USER'S MANUAL

EROSION DUE TO HIGH FREQUENCY STORM EVENTS
(18 Selected Coastal Counties of Florida)

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Prepared For:

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1 INTRODUCTION

This User's Manual presents a method of calculating dune erosion due to high frequency storm events for the 24 selected coastal counties of Florida. High frequency is defined herein as having return periods less than or equal to 25 years. Computations are performed for return periods of 25 years, 15 years, 10 years, and 5 years. The background associated with this methodology and the erosion model (CCCL) used are described in "High Frequency Storm Hydrograph Development and Erosion Model Calibration" (1993).

2 THE CCCLa EROSION MODEL

2.1 DESCRIPTION OF CCCLa

The CCCLa erosion model is an application version of the CCCLa erosion model, the erosion model which DEP uses, however the current CCCLa erosion model has undergone some modifications in the course of this study period. The primary difference between the CCCL and the CCCLa models is in the amount of input data required to run the two erosion models. For both models at least 5 parameters must be specified, namely: duration, storm surge height, astronomical tide, wave height and the scale parameter "A" associated with the survey profile.

To run the CCCL erosion model one needs to supply time series data of storm surge heights, astronomical tidal amplitudes and wave heights for each time step for the duration of the erosion model simulation. To run the CCCLa erosion model, mean values for each of the time series data have been determined for the East Coast and the West Coast of Florida such that running the CCCLa erosion model with the mean values will be equivalent to running the CCCL erosion model. Mean values for the time series data for the Panhandle Coast of Florida have been presented here, except for the mean breaking wave heights which are determined by running the equivalent erosion model CCCLa iteratively given the erosion distances computed from running the CCCL model for at least the 7 severest storm events. Analysis of the erosion distances computed at or above the average survey profile berm elevations indicate little or no erosion considering the present high frequency events for the Panhandle Coast of Florida. Thus breaking wave heights could not be determined above for the Panhandle Coast of Florida. In the CCCLa model, an erosion factor of 1.0 is used.

2.2 INPUT DATA

All the input parameters required to run the CCCla erosion model have been determined for the East Coast and the West Coast of Florida from the analysis of the field data available to compute erosion distances for a given profile data, for the high frequency return periods. Erosion distances computed for counties: Nassau, Duval, St. Johns, Flagler are at 8 feet elevation, and for counties: Volusia, Brevard, Indian River, St. Lucie, Martin, Palm Beach, Broward and Dade are at 7 feet elevation. Erosion distances computed for counties: Gulf, Franklin, Pinellas, Manatee, Sarasota, Charlotte, Lee and Collier are at 5 feet elevation. (Erosion distances computed for counties: Escambia, Okaloosa, Walton and Bay are at 6 feet elevation.) The scale parameter "A" is computed using the "least squares fit" method using the survey profile data up to the water depth of 12 feet.

The only required data to run the CCCLa erosion model is the survey profile data with offshore survey depths to at least 12 feet, in the formerly DNR data format, that is, it should have a header card with the first 3 characters of the country name in capitals starting column 1, followed by a series of profile data in the DNR format. Next the file containing the profile data must be copied to SURVEY.DAT.

For reference, the list of abbreviations used for the counties on the east coast of Florida are:

NAS, DUV, STJ, FLA

VOL, BRE, IND, STL, MAR, PAL, BRO, DAD

PIN, MAN, SAR, CHA,LEE, COL
GUL, FRA

ESC, OKA, WAL, BAY

Some of the parameters set in the CCCLa erosion model are: time step for erosion computation, dt=0.05 hour, erosion contour level, clev=8 feet for Nassau, Duval, St Johns and Flagler counties; clev=7 feet for counties between Volusia and Dade; clev=6 feet for counties between Escambia and Bay; clev=5 feet for Gulf, Franklin and counties between Pinellas and Collier, inclusive, and the duration of model run,dero=18.6 hours for east and west coast of Florida, and dero=12.4 hours for the Panhandle Coast of Florida.

2.3 DATA FILES

There are two files provided for each of the 12 counties on the east coast of Florida, one has the following data: mean astronomical tidal amplitude, and total mean peak storm surge and breaking wave height for the high frequency return periods; the other file has the scale parameter "A" associated with the survey profile. These data are referenced to DNR range monuments of the respective counties such that the values required to run the erosion model CCCLa for a given profile will be interpolated knowing the county and the monument range number.

2.4 PLOTS OF PARAMETER DATA

After smoothing the original computed parameters critical data points have been selected to define the smooth curves for these plots.

a. Figure 1 shows the distribution of the mean tidal amplitude for the east coast of Florida.

b. Figure 2 shows the distribution of the total mean peak storm surge for the east coast of Florida.

c. Figure 3 shows the distribution of the breaking wave height for the east coast of Florida.

d. Figure 4 shows the distribution for the east coast of Florida of the scale parameter "A" associated with the survey profile.

e. Figure 5 shows the distribution of the mean tidal amplitude for the west coast of Florida.

f. Figure 6 shows the distribution of the total mean peak storm surge for the west coast of Florida.

g. Figure 7 shows the distribution of the breaking wave height for the west coast of Florida.

h. Figure 8 shows the distribution for the west coast of Florida of the scale parameter "A" associated with the survey profile.

i. Figure 9 shows the distribution of the mean tidal amplitude for the Panhandle coast of Florida.

j. Figure 10 shows the distribution of the total mean peak storm surge for the Panhandle coast of Florida.

k. Figure 4 shows the distribution for the east coast of Florida of the scale parameter "A" associated with the survey profile.

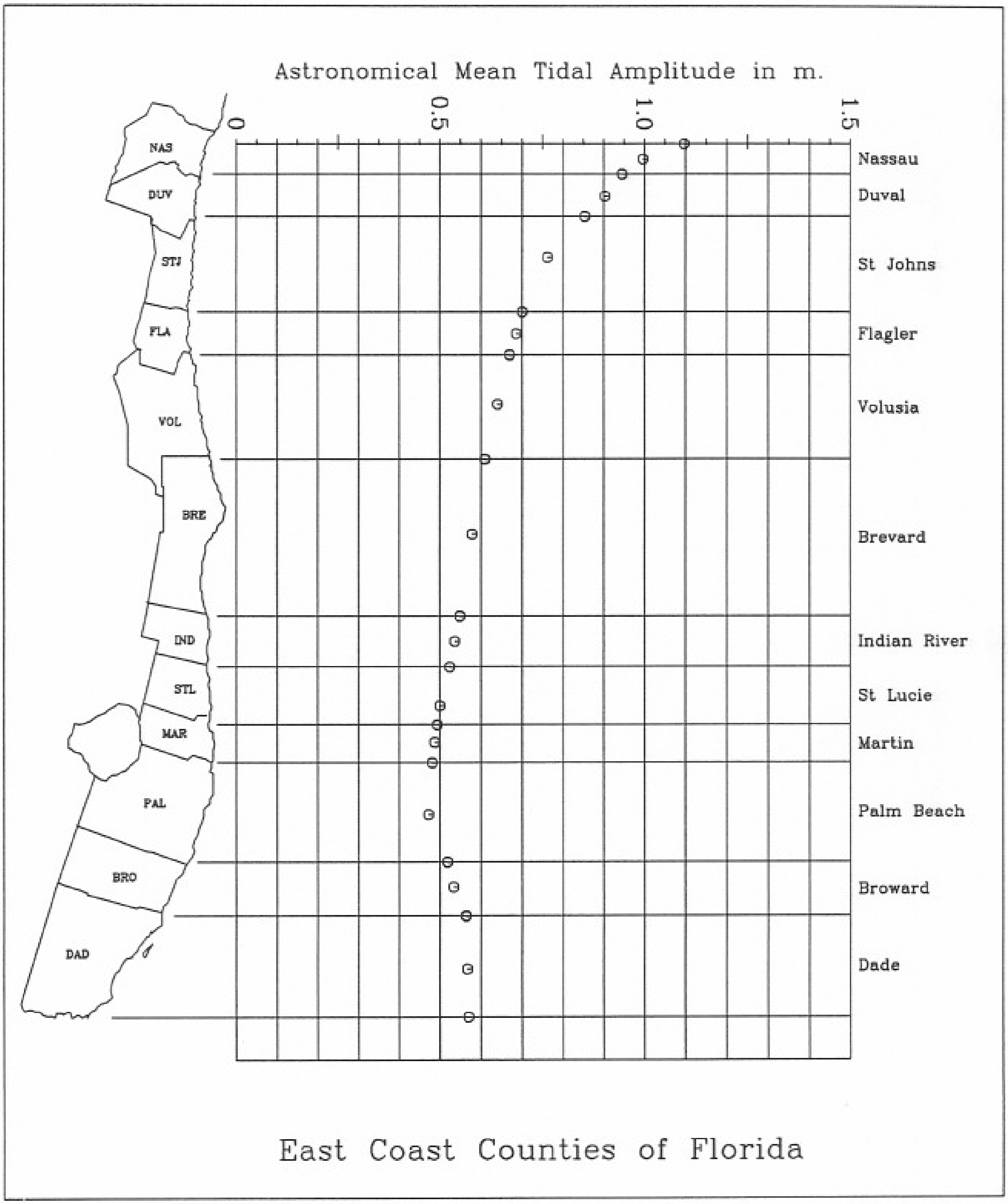

Figure 1. Variation of Mean Astronomical Tidal Amplitude Along the East Coast of Florida.

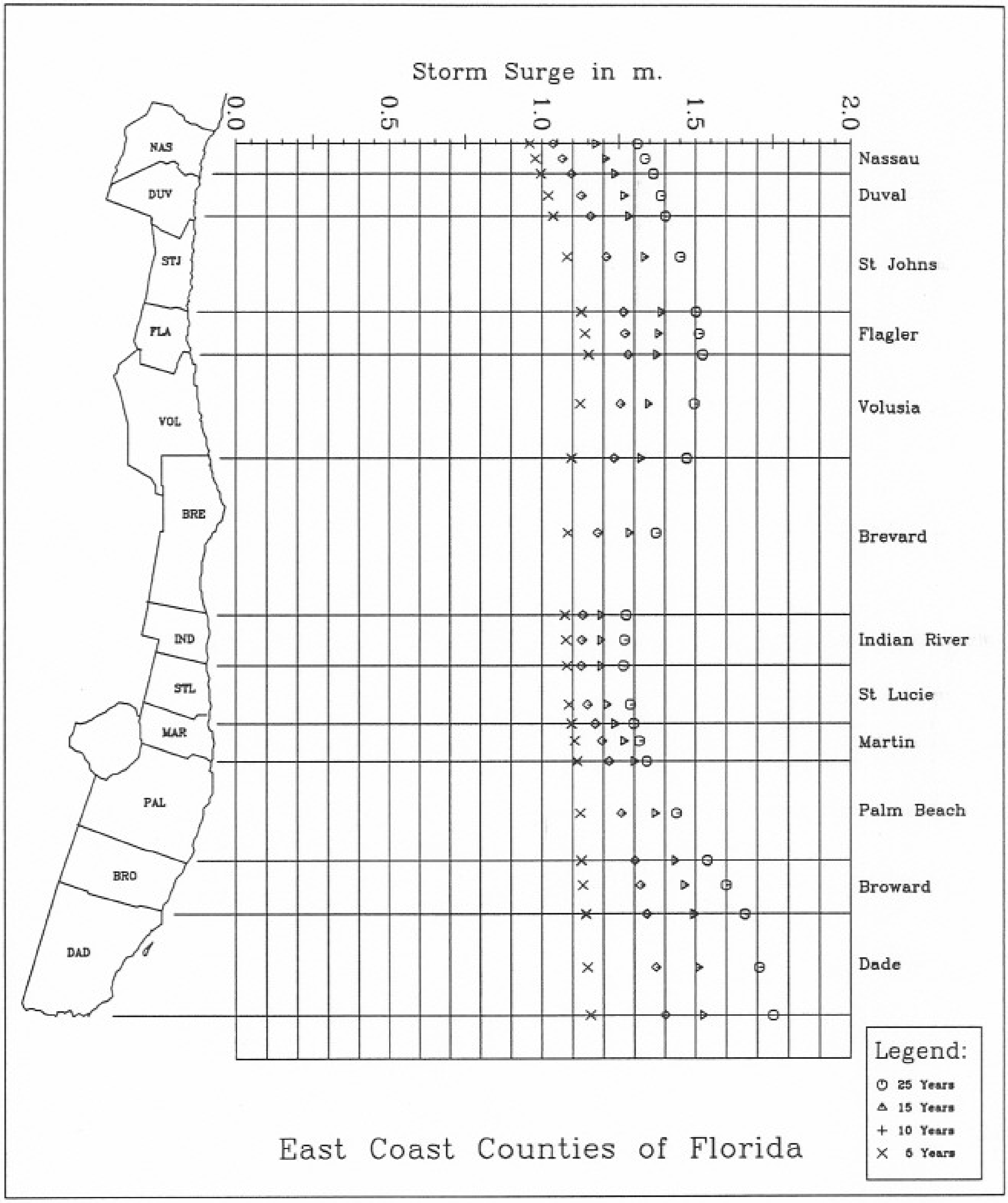

Figure 2. Variation of Equivalent Storm Surge with Return Period Along the East Coast of Florida.

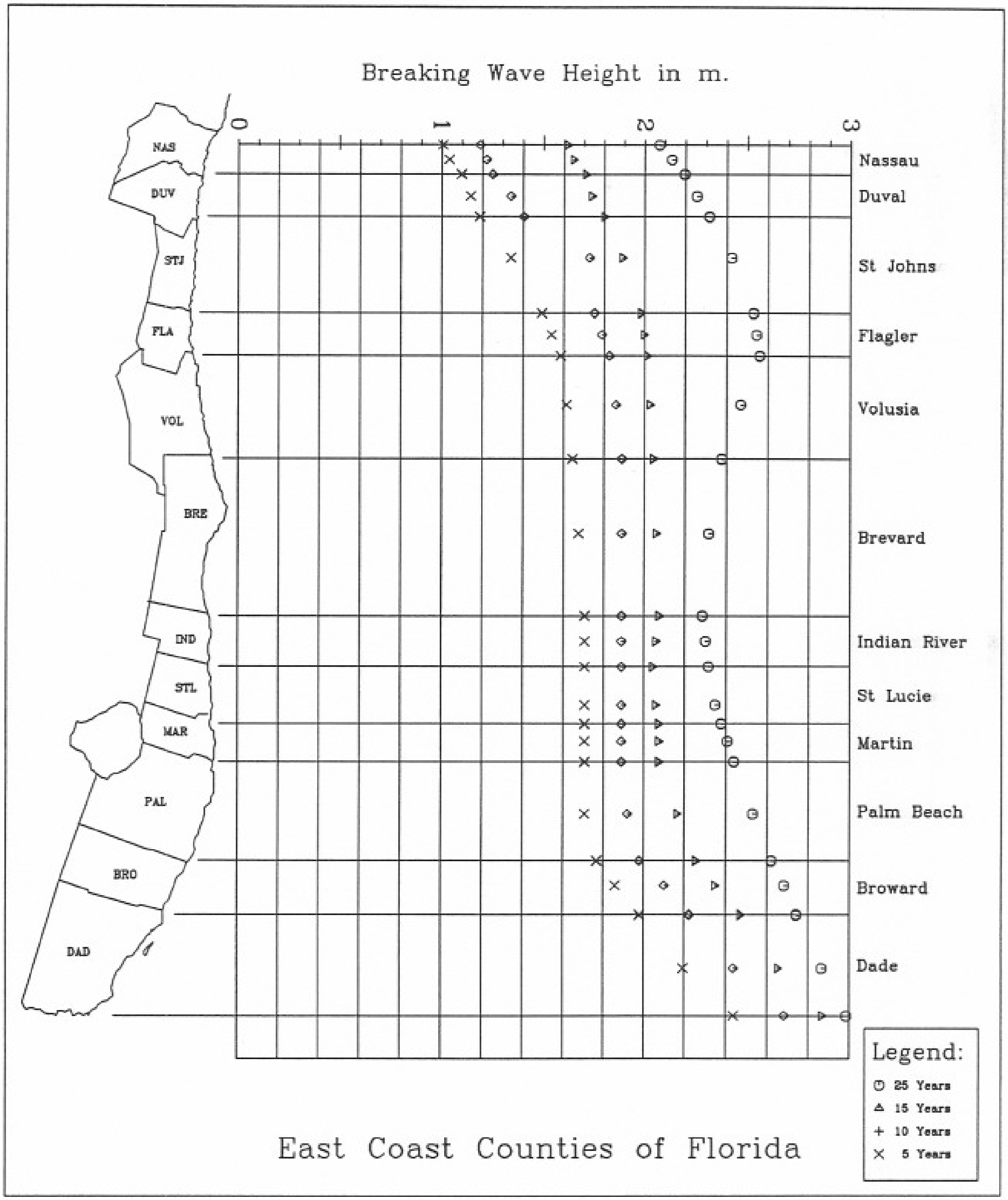

Figure 3. Variation of Equivalent Breaking Wave Height with Return Period Along the East Coast of Florida.

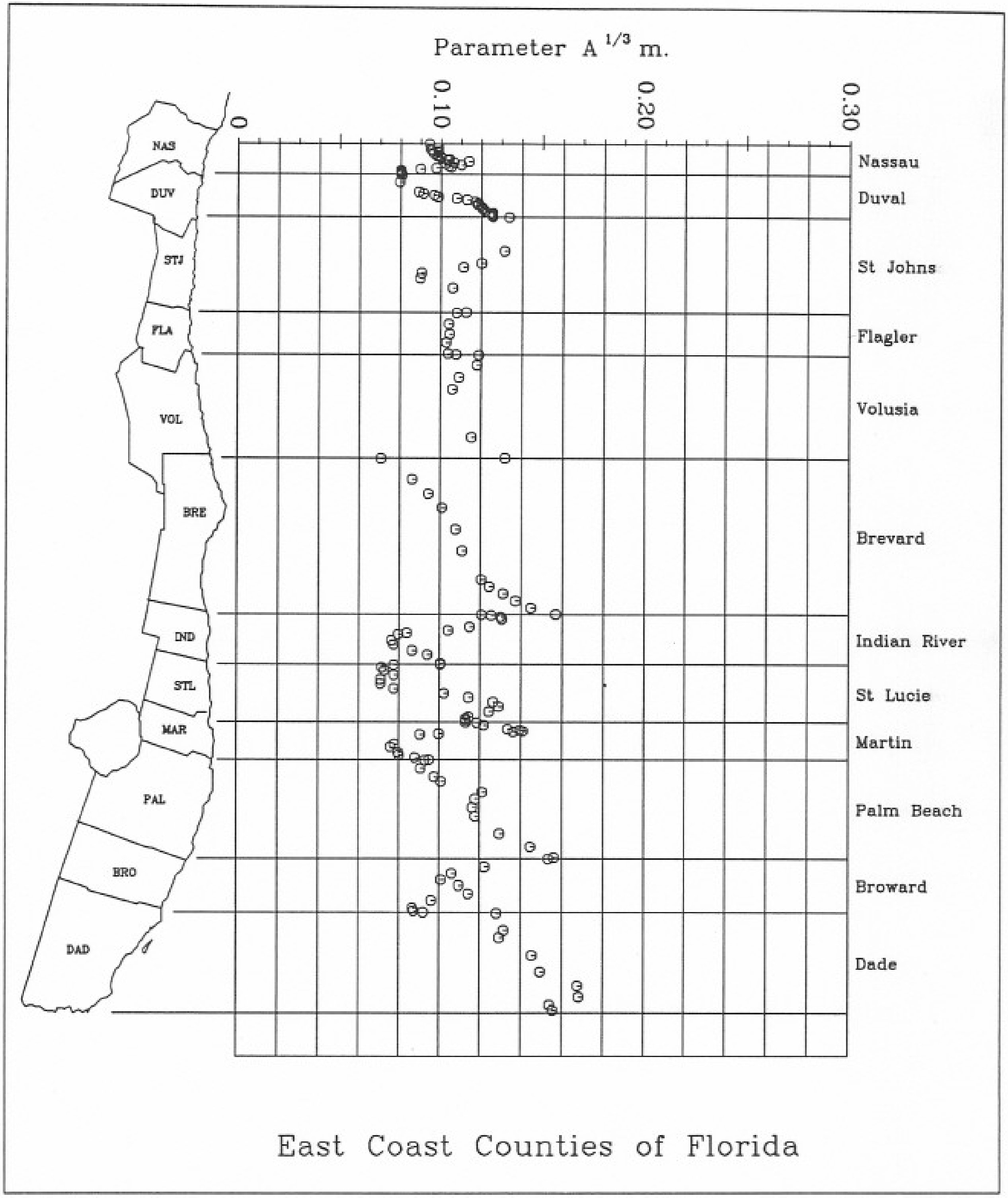

Figure 4. Variation of Scale Parameter "A" Along the East Coast of Florida.

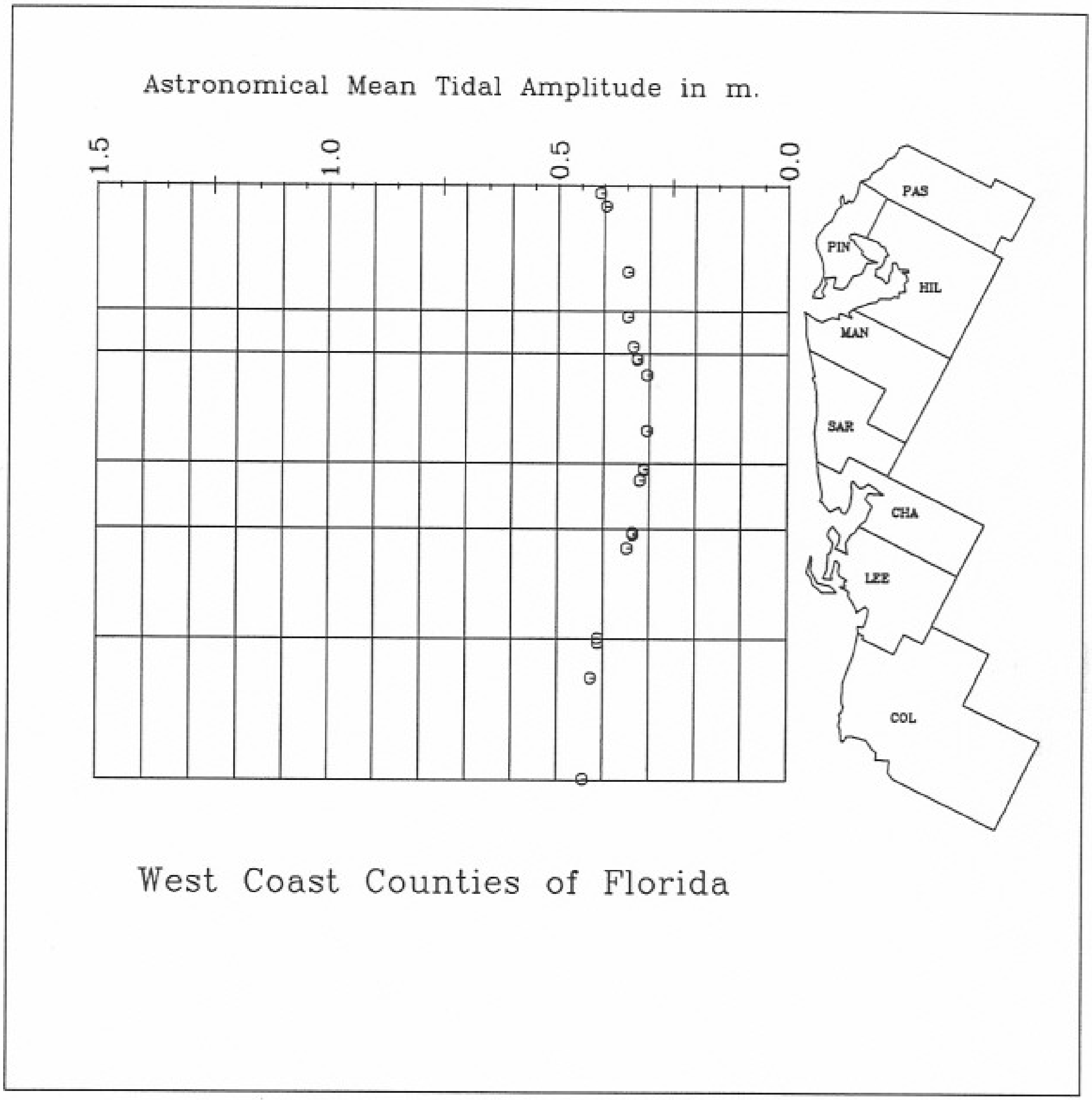

Figure 5. Variation of Mean Astronomical Tidal Amplitude Along the West Coast of Florida.

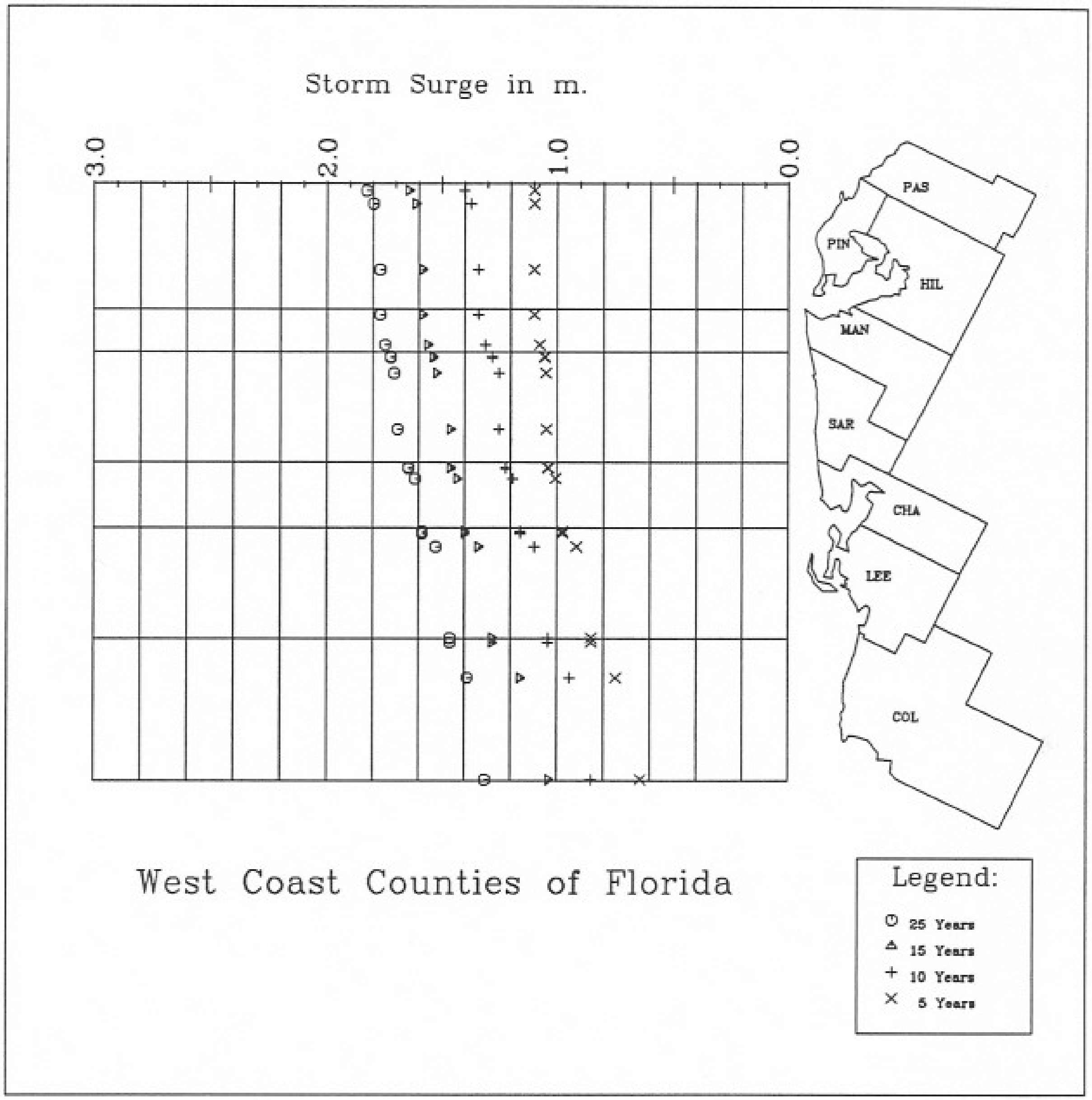

Figure 6. Variation of Equivalent Storm Surge With Return Period Along the West Coast of Florida.

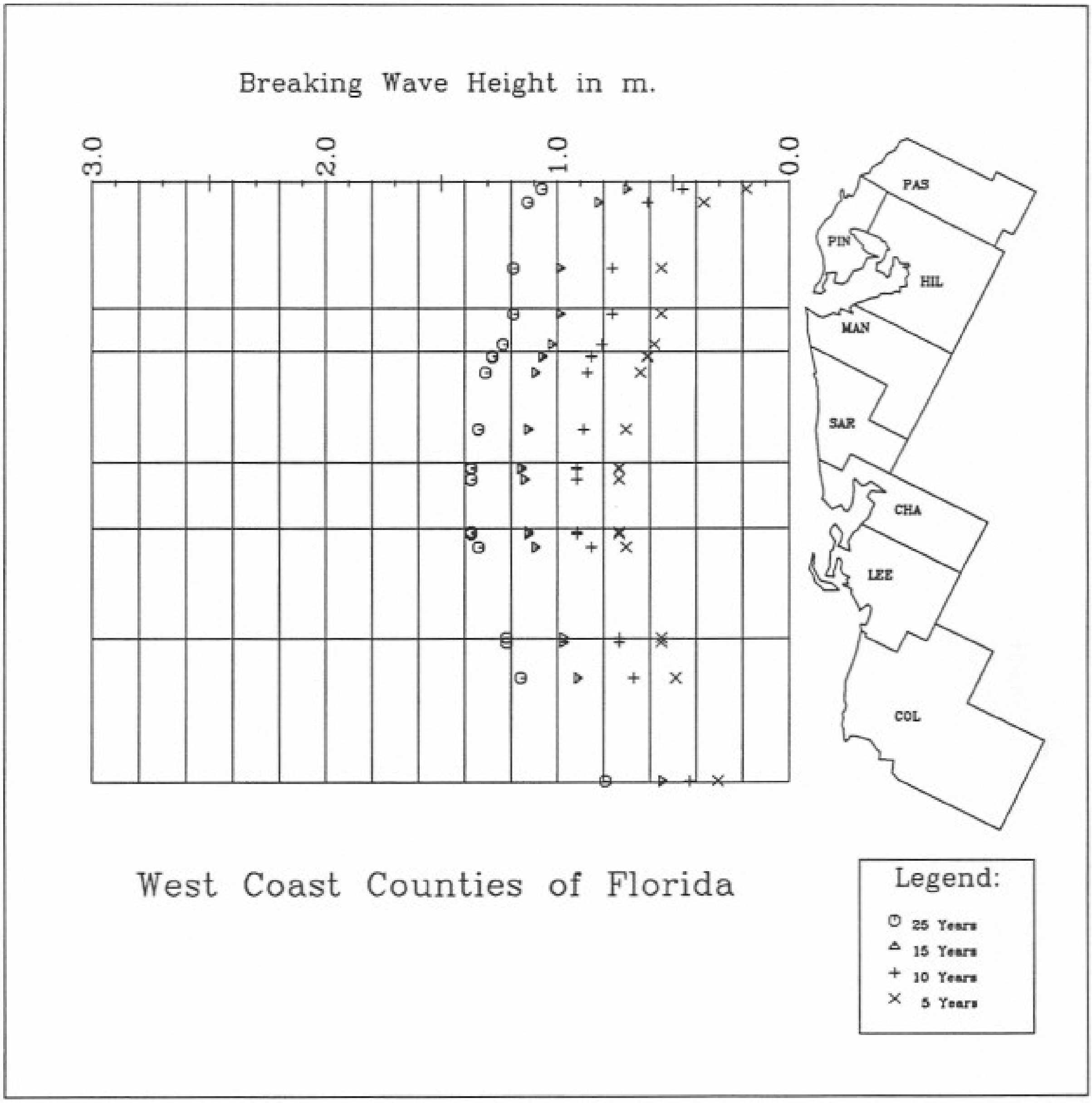

Figure 7. Variation of Equivalent Breaking Wave Height With Return Period Along the East Coast of Florida.

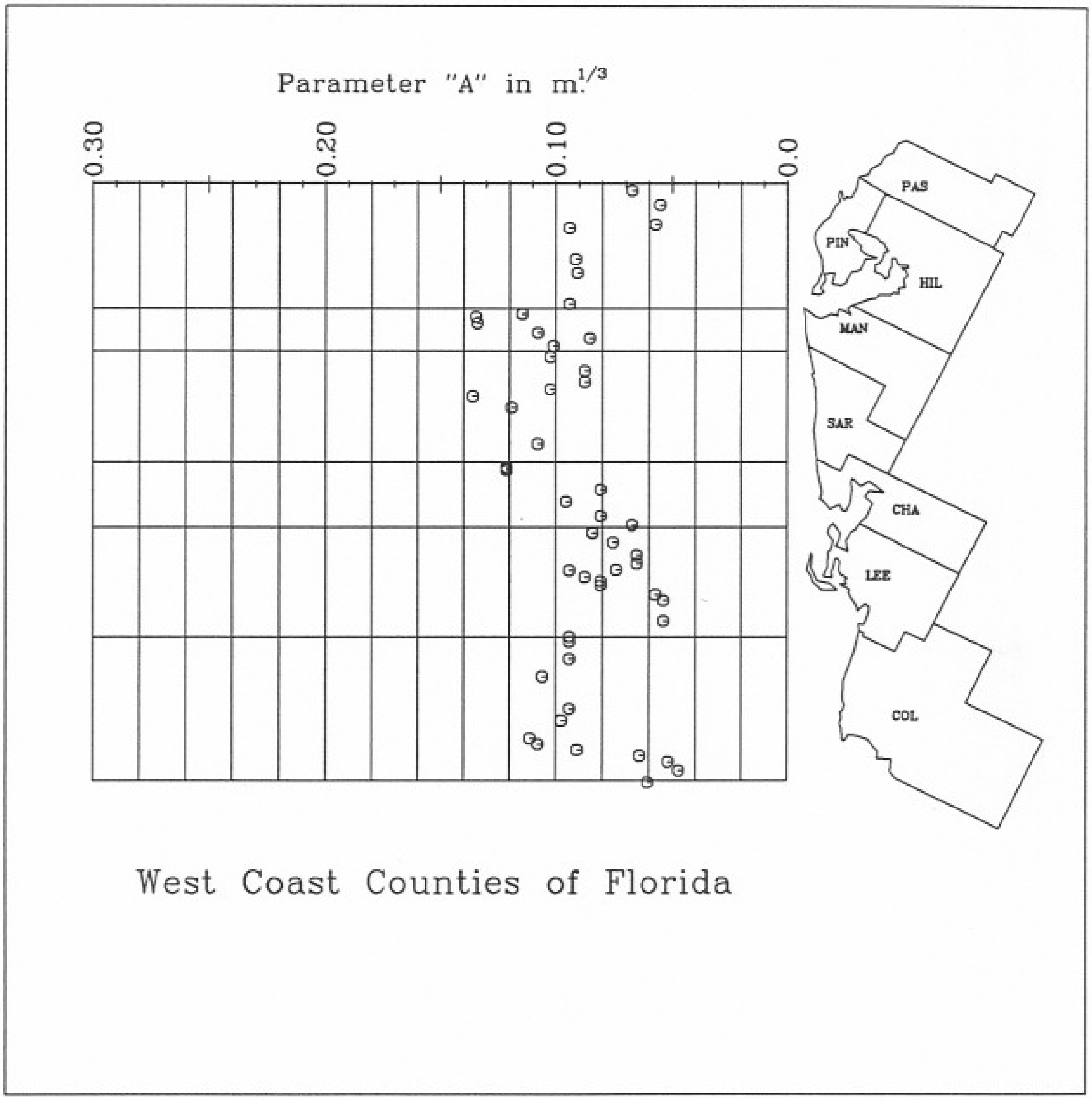

Figure 8. Variation of Scale Parameter "A", Along the West Coast of Florida.

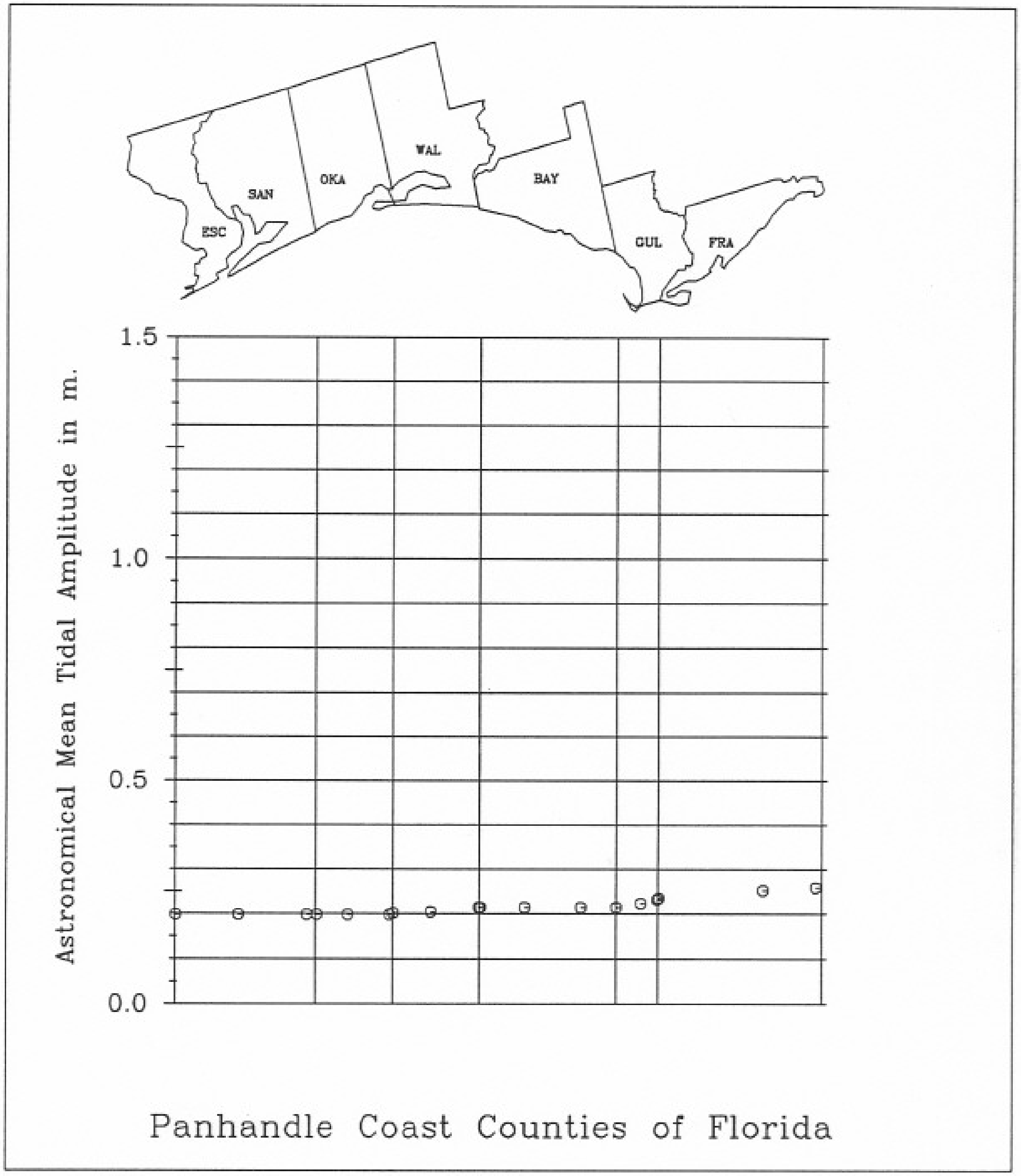

Figure 9. Variation of Mean Astronomical Tidal Amplitude Along the Panhandle Coast of Florida.

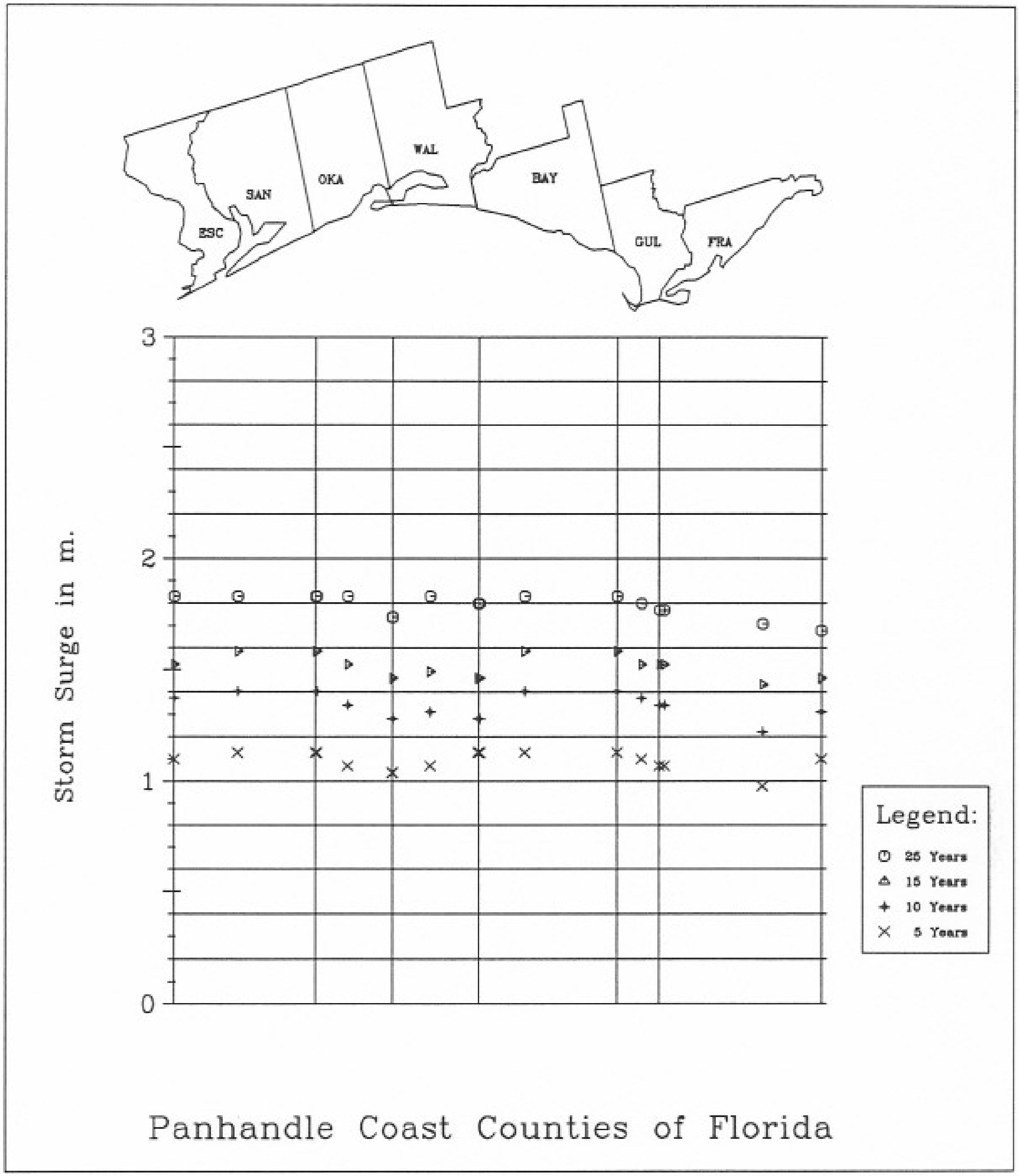

Figure 10. Variation of Storm Surge with Return Period Along the Panhandle Coast of Florida.

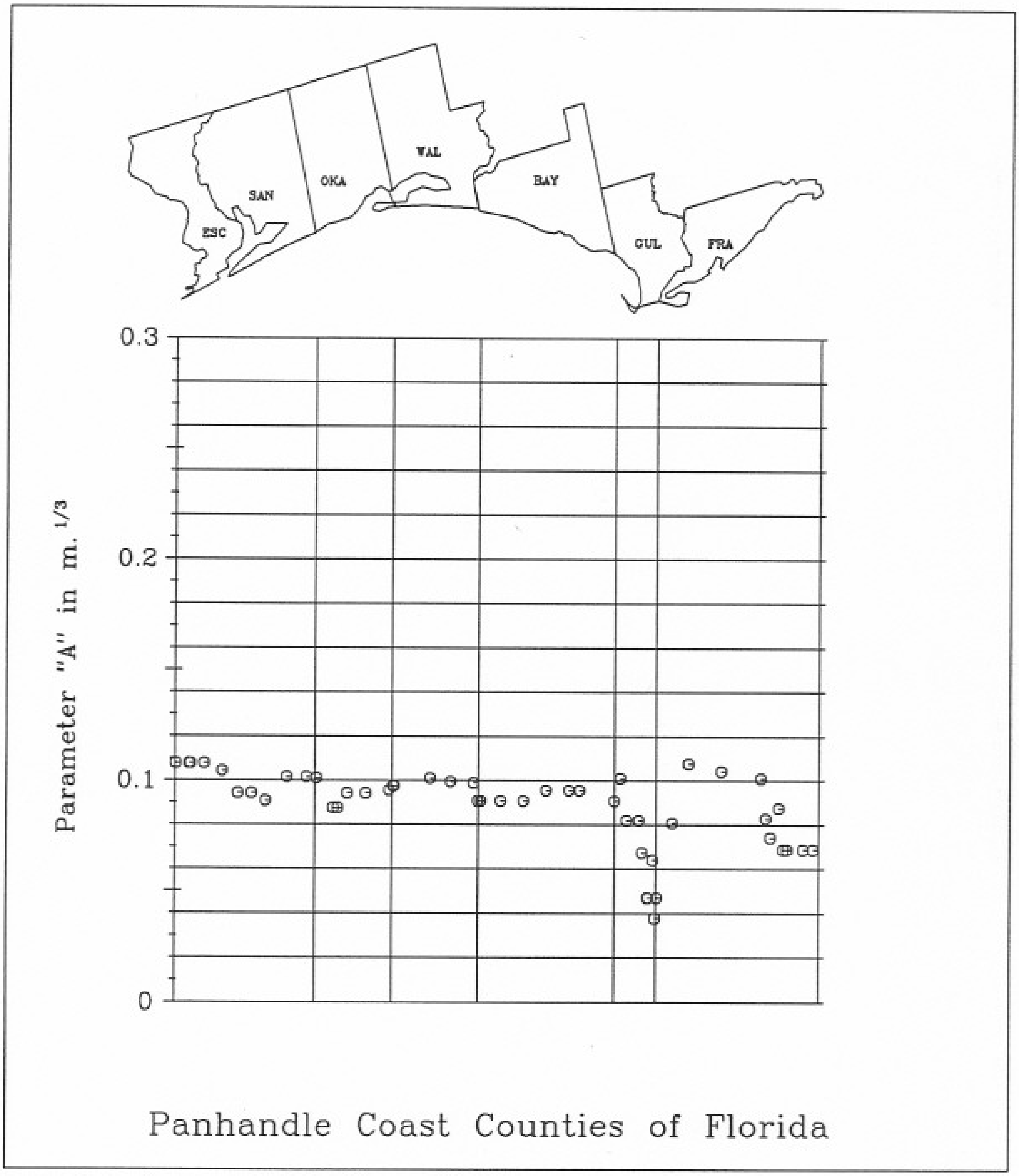

Figure 11. Variation of Scale Parameter "A", Along the Panhandle Coast of Florida.

3 SAMPLE RUN

3.1 Input Survey Profile File: SURVEY.DAT
-(The data are in feet.)

```
FLAGLER         JUL-AUG 72      CONTROL LINE      (R-35 # POINTS?)
R-1      MAY1972 00 1940066.310  432163.110  70.0014.69
         25JUL72 06AUG72  35  0 17 18

  -100.0    8.32  -50.0   10.30    0.0   14.51   31.0   17.38   43.0   16.90
    50.0   14.53   69.0   10.97  100.0    8.77  150.0    1.21  200.0   -3.49
   250.0   -4.13  300.0   -4.44  350.0   -5.77  400.0   -6.14  450.0   -4.71
   500.0   -5.59  550.0   -8.29  704.0  -11.82  777.5  -12.82  851.0  -12.22
   989.0  -10.62 1133.0  -11.42 1289.0  -14.12 1436.0  -17.42 1577.0  -20.72
  1727.0  -22.62 1868.0  -24.32 2012.0  -26.22 2162.0  -28.02 2297.0  -29.42
  2432.0  -31.32 2627.0  -33.42 2777.0  -35.32 2927.0  -36.32 3062.0  -37.72
R-2      MAY1972 00 1939146.500  432510.050  70.0013.81
         25JUL72          11  0 11  0

   -50.0   14.15    0.0   13.79   26.0   16.80   50.0   12.75   80.0   10.49
   100.0    7.23  150.0    0.80  200.0   -4.77  250.0   -6.40  300.0   -7.41
   350.0   -6.31
R-3      MAY1972 00 1938183.290  432862.150  70.0014.80
         25JUL72 06AUG72  38  0 16 22

   -50.0   12.84    0.0   14.47   31.0   15.60   50.0   12.97   53.0   11.57
    68.0    8.48   73.0    4.75  100.0    0.54  150.0   -2.29  200.0   -4.07
   250.0   -4.93  300.0   -5.53  350.0   -5.06  400.0   -4.67  450.0   -5.19
   500.0   -7.52  509.0   -7.53  641.0  -11.33  716.0  -12.93  767.0  -13.63
   881.0  -11.73 1016.0  -10.63 1133.0  -12.03 1265.0  -14.83 1388.0  -17.73
  1526.0  -20.53 1652.0  -22.83 1766.0  -25.03 1907.0  -26.73 2027.0  -28.53
  2162.0  -30.53 2282.0  -32.03 2372.0  -33.23 2507.0  -33.63 2672.0  -34.53
  2792.0  -35.03 2927.0  -37.23 3047.0  -35.53
R-4      MAY1972 00 1937263.450  433216.890  70.0012.81
         25JUL72          10  0 10  0

   -50.0   11.53    0.0   12.57   34.0   13.59   50.0   11.16   58.0    8.76
   100.0    5.19  150.0   -0.56  200.0   -3.76  250.0   -6.34  300.0   -6.09
R-5      MAY1972 00 1936385.690  433570.290  70.0013.69
         25JUL72          10  0 10  0

  -100.0    9.08  -50.0   10.84    0.0   13.26   27.0   13.87   39.0    9.41
    50.0    8.25  100.0    3.37  150.0   -1.85  200.0   -4.39  250.0   -7.49
R-6      MAY1972 00 1935440.460  433912.090  70.0012.66
         25JUL72 06AUG72  34  0 11 23

   -50.0   10.96    0.0   12.46   35.0   13.18   40.0   12.73   50.0   11.81
   100.0    6.29  150.0   -1.08  200.0   -3.69  250.0   -4.38  300.0   -5.52
   350.0   -6.89  369.0   -4.02  468.0   -7.42  582.0  -11.72  699.0  -12.52
   810.0  -12.32  921.0  -11.82 1056.0  -12.72 1191.0  -14.72 1314.0  -17.42
  1446.0  -20.02 1626.0  -23.12 1725.0  -25.03 1845.0  -26.42 1995.0  -27.92
  2106.0  -29.42 2244.0  -31.12 2355.0  -32.72 2520.0  -33.82 2625.0  -35.12
  2706.0  -36.42 2844.0  -37.62 2970.0  -38.62 3075.0  -39.32
R-7      MAY1972 00 1934533.460  434240.950  70.0013.57
         25JUL72          11  0 11  0

   -50.0   11.02    0.0   13.15   14.0   14.50   17.0   13.57   50.0    8.91
   100.0    0.79  150.0   -2.23  200.0   -2.95  250.0   -4.20  300.0   -5.72
   350.0   -6.07
R-8      MAY1972 00 1933644.980  434479.820  70.0011.42
         25JUL72          11  0 11  0

   -50.0    9.46    0.0   11.20   50.0   12.22  100.0   12.71  105.0   11.66
   150.0    6.27  196.0    0.10  200.0   -0.94  250.0   -3.52  300.0   -3.27
   350.0   -4.82
R-9      MAY1972 00 1932634.130  434882.330  70.0011.85
         25JUL72 06AUG72  33  0 12 21

  -100.0    9.14  -50.0   10.55    0.0   11.64   50.0   12.76   64.0   13.36
    80.0   11.69  100.0    8.51  150.0    0.56  200.0   -2.12  250.0   -6.07
   300.0   -5.42  350.0   -5.87  478.0   -4.88  592.0   -9.48  690.0  -11.68
   733.0  -11.58  862.0  -10.98 1000.0  -10.38 1144.0  -11.48 1264.0  -14.08
```

```
 1408.0  -17.18 1522.0  -19.48 1714.0  -21.78 1855.0  -23.98 1990.0  -25.88
 2104.0  -27.68 2254.0  -29.48 2389.0  -31.48 2509.0  -33.28 2698.0  -34.68
 2809.0  -36.28 2959.0  -37.68 3094.0  -38.68
R-10     MAY1972 00 1931703.250  435223.450  70.0011.77
         25JUL72            9  0  9  0

  -50.0   10.05    0.0   11.37   50.0   12.58   62.0   13.59  100.0    6.84
  150.0    0.29  200.0   -3.06  250.0   -4.00  300.0   -6.38
R-11     MAY1972 00 1930829.530  435543.610  70.0011.37
         25JUL72           11  0 11  0

 -100.0    8.27  -50.0    9.56    0.0   11.14   50.0   13.60   54.0   13.04
   56.0   11.15  100.0    5.35  150.0    0.24  200.0   -4.05  250.0   -4.50
  300.0   -5.15
R-12     MAY1972 00 1929911.990  435877.080  70.0011.50
         25JUL72 10AUG72   30  0   9 21

    0.0   11.23  -29.0   10.25   47.0   13.51   50.0   12.63   61.0   11.27
  100.0    5.53  150.0   -0.24  200.0   -3.67  250.0   -5.26  467.0   -5.50
  566.0  -12.20  650.0  -14.20  734.0  -12.70  857.0  -12.00  998.0  -11.80
 1124.0  -14.20 1277.0  -17.20 1403.0  -20.00 1541.0  -22.70 1712.0  -25.20
 1844.0  -27.20 1967.0  -29.20 2141.0  -31.30 2282.0  -33.40 2432.0  -35.50
 2567.0  -37.50 2702.0  -39.20 2777.0  -40.40 2912.0  -42.00 3062.0  -43.10
R-13     MAY1972 00 1929065.260  436176.250  70.0010.22
         25JUL72           10  0 10  0

  -12.0    9.31    0.0    9.98   50.0   13.38   52.0   13.95   55.0   12.67
   68.0   11.93  100.0    7.63  150.0   -0.92  200.0   -3.67  250.0   -5.67
R-14     MAY1972 00 1928184.800  436477.550  70.00 8.98
         25JUL72            8  0  8  0

  -36.0    6.75    0.0    8.90   45.0   12.82   50.0   11.46  100.0    6.26
  150.0    0.04  200.0   -3.37  250.0   -5.42
R-15     MAY1972 00 1927166.190  436829.820  70.00 9.87
         25JUL72 10AUG72   32  0   9 23

    0.0    9.63   47.0   11.76   50.0   11.51   88.0    9.98  100.0    8.06
  150.0    3.02  200.0   -1.82  250.0   -4.29  300.0   -4.34  456.0   -6.40
  555.0  -10.60  677.4  -13.40  708.0  -13.40  771.0  -11.10  813.0  -11.10
  948.0  -11.60 1116.0  -13.10 1230.0  -16.10 1389.0  -19.50 1524.0  -22.40
 1674.0  -24.60 1851.0  -26.60 1974.0  -29.10 2109.0  -30.60 2304.0  -32.90
 2424.0  -34.60 2559.0  -36.10 2709.0  -37.10 2874.0  -37.40 2970.0  -37.50
 2994.0  -38.60 3129.0  -40.90
```

3.2 Output File: CCCLa.OUT

1

County Range		Hb (m.)	Surge (m)	Amp (m)	"A" (m**1/3)	Erosion-@2.4m contour	Return Period
FLA R-	1	2.62	1.52	.70	.1080	-21.8m	25 years
FLA R-	1	2.02	1.40	.70	.1080	-16.7m	15 years
FLA R-	1	1.72	1.28	.70	.1080	-12.7m	10 years
FLA R-	1	1.39	1.16	.70	.1080	-8.2m	5 years
FLA R-	3	2.62	1.52	.70	.1076	-21.9m	25 years
FLA R-	3	2.02	1.40	.70	.1076	-16.4m	15 years
FLA R-	3	1.72	1.28	.70	.1076	-13.1m	10 years
FLA R-	3	1.40	1.16	.70	.1076	-9.4m	5 years
FLA R-	6	2.62	1.52	.70	.1070	-23.7m	25 years
FLA R-	6	2.02	1.40	.70	.1070	-16.2m	15 years
FLA R-	6	1.72	1.28	.70	.1070	-11.8m	10 years
FLA R-	6	1.40	1.16	.70	.1070	-7.3m	5 years
FLA R-	9	2.62	1.52	.70	.1064	-23.0m	25 years
FLA R-	9	2.02	1.40	.70	.1064	-16.7m	15 years
FLA R-	9	1.73	1.28	.70	.1064	-12.5m	10 years

```
FLA R-  9  1.41  1.16  .70  .1064       -8.0m        5 years

FLA R- 12  2.62  1.52  .70  .1059      -22.8m       25 years
FLA R- 12  2.02  1.40  .70  .1059      -16.0m       15 years
FLA R- 12  1.73  1.28  .70  .1059      -11.7m       10 years
FLA R- 12  1.41  1.16  .70  .1059       -7.2m        5 years

FLA R- 15  2.62  1.52  .69  .1053      -23.3m       25 years
FLA R- 15  2.03  1.40  .69  .1053      -14.5m       15 years
FLA R- 15  1.74  1.28  .69  .1053       -9.4m       10 years
FLA R- 15  1.42  1.16  .69  .1053       -4.8m        5 years
```

3.3 Output File: SURVEY.OUT

```
 Init. Smoothed Prof: FLA R-1      #pts= 40 (Dist & Elev.(-ve) are in meters.)
     -30.48      -2.44
     -25.25      -2.74
     -17.55      -3.05
     -12.71      -3.35
      -9.09      -3.66
      -5.47      -3.96
      -1.85      -4.27
       1.61      -4.57
       4.91      -4.88
       9.45      -5.18
      12.34      -5.18
      13.92      -4.88
      14.82      -4.57
      16.10      -4.27
      17.73      -3.96
      19.36      -3.66
      20.98      -3.35
      25.20      -3.05
      29.49      -2.74
      32.03      -2.44
      34.05      -2.13
      36.06      -1.83
      38.08      -1.52
      40.10      -1.22
      42.11       -.91
      44.13       -.61
      46.40       -.30
      49.64        .00
      52.89        .30
      56.13        .61
      59.37        .91
      73.11       1.22
     105.97       1.52
     147.46       1.83
     160.36       2.13
     166.01       2.44
     177.08       2.74
     190.38       3.05
     234.52       3.35
     309.00       3.66
 Final Smoothed Prof (Dist & Elev(-ve) in m.): FLA R-1       #pts= 40  -25 year return
period
       8.86      -5.18
       9.01      -4.88
       9.16      -4.57
       9.31      -4.27
       9.47      -3.96
       9.62      -3.66
       9.77      -3.35
       9.92      -3.05
      10.08      -2.74
      10.23      -2.44
      10.38      -2.13
```

10.57	-1.83
14.97	-1.52
20.64	-1.22
26.98	-.91
36.26	-.61
47.50	-.30
60.16	.00
74.04	.30
89.07	.61
105.09	.91
123.01	1.22
139.60	1.52
155.71	1.83
165.29	2.13
172.52	2.44
179.69	2.74
190.46	3.05
234.52	3.35
309.00	3.66
373.17	3.96
390.78	4.27
404.84	4.57
418.42	4.88
432.00	5.18
445.25	5.49
458.28	5.79
471.30	6.10
487.41	6.40
511.48	6.71

Final Smoothed Prof (Dist & Elev(-ve) in m.): FLA R-1 #pts= 40 -15 year return period

12.34	-5.18
13.92	-4.88
14.25	-4.57
14.40	-4.27
14.56	-3.96
14.71	-3.66
14.86	-3.35
15.01	-3.05
15.17	-2.74
15.32	-2.44
15.47	-2.13
15.63	-1.83
19.33	-1.52
24.47	-1.22
30.31	-.91
38.32	-.61
49.04	-.30
61.19	.00
74.69	.30
87.96	.61
96.20	.91
103.65	1.22
115.73	1.52
147.19	1.83
160.36	2.13
166.01	2.44
177.08	2.74
190.38	3.05
234.52	3.35
309.00	3.66
373.17	3.96
390.78	4.27
404.84	4.57
418.42	4.88
432.00	5.18
445.25	5.49
458.28	5.79
471.30	6.10
487.41	6.40

511.48	6.71

Final Smoothed Prof (Dist & Elev(-ve) in m.): FLA R-1 #pts= 40 -10 year return period

12.34	-5.18
13.92	-4.88
14.82	-4.57
16.10	-4.27
17.73	-3.96
18.73	-3.66
18.88	-3.35
19.04	-3.05
19.19	-2.74
19.34	-2.44
19.49	-2.13
19.65	-1.83
22.40	-1.52
26.64	-1.22
31.74	-.91
38.63	-.61
48.59	-.30
60.18	.00
72.79	.30
80.22	.61
86.24	.91
91.88	1.22
109.43	1.52
147.46	1.83
160.36	2.13
166.01	2.44
177.08	2.74
190.38	3.05
234.52	3.35
309.00	3.66
373.17	3.96
390.78	4.27
404.84	4.57
418.42	4.88
432.00	5.18
445.25	5.49
458.28	5.79
471.30	6.10
487.41	6.40
511.48	6.71

Final Smoothed Prof (Dist & Elev(-ve) in m.): FLA R-1 #pts= 40 - 5 year return period

12.34	-5.18
13.92	-4.88
14.82	-4.57
16.10	-4.27
17.73	-3.96
19.36	-3.66
20.98	-3.35
23.54	-3.05
23.72	-2.74
23.87	-2.44
24.02	-2.13
24.17	-1.83
24.36	-1.52
28.62	-1.22
34.09	-.91
40.63	-.61
49.66	-.30
60.20	.00
67.03	.30
72.52	.61
76.94	.91
82.25	1.22
105.97	1.52
147.46	1.83
160.36	2.13

166.01	2.44
177.08	2.74
190.38	3.05
234.52	3.35
309.00	3.66
373.17	3.96
390.78	4.27
404.84	4.57
418.42	4.88
432.00	5.18
445.25	5.49
458.28	5.79
471.30	6.10
487.41	6.40
511.48	6.71

APPENDIX A

PROGRAM NOTES:

You may compile the Fortran source code of the CCCLa erosion model using any Fortran compiler that uses the Fortran 77 standard. It has been successfully compiled and run on the VAX running the VMS operating system; it has also been run on a 486 microcomputer with MS DOS version 6.0 and MS Fortran compiler version 5.0.

You can follow the steps below to install the program on a personal computer:

1. First create a subdirectory from the root directory in the hard disk, such as,

   [c:>md c:\hfe <return>]

2. Next, copy all the files from the disk provided to the subdirectory in the hard disk, such as,

   [c:>copy a:*.* c:\hfe <return]

3. Although the executable file, CCCLa.exe is included in the disk, it is recommended that you compile and link the source code, CCCLa.for and produce the executable file on your computer system.

4. To run the program on the PC, first copy a file with the profile data in DNR format with the first 3 characters of the county name in capitals on the first line of the file to SURVEY.DAT, then type: CCCLa to start running the program. Output files generated are: CCCLa.OUT and SURVEY.OUT.

5. When CCCLa is running, it will look for these files:

For the East Coast:

```
enas0594.dat,  eduv0594.dat,  estj0594.dat,
efla0594.dat,  evol0594.dat,  ebre0594.dat,
eind0594.dat,  estl0594.dat,  emar0594.dat,
epal0594.dat,  ebro0594.dat,  edad0594.dat, and

anas0594.dat,  aduv0594.dat,  astj0594.dat,
```

```
afla0594.dat,   avol0594.dat,   abre0594.dat,
aind0594.dat,   astl0594.dat,   amar0594.dat,
apal0594.dat,   abro0594.dat,   adad0594.dat.
```

For the West Coast:

```
wpin1094.dat,   wman1094.dat,   wsar1094.dat,
wcha1094.dat,   wlee1094.dat,   wcol1094.dat, and

apin1094.dat,   aman1094.dat,   asar1094.dat,
acha1094.dat,   alee1094.dat,   acol1094.dat.
```

For the Panhandle Coast:

```
pesc1094.dat,   poka1094.dat,   pwal1094.dat,
pbay1094.dat,   pgul1094.dat,   pfra1094.dat, and

aesc1094.dat,   aoka1094.dat,   awal1094.dat,
abay1094.dat,   agul1094.dat,   afra1094.dat.
```

You should not alter these files.

APPENDIX B

CCCLa.FOR SOURCE LISTING

```
c------------------------------------------------------------------------
c       +-------+
c       | CCCLa | This is the application version of the modified CCCL
c       +-------+ model. This program will compute the high frequency
c                 erosion distances for a given survey profile. It is
c                 assumed that the survey profile will be: along the
c                 DEP( formerly DNR) monument,survey bearing, and
c                 DEP data format.
c
c                 The dune erosion model was developed and modified for
c                 the "High Frequency Erosion Project" by R.G.Dean.
c
c               Changes implemented by S.B.Malakar.
c               Updated: 11/15/1994
c
c       |------------------------------------------------------------|
c       |-< Currently for the East & the West Coasts of Florida only >-|
c       | (Insufficient Data to Run the Model for the Panhandle Coast) |
c       |------------------------------------------------------------|
c
c       Comments:
c       This model has been run for ALL the available [*.ccl files]
c       survey profile data for the East & the West coasts of Florida
c       High frequency erosion distances for a survey profile will
c       not be computed or printed: if the survey profile depth is
c       not to at least 12 feet in depth, if the dune elevation is
c       less than the contour elevation (the berm elevation
c       determined for the coastal region), and if accretion is
c       computed.

        parameter (nx=250)
        COMMON /A/ H1(nx),XA(nx),HA(nx),NELM,X1(nx),NP,NELM1
        dimension sxx(5,nx),syy(5,nx),nsxx(5)
        DIMENSION DH(nx),    DX(nx),  DPTC(nx),   XAO(nx),
     -              X(nx,2),NCON(nx),XASAVE(nx),HASAVE(nx)
        DIMENSION        xbsave(nx), stides(7),    hbs(7)
       real     xread(nx),          yread(nx)
       dimension jper(4)
c
        CHARACTER*8 RNGDAT,DOTDAT,BCHDAT,OFFDAT
        CHARACTER*8 CNTY
        character*3 ectys(12)
        CHARACTER*3 wctys(6)
        character*3 pctys(6)
       character*1 rng(8)
       character*3 acnty
        data Ectys/'NAS','DUV','STJ','FLA','VOL','BRE','IND','STL',
     1             'MAR','PAL','BRO','DAD'/
        data wctys/'PIN','MAN','SAR','CHA','LEE','COL'/
        data pctys/'ESC','OKA','WAL','BAY','GUL','FRA'/
       data jper/25,15,10,5/
c
c       Open USER input files:  [ There are other files open in the
c                                 program (data provided). ]
c
       open(UNIT=4,file='survey.dat', status='unknown')
c      open(UNIT=5,file= 'hfe.inp', status='old')
c
c
c       Open output file:
```

```
c
c                 unit 6 for erosion computational data
           open(UNIT=6,file='hfe.out',status='unknown')
c
c       [There is an optional file which may be opened for output of
c        the initial smoothed and final smoothed profiles, survey.out]

C     H(N) VALUES ARE DEPTH VALUES TO CENTER OF ELEMENT.
C     ELEVATIONS ABOVE MEAN SEA LEVEL ARE NEGATIVE.
c
      pi=3.1416
1234  write(*,*)' '
c      write(*,*)' Enter 1 for British Unit, 2 for Metric Unit'
c      read(*,*)ibm
      ibm=1
      if(ibm.lt.1.or.ibm.gt.2)go to 1234
      if(ibm.eq.2)ftm=3.2808
      if(ibm.eq.1)ftm=1.0
c     ifct25=0 => Erosion Factor=1.0; ifct25=1 =>Erosion Factor=efact
1235  write(*,*)' Enter Value for Erosion Factor, efact'
      write(*,*)'                  (1.0  .ge.  efact  .le. 10.0):'
      read(*,*)efact
      ifct25=0
      if(efact.gt.1.0)ifct25=1
      if(efact.lt.1.0.or.efact.gt.10.0)go to 1235
c      efact=1.0
c----------------------- write to screen -----------------------------
       write(*,*)' '
       write(*,*)' '
       write(*,*)' '
       write(*,*)' '
       write(*,*)' '
       write(*,*)' '
      write(*,*)'          ',
     1 '+-----------------------------------------------------------+'
      write(*,*)'          ',
     2 '| Note:           Output is written to file:  HFE.OUT      |'
      write(*,*)'          ',
     3 '|       Init. & final Smoothed profile to file: SURVEY.OUT  |'
      write(*,*)'          ',
     4 '|                                                           |'
      write(*,*)'          ',
     5 '|       Erosion Factor=',efact,'                  |'
      write(*,*)'          ',
     6 '|       British Units in Effect                             |'
      write(*,*)'          ',
     7 '|                                                           |'
      write(*,*)'          ',
     8 '|       ("ero"=-9999.9 indicates accretion for profile)     |'
      write(*,*)'          ',
     9 '+-----------------------------------------------------------+'
       write(*,*)' '
       write(*,*)' '
       write(*,*)' '
       write(*,*)' '
       write(*,*)' '
       write(*,*)' '
       write(*,*)' '
       write(*,*)' '
       write(*,*)' '
       write(*,*)' '
       write(*,*)' '
       write(*,*)' '
       pause
c     dcut= a profile should be surveyed to at least "dcut" depth
c            for erosion to computed
```

```
      dcut=-12.0
      iout=0
c
C       Read erosion model parameters:
c       READ(5,33) CNTY
11        FORMAT(10X,F10.4)
c     READ(5,11)XK
c     READ(5,11)XMD
c     READ(5,22)IFCT25
22        FORMAT(10X,I10)
c
c          dt=time increment in hr for erosion computation;
c       clev=contour elev at which erosion was computed in ft;
c       dero=duration of model run in hrs, used for tidal period,
c            values used 18.6 hr for East & West coasts, 12.4 hr for
c            Panhandle; for area specify: E or e for East coast,
c            W or w for West coast, P or p for Panhandle
c
c     READ(5,11)dt
c     read(5,11)clev
c     read(5,11)dero
c     read(5,31)area
31        format(10x,a1)
c       if iandf=1, then output initial & final smoothed profiles
c     read(5,22)iandf
c     close(unit=5)
c                    Initialize erosion parameters:
      xk=0.075
      xmd=2.00
      dt=0.05
      dero=18.6
      iandf=1
C
c       read survey profile header data:
      read(4,32,end=99999)acnty
32        format(a3)
      backspace(unit=4)
       do 18 i=1,12
       if(ectys(i).eq.acnty)area='e'
       if(ectys(i).eq.acnty)go to 19
       if(i.lt.7.and.wctys(i).eq.acnty)area='w'
       if(i.lt.7.and.wctys(i).eq.acnty)go to 19
       if(i.lt.7.and.pctys(i).eq.acnty)area='p'
       if(i.lt.7.and.pctys(i).eq.acnty)go to 19
18         continue
       write(*,188)
188          format(' *** Error: First 3 characters in line 1 of survey',
     1  1x,'data not county ID or not in CAPs')
       stop


c     area='e'
19    if(iandf.eq.1)open(unit=9,file='survey.out',status='unknown')
c
      timesn=dero/dt
      ntimes=int(timesn)
c
      if(area.eq.'E'.or.area.eq.'e'.or.area.eq.'W'.or.area.eq.'w')
     1        tinc=3.0*pi/timesn
c
      if(area.eq.'P'.or.area.eq.'p')tinc=pi/timesn
c     write(*,333)dt     ,dero,ntimes,tinc,area
333     format('     dt    dero ntimes tinc area ... HFE.inp'
     1       /' ', f7.3,f7.1,i5,f8.3,2x,a1)

c
```

```
         READ(4,33,end=99999)cnty                                       mai1920
33        format(a8)                                                    mai1930
c         write(*,*)' acnty,cnty=',acnty,' ',cnty                       mai1940
c        ######### This is the profile loop, the outermost loop #######  mai1950
  1      READ(4,44,END=99999)RNG,RNGDAT,ICODE,YNORTH,XEAST,AZMUTH       mai1960
         READ(4,55)DOTDAT,BCHDAT,OFFDAT,NP,NPDOT,NPBCH,NPOFF            mai1970
   44    FORMAT(8a1,A8,I2,2F12.3,F7.2)                                  mai1980
   55    FORMAT(A8,A8,A8,4I3,/)                                         mai1990
c                                                                       mai2000
c                                                                       mai2010
c        extract range number irang from rng                            mai2020
        call range(rng,irang)                                           mai2030
c                                                                       mai2040
c        write(*,*)' range#=',irang                                     mai2050
c        get high frequency erosion data                                mai2060
        call hfe(acnty,irang,aval,amp,kounty,stides,hbs)                mai2070
        if(kounty.le.4)clev=-8.0                                        mai2080
        if(kounty.ge.5.and.kounty.le.12)clev=-7.0                       mai2090
        if(kounty.ge.13.and.kounty.le.20)clev=-5.0                      mai2100
        if(kounty.ge.21.and.kounty.le.24)clev=-6.0                      mai2110
        write(*,63)                                                     mai2120
63        format(' ')                                                   mai2130
c         write(*,64)acnty,irang,aval,amp,(stides(i),i=1,4),            mai2140
c      1   (hbs(j),j=1,4)                                               mai2150
c64        format(' hfe: ',a3,' R-',i3,' a=',f5.3,' amp=',f3.1,' stide:',mai2160
c      1   4f5.1,' Hb:',4f5.1)                                          mai2170
        a=aval                                                          mai2180
c                                                                       mai2190
c                                                                       mai2200
c        read survey profile data:                                      mai2210
         READ(4,66,END=99999)(Xread(I),yread(I),I=1,NP)                 mai2220
66        format(5(f7.1,1x,f7.2))                                       mai2230
c        screen survey profile:                                         mai2240
        idcut=0                                                         mai2250
        idunee=0                                                        mai2260
        do 170 i=1,np                                                   mai2270
        if(yread(i).ge.-clev)idunee=1                                   mai2280
        if(yread(i).le.dcut)idcut=1                                     mai2290
170      continue                                                       mai2300
        if(idunee.eq.0.or.idcut.eq.0)go to 1                            mai2310
c                                                                       mai2320
c                                                                       mai2330
c        ----------- start loop  irank --------------------------------  mai2340
        do 450 irank=1,4                                                mai2350
c                                                                       mai2360
        stval=stides(irank)                                             mai2370
        hbi=hbs(irank)                                                  mai2380
c       write(*,*)' irank,hbi(irank)=',irank,hbi                        mai2390
c                                                                       mai2400
      DO 20 I=1,nx                                                      mai2410
      X(I,1)=0.0                                                        mai2420
      X(I,2)=0.0                                                        mai2430
      X1(I)=0.0                                                         mai2440
      H1(I)=0.0                                                         mai2450
      NCON(I)=0                                                         mai2460
       dh(i)=0.0                                                        mai2470
       dx(i)=0.0                                                        mai2480
       dptc(i)=0.0                                                      mai2490
       xao(i)=0.0                                                       mai2500
       xasave(i)=0.0                                                    mai2510
       hasave(i)=0.0                                                    mai2520
       xbsave(i)=0.0                                                    mai2530
      XA(I)=0.0                                                         mai2540
 20   HA(I)=0.0                                                         mai2550
c                                                                       mai2560
c        transfer original survey profile data to x1 & h1:              mai2570
```

```
       i20=1
      DO 40 I=1,NP
       x1(i)=xread(i)
       h1(i)=yread(i)
       IF (i20.eq.1.and.yread(I).LT.dcut) nstop=i
       if(yread(i).lt.dcut)i20=0
 40    CONTINUE
       if(i20.eq.1)NSTOP=I-1
c
      IDUNEM = 1
      DO 50 I = 1,NP
      IF (H1(I) .GT. H1(IDUNEM)) IDUNEM = I
  50  CONTINUE
      MIN1=1
      DO 60 I = 1,IDUNEM
      IF (H1(I) .LT. H1(MIN1)) MIN1 = I
  60  CONTINUE
      MIN2=1
      DO 70 I = IDUNEM,NP
      IF (H1(I) .LT. H1(MIN2)) MIN2 = I
 70   CONTINUE
      IMAX=IFIX(H1(IDUNEM)+0.2)
      IMIN1=IFIX(H1(MIN1))
      IMIN2=IFIX(H1(MIN2))
      NELM1=IMAX-IMIN1+1
      NELM2=IMAX-IMIN2+1
      NELM=NELM1+NELM2
      NL=NELM
      II=1
      IMAXM1=IMAX-1
      DO 80 I=IMIN1,IMAX
      HA(II)=I
      II = II + 1
  80  CONTINUE
      DO 90 I=IMAX,IMIN2,-1
      HA(II)=I
      II = II + 1
 90   CONTINUE
      DO 100  I=1,NELM
      NCON(I)=1
100   XA(I)=0.0
      CALL SMOOTH(IDUNEM,1,2)
      CALL SMOOTH(IDUNEM,NP,1)
      NELM1M = NELM1 - 1
      N2=NELM1+1
      N3=NELM-1
      DO  110 M=1,NELM1M
      XASAVE(M)  = -XA(M)  + X1(IDUNEM)
      HASAVE(M)=-HA(M)
 110  CONTINUE
      XASAVE(NELM1)  = X1(IDUNEM)
      HASAVE(NELM1)  = -HA(NELM1)
      DO  120 M=N2,NELM
      XASAVE(M)  = XA(M)  + X1(IDUNEM)
      HASAVE(M)=-HA(M)
 120  CONTINUE


      DO 130 I=1,NL
      IF (HASAVE(I).GT.-dcut) GO TO 135
 130  CONTINUE
135   NSTOP=I-1

c       ----------------------------------------------------------------
C       (xasave(i),hasave(i),i=1,nstop) contain initial smoothed profile
c       data
```

```
c        write to unit 9:*****
c        if(irank.eq.1.and.iandf.eq.1.and.ibm.eq.2)
c      1 write(9,122)acnty,rng,nstop
c122        format(' Init.Smoothed Prof: ',a3,1x,8a1,' #pts=',i3,
c      1   ' (Dist & Elev.(+ve) are in meters.)')
c        if(irank.eq.1.and.iandf.eq.1.and.ibm.eq.1)
c      1 write(9,123)acnty,rng,nstop
c123        format(' Init. Smoothed Prof: ',a3,1x,8a1,' #pts=',i3,
c      1   ' (Dist & Elev.(+ve) are in ft.)')
        if(irank.ne.1)go to 126
        if(iandf.ne.1)go to 126
         nsxx(1)=nstop
        do 125 i=1,nstop
c          *** write array:
         xasm=xasave(i)/ftm
         yasm=-hasave(i)/ftm
         sxx(1,i)=xasm
         syy(1,i)=yasm
c         write(9,124)xasm,yasm
124        format(' ',2f10.2)
125      continue
126         hastop=hasave(nstop)
c        ------------------------------------------------------------

      DO 140 M=1,NELM1
      I=NELM1-M+1
      NCON(I)=2
      XA(I) = -XA(I) + X1(IDUNEM)
      X(M,1)=XA(I)
 140  CONTINUE
      DO 150 M=N2,NELM
      I=M-NELM1
      XA(M) = XA(M) + X1(IDUNEM)
      X(I,2)=XA(M)
      HA(I)=-HA(M)
      NLS=I
 150  CONTINUE
C-----INITIALIZE 'ACTIVE' PROFILE
      NL=NLS
      X(NELM1,1)=-1000.0
      DO 160 I=1,NL
 160  XA(I)=X(I,2)



C
C-----CALCULATE HSTAR TO NEAREST FOOT
      DO 190 I = 1,NL
      XAO(I) = XA(I)
  190 CONTINUE
      HS = (0.667 * A**1.5 / XMD)**2
      DXS = (HS / A)**1.5
      HSTAR = HS
C
      XR = 0.0
      DH(1) = 1.011
C
C     ESTABLISH INSTANTANEOUS WATER LEVEL, ST
C

      PIO2 = 1.5708

      DO 200 I = 2,NL
      DH(I) = (HA(I) - HA(I-1) - DH(I-1)/2.0)*2.0
  200 CONTINUE
C
```

```
      ZZ=1.0-EXP(-XK*DT)
      IBP=1
      NPA=1
c       dtime=0.02534   !  3 min
       dtimen=-tinc
      DO 320 NTIME = 1,NTIMES
       dtimen=dtimen+tinc
       tidev=amp*sin(dtimen)
      TIME = (NTIME-1)*DT
c
c
      ST = stval+tidev
      DO 230 I = 1,NL
      DPTC(I) = HA(I) + ST
  230 CONTINUE
C
C
       hb=hbi
      DPTB = hb/0.8
      XB = abs(DPTB / A) ** 1.5
C
C     ESTABLISH THE INDICES OF STILL WATER LEVEL AND HSTAR
C
      IE = 1
      AA = 100.0
      DO 240 I = 1,NL
      BB = ABS(DPTC(I) - DPTB)
      IF (BB .GT. AA) GO TO 235
      AA = BB
      IE = I
  235 IF (ABS(DPTC(I)) .LE. DH(I)/2) IWL = I
      IF (ABS(HSTAR - DPTC(I)) .LE. DH(I)/2) ISTAR = I
  240 CONTINUE
      IB=NPA
       xr=0.0
      DO 290 IIT = 1,10
      SUM1 = 0.0
      SUM2 = 0.0
      SUM3 = 0.0
      SUM4 = 0.0
      DO 250 I = IB,ISTAR
      SUM1 = SUM1 + (HA(I) + ST - HSTAR) * DH(I) / XMD +
     1 (DXS+xr) * DH(I)
      SUM4 = SUM4 + DH(I)
      SUM3 = SUM3 + XA(I) * DH(I)
  250 CONTINUE
      ISP = ISTAR + 1
      DO 260 I = ISP, IE
      SUM4 = SUM4 + DH(I)
       if(dptc(i).gt.0.0)
     1  SUM2 = SUM2 + (DPTC(I)/A)**1.5 * DH(I) +dh(i)+xr*dh(i)
      SUM3 = SUM3 + XA(I) * DH(I)
  260 CONTINUE
      IEP = IE + 1
      DO 270 I = IEP,NL
      IFILL = I-1
      IF (XR + XB .LT. XA(I)) GO TO 275
      SUM3 = SUM3 + XA(I) * DH(I)
      SUM4 = SUM4 + DH(I)
      SUM2 = SUM2 + XB * DH(I)+xr*dh(i)
      IFILL = I
  270 CONTINUE
 275  CONTINUE
      XRO = XR
       dxr=0.5/sum4*(sum3-sum2-sum1)
       xr=xr+dxr
```

```
c       XR = 1.0/SUM4 * (SUM3 - SUM2 - SUM1)
C+++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
C
C     ESTABLISH NEW VALUE OF IB
C
      IBO = IB
      BSTAR=XR+DXS-XA(ISTAR)+(DPTC(ISTAR)-HSTAR)/XMD
      BSTAR=BSTAR*ZZ
      XSTAR=XA(ISTAR)+BSTAR
      IB=NPA
      DO 280 I = NPA,IE
      BB=XSTAR+(DPTC(I)-HSTAR)/XMD-XA(I)
      IF (BB.LT.0.0) GO TO 285
      IB=I+1
280   CONTINUE
285   CONTINUE
      IF (IB.LT.1)IB=1

      IF (IB.GT.IWL) IB = IWL
      IF ((IB .EQ. IBO) .AND. (ABS(XRO - XR) .LE. .01)) GO TO 295
C+++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
 290   CONTINUE
 295   CONTINUE


C
C     CALCULATE DX VALUES
C
      DO 300 I = IB,IFILL
      IF (I .GT. ISTAR .AND. I .LE. IE) GO TO 292
      IF (I .GT. IE) GO TO 294
      DX(I) = XA(I) - (XR + DXS + (HA(I) + ST-HSTAR) / XMD)
      GO TO 300
 292  DX(I) = XA(I) - (XR + ((HA(I) + ST)/A)**1.5)
      GO TO 300
 294  DX(I) = XA(I) - (XR + XB)
 300  CONTINUE
      BA = (1.0 - EXP(-XK*DT))
      DO 310 I = IB,IFILL
      BB = -DX(I) * BA
      XA(I) = XA(I) + BB
      IF (NCON(NPA).EQ.2.AND.XA(NPA).LT.X(NPA,1)) NPA=NPA+1
 310  CONTINUE
       xmoff=0.08
       call avala(xmd,xmoff,nl,iwl)

 320     CONTINUE
C
C *** END OF TIME LOOP ***
C
c        ----------------------------------------------------
c        (xa(i),ha(i),i=npa,nstop) final smoothed profile data
       nstop1=nstop-npa+1
c        if(iandf.eq.1.and.ibm.eq.2)
c     1  write(9,322)acnty,rng,nstop1,jper(irank)
c322        format(' Final Smoothed Prof (Dist & Elev(+ve) in m.): ',
c     1  a3,1x,8a1,'   #pts=',i3,'  -',i2,' year return period')

c        if(iandf.eq.1.and.ibm.eq.1)
c     1  write(9,323)acnty,rng,nstop1,jper(irank)
c323        format(' Final Smoothed Prof (Dist & Elev(+ve) in ft): ',
c     1  a3,1x,8a1,'   #pts=',i3,'  -',i2,' year return period')
       if(iandf.ne.1)go to 329
       iss=0
        do 328 i=npa,nstop
       iss=iss+1
```

```
        xams=xa(i)/ftm
        hams=-ha(i)/ftm
         sxx(irank+1,iss)=xams
         syy(irank+1,iss)=hams
c          if(ha(i).gt.hastop)go to 329
c        if((i+1.le.nstop).and.(xa(i+1).lt.xa(i)))go to 329
c          write(9,124)xams,hams
c        ---------------------------------------------------
C
328      continue
         nsxx(irank+1)=iss
329      continue
      DO 330 I = 1,NL
      DX(I) = XA(I) - XAO(I)
 330  CONTINUE
      IF (IFCT25.EQ.0) GO TO 374
c   ======added 11/3/1994 ===== do loop  to comments #1
      DO 340 I=NPA,NL
      IF (DX(I).GT.0.0) GO TO 374
      XA(I)=XA(I)+(efact-1.0)*DX(I)
      DXT=DX(I)*efact
340   continue
c       ============== start of "commenting" #1 ============
c     NPA2=NPA
c      IE=0
c      DO 340 I=NPA,NL
c      IE=I
c      IF (DX(I).GT.0.0) GO TO 342
c      XA(I)=XA(I)+(efact-1.0)*DX(I)
c      DXT=DX(I)*efact
c      write(1,1111)i,dx(i),dxt,efact
c1111   format(' main1: i,dx(i),dxt,efact=',i3,3f10.2)
c      NB=I
c      IF (I.GT.NELM1) GO TO 340
c      IF (XA(I).GT.X(I,1)) GO TO 340
c      XA(I)=X(I,1)
c      DXT=X(I,1)-X(I,2)
c      NPA2=I
c 340  DX(I)=DXT
c 342  CONTINUE
cc     write(1,2222)i,dx(i),dxt,efact
c2222  format(' main2: i,dx(i),dxt,efact=',i3,3f10.2)
c
c      NPA=NPA2
c      IEM1=IE-1
c      IO=0
c      XMIN=10000.0
c      DO 350 I=NPA,NB
c      IF (XA(I).GT.XMIN) GO TO 350
c      IF (DX(I).EQ.0.0) GO TO 350
c      XMIN=XA(I)
c      IO=I
c350   CONTINUE
c      SUM=0.0
c      IF (IO.EQ.0) GO TO 372
c      IBEG=0
c      DO 360 I=1,IO
c      XT=XA(IO) - (HA(IO)-HA(I))/XMD
c      IF (XT.GT.XA(I)) GO TO 360
c      IF (IBEG.EQ.0) IBEG=I
c      SUM=SUM+XA(I)-XT
c      XA(I)=XT
c 360  CONTINUE
c      II=0
c      IF (II.EQ.0) GO TO 374
c      IF (IBEG.EQ.0) GO TO 372
```

```
c       DZ=HA(IE)-HA(IBEG)
c       YMAX=1.5*SUM/DZ
c       DO 370 I=IBEG,IE
c       AA=(HA(IE)-HA(I))/DZ
c       XT=XA(I)
c       IF (I.LT.IO) XT=XA(IO) - (HA(IO)-HA(I))/XMD
c 370  XA(I)=XT + 4.0*YMAX*(AA-AA**2)
c 372  CONTINUE
c     ======== end of commenting #1 ==========================
 374  CONTINUE
      DO 380 I = 1,NL
      DX(I) = XA(I) - XAO(I)
c      write(1,3333)i,dx(i)
3333   format(' main3: i,dx(i)=',i3,f10.2)
 380  CONTINUE
      NPA2=NPA
      DO 390  I=NPA,NL
      IF (DX(I).GT.0.0) GO TO 395
      IF (I.GT.NELM1.OR.XA(I).GT.X(I,1)) GO TO 390
      NPA2=I
390   CONTINUE
 395  CHK=XA(NPA2)-X(NPA2,1)
      IF (CHK.LT.-10.0) NPA2=NPA2+1
      NPA=NPA2
 397  S1=0.0
      NPAM=NPA-1
      IF (NPA.EQ.1) GO TO 402
      DO 400 I=1,NPAM
      IF (HA(I).GT.0.0) GO TO 412
400   S1=S1+(X(I,2)-X(I,1))
402   DO 410 I=NPA,NL
      AA=X(I,2)-XA(I)
      IF (HA(I).GT.0.0) GO TO 412
      IF (AA.LT.0.0) GO TO 412
410    S1=S1+AA
412    CONTINUE
      DO 420 I=1,NL
      IF (HA(I).EQ.Clev) GO TO 425
420   CONTINUE
425   NRNG=I

C -------------------------------------------------------------------
      DO 430 IJK = NPA,NL
       dxijk=dx(ijk)
c     write(1,4444)i,dx(ijk)
4444   format(' main4: ijk,dx(ijk)=',i3,f10.2)

c        write(*,*)' dxijk,ha(ijk)=',dxijk,ha(ijk),ijk
         if(ha(ijk).eq.clev) go to 432
430      CONTINUE
       write(*,431)acnty,rng(1),rng(2),irang,clev
431       format(' ',a3,1x,2a1,i3,
     1   ' no erosion computed for contour elev=',f7.2)
        iout=iout+1
c       if(mod(iout,4).eq.1)write(6,882)
       hbim=hbi/ftm
       stvalm=stval/ftm
       ampm=amp/ftm
       avalm=aval**3
       avalm=(avalm/ftm)**0.3333
       dxijkm=dxijk/ftm
       if(dxijkm.gt.0.0)dxijkm=-9999.9
c      write(6,818)acnty,rng(1),rng(2),irang,stvalm,ampm,avalm,
c     1   jper(irank)
818       format(' ',10x,a3,1x,2a1,i3,6x,F6.2,f5.2,f7.4,
     1   18x,i3,' years')
```

```
      go to 616
c
432   if(hbi.eq.0.0.and.ibm.eq.1)
     1 write(*,433)acnty,rng(1),rng(2),irang,clev
433      format(' ',a3,1x,2a1,i3,
     1   ' no erosion computed for contour elev=',f7.2,'ft')

      hbim=hbi/ftm
      stvalm=stval/ftm
      ampm=amp/ftm
      avalm=aval**3
      avalm=(avalm/ftm)**0.3333
      dxijkm=dxijk/ftm
      if(dxijkm.gt.0.0)dxijkm=-9999.9
      if(hbi.eq.0.0.and.ibm.eq.2)
     1 write(*,434)acnty,rng(1),rng(2),irang,clev
434      format(' ',a3,1x,2a1,i3,
     1   ' no erosion computed for contour elev=',f7.2,'m')
      if(hbi.ne.0.0.and.ibm.eq.1)
     1 write(*,87)acnty,rng(1),rng(2),irang,hbi,stval,amp,aval,
     1   dxijkm,jper(irank)
87       format(' ',a3,1x,2a1,i3,' hb=',F4.1,'ft s.surge=',F3.1,
     1  'ft amp=',f4.2,'ft a=',f4.3,'ft**1/3 ero=',F7.1,'ft ',
     2   i2,' yrs')
      if(hbi.ne.0.0.and.ibm.eq.2)
     1 write(*,871)acnty,rng(1),rng(2),irang,hbim,stvalm,ampm,avalm,
     1   dxijkm,jper(irank)
871      format(' ',a3,1x,2a1,i3,' hb=',F4.1,'m s.surge=',F3.1,
     1  'm amp=',f4.2,'m a=',f4.3,'m**1/3 ero=',F7.1,'m ',
     2   i2,' yrs')

C -----------------------------------------------------------------
      clev1=-clev+0.1
      levc=int(clev1)
      iout=iout+1
      alevc=-clev/ftm
      if(mod(iout,999).eq.1.and.ibm.eq.2)write(6,881)alevc
881      format('1',7x,
     1   'County Range   Hb  Surge  Amp   "A"   Erosion-@',f3.1,
     2   'm Dist Return Period',
     2   /' ',21x,'(m.)   (m)    (m)  (m**1/3)',4x,'contour   From Mon')

      if(mod(iout,999).eq.1.and.ibm.eq.1)write(6,884)alevc
884      format('1',7x,
     1   'County Range   Hb  Surge  Amp   "A"   Erosion-@',f3.1,
     2   'ft Dist Return Period',
     2   /' ',21x,'(ft)  (ft)   (ft)  (ft**1/3)',3x,'contour  From Mon')
c      if(mod(iout,4).eq.1)write(6,882)
882      format(' ')
      hbim=hbi/ftm
      stvalm=stval/ftm
      ampm=amp/ftm
      avalm=aval**3
      avalm=(avalm/ftm)**0.3333
      dxijkm=dxijk/ftm
      if(dxijkm.gt.0.0)dxijkm=-9999.9
      np0=np
      call xmon(np0,clev,dxijk,xero,xread,yread)
      if(ibm.eq.2)xero=xero/ftm
c      write(6,88)acnty,rng(1),rng(2),irang,hbi,stval,amp,aval,
c     1   dxijk,jper(irank)
      if(hbi.gt.0.0.and.ibm.eq.2)
     1 write(6,88)acnty,rng(1),rng(2),irang,hbim,stvalm,ampm,avalm,
     1   dxijkm,xero,jper(irank)
88       format(' ',10x,a3,1x,2a1,i3,F6.2,F6.2,f5.2,f7.4,4x,f7.1,
     1   'm',f7.1,'m',2x,i3,' years')
```

```
        if(hbi.gt.0.0.and.ibm.eq.1)
     1 write(6,89)acnty,rng(1),rng(2),irang,hbim,stvalm,ampm,avalm,
     1   dxijkm,xero,jper(irank)
89        format(' ',10x,a3,1x,2a1,i3,F6.2,F6.2,f5.2,f7.4,4x,f7.1,
     1    'ft',f7.1,'ft',2x,i3,' years')
        if(hbi.le.0.0)
     1 write(6,828)acnty,rng(1),rng(2),irang,stvalm,ampm,avalm,
     1   jper(irank)


828        format(' ',10x,a3,1x,2a1,i3,6x,F6.2,f5.2,f7.4,24x,
     1     i3,' years')


c        if(iout.ne.1.and.mod(iout,44).eq.0)write(6,883)
883        format(' ',//10x,
     1    'Note: A value of 0.0m indicates no erosion',
     1    1x,'or erosion not computed.'//)
450        continue
c       write smoothed profile data: ******************
        if(ibm.eq.1)write(9,455)acnty,(rng(irn),irn=1,6)
455     format(' ',a3,1x,6a1,
     1 ' Smoothed Orig & 25,15,10,5 Yr Final Profs',
     2  ' -(dist,elev) in ft:')
        if(ibm.eq.2)write(9,456)acnty,(rng(irn),irn=1,6)
456     format(' ',a3,1x,6a1,
     1 ' Smoothed Orig & 25,15,10,5 Yr Final Profs,',
     2 ' -(dist,elev) in m:')
        nxx1=nsxx(1)
        nxx2=nsxx(2)
        nxx3=nsxx(3)
        nxx4=nsxx(4)
        nxx5=nsxx(5)
        nxxs=max(nxx1,nxx2,nxx3,nxx4,nxx5)
        nxxt=min(nxx1,nxx2,nxx3,nxx4,nxx5)
c       write(*,*)'max of nsxx=',nxx1,nxx2,nxx3,nxx4,nxx5,nxxs
        do 600 i=1,nxxt
        write(9,606)(sxx(ii,i),syy(ii,i),ii=1,5)
606     format(' ',
     1 f7.1,f7.2,f7.1,f7.2,f7.1,f7.2,f7.1,f7.2,f7.1,f7.2)
c        if(i.le.nxx1)write(9,601)sxx(1,i),syy(1,i)
601     format(' ',f7.1,f7.2)
c        if(i.le.nxx2)write(9,602)sxx(2,i),syy(2,i)
602     format('+',14x,f7.1,f7.2)
c        if(i.le.nxx3)write(9,603)sxx(3,i),syy(3,i)
603     format('+',28x,f7.1,f7.2)
c        if(i.le.nxx4)write(9,604)sxx(4,i),syy(4,i)
604     format('+',42x,f7.1,f7.2)
c        if(i.le.nxx5)write(9,605)sxx(5,i),syy(5,i)
605     format('+',56x,f7.1,f7.2)
600     continue
616     nsxx(1)=0
        nsxx(2)=0
        nsxx(3)=0
        nsxx(4)=0
        nsxx(5)=0
        GO TO 1
c99999          if(mod(iout,44).ne.0)write(6,883)
99999        STOP
         end
       subroutine smooth(NBEG,NMAX,ICODE)
C
C      Smooth survey data:
C            if icode = 2, smooth rear of dune
C            if icode = 1, smooth front of dune
C
```

```
c          smoothing is done from highest elev
C          to 1st or last survey  point
c          uses H,X to set HA, XA
C
        parameter (nx=250)

      COMMON /A/ H1(nx),XA(nx),HA(nx),NELM,X1(nx),NP,NELM1
      NSTART=NBEG
      NFINI=NMAX-1
      IF (ICODE .EQ. 2) NFINI = NMAX
      IF (ICODE .EQ. 2) NSTART = NBEG - 1
C     WRITE(6,10)NSTART,NFINI
 10   FORMAT(' NSTART,NFINI ',2I5)
      INC = 1
      IF (ICODE .EQ. 2) INC = -1
      DO 800 I = NSTART,NFINI,INC
      H11=H1(I)
      H22=H1(I+1)
      DH=ABS(H11-H22)
      DX=X1(I+1)-X1(I)
      HU=H11
      HL=H22
C     WRITE(6,20)H11,H22,DH,DX,HU,HL
 20   FORMAT(' H1,H2,DH,DX,HU,HL ',6F7.2)
      IF (H22.LT.H11) GO TO 100
      HU=H22
      HL=H11
 100  NEL1 = NELM1
      NEL2 = NELM
      IF (ICODE .NE. 2) GO TO 200
      NEL1 = NELM1
      NEL2 = 1
 200  DO 300 NEL=NEL1,NEL2,INC
      IF (HA(NEL).LT.HU) GO TO 400
 300  CONTINUE
C400  WRITE(6,30)NEL,NEL1,NEL2,HA(NEL),HU
 30   FORMAT(' NEL,NEL1,NEL2,HA(NEL),HU',3I5,2F7.2)
400   NB=NEL
      NEL2 = NELM
      IF (ICODE .EQ. 2) NEL2=1
      DO 700 N = NB,NEL2,INC
      IF (HA(N).GT.HL) GO TO 600
      XA(N)=XA(N)+DX
      GO TO 700
 600  DEL1 = (HU - HA(N))/DH
      XA(N) = XA(N) + DX * DEL1
C     WRITE(6,40)N,HA(N),HL,X(N),XA(N),DEL1
 40   FORMAT(' N,HA(N),HL,X(N),XA(N),DEL1 ',I5,5F7.2)
 700  CONTINUE
 800  CONTINUE
      RETURN
        end
      subroutine calca(A,NL)
        parameter (nx=250)

        COMMON /A/ H1(nx),XA(nx),HA(nx),NELM,X1(nx),NP,NELM1
      XM=2.0/3.0
      SUM1=0.0
      SUM2=0.0
      N=0
      XS=0.0
      DO 10 I=1,NL
      IF (HA(I).Lt.0.0) GO TO 10
      IF (XS.NE.0.0) GO TO 5
      IX=I
      XS=XA(I)
```

```
      GO TO 10
    5 if(xa(i).eq.xs)go to 10
c         SUM1=SUM1 + ALOG(XA(I)-XS)
       if((xa(i)-xs).gt.0.0)SUM1=SUM1 + ALOG(XA(I)-XS) ! mod 1/7/1994
c       SUM2=SUM2 + ALOG(HA(I))
      if(ha(i).gt.0.0)SUM2=SUM2 + ALOG(HA(I)) ! mod. 1/7/1994
      N = N + 1
   10 CONTINUE
      XN = FLOAT(N)
      if(xn.gt.0.0)A = EXP((SUM2 - XM*SUM1)/XN)
C     WRITE(6,12)
   12 FORMAT('    I      XA(I)      HA(I)',/)
C     WRITE(6,13)(I,XA(I),HA(I),I=1,NL)
   13 FORMAT(I5,F10.2,F10.2)
C     WRITE(6,15)SUM1,SUM2,XN,A,XS,IX
   15 FORMAT(' SUM1= ',F8.2,' SUM2= ',F8.2,' XN= ',F8.2,' A= ',F8.2,
     -       ' XS= ',F8.2,' IX= ',I5,/)
      RETURN
        end
      subroutine avala(xmd,xmoff,nl,iwl)
       parameter (nx=250)
        COMMON /A/ H1(nx),XA(nx),HA(nx),NELM,X1(nx),NP,NELM1
c       real ha(300),xa(300),xasave(300)
c       do 40 i=1,nl
c40        xasave(i)=xa(i)
       nlm1=nl-1
       do 60 ll=1,10
       do 50 i=1,nlm1
       scur=xmd

       if(i.gt.iwl)scur=xmoff
       dx=xa(i+1)-xa(i)
       if(dx.le.0.0)dx=0.001   ! ** added 12/7/1993
       dh=ha(i+1)-ha(i)
       sl=dh/dx
       if(sl.le.scur.and.dx.gt.0.0)go to 50
       dxa=dh/scur
c        determine excess slope
       dx1=1.1*(dxa-dx)
       xa(i)=xa(i)-dx1/2.0
       xa(i+1)=xa(i+1)+dx1/2.0
50        continue
60        continue
       return
        end
      subroutine range(rng,irang)
       integer x(3)
c     integer value of the monument range ID is extracted, any letters
c     associated with the range ID are ignored.
       character*1 val,rng(8)
       character*1 z(10)
       data z/'1','2','3','4','5','6','7','8','9','0'/
       x(1)=0
       x(2)=0
       x(3)=0
       kk=0
       do 30 k=3,5
       kk=k-2
       val=rng(k)
       do 20 i=1,10
       if(val.eq.z(i))go to 25
20        continue
       kk=kk-1
       go to 35
25        x(kk)=mod(i,10)
c         write(*,*)' i=',i
```

```
30        continue
35        if(kk.eq.1)irang=x(1)
      if(kk.eq.2)irang=x(1)*10+x(2)
      if(kk.eq.3)irang=x(1)*100+x(2)*10+x(3)
      return
       end
     subroutine hfe (acnty,r,a,amp,kounty,stides,hbs)
c       get high frequency erosion data from hfe.dat file
c
c       r= monument number; a=parameter "a"; amp=mean tidal
c       amplitude; stides=max storm tides; hbs=wave heights
c       acnty,cnty= 3 character county id; rid=2 character mon id;
c
      dimension ztide(10),zstide(4,10),zhbs(4,10)
      dimension stides(4),hbs(4)
c    1      ,trange(12)
      integer       r,zr2(100)
      character*3 acnty,cnty,county(24),dum
      character*2 rid
      external yint
c
      data county
     1 /'NAS','DUV','STJ','FLA','VOL','BRE','IND','STL','MAR','PAL',
     2  'BRO','DAD','GUL','FRA','PIN','MAN','SAR','CHA','LEE','COL',
     3  'ESC','OKA','WAL','BAY'/
c
c       data trange
c     1   /82.,80.,209.,100.,234.,219.,119.,115.,127.,227.,128.,113./
c
c       get index for county
      do 10 k=1,24
      if(acnty.eq.county(k))go to 15
10        continue
      write(*,*)' *** Error: county id did not match,acnty=',acnty
      stop
15        kounty=k

      if(kounty.eq. 1)open(unit=3,file='enas0594.dat',status='old')
      if(kounty.eq. 2)open(unit=3,file='eduv0594.dat',status='old')
      if(kounty.eq. 3)open(unit=3,file='estj0594.dat',status='old')
      if(kounty.eq. 4)open(unit=3,file='efla0594.dat',status='old')
      if(kounty.eq. 5)open(unit=3,file='evol0594.dat',status='old')
      if(kounty.eq. 6)open(unit=3,file='ebre0594.dat',status='old')
      if(kounty.eq. 7)open(unit=3,file='eind0594.dat',status='old')
      if(kounty.eq. 8)open(unit=3,file='estl0594.dat',status='old')
      if(kounty.eq. 9)open(unit=3,file='emar0594.dat',status='old')
      if(kounty.eq.10)open(unit=3,file='epal0594.dat',status='old')
      if(kounty.eq.11)open(unit=3,file='ebro0594.dat',status='old')
      if(kounty.eq.12)open(unit=3,file='edad0594.dat',status='old')
      if(kounty.eq.13)open(unit=3,file='pgul1094.dat',status='old')
      if(kounty.eq.14)open(unit=3,file='pfra1094.dat',status='old')
      if(kounty.eq.15)open(unit=3,file='wpin1094.dat',status='old')
      if(kounty.eq.16)open(unit=3,file='wman1094.dat',status='old')
      if(kounty.eq.17)open(unit=3,file='wsar1094.dat',status='old')
      if(kounty.eq.18)open(unit=3,file='wcha1094.dat',status='old')
      if(kounty.eq.19)open(unit=3,file='wlee1094.dat',status='old')
      if(kounty.eq.20)open(unit=3,file='wcol1094.dat',status='old')
      if(kounty.eq.21)open(unit=3,file='pesc1094.dat',status='old')
      if(kounty.eq.22)open(unit=3,file='poka1094.dat',status='old')
      if(kounty.eq.23)open(unit=3,file='pwal1094.dat',status='old')
      if(kounty.eq.24)open(unit=3,file='pbay1094.dat',status='old')
c
      read(3,111)dum
      read(3,111)dum
111         format(1x,a3)
```

```
      do 20 n=1,10
      read(3,11,end=35)cnty,rid,zr2(n),(zstide(i,n),i=1,4),ztide(n),
     1                        (    zhbs(j,n),j=1,4)
11      format(1x,a3,1x,a2,i3,1x,5f7.2/11x,4f7.2)

      if(cnty.ne.acnty)go to 25
c11      format(1x,a3,1x,a2,i3,f7.4)   ... for para.dat
20      continue
      go to 35
25      write(*,22)acnty,cnty
22      format(' *** Error check:',a3,' .ne. ',a3)
      stop
35      close(unit=3)
      n=n-1
c      check if range id match, in which case get amp, stides,hbs direc
      do 50 j=1,n
c     In some cases a monument ID is designated R-0 !
      if(r.eq.0)go to 51
      if(zr2(j).ne.r) go to 50

51      amp=ztide(j)
      do 40 i=1,4
      stides(i)=zstide(i,j)
      hbs(i)=zhbs(i,j)
40      continue
      go to 75
50      continue
      do 60 i=2,n
      if(r.gt.zr2(i-1).and.r.lt.zr2(i))go to 65
60      continue
      write(*,*)' ***Error: Monument Range # out of range=',r
      stop
65      izr2=zr2(i-1)
      x1=float(izr2)
      izr2=zr2(i)
      x2=float(izr2)
      x3=float(r)
c      write(*,*)' hfe: x3,r=',x3,r
      y1=ztide(i-1)
      y2=ztide(i)
      amp=yint(x1,x2,x3,y1,y2)

      do 70 j=1,4

      y1=zstide(j,i-1)
      y2=zstide(j,i)
      stides(j)=yint(x1,x2,x3,y1,y2)

      y1=zhbs(j,i-1)
      y2=zhbs(j,i)
      hbs(j)=yint(x1,x2,x3,y1,y2)
70      continue
c      get parameter "A"
75      continue
      if(kounty.eq. 1)open(unit=3,file='anas0594.dat',status='old')
      if(kounty.eq. 2)open(unit=3,file='aduv0594.dat',status='old')
      if(kounty.eq. 3)open(unit=3,file='astj0594.dat',status='old')
      if(kounty.eq. 4)open(unit=3,file='afla0594.dat',status='old')
      if(kounty.eq. 5)open(unit=3,file='avol0594.dat',status='old')
      if(kounty.eq. 6)open(unit=3,file='abre0594.dat',status='old')
      if(kounty.eq. 7)open(unit=3,file='aind0594.dat',status='old')
      if(kounty.eq. 8)open(unit=3,file='astl0594.dat',status='old')
      if(kounty.eq. 9)open(unit=3,file='amar0594.dat',status='old')
      if(kounty.eq.10)open(unit=3,file='apal0594.dat',status='old')
      if(kounty.eq.11)open(unit=3,file='abro0594.dat',status='old')
      if(kounty.eq.12)open(unit=3,file='adad0594.dat',status='old')
```

```
      if(kounty.eq.13)open(unit=3,file='agul1094.dat',status='old')
      if(kounty.eq.14)open(unit=3,file='afra1094.dat',status='old')
      if(kounty.eq.15)open(unit=3,file='apin1094.dat',status='old')
      if(kounty.eq.16)open(unit=3,file='aman1094.dat',status='old')
      if(kounty.eq.17)open(unit=3,file='asar1094.dat',status='old')
      if(kounty.eq.18)open(unit=3,file='acha1094.dat',status='old')
      if(kounty.eq.19)open(unit=3,file='alee1094.dat',status='old')
      if(kounty.eq.20)open(unit=3,file='acol1094.dat',status='old')
      if(kounty.eq.21)open(unit=3,file='aesc1094.dat',status='old')
      if(kounty.eq.22)open(unit=3,file='aoka1094.dat',status='old')
      if(kounty.eq.23)open(unit=3,file='awal1094.dat',status='old')
      if(kounty.eq.24)open(unit=3,file='abay1094.dat',status='old')

      read(3,111)dum
      read(3,44,end=99) cnty,rid,nr21,za1
      if(acnty.ne.cnty)write(*,*)' ***Error County ID do not match'
      if(acnty.ne.cnty)stop
      if(r.eq.nr21)a=za1
      if(r.eq.nr21)return
      do 80 j=1,500
      read(3,44,end=99) cnty,rid,nr22,za2
44      format(1x,a3,1x,a2,i3,f7.4)
c      write(*,*)' cnty,rid,nr22,za2=',cnty,rid,nr22,za2,r,x3
      if(acnty.ne.cnty)write(*,*)' *Error County ID not matched',cnty
      if(acnty.ne.cnty)stop
      if(r.eq.nr22)a=za2
      if(r.eq.nr22)return
      if(r.gt.nr21.and.r.lt.nr22)go to 85
      nr21=nr22
      za1=za2
80      continue
99      write(*,*)' *** Error Range # out of bound',x3
      stop
85      a=yint(x1,x2,x3,za1,za2)
      close(unit=3)

      return
       end
     function   yint(x1,x2,x3,y1,y2)
c       interpolate between 2 points for y-value:
      deno=x2-x1
      if(abs(deno).le.0.01)deno=0.01
      sl=(y2-y1)/deno
      yint=y2-sl*(x2-x3)
      return
       end
     subroutine xmon(np0,clev,dxijk,xero,xread,yread)
      real xread(250),yread(250)
      do 10 np1=1,np0
      if(yread(np1).lt.0.0)go to 15
10    continue
      write(*,*)' *** Error: survey data needs to extend below msl'
15    do 20 np2=np1,1,-1
      if(yread(np2).gt.-clev.and.yread(np2+1).le.-clev)go to 25
20    continue
      write(*,*)' *** Error: dune elev. lower than clev'
25    xdif=xread(np2+1)-xread(np2)
      xero=xread(np2)
      if(xdif.ne.0.0)slope=(yread(np2+1)-yread(np2))/xdif
      if(xdif.ne.0.0)xero=xread(np2+1)-(yread(np2+1)+clev)/slope
      xero=xero+dxijk
      return
      end
```