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CHINARE DATA REPORT

NO. 4

(METEOROLOGY 4)

Radiation Data at Zhongshan Station, Antarctica
from Feb. 1990 to Jan. 1991

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Radiation Data from Feb. 1990–Jan. 1991 at Zhongshan Station

Bian Lingen Lu Longhua and Jia Pengqun

(Chinese Academy of Meteorological Sciences, Beijing 100081, CHINA)

Radiation and micrometeorological observations using a 32m tower were carried out as part of the CHINARE–VI program. The observations are aimed at the investigations of the structure of the atmospheric boundary layer and the heat balance components near the surface. Zhongshan Station is located at $69^{\circ} 22' S$, $76^{\circ} 22' E$ on Lassman Hill of Antarctic Continent(Fig.1). Its elevation is 17.7m above the sea level. The degrees of the horizontal obstruction around observation site is less than 4 degree(Fig. 2). During the observation period, the condition of the surface changed from bare land to the snow-covered surface with the maximum snow depth of 95 cm.

This data report gives the results of radiation observation. The observation period is from February 12,1990 to January 31,1991. Three radiation components, i.e., global and reflected shortwave downward radiation (Q and QA) and the net radiation including shortwave and longwave(B) were measured by pyranometers($0.3-2.4\mu m$) and net pyrradiometer ($0.3-30.0\mu m$). These instruments were placed at height of 1.5m above the surface. The sensitivity constants of the meters for measuring Q, QA and B are 7.26, 8.10 and $8.31 \mu v / Wm^{-2}$ respectively. The resolution of the meters is $1 Wm^{-2}$, the precision $\pm 7 Wm^{-2}$. The calibration of the meters in Chinese Academy of Meteorological Sciences has been done before and after the observations in Antarctica. All observational elements were sampled every minute and recorded by data logger and computer system. The hourly mean values of these elements are presented in this volume(Tables 1, 2 and 4).

Other two computative elements, i.e., the surface albedo(A) and effective radiation in the surface(F) are also given(Tables 3 and 5). The value of A is obtained by

$$A = \frac{\sum QA}{\sum Q} \quad (1)$$

and the value of F is calculated by

$$F = Q(1 - A) - B \quad (2)$$

To give a general idea on the radiative situation of the station, the monthly mean diurnal variations and the daily variations throughout the observing period of all elements except QA in the representative months (January, April, July and October) are shown in Figs. 3 and 4. Numerals 999 are printed in tables for missing data.

Acknowledgments. The authors wish to acknowledge the joint efforts of all members of Chinese National Antarctic Research Expedition-VI (CHINARE-VI), who led by Mr. Li Zhenpai and Guo Xiaogang(in summer) and Mr. Dong Zhaoqian(in winter). Particular thanks are due to Lu Changgui and Xue Zhenhe for their taking part in the observation and to Mr. Zhou Guoxian and Ms. Wei Shuang who were also responsible for the computer processing of the data.

中山站 1990 年 2 月—1991 年 1 月辐射资料

卞林根 陆龙骅 贾朋群

(中国气象科学研究院, 北京 100081)

作为中国第六次南极考察队科考计划的一部分, 我们在中山站安装了 32 米气象塔, 进行了辐射平衡和微气象观测。其主要目的是考察和研究该地区近地面边界层的物理结构和热量平衡的基本特征。中山站($69^{\circ} 22' S, 76^{\circ} 22' E$)位于东南极大陆的拉斯曼丘陵上, 海拔高度 17.7 米(图 1)。辐射观测点下垫面较为平坦, 水平自然遮蔽度小于 4° (图 2)。观测期间, 地表积雪有明显的季节变化, 暖季(12—2 月)积雪少, 寒季(3—11 月)积雪多, 最厚积雪为 95cm。

本报告给出了 1990 年 2 月 1 日至 1991 年 1 月 31 日辐射观测的基本资料。观测的辐射平衡分量有总辐射(Q)、反射辐射(QA)和净辐射(B)。Q 和 QA 观测采用的是天空辐射表(波长 $0.3\text{--}2.40\mu\text{m}$), B 观测采用的是净全辐射表(波长 $0.3\text{--}30.0\mu\text{m}$)。总辐射表、反射辐射表和净辐射表的灵敏度分别为 7.26 、 8.10 和 $8.31\mu\text{V}/\text{Wm}^{-2}$ 。辐射表安装高度距地面 1.5 米。辐射仪器在南极观测前后, 在中国气象科学研究院检定所进行了标定。辐射采样仪的分辨率为 $1\text{W}/\text{m}^2$, 精度为 $\pm 7\text{W}/\text{m}^2$ 。本次考察设定的采样时间间隔为 1 分钟。表 1、表 2 和表 4 分别给出总辐射、反射辐射和净辐射观测期间的每小时平均值。另外, 表 3 和表 5 还给出了计算量反射率(A)和有效辐射(F)的每小时平均值。反射率和有效辐射分别由公式(1)和(2)获得:

$$A = \frac{\sum QA}{\sum Q} \quad (1)$$

$$F = Q(1 - A) - B \quad (2)$$

为了解中山站地区各个辐射平衡分量的基本特点, 图 3 和图 4 分别给出了总辐射、反射率、净辐射和有效辐射的日变化(1 月、4 月、7 月、10 月)和整个观测期间的日际变化。本资料缺测用 999 表示。

致谢:

本次观测得到了中国第六次南极考察队队长李振培、国晓港、董兆乾和全体考察队员的大力协助, 逯昌贵、薛振和、王星参加了部分仪器安装和观测工作, 周国贤和魏霜参加了辐射资料的处理工作, 谨此衷心感谢。

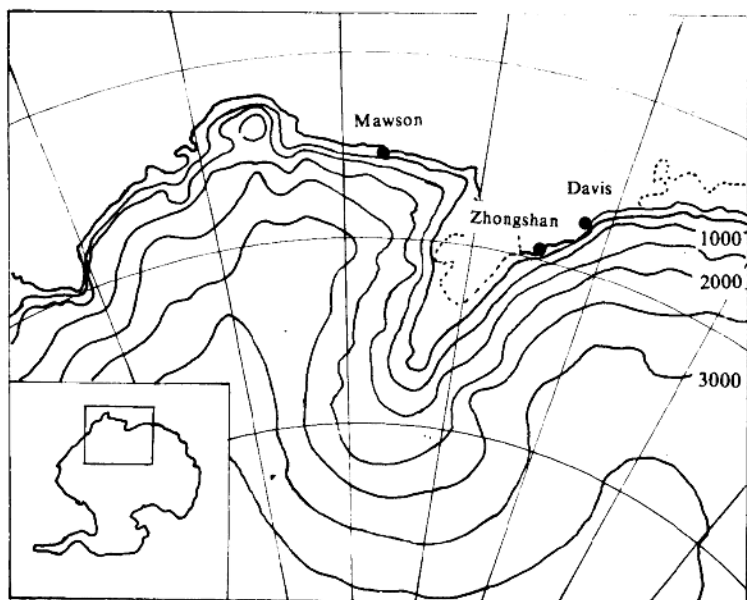


FIG.1. The position of Zhongshan Station on the Antarctic continent

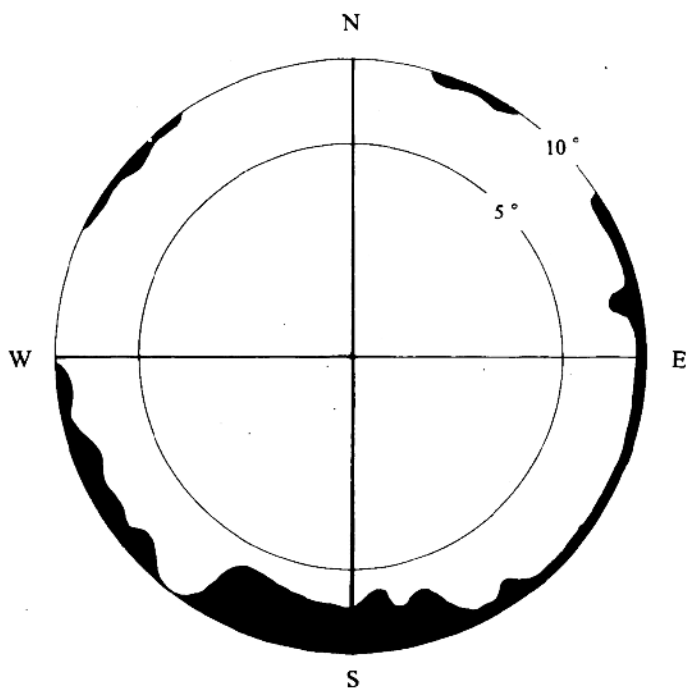


FIG.2. The degrees of horizontal obstruction around observational site.

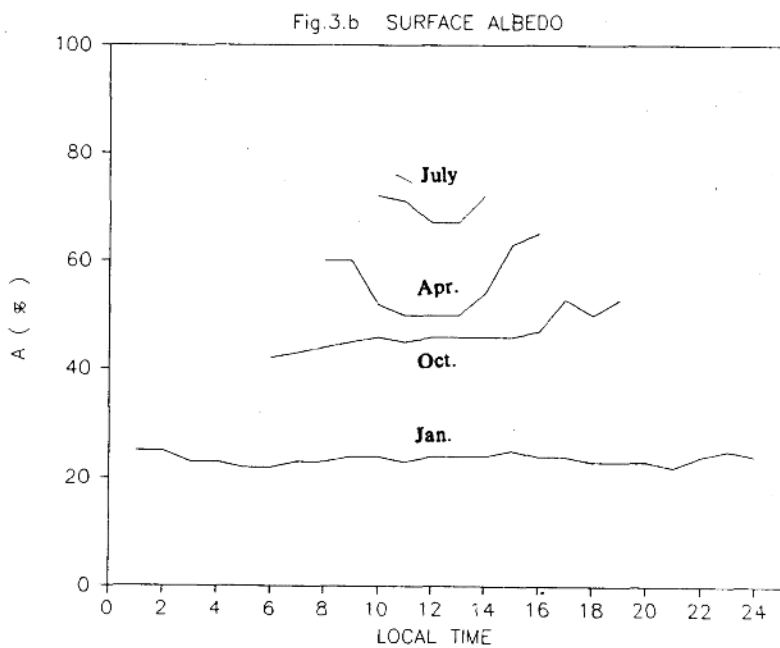
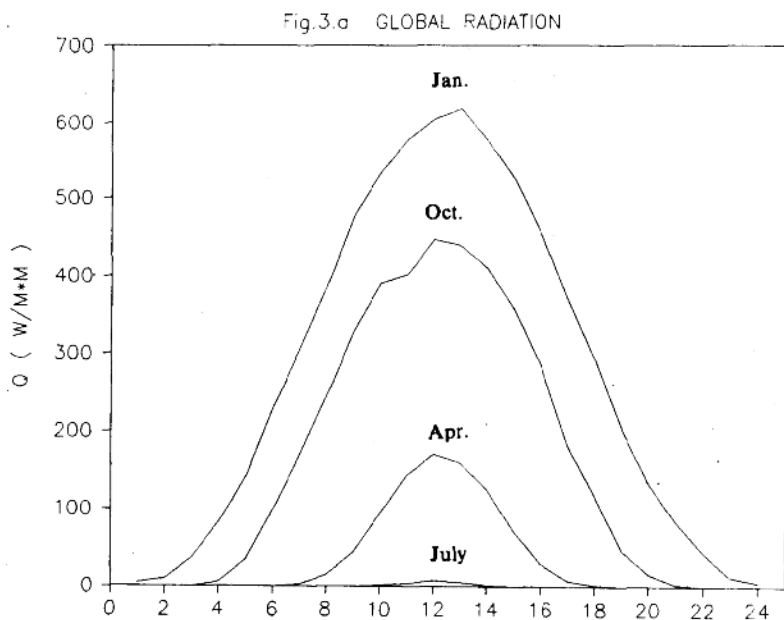


FIG.3. The monthly diurnal variation of global radiation (a), surface albedo (b), net radiation (c) and effective radiation (d).

Fig 3 c NET RADIATION

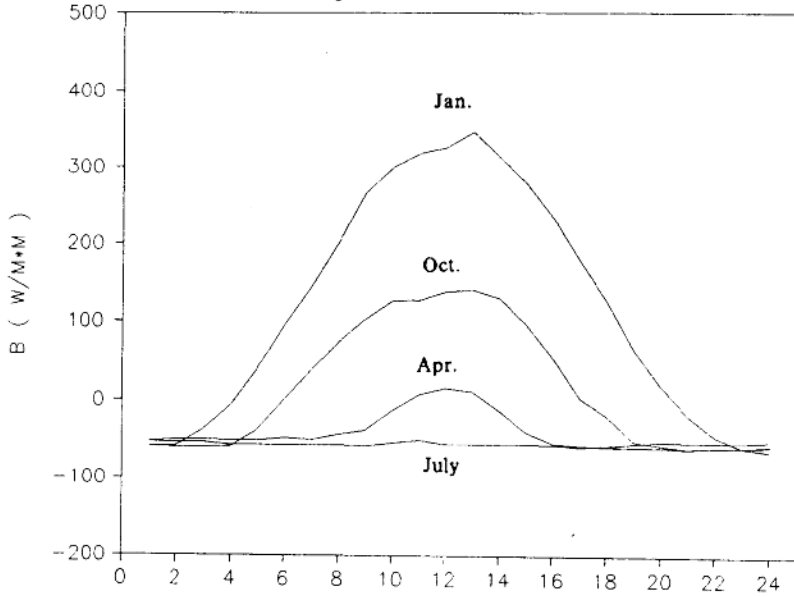


Fig.3.d EFFECTIVE RADIATION

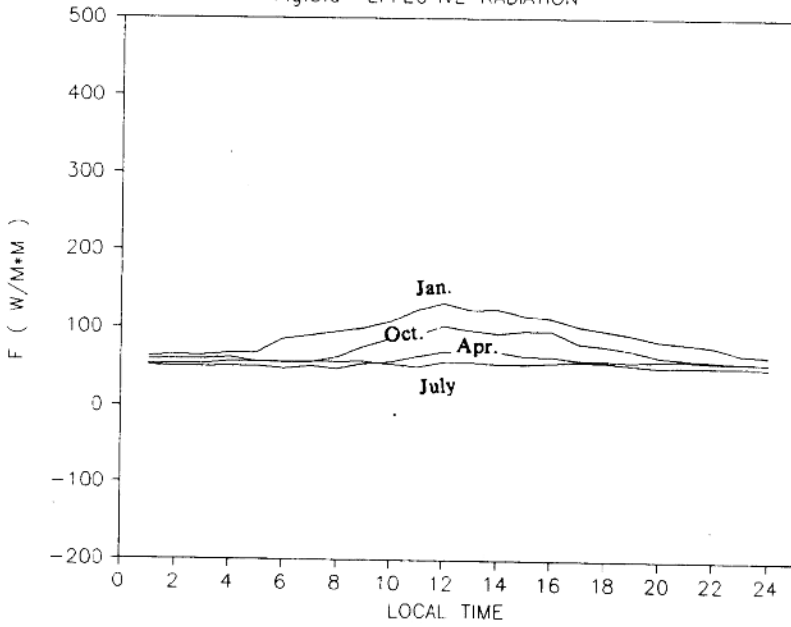


FIG.3. (continued)

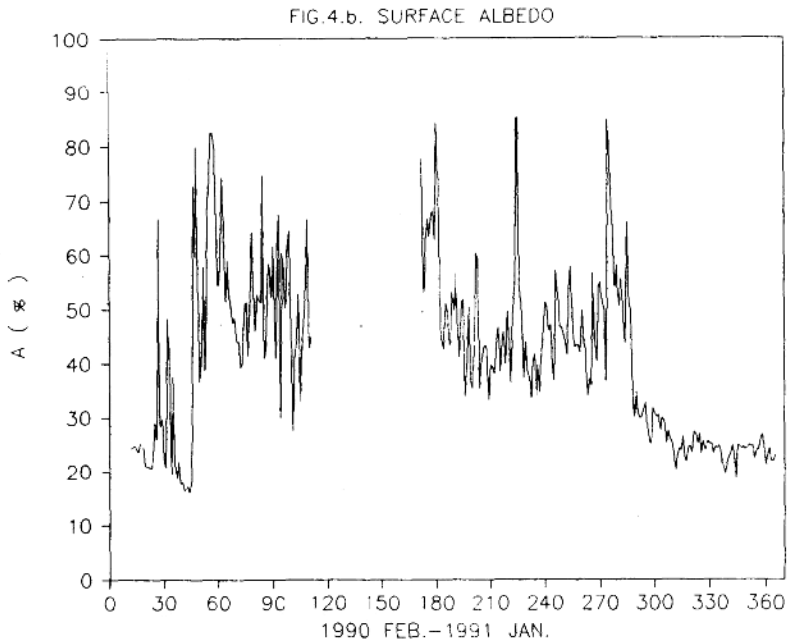
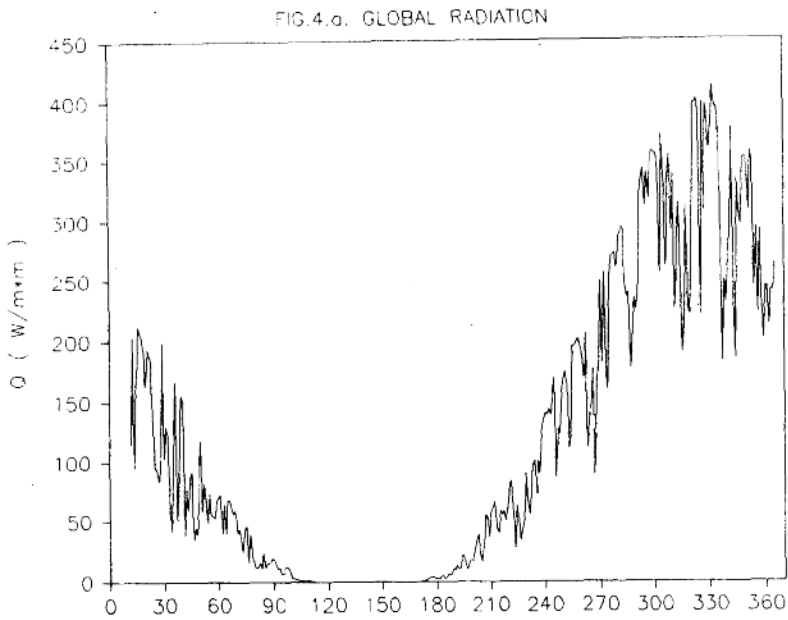


FIG.4. The daily variation of global radiation (a), surface albedo (b), net radiation (c) and effective radiation (d).

FIG.4.c. NET RADIATION

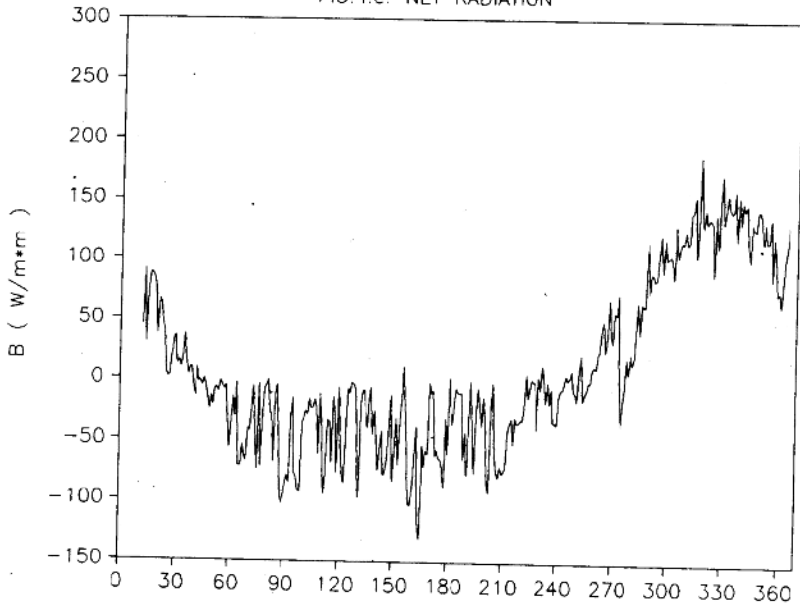


FIG.4.d. EFFECTIVE RADIATION

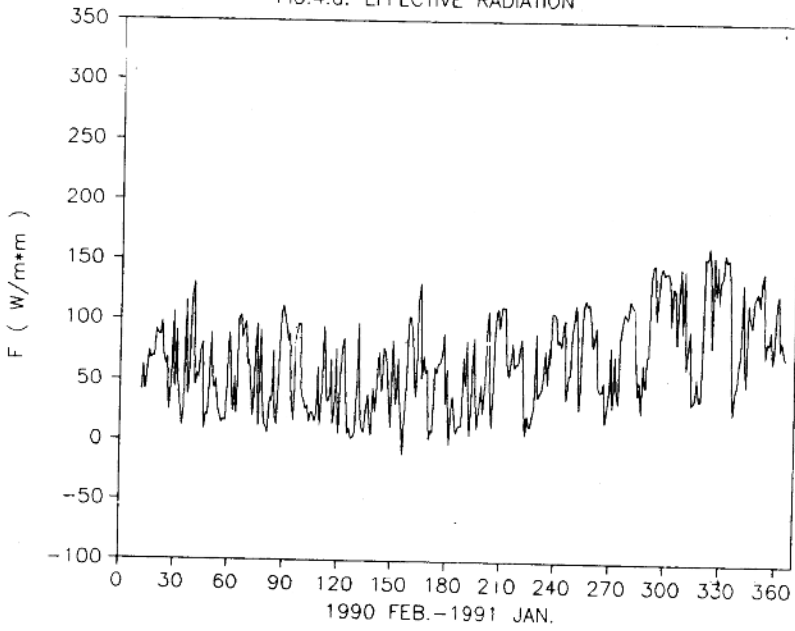


FIG.4. (continued)

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TABLE.1 HOURLY MEAN GLOBAL RADIATION

FEB. 1990		GLOBAL RADIATION (W/M ²)														
DAY LT.	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	
01	999	999	999	999	999	999	999	999	999	999	999	0	0	0	0	
02	999	999	999	999	999	999	999	999	999	999	999	0	0	0	0	
03	999	999	999	999	999	999	999	999	999	999	999	0	1	0	0	
04	999	999	999	999	999	999	999	999	999	999	999	5	7	2	2	
05	999	999	999	999	999	999	999	999	999	999	999	59	68	12	11	
06	999	999	999	999	999	999	999	999	999	999	999	74	234	66	63	
07	999	999	999	999	999	999	999	999	999	999	999	101	203	103	109	
08	999	999	999	999	999	999	999	999	999	999	999	215	369	146	177	
09	999	999	999	999	999	999	999	999	999	999	999	296	438	197	253	
10	999	999	999	999	999	999	999	999	999	999	999	284	407	209	342	
11	999	999	999	999	999	999	999	999	999	999	999	253	426	187	428	
12	999	999	999	999	999	999	999	999	999	999	999	262	453	199	463	
13	999	999	999	999	999	999	999	999	999	999	999	261	445	206	452	
14	999	999	999	999	999	999	999	999	999	999	999	252	513	254	418	
15	999	999	999	999	999	999	999	999	999	999	999	210	406	223	408	
16	999	999	999	999	999	999	999	999	999	999	999	167	345	129	356	
17	999	999	999	999	999	999	999	999	999	999	999	126	263	105	278	
18	999	999	999	999	999	999	999	999	999	999	999	77	163	87	99	
19	999	999	999	999	999	999	999	999	999	999	999	64	108	85	104	
20	999	999	999	999	999	999	999	999	999	999	999	36	34	62	42	
21	999	999	999	999	999	999	999	999	999	999	999	7	6	4	7	
22	999	999	999	999	999	999	999	999	999	999	999	1	2	1	2	
23	999	999	999	999	999	999	999	999	999	999	999	0	0	0	0	
24	999	999	999	999	999	999	999	999	999	999	999	0	0	0	0	
MEAN	999	999	999	999	999	999	999	999	999	999	999	115	204	95	167	

FEB. 1990

GLOBAL RADIATION (W/M²)

16	17	18	19	20	21	22	23	24	25	26	27	28	MEAN
0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	3	2	1	2	1	2	2	3	2	0	0	0	2
16	17	11	11	15	15	12	19	14	11	9	3	3	18
129	125	109	105	81	105	29	87	41	32	94	15	15	83
193	203	185	162	156	257	90	321	111	81	133	47	36	147
367	355	337	319	218	286	277	295	270	137	245	92	67	245
446	432	421	389	350	388	380	361	365	175	203	137	103	314
458	445	439	418	358	489	482	504	416	203	258	172	178	357
517	521	519	504	543	532	543	470	378	241	269	306	216	403
536	541	546	521	458	581	580	419	396	267	245	292	267	413
546	538	525	509	576	526	535	501	381	282	192	196	319	411
512	517	505	476	371	535	526	483	365	253	164	167	286	388
437	435	446	435	216	470	421	429	231	221	172	225	236	331
346	323	376	347	176	173	195	294	185	164	131	171	183	239
272	265	235	216	154	155	163	173	163	98	61	102	142	175
178	119	123	108	145	94	156	40	43	65	42	47	92	99
99	85	92	82	72	22	98	9	8	33	29	29	53	63
40	34	17	16	10	14	20	2	4	12	12	2	12	22
3	2	2	1	2	2	2	0	1	2	3	0	2	3
0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0
212	207	204	192	163	194	188	184	141	95	94	83	92	155

MAR. 1990

GLOBAL RADIATION (W/M²)

DAY LT.	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15
01	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
02	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
03	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04	1	0	0	0	0	0	0	2	1	2	2	1	0	0	0
05	6	2	2	3	2	1	5	17	6	8	11	6	3	3	2
06	31	17	47	14	14	12	22	89	33	31	114	78	28	31	30
07	122	58	128	31	61	29	135	194	58	92	131	161	58	78	72
08	222	103	183	63	64	42	146	286	72	222	267	247	78	133	114
09	289	150	317	181	100	65	181	358	89	233	345	328	83	161	156
10	328	211	322	200	131	59	254	420	108	272	406	397	92	208	192
11	490	287	524	185	148	96	292	496	114	311	481	475	105	256	207
12	601	300	511	224	179	117	376	518	137	249	498	492	105	240	163
13	517	383	358	265	169	107	327	482	144	233	463	457	96	236	153
14	505	307	220	457	93	126	276	415	128	252	396	387	86	192	121
15	526	240	199	240	159	138	270	403	130	240	382	366	81	171	110
16	450	157	128	531	103	99	120	223	108	50	178	157	54	99	66
17	401	132	115	340	93	69	101	66	57	40	40	35	40	49	27
18	235	115	43	162	73	27	9	38	17	15	17	9	4	12	12
19	64	14	14	44	11	2	2	3	2	2	1	2	1	1	2
20	6	3	3	3	3	0	0	0	0	0	0	0	0	0	0
21	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MEAN	200	103	130	123	58	41	105	167	50	94	155	150	38	78	59

MAR. 1990

GLOBAL RADIATION (W/M²)

16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	MEAN
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
6	3	1	1	2	2	4	2	2	1	0	0	0	0	0	0	3
61	50	14	8	11	11	33	21	11	6	2	2	2	1	0	2	27
75	136	36	36	31	89	117	74	44	36	4	6	14	6	3	17	69
156	217	56	53	56	144	203	153	94	94	11	6	39	39	33	31	117
214	295	72	58	78	222	278	136	172	147	81	42	86	86	75	147	169
264	356	100	144	108	272	333	314	206	206	114	86	125	125	133	222	216
327	413	111	151	114	262	404	194	305	250	163	154	157	157	154	253	259
214	243	102	137	131	307	412	157	367	268	147	204	189	189	179	294	266
211	169	80	131	121	345	374	131	326	230	160	281	195	195	185	291	252
201	109	77	125	96	265	307	96	249	192	160	249	189	189	125	243	220
179	110	81	130	102	216	172	69	118	179	146	289	159	159	183	37	193
108	70	50	74	50	83	97	33	66	91	108	256	99	99	128	70	129
53	31	31	18	18	31	98	13	22	27	49	154	44	44	53	31	75
4	4	17	11	9	14	14	6	3	2	13	47	17	9	4	2	31
1	1	1	2	1	2	1	2	0	0	2	3	2	2	1	0	6
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
86	92	35	45	39	94	119	58	83	72	48	74	55	54	52	68	85

APR. 1990

GLOBAL RADIATION (W/M²)

DAY LT.	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15
01	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
02	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
03	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
06	0	0	0	0	0	0	2	1	0	0	0	0	0	0	0
07	3	2	3	2	2	2	15	9	2	2	1	1	0	0	1
08	25	14	19	25	10	65	86	67	6	14	8	6	3	4	6
09	92	94	44	69	22	156	156	125	31	69	33	22	33	19	58
10	237	230	80	120	83	247	253	167	97	157	70	87	77	53	90
11	308	345	126	290	133	256	277	253	195	229	130	164	181	92	161
12	338	383	144	287	188	311	301	249	260	253	167	154	232	103	212
13	335	161	178	311	174	280	260	311	273	270	174	147	126	96	226
14	272	184	169	253	178	197	178	169	222	219	153	166	100	125	175
15	53	158	117	122	89	100	78	94	150	144	136	147	69	56	108
16	25	117	47	50	56	28	11	14	83	69	67	92	25	36	47
17	14	39	17	17	14	3	2	1	17	4	8	47	3	8	3
18	2	5	5	2	1	0	0	0	3	1	2	5	0	2	0
19	0	1	1	0	0	0	0	0	0	0	0	1	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MEAN	71	72	40	65	40	69	67	61	56	60	40	43	35	25	45

APR. 1990

GLOBAL RADIATION (W/M²)

16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	MEAN
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
39	4	3	1	1	2	1	2	1	2	0	0	0	0	0	14
92	14	36	17	17	17	6	11	19	22	3	3	3	3	3	43
173	40	77	40	40	40	33	53	33	90	27	27	23	33	30	94
188	65	137	82	68	31	51	68	68	109	51	72	38	48	106	144
233	75	195	137	75	38	58	79	41	120	82	116	79	106	113	171
185	72	215	113	68	79	75	79	38	109	55	79	113	109	103	160
119	50	166	72	47	59	31	56	28	84	47	31	84	78	72	126
42	39	89	36	25	11	28	28	28	25	17	22	39	33	36	71
28	11	19	11	6	2	3	6	3	4	4	6	3	2	5	29
3	2	3	2	1	0	0	1	0	1	1	2	0	0	1	7
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
46	15	39	21	15	12	12	16	11	24	12	15	16	17	20	36

MAY. 1990

GLOBAL RADIATION (W/M²)

DAY LT.	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15
01	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
02	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
03	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
06	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
09	3	3	6	8	4	2	3	3	1	2	1	2	0	0	0
10	56	50	67	50	17	11	17	11	11	10	8	6	7	6	0
11	100	88	63	58	46	29	58	54	50	25	13	13	13	13	5
12	108	72	76	72	43	43	76	94	79	69	22	18	14	18	6
13	97	53	27	60	30	37	90	83	73	63	17	23	10	13	4
14	58	33	7	22	14	17	39	47	39	25	8	8	4	4	2
15	22	14	5	7	3	6	6	6	28	14	7	4	3	0	2
16	2	0	0	0	1	4	3	3	6	7	2	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MEAN	19	13	10	12	7	6	12	13	12	9	3	3	2	2	1