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URBAN AND REGIONAL LAND USE ANALYSIS: CARETS AND CENSUS CITIES EXPERIMENT PACKAGE

SKYLAB/EREP INVESTIGATION NO. 469
NASA Order No. T-5290 B

MONTHLY PROGRESS REPORT

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February 25, 1975

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Monthly Progress Report: February 25, 1975
Investigation No. 469

a.1. CARETS--Land use analysis: No change.

a.2. CARETS--Land use climatology: During the period of this report the climatology team has involved itself with 1). the manipulation of channel 21, S-192 tape data in the Baltimore-Washington area; 2). refining the technique of calibrating the channel 21 data to the terrestrial surface; and 3). setting-up Outcalt's simulator on the computer here at USGS Headquarters. Progress has been made in all areas to the extent that it is now possible to use the Skylab data, as well as data from Aircraft Mission 55M, to compare with simulations run on the Outcalt model.

a.3. Census Cities: Interpretation and change detection utilizing Skylab 3, S-190B coverage have been completed for the 400 sq. km. area (sheet 560-660, Atlas of Urban and Regional Change) centering around New Haven, Connecticut. Land use and land use change maps at a scale of 1:100,000 have been compiled and will appear in the final report to be submitted in June. All Level II (USGS Circular 671) urban and built-up categories could be identified from the S-190B imagery, as well as some more precise sub-categories under residential and transportation. Agricultural land could be distinguished only at a Level I degree of detail. Open land in the urbanized area was defined solely on the basis of cover under the appropriate observable Level II category, i.e., improved (golf course, cemetery, etc.), forested, (decidious, coniferous, mixed), or wetland (forested, non-forested). Various categories of water and barren land were easily delimited under appropriate Level II listings.

Changes between 1970-1973 were few and small in size in this essentially dense, urban core area. Most changes involved open land changing to small residential tracts or commercial areas, ponds being drained or additions being made existing industrial areas. Several of the latter type involved the expansion of oil tank farms, indicating an increased oil storage/wholesaling capacity for the area between 1970-1973. Other types of changes and their possible implications will be documented in the final report to be submitted under this contract.

Work on the Phoenix test site involves similar interpretation and change detection being performed on the 400 sq. km. area (sheet 700-400, Atlas of Urban and Regional Change) that includes Scottsdale, Paradise Valley and western Phoenix. As in New Haven, all Level II urban and built-up categories can be delimited from the S-190B imagery. Difficulty is being encountered, however, in distinguishing multi-family housing from single-family housing. Changes in this area between 1970 and 1973 seem to have occurred primarily north of the Arizona Canal and mainly involve desert brushland changing to residential use.

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Work on the Washington and San Francisco sites has started and will be detailed in future progress reports.

b. Recommendations concerning decisions and/or actions required to ensure attainment of the experiment's acientific objectives: At the present time a final decision has not been made regarding the PCM count intervals for the S055-4 data requested in the December, 1974 monthly report. However, this decision should be forthcoming in the March report.

c. Expected accomplishments during the next report periods: Two major tasks remain to be performed. One is to produce a gray map of temperature distribution for the Baltimore-Washington area, which will illustrate the relationship between land use and the thermal regime. The other is to begin running simulations on the Outcalt model for various land uses and then compare these "predicted" values with those obtained from the scanners on aircraft mission 55M and Skylab 3.

d. Significant results and their relationship to practical applications or operational problems: Several products were derived from the S-192 tapes this reporting period. Attachment 1 is the printout of temperatures in degrees Celsius. It was derived from PCM counts using the Pease's modified gray-window technique in the January monthly report. The variables are as follows: R_2 = spectral radiance received at the spacecraft in watts/cm^2/um/ster; R_0 = spectral radiance leaving the earth's surface in watts/cm^2/um/ster; N = global spectral radiance at the earth's surface in watts/cm^2/um; and W = global radiance at the earth's surface in watts/cm^2. Attachment 2 is a histogram depicting number of pixel elements per PCM count. Attachment 3 is a statistical summary providing the mean, median, mode, standard deviation, and coefficient of skewness. All three Attachments are for the same 10 x 10 block-smoothed scene covering the Baltimore-Washington corridor including Chesapeake Bay.

Robert Pease has continued work on documenting the calibration of the data. To improve upon the basic technique included in last month's report we now have a more refined version which goes beyond documentation and makes suggestions for improving data collection operations.

Another accomplishment this month was getting the Outcalt simulator set up on the USGS computer. On February 14, Samuel Outcalt visited the National Center and along with Carol Jenner (one of John Lewis' students) modified the latest version of the simulator to run on the computer here. The input data to the model are basically meteorological and geographical in nature. Attachment 4 is a sample of the output derived from a climatic simulation based on a medium density residential area. The output data is presented in three matrices: 1) radiation values in langleys/minute; 2) energy balance constituents (RN = net radiation, S = soil heat flux, H = sensible heat flux, LE = latent heat flux) in langleys/minute and temperature

in degrees Celsius; and 3) soil temperature matrix. The next step will be to run simulations for various land uses using meteorological data from August 5, 1973 and compare these values with those actually observed by Skylab's scanner.

e. Summary outlook for remaining effort to be performed: No change.

f. Travel summary and plans: Samuel Outcalt visited the National Center on February 14 as described in section d. From April 20 to April 23, Robert Alexander, Harry Lins, John Lewis, Robert Pease, and Samuel Outcalt will be in Milwaukee, Wisconsin to make the presentations at the Association of American Geographers annual meeting. While there they will collaborate on the manuscript production for the Skylab final report.

Approved:

Robert H. Alexander
Project Investigator
Skylab/EREP Investigation No. 469

Attachment 1— PCM count to temperature (°C) conversion

PCM	R2	R0	N	W	DEG C
0	1.3114E-04	-4.5043E-05	-1.5723E-04	-2.2453E-03	0.0
1	1.3590E-04	-3.8177E-05	-1.3326E-04	-1.9030E-03	0.0
2	1.4067E-04	-3.1311E-05	-1.0930E-04	-1.5608E-03	0.0
3	1.4543E-04	-2.4445E-05	-8.5330E-05	-1.2185E-03	0.0
4	1.5020E-04	-1.7579E-05	-6.1363E-05	-8.7627E-04	0.0
5	1.5496E-04	-1.0713E-05	-3.7396E-05	-5.3402E-04	0.0
6	1.5973E-04	-3.8473E-06	-1.3430E-05	-1.9177E-04	0.0
7	1.6449E-04	3.0187E-06	1.0537E-05	1.5047E-04	-201.2
8	1.6926E-04	9.8847E-06	3.4504E-05	4.9272E-04	-176.4
9	1.7402E-04	1.6751E-05	5.8471E-05	8.3496E-04	-162.8
10	1.7879E-04	2.3617E-05	8.2438E-05	1.1772E-03	-153.0
11	1.8355E-04	3.0483E-05	1.0640E-04	1.5195E-03	-145.0
12	1.8832E-04	3.7349E-05	1.3037E-04	1.8617E-03	-138.4
13	1.9308E-04	4.4215E-05	1.5434E-04	2.2040E-03	-132.6
14	1.9785E-04	5.1081E-05	1.7831E-04	2.5462E-03	-127.4
15	2.0261E-04	5.7947E-05	2.0227E-04	2.8884E-03	-122.8
16	2.0738E-04	6.4813E-05	2.2624E-04	3.2307E-03	-118.5
17	2.1214E-04	7.1679E-05	2.5021E-04	3.5729E-03	-114.5
18	2.1691E-04	7.8545E-05	2.7417E-04	3.9152E-03	-110.9
19	2.2167E-04	8.5411E-05	2.9814E-04	4.2574E-03	-107.5
20	2.2644E-04	9.2277E-05	3.2211E-04	4.5997E-03	-104.2
21	2.3120E-04	9.9143E-05	3.4607E-04	4.9419E-03	-101.2
22	2.3597E-04	1.0601E-04	3.7004E-04	5.2842E-03	-98.3
23	2.4073E-04	1.1287E-04	3.9401E-04	5.6264E-03	-95.5
24	2.4550E-04	1.1974E-04	4.1797E-04	5.9687E-03	-92.9
25	2.5026F-04	1.2661E-04	4.4194E-04	6.3109E-03	-90.3
26	2.5503E-04	1.3347E-04	4.6591E-04	6.6531E-03	-87.9
27	2.5979E-04	1.4034E-04	4.8987E-04	6.9954E-03	-85.6
28	2.6456E-04	1.4720E-04	5.1384E-04	7.3376E-03	-83.3
29	2.6932E-04	1.5407E-04	5.3781E-04	7.6799E-03	-81.1
30	2.7409E-04	1.6094E-04	5.6177E-04	8.0221E-03	-79.0
31	2.7885E-04	1.6780E-04	5.8574E-04	8.3644E-03	-77.0
32	2.8362E-04	1.7467E-04	6.0971E-04	8.7066E-03	-75.0
33	2.8839E-04	1.8153E-04	6.3367E-04	9.0489E-03	-73.1
34	2.9315E-04	1.8840E-04	6.5764E-04	9.3911E-03	-71.2
35	2.9791E-04	1.9527E-04	6.8161E-04	9.7334E-03	-69.4
36	3.0268E-04	2.0213E-04	7.0557E-04	1.0076E-02	-67.7
37	3.0744E-04	2.0900E-04	7.2954E-04	1.0418E-02	-65.9
38	3.1221E-04	2.1586E-04	7.5351E-04	1.0760E-02	-64.3
39	3.1697E-04	2.2273E-04	7.7748E-04	1.1102E-02	-62.6
40	3.2174F-04	2.2960E-04	8.0144E-04	1.1445E-02	-61.0
41	3.2650E-04	2.3646E-04	8.2541E-04	1.1787E-02	-59.5
42	3.3127E-04	2.4333E-04	8.4938E-04	1.2129E-02	-57.9
43	3.3603E-04	2.5019E-04	8.7334E-04	1.2471E-02	-56.4
44	3.4080E-04	2.5706E-04	8.9731E-04	1.2814E-02	-54.9
45	3.4556E-04	2.6393E-04	9.2128E-04	1.3156E-02	-53.5
46	3.5033E-04	2.7079E-04	9.4524E-04	1.3498E-02	-52.1
47	3.5509E-04	2.7766E-04	9.6921E-04	1.3840E-02	-50.7
48	3.5986E-04	2.8452E-04	9.9318E-04	1.4183E-02	-49.3
49	3.6462E-04	2.9139E-04	1.0171E-03	1.4525E-02	-48.0
50	3.6939E-04	2.9826E-04	1.0411E-03	1.4867E-02	-46.7
51	3.7415E-04	3.0512E-04	1.0651E-03	1.5209E-02	-45.4
52	3.7892E-04	3.1199E-04	1.0890E-03	1.5552E-02	-44.1
53	3.8368E-04	3.1885E-04	1.1130E-03	1.5894E-02	-42.9
54	3.8845E-04	3.2572E-04	1.1370E-03	1.6236E-02	-41.7
55	3.9321E-04	3.3259E-04	1.1610E-03	1.6578E-02	-40.4
56	3.9798E-04	3.3945E-04	1.1849E-03	1.6921E-02	-39.3
57	4.0274E-04	3.4632E-04	1.2089E-03	1.7263E-02	-38.1

PCH	R2	R0	N	W	DEG C
58	4.0751E-04	3.5318E-04	1.2328E-03	1.7605E-02	-36.9
59	4.1227E-04	3.6005E-04	1.2568E-03	1.7947E-02	-35.8
60	4.1704E-04	3.6692E-04	1.2808E-03	1.8290E-02	-34.7
61	4.2180E-04	3.7378E-04	1.3047E-03	1.8632E-02	-33.6
62	4.2657E-04	3.8065E-04	1.3287E-03	1.8974E-02	-32.5
63	4.3133E-04	3.8751E-04	1.3527E-03	1.9316E-02	-31.4
64	4.3610E-04	3.9438E-04	1.3766E-03	1.9659E-02	-30.3
65	4.4086E-04	4.0125E-04	1.4006E-03	2.0001E-02	-29.3
66	4.4563E-04	4.0811E-04	1.4245E-03	2.0343E-02	-28.2
67	4.5039E-04	4.1498E-04	1.4485E-03	2.0685E-02	-27.2
68	4.5516E-04	4.2184E-04	1.4725E-03	2.1027E-02	-26.2
69	4.5992E-04	4.2871E-04	1.4965E-03	2.1370E-02	-25.2
70	4.6469E-04	4.3558E-04	1.5204E-03	2.1712E-02	-24.2
71	4.6945E-04	4.4244E-04	1.5444E-03	2.2054E-02	-23.2
72	4.7422E-04	4.4931E-04	1.5684E-03	2.2396E-02	-22.3
73	4.7898E-04	4.5617E-04	1.5923E-03	2.2739E-02	-21.3
74	4.8375E-04	4.6304E-04	1.6163E-03	2.3081E-02	-20.4
75	4.8851E-04	4.6991E-04	1.6403E-03	2.3423E-02	-19.5
76	4.9328E-04	4.7677E-04	1.6642E-03	2.3765E-02	-18.5
77	4.9804E-04	4.8364E-04	1.6882E-03	2.4108E-02	-17.6
78	5.0281E-04	4.9050E-04	1.7122E-03	2.4450E-02	-16.7
79	5.0757E-04	4.9737E-04	1.7361E-03	2.4792E-02	-15.8
80	5.1234E-04	5.0424E-04	1.7601E-03	2.5134E-02	-14.9
81	5.1710E-04	5.1110E-04	1.7841E-03	2.5477E-02	-14.1
82	5.2187E-04	5.1797E-04	1.8080E-03	2.5819E-02	-13.2
83	5.2663E-04	5.2483E-04	1.8320E-03	2.6161E-02	-12.4
84	5.3140E-04	5.3170E-04	1.8560E-03	2.6503E-02	-11.5
85	5.3616E-04	5.3857E-04	1.8799E-03	2.6846E-02	-10.7
86	5.4093E-04	5.4543E-04	1.9039E-03	2.7188E-02	-9.8
87	5.4569E-04	5.5230E-04	1.9279E-03	2.7530E-02	-9.0
88	5.5046E-04	5.5916E-04	1.9518E-03	2.7872E-02	-8.2
89	5.5522E-04	5.6603E-04	1.9758E-03	2.8215E-02	-7.4
90	5.5999E-04	5.7290E-04	1.9998E-03	2.8557E-02	-6.6
91	5.6475E-04	5.7976E-04	2.0237E-03	2.8899E-02	-5.8
92	5.6952E-04	5.8663E-04	2.0477E-03	2.9241E-02	-5.0
93	5.7429E-04	5.9349E-04	2.0717E-03	2.9583E-02	-4.2
94	5.7905E-04	6.0036E-04	2.0957E-03	2.9926E-02	-3.4
95	5.8381E-04	6.0723E-04	2.1196E-03	3.0268E-02	-2.7
96	5.8858E-04	6.1409E-04	2.1436E-03	3.0610E-02	-1.9
97	5.9334E-04	6.2096E-04	2.1676E-03	3.0953E-02	-1.2
98	5.9811E-04	6.2782E-04	2.1915E-03	3.1295E-02	-0.4
99	6.0287E-04	6.3469E-04	2.2155E-03	3.1637E-02	0.3
100	6.0764E-04	6.4156E-04	2.2395E-03	3.1979E-02	1.1
101	6.1240E-04	6.4842E-04	2.2634E-03	3.2322E-02	1.8
102	6.1717E-04	6.5529E-04	2.2874E-03	3.2664E-02	2.5
103	6.2193E-04	6.6215E-04	2.3114E-03	3.3006E-02	3.2
104	6.2670E-04	6.6902E-04	2.3353E-03	3.3348E-02	4.0
105	6.3146E-04	6.7589E-04	2.3593E-03	3.3691E-02	4.7
106	6.3623E-04	6.8275E-04	2.3833E-03	3.4033E-02	5.4
107	6.4099E-04	6.8962E-04	2.4072E-03	3.4375E-02	6.1
108	6.4576E-04	6.9648E-04	2.4312E-03	3.4717E-02	6.8
109	6.5052E-04	7.0335E-04	2.4552E-03	3.5060E-02	7.4
110	6.5529E-04	7.1022E-04	2.4791E-03	3.5402E-02	8.1
111	6.6005E-04	7.1708E-04	2.5031E-03	3.5744E-02	8.8
112	6.6482E-04	7.2395E-04	2.5271E-03	3.6086E-02	9.5
113	6.6958E-04	7.3081E-04	2.5510E-03	3.6429E-02	10.1
114	6.7435E-04	7.3768E-04	2.5750E-03	3.6771E-02	10.8
115	6.7911E-04	7.4454E-04	2.5990E-03	3.7113E-02	11.5
116	6.8388E-04	7.5141E-04	2.6229E-03	3.7456E-02	12.1

PCM	R2	R0	N	W	DEG C
117	6.8864E-04	7.5828E-04	2.6469E-03	3.7798E-02	12.8
118	6.9341E-04	7.6514E-04	2.6709E-03	3.8140E-02	13.4
119	6.9817E-04	7.7201E-04	2.6948E-03	3.8482E-02	14.0
120	7.0294E-04	7.7888E-04	2.7188E-03	3.8824E-02	14.7
121	7.0770E-04	7.8574E-04	2.7428E-03	3.9167E-02	15.3
122	7.1247E-04	7.9261E-04	2.7667E-03	3.9509E-02	15.9
123	7.1723E-04	7.9947E-04	2.7907E-03	3.9851E-02	16.6
124	7.2200E-04	8.0634E-04	2.8147E-03	4.0193E-02	17.2
125	7.2676E-04	8.1321E-04	2.8386E-03	4.0536E-02	17.8
126	7.3153E-04	8.2007E-04	2.8626E-03	4.0878E-02	18.4
127	7.3629E-04	8.2694E-04	2.8866E-03	4.1220E-02	19.0
128	7.4106E-04	8.3380E-04	2.9105E-03	4.1562E-02	19.6
129	7.4582E-04	8.4067E-04	2.9345E-03	4.1905E-02	20.2
130	7.5059E-04	8.4754E-04	2.9585E-03	4.2247E-02	20.8
131	7.5535E-04	8.5440E-04	2.9824E-03	4.2589E-02	21.4
132	7.6012E-04	8.6127E-04	3.0064E-03	4.2931E-02	22.0
133	7.6488E-04	8.6813E-04	3.0304E-03	4.3273E-02	22.6
134	7.6965E-04	8.7500E-04	3.0543E-03	4.3616E-02	23.2
135	7.7441E-04	8.8187E-04	3.0783E-03	4.3958E-02	23.8
136	7.7918E-04	8.8873E-04	3.1023E-03	4.4300E-02	24.3
137	7.8394E-04	8.9560E-04	3.1262E-03	4.4642E-02	24.9
138	7.8871E-04	9.0246E-04	3.1502E-03	4.4985E-02	25.5
139	7.9347E-04	9.0933E-04	3.1742E-03	4.5327E-02	26.0
140	7.9824E-04	9.1620E-04	3.1981E-03	4.5669E-02	26.6
141	8.0300E-04	9.2306E-04	3.2221E-03	4.6011E-02	27.2
142	8.0777E-04	9.2993E-04	3.2461E-03	4.6354E-02	27.7
143	8.1253E-04	9.3679E-04	3.2700E-03	4.6696E-02	28.3
144	8.1730E-04	9.4366E-04	3.2940E-03	4.7038E-02	28.8
145	8.2206E-04	9.5053E-04	3.3180E-03	4.7380E-02	29.4
146	8.2683E-04	9.5739E-04	3.3419E-03	4.7723E-02	29.9
147	8.3159E-04	9.6426E-04	3.3659E-03	4.8065E-02	30.5
148	8.3636E-04	9.7112E-04	3.3899E-03	4.8407E-02	31.0
149	8.4112E-04	9.7799E-04	3.4138E-03	4.8749E-02	31.5
150	8.4589E-04	9.8486E-04	3.4378E-03	4.9092E-02	32.1
151	8.5065E-04	9.9172E-04	3.4618E-03	4.9434E-02	32.6
152	8.5542E-04	9.9859E-04	3.4857E-03	4.9776E-02	33.1
153	8.6018E-04	1.0055E-03	3.5097E-03	5.0118E-02	33.6
154	8.6495E-04	1.0123E-03	3.5337E-03	5.0461E-02	34.2
155	8.6971E-04	1.0192E-03	3.5576E-03	5.0803E-02	34.7
156	8.7448E-04	1.0261E-03	3.5816E-03	5.1145E-02	35.2
157	8.7924E-04	1.0329E-03	3.6056E-03	5.1487E-02	35.7
158	8.8401E-04	1.0398E-03	3.6295E-03	5.1830E-02	36.2
159	8.8877E-04	1.0466E-03	3.6535E-03	5.2172E-02	36.7
160	8.9354E-04	1.0535E-03	3.6775E-03	5.2514E-02	37.2
161	8.9830E-04	1.0604E-03	3.7014E-03	5.2856E-02	37.8
162	9.0307E-04	1.0672E-03	3.7254E-03	5.3199E-02	38.3
163	9.0783E-04	1.0741E-03	3.7494E-03	5.3541E-02	38.8
164	9.1260E-04	1.0810E-03	3.7733E-03	5.3883E-02	39.3
165	9.1736E-04	1.0878E-03	3.7973E-03	5.4225E-02	39.7
166	9.2213E-04	1.0947E-03	3.8213E-03	5.4568E-02	40.2
167	9.2689E-04	1.1016E-03	3.8452E-03	5.4910E-02	40.7
168	9.3166E-04	1.1084E-03	3.8692E-03	5.5252E-02	41.2
169	9.3642E-04	1.1153E-03	3.8932E-03	5.5594E-02	41.7
170	9.4119E-04	1.1222E-03	3.9171E-03	5.5937E-02	42.2
171	9.4595E-04	1.1290E-03	3.9411E-03	5.6279E-02	42.7
172	9.5072E-04	1.1359E-03	3.9651E-03	5.6621E-02	43.1
173	9.5548E-04	1.1428E-03	3.9890E-03	5.6963E-02	43.6
174	9.6025E-04	1.1496E-03	4.0130E-03	5.7306E-02	44.1
175	9.6501E-04	1.1565E-03	4.0370E-03	5.7648E-02	44.6

PCM	R2	R0	N	W	DEG C
176	9.6978E-04	1.1634E-03	4.0609E-03	5.7990E-02	45.0
177	9.7454E-04	1.1702E-03	4.0849E-03	5.8332E-02	45.5
178	9.7931E-04	1.1771E-03	4.1089E-03	5.8675E-02	46.0
179	9.8407E-04	1.1840E-03	4.1328E-03	5.9017E-02	46.4
180	9.8884E-04	1.1908E-03	4.1568E-03	5.9359E-02	46.9
181	9.9360E-04	1.1977E-03	4.1808E-03	5.9701E-02	47.4
182	9.9837E-04	1.2046E-03	4.2047E-03	6.0044E-02	47.8
183	1.0331E-03	1.2114E-03	4.2287E-03	6.0386E-02	48.3
184	1.0079E-03	1.2183E-03	4.2527E-03	6.0729E-02	48.7
185	1.0127E-03	1.2252E-03	4.2766E-03	6.1070E-02	49.2
186	1.0174E-03	1.2320E-03	4.3006E-03	6.1413E-02	49.6
187	1.0222E-03	1.2389E-03	4.3246E-03	6.1755E-02	50.1
188	1.0270E-03	1.2458E-03	4.3485E-03	6.2097E-02	50.5
189	1.0317E-03	1.2526E-03	4.3725E-03	6.2439E-02	51.0
190	1.0365E-03	1.2595E-03	4.3965E-03	6.2781E-02	51.4
191	1.0413E-03	1.2664E-03	4.4204E-03	6.3124E-02	51.9
192	1.0460E-03	1.2732E-03	4.4444E-03	6.3466E-02	52.3
193	1.0508E-03	1.2801E-03	4.4684E-03	6.3808E-02	52.7
194	1.0556E-03	1.2870E-03	4.4923E-03	6.4150E-02	53.2
195	1.0603E-03	1.2939E-03	4.5163E-03	6.4493E-02	53.6
196	1.0651E-03	1.3007E-03	4.5403E-03	6.4835E-02	54.0
197	1.0699E-03	1.3076E-03	4.5642E-03	6.5177E-02	54.5
198	1.0746E-03	1.3144E-03	4.5882E-03	6.5519E-02	54.9
199	1.0794E-03	1.3213E-03	4.6122E-03	6.5862E-02	55.3
200	1.0841E-03	1.3282E-03	4.6361E-03	6.6204E-02	55.7
201	1.0889E-03	1.3350E-03	4.6601E-03	6.6546E-02	56.2
202	1.0937E-03	1.3419E-03	4.6841E-03	6.6888E-02	56.6
203	1.0984E-03	1.3488E-03	4.7080E-03	6.7231E-02	57.0
204	1.1032E-03	1.3556E-03	4.7320E-03	6.7573E-02	57.4
205	1.1080E-03	1.3625E-03	4.7560E-03	6.7915E-02	57.9
206	1.1127E-03	1.3694E-03	4.7799E-03	6.8257E-02	58.3
207	1.1175E-03	1.3762E-03	4.8039E-03	6.8600E-02	58.7
208	1.1223E-03	1.3831E-03	4.8279E-03	6.8942E-02	59.1
209	1.1270E-03	1.3899E-03	4.8518E-03	6.9284E-02	59.5
210	1.1318E-03	1.3968E-03	4.8758E-03	6.9626E-02	59.9
211	1.1366E-03	1.4037E-03	4.8998E-03	6.9969E-02	60.3
212	1.1413E-03	1.4105E-03	4.9237E-03	7.0311E-02	60.7
213	1.1461E-03	1.4174E-03	4.9477E-03	7.0653E-02	61.1
214	1.1509E-03	1.4243E-03	4.9717E-03	7.0995E-02	61.5
215	1.1556E-03	1.4311E-03	4.9956E-03	7.1338E-02	61.9
216	1.1604E-03	1.4380E-03	5.0196E-03	7.1680E-02	62.3
217	1.1651E-03	1.4449E-03	5.0436E-03	7.2022E-02	62.7
218	1.1699E-03	1.4517E-03	5.0675E-03	7.2364E-02	63.1
219	1.1747E-03	1.4586E-03	5.0915E-03	7.2707E-02	63.5
220	1.1794E-03	1.4655E-03	5.1155E-03	7.3049E-02	63.9
221	1.1842E-03	1.4723E-03	5.1394E-03	7.3391E-02	64.3
222	1.1890E-03	1.4792E-03	5.1634E-03	7.3733E-02	64.7
223	1.1937E-03	1.4861E-03	5.1874E-03	7.4076E-02	65.1
224	1.1985E-03	1.4929E-03	5.2113E-03	7.4418E-02	65.5
225	1.2033E-03	1.4998E-03	5.2353E-03	7.4760E-02	65.9
226	1.2080E-03	1.5067E-03	5.2593E-03	7.5102E-02	66.3
227	1.2128E-03	1.5135E-03	5.2832E-03	7.5445E-02	66.7
228	1.2176E-03	1.5204E-03	5.3072E-03	7.5787E-02	67.0
229	1.2223E-03	1.5273E-03	5.3312E-03	7.6129E-02	67.4
230	1.2271E-03	1.5341E-03	5.3551E-03	7.6471E-02	67.8
231	1.2319E-03	1.5410E-03	5.3791E-03	7.6814E-02	68.2
232	1.2366E-03	1.5479E-03	5.4031E-03	7.7156E-02	68.6
233	1.2414E-03	1.5547E-03	5.4270E-03	7.7498E-02	69.0
234	1.2461E-03	1.5616E-03	5.4510E-03	7.7840E-02	69.3

ORIGINAL PAGE IS
OF POOR QUALITY

PCW	R2	RO	N	V	DEG C
235	1.2509E-03	1.5655E-03	5.4750E-03	7.8183E-02	69.7
236	1.2557E-03	1.5753E-03	5.4989E-03	7.8525E-02	70.1
237	1.2604E-03	1.5822E-03	5.5229E-03	7.8867E-02	70.5
238	1.2652E-03	1.5891E-03	5.5469E-03	7.9209E-02	70.8
239	1.2700E-03	1.5959E-03	5.5708E-03	7.9552E-02	71.2
240	1.2747E-03	1.6028E-03	5.5948E-03	7.9894E-02	71.6
241	1.2795E-03	1.6097E-03	5.6188E-03	8.0236E-02	71.9
242	1.2843E-03	1.6165E-03	5.6427E-03	8.0578E-02	72.3
243	1.2890E-03	1.6234E-03	5.6667E-03	8.0920E-02	72.7
244	1.2938E-03	1.6303E-03	5.6907E-03	8.1263E-02	73.0
245	1.2985E-03	1.6371E-03	5.7146E-03	8.1605E-02	73.4
246	1.3033E-03	1.6440E-03	5.7386E-03	8.1947E-02	73.8
247	1.3081E-03	1.6509E-03	5.7626E-03	8.2289E-02	74.1
248	1.3129E-03	1.6577E-03	5.7865E-03	8.2632E-02	74.5
249	1.3176E-03	1.6646E-03	5.8105E-03	8.2974E-02	74.8
250	1.3224E-03	1.6715E-03	5.8345E-03	8.3316E-02	75.2
251	1.3272E-03	1.6783E-03	5.8584E-03	8.3659E-02	75.6
252	1.3319E-03	1.6852E-03	5.8824E-03	8.4001E-02	75.9
253	1.3367E-03	1.6921E-03	5.9064E-03	8.4343E-02	76.3
254	1.3414E-03	1.6989E-03	5.9303E-03	8.4685E-02	76.6
255	1.3462E-03	1.7058E-03	5.9543E-03	8.5027E-02	77.0

Attachment 2 -- Histogram of pixels per PCM count

ORIGINAL PAGE IS
OF POOR QUALITY.

← 8.8°C

Lowest Temp. = -3.4°C

Highest Temp. = 52.3°C

← 46.4°C

DN= CT= 235. # PIXELS= 0
DN= CT= 236. # PIXELS= 0
DN= CT= 237. # PIXELS= 0
DN= CT= 238. # PIXELS= 0
DN= CT= 239. # PIXELS= 0
DN= CT= 240. # PIXELS= 0
DN= CT= 241. # PIXELS= 0
DN= CT= 242. # PIXELS= 0
DN= CT= 243. # PIXELS= 0
DN= CT= 244. # PIXELS= 0
DN= CT= 245. # PIXELS= 0
DN= CT= 246. # PIXELS= 0
DN= CT= 247. # PIXELS= 0
DN= CT= 248. # PIXELS= 0
DN= CT= 249. # PIXELS= 0
DN= CT= 250. # PIXELS= 0
DN= CT= 251. # PIXELS= 0
DN= CT= 252. # PIXELS= 0
DN= CT= 253. # PIXELS= 0
DN= CT= 254. # PIXELS= 0
DN= CT= 255. # PIXELS= 0

Attachment 3 -- Statistical summary

ORIGINAL PAGE IS OF POOR QUALITY

0	0	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	1	95	0	96	0	97	1	98	0	99	1
100	1	101	3	102	1	103	3	104	3	105	3	106	7	107	5	108	6	109	6
110	5	111	15	112	11	113	4	114	11	115	8	116	10	117	22	118	21	119	21
120	23	121	22	122	24	123	20	124	41	125	45	126	31	127	30	128	44	129	44
130	[illegible]	131	65	132	52	133	61	134	48	135	63	136	77	137	75	138	115	139	94
140	[illegible]	141	122	142	155	143	144	144	195	145	186	146	203	147	278	148	594	149	652
150	751	151	756	152	652	153	878	154	848	155	837	156	626	157	524	158	465	159	396
160	[illegible]	161	270	162	251	163	216	164	190	165	156	166	157	167	106	168	74	169	74
170	52	171	46	172	31	173	25	174	25	175	26	176	22	177	16	178	20	179	10
180	[illegible]	181	6	182	6	183	3	184	2	185	1	186	1	187	0	188	0	189	0
190	0	191	0	192	1	193	0	194	0	195	0	196	0	197	0	198	0	199	0
200	0	201	0	202	0	203	0	204	0	205	0	206	0	207	0	208	0	209	0
210	0	211	0	212	0	213	0	214	0	215	0	216	0	217	0	218	0	219	0
220	0	221	0	222	0	223	0	224	0	225	0	226	0	227	0	228	0	229	0
230	0	231	0	232	0	233	0	234	0	235	0	236	0	237	0	238	0	239	0
240	0	241	0	242	0	243	0	244	0	245	0	246	0	247	0	248	0	249	0
250	0	251	0	252	0	253	0	254	0	255	0		0	0	0	0	0	0	0

SUM OF OBSERVATIONS= 1939458
NUMBER OF OBSERVATIONS= 12772
MODE= 153.00000
MEDIAN= 152.00000
MEAN= 151.85233
STANDARD DEVIATION= 10.08963
SKEWNESS: PEARSONS 1 (MODE)= -.34124
SKEWNESS: PEARSONS 2 (MED.)= -.34124

Attachment 4 -- Sample of output from the
Outcalt climate simulator

LATITUDE= 39.9
MEAN DIURNAL AIR TEMP.(C)= 21.0
SOLAR DECLINATION= 1N.4
AIR SATURATION FRACTION= 0.40
STARTING PRESSURE (MB)=1000.
AIR WIND VELOCITY(CM/SEC)= 50.
DUST PARTICLES/CC= 2.0
SOIL THERMAL DIFFUSIVITY(CGS)=.0050
ORBITAL RADIUS VECTOR=1.01506
SOIL HEAT CAPACITY(CGS)=.5000
ALBEDO=0.20
ROUGHNESS LENGTH(CM)= 20.
PRECIPITABLE WATER(CM)= 10.
SOIL WET FRACTION=1.00
SKY EMISSIVITY TEMP.(C)= -1.0
SIMPLETTE=0.10
EXP. SHAPE= 0.0
SLOPE= 0.0

SOIL THERMAL DEPTH(CM)= 51.
AIR MIXING DEPTH(CM)= 1240.
AIR HEAT TRANSFER COEF.(CGS)= 0.00100

TIME (SUN)	EAT TEMP	BEAM	DIFF	BACK	TOTAL	VERT RAD	SLOPE RAD
		LY/MIN					
5.	2n.	0.	13.	1.	15.	0.	12.
6.	3n2.	114.	91.	10.	214.	658.	180.
7.	7n4.	304.	114.	14.	442.	945.	403.
8.	10n4.	534.	124.	17.	715.	977.	657.
9.	13n2.	741.	130.	19.	1029.	892.	879.
10.	15n4.	1078.	133.	20.	1228.	770.	1040.
11.	17n7.	1149.	135.	21.	1334.	672.	1137.
12.	18n3.	1242.	136.	21.	1234.	634.	1169.
13.	17n7.	1104.	135.	21.	1355.	672.	1137.
14.	16n4.	1078.	133.	20.	1224.	770.	1040.
15.	13n2.	941.	131.	19.	1029.	892.	879.
16.	10n4.	534.	124.	17.	775.	977.	657.
17.	7n4.	304.	114.	14.	442.	945.	403.
18.	3n2.	114.	91.	10.	214.	658.	180.
19.	2n.	0.	11.	1.	15.	0.	12.

SOLAR TIME	SOIL	AT	S	N	LE	T (C.)
			ALL LY/MIN			
0.	0.	-7n.	6n.	103.	-95.	12.4
1.	0.	-7n.	63.	104.	-93.	12.2
2.	0.	-7n.	64.	105.	-91.	12.1
3.	0.	-7n.	67.	106.	-90.	12.0
4.	0.	-7n.	63.	107.	-87.	11.9

0.	12.	-62.	45.	166.	-49.	12.0
1.	140.	92.	-27.	64.	-144.	14.5
2.	401.	204.	-90.	-7.	-251.	17.8
3.	737.	524.	-134.	-0.	-341.	21.1
4.	771.	721.	-152.	-43.	-531.	23.9
5.	1003.	871.	-150.	-78.	-649.	24.8
6.	1137.	965.	-139.	-99.	-724.	26.9
7.	1199.	999.	-120.	-109.	-765.	27.4
8.	1137.	967.	-95.	-104.	-766.	27.4
9.	1003.	871.	-64.	-93.	-712.	26.7
10.	825.	715.	-26.	-70.	-622.	25.3
11.	657.	577.	21.	-34.	-499.	23.3
12.	511.	477.	72.	10.	-359.	20.4
13.	440.	477.	114.	51.	-234.	17.4
14.	12.	536.	103.	84.	-121.	14.6
15.	0.	611.	110.	93.	-125.	13.5
16.	0.	711.	94.	87.	-115.	13.2
17.	0.	771.	64.	99.	-104.	12.9
18.	0.	771.	29.	101.	-103.	12.7

SOIL TEMPERATURE MATRIX

TIME(HRS)	0.	6.	12.	25.
0.0	12.0	13.5	15.1	17.1	18.4
1.00	12.2	13.6	14.8	16.8	18.5
2.00	12.1	13.4	14.5	16.5	18.4
3.00	12.0	13.2	14.3	16.2	18.3
4.00	11.9	13.1	14.1	16.0	18.2
5.00	12.0	13.0	14.0	15.9	18.1
6.00	12.2	13.0	14.2	15.7	18.0
7.00	12.6	13.2	14.3	15.8	18.0
8.00	13.1	13.6	14.6	16.0	18.1
9.00	13.9	14.2	15.0	16.3	18.3
10.00	14.9	15.0	15.6	16.7	18.6
11.00	15.9	15.9	16.4	17.2	18.8
12.00	16.9	16.9	17.2	17.8	19.1
13.00	17.8	17.8	18.1	18.5	19.4
14.00	18.6	18.6	18.9	19.1	19.7
15.00	19.3	19.3	19.6	19.7	19.9
16.00	19.8	19.8	20.1	20.2	20.0
17.00	20.1	20.1	20.3	20.4	20.1
18.00	20.4	20.3	20.4	20.5	20.1
19.00	20.4	20.3	20.4	20.4	20.0
20.00	20.3	20.2	20.3	20.3	19.9
21.00	20.1	20.0	20.1	20.1	19.9
22.00	19.9	19.8	19.9	19.9	19.8
23.00	19.7	19.6	19.7	19.7	19.7
24.00	19.5	19.5	19.5	19.5	19.5