

DTIC**ELECTE****MAR 31 1993****AD-A262 471****1****CHAPTER 16. WHITECAP MEASUREMENTS**

by

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Video Cameras and tape recorders were installed on research vessels taking part in the Gulf of Alaska experiments to collect the data necessary for the determination of the fraction of the sea surface covered by Stage A Whitecaps (spilling wave crests). Two systems were installed; one on the R/V CORY CHOUEST and the other on the R/V J.P. TULLEY. Each system consisted of two NTSC format video cameras, VHS tape recorders, monitors, and date/time encoders. The cameras were mounted high in each ship's superstructure, and the cameras depressed to view the surface of the ocean from just above the horizon to the near sea surface at the bottom of the picture. Time was encoded to allow synchronization of recorded events with other recorded parameters. Video images were recorded during daylight hours for the days on station. The VHS format recorder allowed continuous recording for a period of eight hours. This data set was by far the largest we at the Marine Sciences Institute have been able to collect and analyze. It provides the basis for an assessment of how whitecap coverage varies as the wind conditions change.

All equipment and the data tapes were removed from the vessels and shipped to the University of Connecticut by Johns Hopkins Personnel.

At the Marine Sciences Institute, Groton, Connecticut, analysis of video tapes from the R/V CORY CHOUEST and from the Canadian R/V J.P. TULLEY was accomplished using the PC Vision Frame Grabber boards, and software developed at the Marine Sciences Institute by Dr. Wang Qin.

Tapes to be analyzed were played in a JVC Video Cassette Recorder, Model BR-3200U, and the video signal sent to the ITEX/PC Vision Frame Grabber, and in parallel, to a JVC TM-9U color video monitor. This monitor allows the operator to view the video signal as recorded. The frame grabber "captures" a video frame, and stores it in a NECA 486-33Mhz IBM compatible computer for analysis.

Dr. Wang Qin, working in "C" language, developed an algorithm to control the area of analysis, compare gray scale pixel values, and discriminate between "sky", water, and by judicious selection of gray scale values, Stage "A" Whitecaps, and Stage "A" plus Stage "B" Whitecaps. This system has been compared to the Hamamatsu Analysis procedures, and has been

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found to be comparable, and to have several advantages.

Using the Hamamatsu system, an area of the monitor screen, representing the area of analysis is selected. This area is often small when compared to the screen size due to the sky effect. The Hamamatsu Area Analyzer counts all pixels with a gray scale value lighter than a threshold, which has to be set by the operator. Some of the parameters which effect the threshold setting are: time and brightness of the day; sun-light or over-cast conditions; and sun position, roughness and specular reflections from the water surface. During analysis, the roll of the ship platform often brings a portion of the sky into the picture. If the "sky" intrudes into the area selected for analysis, an error is generated in the whitecap fraction, as the "sky" will be counted as whitecap. Thus, for an analysis interval, the analysis area often has to be drastically reduced to preclude this error.

Using the frame grabber, gray scale values of all pixels are determined, and sent to the computer. These values are compared to locate the interface of "sky" and water. The "sky" portion of the video frames are then excluded from further consideration in the computation of the whitecap fraction. The left, right and lower bounds of the analysis area are set by the operator. The upper bound is controlled by the computer analysis of the "sky" interface, thus the area considered for determining the whitecap fraction is maximized.

In determining exactly which pixels will be counted, the operator has control of two thresholds. One controls the maximum brightness of the "sky", the other sets the minimum brightness of the stage "A" whitecap. Choosing still lower minimum brightness values allows one to count (stage "A" + stage "B") whitecaps.

The analyzed video frame from the computer is sent back through the frame grabber with the gray scale value of the pixels counted as whitecap modified to an intense white value. The entire video picture is then presented on a second JVC TM-9U monitor, so the operator can observe in real time the pixels included in the whitecap fraction.

The standard NTSC video system will paint sixty scans of the video image, using alternate scan lines on the video monitor, each second, thus giving thirty complete images. Using the Hamamatsu system, we were able to analyze thirty complete images each second. Due to the time necessary for frame grabbing, analysis of the "sky", additional analysis of the remainder of the video presentation, computer access time, and computer cycle time to calculate and store one second averages, the frame grabber system is reduced to calculating the one second whitecap averages based on looking at only five video

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frames each second. This is considered more than adequate for computing one second whitecap average fractions.

The accuracy of this system of analysis is still based to some extent on operator judgment. There are also some problems caused by the changing parameters such as reflections of sunlight, etc. To minimize these, the operator has control over adjustment of both the sky and whitecap thresholds during the entire data processing event.

It is envisioned that the next generation of analysis equipment will be much faster, being able to analyze every video frame; more accurate, in that the parameters will be based only on physical conditions, and not on operator judgments; and that the entire data acquisition system will be made more adaptable to use at sea, and in the air from a variety of platforms.

In working with the video tapes from the CORY CHOUEST, and the J.P. TULLEY, several checks were done to ensure uniformity of operators, and results. Several analysis intervals were done on both the Hamamatsu Area Analyzer and on the P.C. Vision Frame Grabber. The results were compared and found to be in agreement. In addition, different operators were required to analyze several identical segments on the same tapes for comparison. Again, the results were in very good agreement.

Not all tapes were able to be analyzed. This was due to several factors such as rain or salt spray that appeared on the camera windows, as a result of sea and weather conditions. Specular reflections also interfered with analysis. In some segments there was insufficient light at the start or end of the recording day.

In all, this effort resulted in the largest data sets from ships at sea thus far analyzed. One hundred twenty one intervals from the CORY CHOUEST (Eighty-eight original, thirty-three supplemental) were analyzed, one hundred eighty three (Revised) from the J.P. TULLEY were processed.

The results are presented in three tables, along with several representative graphs of the Log of the Stage A Whitecap Fraction (one second averages + 0.0001) verses time, for 600 second periods. Included with the graphs is the relevant information as to the ship, tape, Julian day and year, and the meteorological data from the 17 December, 1992, as updated by JHU/APL. The analysis interval start times were based upon analysis constraints rather than on artificial clock constraints. Where possible consecutive ten minute sequences were analyzed, and as a result, there are several periods with continuous analysis results for as long as seventy minutes. The time for the meteorological data utilized in the analysis

was the average for the period just prior to the analysis start.

The results of this work are presented only for PHASE II of the Experiment, as the meteorological data for PHASES I and III are not yet available.

WHITECAP DATA SET NO:

DATA TYPE: WA

SOURCE: GULF OF ALASKA, FEBRUARY / MARCH, 1992
VIDEO DATA FROM RESEARCH VESSEL CORY CHOUEST

CITATION:

NUMBER OF OBSERVATIONS: EIGHTY-EIGHT

JULIAN DAY 55, TAPE #13

OBN	U10	WD	ATEMP	WTEMP	WFRAC
RV1-1756	9.6	184.2	6.7	5.4	0.0005245
RV1-1826	9.1	191.0	6.6	5.4	0.0015848
RV1-1856	10.0	188.6	6.8	5.5	0.0012460
RV1-1926	9.5	190.1	6.8	5.5	0.0008314
RV1-1956	8.1	187.9	6.7	5.5	0.0001773
RV1-2026	8.3	186.6	6.8	5.6	0.0005520
RV1-2056	9.0	185.8	7.0	5.7	0.0017131
RV1-2126	8.4	185.1	6.9	5.8	0.0005764
RV1-2156	8.8	185.8	6.9	5.8	0.0006399
RV1-2226	8.1	192.0	6.9	5.7	0.0006765
RV1-2256	7.5	188.1	6.9	5.7	0.0002347
RV1-2326	7.7	189.4	6.9	5.7	0.0002711
RV1-2356	5.6	208.0	6.9	5.7	0.0000979

JULIAN DAY 56

RV1-0026	3.5	236.7	6.7	5.7	0.0003330
RV1-0056	4.1	229.6	6.9	5.8	0.0000255
RV1-0126	3.3	238.0	6.9	5.9	0.0002620

JULIAN DAY 56, TAPE #14

RV1-1718	14.9	13.4	4.1	5.3	0.0028182
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JULIAN DAY 57, TAPE #15

RV1-0334	1.8	227.5	6.4	5.6	0.0001507
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JULIAN DAY 57, TAPE #16

RV1-1700	11.2	283.8	3.1	5.2	0.0004848
RV1-1730	12.0	283.6	3.0	5.2	0.0004755
RV1-1800	8.9	270.4	3.0	5.2	0.0005843
RV1-1830	5.7	310.5	1.9	5.4	0.0004628
RV1-1900	8.2	271.3	3.6	5.3	0.0010653
RV1-1930	9.4	289.7	3.5	5.3	0.0003071
RV1-2000	8.0	305.6	3.3	5.3	0.0006975

OBN	U10	WD	ATEMP	WTEMP	WFRAC
JULIAN DAY 57, TAPE #16 CONT.					
RV1-2030	10.4	285.4	3.2	5.5	0.0003160
RV1-2100	8.8	284.4	2.3	5.4	0.0005778
RV1-2130	5.5	280.6	2.9	5.6	0.0000342
RV1-2200	6.6	297.7	3.4	5.7	0.0002257
RV1-2230	6.0	311.2	3.6	5.8	0.0003225

JULIAN DAY 57, TAPE #17

RV1-2308	5.9	329.1	3.2	5.7	0.0000193
RV1-2338	5.1	326.6	3.3	5.7	0.0000102

JULIAN DAY 58

RV1-0008	3.5	326.0	3.3	5.7	0.0000049
RV1-0038	6.6	305.5	3.0	5.7	0.0000657
RV1-0108	7.8	307.5	2.5	5.7	0.0002418
RV1-0138	6.5	305.7	2.7	5.8	0.0008910
RV1-0208	5.0	326.2	3.1	5.8	0.0000892
RV1-0238	5.1	352.8	3.3	5.7	0.0019790
RV1-0308	4.8	351.0	3.3	5.7	0.0013622
RV1-0338	4.8	350.2	3.2	5.6	0.0000330

JULIAN DAY 58, TAPE #18

RV1-1640	9.1	319.6	2.8	5.5	0.0006555
RV1-1710	7.9	318.5	2.6	5.4	0.0048386
RV1-1740	9.5	339.9	2.1	5.3	0.0012790
RV1-1840	10.0	284.2	2.2	5.2	0.0006834
RV1-1910	11.2	302.7	2.5	5.3	0.0009044
RV1-1940	12.1	291.0	1.9	5.3	0.0003393
RV1-2010	9.4	299.1	1.3	5.4	0.0009487
RV1-2040	11.2	316.6	1.2	5.5	0.0015495
RV1-2110	7.8	303.5	1.6	5.6	0.0001239
RV1-2140	10.3	299.9	2.7	5.6	0.0015653
RV1-2240	7.5	289.8	3.0	5.7	0.0003009

JULIAN DAY 58, TAPE #19

RV1-2302	7.4	288.2	2.8	5.6	0.0004559
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JULIAN DAY 59

RV1-0048	6.6	284.5	2.9	5.4	0.0000007
RV1-0208	4.9	266.7	2.8	5.3	0.0001188
RV1-0238	5.6	302.9	2.7	5.3	0.0002610
RV1-0308	5.7	277.1	2.7	5.3	0.0000001
RV1-0338	5.4	268.6	2.7	5.3	0.0000003

OBN	U10	WD	ATEMP	WTEMP	WFRAC
JULIAN DAY 59, TAPE #20					
RV1-1700	4.6	155.9	3.2	5.5	0.0000000
RV1-1730	5.5	159.4	3.2	5.5	0.0000019
RV1-1800	4.1	130.1	2.9	5.5	0.0000079
RV1-1830	4.6	137.1	3.1	5.5	0.0000001
RV1-1900	6.8	147.0	3.3	5.5	0.0000310
RV1-1930	5.2	156.1	3.4	5.5	0.0000162
RV1-2000	6.9	158.6	4.1	5.6	0.0000149
RV1-2030	7.1	153.7	4.3	5.6	0.0001157

JULIAN DAY 60, TAPE #21

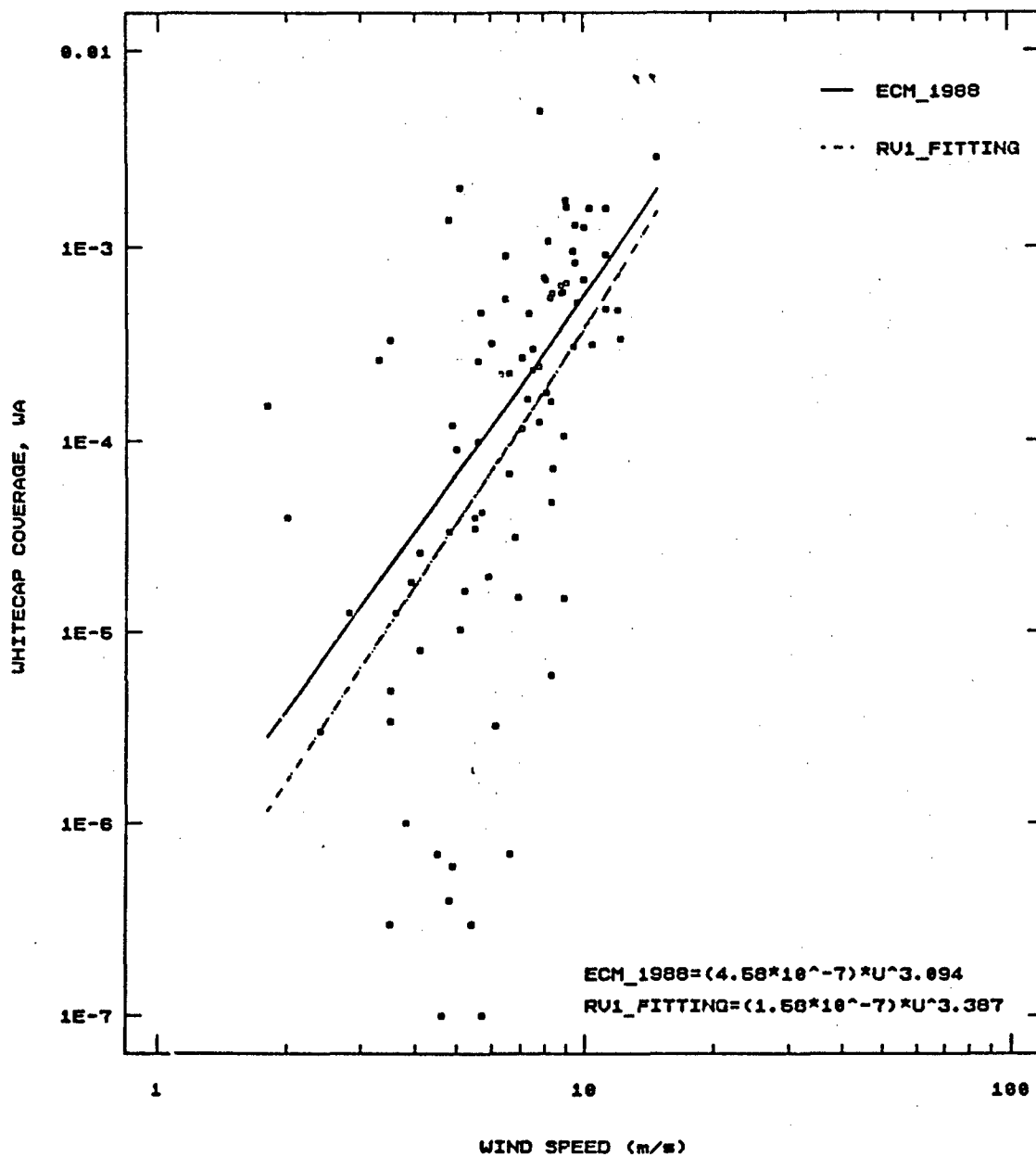
RV1-0100	8.3	153.1	5.2	5.4	0.0000059
RV1-0130	8.9	146.9	4.9	5.4	0.0000147
RV1-0200	8.4	151.7	4.8	5.3	0.0000710
RV1-0230	8.3	146.6	4.9	5.3	0.0001598
RV1-0300	8.9	144.9	4.9	5.2	0.0001045
RV1-0330	8.3	141.4	5.0	5.2	0.0000468

JULIAN DAY 60, TAPE #22

RV1-1700	7.3	140.2	5.6	5.5	0.0001648
RV1-1730	6.5	142.5	5.6	5.4	0.0005443
RV1-1800	6.3	145.9	5.6	5.3	0.0002208
RV1-1830	5.5	150.7	5.8	5.4	0.0000389
RV1-1900	6.1	164.5	5.8	5.4	0.0000032
RV1-1930	5.7	164.8	5.6	5.3	0.0000415
RV1-2045	4.8	159.3	5.6	5.3	0.0000004
RV1-2255	3.5	158.6	5.8	5.4	0.0000003
RV1-2325	3.8	169.5	5.7	5.4	0.0000010
RV1-2355	2.0	170.5	5.7	5.4	0.0000390

JULIAN DAY 61, TAPE #23

RV1-0017	3.6	206.5	5.7	5.4	0.0000124
RV1-0047	4.9	199.3	5.5	5.5	0.0000006
RV1-0117	4.5	195.3	5.4	5.5	0.0000007
RV1-0147	3.9	194.7	5.5	5.5	0.0000180
RV1-0217	3.5	184.8	5.4	5.5	0.0000034
RV1-0247	2.8	158.4	5.5	5.5	0.0000125
RV1-0317	2.4	191.3	5.5	5.4	0.0000030



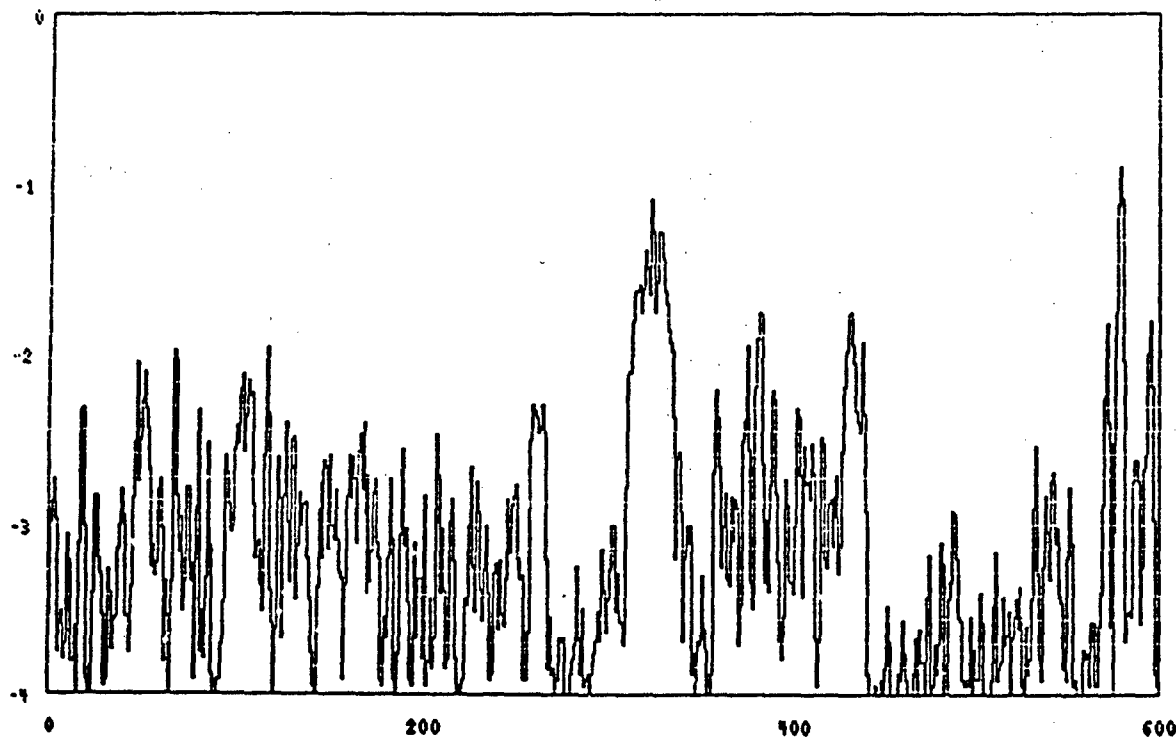
ANALYSIS OF RESEARCH VESSEL ONE DATA

TAPE/EVENT NUMBER :RV1-1718 YR/JUL DAY :1992/56 START TIME : 1718

WHITECAP AVERAGE : 0.0028182 VARIANCE : 0.0000874
SKEWNESS : 7.2874822 KURTOSIS : 66.6426393

METEROLOGICAL DATA :
W_S(m/s) W_D T_air T_water STABILITY
14.9 13.4 4.1 5.3 UNSTABLE

LogH vs Time



Time (seconds)

ANALYSIS OF RESEARCH VESSEL ONE DATA

TAPE/EVENT NUMBER :RV1-0334 YR/JUL DAY :1992/57 START TIME : 0334

WHITECAP AVERAGE : 0.0001507
SKEWNESS : 12.0700594

VARIANCE : 0.0000009
KURTOSIS :183.3030686

METEROLOGICAL DATA :

W_s(m/s)
1.8

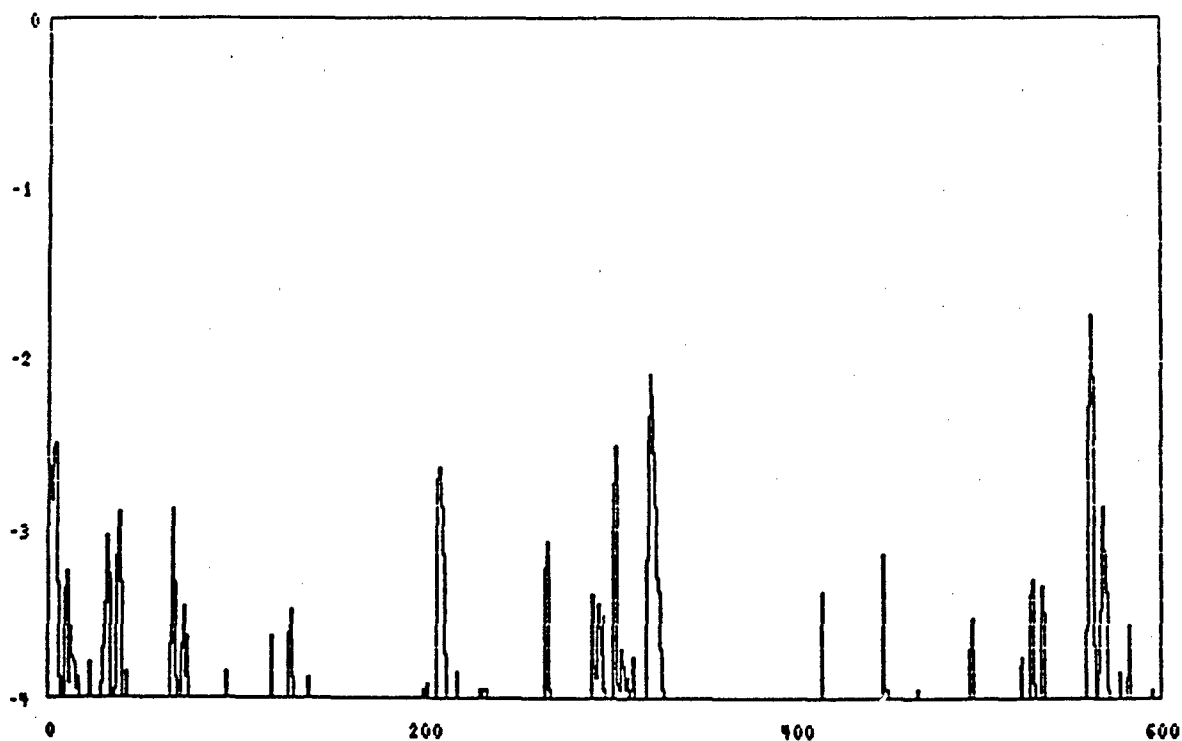
W_D
227.5

T_{air}
6.4

T_{water}
5.6

STABILITY
STABLE

LogH vs Time



Time (seconds)

Supplement #1

23 November, 1992

The listed whitecap fractions included in this report are supplemental to those provided in the original report dated August, 1992, and consist of thirty-three additional intervals analyzed since the issue of that report. The numbering sequences have been augmented to reflect the vessel, RV1, the tape sequence number, the file name, and a dash (-) number. The file name consists of the four digit ZULU time of the start of the analysis interval. When possible, the analysis period consisted of thirty minutes of continuous operation. These periods were further broken down into ten minute periods for processing, and for graphing. Thus, "-1" indicates the ten minute interval starting at the file specified time, and a "-3" indicates the third ten minute period of the thirty minute interval.

We have also included in the tabular report the standard deviation of the one second averages used in computing the whitecap fraction.

A plot of the expected fitted line and the actual fitted line are also provided.

SOURCE: GULF OF ALASKA, FEBRUARY / MARCH, 1992

VIDEO DATA FROM RESEARCH VESSEL CORY CHOUEST

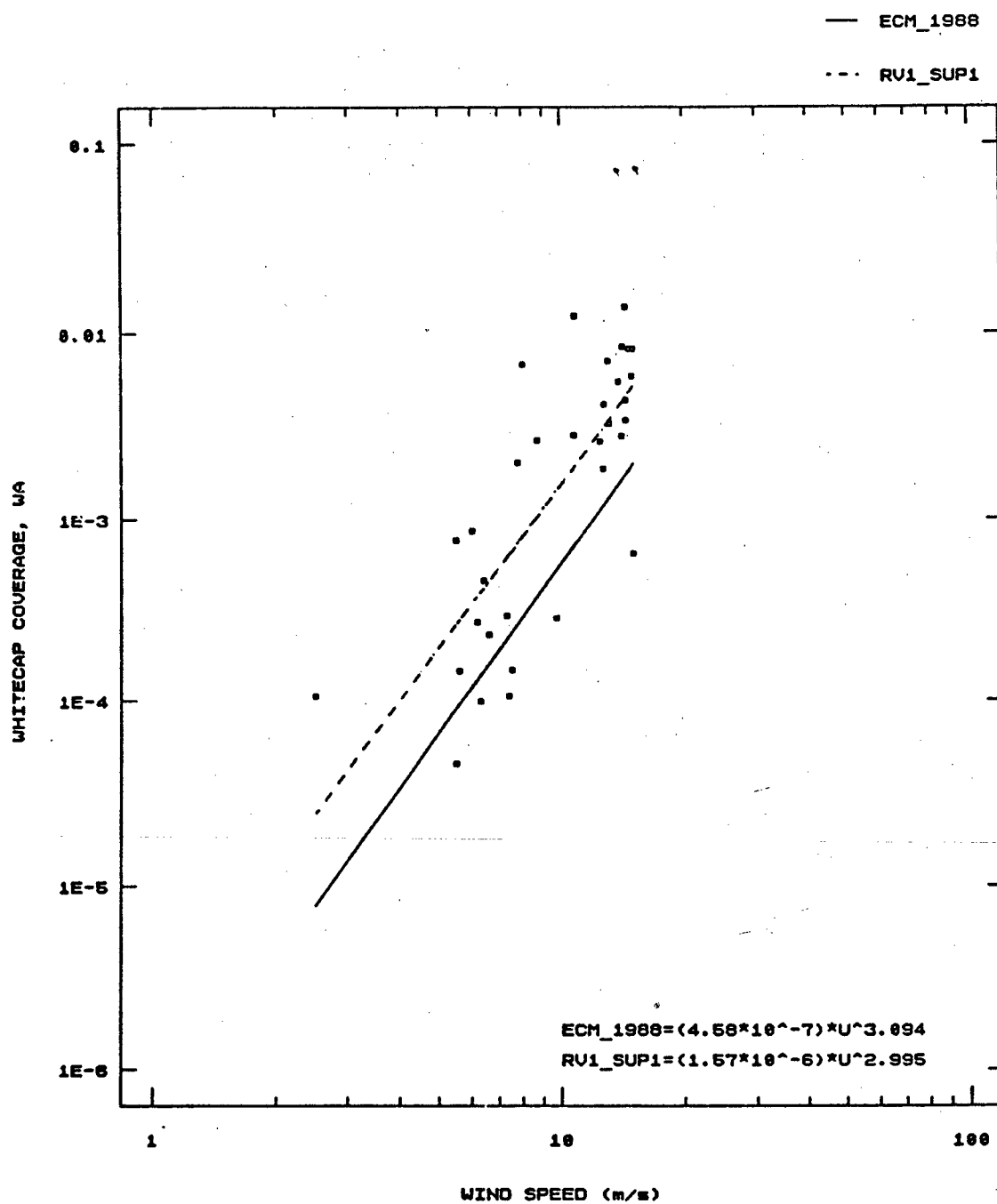
CITATION: (RV1 Suppliment #1, DTD 18 NOVEMBER, 1992)

NUMBER OF OBSERVATIONS: 33

ORN	START TIME	DURATION SECS	U10 M/S	WD DEG	ATEMP DEG C	WTEMP DEG C	WFRAC	STD.DEV.
JULIAN DAY: 55, TAPE #13								
RV1-13/1751-1	1751	329	9.7	184.2	6.7	5.4	0.0002793	0.0308630
JULIAN DAY: 55, TAPE#13								
RV1-13/0156-1	0156	473	2.5	308.3	6.4	5.9	0.0001052	0.0215025
JULIAN DAY: 56, TAPE #14								
RV1-14/1713-2	1728	437	15.0	13.4	4.1	5.3	0.0006327	0.0373464
RV1-14/1808-1	1808	601	12.6	12.9	4.1	5.3	0.0018641	0.0691036
RV1-14/1818-1	1818	601	12.4	17.7	4.2	5.3	0.0026360	0.0825967
RV1-14/1836-1	1836	590	12.7	15.3	4.2	5.3	0.0041805	0.1017439
RV1-14/1907-1	1907	601	13.0	15.6	4.3	5.4	0.0070373	0.1413512
RV1-14/1927-1	1927	601	13.1	17.0	4.3	5.5	0.0032985	0.0920474
RV1-14/1937-1	1937	601	14.0	15.2	4.2	5.6	0.0028017	0.0777084
RV1-14/2007-1	2007	601	14.4	15.8	4.2	5.7	0.0135544	0.1731999
RV1-14/2007-2	2017	601	14.4	20.6	4.3	5.7	0.0043953	0.0870834
RV1-14/2007-3	2027	601	14.4	20.6	4.3	5.7	0.0034233	0.0823759
RV1-14/2037-1	2037	601	13.8	7.9	4.3	5.7	0.0054935	0.1011606
RV1-14/2037-2	2047	601	14.9	5.9	4.3	5.7	0.0058868	0.1100105
RV1-14/2110-1	2110	601	14.6	12.8	4.3	5.7	0.0081470	0.1251909
RV1-14/2140-1	2140	601	14.1	17.9	4.4	5.7	0.0084209	0.1196893
RV1-14/2210-1	2210	601	15.0	25.4	4.5	5.7	0.0081491	0.1175594
JULIAN DAY: 57, TAPE #15								
RV1-15/0235-1	0235	601	6.0	157.2	6.8	5.3	0.0008467	0.0504163
RV1-15/0235-2	0245	600	5.5	155.8	6.8	5.3	0.0007496	0.0532648
JULIAN DAY: 58, TAPE #18								
RV1-18/1640-2	1650	601	7.8	328.4	2.0	5.5	0.0020197	0.0722405
RV1-18/1640-3	1700	596	8.0	318.5	2.6	5.4	0.0068031	0.1036333
RV1-18/1810-1	1810	513	8.7	319.4	2.4	5.3	0.0026598	0.0701825
RV1-18/2140-2	2150	601	10.8	293.1	2.8	5.7	0.0121401	0.1257245
RV1-18/2140-3	2200	300	10.7	325.8	2.4	5.8	0.0028629	0.0613402
RV1-18/2240-2	2250	601	7.5	293.9	2.9	5.6	0.0001449	0.0272434

JULIAN DAY: 60, TAPE #22

OBN	START TIME	DURATION SECS	U10 M/S	WD DEG	ATEMP DEG C	WTEMP DEG C	WFRAC	STD.DEV.
RV1-22/1700-2	1710	601	7.4	140.2	5.6	5.5	0.0001054	0.0190164
RV1-22/1700-3	1720	597	7.3	141.4	5.6	5.4	0.0002876	0.0317245
RV1-22/1730-2	1740	601	6.6	142.5	5.6	5.4	0.0002275	0.0295755
RV1-22/1730-3	1750	596	6.3	147.0	5.6	5.3	0.0000987	0.0186865
RV1-22/1800-2	1810	601	6.4	145.9	5.6	5.3	0.0004496	0.0433671
RV1-22/1800-3	1820	597	6.2	149.2	5.7	5.4	0.0002672	0.0356714
RV1-22/1830-2	1840	601	5.5	150.7	5.8	5.4	0.0000451	0.0130868
RV1-22/1830-3	1850	596	5.6	153.5	5.8	5.4	0.0001441	0.0206693



RV1_SUP1 DATA

DATE 12/11/92

ANALYSIS OF RESEARCH VESSEL ONE DATA

TAPE/EVENT NUMBER : RV1-TAPE #14/2007-2 YR/JUL DAY : 1992/56

START TIME (JD/HHMM)---56/ 2017 DURATION 601

WHITECAP AVERAGE : 0.0043953 VARIANCE : 0.0000575

STANDARD DEVIATION: 0.0870834 SKEWNESS : 4.1629006

KURTOSIS : 21.2986728

METEROLOGICAL DATA :

W_S(m/s)
14.4

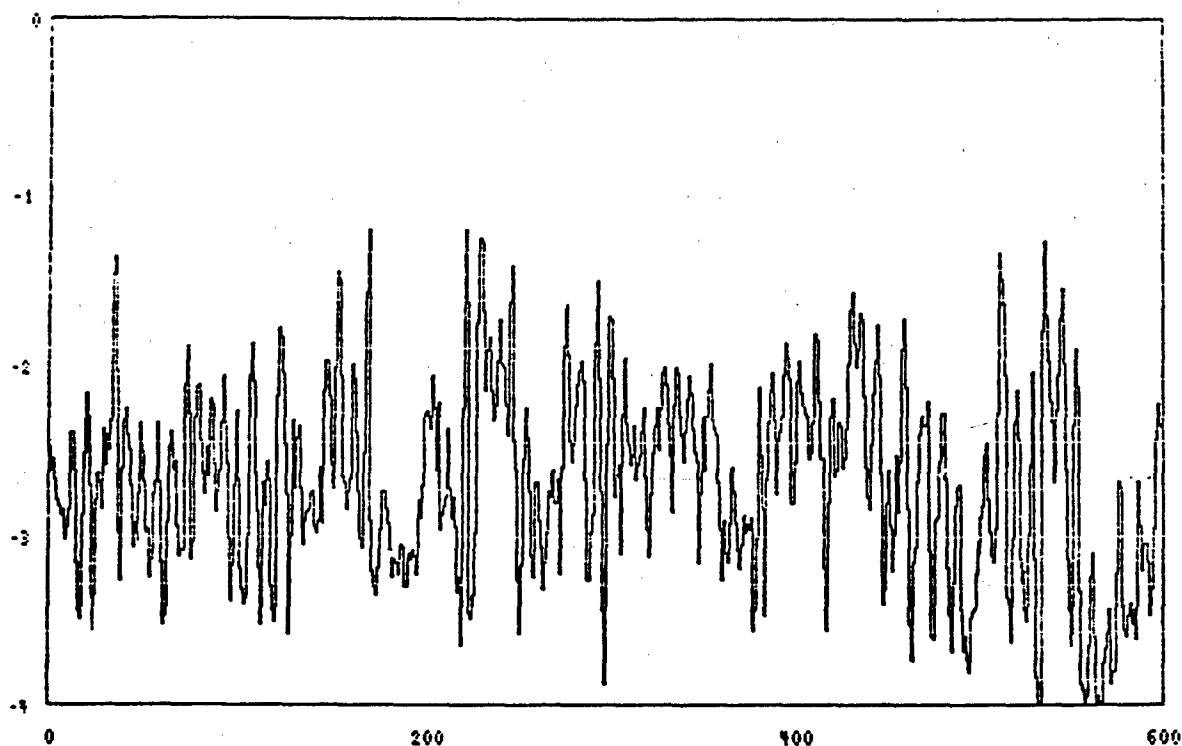
W_D
20.6

T_air
4.3

T_water
5.7

STABILITY
UNSTABLE

LogH vs Time



Time (seconds)

DATE 16/11/92

ANALYSIS OF RESEARCH VESSEL ONE DATA

TAPE/EVENT NUMBER : RV1-TAPE #22/1830-3 YR/JUL DAY : 1992/60

START TIME (JD/HHMM)---60/ 1850 DURATION 596

WHITECAP AVERAGE : 0.0001441 VARIANCE : 0.0000002

STANDARD DEVIATION: 0.0206693 SKEWNESS : 5.5690796

KURTOSIS : 39.9101132

METEROLOGICAL DATA :

W_S(m/s)
5.6

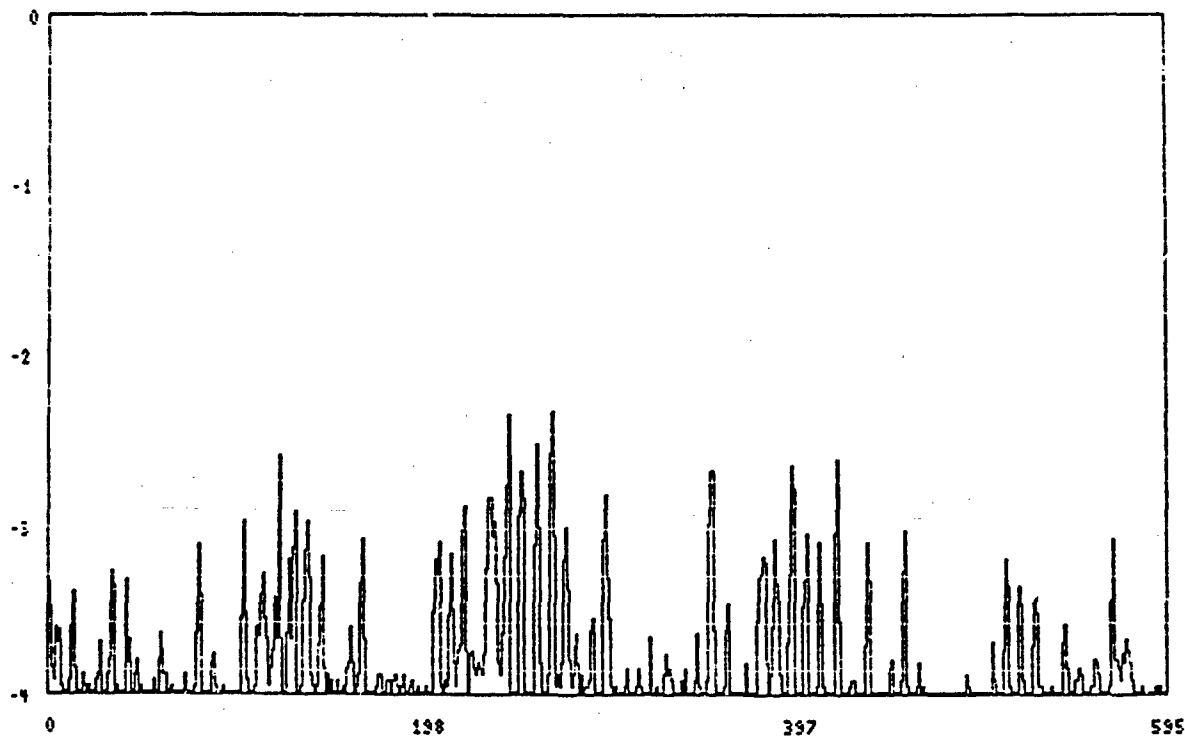
W_D
153.5

T_air
5.8

T_water
5.4

STABILITY
NEUTRAL

LogH vs Time



Time (seconds)

Revision One

November, 1992

The below listing of whitecap fractions, generated from the video records taken on board the R/V J.P. TULLEY, are based upon the latest revision of meteorological data (12/17/92) provided by JHU/APL, and the analysis of all viable intervals recorded during Phase 2 of the Alaskan Gulf test.

Our original report, dated August, 1992, contained seventy nine events analyzed in ten minute segments at approximately thirty minute intervals, conditions permitting. This update reports whitecap fraction for all intervals, with a duration greater than 300 seconds, that were analyzed. Many intervals are contiguous, with a duration of several hours. Others are small time intervals that were able to be analyzed only with difficulty, due to light conditions or weather.

Based upon interpretation of many previous whitecap data sets, and in light of the good agreement with expected results from other research platforms in the immediate area, it is suggested that the wind speeds recorded on board the TULLEY may be in error. Included in this report is our evaluation of expected wind speeds required to generate the evaluated whitecap fraction.

These data are reported under Julian date, MSI tape number, and Run number headings. Each data segment consists of the Observation Number(OBN), which consists of the "Vessel Designation-MSI tape number / file number-interval"; the "Zulu" start time of the interval; the duration of the interval in seconds; the windspeed average(U10, m/s), the wind direction(WD), the air temperatures(ATEMP, Deg C.), and water temperatures(WTEMP, Deg C.). derived from the closest previous meteorological data entry; the whitecap fraction averaged over the stated interval; and the standard deviation of the one second averages of the whitecap fraction over the duration of the data interval.

The one second whitecap averages were derived from the analysis of the video registration made during the test period February/March, 1992. Each second of video recording is made up of thirty images. Five of these were analyzed, and averaged to obtain the one second whitecap average. A number of these one second averages were then averaged to obtain the whitecap fraction over the stated interval.

A graph of (log of the whitecap fraction + 0.0001) verses time for several intervals is also provided.

WHITECAP DATA SET NO:

DATA TYPE: WHITECAP AVERAGES (WA)

SOURCE: GULF OF ALASKA, FEBRUARY / MARCH, 1992
VIDEO DATA FROM CANADIAN RESEARCH VESSEL J.P. TULLEY

CITATION:

NUMBER OF OBSERVATIONS: 183

OBN	START TIME	DURATION SECS	U10	WD	ATEMP	WTEMP	WFRAC	STD.DEV.
JULIAN DAY 55, TAPE #9, RUN #92-310/311								
RV3-9/1640-1	1640	600	9.3	169.5	7.1	5.7	0.0022283	0.0659856
RV3-9/1640-2	1650	600	9.3	169.5	7.1	5.7	0.0009787	0.0402410
RV3-9/1640-3	1700	595	10.4	175.4	7.2	5.7	0.0025467	0.0688394
RV3-9/1710-1	1710	600	10.4	176.4	7.2	5.7	0.0012378	0.0584512
RV3-9/1710-2	1720	600	10.4	176.4	7.2	5.7	0.0013632	0.0557823
RV3-9/1710-3	1730	594	11.9	185.4	7.0	5.7	0.0018255	0.0704822
RV3-9/1740-1	1740	600	11.9	185.4	7.0	5.7	0.0025679	0.0673368
RV3-9/1810-1	1810	600	11.6	178.5	7.0	5.7	0.0029150	0.0853688
RV3-9/1810-2	1820	399	11.6	178.5	7.0	5.7	0.0021155	0.0717987
RV3-9/1955-1	1955	600	10.1	177.8	6.9	5.8	0.0072179	0.1220106
RV3-9/1955-2	2005	600	9.8	143.4	6.9	5.8	0.0036395	0.0806942
RV3-9/1955-3	2015	595	9.8	143.4	6.9	5.8	0.0024282	0.0692435
RV3-9/2025-1	2025	600	9.8	143.4	6.9	5.8	0.0031015	0.0799125
JULIAN DAY 56, TAPE #10, RUN #92-312/313								
RV3-10/2043-1	2043	600	18.5	184.4	3.9	5.6	0.0042930	0.0960975
RV3-10/2136-1	2136	426	17.7	349.8	4.0	5.6	0.0044629	0.0864424
RV3-10/2143-1	2143	600	17.7	349.8	4.0	5.6	0.0038426	0.0893107
RV3-10/2143-2	2153	600	17.7	349.8	4.0	5.6	0.0080821	0.1279188
RV3-10/2143-3	2203	581	16.8	305.2	4.2	5.6	0.0052303	0.1115265
RV3-10/2223-1	2223	600	16.8	305.2	4.2	5.6	0.0064040	0.1419490
RV3-10/2223-2	2233	600	15.7	251.5	4.4	5.5	0.0028828	0.0854350
RV3-10/2223-3	2243	595	15.7	251.5	4.4	5.5	0.0021397	0.0693543
RV3-10/2253-1	2253	569	15.7	251.5	4.4	5.5	0.0032206	0.0828732
JULIAN DAY #57								
RV3-10/1624-1	1624	569	12.1	281.7	3.0	5.5	0.0052828	0.1210952
RV3-10/1633-1	1633	384	12.2	271.2	3.3	5.6	0.0022067	0.0858436
RV3-10/1648-1	1648	356	12.2	271.2	3.3	5.6	0.0036310	0.0908617
RV3-10/1654-1	1654	600	12.2	271.2	3.3	5.6	0.0013296	0.0712368
RV3-10/1654-2	1704	600	10.9	235.8	3.2	5.7	0.0005435	0.0471536
RV3-10/1654-3	1714	595	10.9	235.8	3.2	5.7	0.0004236	0.0370456
RV3-10/1724-1	1724	600	10.9	235.8	3.2	5.7	0.0015727	0.0695918
RV3-10/1724-2	1734	600	9.5	280.6	3.2	5.7	0.0005101	0.0352549

JULIAN DAY 57, TAPE #10, RUN #91-312/313 (Cont.)

OBN	START TIME	DURATION SECS	U10 M/S	WD DEG	ATEMP DEG C	WTEMP DEG C	WFRAC	STD.DEV.
RV3-10/1724-3	1744	595	9.5	280.6	3.2	5.7	0.0010394	0.0589999
RV3-10/1757-1	1757	301	9.5	280.6	3.2	5.7	0.0022387	0.0614966
RV3-10/1804-1	1804	600	9.5	250.5	3.8	5.7	0.0008934	0.0519514
RV3-10/1804-2	1814	600	9.5	250.5	3.8	5.7	0.0004536	0.0334726
RV3-10/1804-3	1824	595	9.5	250.5	3.8	5.7	0.0003164	0.0319993
RV3-10/1834-1	1834	600	9.6	141.4	2.9	5.7	0.0011189	0.0623954
RV3-10/1834-2	1844	600	9.6	141.4	2.9	5.7	0.0010969	0.0615552
RV3-10/1834-3	1854	595	9.6	141.4	2.9	5.7	0.0005457	0.0531371
RV3-10/1904-1	1904	601	7.1	322.7	2.9	5.7	0.0002337	0.0272613

JULIAN DAY 57, TAPE #11, RUN #92-314

RV3-11/2024-1	2024	601	8.1	270.8	3.7	5.7	0.0006134	0.0575886
RV3-11/2045-1	2045	601	9.5	288.8	3.3	5.7	0.0008583	0.0657565
RV3-11/2045-2	2055	601	9.5	288.8	3.3	5.7	0.0010153	0.0486471
RV3-11/2045-3	2105	595	9.3	275.1	3.2	5.6	0.0003976	0.0275470
RV3-11/2115-1	2115	601	9.3	275.1	3.2	5.6	0.0002764	0.0262088
RV3-11/2115-2	2125	601	9.3	275.1	3.2	5.6	0.0010531	0.0572571
RV3-11/2115-3	2135	523	6.6	274.8	3.8	5.7	0.0003641	0.0332252
RV3-11/2144-1	2144	552	6.6	274.8	3.8	5.7	0.0000570	0.0142522
RV3-11/2155-1	2155	601	6.6	274.8	3.8	5.7	0.0000217	0.0163373
RV3-11/2226-1	2226	601	7.1	301.3	2.6	5.7	0.0000247	0.0146638
RV3-11/2256-1	2256	601	4.6	308.5	2.0	5.6	0.0000943	0.0285904
RV3-11/2326-1	2326	530	5.6	334.4	3.0	5.7	0.0000621	0.0128394
RV3-11/2334-1	2334	601	4.2	326.6	3.2	5.7	0.0000787	0.0232590

JULIAN DAY 58

RV3-11/0014-1	0014	601	3.9	332.7	3.2	5.7	0.0000268	0.0156021
RV3-11/0044-1	0044	429	6.2	292.3	2.9	5.7	0.0000259	0.0133226
RV3-11/0053-1	0053	601	6.2	292.3	2.9	5.7	0.0000287	0.0119487
RV3-11/0123-1	0123	601	6.7	304.8	2.6	5.7	0.0000034	0.0051347
RV3-11/0153-1	0153	601	5.8	322.2	3.0	5.7	0.0000200	0.0124494
RV3-11/0223-1	0223	601	5.6	320.3	3.1	5.6	0.0000069	0.0066534
RV3-11/0253-1	0253	601	5.6	333.6	3.2	5.7	0.0000009	0.0036335
RV3-11/0323-1	0323	601	5.4	337.9	3.1	5.7	0.0000003	0.0018874

JULIAN DAY 58, TAPE #12, RUN #92-315

RV3-12/1636-1	1636	601	11.8	309.0	2.4	5.4	0.0009962	0.0461041
RV3-12/1636-2	1646	601	11.8	309.0	2.4	5.4	0.0007378	0.0444412
RV3-12/1636-3	1656	595	11.8	309.0	2.4	5.4	0.0010722	0.0424057
RV3-12/1706-1	1706	601	12.6	309.7	1.9	5.3	0.0018339	0.0441860
RV3-12/1717-1	1717	601	12.6	309.7	1.9	5.3	0.0012870	0.0413295
RV3-12/1717-2	1727	601	12.6	309.7	1.9	5.3	0.0003964	0.0369946
RV3-12/1717-3	1737	594	10.6	294.5	2.3	5.3	0.0003637	0.0305593
RV3-12/1747-1	1747	601	10.6	294.5	2.3	5.3	0.0011187	0.0498624

JULIAN DAY 58, TAPE #12, RUN #92-315 (CONT.)

OBN	START TIME	DURATION SECS	U10 M/S	WD DEG	ATEMP DEG C	WTEMP DEG C	WFRAC	STD.DEV.
RV3-12/1747-2	1757	601	10.6	294.5	2.3	5.3	0.0005414	0.0256625
RV3-12/1747-3	1807	595	9.8	331.9	2.5	5.3	0.0005645	0.0430376
RV3-12/1822-1	1822	601	9.8	331.9	2.5	5.3	0.0006368	0.0389537
RV3-12/1822-2	1832	601	10.4	301.0	3.5	5.4	0.0004156	0.0395548
RV3-12/1822-3	1842	595	10.4	301.0	3.5	5.4	0.0002475	0.0250395
RV3-12/1852-1	1852	601	10.4	301.0	3.5	5.4	0.0007709	0.0454550
RV3-12/1852-2	1902	601	9.7	300.8	3.7	5.4	0.0002731	0.0286809
RV3-12/1852-3	1912	595	9.7	300.8	3.7	5.4	0.0004981	0.0359134
RV3-12/1922-1	1922	601	9.7	300.8	3.7	5.4	0.0004230	0.0285352
RV3-12/1922-2	1932	601	10.3	285.3	3.7	5.6	0.0004985	0.0316352
RV3-12/1922-3	1942	569	10.3	285.3	3.7	5.6	0.0005607	0.0330920
RV3-12/2057-1	2057	601	10.5	225.1	1.9	5.5	0.0010509	0.0662090
RV3-12/2057-2	2107	601	9.6	341.9	1.0	5.5	0.0002645	0.0283571
RV3-12/2057-3	2117	595	9.6	341.9	1.0	5.5	0.0000001	0.0009567
RV3-12/2127-1	2127	601	9.6	341.9	1.0	5.5	0.0000544	0.0115570
RV3-12/2143-1	2143	601	10.7	338.3	2.6	5.5	0.0000411	0.0193459
RV3-12/2232-1	2232	601	8.1	168.3	4.7	5.5	0.0004263	0.0343559
RV3-12/2232-1	2232	601	11.2	300.4	2.7	5.5	0.0004263	0.0343559
RV3-12/2232-2	2242	601	11.2	300.4	2.7	5.5	0.0003620	0.0606859
RV3-12/2256-1	2256	397	11.2	300.4	2.7	5.5	0.0000674	0.0236871

JULIAN DAY 59

RV3-12/0017-1	0017	601	7.8	237.6	3.1	5.3	0.0006034	0.0418029
RV3-12/0017-2	0027	601	7.8	237.6	3.1	5.3	0.0001768	0.0183709
RV3-12/0017-3	0037	595	8.0	268.9	3.3	5.5	0.0006458	0.0449397

JULIAN DAY 59, TAPE #13, RUN #92-316/317

RV3-13/0054-1	0054	601	8.0	268.9	3.3	5.5	0.0001795	0.0224357
RV3-13/0054-2	0104	601	7.8	297.4	3.1	5.5	0.0000113	0.0088889
RV3-13/0124-1	0124	601	7.8	297.4	3.1	5.5	0.0002018	0.0285219
RV3-13/0124-2	0134	601	8.6	224.8	2.9	5.6	0.0001193	0.0191112
RV3-13/0124-3	0144	595	8.6	224.8	2.9	5.6	0.0001644	0.0347159
RV3-13/0154-1	0154	601	8.6	224.8	2.9	5.6	0.0000923	0.0227704
RV3-13/0154-2	0204	601	7.4	289.5	2.9	5.6	0.0000115	0.0098914
RV3-13/0154-3	0214	595	7.4	289.5	2.9	5.6	0.0003106	0.0516412
RV3-13/0234-1	0234	601	7.8	291.0	2.7	5.4	0.0000008	0.0026424
RV3-13/0304-1	0304	601	5.3	304.3	2.7	5.5	0.0000208	0.0137568
RV3-13/0304-2	0314	601	5.3	304.3	2.7	5.5	0.0000215	0.0104927
RV3-13/0304-3	0324	595	5.3	304.3	2.7	5.5	0.0000199	0.0160140
RV3-13/0334-1	0334	601	6.3	282.6	2.7	5.5	0.0001058	0.0226823
RV3-13/0334-2	0344	601	6.3	282.6	2.7	5.5	0.0000208	0.0138575
RV3-13/0334-3	0354	328	6.3	282.6	2.7	5.5	0.0000000	0.0138575
RV3-13/1651-1	1651	520	5.6	156.6	3.2	5.3	0.0000037	0.0056943
RV3-13/1707-1	1707	601	5.0	34.7	3.1	5.2	0.0000033	0.0050684
RV3-13/1818-1	1818	601	5.3	112.7	4.1	5.3	0.0000302	0.0134682

JULIAN DAY 59, TAPE #13, RUN #92-316/317 (CONT.)

OBN	START TIME	DURATION SECS	U10 M/S	WD DEG	ATEMP DEG C	WTEMP DEG C	WFRAC	STD.DEV.
RV3-13/1818-2	1828	601	5.3	112.7	4.1	5.3	0.0000000	0.0009028
RV3-13/1836-1	1836	601	6.2	87.7	3.8	5.3	0.0000061	0.0077628
RV3-13/1836-2	1846	601	6.2	87.7	3.8	5.3	0.0000012	0.0029052
RV3-13/1836-3	1856	589	6.2	87.7	3.8	5.3	0.0000041	0.0052048
RV3-13/1906-1	1906	601	5.4	90.8	3.7	5.3	0.0000102	0.0054840
RV3-13/1905-2	1916	601	5.4	90.8	3.7	5.3	0.0000341	0.0131270
RV3-13/1906-3	1926	595	5.4	90.8	3.7	5.3	0.0000537	0.0157912
RV3-13/1936-1	1936	601	6.9	135.4	3.9	5.3	0.0000362	0.0113091
RV3-13/1936-2	1946	601	6.9	135.4	3.9	5.3	0.0000289	0.0095763
RV3-13/1936-3	1956	595	6.9	135.4	3.9	5.3	0.0001300	0.0207860
RV3-13/2006-1	2006	601	7.9	135.5	4.2	5.3	0.0000546	0.0133128
RV3-13/2006-2	2016	601	7.9	135.5	4.2	5.3	0.0000478	0.0119139
RV3-13/2006-3	2026	595	7.9	135.5	4.2	5.3	0.0001051	0.0157132
RV3-13/2036-1	2036	601	8.0	112.8	4.3	5.5	0.0000903	0.0142703
RV3-13/2036-2	2046	601	8.0	112.8	4.3	5.5	0.0001191	0.0178119
RV3-13/2057-1	2057	601	8.0	112.8	4.3	5.5	0.0000595	0.0167849

JULIAN DAY 59, TAPE#14, RUN #92-318

RV3-14/2130-1	2130	601	8.9	61.7	4.6	5.5	0.0001368	0.0210462
RV3-14/2130-2	2140	601	8.9	61.7	4.6	5.5	0.0002016	0.0231316
RV3-14/2130-3	2150	595	8.9	61.7	4.6	5.5	0.0000632	0.0131882
RV3-14/2200-1	2200	601	6.9	101.1	4.0	5.4	0.0001503	0.0207920
RV3-14/2200-2	2210	601	6.9	101.1	4.0	5.4	0.0000283	0.0123272
RV3-14/2200-3	2220	594	6.9	101.1	4.0	5.4	0.0000324	0.0139659
RV3-14/2235-1	2235	601	8.1	168.3	4.7	5.5	0.0001087	0.0214924
RV3-14/2235-2	2245	541	8.1	168.3	4.7	5.5	0.0000357	0.0122704
RV3-14/2235-3	2255	594	8.1	168.3	4.7	5.5	0.0000000	0.0122704
RV3-14/2305-1	2305	601	7.5	128.1	4.7	5.6	0.0001047	0.0171870
RV3-14/2305-2	2315	601	7.5	128.1	4.7	5.6	0.0000666	0.0131958
RV3-14/2305-3	2325	594	7.5	128.1	4.7	5.6	0.0000033	0.0045560
RV3-14/2337-1	2337	601	7.6	204.0	4.7	5.4	0.0001036	0.0228252
RV3-14/2337-2	2347	601	7.6	204.0	4.7	5.4	0.0002076	0.0319764

JULIAN DAY 60

RV3-14/0000-1	0000	601	9.1	148.1	5.1	5.3	0.0000438	0.0132225
RV3-14/0000-2	0010	601	9.1	148.1	5.1	5.3	0.0000046	0.0051897
RV3-14/0000-3	0020	595	9.1	148.1	5.1	5.3	0.0000086	0.0082813
RV3-14/0030-1	0030	601	7.6	85.9	5.6	5.5	0.0000295	0.0124840
RV3-14/0030-2	0040	601	7.6	85.9	5.6	5.5	0.0000101	0.0060211
RV3-14/0030-3	0050	595	7.6	85.9	5.6	5.5	0.0000500	0.0114147
RV3-14/0100-1	0100	601	8.9	122.1	5.0	5.5	0.0000833	0.0165355
RV3-14/0100-2	0110	601	8.9	122.1	5.0	5.5	0.0000233	0.0084292
RV3-14/0100-3	0120	595	8.9	122.1	5.0	5.5	0.0000321	0.0096358
RV3-14/0130-1	0130	601	8.4	128.1	4.9	5.6	0.0000433	0.0111006
RV3-14/0130-2	0140	601	8.4	128.1	4.9	5.6	0.0000867	0.0143291

JULIAN DAY 59, TAPE#14, RUN #92-318 (CONT.)

OBN	START TIME	DURATION SECS	U10 M/S	WD DEG	ATEMP DEG C	WTEMP DEG C	WFRAC	STD.DEV.
RV3-14/0130-3	0150	595	8.4	128.1	4.9	5.6	0.0000234	0.0091069
RV3-14/0200-1	0200	601	9.2	209.4	5.1	5.6	0.0001696	0.0242613
RV3-14/0200-2	0210	601	9.2	209.4	5.1	5.6	0.0000450	0.0109633
RV3-14/0200-3	0220	595	9.2	209.4	5.1	5.6	0.0000030	0.0048134
RV3-14/0241-1	0241	601	8.5	41.2	5.2	5.6	0.0000245	0.0106935
RV3-14/0241-2	0251	601	8.5	41.2	5.2	5.6	0.0000765	0.0174569
RV3-14/0241-3	0301	595	8.2	34.5	4.9	5.6	0.0000614	0.0192242
RV3-14/0311-1	0311	601	8.2	34.5	4.9	5.6	0.0000569	0.0150111
RV3-14/0311-2	0321	601	8.2	34.5	4.9	5.6	0.0000737	0.0162512
RV3-14/0311-3	0331	594	9.2	123.2	4.8	5.6	0.0000527	0.0117284
RV3-14/0341-1	0341	601	9.2	123.2	4.8	5.6	0.0004147	0.0375790
RV3-14/0341-2	0351	536	9.2	123.2	4.8	5.6	0.0000827	0.0174192

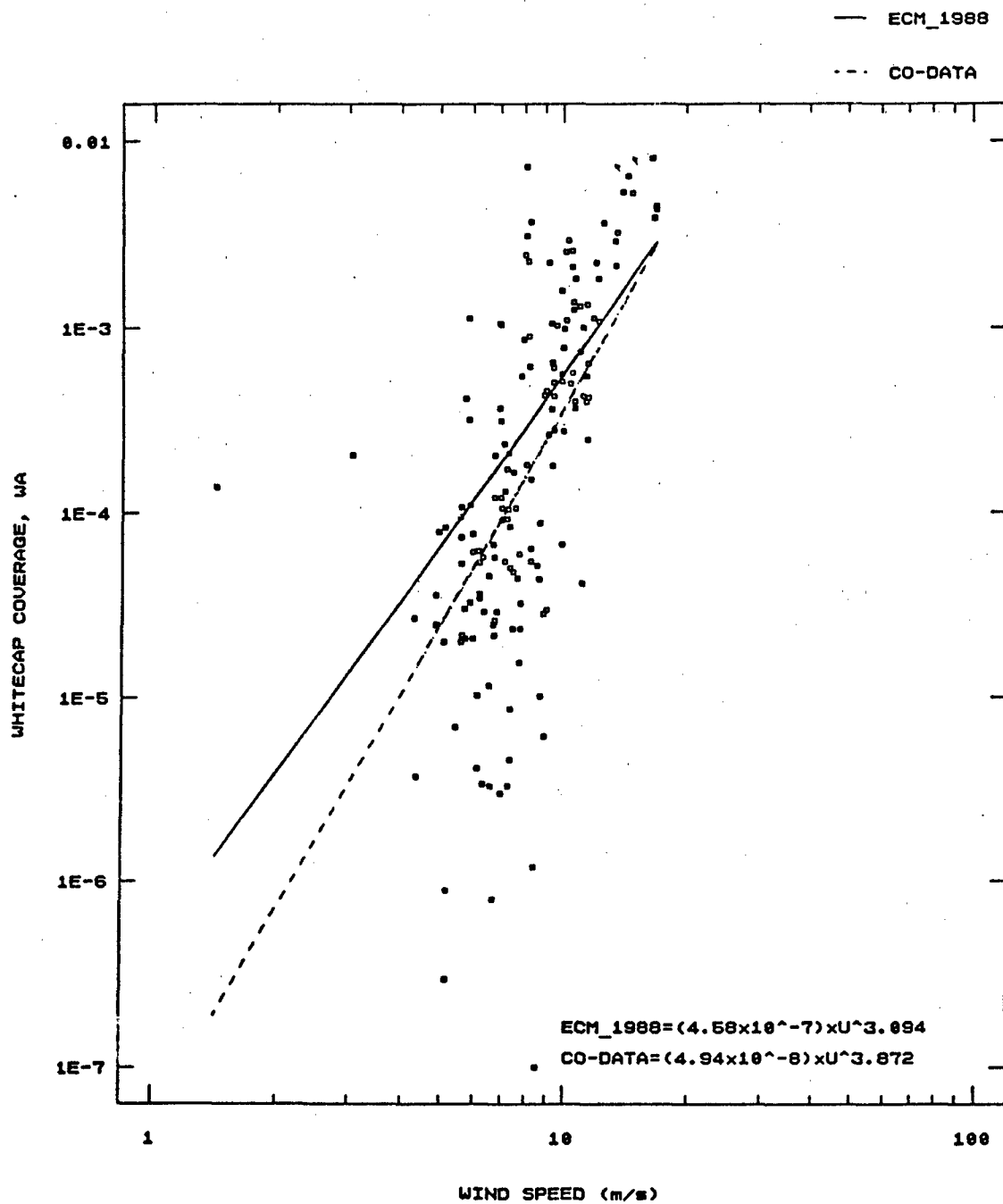
JULIAN DAY 60, TAPE #15, RUN #92-319

RV3-15/1739-1	1739	601	6.7	80.9	5.7	5.6	0.0000054	0.0056039
RV3-15/1809-1	1809	601	6.5	106.5	5.7	5.6	0.0001218	0.0200777
RV3-15/1809-2	1819	601	6.5	106.5	5.7	5.6	0.0000202	0.0097819
RV3-15/1809-3	1829	594	6.5	106.5	5.7	5.6	0.0000776	0.0186649
RV3-15/1839-1	1839	601	6.8	127.6	5.7	5.6	0.0001025	0.0257765
RV3-15/1839-2	1849	601	6.8	127.6	5.7	5.6	0.0000964	0.0223541
RV3-15/1839-3	1859	594	6.8	127.6	5.7	5.6	0.0001700	0.0229380
RV3-15/2030-1	2030	601	4.2	253.0	5.4	5.3	0.0000233	0.0126913
RV3-15/2030-2	2040	601	4.2	253.0	5.4	5.3	0.0000137	0.0112956
RV3-15/2030-3	2050	594	4.2	253.0	5.4	5.3	0.0000009	0.0028143
RV3-15/2120-1	2120	601	3.4	16.3	5.6	5.3	0.0000002	0.0017210
RV3-15/2150-1	2150	601	4.3	136.0	6.2	5.2	0.0000000	0.0017210
RV3-15/2220-1	2220	601	3.6	66.6	6.4	5.3	0.0000002	0.0014112
RV3-15/2250-1	2250	601	3.4	64.8	6.3	5.3	0.0000004	0.0024109
RV3-15/2320-1	2320	601	4.8	333.2	5.8	5.3	0.0000001	0.0013144
RV3-15/2350-1	2350	601	3.5	86.8	6.2	5.3	0.0000001	0.0010732

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RV3-15/0020-1	0020	601	3.7	330.3	5.9	5.3	0.0000000	0.0010732
RV3-15/0114-1	0114	601	3.4	301.4	5.6	5.6	0.0000000	0.0006384
RV3-15/0144-1	0144	456	4.4	309.2	5.5	5.6	0.0000029	0.0069400

END OF ANALYSIS, R/V J.P. TULLEY, GULF OF ALASKA



COMBINE DATA

DATE (DD/MM/YY) 3/11/92

ANALYSIS OF RESEARCH VESSEL THREE DATA

TAPE/EVENT NUMBER : RV3-10/2043-1 YR/JUL DAY : 1992/56

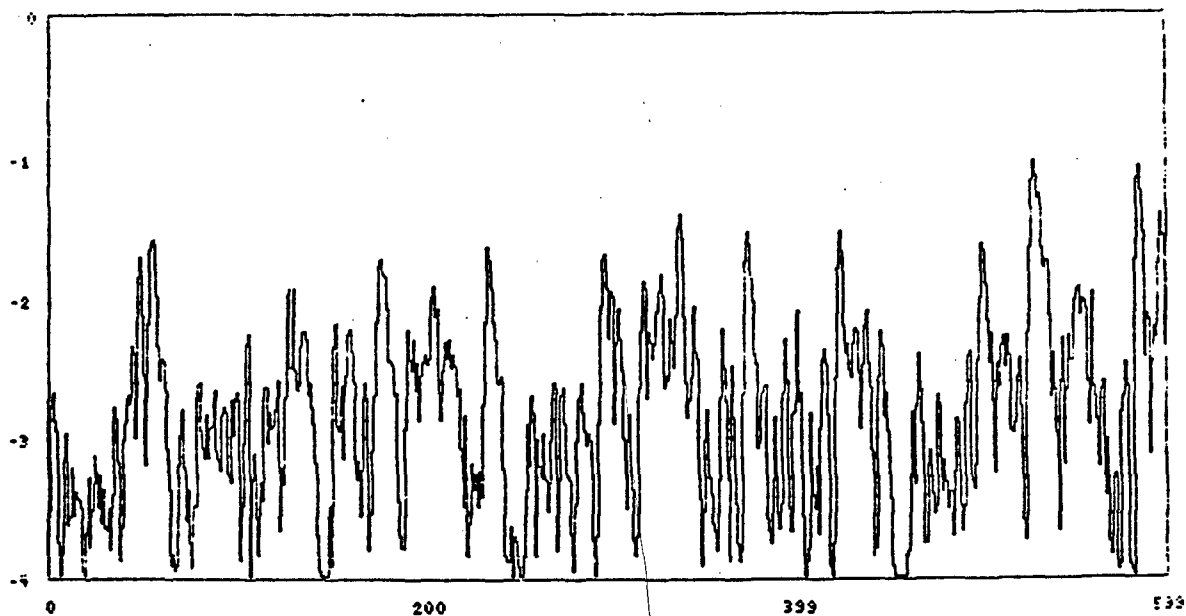
ANALYSIS START TIME (JD/HHMM) --- 56/2043 DURATION 600 SEC.

WHITECAP AVERAGE : 0.0042930 VARIANCE : 0.0000853
STANDARD DEVIATION: 0.0960975 SKEWNESS : 5.0880155
KURTOSIS : 32.7880390

METEOROLOGICAL DATA :

W _{50m/s}	W _D	T _{air}	T _{water}	STABILITY
18.5	184.4	3.9	5.6	UNSTABLE

LogH vs Time



Time (seconds)

DATE (DD/MM/YY) 4/11/92

ANALYSIS OF RESEARCH VESSEL THREE DATA

TAPE/EVENT NUMBER :RV3-15/0144-1 YR/JUL DAY :1992/61

ANALYSIS START TIME (JD/HHMM)--- 61/144 DURATION 456 SEC.

WHITECAP AVERAGE : 0.0000029 VARIANCE : 0.0000000

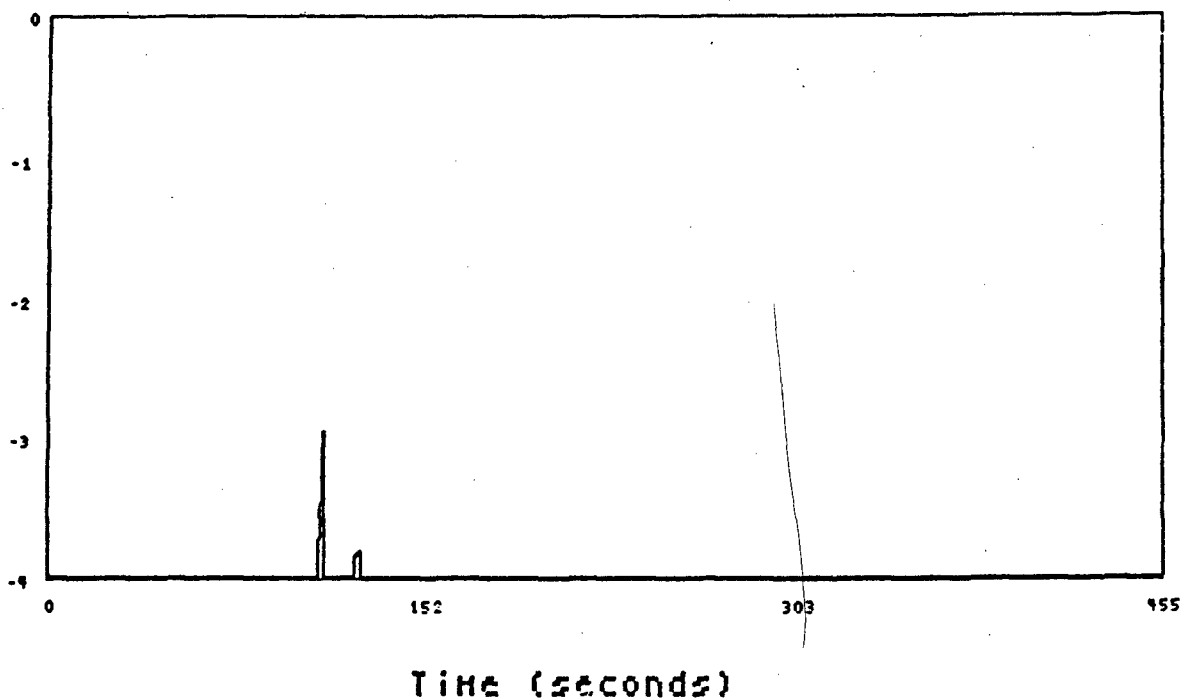
STANDARD DEVIATION: 0.0069400 SKEWNESS : 19.7206137

KURTOSIS :401.0689256

METEROLOGICAL DATA :

W_S(m/s)	W_D	T_air	T_water	STABILITY
4.4	309.2	5.5	5.6	NEUTRAL

LogH vs Time



**END
FILMED**

DATE:

4-93

DTIC