

N O T I C E

THIS DOCUMENT HAS BEEN REPRODUCED FROM
MICROFICHE. ALTHOUGH IT IS RECOGNIZED THAT
CERTAIN PORTIONS ARE ILLEGIBLE, IT IS BEING RELEASED
IN THE INTEREST OF MAKING AVAILABLE AS MUCH
INFORMATION AS POSSIBLE

"Made available under NASA contract with
Calspan Corporation for the purpose of
conducting research and development
Programs in the field of space technology
for any use made therefrom."

81-10091
CR-144089

CALSPAN ADVANCED TECHNOLOGY CENTER

APPLICATIONS OF HCMM SATELLITE DATA

Contract No. NAS5-24263

(81-10091) APPLICATIONS OF HCMM SATELLITE
DATA Quarterly Report, 23 May - 23 Aug.
1980 (Calspan Advanced Technology Center)
10 p HC A02/MF A01 CSCI 05B

N81-26515

Unclas
00091
G3/43

Twelfth Quarterly Report

5/23/80 - 8/23/80

Prepared for:

NASA Goddard Space Flight Center
Greenbelt, Maryland 20771

RECEIVED

SEP 25 1980
SIS/902.6

HCMM-006
Type II

A DIVISION OF CALSPAN CORPORATION

10000 WOODBURN ROAD, GREENBELT, MARYLAND 20771

Objectives:

The objectives of this investigation are to study the thermal properties of Great Lakes, Erie and Ontario, as they relate to water quality, lake hydrology and energy exchange; to study the urban heat island problem in selected areas adjacent to these lakes; and to refine techniques required to obtain accurate surface radiometric temperatures.

Problems:

No significant problems this reporting period.

Accomplishments:

Efforts this reporting period have been directed in all three major program directions and considerable advances were made in each area.

Satellite Sensor Calibration

The May 22, 1978 underflight data were radiometrically calibrated at several locations and surface water temperature measurements were made for several areas approximating the field of view of the HCMM sensor. The temperatures obtained from the radiometrically corrected imagery were then plotted against the apparent temperatures for these same locations obtained from the HCMM CCT's. Figure 1 contains an example of the values obtained near nine mile point on Lake Ontario. Figure 2 is a plot of the least squares fit between the surface and satellite observation for two areas approximately 100 miles apart. These results indicate the corrections needed for the satellite data at specific locations and will provide some of the input for development of a more generalized model for radiometric correction of HCMM data.

Thermal Bar Studies

The sensor calibration model described above will be used to correct HCMM data to provide detailed maps of thermal bar development in Lake Ontario. Figure 3 shows an uncorrected map of the observed isotherms generated from a HCMM CCT. Once the point corrections described above are finalized and limb functions incorporated for whole scene correction, actual surface temperature maps of the entire lake can be generated.

During the reporting period, Landsat CCT's covering portions of Lake Ontario for two dates during the thermal bar were received. The tapes contain data for all 4 MSS bands, and can provide information on water quality associated with the thermal bar. The two tapes are described in the updated project listing of CCT's provided herein as Table 1.

Canada Centre for Inland Waters (CCIW) provided a provisional listing of Lake Ontario data from its Great Lakes water quality monitoring program. The listing consists of data from 93 monitoring stations taken during the period May 8-12, 1978 and from 94 stations during June 5-9. A sample page for one of the monitoring stations is provided as Table 2. These supplementary data sources will be used to evaluate the effects of the thermal bar on water quality and the potential for satellite observation of the phenomena.

Landsat derived water quality signatures, particularly in large lakes, are often masked by variations in the intervening atmosphere. Initial investigations into monitoring and accounting for variations in the atmosphere across a portion of a Landsat image have been undertaken. The correlation of atmospheric effects between individual wavelengths is being investigated using Landsat coverage of Lake Ontario. The area chosen contains stratus clouds of varying density which permit the correlations to be developed.

Examination of the exposure levels within bands 4, 5, and 7 indicate that the effects of variable cloud cover on the three bands is linearly correlated as shown in Figure 4. Therefore, if the atmospheric effects due to cloud cover or haze can be identified in one band, the corresponding effects in the other bands can be predicted. Since turbidity has only a small effect on the infrared reflectance of water, water is characterized by a relatively constant reflectance level within band 7 imagery. Variations in the atmospheric component of exposure over water bodies can therefore be monitored easily within this band. Atmospheric effects can then be predicted for bands 4 and 5 and removed pixel by pixel based on the information obtained from band 7. Once the variable atmospheric effects have been removed from the band 4 and band 5 imagery, the variations in exposure due to water quality (visible in bands 4 and 5) can be determined.

Heat Island Phenomena

Thermal patterns of several urban areas have been generated from HCMM tapes and scaled to corresponding land use and topographic maps. The resulting map overlays are being interpreted in terms of land use influence on the extent and severity of heat island indicators.

Significant Results

HCMM derived data were successfully cross-calibrated using under-flight data. The sensor calibration model provides a foundation for development of a refined model for radiometric correction of HCMM data.

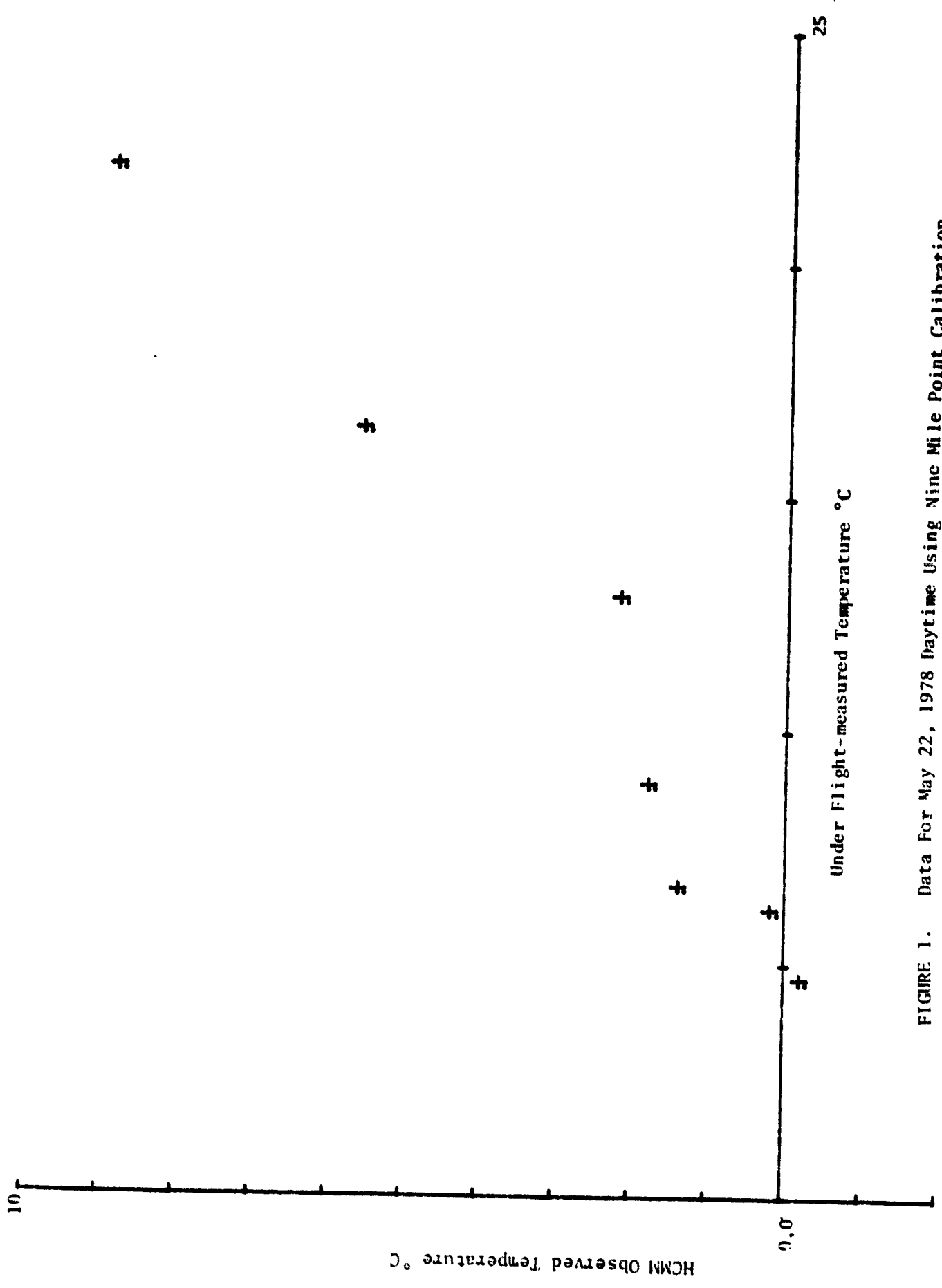


FIGURE 1. Data For May 22, 1978 Daytime Using Nine Mile Point Calibration

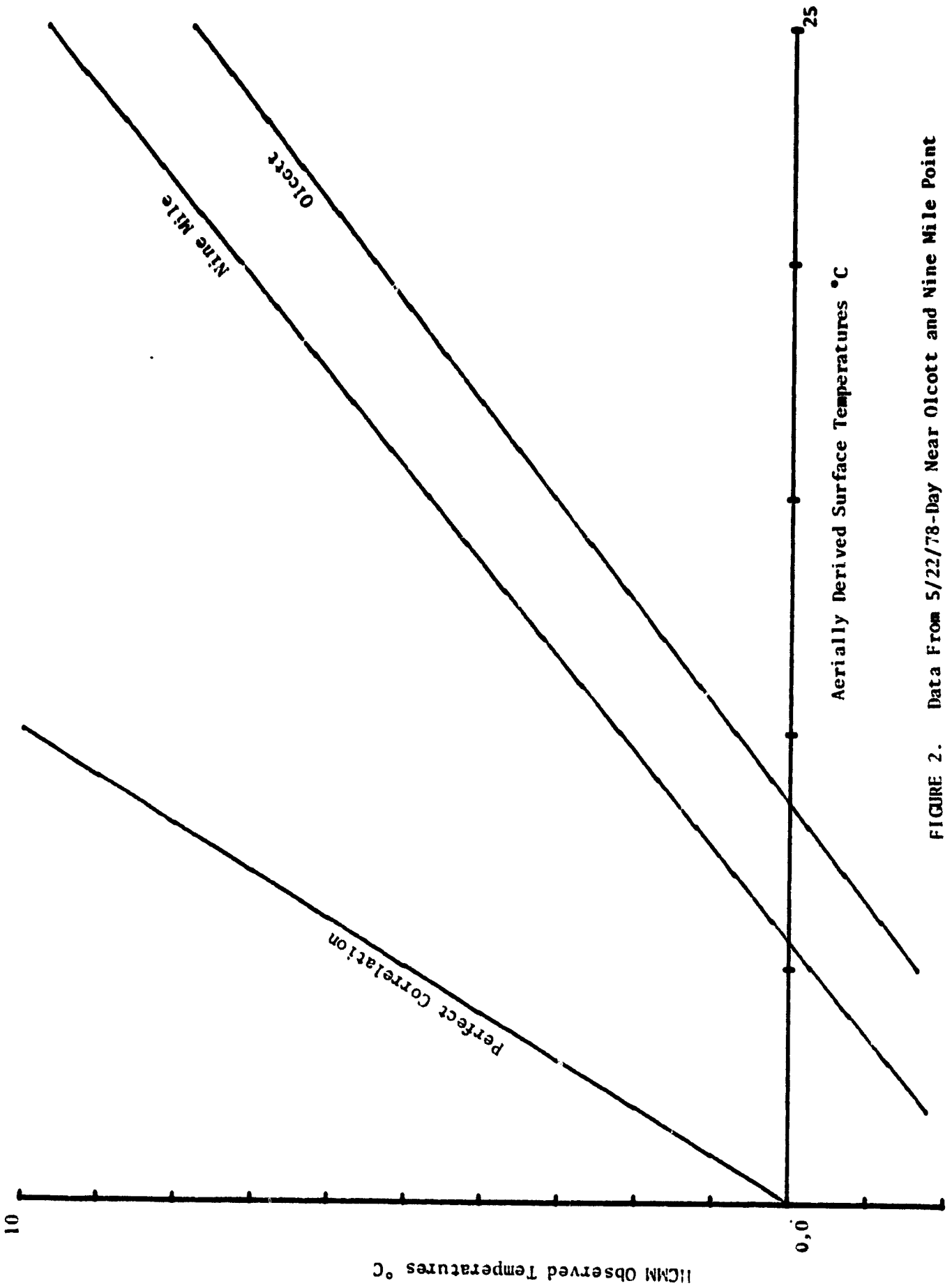


FIGURE 2. Data From 5/22/78-Day Near Olcott and Nine Mile Point

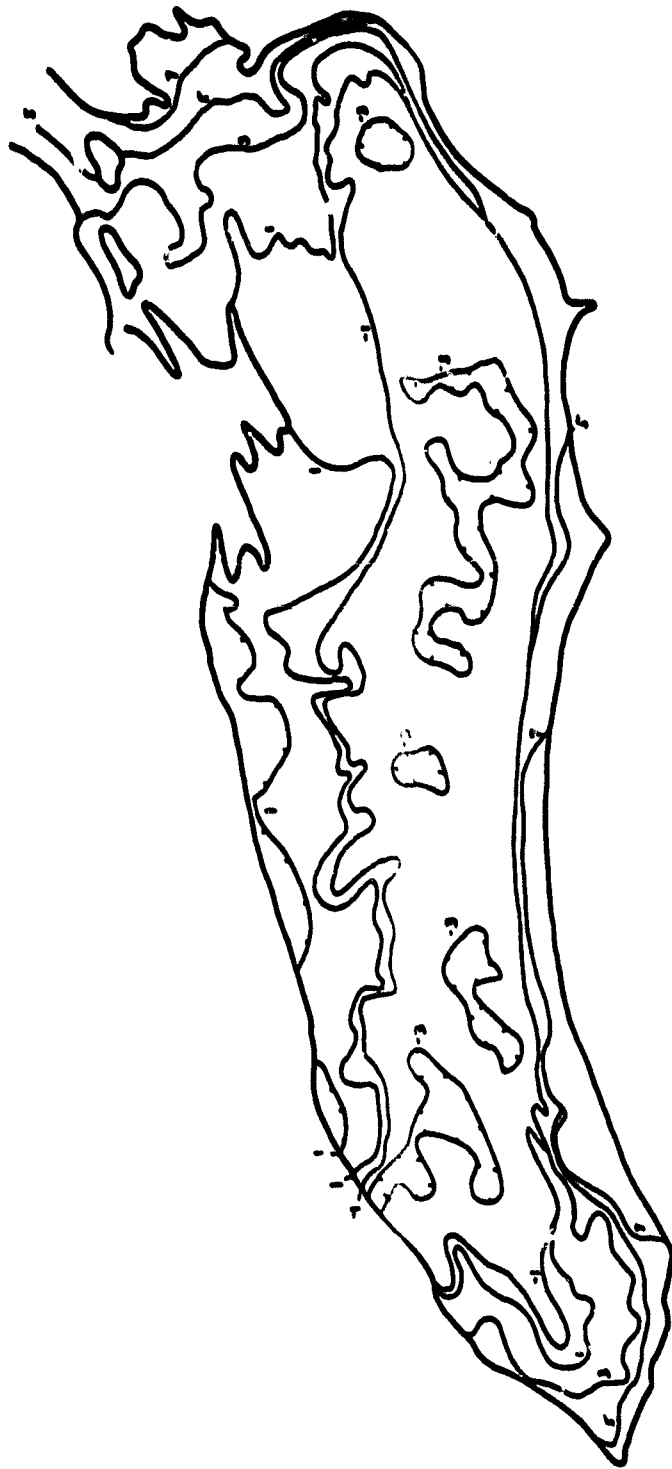


FIGURE 3

Apparent Radiometric Temperature ($^{\circ}\text{C}$)

Lake Ontario - 6 June 1978

243 Night IR

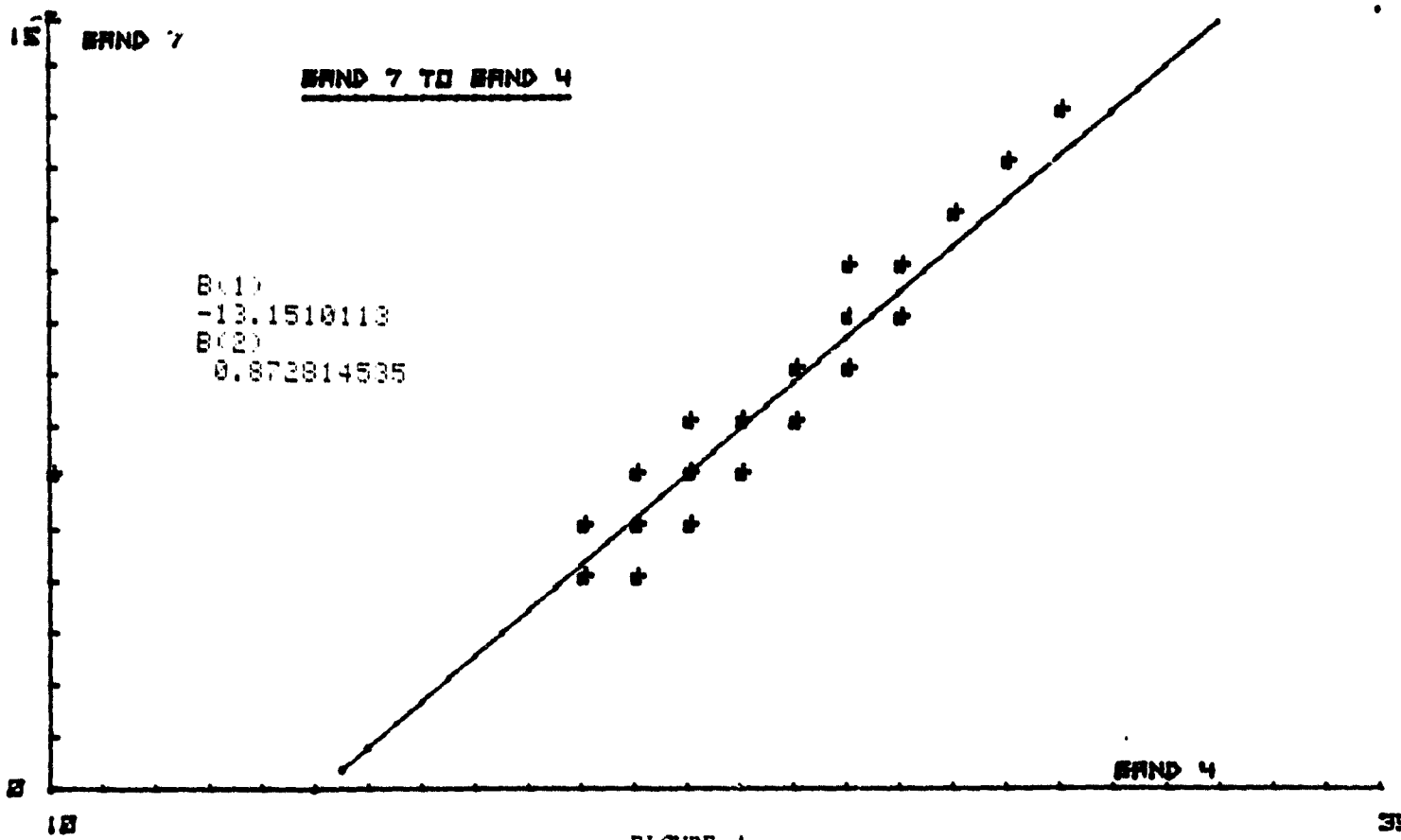
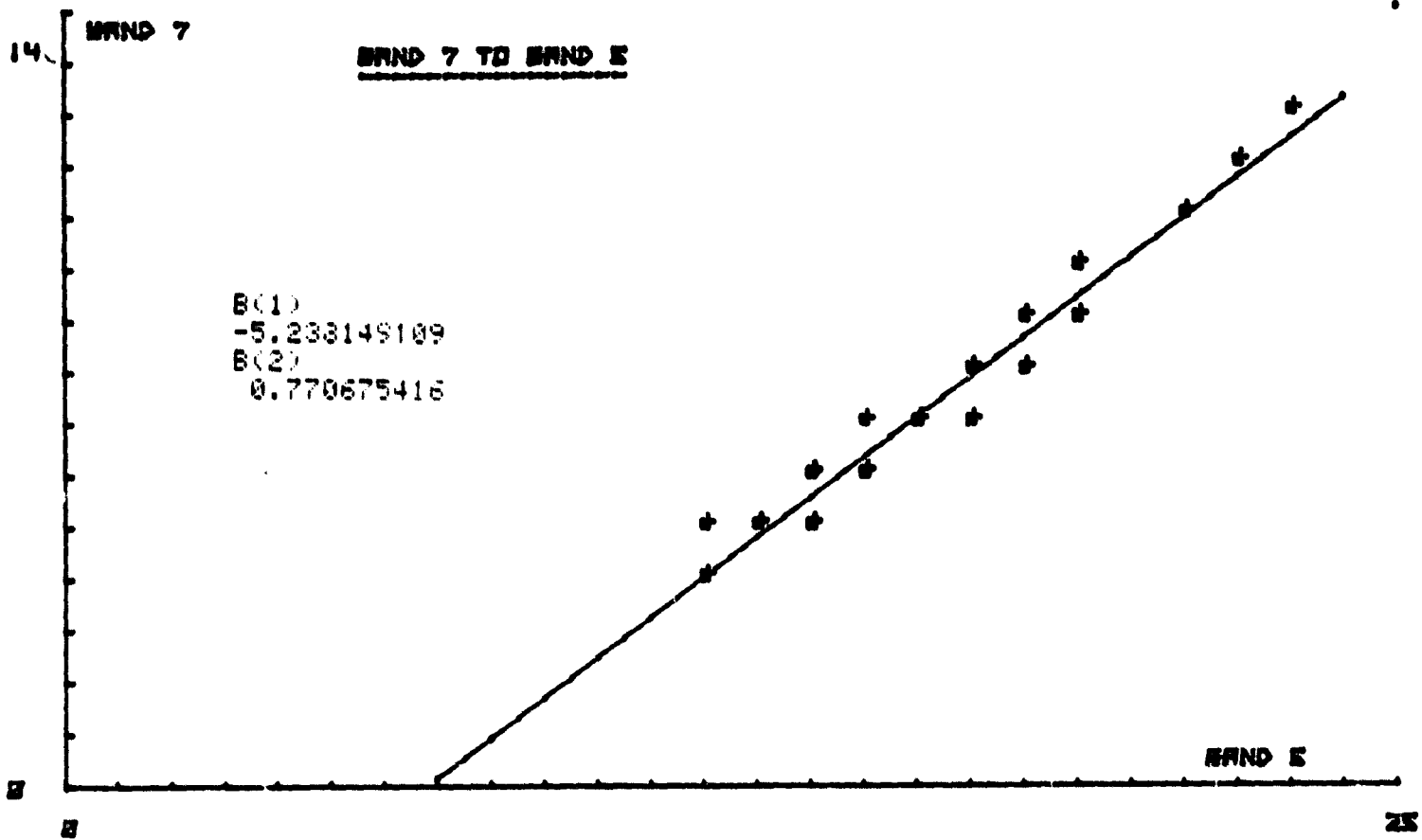


FIGURE 4

TABLE 1

LISTING OF CCT'S FOR GREAT CAPACITY TAPPING MISSION (HMM) PROGRAM
(Includes Registered Tapes)

<u>Tape Inventory Control No.</u>	<u>Scene Ident. No.</u>	<u>Imagery Description</u>	<u>Targets Covered</u>
RP 6912H	AA0026 18490-1 " " -2	22 May '78 Day/VIS (027) " " Day/IR (028)	Buffalo, Rochester, Syracuse, L. Ontario
RS 0478A	AA0026 18500-1 " " -2	22 May '78 Day/VIS (025) " " Day/IR (026)	Lake Ontario
RE 6260G	AA0190 18020-1 " " -2	22 May '78 Day/VIS (030) " " Day/IR (030)	All Targets Clear (some probably reformated from RP 6912H to include all targets in one scene - recommend checking tape lead coordinates to confirm this)
RI 8303I	AA0110 18140-1 " " -2	2 Nov. '78 Day/VIS (003) " " Day/IR (004)	Rochester, Syracuse, E. 2/3 L. Ontario
RP 6118E	AA0041 07360-3	14 Aug. '78 Day/VIS (105) " " Day/IR (106)	Rochester, Syracuse, L. Ontario
PM 2014K	AA0041 07360-3	6 June '78 Night/IR (243)	All Targets Clear (some apparently requires two tapes - see RP 6118E)
QL 5109F	AA0041 18310-1	6 June '78 Night/IR (243)	All Targets Clear (some apparently requires two tapes - see RP 6118E)
RT 1628A	AA0041 18310-2	6 June '78 Day/VIS (011)	All Targets Clear (transparency shows interference line running through Rochester and southern shore of Lake Ontario near Rochester)
CL 0769H	AA0078 07250-3	6 June '78 Day/IR (017)	All Targets Clear
RM 4963C	AA0153 07200-3	13 July '78 Night/IR (024)	All Targets Clear
SD 1909B	AA0153 18160-1	26 September '78 Night/IR	All Targets Clear (recommend checking tape lead to verify description)
SD 1915F	AA0153 18160-2	26 September '78 Day/VIS (050)	All Targets Clear
SD 1547K	AA0153 07160-6	26 September '78 Day/IR (051)	All Targets Clear
	AA0153 07160-7	26 September '78 Day/VIS Elongated	All Targets Clear
	AA0153 07160-8	26 September '78 Day/IR Elongated	All Targets Clear
	AA0153 07160-8	26 September '78 Night/IR Elongated	All Targets Clear
	83010115175X0	14 June '78 Path 18 Row 36	Buff., Roch., L. Ont. from Niagara-on-the-Lake to Sodus Bay - very clear. Close to June 6th underflight.
	83008215120X0	26 May '78 Path 17 Row 30	Roch., Syr., Finger Lakes, L. Ont. from Braddock Bay to Sandy Pond. Close to May 22nd underflight.

ORIGINAL PAGE IS
OF POOR QUALITY

TABLE 2

DATE ACCESED 27/06/90

PAGE 51

CCIW WATER QUALITY MONITORING PROGRAM

CRUISE NUMBER 78-22-007
VESSEL NAME LIMNOS

LAKE ONTARIO
STARTING DATE 05/06/1978

C-REF-11C 007	LAT 44-41-54N	YEAR 1978	NO. OF PHS 6
CONS. NO 049	LON 076-24-50W	MONTH 06	SOUNDING 22.0
COUNTRY 13	WIND 135W	DAY 07	WT TYPE ELEFC
INSTITUTE 22	WIND SP 14 KT	TIME 1642	PERM. STA. NO. 089
AIR TEMP 12.2			

BATHY THERMOGRAPHY:

DEPTH	TEMP.	0.0	5.0	9.0	14.0	20.0	25.0
0.0	4.2	4.2	4.1	4.0	3.9	3.8	3.8
1.0							
2.0							
3.0							
4.0							
5.0							
6.0							
7.0							
8.0							
9.0							
10.0							
11.0							
12.0							
13.0							
14.0							
15.0							
16.0							
17.0							
18.0							
19.0							
20.0							
21.0							
22.0							
23.0							
24.0							
25.0							
26.0							
27.0							
28.0							
29.0							
30.0							
31.0							
32.0							
33.0							
34.0							
35.0							
36.0							
37.0							
38.0							
39.0							
40.0							
41.0							
42.0							
43.0							
44.0							
45.0							
46.0							
47.0							
48.0							
49.0							
50.0							
51.0							
52.0							
53.0							
54.0							
55.0							
56.0							
57.0							
58.0							
59.0							
60.0							
61.0							
62.0							
63.0							
64.0							
65.0							
66.0							
67.0							
68.0							
69.0							
70.0							
71.0							
72.0							
73.0							
74.0							
75.0							
76.0							
77.0							
78.0							
79.0							
80.0							
81.0							
82.0							
83.0							
84.0							
85.0							
86.0							
87.0							
88.0							
89.0							
90.0							
91.0							
92.0							
93.0							
94.0							
95.0							
96.0							
97.0							
98.0							
99.0							
100.0							