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Heat Budget Observations for the FIRE/SRB Wisconsin Experiment Region from October 9 Through November 2, 1986

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TABLE OF CONTENTS

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by

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SUMMARY

A map and concise tables are presented which show locations, pixel size, and heat budget products from the NOAA-9 satellite for the FIRE/SRB Wisconsin experiment region during October 9 through November 2, 1986. In addition to the operational standard products, a narrowband albedo parameter is calculated and presented based on values from AVHRR band 1. This parameter is useful in identifying and/or quantifying clouds on a global basis using a polar-stereographic grid system.

INTRODUCTION

A field experiment was conducted in Wisconsin during October 1986 for purposes of both intensive cirrus-cloud measurements and Surface Radiation Budget (SRB) algorithm validation activities. The cirrus-cloud measurements were part of the First ISCCP (International Satellite Cloud Climatology Project) Regional Experiment (FIRE) as described by Starr[1]. The algorithm validation activity was the first experiment of an SRB algorithm intercomparison program based on scientific recommendations from Suttles and Ohring[2]. Both the FIRE and SRB experiments require use of heat budget and albedo data products. It is the purpose of this document to present those data in a concise form such that investigators from both programs may quickly evaluate the usefulness of this satellite product to their own particular needs.

DATA DESCRIPTION

Heat budget parameters are given over a hemispheric 125 by 125 element polar-stereographic grid. Values for each element in the grid are determined by averaging an 11 by 11 array of Advanced Very High Resolution Radiometer (AVHRR) Global Area Coverage (GAC) values surrounding the element location. Each GAC pixel is made up of four smaller AVHRR Local Area Coverage (LAC) pixels. Along an instrument scan, four overlapping LAC pixels are averaged to produce a GAC pixel (see figure 1). On the same scan, a LAC pixel is skipped and another four LAC pixels are

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averaged to produce the adjacent along-scan GAC pixel. This averaging-skipping process is continued until the end of that particular instrument scan. All LAC pixels on the next two scans are then ignored, and the four-pixel averaging, one-pixel skipping process is again applied on the third instrument scan later in the satellite orbit track. Alongtrack GAC pixels are spaced three scans apart. The along-scan and alongtrack distances between adjacent GAC pixels (resolution) are 4.14 by 3.55 km (visible band) and 3.88 by 3.32 km (infrared band) at the subsatellite point. The GAC resolution area consists of 4 counted LAC pixels and 11 ignored LAC vaules. The 11 by 11 array of GAC pixels used to obtain heat budget values is therefore based on actual measurements of only 26.7 percent of the area covered by the 11 by 11 GAC array. At the subsatellite point, the heat budget pixel is 45 by 39 km (visible band) and 42 by 36 km (infrared band). The array size becomes 140 by 39 km (visible band) and 131 by 36 km (infrared band) at the edge of the scan.

Figure 2 is a 725 by 950 km map showing the polar-stereographic element locations along with those of the FIRE/SRB surface stations, where shortwave (SW) and/or longwave (LW) downwelled irradiance data were obtained. Coordinates for the polar-stereographic elements are given in table 1, and table 2 gives locations for the FIRE/SRB ground stations. Times of the NOAA-9 overpasses are given in table 3. (Zero hour GMT for October 10 is actually 6 p.m. c.s.t. on October 9 at the surface stations.) Local sunrise was at approximately 12:30 GMT and sunset was near 23:00 GMT. Also given in table 3 are the approximate pixel sizes of the heat budget data after the 11 by 11 averaging of the GAC values has been completed. The size values given are based on the center of the 16-element polar-stereographic grid.

The polar-stereographic grid shown in the figure is approximately 500 by 500 km in size. Over the 25-day experiment, there should have been 400 (16 elements times 25 days) NOAA-9 heat budget data sets in this region based on orbit and view-angle calculations. Parts of four sets on October 26 and six sets on October 31 are missing from the standard-product tapes indicating a data acquisition success rate of 97.5 percent for this particular satellite product.

Table 4 gives top-of-the-atmosphere values for an albedo parameter, absorbed solar radiation, and available downwelled solar radiation over the bandwidth (0.58-0.68 micrometers) of NOAA-9 AVHRR channel 1. Both daytime and nighttime upwelled longwave radiation are also given. Rows or columns with ***** symbols denote either missing or undefined data. Absorbed solar radiation, available solar radiation, and longwave radiation are taken directly from the heat budget standard product tapes. Analysis methods and data limitations for these parameters are given in Gruber[3] and Gruber, et al.[4]. The albedo parameter (A) was computed from tape values of absorbed solar (S) and available solar (I_o) using the following equation:

$$A = 1 - \frac{S}{I_o} \qquad (1)$$

The above equation is the inverse of that used to compute absorbed solar radiance from AVHRR albedo for the standard product tapes. The albedo parameter is a narrowband value relative to a Lambertian surface without directional effects being fully considered. Satellite visible counts are divided by the cosine of the solar zenith angle, but are not corrected for the bidirectional reflectance function of the observed surface. It is assumed that albedo value does not depend on either solar zenith or satellite-viewing angles in either elevation or azimuth. The resulting value has to be viewed with some caution because of these assumptions.

As part of the Wisconsin SRB experiment, U-2 aircraft flights were conducted over White Sands, New Mexico, using a NOAA spectrometer to validate prelaunch calibration of the AVHRR instrument. In addition, the University of California used an indirect technique test the AVHRR calibration during the same time period. Preliminary results* suggest a moderate change in calibration values for both channels 1 and 2 of the satellite instrument. If final results confirm the change, data contained in this document may require future correction.

CONCLUDING REMARKS

The region examined in this study was approximately 500 by 500 km in size. Over the 25-day period of the investigation, 97.5 percent of the possible NOAA-9 data were obtained. While the standard product polar-stereographic grid system did not coincide with the FIRE/SRB surface stations, it is believed that the data may provide a useful test of area averaging procedures.

REFERENCES

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2. Suttles, J. T., and Ohring, G.: Surface Radiation Budget for Climate Applications. NASA RP-1169, 1986.

3. Gruber, Arnold: Determination of the Earth-Atmosphere Radiation Budget From NOAA Satellite Data. NOAA Technical Report NESS 76, March 1978.

4. Gruber, Arnold; Ruff, Irwin; and Earnest, Charles: Determination of the Planetary Radiation Budget From TIROS-N Satellites. NOAA Technical Report NESDIS 3, August 1983.

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* Personal communications with G. R. Smith, NOAA NESDIS, and Robert Frouin, U. California, June 1987.

TABLE 1. COORDINATES OF HEAT BUDGET GRID POINTS

Grid point	Latitude (deg N)	Longitude (deg W)
A	45.60	93.50
B	45.94	91.31
C	46.21	89.09
D	46.43	86.84
E	44.09	92.99
F	44.41	90.89
G	44.67	88.75
H	44.88	86.58
I	42.59	92.53
J	42.90	90.49
K	43.15	88.43
L	43.35	86.34
M	41.11	92.09
N	41.40	90.12
O	41.64	88.13
P	41.83	86.12

TABLE 2. COORDINATES OF FIRE/SRB SURFACE STATIONS

Station	Latitude (deg N)	Longitude (deg W)
1. Madison(Truax)	43.13	89.32
2. Ft. McCoy	43.96	90.76
3. Stevens Point	44.55	89.53
4. Baraboo	43.52	89.77
5. Adams County	43.97	89.80
6. Wautoma	44.04	89.30
7. Oshkosh	43.99	88.56
8. Wausau	44.92	89.62
9. Arlington	43.33	89.37
10. Portage	43.56	89.48
11. Reedsburg	43.53	89.97
12. Plain	43.28	90.04
13. Tri-County	43.21	90.19
14. Dodgeville	42.99	90.15
15. Mt. Horeb	43.00	89.74
16. Arena	43.16	89.91
17. Sauk City	43.30	89.74
18. Middleton	43.11	89.53

TABLE 3. SATELLITE TIMES AND PIXEL SIZES

	NOAA-9 Overpass Time (GMT)		Average Pixel Size		
Day	Night	Day	Day visible (km)	Day infrared (km)	Night infrared (km)
Oct 9	9:35	21:03	85x39	82x36	44x36
Oct 10	9:24	20:52	72x39	67x36	42x36
Oct 11	9:13	20:41	59x39	54x36	47x36
Oct 12	9:02	20:30	50x39	46x36	56x36
Oct 13	8:51	20:20	45x39	42x36	69x36
Oct 14	8:41	20:09	47x39	45x36	86x36
Oct 15	10:11	19:58	55x39	52x36	82x36
Oct 16	10:00	19:47	67x39	63x36	66x36
Oct 17	9:49	19:36	82x39	77x36	54x36
Oct 18	9:38	21:07	94x39	88x36	45x36
Oct 19	9:28	20:56	77x39	72x36	42x36
Oct 20	9:17	20:45	62x39	58x36	45x36
Oct 21	9:06	20:34	52x39	48x36	52x36
Oct 22	8:55	20:23	46x39	43x36	64x36
Oct 23	8:45	20:13	46x39	43x36	81x36
Oct 24	10:14	20:02	52x39	49x36	86x36
Oct 25	10:04	19:51	63x39	59x36	70x36
Oct 26	9:53	19:41	77x39	72x36	57x36
Oct 27	9:42	19:30	94x39	87x36	47x36
Oct 28	9:32	21:00	82x39	76x36	43x36
Oct 29	9:21	20:49	66x39	61x36	44x36
Oct 30	9:10	20:38	54x39	50x36	50x36
Oct 31	8:59	20:27	47x39	44x36	60x36
Nov 1	8:49	20:17	45x39	42x36	75x36
Nov 2	10:18	20:06	50x39	47x36	91x36

TABLE 4. HEAT BUDGET DATA

OCTOBER 9

Grid point	Albedo parameter (0-1)	Absorbed solar radiation (W/m^2)	Available solar energy (W/m^2)	Daytime longwave radiation (W/m^2)	Nighttime longwave radiation (W/m^2)
A	0.116	224.2	253.6	262.7	233.5
B	0.103	225.7	251.5	259.4	231.6
C	0.100	224.7	249.8	253.9	227.5
D	0.167	206.9	248.5	243.8	231.6
E	0.125	229.9	262.8	267.0	194.6
F	0.111	231.8	260.8	263.4	203.3
G	0.139	223.2	259.2	257.0	202.1
H	0.180	211.6	258.0	247.9	207.7
I	0.238	207.0	271.7	258.6	207.6
J	0.182	220.8	269.9	257.3	212.2
K	0.284	192.3	268.4	238.6	219.8
L	0.151	226.8	267.2	245.3	235.6
M	0.351	181.9	280.3	234.2	241.3
N	0.405	165.9	278.7	229.5	244.1
O	0.443	154.5	277.3	213.1	245.1
P	0.287	197.0	276.2	234.1	239.5

TABLE 4. CONTINUED

OCTOBER 10

Grid point	Albedo parameter (0-1)	Absorbed solar radiation (W/m^2)	Available solar energy (W/m^2)	Daytime longwave radiation (W/m^2)	Nighttime longwave radiation (W/m^2)
A	0.605	98.9	250.2	225.8	229.3
B	0.357	159.5	248.2	236.4	229.5
C	0.158	207.4	246.4	241.7	227.1
D	0.289	174.2	245.1	230.8	234.8
E	0.344	170.2	259.5	247.2	237.4
F	0.200	205.9	257.5	255.7	233.7
G	0.267	187.7	255.9	249.6	233.4
H	0.150	216.4	254.7	254.7	247.6
I	0.269	196.4	268.5	255.2	240.6
J	0.183	217.9	266.7	263.1	236.5
K	0.156	223.8	265.2	262.5	238.6
L	0.115	233.7	264.0	261.1	246.8
M	0.153	234.9	277.2	267.2	245.4
N	0.121	242.3	275.5	273.0	242.9
O	0.123	240.3	274.1	271.4	241.5
P	0.112	242.4	273.0	268.6	243.8

TABLE 4. CONTINUED

OCTOBER 11

Grid point	Albedo parameter (0-1)	Absorbed solar radiation (W/m^2)	Available solar energy (W/m^2)	Daytime longwave radiation (W/m^2)	Nighttime longwave radiation (W/m^2)
A	0.623	93.2	246.9	152.4	184.3
B	0.643	87.4	244.8	156.3	186.8
C	0.699	73.1	243.1	157.1	207.1
D	0.652	84.2	241.7	176.4	230.5
E	0.687	80.1	256.2	145.2	157.0
F	0.611	99.0	254.3	174.9	181.2
G	0.581	105.8	252.6	183.1	215.4
H	0.480	130.7	251.4	191.2	239.8
I	0.639	95.8	265.3	163.4	183.2
J	0.539	121.3	263.4	177.7	207.5
K	0.414	153.6	261.9	177.2	238.2
L	0.326	175.6	260.7	191.8	245.8
M	0.514	133.1	274.1	180.7	207.8
N	0.435	154.0	272.4	189.0	245.1
O	0.307	187.7	270.9	201.7	248.9
P	0.251	202.2	269.8	217.8	246.1

TABLE 4. CONTINUED

OCTOBER 12

Grid point	Albedo parameter (0-1)	Absorbed solar radiation (W/m^2)	Available solar energy (W/m^2)	Daytime longwave radiation (W/m^2)	Nighttime longwave radiation (W/m^2)
A	0.499	122.4	244.4	211.5	200.6
B	0.546	110.0	242.3	221.8	195.0
C	0.524	114.5	240.6	238.0	163.8
D	0.612	92.9	239.2	246.1	146.3
E	0.502	126.3	253.8	223.2	202.3
F	0.497	126.6	251.8	229.0	186.9
G	0.526	118.5	250.2	238.5	170.7
H	0.628	92.6	248.9	247.2	161.6
I	0.515	127.5	262.9	226.2	214.9
J	0.519	125.6	261.0	229.4	189.1
K	0.577	109.8	259.5	231.9	160.0
L	0.551	115.9	258.3	225.9	198.1
M	0.492	138.1	271.7	228.0	235.6
N	0.601	107.6	270.0	204.3	163.3
O	0.594	109.1	268.6	165.5	161.8
P	0.630	98.9	267.5	143.3	193.1

TABLE 4. CONTINUED

OCTOBER 13

Grid point	Albedo parameter (0-1)	Absorbed solar radiation (W/m^2)	Available solar energy (W/m^2)	Daytime longwave radiation (W/m^2)	Nighttime longwave radiation (W/m^2)
A	0.441	135.2	241.7	199.0	217.1
B	0.511	117.2	239.6	201.9	208.2
C	0.527	112.5	237.8	195.6	218.9
D	0.520	113.4	236.4	219.5	229.9
E	0.552	112.4	251.1	184.2	183.5
F	0.597	100.4	249.2	165.5	198.7
G	0.572	106.0	247.5	190.8	222.1
H	0.642	88.2	246.2	191.7	230.7
I	0.548	117.6	260.3	184.2	161.9
J	0.482	134.0	258.5	199.3	185.9
K	0.561	112.8	256.9	207.4	218.4
L	0.618	97.7	255.7	213.1	234.6
M	0.454	147.1	269.3	205.0	165.2
N	0.436	150.9	267.5	217.0	189.3
O	0.569	114.7	266.1	224.4	232.6
P	0.631	97.9	265.0	212.8	239.8

TABLE 4. CONTINUED

OCTOBER 14

Grid point	Albedo parameter (0-1)	Absorbed solar radiation (W/m^2)	Available solar energy (W/m^2)	Daytime longwave radiation (W/m^2)	Nighttime longwave radiation (W/m^2)
A	0.104	213.5	238.4	246.2	191.3
B	0.224	183.4	236.2	223.3	170.6
C	0.461	126.5	234.5	197.0	183.3
D	0.343	153.1	233.1	204.3	200.9
E	0.129	215.9	247.9	244.7	190.8
F	0.281	176.9	245.9	224.8	183.3
G	0.495	123.4	244.2	203.1	199.5
H	0.427	139.1	242.9	205.9	201.1
I	0.188	208.7	257.1	239.9	210.5
J	0.361	163.2	255.3	215.1	191.6
K	0.426	145.5	253.7	206.2	211.9
L	0.497	126.9	252.5	197.7	207.9
M	0.206	211.3	266.1	238.8	227.3
N	0.311	182.3	264.4	221.1	207.2
O	0.321	178.4	262.9	215.9	212.9
P	0.451	143.8	261.8	208.5	218.3

TABLE 4. CONTINUED

OCTOBER 15

Grid point	Albedo parameter (0-1)	Absorbed solar radiation (W/m^2)	Available solar energy (W/m^2)	Daytime longwave radiation (W/m^2)	Nighttime longwave radiation (W/m^2)
A	0.242	178.1	235.0	229.8	228.8
B	0.401	139.4	232.9	216.0	226.3
C	0.341	152.2	231.1	213.1	223.1
D	0.137	198.2	229.7	234.8	225.2
E	0.160	205.5	244.6	251.5	229.8
F	0.276	175.6	242.6	233.9	229.6
G	0.263	177.5	240.9	229.1	231.6
H	0.256	178.3	239.6	231.8	229.9
I	0.145	217.2	253.9	263.8	231.0
J	0.070	234.4	252.0	260.9	230.1
K	0.075	231.7	250.5	257.4	235.1
L	0.184	203.4	249.2	242.4	230.6
M	0.115	232.8	263.0	267.1	235.1
N	0.074	241.9	261.2	268.6	233.5
O	0.072	241.0	259.8	266.3	234.1
P	0.184	211.1	258.6	246.6	230.8

TABLE 4. CONTINUED

OCTOBER 16

Grid point	Albedo parameter (0-1)	Absorbed solar radiation (W/m^2)	Available solar energy (W/m^2)	Daytime longwave radiation (W/m^2)	Nighttime longwave radiation (W/m^2)
A	0.141	199.8	232.5	266.3	234.4
B	0.498	115.6	230.4	236.6	230.7
C	0.551	102.7	228.6	226.4	223.2
D	0.437	127.9	227.2	225.8	204.4
E	0.141	208.0	242.1	270.8	232.4
F	0.275	174.1	240.1	252.7	218.7
G	0.564	104.0	238.5	229.8	193.5
H	0.588	97.6	237.1	225.6	175.4
I	0.140	216.3	251.5	273.4	227.2
J	0.161	209.5	249.6	265.8	215.7
K	0.373	155.5	248.0	243.5	176.6
L	0.573	105.5	246.8	231.2	160.0
M	0.124	228.4	260.6	272.4	228.8
N	0.201	206.7	258.8	263.4	210.2
O	0.267	188.7	257.4	246.2	187.0
P	0.288	182.4	256.2	236.4	183.7

TABLE 4. CONTINUED

OCTOBER 17

Grid point	Albedo parameter (0-1)	Absorbed solar radiation (W/m^2)	Available solar energy (W/m^2)	Daytime longwave radiation (W/m^2)	Nighttime longwave radiation (W/m^2)
A	0.385	141.3	229.7	246.4	236.0
B	0.396	137.3	227.5	238.0	227.6
C	0.101	203.0	225.7	251.5	221.9
D	0.067	209.2	224.3	252.3	223.7
E	0.317	163.5	239.4	252.9	238.4
F	0.283	170.1	237.3	246.9	232.8
G	0.241	178.8	235.7	246.6	225.4
H	0.179	192.3	234.3	246.8	226.6
I	0.236	190.1	248.8	260.4	241.3
J	0.233	189.3	246.9	255.5	237.8
K	0.445	136.2	245.3	236.9	231.4
L	0.258	181.1	244.1	244.5	233.4
M	0.149	219.5	258.0	268.8	246.6
N	0.196	206.1	256.2	262.7	241.9
O	0.269	186.2	254.7	255.7	234.9
P	0.332	169.3	253.6	246.8	232.9

TABLE 4. CONTINUED

OCTOBER 18

Grid point	Albedo parameter (0-1)	Absorbed solar radiation (W/m^2)	Available solar energy (W/m^2)	Daytime longwave radiation (W/m^2)	Nighttime longwave radiation (W/m^2)
A	0.132	196.6	226.4	265.7	237.4
B	0.114	198.6	224.2	262.8	231.2
C	0.100	200.2	222.4	261.1	228.3
D	0.107	197.3	221.0	257.4	235.9
E	0.145	201.8	236.1	267.2	237.5
F	0.128	204.1	234.1	265.4	233.7
G	0.183	189.9	232.4	259.0	232.7
H	0.163	193.3	231.0	255.5	244.1
I	0.147	209.4	245.6	269.9	237.9
J	0.145	208.3	243.7	268.1	236.3
K	0.145	207.1	242.1	264.2	238.1
L	0.103	216.1	240.8	262.0	245.8
M	0.128	222.2	254.8	270.9	241.7
N	0.140	217.7	253.0	273.0	239.2
O	0.136	217.5	251.6	273.1	237.4
P	0.129	218.1	250.4	269.1	239.4

TABLE 4. CONTINUED

OCTOBER 19

Grid point	Albedo parameter (0-1)	Absorbed solar radiation (W/m^2)	Available solar energy (W/m^2)	Daytime longwave radiation (W/m^2)	Nighttime longwave radiation (W/m^2)
A	0.149	190.5	223.9	257.0	238.9
B	0.110	197.3	221.7	267.8	234.6
C	0.105	196.9	219.9	268.2	233.3
D	0.101	196.4	218.5	263.9	242.8
E	0.142	200.4	233.7	261.7	240.2
F	0.128	201.9	231.6	269.1	237.3
G	0.129	200.2	229.9	269.7	237.0
H	0.111	203.2	228.6	262.1	249.1
I	0.131	211.4	243.2	271.7	244.1
J	0.144	206.5	241.3	271.4	239.4
K	0.131	208.4	239.7	271.6	241.7
L	0.112	211.6	238.4	264.8	249.0
M	0.122	221.7	252.5	274.7	249.1
N	0.166	209.0	250.7	272.9	242.6
O	0.139	214.5	249.2	278.4	238.2
P	0.135	214.4	248.0	273.6	239.6

TABLE 4. CONTINUED

OCTOBER 20

Grid point	Albedo parameter (0-1)	Absorbed solar radiation (W/m^2)	Available solar energy (W/m^2)	Daytime longwave radiation (W/m^2)	Nighttime longwave radiation (W/m^2)
A	0.097	199.2	220.6	278.5	251.6
B	0.100	196.5	218.4	275.1	244.9
C	0.120	190.7	216.6	271.7	237.7
D	0.178	176.8	215.1	255.1	238.4
E	0.111	204.8	230.4	278.4	238.9
F	0.148	194.4	228.3	268.1	235.0
G	0.198	181.8	226.6	259.2	242.1
H	0.190	182.4	225.3	256.9	251.5
I	0.127	209.5	240.0	274.8	252.4
J	0.116	210.5	238.0	276.4	243.3
K	0.136	204.2	236.4	271.8	245.5
L	0.261	173.8	235.2	243.9	250.0
M	0.136	215.3	249.3	267.9	253.6
N	0.172	205.0	247.5	268.4	249.1
O	0.157	207.5	246.0	274.3	243.7
P	0.288	174.3	244.8	251.2	239.3

TABLE 4. CONTINUED

OCTOBER 21

Grid point	Albedo parameter (0-1)	Absorbed solar radiation (W/m^2)	Available solar energy (W/m^2)	Daytime longwave radiation (W/m^2)	Nighttime longwave radiation (W/m^2)
A	0.077	201.1	217.8	278.1	253.2
B	0.078	198.7	215.6	275.2	246.8
C	0.085	195.6	213.8	272.3	241.1
D	0.126	185.5	212.3	251.4	215.8
E	0.096	205.9	227.7	277.2	257.7
F	0.086	206.3	225.6	277.6	255.3
G	0.126	195.8	223.9	273.8	251.2
H	0.107	198.7	222.6	261.9	251.3
I	0.113	210.6	237.4	269.5	256.0
J	0.097	212.6	235.4	278.4	255.7
K	0.138	201.5	233.8	273.2	257.0
L	0.108	207.3	232.5	267.1	257.5
M	0.153	209.0	246.8	249.5	255.8
N	0.099	220.8	245.0	280.3	256.4
O	0.140	209.3	243.4	279.5	256.5
P	0.193	195.4	242.2	270.7	255.2

TABLE 4. CONTINUED

OCTOBER 22

Grid point	Albedo parameter (0-1)	Absorbed solar radiation (W/m^2)	Available solar energy (W/m^2)	Daytime longwave radiation (W/m^2)	Nighttime longwave radiation (W/m^2)
A	0.370	135.6	215.3	176.5	167.3
B	0.290	151.2	213.1	184.9	205.8
C	0.235	161.6	211.3	196.4	233.8
D	0.258	155.6	209.8	191.0	250.9
E	0.625	84.6	225.3	149.2	148.5
F	0.469	118.5	223.2	160.2	187.4
G	0.449	122.1	221.4	145.4	223.5
H	0.391	134.1	220.1	154.3	255.9
I	0.647	83.0	235.0	173.1	163.4
J	0.592	95.0	233.0	152.5	201.8
K	0.417	134.8	231.4	156.3	238.8
L	0.349	149.9	230.1	165.7	255.1
M	0.565	106.2	244.4	203.4	171.7
N	0.556	107.7	242.6	153.1	214.7
O	0.406	143.3	241.1	161.4	250.9
P	0.303	167.1	239.9	185.3	254.0

TABLE 4. CONTINUED

OCTOBER 23

Grid point	Albedo parameter (0-1)	Absorbed solar radiation (W/m^2)	Available solar energy (W/m^2)	Daytime longwave radiation (W/m^2)	Nighttime longwave radiation (W/m^2)
A	0.438	119.1	212.0	235.5	236.7
B	0.480	109.2	209.8	231.0	228.9
C	0.412	122.4	208.0	237.6	226.8
D	0.262	152.3	206.5	238.9	225.0
E	0.421	128.5	222.0	237.7	235.3
F	0.390	134.1	219.9	238.0	223.6
G	0.505	108.1	218.2	230.0	207.9
H	0.350	141.0	216.8	242.6	187.4
I	0.477	121.3	231.8	227.3	235.2
J	0.410	135.6	229.8	237.5	239.1
K	0.356	146.8	228.1	240.8	231.8
L	0.316	155.2	226.9	236.6	219.1
M	0.453	132.0	241.3	229.6	242.8
N	0.358	153.8	239.4	248.2	225.8
O	0.330	159.3	237.9	247.0	203.7
P	0.422	136.9	236.7	238.5	205.9

TABLE 4. CONTINUED

OCTOBER 24

Grid point	Albedo parameter (0-1)	Absorbed solar radiation (W/m^2)	Available solar energy (W/m^2)	Daytime longwave radiation (W/m^2)	Nighttime longwave radiation (W/m^2)
A	0.624	78.8	209.6	216.7	216.1
B	0.516	100.3	207.3	222.9	223.7
C	0.329	137.8	205.5	235.2	234.7
D	0.090	185.7	204.0	250.6	238.8
E	0.584	91.3	219.6	216.4	219.8
F	0.394	131.8	217.5	209.3	217.7
G	0.343	141.8	215.7	206.0	227.2
H	0.226	165.8	214.3	221.8	243.6
I	0.656	78.8	229.3	211.2	209.6
J	0.609	89.0	227.4	184.3	198.7
K	0.524	107.4	225.7	205.4	186.0
L	0.324	151.7	224.4	225.1	199.5
M	0.704	70.6	238.9	199.4	169.7
N	0.689	73.6	237.0	181.4	166.4
O	0.648	82.9	235.5	168.2	164.4
P	0.573	100.0	234.3	176.4	178.6

TABLE 4. CONTINUED

OCTOBER 25

Grid point	Albedo parameter (0-1)	Absorbed solar radiation (W/m^2)	Available solar energy (W/m^2)	Daytime longwave radiation (W/m^2)	Nighttime longwave radiation (W/m^2)
A	0.533	96.6	206.7	221.3	239.4
B	0.517	98.7	204.4	206.4	220.3
C	0.391	123.3	202.6	216.1	219.3
D	0.230	154.8	201.1	221.8	233.6
E	0.581	90.9	216.7	169.9	218.7
F	0.539	99.0	214.6	152.3	205.2
G	0.485	109.7	212.9	155.3	206.6
H	0.285	151.2	211.5	191.1	202.5
I	0.644	80.7	226.6	160.0	169.8
J	0.669	74.3	224.6	167.9	161.0
K	0.651	77.9	222.9	175.1	144.9
L	0.538	102.4	221.6	179.6	162.0
M	0.718	66.5	236.2	169.9	150.4
N	0.709	68.1	234.3	189.2	159.6
O	0.684	73.5	232.8	219.7	144.9
P	0.649	81.4	231.6	212.4	154.0

TABLE 4. CONTINUED

OCTOBER 26

Grid point	Albedo parameter (0-1)	Absorbed solar radiation (W/m^2)	Available solar energy (W/m^2)	Daytime longwave radiation (W/m^2)	Nighttime longwave radiation (W/m^2)
A	0.303	142.4	204.2	251.4	216.6
B	0.250	151.5	202.0	252.9	204.3
C	0.501	99.8	200.1	236.4	212.5
D	*****	*****	*****	*****	209.7
E	0.397	129.3	214.3	243.9	213.0
F	0.500	106.0	212.2	238.1	210.9
G	0.646	74.4	210.4	230.6	219.3
H	*****	*****	*****	*****	209.6
I	0.537	103.9	224.2	232.7	204.5
J	0.655	76.6	222.2	227.3	210.9
K	0.652	76.8	220.5	230.5	231.1
L	*****	*****	*****	*****	218.9
M	0.615	90.1	233.9	226.8	205.3
N	0.650	81.1	232.0	216.3	214.5
O	0.615	88.6	230.4	222.3	238.1
P	*****	*****	*****	*****	239.4

TABLE 4. CONTINUED

OCTOBER 27

Grid point	Albedo parameter (0-1)	Absorbed solar radiation (W/m^2)	Available solar energy (W/m^2)	Daytime longwave radiation (W/m^2)	Nighttime longwave radiation (W/m^2)
A	0.128	175.1	200.9	270.7	241.8
B	0.182	162.6	198.7	241.8	235.2
C	0.086	179.8	196.8	264.8	235.1
D	0.076	180.5	195.3	261.2	224.0
E	0.130	183.6	211.1	272.5	239.4
F	0.119	184.1	208.9	266.5	239.6
G	0.098	186.8	207.1	267.2	233.9
H	0.090	187.2	205.8	258.8	231.3
I	0.117	195.2	221.0	275.3	239.9
J	0.112	194.5	219.0	271.2	241.8
K	0.104	194.6	217.3	267.4	232.8
L	0.219	168.6	216.0	255.9	224.3
M	0.114	204.5	230.7	274.6	245.1
N	0.123	200.7	228.8	271.1	236.2
O	0.213	178.7	227.2	263.0	226.8
P	0.610	88.2	226.0	239.7	217.7

TABLE 4. CONTINUED

OCTOBER 28

Grid point	Albedo parameter (0-1)	Absorbed solar radiation (W/m^2)	Available solar energy (W/m^2)	Daytime longwave radiation (W/m^2)	Nighttime longwave radiation (W/m^2)
A	0.304	138.2	198.5	232.2	226.8
B	0.343	128.9	196.2	215.5	231.3
C	0.326	130.9	194.3	214.4	229.4
D	0.432	109.6	192.8	182.8	242.0
E	0.208	165.3	208.6	223.6	239.9
F	0.231	158.8	206.5	214.6	241.5
G	0.270	149.5	204.7	217.2	244.6
H	0.302	142.0	203.3	201.1	253.0
I	0.249	164.2	218.6	203.1	242.8
J	0.248	162.9	216.6	218.7	247.6
K	0.186	175.0	214.9	246.6	249.5
L	0.210	168.7	213.6	232.5	254.6
M	0.207	181.1	228.3	229.7	251.2
N	0.181	185.5	226.4	255.9	248.8
O	0.173	185.9	224.8	254.7	248.7
P	0.171	185.4	223.6	252.0	249.0

TABLE 4. CONTINUED

OCTOBER 29

Grid point	Albedo parameter (0-1)	Absorbed solar radiation (W/m^2)	Available solar energy (W/m^2)	Daytime longwave radiation (W/m^2)	Nighttime longwave radiation (W/m^2)
A	0.193	158.6	196.5	241.9	234.7
B	0.118	171.3	194.2	249.5	229.1
C	0.110	171.1	192.3	246.3	227.8
D	0.175	157.4	190.8	240.3	230.5
E	0.107	184.6	206.7	260.9	237.2
F	0.098	184.5	204.6	260.0	233.2
G	0.138	174.9	202.8	257.9	236.3
H	0.282	144.7	201.4	244.8	226.5
I	0.114	192.1	216.7	263.9	243.6
J	0.122	188.6	214.7	261.4	226.9
K	0.394	129.1	213.0	243.1	213.3
L	0.509	103.9	211.7	236.1	214.3
M	0.102	203.5	226.5	263.1	241.3
N	0.223	174.5	224.6	255.2	215.5
O	0.519	107.2	223.0	238.7	209.4
P	0.603	88.0	221.8	238.6	206.9

TABLE 4. CONTINUED

OCTOBER 30

Grid point	Albedo parameter (0-1)	Absorbed solar radiation (W/m^2)	Available solar energy (W/m^2)	Daytime longwave radiation (W/m^2)	Nighttime longwave radiation (W/m^2)
A	0.435	109.6	194.0	169.9	217.5
B	0.145	163.9	191.8	229.5	222.2
C	0.215	149.1	189.9	237.1	221.1
D	0.199	151.0	188.4	238.0	217.7
E	0.309	141.2	204.3	191.6	228.0
F	0.121	177.6	202.1	244.1	228.3
G	0.220	156.2	200.3	244.3	230.4
H	0.295	140.3	198.9	239.5	222.7
I	0.119	188.8	214.3	252.8	233.6
J	0.103	190.4	212.3	256.5	235.6
K	0.113	186.7	210.6	256.6	239.8
L	0.137	180.7	209.3	255.2	240.3
M	0.081	206.1	224.2	264.0	239.0
N	0.100	199.9	222.2	264.3	238.8
O	0.109	196.6	220.6	267.6	240.0
P	0.118	193.5	219.4	263.5	239.4

TABLE 4. CONTINUED

OCTOBER 31

Grid point	Albedo parameter (0-1)	Absorbed solar radiation (W/m^2)	Available solar energy (W/m^2)	Daytime longwave radiation (W/m^2)	Nighttime longwave radiation (W/m^2)
A	0.426	109.5	190.8	191.5	165.2
B	0.543	86.1	188.5	181.2	167.7
C	0.589	76.7	186.6	179.7	159.5
D	0.579	78.0	185.1	193.2	142.1
E	0.641	72.2	201.0	174.5	162.5
F	0.604	78.8	198.9	188.1	150.8
G	0.429	112.6	197.1	196.4	146.9
H	0.224	151.8	195.7	215.5	*****
I	0.527	99.9	211.1	209.2	197.9
J	0.335	139.0	209.1	216.9	178.7
K	0.158	174.6	207.4	232.8	*****
L	0.132	178.8	206.0	236.5	*****
M	0.207	175.2	221.0	234.5	193.3
N	0.134	189.7	219.1	260.0	*****
O	0.084	199.3	217.5	274.1	*****
P	0.100	194.6	216.2	271.3	*****

TABLE 4. CONTINUED

NOVEMBER 1

Grid point	Albedo parameter (0-1)	Absorbed solar radiation (W/m^2)	Available solar energy (W/m^2)	Daytime longwave radiation (W/m^2)	Nighttime longwave radiation (W/m^2)
A	0.233	144.6	188.6	188.5	209.2
B	0.165	155.5	186.3	200.5	197.7
C	0.152	156.3	184.4	203.4	184.1
D	0.206	145.3	182.9	197.7	169.0
E	0.418	115.7	198.9	174.4	204.9
F	0.442	109.8	196.7	160.6	198.2
G	0.292	138.0	194.9	189.4	172.8
H	0.278	139.8	193.5	203.0	175.3
I	0.521	100.1	209.0	197.1	209.8
J	0.453	113.2	207.0	202.9	203.7
K	0.428	117.4	205.3	209.5	212.0
L	0.437	114.7	203.9	201.8	200.8
M	0.578	92.5	219.0	217.7	220.3
N	0.587	89.6	217.0	214.7	233.3
O	0.549	97.1	215.4	219.8	244.1
P	0.417	124.9	214.2	226.8	243.0

TABLE 4. CONCLUDED

NOVEMBER 2

Grid point	Albedo parameter (0-1)	Absorbed solar radiation (W/m^2)	Available solar energy (W/m^2)	Daytime longwave radiation (W/m^2)	Nighttime longwave radiation (W/m^2)
A	0.349	121.1	186.1	185.3	220.4
B	0.346	120.2	183.8	176.5	217.8
C	0.205	144.6	181.9	191.6	218.3
D	0.162	151.2	180.4	220.7	225.7
E	0.199	157.3	196.5	219.9	218.4
F	0.208	153.8	194.3	211.1	220.4
G	0.221	150.0	192.5	196.2	225.2
H	0.125	167.2	191.1	221.2	237.9
I	0.090	188.0	206.6	253.4	189.4
J	0.079	188.5	204.6	250.3	211.9
K	0.069	188.8	202.9	251.3	228.9
L	0.049	191.7	201.5	253.7	238.8
M	0.175	178.8	216.6	233.7	197.8
N	0.092	194.8	214.6	250.2	220.5
O	0.073	197.4	213.0	257.7	224.5
P	0.071	196.7	211.8	256.7	219.7

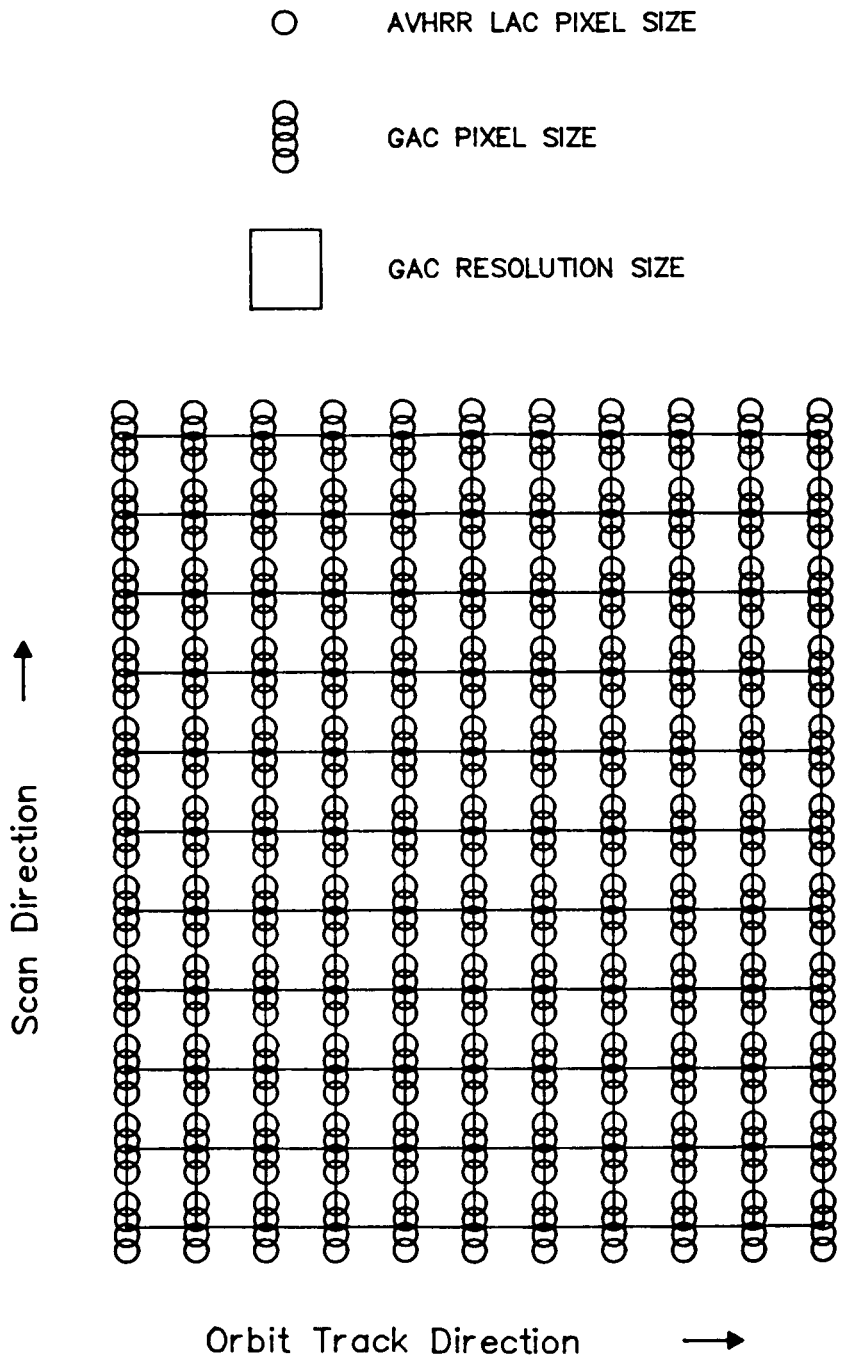

Figure 1.-Heat Budget 11-by-11 GAC Array Configuration.

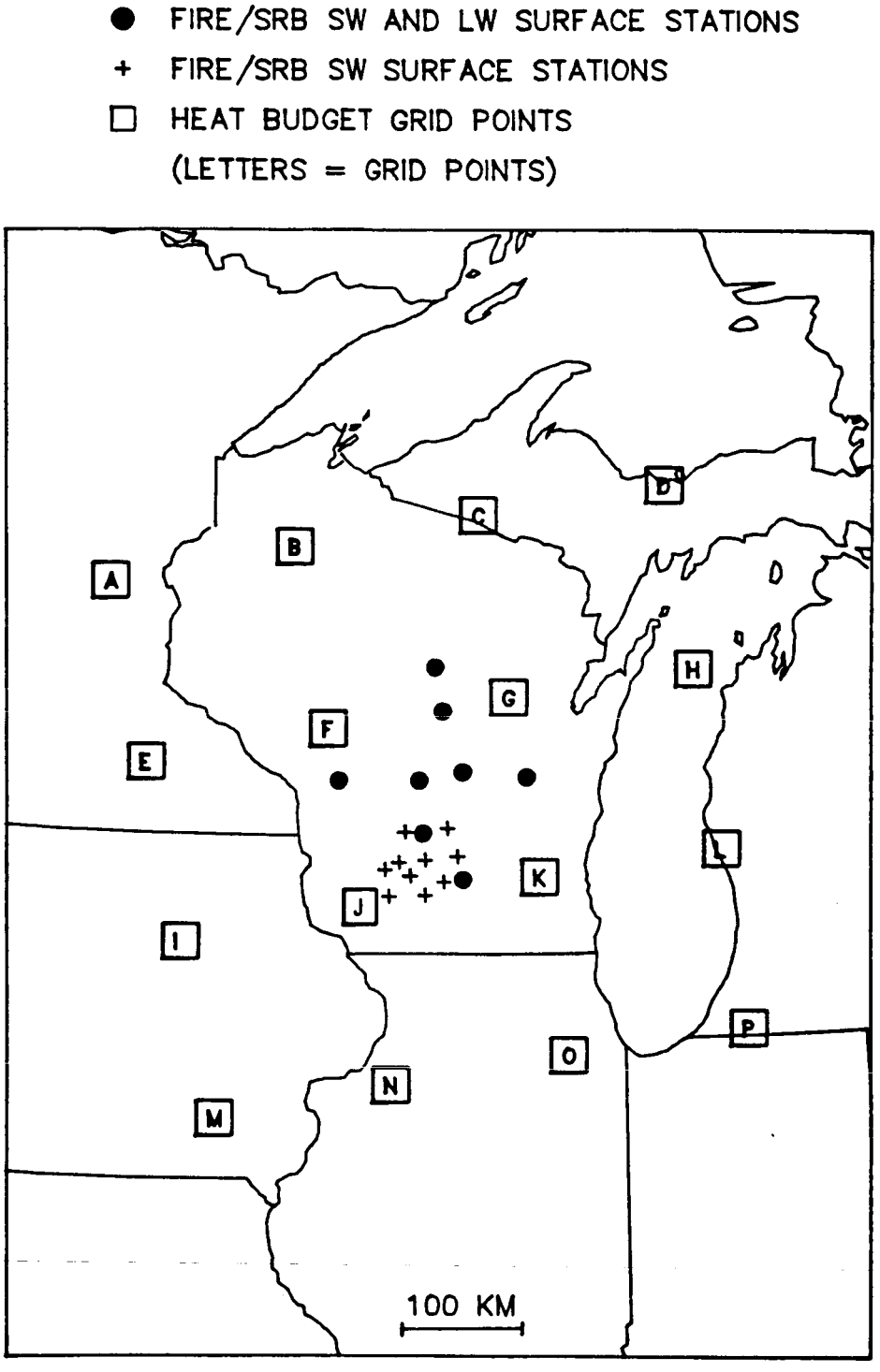

Figure 2.-Location of Heat Budget Grid Points.

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16. Abstract

A map and concise tables are presented which show locations, pixel size, and heat budget products from the NOAA-9 satellite for the FIRE/SRB Wisconsin experiment region during October 9 through November 2, 1986. In addition to the operational standard products, a narrowband albedo parameter is calculated and presented based on values from AVHRR band 1. This parameter is useful in identifying and/or quantifying clouds on a global basis using a polar-stereographic grid system.

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