.0
5	03/28/1996	11/10/1996	21°18.9'	157°35.2'	91.0

2. Results

The wave power flux in W/m was calculated using

$$P = \rho g \int_0^{\infty} Cg(f, h) S(f, h) df \quad (1)$$

where $S(f, h)$ is local wave spectrum, f is wave frequency, h is local water depth, Cg is local group speed, $g = 9.81 \text{ m/s}^2$ is gravitational acceleration, and $\rho = 1025 \text{ kg/m}^3$ is sea water density. Table 2 provides the average monthly wave power flux for each time period to demonstrate the seasonal variation. The daily and monthly average, median, 5th and 95th percentile of the wave power are calculated and shown in Figures 2 through 11.

The wave climate in Hawaii is composed of year-round wind waves from the northeast as well as swells from the North and South Pacific during winter and summer months. Therefore, Makapu'u is characterized by higher power flux in winter and lower wave power flux in summer. Between May and September, the average monthly wave power flux is less than 15 kW. Between October and April, higher values were observed. The power probability density function in Figure 12-16 shows a similar feature where the distributions are skewed towards the high values due to exposure to the larger swells from the North Pacific.

Directional histograms are a convenient way to present the occurrence, magnitude, and direction of the wave climate at a particular site. However, the Makapu'u buoy is non-directional and only measures motions in the heave axis, resulting in a 1D frequency spectra $S(f)$. Therefore directional histograms are not be presented; further numerical modeling is required to attain the full 2D spectra $S(f, \theta)$.

Lastly, the occurrence of events in terms of significant wave height (H_s) and wave periods (T_e or T_{02}) are presented in tables 2-6 utilizing all of the measured data of each time period. These are useful in the estimation of possible power generated for a particular wave energy converter. The significant wave height H_s is defined by

$$H_s = 4 \sqrt{\int S(f) df} \quad (2)$$

The characteristic wave periods T_e and T_{02} are defined by

$$T_e = \frac{m_{-1}}{m_0} \quad (3)$$

$$T_{02} = \sqrt{\frac{m_0}{m_2}} \quad (4)$$

where m_0 , m_1 , and m_2 are computed from

$$m_n = \int_0^{\infty} f^n S(f) df \quad (5)$$

Eq. (5) also provides the definition for the n -th spectral moment.

Table 2 - Monthly Average Wave Power Flux

	Power Flux (kW/m)											
Time Period	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1981-1982	17.99	12.78	25.02	18.91	12.86	9.40	12.11	12.37	13.53	15.49	28.29	23.35
1983-1985	17.45	22.73	25.52	20.01	12.43	9.98	10.98	10.71	9.62	15.43	17.42	17.69
1985-1989	25.02	19.32	17.78	18.92	18.02	10.88	11.80	9.68	10.25	13.22	22.12	25.13
1992-1994	16.67	40.32	20.97	19.39	12.64	10.28	12.27	13.30	8.52	12.53	19.90	17.32
1995-1996	15.78	15.49	14.67	17.24	10.26	10.94	10.31	8.59	10.01	14.61	33.84	

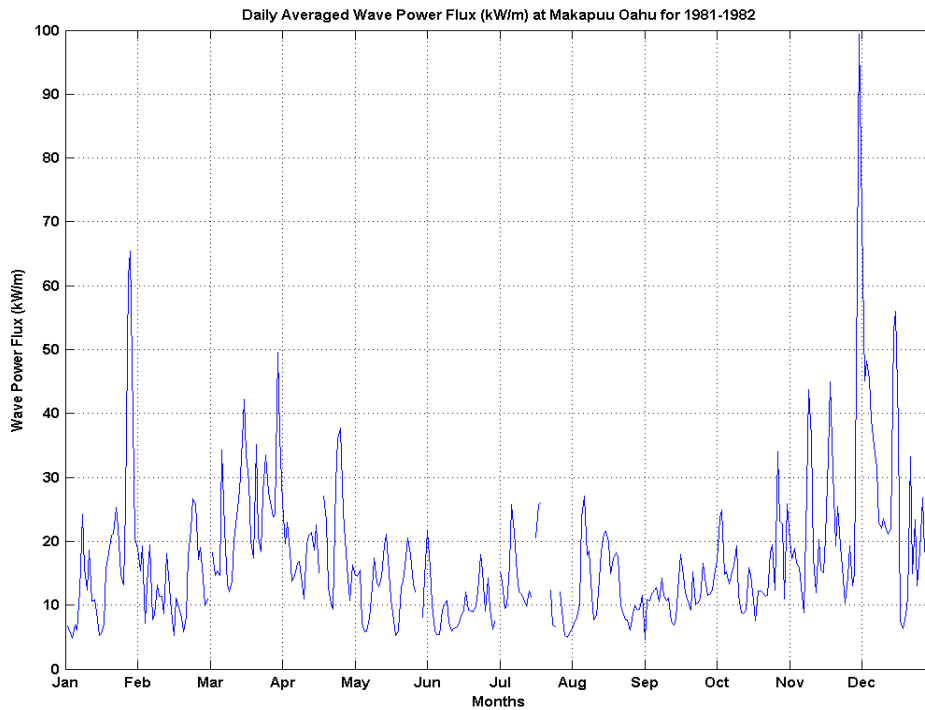


Figure 2 – Daily average wave power flux for 1981-1982

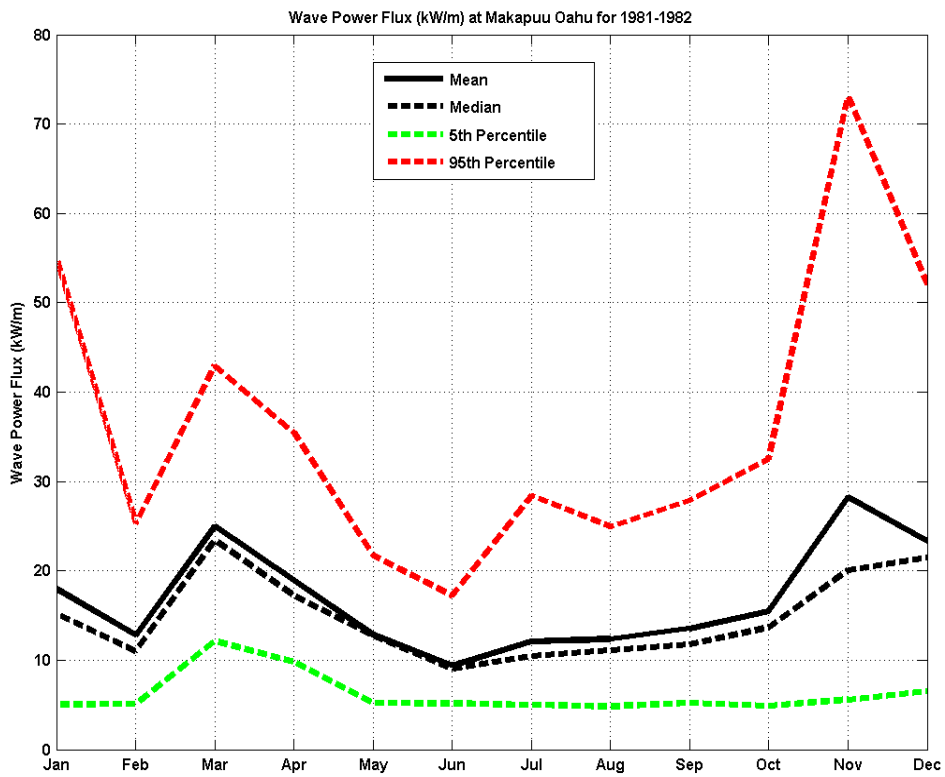


Figure 3 – Monthly average wave power flux for 1981-1982

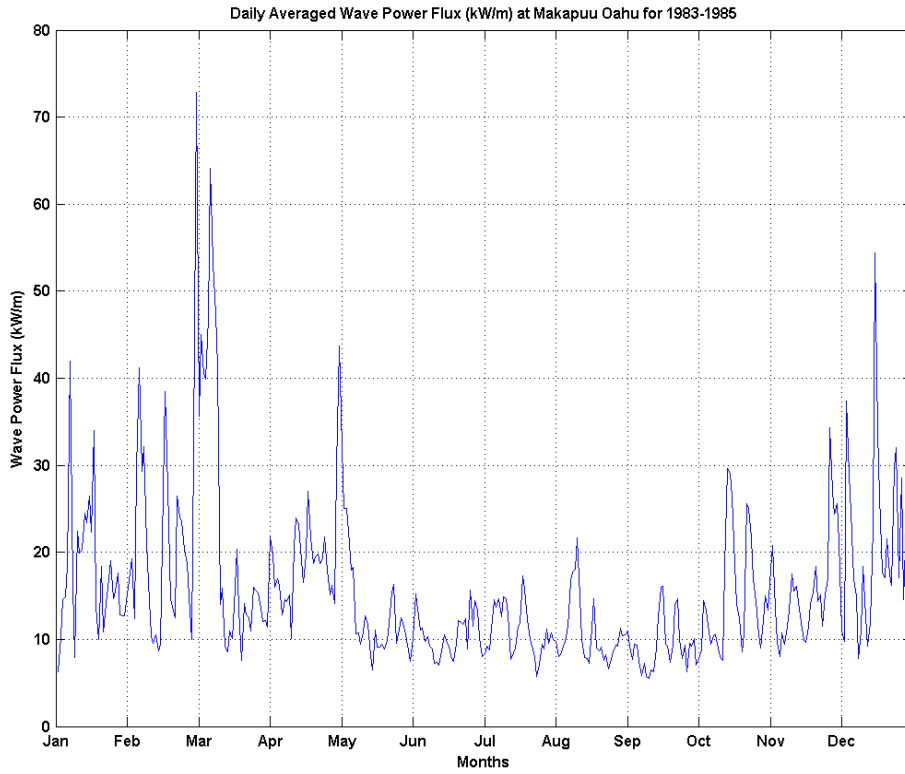


Figure 4 – Daily average wave power flux for 1983-1985

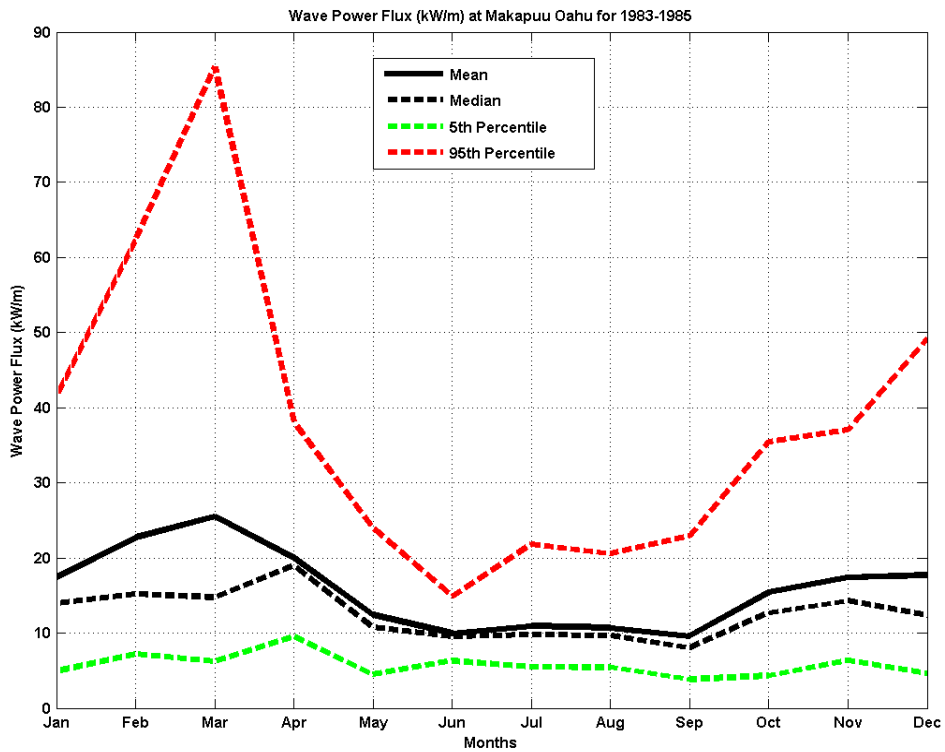


Figure 5 – monthly average wave power flux for 1983-1985

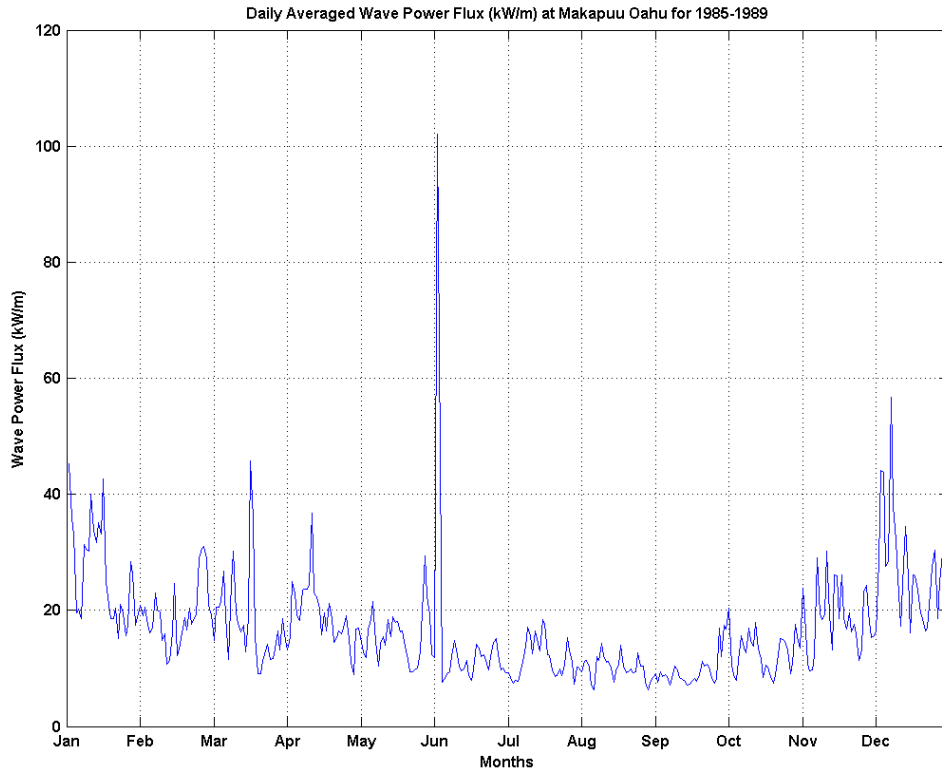


Figure 6 – Daily average wave power flux for 1985-1989

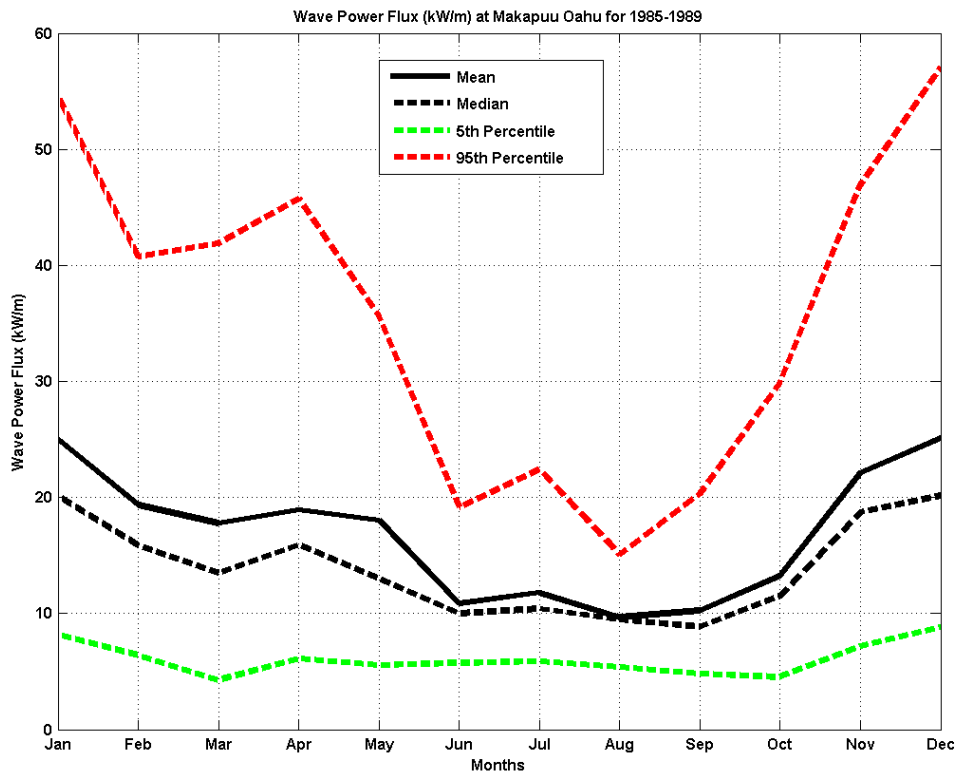


Figure 7 – Monthly average wave power flux for 1985-1989

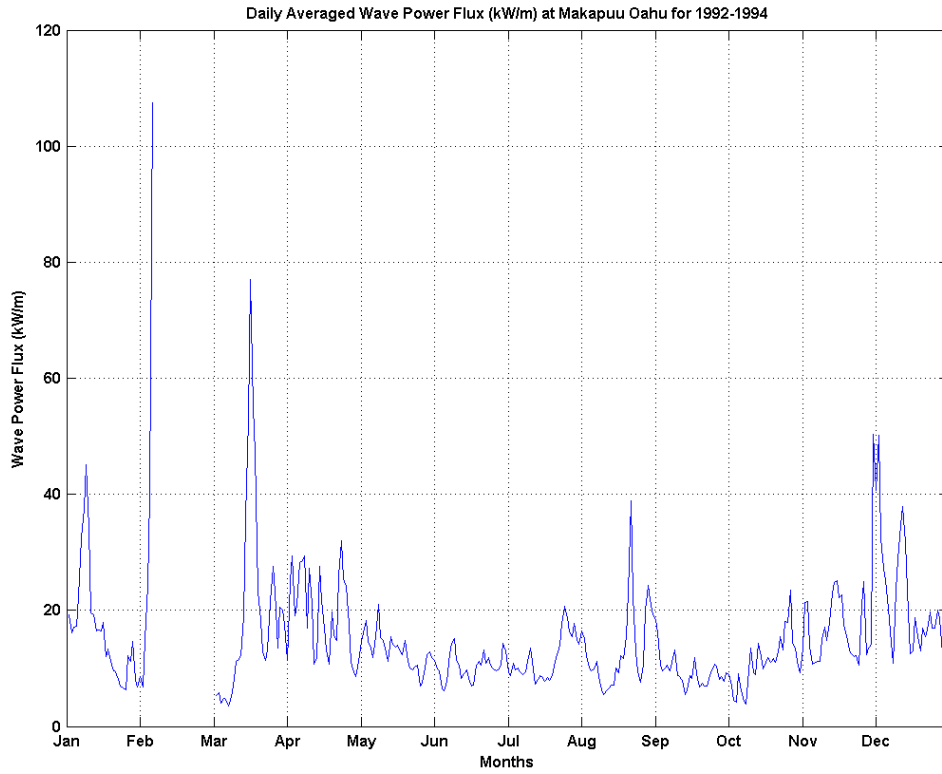


Figure 8 – Daily average wave power flux for 1992-1994

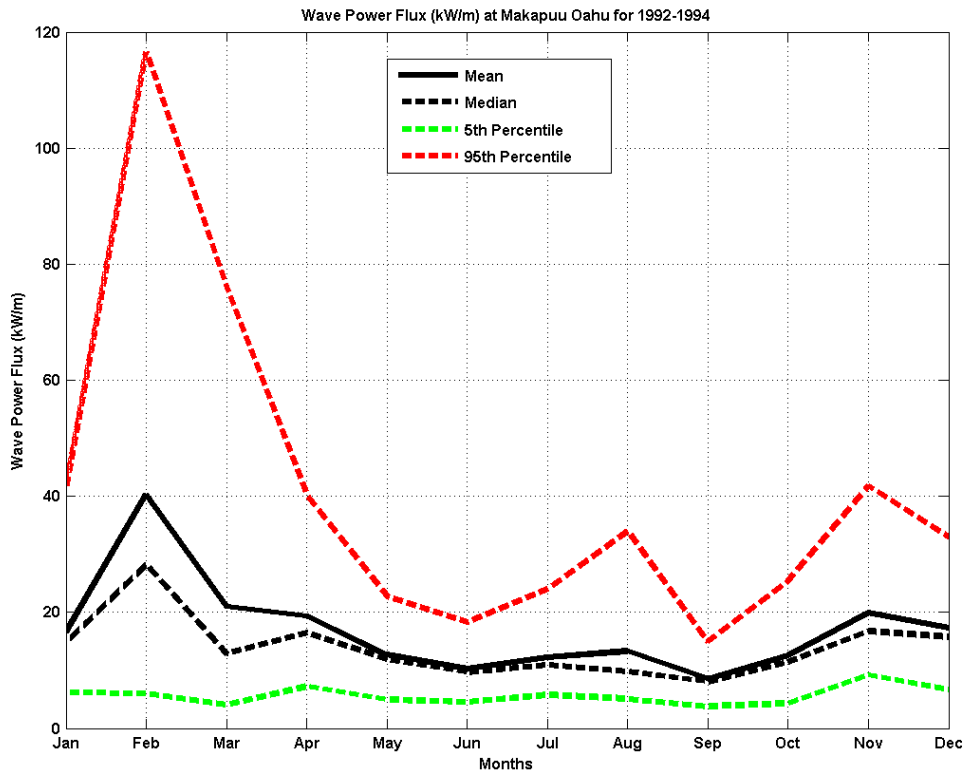


Figure 9 – Monthly average wave power flux for 1992-1994

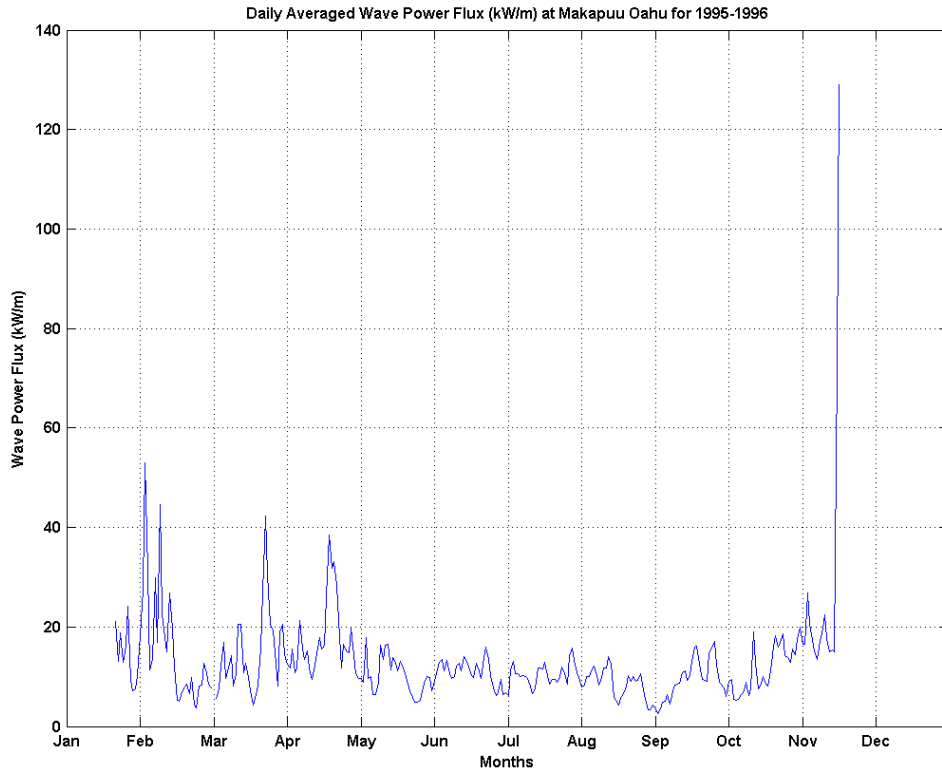


Figure 10 – Daily average wave power flux for 1995-1996

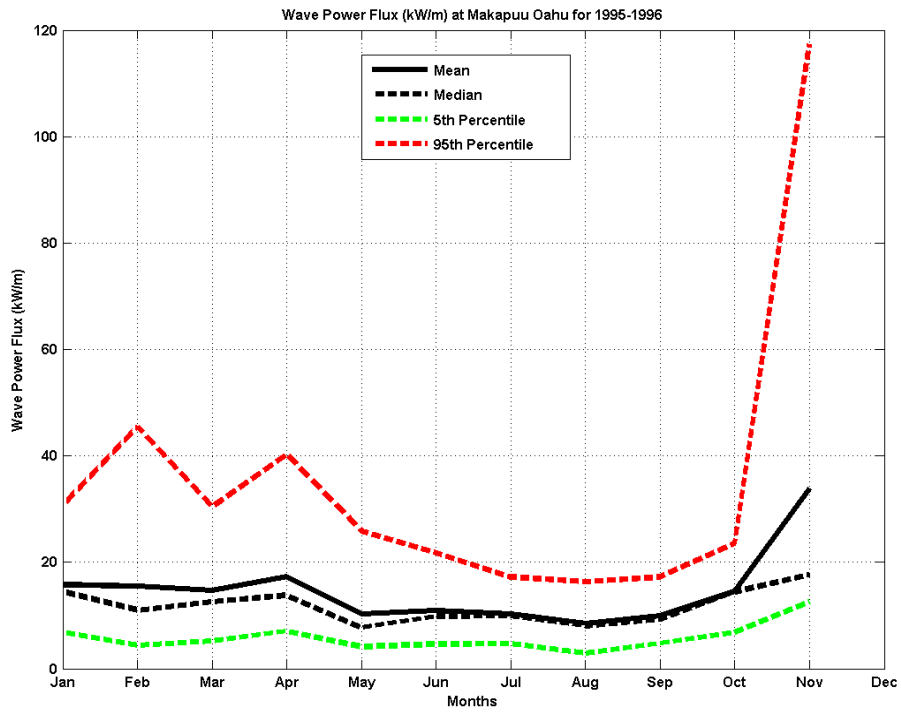


Figure 11 – Monthly average wave power flux for 1995-1996

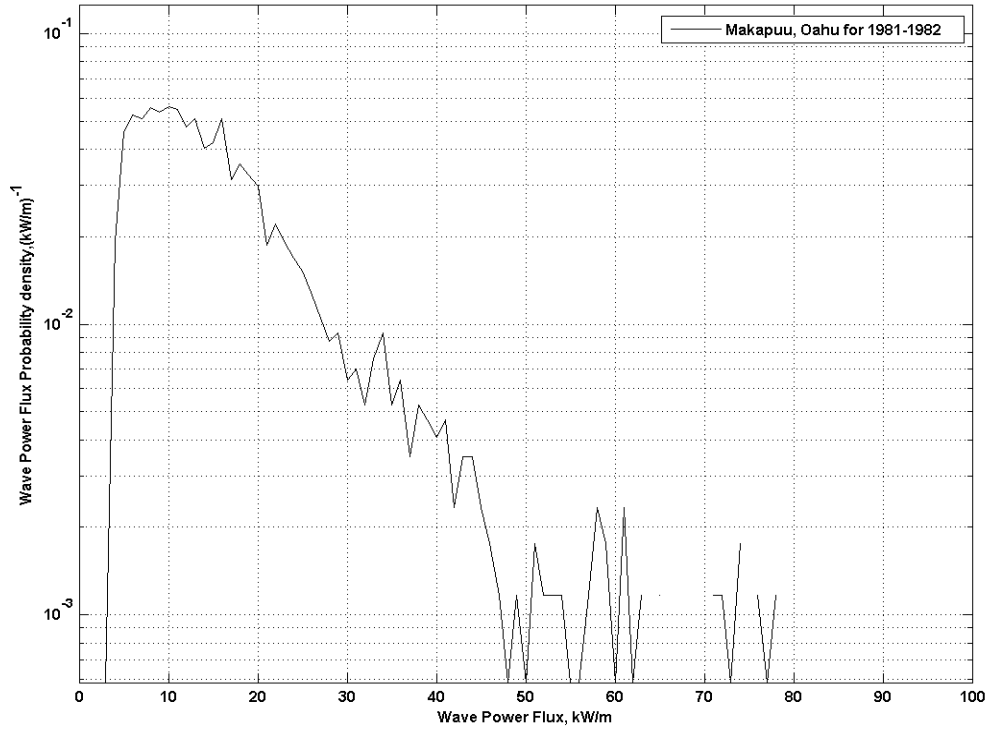


Figure 12 – Wave power flux probability density function for 1981-1982

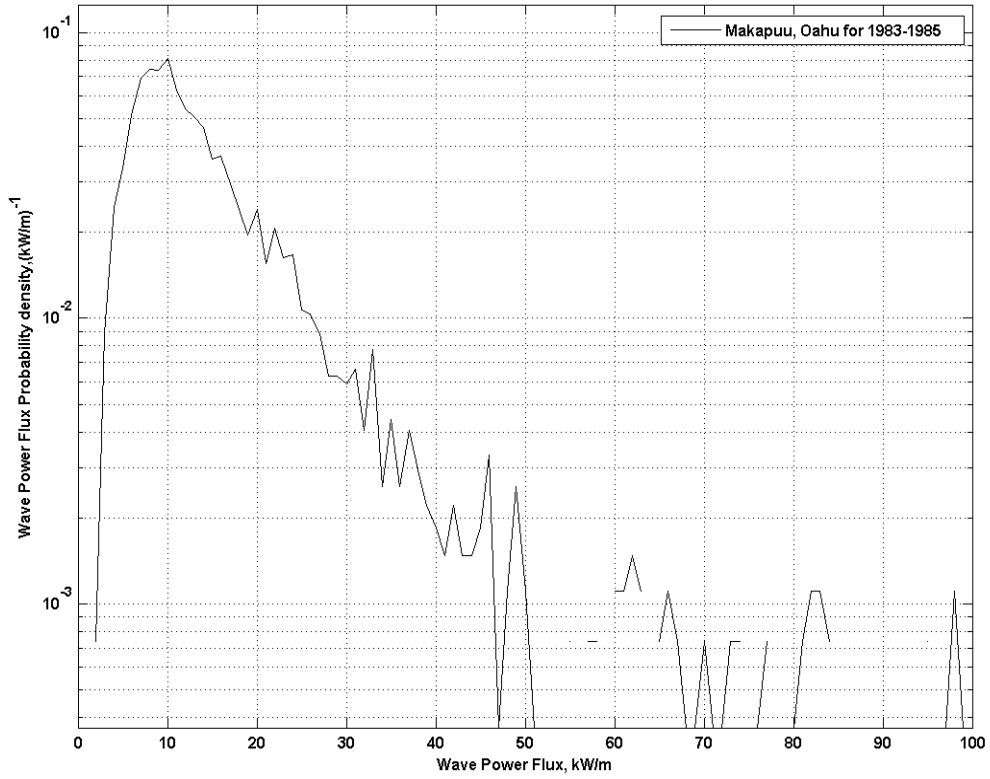


Figure 13 – Wave power flux probability density function for 1983-1985

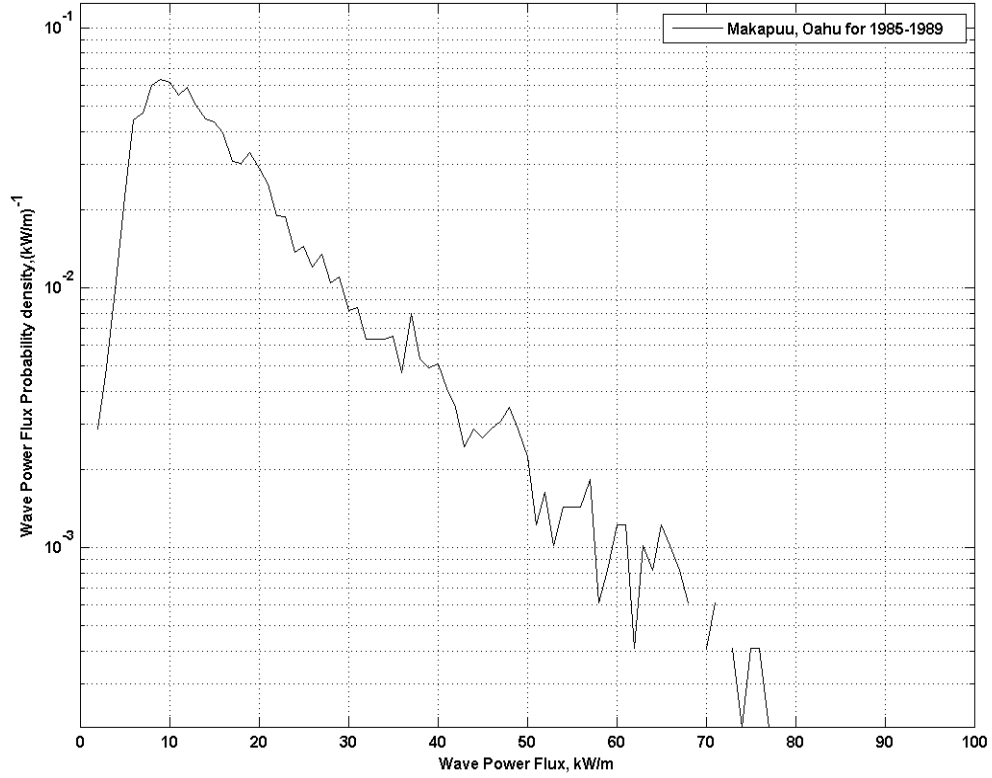


Figure 14 – Wave power flux probability density function for 1985-1989

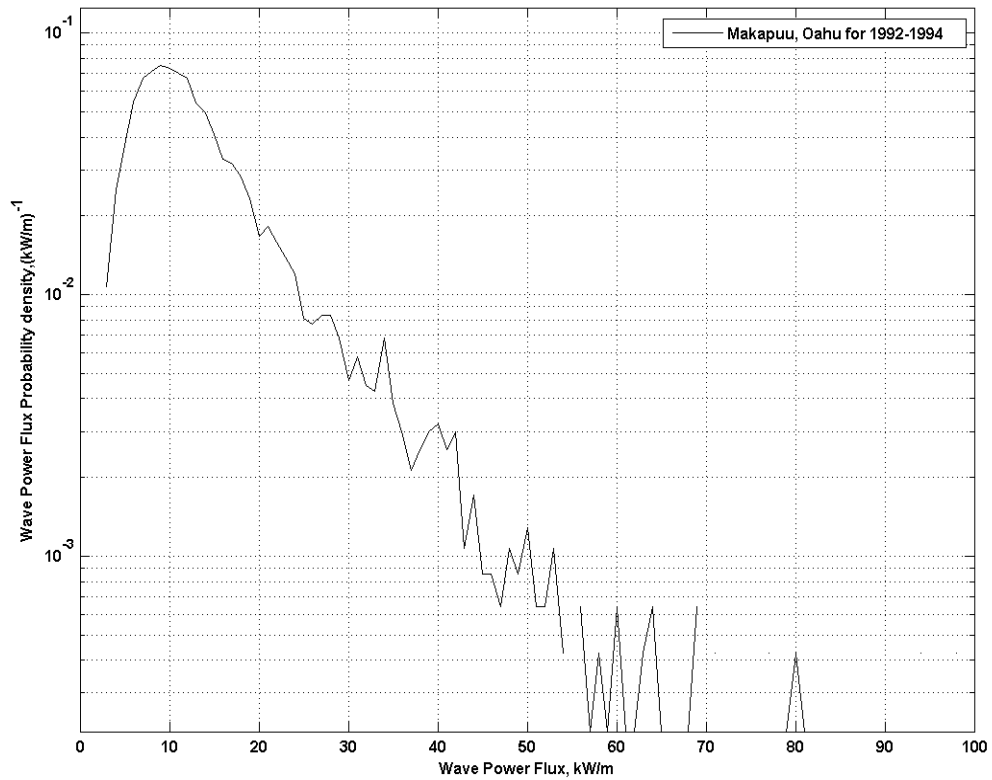


Figure 15 – Wave power flux probability density function for 1992-1994

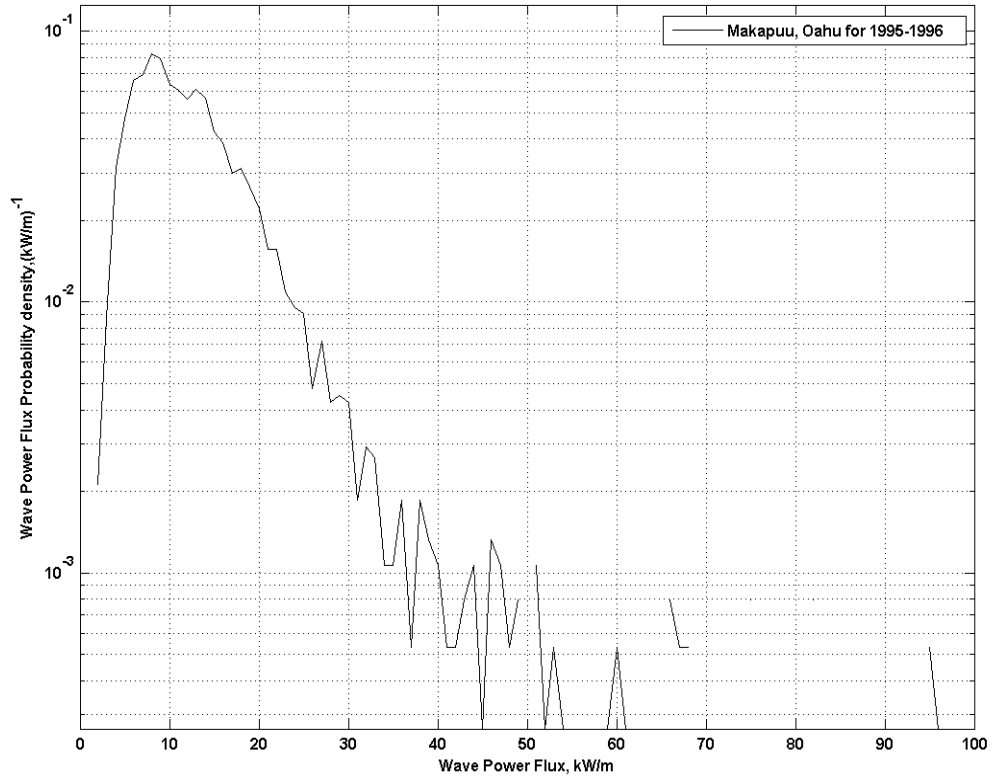


Figure 16 – Wave power flux probability density function for 1995-1996

Table 3– Te-Hs Occurrence in Makapuu Point over the year 1981-1982

		Te (s)																						
		5	5.5	6.0	6.5	7.0	7.5	8.0	8.5	9.0	9.5	10	10.5	11.0	11.5	12.0	12.5	13.0	13.5	14.0	14.5		>15.0	
Hs (m)	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	1.0	0	0	0	0	0	0	3	4	2	0	0	0	0	0	0	0	0	0	0	0	0	0	9
	1.5	0	0	2	16	49	72	75	72	58	34	10	5	6	2	0	0	0	0	0	0	0	0	401
	2.0	0	0	0	18	87	102	92	105	75	47	27	12	10	4	0	1	0	0	0	0	0	0	580
	2.5	0	0	0	2	58	125	96	61	42	20	13	8	5	7	3	0	0	0	0	0	0	0	440
	3.0	0	0	0	0	3	32	50	37	21	9	9	5	3	4	0	0	0	0	0	0	0	0	173
	3.5	0	0	0	0	0	2	21	15	11	8	2	1	2	2	0	0	0	1	0	0	0	0	65
	4.0	0	0	0	0	0	0	5	11	3	5	3	0	0	1	0	0	0	0	0	0	0	0	28
	4.5	0	0	0	0	0	0	1	4	4	2	0	0	0	0	0	0	0	0	0	0	0	0	11
	5.0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	3
	5.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	6.0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	2
	6.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
7.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
>7.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

Total: 1712

Table 4– T02-Hs Occurrence in Makapuu Point over the year 1981-1982

		T02 (s)																					
		5	5.5	6.0	6.5	7.0	7.5	8.0	8.5	9.0	9.5	10	10.5	11.0	11.5	12.0	12.5	13.0	13.5	14.0	14.5		>15.0
Hs (m)	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	1.0	0	0	2	2	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9
	1.5	0	27	100	101	82	58	21	10	2	0	0	0	0	0	0	0	0	0	0	0	0	401
	2.0	0	8	134	165	103	80	50	25	13	1	1	0	0	0	0	0	0	0	0	0	0	580
	2.5	0	0	38	209	87	52	27	14	5	6	2	0	0	0	0	0	0	0	0	0	0	440
	3.0	0	0	0	43	67	34	13	9	3	3	1	0	0	0	0	0	0	0	0	0	0	173
	3.5	0	0	0	0	29	19	11	1	2	3	0	0	0	0	0	0	0	0	0	0	0	65
	4.0	0	0	0	0	6	12	6	3	0	0	1	0	0	0	0	0	0	0	0	0	0	28
	4.5	0	0	0	0	0	5	4	2	0	0	0	0	0	0	0	0	0	0	0	0	0	11
	5.0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
	5.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	6.0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
	6.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
7.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
>7.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

Total:1712

Table 5– Te-Hs Occurrence in Makapuu Point over the year 1983-1985

		Te (s)																								
		5	5.5	6.0	6.5	7.0	7.5	8.0	8.5	9.0	9.5	10	10.5	11.0	11.5	12.0	12.5	13.0	13.5	14.0	14.5	>15.0				
Hs (m)	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	1.0	0	0	0	0	2	5	12	9	9	8	3	2	0	0	0	0	0	0	0	0	0	0	0	0	50
	1.5	0	0	0	19	87	145	106	114	88	46	26	17	9	4	0	0	0	0	0	0	0	0	0	0	661
	2.0	0	0	0	78	237	244	176	112	93	75	41	24	12	6	5	1	1	0	0	0	0	0	0	0	1105
	2.5	0	0	0	5	95	148	101	58	38	34	23	19	9	10	8	1	0	0	0	0	0	0	0	0	549
	3.0	0	0	0	0	7	74	50	20	9	12	14	16	8	12	2	2	0	0	0	0	0	0	0	0	226
	3.5	0	0	0	0	0	7	19	9	3	2	3	4	1	5	1	4	1	0	0	0	0	0	0	0	59
	4.0	0	0	0	0	0	1	6	7	1	0	2	0	2	3	0	3	2	0	0	0	0	0	0	0	27
	4.5	0	0	0	0	0	0	0	6	10	1	6	2	0	0	0	0	0	0	0	0	0	0	0	0	25
	5.0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
	5.5	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
	6.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	6.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	7.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
>7.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

Total: 2709

Table 6– T02-Hs Occurrence in Makapuu Point over the year 1983-1985

		T02 (s)																							
		5	5.5	6.0	6.5	7.0	7.5	8.0	8.5	9.0	9.5	10	10.5	11.0	11.5	12.0	12.5	13.0	13.5	14.0	14.5	>15.0			
Hs (m)	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	1.0	0	2	5	14	15	8	4	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	50
	1.5	0	36	198	139	132	85	42	22	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	661
	2.0	0	22	412	322	133	72	62	54	14	11	2	1	0	0	0	0	0	0	0	0	0	0	0	1105
	2.5	0	0	55	250	114	40	25	35	14	8	6	2	0	0	0	0	0	0	0	0	0	0	0	549
	3.0	0	0	0	74	78	12	14	19	12	10	5	2	0	0	0	0	0	0	0	0	0	0	0	226
	3.5	0	0	0	1	28	11	2	1	6	2	6	1	1	0	0	0	0	0	0	0	0	0	0	59
	4.0	0	0	0	0	4	11	0	2	0	2	5	2	1	0	0	0	0	0	0	0	0	0	0	27
	4.5	0	0	0	0	0	9	8	5	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25
	5.0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
	5.5	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
	6.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	6.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	7.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
>7.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Total: 2709

Table 7– Te-Hs Occurrence in Makapuu Point over the year 1985-1989

		Te (s)																						
		5	5.5	6.0	6.5	7.0	7.5	8.0	8.5	9.0	9.5	10	10.5	11.0	11.5	12.0	12.5	13.0	13.5	14.0	14.5		>15.0	
Hs (m)	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	1.0	0	0	0	0	0	4	10	12	15	7	1	0	0	0	0	0	0	0	0	0	0	0	49
	1.5	0	0	1	35	130	178	156	167	94	74	43	17	4	2	2	0	0	0	0	0	0	0	903
	2.0	0	0	1	89	383	411	282	195	192	167	106	50	31	20	2	0	1	0	0	0	0	0	1930
	2.5	0	0	0	6	140	275	239	135	104	100	95	63	38	15	8	7	2	1	1	0	0	0	1229
	3.0	0	0	0	0	8	78	104	80	51	44	43	29	23	12	9	3	3	1	0	0	0	0	488
	3.5	0	0	0	0	0	6	43	42	30	14	23	15	7	4	1	4	2	1	0	0	0	0	192
	4.0	0	0	0	0	0	1	6	25	13	5	6	5	4	0	1	0	0	0	0	0	0	1	67
	4.5	0	0	0	0	0	0	0	5	6	1	1	3	1	1	3	1	0	1	0	0	0	0	23
	5.0	0	0	0	0	0	0	0	0	2	3	0	1	0	0	0	1	1	0	0	0	0	0	8
	5.5	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	2	0	0	0	0	0	3
	6.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
	6.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
7.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
7.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
>7.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

Total: 4897

Table 8– T02-Hs Occurrence in Makapuu Point over the year 1985-1989

		T02 (s)																					
		5	5.5	6.0	6.5	7.0	7.5	8.0	8.5	9.0	9.5	10	10.5	11.0	11.5	12.0	12.5	13.0	13.5	14.0	14.5		>15.0
Hs (m)	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	1.0	0	0	1	10	10	17	10	1	0	0	0	0	0	0	0	0	0	0	0	0	0	49
	1.5	0	45	277	194	142	121	72	38	11	3	0	0	0	0	0	0	0	0	0	0	0	903
	2.0	0	32	583	560	256	187	140	100	42	26	3	1	0	0	0	0	0	0	0	0	0	1930
	2.5	0	0	98	471	245	136	98	82	60	17	15	7	0	0	0	0	0	0	0	0	0	1229
	3.0	0	0	1	92	150	95	50	37	34	12	11	3	3	0	0	0	0	0	0	0	0	488
	3.5	0	0	0	3	63	56	29	19	8	6	3	3	2	0	0	0	0	0	0	0	0	192
	4.0	0	0	0	1	6	32	15	9	2	0	1	0	0	1	0	0	0	0	0	0	0	67
	4.5	0	0	0	0	0	8	4	5	0	3	2	1	0	0	0	0	0	0	0	0	0	23
	5.0	0	0	0	0	0	1	3	3	0	0	0	0	1	0	0	0	0	0	0	0	0	8
	5.5	0	0	0	0	0	0	0	1	0	0	0	1	1	0	0	0	0	0	0	0	0	3
	6.0	0	0	0	0	0	0	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0	3
	6.5	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	2
7.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
7.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
>7.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

Total: 4897

Table 9– Te-Hs Occurrence in Makapuu Point over the year 1992-1994

		Te (s)																							
		5	5.5	6.0	6.5	7.0	7.5	8.0	8.5	9.0	9.5	10	10.5	11.0	11.5	12.0	12.5	13.0	13.5	14.0	14.5		>15.0		
Hs (m)	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	1.0	0	0	0	6	6	11	26	11	6	3	1	0	0	0	0	0	0	0	0	0	0	0	0	70
	1.5	0	0	2	53	195	191	253	194	136	67	33	15	11	5	0	0	0	0	0	0	0	0	0	1155
	2.0	0	0	0	79	433	608	350	212	143	87	45	26	13	6	2	0	0	0	0	0	0	0	0	2004
	2.5	0	0	0	6	140	308	200	88	54	60	35	27	12	8	3	3	0	0	0	0	0	0	0	944
	3.0	0	0	0	0	7	84	112	48	20	24	16	24	10	7	2	0	0	0	0	0	0	0	0	354
	3.5	0	0	0	0	0	4	43	19	4	9	10	3	4	2	0	2	0	0	0	0	0	0	0	100
	4.0	0	0	0	0	0	0	6	6	1	5	0	2	1	0	0	2	0	0	0	0	0	0	0	23
	4.5	0	0	0	0	0	0	0	6	5	0	0	1	0	1	0	3	2	0	0	0	0	0	0	18
	5.0	0	0	0	0	0	0	0	2	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10
	5.5	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
	6.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	6.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
7.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
>7.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

Total: 4680

Table 10– T02-Hs Occurrence in Makapuu Point over the year 1992-1994

		T02 (s)																						
		5	5.5	6.0	6.5	7.0	7.5	8.0	8.5	9.0	9.5	10	10.5	11.0	11.5	12.0	12.5	13.0	13.5	14.0	14.5		>15.0	
Hs (m)	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	1.0	0	15	9	21	18	5	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	70
	1.5	0	104	354	319	178	114	62	17	4	3	0	0	0	0	0	0	0	0	0	0	0	0	1155
	2.0	0	28	665	798	261	122	84	27	15	3	1	0	0	0	0	0	0	0	0	0	0	0	2004
	2.5	0	0	66	493	203	57	63	36	19	5	2	0	0	0	0	0	0	0	0	0	0	0	944
	3.0	0	0	0	73	161	40	30	26	13	8	3	0	0	0	0	0	0	0	0	0	0	0	354
	3.5	0	0	0	1	46	22	17	5	3	1	3	2	0	0	0	0	0	0	0	0	0	0	100
	4.0	0	0	0	0	5	7	4	2	2	1	0	0	2	0	0	0	0	0	0	0	0	0	23
	4.5	0	0	0	0	0	5	6	0	0	1	1	2	3	0	0	0	0	0	0	0	0	0	18
	5.0	0	0	0	0	0	2	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10
	5.5	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
	6.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	6.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
7.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
>7.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

Total: 4680

Table 11– Te-Hs Occurrence in Makapuu Point over the year 1995-1996

		Te (s)																								
		5	5.5	6.0	6.5	7.0	7.5	8.0	8.5	9.0	9.5	10	10.5	11.0	11.5	12.0	12.5	13.0	13.5	14.0	14.5	>15.0				
Hs (m)	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	1.0	0	0	0	0	0	6	16	26	20	33	12	11	0	0	0	0	0	0	0	0	0	0	0	124	
	1.5	0	0	9	32	133	213	154	139	142	127	103	46	8	2	1	0	1	1	0	0	0	0	0	1111	
	2.0	0	0	1	46	324	355	224	162	151	129	75	45	29	12	6	0	3	0	0	0	0	0	0	1562	
	2.5	0	0	0	1	93	243	115	72	58	86	48	22	16	13	7	1	0	0	0	0	0	0	0	775	
	3.0	0	0	0	0	3	11	15	30	9	9	10	10	3	1	0	5	0	0	0	0	0	0	0	106	
	3.5	0	0	0	0	0	0	4	13	6	3	1	2	1	3	0	1	1	0	0	0	0	0	0	35	
	4.0	0	0	0	0	0	0	0	5	3	0	0	5	3	8	2	4	0	0	0	0	0	0	0	30	
	4.5	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	2	3	3	0	0	0	0	0	11	
	5.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	0	0	0	0	3	
	5.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	2	
	6.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	6.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
7.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
>7.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

Total: 3759

Table 12– T02-Hs Occurrence in Makapuu Point over the year 1995-1996

		T02 (s)																							
		5	5.5	6.0	6.5	7.0	7.5	8.0	8.5	9.0	9.5	10	10.5	11.0	11.5	12.0	12.5	13.0	13.5	14.0	14.5	>15.0			
Hs (m)	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	1.0	0	0	13	25	22	29	27	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	124
	1.5	0	51	278	265	152	131	123	74	28	6	1	1	1	0	0	0	0	0	0	0	0	0	0	1111
	2.0	0	5	382	532	265	161	89	80	25	15	4	2	2	0	0	0	0	0	0	0	0	0	0	1562
	2.5	0	0	32	314	201	86	72	26	25	7	9	3	0	0	0	0	0	0	0	0	0	0	0	775
	3.0	0	0	0	12	40	25	7	9	7	0	2	3	1	0	0	0	0	0	0	0	0	0	0	106
	3.5	0	0	0	0	8	14	5	1	2	3	0	1	1	0	0	0	0	0	0	0	0	0	0	35
	4.0	0	0	0	0	0	7	1	1	6	8	3	4	0	0	0	0	0	0	0	0	0	0	0	30
	4.5	0	0	0	0	0	0	0	0	0	1	0	3	6	1	0	0	0	0	0	0	0	0	0	11
	5.0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	3
	5.5	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	2
	6.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	6.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
7.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
>7.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

Total: 3759

