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说　明

太阳地球物理资料的来源包括北京天文台（简称北台或 BEIJ）、空间科学与应用研究中心、北京地磁台（BGMO）、北京天文馆（北馆或 PLAT）、陕西天文台（陕台或 LINT）、紫金山天文台（紫台或 PURP）、乌鲁木齐天文工作站（乌站或 WLMQ）和云南天文台（云台或 YUNN）共八个单位的有关观测结果。内容分下列九个部分：

1. 太阳黑子相对数与面积数值、太阳黑子观测等二种表格，由紫金山天文台编辑。
2. 太阳黑子相对数的平滑值预报。
3. 太阳耀斑表、耀斑巡视时间表。
4. 太阳射电辐射流量表，太阳射电显著事件表，太阳射电辐射巡视时间表和太阳射电辐射显著事件图。
5. 宇宙线强度由空间科学与应用研究中心编辑。
6. 突然电离层扰动（D 层）表。
7. 地磁活动指数 K 和 A_k 表。
8. 磁暴表由北京地磁台编辑。
9. 不定期刊登有关论文。

以上各种数据表均利用计算机（VAX　11/780）存取及作必要的计算和检验，并提供照相印刷的正本。

内容简介

1. 与黑子有关的二种表格，目视观测（手描）以云台的观测为主。云台缺测时，则用其它台站的结果，并在备注栏内注明台站简称；照相面积由北台提供。“太阳黑子观测”表中的群号为综合各台站观测记录后的统一编号。（See）栏给出观测时大气视宁静度的优劣评分。“5”为最佳；“1”为最差。

2. 黑子相对数的平滑值预报给出近一年的预报值 R′ 和置信度为 90%的预报误差 E′。预报方法参见 1989 年 1 月 CSGD 的论文部分。

3. 黑子表和耀斑表中的日面位置指卡林顿（Carrington）坐标。中经距（CMD）指黑子或耀斑所在经圈与日面中心经圈之经度差，以度表示。E、W 分别表示在日面中心经圈之东西。日心距（r/R）指太阳圆面上的黑子或耀斑相对于日面中心之距离，以太阳半径为单位。视面积（Sd）指其在太阳圆面上的表观面积，以太阳圆面积的 10^{-6} 为单位。校正面积（Sp）指经过投影改正后，黑子或耀斑在太阳球面上的真正面积，以太阳半球面积的 10^{-6} 为单位。黑子型别（Type）按 McIntosh 分型。详见附录 1。

4. 太阳耀斑表列出北台、紫台、乌站、云台等单位用色球望远镜（通过 H_α 单色光）观测到的耀斑和亚耀斑。表中列出耀斑发生的时刻。其中极大（Max）表示耀斑亮度极大时的时刻；面积（Area）为极大时刻的面积。视面积（Sd）和校正面积（Sp）按 Sec θ 关系换算得到。耀斑级别（Imp）以两个字符表示，第一个字符由耀斑在极大时刻的面积决定；第二个字符表示耀斑亮度，由各观测台站根据经验确定。其中 B 表示“亮”、N 表示亮度“中等”，F 表示

"弱"。当耀斑日心距 r/R<0.906 时，即耀斑日心角 θ（指耀斑和观测者在日心处的张角）<65°时，其级别按"校正面积 Sp"定级，如下表所示：

	耀斑级别		
校正面积 Sp	弱(F)	中等(N)	亮(B)
⩽100	−F	−N	−B
101−250	1F	1N	1B
251−600	2F	2N	2B
601−1200	3F	3N	3B
⩾1201	4F	4N	4B

当耀斑日心距 r/R⩾0.906 时，即耀斑日心角⩾65°时，其级别按"视面积 Sd"定级，如下表所示：

	耀斑级别			
日心距 r/R	−	1	2	3
.906—.939	Sd<90	90—279	280—599	Sd⩾600
.940—.984	75	75—239	240—499	500
.985—.999	50	50—179	180—349	350
1.000	45	45—169	170—299	300

耀斑表中资料栏内各字母分别表示：

C：全部或绝大部分过程有照相观测。

P：部分或很少部分过程有照相观测。

V：全部或大部分过程有目视观测。

备注栏内的各字母的意义详见附录 2。

5. 耀斑巡视时间表仅包括照相巡视，目视和照相间隔小于 5 分钟时，看作连续巡视时段，用（From—To）表示。

6. 太阳射电辐射流量表，给出在各固定单频上每天太阳辐射总流量在当地太阳中天前后（一般北台、紫台在 0400 UT 左右、云台在 0500 UT 左右）的以 10^{-22}・瓦・米$^{-2}$・赫$^{-1}$ (s.f.u.) 为单位的实测值，并均已归算到日—地平均距离 1 AU。

7. 在太阳射电显著事件表中列出的各栏有国内外约定的意义。在流量密度（Flux Density）栏内，峰值（Peak）表示峰时流量的增值；相对值（Rel）表示峰值流量与爆发前流量之比值；平均值（Mean）表示流量密度的增值对时间求积分，除以爆发持续时间，频率单位为兆赫（MHz），持续时间（Duration）为分，峰值及平均值单位为 s.f.u.。

太阳射电爆发的分型详见附录 3。分型中 1 S，2 S/F，3 S，4 S/F，5 S，20 GRF，21 GRF，22 GRF，23 GRF，41 F，45 C，46 C，47 GB 型爆发只适用于频率 f>600 MHz 的射电爆发；而 6 S，7 C，27 RF，42 SER，43 NS，44 NS，48 C，49 GB 型爆发只适用于 f<600 MHz 的爆发；28 PRE，29 PBI，30 PBI，31 ABS 不能单独存在。

最后，请使用者注意，为了描述简单起见，在附录 3“太阳射电爆发分型”的定义中，取了流量密度的绝对值（原始值以 s. f. u. 为单位）与持续时间的绝对值（原始值以分为单位）进行大小比较（两个量进行比较时均为无量纲量）。

8. 对于峰值流量较大，而且记录质量较好的爆发，在太阳射电显著事件图中给出。图中左上角给出日期、频率，右上角给出观测台站，横坐标为时间（UT），纵坐标为爆发流量。

9. 太阳射电巡视时间表为各单频射电望远镜实际巡视时间（不计入小于半小时的停顿）。连续巡视时段用（From—To）表示。

10. 宇宙线强度表中分别给出 18—NM—64 超中子堆（SUPER NEUTRON MONITOR）记录的中子数和 ACK－1 大游离室（ION CHAMBER）记录的 μ 介子（MESON）数。每小时的数据都已作了气压校正。中子堆数据表内给出的值是记数率与 1500 的差，求实际值时还需乘以定标因子 256。μ 介子数据表列出的是相对强度与 1000 的差，单位是 0.1%。表中的空格“ ”和“……”表示没有数据。表中最后两列分别给出日均值（Mean）和有记录的小时数（N）。还给出了月均值(Monthly Mean)。最后四行是仪器全天工作天数的月平均日变化(Monthly Mean Daily variation）与相应的月均值的差，以及按世界时（U.T.）和北京时（B.T.）的调和分量（Harmonic Components）。从第一阶取到第四阶。表中给出各阶（Order）的正弦（SIN）、余弦（COS）、幅值（Amplitude）和极大值的时间（Max.—Hr）。

宇宙线强度图是以 Bartels 太阳旋转周（Solar Rotation）为周期，分别给出中子和 μ 介子每小时强度变化曲线。两条横线之间的距离表示强度变化为 5%，垂直线表示世界时 0^h。

11. 突然电离层扰动（D 层）（简称 SID）表给出了对罗兰 C 100 kHz 低频信号和奥米加 10.2 kHz 甚低频信号传播的观测所得到的相位突然异常（SPA）和场强突然异常（SFA）的数据。SPA 和 SFA 属突然电离层扰动中的两种表现形式，是电离层 D 层状态突然改变所导致的。这里，低频相位突然异常（LF—SPA）数据由陕台和云台提供，而甚低频相位突然异常（VLF—SPA）数据和低频场强突然异常（LF—SFA）数据则仅由陕台提供。（VLF—SPA）一般为奥米加导航系统 E 台 10.2 kHz 信号的结果。若接受其它台站信号时，将在相应的数据后面用括号内的字母表明。

表中所列的 LF—SPA 数值（以微秒为单位）是对实测值进行了太阳天顶角改正后的结果，所用的分析和计算表达式如下：

$$\Delta\varphi_0=\left(\frac{5.0}{1.6+3.4\cos Z(h_m)}\right)\times\Delta\varphi' + \begin{cases} 7.3\times[\cos Z(h_m)-\cos Z(h_s)], & \text{当 } h_m\leqslant 12 \text{ 和 } Z(h_m)\leqslant 80^\circ \\ 0, & \text{当 } 12<h_m<13 \\ 7.3\times[\cos Z(h_m-1)-\cos Z(h_s-1)], & \text{当 } h_m\geqslant 13 \text{ 和 } Z(h_m)\leqslant 80^\circ \end{cases}$$

这里 $\Delta\varphi'$（以微秒为单位）是 LF—SPA 的实测值，而 $\Delta\varphi_0$（以微秒为单位）是将 $\Delta\varphi'$ 统一归算到太阳天顶角为零的改正结果。式中，h_s 和 h_m 是 SPA 传播路径中点的开始和极大时间，用地方平太阳时表示；Z 是相应的太阳天顶角。VLF—SPA（以微秒为单位）是未经任何改正的实测值。LF—SFA 给出以分贝为单位的幅度变化，其中，正、负号分别表示幅度的增加和减少。如果对同一 LF—SFA 事件给出一负一正两个值，则表示幅度先减少，后增加；符号“0”表示幅度无变化。另外，所列值后面的字母 E 表示真实值小于所列值；字母 D 表示真实

值大于所列值；字母 U 则代表观测结果不太确定。SID 的级别是根据 $\Delta\varphi_0$ 值所确定的（最小 1－级，最大 3＋级），其对应关系如下表所示：

$\Delta\varphi_0$	(0,-1]	(-1,-2]	[-2,-3]	(-3,-4]	(-4,-5]	(-5,-6]	(-6,-7]	(-7,-8]	[-8,-∞)
级别	1－	1	1＋	2－	2	2＋	3－	3	3＋

12. 地磁活动指数 K 和 A_K 表中日期后有 Q 者表示当月五天地磁最平静日；有 D 者表示当月 5 天地磁最扰动日。三小时时段的 K 指数由各时段地磁水平强度 H 的时均值消去正常日变化后的变化磁场值决定。就中、低纬度地区而言，其对应关系如下：

H＝	3	6	12	24	40	70	120	200	300	(单位为 nT)
K＝0	1	2	3	4	5	6	7	8	9	

每日等效幅度 A_K 是当日 8 个三小时时段等效幅度 a_K 的平均。K 指数与 a_K 的对应关系如下：

K＝0	1	2	3	4	5	6	7	8	9	
a_K＝0	3	7	15	27	48	80	140	240	400	(单位为 1.2 nT)

13. 在磁暴表中，SC 表示急始磁暴；SC* 表示先有一小负脉冲然后继以主要脉冲的急始磁暴，在量 SC* 的急始幅度时，仅量取主要脉冲幅度；GC 表示缓始磁暴。活动程度栏中以 m、ms、s 分别表示中常、中烈和强烈磁暴。即分别对应于 K＝5，6－7，8－9 的磁暴。

北京地磁台的地理坐标：40.0° N、116.2° E；地磁坐标：28.9° N、186.1° E；海拔高度：43 米。

以上所有图表中的时间一律采用世界时（UT）。由世界时转换到北京时间（东径 120° 标准时）应加上八小时。例如 2300—2400（UT）观测太阳耀斑即相当于北京时间次日上午 0700—0800。

对“太阳地球物理资料”的意见，请寄北京 100080（邮政编码）中国科学院北京天文台“太阳地球物理资料”编辑组。电话：2567194，电报挂号：9053，电传：22040 BAOAS CN。

附录 1　　McIntosh 黑子分型法

黑子的分型由三个字母组成。第一个字母为修正的 Zürich 分型，第二个字母为黑子群中最大黑子的半影情况，第三个字母为黑子群中黑子的分布情况，现将各型分述如下：

（1） 修正的 Zürich 分型

A　无半影单极群。B 型长度无限制。

B　无半影双极群。大多数长度<10°，在老的群中长度可达 20°。黑子间距>3°者视为双极群。

C　一个极性中有半影的双极群，当半影径向跨度>5°时，则划为 D 型。C 型长度无限制。

D　二个极性中均有半影的双极群，其径向跨度<10°。

E　二个极性中均有半影的双极群，其径向跨度达 10°—15°。

F　二个极性中均有半影的双极群，其径向跨度>15°。

H　有半影的单极群，伴随黑子距主黑子半影<3°。其主要黑子几乎总是原双极群中的前导黑子。当半影径向跨度>5°时，则划为 D 型。

（2） 最大黑子的半影情况

x　无半影(黑子周围灰区宽度>3″时才能视为半影)。

r　不成熟和不规则半影，其宽度～3″，比正常半影亮，半影结构为颗粒状而非纤维状。

s　对称和近于园形半影，其结构为纤维状，黑子直径<2.5°，本影密集于半影中央。这种黑子变化缓慢。

a　不对称或复杂的半影，其结构为纤维状，黑子直径<2.5°，不对称半影的轮廓不规则或明显变长(不园)，半影中有二个以上本影。这种黑子往往逐日变化。

h　大的对称半影，其直径>2.5°。除了尺度较大外，其余特征与 s 相同。

k　大的不对称半影，其直径>2.5°。除了尺度较大外，其余特征与 a 相同。当半影的径向跨度>5°时，几乎可肯定半影中有二种极性，从而黑子群成为 Dkc 或 Ekc 或 Fkc 型。

（3） 群中的黑子分布

x　单个黑子。

o　开放型分布。前导与后随黑子之间无黑子，黑子群可明确划分为二部分相反极性。开放型分布暗示极性变换线附近的磁场梯度较小。

i　中间型分布。前导与后随黑子之间有一些黑子，但它们均无半影。

c　密集型分布。前导与后随黑子之间有很多黑子，其中至少一个有半影。密集型分布的极端情况是整群黑子处在连续的半影区中。密集型分布暗示极性变换线附近的磁场梯度很大。

注：Zürich分型中的 G 型与 J 型，在 McIntosh 分型法的第一个字母中已不再出现。

Zürich 分型中的 G 型现对应 McIntosh 分型法中的 Ero、Eso、Eao、Eho、Eko 和 Fro、Fso、Fao、Fho、Fko。

Zürich 分型中的 J 型现对应 McIntosh 分型法中的：Hrx、Hsx、Hax。

附录 2

耀斑表中备注栏内各字母的意义(IAU 系统)

A＝底部位于中经距小于 90°区域的爆发日珥。

B＝可能是一个比较大的耀斑的尾声。

C＝十分钟以前还看不见。

D＝一个亮点。

E＝两个或多个亮点。

F＝有几个爆发中心。

G＝在邻近区域无可见黑子。

H＝有高速暗条伴随的耀斑。

I＝活动区的范围很大。

J＝耀斑前或后谱斑亮度有明显变化。

K＝有好几个亮度极大。

L＝现存暗条有突然活动的迹象。

M＝白光耀斑。

N＝耀斑连续光谱出现各种偏振效应。

O＝用 CaII 的 H 或 K 线对耀斑进行了观测。

P＝耀斑有 HeD_3 发射。

Q＝耀斑的巴尔麦连续区呈现发射。

R＝耀斑的 H_α 线显著不对称表明有高速物质抛射。

S＝暗条消失以后在同一位置有增亮现象发生。

T＝整天活动的区域。

U＝平行型（‖）或会聚型（Y）的双亮带耀斑。

V＝有爆发相的事件：在大约一分钟内，耀斑面积扩展有伴随或不伴随亮度的急剧增大。

W＝强度极大后，耀斑面积突增。

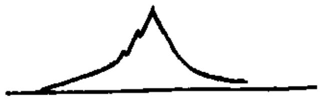
X＝耀斑的 H_α 线很宽。

Y＝环形日珥系统。

Z＝大的黑子本影为耀斑所掩盖。

附录 3

太 阳 射 电 爆 发 分 型

类 型	定 义	图 形
1 S	持续时间和峰值流量均小于 10。	
2 S/F	1 S 型爆发上叠有起伏。	
3 S	峰值流量的绝对值大于持续时间的绝对值，且峰值流量大于 10。	
4 S/F	3 S 爆发上叠有起伏。	
5 S	不符合其它简单型爆发定义，且峰值流量的绝对值大于持续时间的绝对值的爆发。	
6 S	持续时间为 1 或 2 分钟的简单上升和下降的爆发。	
7 C	持续时间为几秒，峰值流量小于 10 的复杂型爆发。	
8 S	迅速上升又迅速下降、持续时间接近或小于 1 分钟，且峰值流量大于10的简单爆发。	

类型		定义	图形
20	GRF	持续时间从10分钟到几小时，峰值流量的绝对值小于持续时间的绝对值，且流量值不超过50。	
21	GRF	20 GRF型爆发上叠加有清晰的可分别列出的爆发。	
22	GRF	20 GRF型爆发上有可分别列出的起伏。	
23	GRF	20 GRF型爆发上有可分别列出的起伏及爆发。	
24	R	持续时间为5到30分钟流量持续上升，且在上升后数小时内不伴随下降。“持续时间”附有字母D。	
25	R	24 R型爆发上叠加有爆发。	
26	FAL	持续时间为5到30分钟（指图中斜的部分）中等强度的流量下降，下降前数小时无流量上升。	
27	RF	有或多或少规律的连续谱上升和下降，持续时间为分到小时。	

类型	定义	图形
28 PRE	在主爆发之前，流量逐渐上升地（时间大于10分钟）增强，先兆的结束取在斜率突变的时刻。	
29 PBI	爆发后，流量在逐渐下降时（时间大于10分钟）仍有明显的增强，增强的开始取在斜率突变的时刻。	
30 PBI	在29 PBI型爆发上叠加有爆发。	
31 ABS	爆发后流量密度逐渐下降后又回到事件前水平。	
32 ABS	流量密度逐渐下降后又回到事件前水平。	
40 F	流量密度有一系列迅速又无规则的变化，各峰无法明显区别，各次峰强度小于主峰的15%。	
41 F	彼此接近的一群小爆发，每个小爆发均下降至爆发前水平，每两个爆发的时间间隔小于或等于5分钟。	

类 型	定 义	图 形
42 SER	具有显著时间间隔的一系列爆发，每个爆发均降至爆发前水平。	
43 NS	噪爆开始。“持续时间”带有字母 D。	
44 NS	进行中的噪爆。“开始时间”带有字母 E，“持续时间”带有字母 D。	
45 C	几个或多个简单爆发的合成。	
46 C	45 C 型爆发上有起伏。	
47 GB	峰值流量密度＞500 的爆发。	
48 C	有大振幅、复杂变化的复杂型爆发。	
49 GB	持续时间大于 10 分钟、流量有较大增强的爆发。	

CHINESE SOLAR GEOPHYSICAL DATA (CSGD)
EXPLANATION OF DATA REPORTS

Introduction

The solar geophysical data contained in " Chinese Solar Geophysical Data " are collected by Beijing Astronomical Observatory (BEIJ), Center for Space Science and Applied Research, Beijing Geomagnetic Observatory (BGMO), Beijing Planetarium (PLAT), Purple Mountain Observatory (PURP), Shaanxi Observatory (LINT), Wulumuqi Astronomical Station (WLMQ) and Yunnan Observatory (YUNN). The data in CSGD consist of the following nine parts:

1. Daily Relative Sunspot Numbers and Sunspot Areas, Daily Sunspot Observations compiled by Purple Mountain Observatory;
2. Smoothed (Predicted) Sunspot Numbers;
3. H-Alpha Solar Flares and Intervals of H-Alpha Flare Patrol Observation;
4. Solar Radio Emission Flux and Solar Radio Emission Outstanding Occurrences, Intervals of Solar Radio Emission Patrol Observations and Solar Radio Emission Burst Profiles;
5. Cosmic Ray Meson and Neutron Intensity compiled by Center for Space Science and Applied Research;
6. Sudden Ionospheric Disturbances (D-Region) (SID);
7. Geomagnetic Indices K and A_K;
8. Magnetic Storms compiled by Beijing Geomagnetic Observatory;
9. Special issues for the data of some selected events and their corresponding solar-terrestrial effects and preliminary analyses are nonperiodically published.

All the data mentioned above are stored in a VAX 11/780 computer with which some calculations are made and data are checked before the final data reports are photoprinted.

Brief Explanation of the Main Contents

1. There are two kinds of sunspot tables in which the visual data mainly come from the observations of Yunnan Observatory while photographic results of spot areas are supplied by Beijing Astronomical Observatory. When there are gaps in these observations the table will be filled by observations made on the same day by other observatories whose corresponding names will appear in the column of remarks. Sunspot group numbers in the table of " Daily Sunspot Observations " are standardized after collecting all sunspot observations from different observatories. The estimated Seeing Conditions are given in the column " See " on a 5-level scale from best (5) to worst (1).

2. The predicted values of R' with the errors E' referred to the confidance 90 % are given for a year in the table of " Smoothed (Predicted) Sunspot Numbers ". The method of prediction may be found in the CSGD January 1989, 27 .

3. In the table of " Daily Sunspot Observations " and the table of " H-Alpha Solar Flares ", Carrington coordinates are used for the positions measurement of sunspot groups or flares. Central Meridian Distance shows the distance in degrees between the central meridian and the meridian where a sunspot group or flare is located. E and W indicate that the sunspot group or flare lies to the east or to the west of the central meridian,

respectively. Heliocentric Distance measured in units of disk radius represents the distance from the centre of gravity of the sunspot group or flare on the disk to the centre of the disk. Apparent Areas Sd is the area projected on the disk in millionths of the disk and the Corrected Area Sp is the real area of the sunspot group or flare occupied on the sun surface in millionths of the hemisphere after the projecting correction of Apparent Area Sd is considered. McIntosh classification is used for sunspot classification.

4. The table of " H-Alpha Solar Flares " gives H-Alpha flare patrol observations including subflares made by Beijing Astronomical Observatory,Purple Mountain Observatory, Wulumuqi Astronomical Station, and Yunnan Observatory. For each flare, start time, end time, and the time of maximum phase which shows the maximum of flare brightness are given, and the area is that measured at the time of maximum phase. For flares less than 65° from the centre of the disk, the formula relating apparent area Sd and corrected area Sp is the so called $Sec\theta$ law. Two figures are assigned to each flare to show the importance of the flare. The first figure is defined by the area of the flare at the maximum phase and the second one is only a qualitative scale where each Observatory uses its experience to decide if a flare is rather faint (F), normal (N), or rather bright(B). For flares less than 65° from the centre of the disk, i.e., the heliocentric distance is less than 0.906, the first figure assigned to the flare importance is defined by the corrected area Sp according to the following table where areas are given in millionths of solar hemisphere.

Corrected Area Sp in Millionths of Hemisphere	Relative Intensity Evaluation		
	Faint (F)	Normal(N)	Brilliant(B)
≤ 100	-F	-N	-B
101 — 250	1F	1N	1B
251 — 600	2F	2N	2B
601 - 1200	3F	3N	3B
≥ 1201	4F	4N	4B

For flares equal to or greater than 65° from the centre of the disk, i. e., the heliocentric distance is equal to or greater than 0.906, the first figure assigned to the flare importance can be estimated by the apparent area Sd according to the following table where the areas are given in millionths of the disk.

Heliocentric Distance r/R	Importance			
	–	1	2	3
.906 - .939	Sd $<$ 90	90 - 279	280 - 599	Sd $\geq$ 600
.940 - .984	75	75 - 239	240 - 499	500
.985 - .999	50	50 - 179	180 - 349	350
1	45	45 - 169	170 - 299	300

The letters C, P, and V in the column marked " Observation Type " represent the nature and completeness of available observations, i.e.:

C — a complete or quasi-complete sequence of photographs was obtained;

P — one or a few photographs of the event were obtained resulting in incomplete time coverage;

V — all (or most of) the development of the flare was visually observed.

One or more than one upper case letter from A to Z appear in the column marked " Remarks " which follows an International Astronomical Union notation, in which each letter of the Alphabet stands for a particular noteworthy condition, as shown in Appendix 1.

5. In the graph of " Intervals of H-Alpha Flare Patrol Observations ", the dark areas are times of neither visual nor cinematographic patrol while the blank areas are time of cinematographic patrol. Flare patrol observations are considered to be continuous if the intervals of no flare patrol observations are less than five minutes.

6. The table of " Daily Solar Radio Emission Flux " gives the flux values of the sun calibrated in units of $10^{-22} \cdot W \cdot M^{-2} \cdot Hz^{-1}$ (s.f.u.) at the time around meridian transit (BEIJ, PURP : around 0400 UT; YUNN: around 0500 UT) every day at different fixed radio frequencies. All flux values are adjusted to mean sun-earth distance: 1 AU.

7. The meaning of each column in the table of " Solar Radio Emission Outstanding Occurrences " is an international implied consent. In the column of Flux Density, "Peak" represents the peak value of flux density of the event; " Rel " represents the relative value $\Delta S/S$, i.e., the ratio of the flux increment ΔS and the flux S before the burst; " Mean " represents the mean flux increment which is an integral of flux increment over the time of duration and divided by the duration. Both the peak flux density and the mean flux density are measured in units of " s.f.u. ", frequency in units of MHz and duration in units of minutes.

For the classification of bursts see Appendix 2. Among the types, 1 S, 2 S/F, 3 S, 4 S/F, 5 S, 20 GRF, 21 GRF, 22 GRF, 23 GRF, 41 F, 45 C, 46 C and 47 GB are used in the range of frequency greater than 600 MHz, 6 S, 7 C, 27 RF, 42 SER, 43 NS, 44 NS, 48 C and 49 GB are used in the range of frequency less than 600 MHz, and on the other hand, 28 PRE, 29 PBI, 30 PBI and 31 ABS are not independent types at all.

Finally, one must notice that, for simplicity, we use the absolute value of flux density (with original value in s.f.u.) and duration (with original value in minute) for the definition of classification in Appendix 2.

8. In the " Profiles Figure of Solar Radio Emission Outstanding Occurrences ", the date, peak fluxes, and frequencies of events are given on the right corner. The time is denoted on the abscissa axis and the amplitude in units of s.f.u. is denoted on the ordinate axis.

9. The table of " Intervals of Solar Radio Emission Patrol Observations " gives the time coverage of the patrol observations made with those radio telescopes that contribute the data. The data gaps less than half hour are not listed.

10. The intensities of cosmic ray neutrons and mesons, which are recorded with 18-NM-64 super neutron monitor (NM) and ACK-1 large ion chamber (IC), are monthly tabulated. The hourly mean values in the table are already corrected for the atmospheric pressure. The real counting rates of cosmic ray neutrons are the counting rates in the table plus 1500 and multiplies with the scaling factor 256. The relative intensity of cosmic ray mesons is the tabulated values plus 1000 and in the units of 0.1 %. The space "   " and the dash " — " means no data.

The gragh expresses the variations of cosmic ray intensity monitored with the NM and IC hourly. The abscissa is the cycle of the Bartels Solar Rotation. The intensity variation between two horizontal lines corresponds to 5%. The vertical lines indicate 0^h UT.

11. The table of " Sudden Ionosphereic Disturbances (D-Region) " (SID) presents

the informations of the Sudden Phase Anomalies (SPA) and the Sudden Field Anomalies (SFA) based on the observations of the propagations of the Loran-C signals at 100 kHz (LF) and the Omega signals at 10.2 kHz (VLF), which are the particular types of the SID, resulted from the sudden changes of the condition in the D-Region of the ionosphere. Here, the Sudden Phase Anomalies at low frequency (LF-SPA) are reported by both Shaanxi Observatory and Yunnan Observatory while the Sudden Phase Anomalies at very low frequency (VLF-SPA) and the Sudden Field Anomalies at low frequency (LF-SFA) are reported by Shaanxi Observatory only. (VLF-SPA) in the signal received from 10.2 kHz Omega-E Station. The letter in the bracket will be given other signal.

The values of the (LF-SPA) in μs listed in this table are the corrected results of the measurements for the solar zenith correction with following expression resulted from the analyses and calculation:

$$\Delta\phi_0 = \frac{5.0}{1.6 + 3.4\cos Z(h_m)} \cdot \Delta\phi' +$$

$$+\begin{cases} 7.3 \times [cosZ(h_m) - cosZ(h_s)]\,, & when\ h_m \le 12\ and\ Z(h_m) \le 80°; \\ 0\,, & when\ 12 < h_m < 13; \\ 7.3 \times [cosZ(h_m - 1) - cosZ(h_s - 1)]\,, & when\ h_m \ge 13\ and\ Z(h_m) \le 80°; \end{cases}$$

where,$\Delta\phi'$ in μs is a measured value of (LF-SPA) , $\Delta\phi_0$ in μs is a corrected result of $\Delta\phi'$, i.e., a value normalized to the solar zenith angle of zero. h_s and h_m , in local mean solar time for the middle point of the propagation path are the SPA start time and the SPA maximum time, respectively, and Z is the corresponding solar zenith angle. The values of the (VLF-SPA) in μs are the measurement results without any correction and the listed values of (LF-SFA) in db give the information of amplitude variation, in which, the signs " + ", and " – " prefixed to the values indicate the increase and the decrease of the amplitude, respectively. In case there are two values listed for the same (LF-SFA) event, one negative and the other positive, it means the amplitude decrease at first and increase afterwards. Sign " 0 " indicates that there was no amplitude change. Besides, " E " after the listed value means that the real value is less than the listed one; the letter " D " after the listed value indicates that the real value is greater than the listed one ; letter " U " denotes an uncertainty in measurement. As for the importance rating, based on a scale of 1–, the least, to 3+, the most important, is derived from the values of $\Delta\phi_0$, shown as the following table:

$\Delta\phi_0$	(0,-1]	(-1,-2]	(-2,-3]	(-3,-4]	(-4,-5]	(-5,-6]	(-6,-7]	(-7,-8]	(-8,-∞]
IMP.	1–	1	1+	2–	2	2+	3–	3	3+

12. The data included in the table of " The Geomagnetic Activity Indices K and A_K " are: three-hourly K index, five quietest days of the month (Q) and five most disturbed days of the month (D). Three-hourly K index; is determined by the H components measured in nT in each corresponding three-hourly period and subtracted by the diurnal normal changes of geomagnetic field. For mid and low latitude areas, the corresponding relation of H and K is as follows :

H =	3,	6,	12,	24,	40,	70,	120,	200,	300	(in nT)
K = 0,	1,	2,	3,	4,	5,	6,	7,	8,	9	

Daily effective A_K is the average of eight values of three-hourly index a_K, the corresponding relation of K and a_K is as follows :

K =	0,	1,	2,	3,	4,	5,	6,	7,	8,	9
a_K =	0,	3,	7,	15,	27,	48,	80,	140,	240,	400 (in 1.2 nT)

13. Three kinds of geomagnetic storm are listed in the table of "The Magnetic Storms": sudden commencement (SC), a small negative initial impulse followed by a main impulse (SC*) and gradual commencement (GC). Three degrees are used for the rating of geomagnetic storms, i.e.: moderate (m), moderate severe (ms) and severe (s) corresponding to K=5, K=6 or 7, and K=8 or 9, respectively.

Beijing Geomagnetic Observatory is located at $40.0°N$, $116.2°E$ geographic coordinates, $28.9°N$, $186.1°E$ geomagnetic coordinates, and 43 meters above sea level.

The time used in all these data reports is Universal Time (UT). To transform UT to Beijing Standard Time ($120°E$) one can simply add 8 hours to Universal Time. For instance, for a flare observed at 2230–2400 UT, the equivalent Beijing Standard Time is 0630–0800 next day.

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Appendix 1

The International Astronomical Union Notation for H-Alpha Solar Flares

A = Eruptive prominence whose base is less than 90° from the central meridian.
B = Probably the end of a more important flare.
C = Invisible 10 minutes before.
D = Brilliant Point.
E = Two or more brilliant points.
F = Several eruptive centers.
G = No visible spots in the neighborhood.
H = Flare accompanied by a high speed dark filament.
I = Active region very extended.
J = Distinct variations of plage intensity before or after the flare.
K = Several intensity maxima.
L = Existing filaments show signs of sudden activity.
M = White-light flare.
N = Continuous spectrum shows effects of polarization.
O = Observations have been made in the calcium II lines H or K.
P = Flare shows helium D_3 in emission.
Q = Flare shows the Balmer continuum in emission.
R = Marked asymmetry in H-alpha line suggests ejection of high velocity material.
S = Brightness follows disappearance of filament (same position).
T = Region active all day.
U = Two bright branches, parallel (||) or converging (Y).
V = Occurrence of an explosive phase: important and abrupt expansion in about a minute with or without important intensity increase.
W = Great increase in area after time of maximum intensity.
X = Unusually wide H-alpha line.
Y = System of loop-type prominences.
Z = Major sunspot umbra covered by flare.

Appendix 2

Classification of Solar Radio Bursts

Type	Definition	Figure
1 S	Peak flux density (sfu) and duration (min) both less than 10.0.	
2 S/F	1 S with fluctuations.	
3 S	Peak flux density (sfu) greater than both the duration (min) and 10.0.	
4 S/F	3 S with fluctuations.	
5 S	Different from the simple events defined above, also peak flux density (sfu) greater than duration (min) of the burst.	
6 S	Simple rise and fall of minor burst with duration 1 or 2 min .	
7 C	Complex events with duration of several seconds and flux density (sfu) less than 10.0.	
8 S	An event which shows a rapid rise to a single peak, followed by a rapid fall to the pre-event level with a duration about one minute or less and flux density (sfu) greater than 10.0.	

GRF Bursts have duration in the range from 10 minutes to several hours and flux density (sfu) less than both the duration (min) and 50.0.

21 GRF 20 GRF type burst with superimposed distinct bursts to be able to list separately.

22 GRF 20 GRF type burst with fluctuations to be able to list separately.

23 GRF 20 GRF type burst with fluctuations and superimposed bursts both to be able to list separately.

24 R A moderate rise of flux from 5 to 30 minutes duration with no accompanying decline during the following hours and with symbol D.

25 R 24 R type bursts with superimposed bursts.

26 FAL A moderate decline of flux from 5 to 30 minutes duration with no rise of flux during the foregoing hours and with symbol D.

27 RF The rise and fall of continuous spectrum more or less regularly with duration in the range from minutes to hours.

28 PRE — A precursive enhancement of the flux density level with duration greater than 10 min preceding the main burst if it is a gradual rise; the end of the precursor is taken at the time when the slope suddenly changes.

29 PBI — A post-burst enhancement of flux density level with duration greater than 10 min if it decreases gradually; the start of the enhancement is taken at the time when the slope suddenly changes.

30 PBI — 29 PBI type events with superimposed bursts.

31 ABS — After the burst a gradual decrease of the flux density with a subsequent return to the pre-event level.

32 ABS — A gradual decrease of the flux density with a subsequent return to the pre-event level.

40 F — A series of rapid irregular changes in the flux density level, with no distinct peak grouping into individual events; the intensity of each component is less than 15% of the main peak.

41 F — A number of single bursts occur in succession and the flux level returns to the pre-event level; the interval between each two bursts is equal to or less than 5 min.

42 SER — A series of bursts occur with considerable time intervals between bursts; the flux level of each burst returns to the pre-burst.

43 NS Onset of Noise Storm. Duration of events with symbol D.

44 NS Noise Storm in progress. Starting time with symbol E, and duration with symbol D.

45 C Combination of a few or many simple bursts.

46 C 45 C burst with fluctuations.

47 GB Peak flux density of 500 sfu or more.

48 C A complex event with complex and large variation of amplitude.

49 GB Major increase of flux density, duration greater than 10 min.

DAILY RELATIVE SUNSPOT NUMBERS AND SUNSPOT AREAS

JANUARY 1989

		Relative-Numbers			Sunspot Areas					
					Drawing			Photographic		
Day	Gro.	N.H.	S.H.	Sum	N.H.	S.H.	Sum	N.H.	S.H.	Sum
1	9	52	95	147	547	821	1368	701	888	1589
2	11	69	98	167	225	637	862	1038	1449	2487
3	13	66	89	155	308	566	874	816	817	1633
4	9	53	109	162	801	1018	1819	867	911	1778
5	13	55	91	146	696	689	1385			
6	15	73	85	158	726	677	1403			
7	12	66	80	146	594	1444	2038	913	2884	3797
8	11	79	112	191	714	2460	3174	824	1577	2401
9	11	75	110	185	575	2206	2781	606	2063	2669
10	14	75	127	202	786	2141	2927			
11	14	82	140	222	663	2406	3069	489	2347	2836
12	14	68	126	194	889	2184	3073	809	2449	3258
13	14	93	153	246	781	2365	3146	637	2430	3067
14	10	80	134	214	564	2562	3126	868	3051	3919
15	10	65	94	159	1219	2607	3826	1133	3344	4477
16	9	77	80	157	1695	2569	4264	2177	2760	4937
17	7	77	59	136	2031	2330	4361	1695	2430	4125
18	10	109	65	174	2139	1941	4080			
19	9	84	52	136	2196	1529	3725	2191	1076	3267
20	9	95	40	135	2286	1358	3644	2120	770	2890
21	9	73	22	95	2109	265	2374	2146	206	2352
22	10	73	35	108	2019	519	2538			
23	9	83	53	136	1173	322	1495	1562	981	2543
24	9	92	55	147	1335	515	1850	1610	1015	2625
25	9	86	69	155	1251	445	1696	2153	848	3001
26	8	72	78	150	1115	545	1660	1914	1432	3346
27	5	60	102	162	899	536	1435	1755	1414	3169
28	7	62	134	196	833	492	1325	1071	1114	2185
29	9	52	164	216	691	491	1182	1300	865	2165
30	6	37	117	154	964	629	1593	1249	876	2125
31	8	39	110	149	645	717	1362	643	812	1455
Mean		71.7	92.8	164.5	1079.6	1289.9	2369.5			

DAILY SUNSPOT OBSERVATIONS

JANUARY 1989

Day	Group	CMP Mo-Day	Lat	L	CMD	Type	r/R	Sd	Corre. Whole	Area Max	See	Remarks
1.10	403	12-27.5	21	167	59W	DEC	0.89	463	497	117	3	
	404	12-28.4	-19	155	48W	EAC	0.76	589	452	184	3	
	407	12-28.6	16	152	44W	CRI	0.74	42	31	12	3	
	408	12-30.4	-16	129	21W	DSC	0.40	450	246	76	3	
	410	1- 2.1	-18	94	12E	AXX	0.32	4	2	2	3	
	411	12-28.1	-42	158	49W	CRO	0.84	25	23	15	3	
	415	1- 2.8	27	83	23E	BXO	0.60	8	5	3	3	
	416	12-31.6	-18	112	6W	DRI	0.26	189	98	52	3	
	1	1- 7.4	21	24	81E	AXX	0.99	4	14	14	3	
2.06	403				73W	DSI	0.97	76	145	40	3	
	404				61W	EAI	0.86	185	183	79	3	
	407				57W	CRI	0.86	38	37	8	3	
	408				34W	EAC	0.56	559	338	137	3	
	410				0W	BXO	0.26	13	7	2	3	
	411				61W	BXI	0.92	8	11	5	3	
	412	12-29.9	20	135	40W	AXX	0.72	4	3	3	3	
	415				11E	BXO	0.55	8	5	3	3	
	416				20W	CAI	0.43	177	98	72	3	
	1				69E	AXX	0.95	4	7	7	3	
	2	1- 8.2	10	13	81E	AXX	0.99	8	28	14	3	
3.06	403				85W	BXO	0.99	8	28	14	3	
	404				72W	DSO	0.94	46	69	38	3	
	407				73W	BXO	0.95	25	42	14	3	
	408				47W	EAC	0.74	400	295	180	3	
	410				14W	BXI	0.34	17	9	2	3	
	411				76W	CRO	0.97	13	24	16	3	
	415				3W	BXO	0.52	8	5	2	3	
	416				32W	DAC	0.56	273	165	92	3	
	1				56E	AXX	0.86	8	8	4	3	
	2				67E	CSI	0.93	55	75	40	3	
	3	1- 2.2	-13	91	11W	BXI	0.24	8	4	2	3	
	4	1- 8.2	18	13	69E	AXX	0.94	8	13	6	3	
	5	1- 9.1	26	2	75E	HAX	0.97	71	137	129	3	
4.09	408				60W	DAI	0.86	290	286	137	3	PLAT
	410				28W	BXI	0.51	42	24	2	3	PLAT
	416				43W	EAI	0.70	551	386	236	3	PLAT

DAILY SUNSPOT OBSERVATIONS

JANUARY 1989

Day	Group	CMP Mo-Day	Lat	L	CMD	Type	r/R	Sd	Corre. Area Whole	Max	See	Remarks
	2				55E	DAI	0.83	378	337	202	3	PLAT
	4				55E	HSX	0.85	21	20	20	3	PLAT
	5				64E	DAI	0.93	324	444	317	3	PLAT
	6	1- 5.1	-22	54	13E	AXX	0.37	4	2	2	3	PLAT
	7	1- 9.9	-18	350	79E	HAX	0.98	130	306	296	3	PLAT
	8	1- 9.9	-26	350	73E	AXX	0.95	8	14	7	3	PLAT
5.06	408				74W	DRO	0.95	76	126	70	4	
	410				43W	CRI	0.70	34	24	12	4	
	415				25W	AXX	0.63	4	3	3	4	
	416				59W	EAC	0.86	231	228	104	4	
	1				27E	BXI	0.59	8	5	3	4	
	2				43E	EKI	0.70	400	280	186	4	
	3				36W	BXO	0.59	8	5	3	4	
	4				42E	HRX	0.72	21	15	15	4	
	5				49E	EKI	0.83	442	393	337	4	
	7				65E	CHI	0.90	210	237	223	4	
	8				61E	BXI	0.89	8	9	5	4	
	9	1- 5.1	-13	54	1E	BXO	0.16	8	4	2	4	
	10	1-11.3	-14	332	84E	HSX	0.99	17	56	56	4	
6.06	408				85W	AXX	0.99	8	28	28	4	
	410				58W	CRI	0.85	55	52	28	4	
	415				39W	AXX	0.75	4	3	3	4	
	416				72W	EAC	0.94	151	227	94	4	
	1				17E	AXX	0.52	4	2	2	4	
	2				29E	EKO	0.54	471	280	190	4	
	3				44W	BXO	0.70	8	6	3	4	
	4				29E	AXX	0.59	13	8	5	4	
	5				37E	EKO	0.72	576	418	329	4	
	7				51E	CHI	0.78	315	253	239	4	
	8				47E	BXI	0.76	13	10	3	4	
	10				68E	HAX	0.92	46	59	59	4	
	11	1-10.5	30	343	62E	AXX	0.92	4	5	5	4	
	12	1-11.6	30	328	75E	AXX	0.98	4	10	10	4	
	13	1-12.4	-29	318	85E	HRX	0.99	13	42	28	4	
7.06	410				69W	CRI	0.93	29	40	12	2	
	416				83W	DRI	0.98	25	59	39	2	
	1				4E	AXX	0.41	8	5	2	2	

DAILY SUNSPOT OBSERVATIONS

JANUARY 1989

Day	Group	CMP Mo-Day	Lat	L	CMD	Type	r/R	Sd	Corre. Area Whole	Max	See Remarks
	2				17E	EKO	0.37	404	217	142	2
	4				16E	AXX	0.44	8	5	5	2
	5				24E	EKI	0.62	568	362	207	2
	7				37E	CHO	0.63	412	266	261	2
	8				34E	BXI	0.63	17	11	3	2
	10				55E	CSI	0.80	63	53	46	2
	12				60E	AXX	0.91	4	5	5	2
	13				69E	HRX	0.93	21	29	17	2
	14	1-13.2	-32	307	79E	DKC	0.98	421	986	986	2
8.06	410				82W	DAI	0.99	67	223	139	4
	2				2E	FSO	0.23	488	251	86	4
	4				2E	AXX	0.37	8	5	5	4
	5				12E	EKI	0.53	757	446	233	4
	7				24E	CHO	0.46	475	268	260	4
	8				23E	BXI	0.52	17	10	2	4
	10				43E	ESI	0.69	345	238	139	4
	11				30E	BXO	0.70	8	6	3	4
	13				56E	CSO	0.86	50	50	41	4
	14				67E	EKC	0.93	122	1671	1613	4
	15	1-13.2	24	307	66E	AXX	0.94	4	6	6	4
9.06	1				22W	AXX	0.62	4	3	3	3
	2				12W	FSO	0.32	391	207	89	3
	4				9W	BXO	0.41	13	7	2	3
	5				0W	EKI	0.51	610	353	100	3
	7				11E	CHO	0.32	538	284	275	3
	8				11E	BXI	0.43	17	9	2	3
	10				30E	EAI	0.53	610	359	144	3
	13				43E	CRI	0.76	46	36	23	3
	14				54E	EKC	0.85	1522	1448	1372	3
	15				55E	AXX	0.89	4	5	5	3
	16	1-15.3	-32	279	82E	HRX	0.99	21	70	70	3
10.02	2				26W	FSO	0.46	362	204	81	3
	4				22W	BXO	0.49	8	5	2	3
	5				12W	EKI	0.53	589	347	134	3
	7				2W	CHO	0.25	551	285	278	3
	8				2W	BXO	0.39	8	5	2	3
	10				16E	EAI	0.32	652	344	162	3

DAILY SUNSPOT OBSERVATIONS

JANUARY 1989

Day	Group	CMP Mo-Day	Lat	L	CMD	Type	r/R	Sd	Corre. Area Whole	Corre. Area Max	See	Remarks
	13				30E	CRI	0.63	25	16	8	3	
	14				41E	EKC	0.74	1863	1375	1319	3	
	16				70E	CSI	0.94	67	101	94	3	
	17	1- 7.9	-4	17	29W	AXX	0.47	8	5	2	3	
	18	1-12.4	24	317	32E	AXX	0.69	8	6	3	3	
	19	1-15.0	-20	283	66E	BXO	0.91	8	10	5	3	
	20	1-15.9	21	271	78E	BXO	0.98	42	99	59	3	
	21	1-16.2	29	267	80E	HSX	0.99	38	125	125	3	
11.06	2				40W	FSO	0.67	160	107	42	3	
	5				25W	ESO	0.62	332	212	110	3	
	7				15W	CHO	0.33	500	265	256	3	
	8				15W	CRO	0.43	46	26	19	3	
	10				3E	EAI	0.18	521	265	150	3	
	11				8W	BXO	0.59	8	5	3	3	
	13				18E	BXO	0.51	13	7	2	3	
	14				28E	EKC	0.62	2418	1542	1454	3	
	16				57E	CSO	0.86	84	83	79	3	
	18				18E	BXO	0.54	8	5	2	3	
	19				52E	BXO	0.79	29	24	14	3	
	20				65E	DAI	0.93	172	236	161	3	
	21				68E	CSO	0.95	59	98	91	3	
	22	1-17.0	-20	256	78E	HAX	0.97	101	194	137	3	
12.06	2				52W	ESO	0.78	151	121	61	3	
	5				38W	ESI	0.74	126	93	53	3	
	7				28W	CHO	0.49	383	220	215	3	
	8				29W	BXO	0.56	25	15	8	3	
	10				11W	EAI	0.28	378	197	153	3	
	11				21W	BXO	0.66	8	6	3	3	
	13				4E	BXO	0.41	8	5	2	3	
	14				15E	EKC	0.51	2620	1519	1404	3	
	16				44E	CSO	0.76	50	39	36	3	
	19				39E	BXO	0.64	13	8	3	3	
	20				52E	DAI	0.85	177	168	112	3	
	21				55E	HSX	0.89	76	81	81	3	
	22				65E	CAI	0.91	151	181	171	3	
	23	1-17.6	17	249	72E	CAI	0.97	219	420	372	3	
13.11	2				64W	CSO	0.91	34	40	25	3	PLAT

DAILY SUNSPOT OBSERVATIONS

JANUARY 1989

Day	Group	CMP Mo-Day	Lat	L	CMD	Type	r/R	Sd	Corre. Whole	Area Max	See	Remarks
	5				50W	DAI	0.84	97	89	54	3	PLAT
	7				40W	CKO	0.66	408	270	267	3	PLAT
	8				42W	BXO	0.71	21	15	6	3	PLAT
	10				24W	CAI	0.44	311	173	147	3	PLAT
	14				2E	EKC	0.44	3078	1711	1648	3	PLAT
	16				30E	CSO	0.63	34	22	16	3	PLAT
	19				27E	AXX	0.49	8	5	5	3	PLAT
	20				40E	CAI	0.70	151	106	94	3	PLAT
	21				42E	HSX	0.78	38	30	27	3	PLAT
	22				50E	CAO	0.78	210	169	162	3	PLAT
	23				60E	DKI	0.89	471	506	429	3	PLAT
	24	1-11.4	29	331	23W	AXX	0.64	8	5	5	3	PLAT
	25	1-13.1	20	308	0W	AXX	0.41	8	5	2	3	PLAT
14.05	5				64W	BXX	0.92	4	5	5	4	PURP
	7				56W	HKX	0.82	332	287	287	4	PURP
	10				36W	CAO	0.60	223	139	134	4	PURP
	14				8W	FKC	0.48	3352	1914	1604	4	PURP
	16				17E	CAI	0.54	76	45	35	4	PURP
	20				27E	DAI	0.60	265	165	81	4	PURP
	21				30E	CRO	0.70	21	15	12	4	PURP
	22				40E	HKX	0.67	236	158	155	4	PURP
	23				50E	DKO	0.80	450	379	333	4	PURP
	26	1-16.0	-17	270	27E	CSO	0.49	34	19	17	4	PURP
15.17	5				77W	BXO	0.97	8	16	8	3	
	7				69W	HAX	0.92	193	246	246	3	
	10				55W	CSO	0.82	168	146	142	3	
	14				24W	FKC	0.55	3356	2012	1979	3	
	16				2E	BXO	0.46	29	17	5	3	
	20				11E	DKI	0.46	892	502	265	3	
	22				24E	CAI	0.46	311	175	173	3	
	23				31E	DAI	0.61	580	366	188	3	
	26				13E	BXI	0.31	21	11	7	3	
	27	1-21.2	21	201	81E	HSX	0.98	143	335	335	3	
16.17	7				82W	HSX	0.99	42	139	139	2	
	10				69W	CSO	0.93	101	138	133	2	
	14				35W	FKC	0.68	3120	2123	2089	2	
	16				12W	BXO	0.48	17	10	5	2	

DAILY SUNSPOT OBSERVATIONS

JANUARY 1989

Day	Group	CMP Mo-Day	Lat	L	CMD	Type	r/R	Sd	Corre. Whole	Area Max	See Remarks
	20				3W	EKC	0.43	1829	1011	481	2
	22				11E	CAI	0.32	294	155	149	2
	23				19E	DSI	0.47	618	350	167	2
	26				2W	BXO	0.21	8	4	2	2
	27				66E	CHO	0.93	244	334	323	2
17.12	10				81W	HSX	0.98	55	128	128	2
	14				47W	FKC	0.78	2523	2023	1955	3
	16				24W	CRO	0.56	55	33	23	3
	20				14W	EKC	0.48	2389	1364	648	3
	22				1W	CSI	0.26	282	146	144	3
	23				6E	DSO	0.38	568	307	136	3
	27				53E	CHO	0.85	378	360	352	3
18.12	14				59W	FKC	0.87	1724	1771	1745	3
	16				36W	BXO	0.68	29	20	6	3
	18				75W	AXX	0.98	4	10	10	3
	20				26W	EKC	0.59	2607	1609	623	3
	22				13W	CSO	0.33	273	145	143	3
	23				7W	DSO	0.39	273	148	69	3
	26				27W	AXX	0.48	8	5	2	3
	27				41E	CHO	0.74	433	320	298	3
	28	1-20.3	14	213	29E	AXX	0.57	4	3	3	3
	29	1-23.7	22	169	69E	HRX	0.95	29	49	49	3
19.05	14				68W	FKC	0.93	1001	1371	738	3
	16				49W	BXO	0.79	8	7	3	3
	20				38W	FKC	0.71	2397	1708	779	3
	22				26W	CSO	0.49	244	140	131	3
	23				19W	DSO	0.48	257	146	60	3
	27				28E	CHO	0.61	454	286	281	3
	29				57E	HSX	0.89	42	45	45	3
	30	1-14.5	30	290	60W	AXX	0.92	8	11	5	3
	31	1-24.0	-18	165	68E	BXO	0.92	8	11	5	3
20.06	14				79W	FKC	0.98	505	1184	690	3
	16				61W	AXX	0.89	8	9	5	3
	20				51W	FKC	0.84	1892	1739	1121	3
	22				39W	CSO	0.64	236	154	148	3
	23				32W	DSI	0.62	223	142	51	3

DAILY SUNSPOT OBSERVATIONS

JANUARY 1989

Day	Group	CMP Mo-Day	Lat	L	CMD	Type	r/R	Sd	Corre. Area Whole	Corre. Area Max	See Remarks
	27				15E	FHO	0.49	601	346	305	3
	29				45E	CSO	0.78	67	54	54	3
	31				53E	BXO	0.80	13	11	7	3
	32	1-24.9	26	153	58E	AXX	0.90	4	5	5	3
21.06	14				87W	HAX	0.99	34	111	111	3
	20				64W	FKC	0.93	1072	1469	997	3
	22				52W	HSX	0.78	185	148	148	3
	23				45W	DSO	0.76	143	110	42	3
	27				2E	CHO	0.44	517	288	283	3
	29				32E	HSX	0.67	50	34	34	3
	31				39E	AXX	0.66	8	6	6	3
	32				41E	BXO	0.76	8	6	3	3
	33	1-26.5	17	132	73E	DSI	0.97	105	202	89	3
22.15	20				76W	DKC	0.98	353	829	829	3
	22				66W	HSX	0.91	114	136	136	3
	23				56W	CSO	0.86	97	95	50	3
	27				12W	CHO	0.47	564	319	315	3
	29				19E	HRX	0.54	55	32	32	3
	31				22E	BXO	0.41	21	12	5	3
	32				34E	AXX	0.70	4	3	3	3
	33				59E	DAC	0.89	690	741	212	3
	34	1-17.4	-15	252	63W	AXX	0.89	8	9	5	3
	35	1-29.0	-18	98	81E	DSI	0.99	109	362	209	3
23.08	22				80W	HSX	0.98	17	39	39	3
	23				69W	CRO	0.93	29	40	17	3
	27				24W	CHI	0.57	463	283	275	3
	29				7E	HRX	0.47	25	14	12	3
	31				11E	BXO	0.31	17	9	2	3
	32				21E	BXI	0.60	17	10	3	3
	33				45E	EKC	0.76	1077	826	284	3
	34				75W	BXI	0.95	8	14	7	3
	35				74E	FSI	0.95	156	260	49	3
24.06	23				72W	BXO	0.95	8	14	7	3
	27				36W	CHI	0.70	425	298	289	3
	29				5W	HRX	0.47	21	12	10	3
	31				1W	BXO	0.23	8	4	2	3

DAILY SUNSPOT OBSERVATIONS

JANUARY 1989

Day	Group	CMP Mo-Day	Lat	L	CMD	Type	r/R	Sd	Corre. Area Whole	Max	See Remarks
	32				9E	BXI	0.52	13	7	2	3
	33				32E	FKC	0.63	1556	1004	399	3
	35				62E	FKC	0.89	467	501	230	3
	36	1-25.2	-27	149	16E	BXI	0.46	8	5	2	3
	37	1-25.9	-18	139	26E	BXI	0.46	8	5	2	3
25.11	27				50W	CHI	0.83	324	288	281	3
	29				17W	BXO	0.54	13	7	5	3
	31				15W	BXO	0.36	13	7	2	3
	32				3W	BXI	0.53	8	5	2	3
	33				18E	FKC	0.49	1653	951	356	3
	35				50E	FSC	0.76	555	426	110	3
	36				1E	BXI	0.36	8	5	2	3
	37				11E	BXO	0.28	8	4	2	3
	38	1-28.1	-20	111	39E	AXX	0.67	4	3	3	3
26.05	27				63W	HHX	0.92	177	225	225	3
	29				30W	AXX	0.66	4	3	3	3
	31				25W	BXO	0.46	13	7	2	3
	32				18W	BXO	0.59	8	5	3	3
	33				6E	FKC	0.40	1615	882	356	3
	35				38E	FSC	0.63	614	396	122	3
	36				8W	BXO	0.31	8	4	2	3
	39	2- 1.3	-22	56	79E	ERI	0.98	59	138	30	3
27.08	27				75W	HSX	0.98	80	187	178	3
	31				34W	BXO	0.56	8	5	3	3
	33				7W	FHC	0.40	1304	712	322	3
	35				25E	FSC	0.46	648	365	123	3
	39				66E	EAI	0.91	139	166	80	3
28.06	27				87W	AXX	0.99	8	28	28	4
	31				49W	BXI	0.75	13	9	3	4
	33				18W	FKC	0.49	1400	805	310	4
	35				12E	FSI	0.32	580	306	93	4
	36				41W	BXO	0.69	8	6	3	4
	38				0W	BXI	0.25	13	7	2	4
	39				53E	EAC	0.82	189	164	84	4
29.05	31				61W	BXO	0.86	8	8	4	4

DAILY SUNSPOT OBSERVATIONS

JANUARY 1989

Day	Group	CMP Mo-Day	Lat	L	CMD	Type	r/R	Sd	Corre. Whole	Area Max	See Remarks
	33				31W	FKC	0.62	1077	687	287	4
	35				0W	FAI	0.23	479	246	93	3
	37				40W	BXO	0.66	8	6	3	3
	38				15W	CAI	0.34	130	69	58	3
	39				41E	EAC	0.68	219	149	63	3
	40	1-24.9	-34	153	55W	AXX	0.84	8	8	4	3
	41	1-26.5	-15	132	34W	BXO	0.57	8	5	3	3
	42	2- 2.2	19	44	53E	AXX	0.85	4	4	4	3
30.06	33				44W	FKC	0.75	1270	955	335	3
	35				14W	FAI	0.33	513	272	103	3
	37				54W	BXO	0.80	8	7	4	3
	38				27W	DAI	0.49	122	70	36	3
	39				28E	EAC	0.51	484	280	97	3
	42				40E	BXO	0.72	13	9	6	3
31.06	33				57W	FAC	0.85	673	640	172	3
	35				27W	FAI	0.51	336	195	93	3
	38				41W	CAI	0.68	97	66	54	3
	39				15E	EAC	0.38	580	314	145	3
	42				28E	BXO	0.60	8	5	3	3
	43	1-30.2	-25	83	11W	AXX	0.37	4	2	2	3
	44	2- 5.7	-22	357	75E	HSX	0.95	67	112	112	3
	45	2- 6.4	-18	349	86E	AXX	0.99	8	28	28	3

SMOOTHED (PREDICTED) SUNSPOT NUMBERS

OCTOBER 1988 – SEPTEMBER 1989

Time	88,10	88,11	88,12	89,01	89,02	89,03	89,04	89,05	89,06	89,07	89,08	89,09
R'	127.4	132.9	137.8	142.5	147.0	151.4	155.8	160.1	164.4	168.7	173.1	177.5
E'	1.3	1.3	5.5	11.4	13.2	18.2	24.9	25.6	31.2	32.1	36.3	35.5

H-ALPHA SOLAR FLARES

JANUARY 1989

Day	Sta	Time Start (UT)	Time Max (UT)	Time End (UT)	Lat	L	CMD	Cen Dist	Area Measurement Appar (Sd)	Area Measurement Corr (Sp)	Imp	Obs Type	A.R.	Rem
1	YUNN	0411	0422	0447	S17	110	W 5	.264	126	65	-N	C	416	
1	YUNN	0608	0618	0632D	S20	157	W53	.809	236	201	1B	P	404	F
1	YUNN	0612	0614	0618	N21	162	W58	.880	79	83	-N	C	403	
1	YUNN	0620	0622	0626	S17	111	W 7	.269	189	98	-N	C	416	
2	YUNN	0210	0213	0246	S19	113	W20	.427	94	52	-N	C	416	
3	YUNN	0301	0306	0315	S15	115	W35	.590	189	117	1N	C	416	
3	BEIJ	0305E	0305	0321	S19		W34				2F	V	416	
4	YUNN	0758E	0810	0830	S20	115	W51	.792	47	38	-N	P	416	E
5	YUNN	0113	0134	0209	S21	116	W62	.887	31	34	-N	P	416	
5	YUNN	0416	0420	0428D	S22	344	E69	.937	16		-N	P	7	
6	YUNN	0344	0350	0357D	S20	98	W58	.858	31	30	-N	P	410	
7	YUNN	0051	0053	0202	S17	97	W69	.935	79		-N	C	410	
7	YUNN	0106E	0107	0116	N26	357	E31	.676	63	43	-N	P	5	
7	YUNN	0132E	0132	0145	N10	11	E17	.378	63	34	-N	P	2	
8	YUNN	0040E	0043U		S19	98	W83	.991	47		-N	P	410	
8	YUNN		0226	0306	S19	103	W89	1.	63		1N	C	410	AK
9	YUNN	0119E	0120U	0222	N29	343	E19	.616	393	249	1B	P		G
9	YUNN	0253	0306U	0306D	S17	324	E37	.619	24	15	-N	P	10	
9	YUNN	0725	0755	0810	S30	309	E49	.801	31	26	-N	C	14	
9	YUNN	0734	0735	0743	S29	310	E48	.789	16	13	-N	P	14	
9	YUNN	0734E	0800U	0856D	S14	333	E25	.454	157	88	-B	P	10	
9	YUNN	0743	0751	0818	S29	325	E33	.639	31	20	-N	C		G
10	YUNN	0048E	0048U		S31	310	E39	.711	31	22	-B	P	14	
10	YUNN		0200	0225	S30	312	E36	.680	157	107	1B	C	14	
10	YUNN	0238	0243	0351D	S32	307	E41	.743	47	35	-N	P	14	
10	YUNN	0627E	0634	0750	S35	304	E41	.747	126	95	-B	P	14	
10	YUNN	0815E	0815U	0823	S29	311	E34	.656	47	31	-N	P	14	E
11	YUNN	0241	0245	0253	S17	335	W 1	.222	31	16	-N	C	10	
11	YUNN	0440	0444	0638	N33	340	W 7	.615	393	249	1B	P	11	

H-ALPHA SOLAR FLARES

JANUARY 1989

		Time						Area Measurement						
Day	Sta	Start (UT)	Max (UT)	End (UT)	Lat	L	CMD	Cen Dist	Appar (Sd)	Corr (Sp)	Imp	Obs Type	A.R.	Rem
11	YUNN	0626	0635		S28	302	E30	.607	63	40	-B	C	14	
11	YUNN		0648	0700	S36	303	E29	.663	157	105	1B	C	14	FK
12	YUNN	0023E	0027U	0043	S27	305	E17	.467	31	18	-N	P	14	
12	YUNN	0043	0056	0120	S34	299	E23	.605	24	15	-B	C	14	
12	YUNN	0123	0138	0202	N22	277	E45	.778	94	75	-N	C	20	
12	YUNN	0248E	0248U	0257	S35	300	E21	.595	24	15	-N	P	14	
12	YUNN	0432E	0441U	0512	S34	303	E17	.547	79	47	-N	P	14	
12	YUNN	0630	0638	0714	S28	306	E13	.458	79	44	-N	C	14	
12	YUNN	0738	0744	0811	S32	298	E20	.549	157	94	-N	C	14	
12	YUNN	0825	0829	0829D	S31	303	E15	.507	47	27	-N	P	14	
15	YUNN	0329	0333		S29	301	W20	.518	16	9	-N	P	14	
15	YUNN		0416		S32	305	W24	.579	157	96	-N	P	14	
15	YUNN		0501	0551	S32	306	W26	.529	314	185	1N	P	14	FK
15	YUNN	0338	0350	0402	N21	271	E10	.464	63	36	-N	C	20	
15	YUNN	0406	0412	0419	N22	268	E13	.499	79	46	-N	C	20	
15	YUNN	0538	0543	0607	N30	262	E18	.619	189	120	1B	P	20	
15	YUNN	0559	0616	0657	S13	311	W31	.632	79	51	-N	P	14	
15	YUNN	0633	0648	0727	N22	281	W 2	.449	236	132	1N	C	20	
15	YUNN	0754	0756	0844	S32	311	W32	.656	63	42	-N	C	14	
16	YUNN	0511	0519	0552	S32	302	W35	.677	63	43	-N	C	14	
16	YUNN	0514	0519	0541	S31	284	W17	.512	31	18	-N	C	16	
16	YUNN	0614	0616	0621	N23	281	W14	.518	47	27	-N	C	20	
16	YUNN	0625	0627	0647D	S31	305	W38	.699	189	132	1B	P	14	
16	YUNN	0639	0641	0647D	S20	331	W65	.905	31	36	-N	P	9	
16	YUNN	0721	0736	0809	S25	298	W32	.598	110	69	-N	P	14	
16	YUNN	0724	0729	0736	S16	334	W68	.925	126		1N	C	9	
16	YUNN	0729	0736	0754	N21	244	E22	.552	346	207	1F	C	23	
16	YUNN	0833E	0843U	0902	S28	304	W39	.692	126	87	-B	P	14	
16	YUNN	0852	0900	0914	N29	178	E87	1.				P		AG
16	YUNN	0904E	0906	0924D	S31	304	W39	.707	79	56	-N	P	14	
17	YUNN	0142	0146	0204	S30	310	W54	.839	31	28	-N	C	14	
17	YUNN	0355	0358	0417	S19	253	E 2	.251	79	41	-N	C	22	
17	YUNN	0501	0502	0506	N18	246	E 8	.410	47	26	-N	C	23	
17	YUNN	0508	0514	0540	N21	269	W15	.493	79	45	-N	C	20	
17	YUNN	0512	0514	0524	N18	246	E 8	.412	47	26	-N	C	23	

JANUARY 1989

Day	Sta	Time Start (UT)	Time Max (UT)	Time End (UT)	Lat	L	CMD	Cen Dist	Area Measurement Appar (Sd)	Area Measurement Corr (Sp)	Imp	Obs Type	A.R.	Rem
17	YUNN	0533	0540	0603	N21	244	E10	.461	865	487	2B	C	23	F
17	YUNN	0559	0616	0635	N29	241	E12	.580	126	77	-N	P	23	F
17	YUNN	0632	0640	0650	S20	253	E 0	.258	189	98	-N	C	22	
17	YUNN	0831E	0831U	0900	S19	253	W 1	.245	189	97	-N	P	22	E
17	YUNN	0840	0844	0848	N25	270	W18	.564	63	38	-F	C	20	E
18	YUNN	0511E	0511U	0528	S30	309	W68	.929	47		-N	P	14	
18	YUNN	0606	0637		S31	310	W70	.942	79		1B	C	14	
18	YUNN		0733	0902D	S32	308	W68	.934	189		1B	P	14	FK
19	YUNN	0236	0258	0345	N20	271	W42	.740	157	117	1N	C	20	E
19	YUNN	0410	0412	0418	N23	247	W19	.561	31	19	-F	C	20	
19	YUNN	0912E	0912U	0916	S36	299	W73	.959	31		-N	P	14	
20	YUNN	0118	0124	0207	S19	267	W50	.775	31	25	-B	P		G
23	YUNN	0153E	0220U	0238D	N16	128	E49	.795	472	389	2N	P	33	F
23	PURP	0216E	0217		N15	130	E47	.767	189	147	1N	C	33	EK
23	PURP		0221	0231	N15	130	E47	.767	189	147	1N	C	33	
23	YUNN	0605	0635U	0645D	N21	200	W26	.593	79	49	-N	P	27	
23	YUNN	0617	0635	0654D	N17	129	E45	.765	472	366	2B	P	33	F
23	YUNN	0733	0738	0750D	N19	120	E54	.854	126	121	1N	P	33	
24	PURP	0433E	0437	0440	N17	127	E35	.644	151	99	-N	C	33	E
25	YUNN	0256	0300	0309D	N18	128	E22	.530	94	55	-N	P	33	E
25	PURP	0540E	0543	0555	N17	131	E17	.456	75	42	-N	C	33	E
27	YUNN	0243E	0247U	0300	N17	135	W11	.427	241	133	1N	P	33	
27	YUNN	0256E	0256U	0308	S22	53	E71	.943	24		-N	P	39	
27	YUNN	0313	0328	0413	S19	92	E31	.548	402	240	1B	C	35	
27	YUNN	0707	0712	0728	N17	133	W12	.441	48	27	-N	C	33	E
27	YUNN	0724	0728	0743	S16	158	W37	.613	129	82	-N	C	31	E
28	YUNN	0248	0300	0317	N17	133	W23	.533	24	14	-N	C	33	
30	YUNN	0226	0235	0247	N17	126	W42	.732	32	23	-N	C	33	
30	YUNN	0802	0804	0811	S19	108	W27	.486	129	74	-N	C	38	
31	YUNN	0345	0354	0354D	S21	91	W21	.430	32	18	-N	P	35	
31	PURP	0442	0442U	0443D	S23	55	E15	.367	75	40	-N	P	39	D

INTERVALS OF H-ALPHA FLARE PATROL OBSERVATION

JANUARY 1989

Day	From	To	From	To	From	To	From	To	From	To	From	To	From	To
1	321	632												
2	35	700												
3	33	55	100	620										
4	350	545	758	845										
5	133	428												
6	48	245	255	302	313	419								
7	51	341	450	500										
8	40	58	107	620										
9	119	306	735	840	850	855								
10	48	351	637	651	658	823								
11	214	310	318	351	358	541	559	737	755	907				
12	23	50	58	149	158	213	229	400	432	512	524	532	545	606
	612	829												
13	136	142	150	222	230	236	248	255						
14	51	126	136	149	158	321	433	435	442	538	544	557	612	758
15	12	27	103	108	122	200	209	222	329	340	350	900		
16	446	453	459	641	711	924								
17	107	152	204	207	248	300	310	417	446	906				
18	106	207	250	648	730	902								
19	147	203	218	843	851	916								
20	105	225	234	622										
21	55	230	245	322										
22	328	340												
23	153	251	605	655	725	750								
24	15	200	225	312	433	505								
25	239	309	519	531	540	555								
26	103	142												
27	159	219	243	413	635	743								
28	48	142	150	330										
29	49	249	347	400										
30	153	308	325	331	652	820								
31	150	210	225	301	325	359	436	449	503	505	512	520		

SOLAR RADIO EMISSION FLUX

JANUARY 1989

Day	BEIJ 2840	PURP 2700	YUNN 2840
1	168	138	168
2	174	142	193
3	175	147	173
4	188	150	177
5	196	154	196
6		153	187
7		155	202
8	213	167	209
9	237	185	230
10	236	170	203
11	251	183	181
12	249	192	181
13	258	190	204
14	271	211	198
15	285	207	197
16	286	203	205
17	275	205	201
18	270	187	193
19	244	163	182
20	230	178	170
21	223	165	160
22	197	142	150
23	201	141	152
24	190	147	166
25	210	159	168
26	211	156	177
27	214	156	178
28	199	160	160
29	194	156	152
30	194	149	152
31	194	144	146
Mean	221.8	166.3	181.0

SOLAR RADIO EMISSION OUTSTANDING OCCURRENCES

JANUARY 1989

Day	Freq	Sta	Type	Start (UT)	Time of Maximum (UT)	Duration (Min)	Flux Peak	Density Rel	Mean
04	2840	BEIJ	1 S	0412	0412.8	2.0	3.1		
06	2840	YUNN	5 S	0505.3	0506.6	4	55		
06	2840	BEIJ	3 S	0508	0509.0	3.0	50.1		
07	2700	PURP	4 S/F	0141.8	0143.9	4.9	18		
07	2840	BEIJ	5 S	0401	0405.0	8.0	11.0		
07	2700	PURP	2 S/F	0404.7	0406.1	4.3	12		
08	2840	BEIJ	1 S	0309	0311.4	6.0	8.7		
08	2840	BEIJ	1 S	0323.0	0325.9	8.0	5.3		
09	2700	PURP	45 C	0106.5	0109.1	12.5	87		
09	2700	PURP	23 GRF	0436.2	0500.8	40.0	23		
09	2700	PURP	3 S	0752.1	0754.3	5.4	21		
10	2840	BEIJ	20 GRF	0448.0	0451.0	12.0	2.0		
10	2700	PURP	2 S/F	0542.2	0547.3	6.5	26		
10	2840	BEIJ	45 C	0548.0	0551.7	7.0	22.0		
10	2840	BEIJ	45 C	0620.0	0622.6	8.0	27.5		
12	2840	BEIJ	45 C	0416.0	0422.7	7.5	53.3		
12	2840	YUNN	45 C	0418.3	0423.4	12.7	44		
12	2700	PURP	45 C	0421.0	0423.5	6.0	45		
12	2840	BEIJ	29 PBI	0423.5		16.5	13.7		
13	2840	YUNN	45 C	0348.7	0354.7	15.7	121		
13	2700	PURP	46 C	0352.4	0354.3	5.6	70		
14	2700	PURP	1 S	0205.4	0207.6	6.2	13		
14	2840	YUNN	5 S	0308.4	0309.1	2.8	24		
14	2840	YUNN	45 C	0324	0326.2	7.7	23		
14	2840	YUNN	45 C	0358.7	0410.7	25	50		
15	2840	BEIJ	1 S	0414.0	0414.6	2.0	13.1		
15	2700	PURP	46 C	0414.5	0415.1	2.5	23		
15	2840	BEIJ	5 S	0611.0	0612.8	15.0	20.3		
15	2840	YUNN	5 S	0613.8	0625	2.2	13		
15	2700	PURP	2 S/F	0614.0	0614.5	1.8	18		
15	2700	PURP	2 S/F	0619.0	0620.1	3.0	12		
17	2840	YUNN	5 S	0836.3	0837.1	3.2	35		
18	2700	PURP	28 PRE	0608.6					
18	2700	PURP	47 GB	0641.9	0659.3	111.4	162		
18	2700	PURP	29 PBI	0703.8					
20	2840	YUNN	5 S	0554.3	0555.1	2.7	15		
21	2840	BEIJ	45 C	0520.0	0530.7	16.0	15.2		
24	2840	YUNN	3 S	0809	0810	7	87		
26	2840	YUNN	45 C	0426.4	0446	40.2	131		
26	2840	BEIJ	46 C	0631.0	0638.1	11.0	30.5		
26	2840	YUNN	45 C	0632.5	0637.5	9.5	64		
27	2840	BEIJ	3 S	0328.0E	0329.7	4.5D	98.7D		

SOLAR RADIO EMISSION OUTSTANDING OCCURRENCES

JANUARY 1989

Day	Freq	Sta	Type	Start (UT)	Time of Maximum (UT)	Duration (Min)	Flux Density Peak	Rel	Mean
27	2840	YUNN	5 S	0328.2	0329.8	10.8	181		
27	2840	BEIJ	30 PBI	0332.5		56.5	14.6		
27	2840	BEIJ	1 S	0333.6	0333.9	1.0	0.48		
27	2840	BEIJ	1 S	0424.5	0425.1	1.4	0.07		
27	2840	BEIJ	20 GRF	0451.9	0455.0	7.5	1.36		

INTERVALS OF SOLAR RADIO EMISSION PATROL OBSERVATION

JANUARY 1989

Day	BEIJ From	BEIJ To	PURP From	PURP To	YUNN From	YUNN To
	2840		2700		2840	
1	0030	0720	0014	0830	0052	0925
2	0050	0651	0021	0830	0207	0821
3	0035	0645	0035	0825	0200	0906
4	0350	0543	0021	0825	0156	0816
5	0037	0747	0034	0835	0407	0800
6	0405	0606	0055	0827	0210	0830
7	0120	0720	0021	0825	0220	1000
8	0230	0710	0015	0835	0507	0901
9	0055	0745	0034	0825	0506	1000
10	0320	0745	0050	0820	0040	0930
11	0325	0640	0115	0828	0030	0920
12	0320	0745	0040	0825	0030	1007
13	0410	0518	0047	0835	0040	0830
14			0017	0830	0030	0800
15	0359	0750	0033	0815	0400	0820
16	0351	0740	0410	0825	0030	0920
17			0044	0824	0047	0925
18			0037	0828	0214	0935
19	0403	0745	0040	0827	0038	0930
20	0501	0745	0037	0820	0027	0930
21	0215	0722	0033	0829	0025	0804
22	0033	0525	0022	0825	0239	0745
	0800	0825				
23	0011	0551	0034	0830	0120	0845
24	0040	0553	0034	0825	0215	0826
25	0040	0533	0047	0653	0201	0805
26	0044	0553	0038	0835	0201	0823
27	0314	0818	0037	0420	0150	1008
28	0310	0500	0040	0835	0150	1028
29	0042	0757	0100	0811	0201	0835
30	0049	0619	0038	0806	0126	0830
31	0047	0155	0044	0803	0207	0837
	0330	0742				

SUDDEN IONOSPHERIC DISTURBANCES (D REGION)

JANUARY 1989

Day	Sta	Start (UT)	Max (UT)	End (UT)	Imp	SPA LF	SPA VLF	SFA LF
01	LINT	0403	0423	0522	1-	- 0.4	- 7.4	- 2.5
01	LINT	0607	0623	0750D	3-	- 6.4	-35.1	- 4.6
02	LINT	0212	0220	0310	1-	- 0.6	-	- 0.6,+ 0.1
02	YUNN	0344	0351	0416	1	- 1.8		
02	LINT	0343	0353	0434	1-	- 0.5	-	- 1.6
02	YUNN	0443	0453	0518	1	- 1.6		
02	YUNN	0542	0548	0613	1	- 1.3		
03	LINT	0046	0055	0124D	1+	- 2.4	- 5.3	- 3.9
03	LINT	0200	0210	0303D	1-	- 0.4	- 4.3	0
03	LINT	0303	0311	0414	2-	- 3.3	-14.9	- 0.5
03	YUNN	0301	0313	0353	2	- 4.4		
03	LINT	0523	0530	0620	1-	- 0.5	-14.9	- 0.4
03	LINT	0630	0639	0703	1-	- 0.5	- 3.2	- 1.1
04	LINT	0631	0635	0710D	1-	- 0.7	-	- 0.8
04	YUNN	0632	0642	0732	1	- 0.8		
05	LINT	0201	0209	0310	1	- 1.8	- 3.2	0.2
05	LINT	0416	0438	0520	1	- 1.3	- 6.4	- 1.3,+ 0.4
05	LINT	0548	0550	0636D	1-	- 0.6	- 3.2	0
05	LINT	0636	0645	0730D	1	- 1.8	-11.7	0.4
05	LINT	0757	0802	0830U	1	- 1.3	0	0
06	LINT	0232	0239	0310U	1-	- 0.9	- 6.4	- 1.9
06	LINT	0500	0510	0620U	3-	- 6.4	-36.2	-17.1
07	LINT	0038	0044	0120U	1+	- 2.6	- 6.4	18.2
07	LINT	0230	0250	0328D	2-	- 3.3	-18	- 7.7
07	LINT	0328	0350	0402D	2-	- 3.8	-18	- 9.1,+ 3.1
07	LINT	0402	0430	0456D	3-	- 6.3	-58.5	15
07	LINT	0456	0525	0610	1	- 1.9	0	- 2.3
08	LINT	0102	0108	0133D	1	- 1.5	- 4.3	1
08	LINT	0133	0143	0156D	1-	- 0.4	- 4.3	- 0.2,+ 0.6
08	LINT	0156	0208	0253D	1+	- 2.5	-10.4	- 2
08	LINT	0253	0302	0327D	1+	- 2.6	-16	- 3.5
08	LINT	0327	0334	0440	1	- 1.3	- 9.6	- 2
08	LINT	0518	0520	0532D	1	- 1.1	- 7.4	- 1.8
08	LINT	0532	0544	0647D	1+	- 2.1	-12.8	- 2.8
08	LINT	0647	0656	0808	2+	- 5.8	-33	- 3.7
09	LINT	0050	0106	0107D	2+	- 5.2	-18	- 2.5
09	LINT	0107	0117	0236	1	- 1.9	-18	- 2.1
09	LINT	0351	0358	0446D	1	- 1.4	-10.4	- 3.2
09	LINT	0446	0511	0640	3+	- 8.4	-58.5	-11.1,+ 3.1
09	LINT	0700	0713	0806	1+	- 2.6	-13.8	0
10	LINT	0158	0203	0244	1-	- 0.5	- 3.2	0.7
10	LINT	0332	0338	0438	1+	- 2.7	-13.8	- 2.4

SUDDEN IONOSPHERIC DISTURBANCES (D REGION)

JANUARY 1989

Day	Sta	Start (UT)	Max (UT)	End (UT)	Imp	SPA LF	SPA VLF	SFA LF
10	LINT	0451	0506	0515D	2+	- 5.5	-30.9	- 5 , + 1.7
10	LINT	0515	0519	0622D	1-	- 0.4	- 5.3	0
10	LINT	0622	0629	0720U	2	- 4.2	-31.9	4.4
11	LINT	0209	0214	0252D	1	- 1.1	- 5.3	1.1
11	LINT	0252	0256	0300D	1-	- 0.8	- 9.6	2.7
11	LINT	0300	0307	0316	1-	- 0.4U	- 4.3	- 0.7
11	LINT	0442	0500	0630	2-	- 3.4	-19.1	- 2.4,+ 0.2
11	LINT	0640	0649	0750	1	- 3.0	-30.9	- 1.7
12	LINT	0059	0107	0146D	1	- 2.0	0	- 0.3,+ 1.2
12	LINT	0146	0151	0206D	1-	- 0.7	- 5.3	0.5
12	LINT	0206	0210	0230	1-	- 0.2	0	0
12	LINT	0254	0300	0314D	1-	- 0.4	- 3.2	0
12	LINT	0345	0350	0409D	1-	- 0.3	- 2.1	- 0.4
12	LINT	0418	0429	0510U	2	- 4.5	-27.7	- 5.4,+ 0.8
12	LINT	0640	0643	0710	1-	- 0.7	- 6.4	- 1.7
13	LINT	0140	0149	0158D	1-	- 0.9	- 4.3	0.9
13	LINT	0158	0202	0220	1-	- 0.1	- 4.3	0
13	LINT	0349	0402	0511D	3-	- 6.8	-40.4	- 8.3,+ 1.9
13	YUNN	0419	0426	0500	2-	- 3.2		
13	LINT	0511	0514	0540D	1-	- 0.3	- 3.2	0.2
13	YUNN	0646	0656	0731	1	- 1.7		
14	LINT	0206	0221	0224D	2	- 5.6	-25.5	- 2.2
14	LINT	0224	0228	0257D	1-	- 0.8	- 7.4	- 1.2
14	LINT	0257	0311	0324D	1	- 1.9	-23.4	5
14	LINT	0324	0330	0405D	2-	- 3.4	-34.0	6.1
14	LINT	0405	0415	0510D	2	- 4.2	-48.9	4
15	LINT	0300	0309	0338U	1-	- 1.0	- 6.4	- 0.7
15	LINT	0338	0352	0430U	2-	- 3.1	-20.2	- 1.7,+ 0.4
15	LINT	0503	0512	0530U	1-	- 0.7	- 8.5	1.6
16	YUNN	0323	0328	0358	2-	- 3.2		
16	YUNN	0623	0631	0651	2	- 4.2		
16	YUNN	0953	1013	1100	3+	-13.1		
17	LINT	0142	0158	0226D	2-	- 3.4	-19.1	4.1
17	LINT	0226	0229	0310	1-	- 0.4	- 5.3	0
17	LINT	0517	0521	0536U	1-	- 0.9	- 9.6	- 0.8
17	LINT	0536	0546	0634	1	- 3	-18.0	- 1.6
17	LINT	0642	0646	0720	1-	- 0.6	- 4.3	0.5
18	LINT	0328	0358	0508D	2-	- 3.3	-14.9	- 3.8
18	LINT	0508	0514	0609D	2-	- 4	-21.3	- 2.1
18	LINT	0609	0628	0710U	3	-10.2	-57.4	5.5
19	LINT	0242	0250	0252U	1-	- 0.6	- 2.1	0.6
19	LINT	0257	0302	0307U	1-	- 0.9	- 4.3	0

SUDDEN IONOSPHERIC DISTURBANCES (D REGION)

JANUARY 1989

Day	Sta	Start (UT)	Max (UT)	End (UT)	Imp	SPA LF	SPA VLF	SFA LF
19	LINT	0310	0320	0430	1	- 1.4	- 6.4	- 0.5
20	YUNN	0123	0136	0226	3	- 7.7		
20	LINT	0121	0138	0220	2-	- 3.5	-11.7	- 1
20	LINT	0417	0421	0518	1	- 1.5	- 7.4	- 2.9
20	YUNN	0416	0422	0442	1+	- 2.7		
20	LINT	0600	0604	0625	1-	- 0.3	- 2.1	0
21	LINT	0233	0245	0255U	1-	- 1	- 4.3	- 0.3
21	YUNN	0256	0301	0331	1+	- 2.6		
21	LINT	0255	0306	0412	1	- 1.8	- 7.4	- 2.4,- 0.2
21	LINT	0429	0435	0520	1-	- 0.4	- 3.2	- 0.3
21	LINT	0547	0605	0635D	1+	- 2.2	-10.6	- 1.8
21	LINT	0635	0651	0705D	2-	- 3.4	-16	- 0.9
21	YUNN	0701	0709	0729	1	- 1.5		
21	LINT	0705	0715	0800U	2-	- 3.6	-22.3	1.7
22	LINT	0116		0150U			-11.7	
22	LINT	0220		0255U			- 9.6	
22	LINT	0255	0303	0326U	1+	- 2.1	-16	1.4
22	LINT	0726	0735	0810	1	- 1.6	- 8.5	- 0.4
23	LINT	0202	0206	0255	1-	- 0.5	- 8.5	0.8
23	LINT	0331	0339	0425	1-	- 0.5	- 4.3	0
23	YUNN	0636	0645	0705	2-	- 3.2		
23	LINT	0637	0647	0750	1	- 1.6	- 7.4	- 0.4
25	LINT	0326	0343	0420	1-	- 0.6	0	- 0.2
25	LINT	0530	0538	0610D	1-	- 0.7	0	0.6
25	LINT	0624	0632	0647D	1-	- 0.7	- 8.5	0
25	LINT	0647	0653	0820U	1	- 1.7	-14.9	- 1
26	LINT	0000	0010	0045	2+	- 5.4		- 4.4
26	YUNN	0015	0023	0053	3+	-14.4		
26	LINT	0314	0327	0425D	1+	- 2.2	-10.6	- 2.8
26	YUNN	0429	0441	0503	3	- 7.9		
26	LINT	0425	0445	0600U	3+	- 8.5	-51	- 2.8,+ 5.3
26	LINT	0636		0727			-13.8	
27	LINT	0232	0238	0300	1-	- 0.6	- 5.3	- 1.3
27	LINT	0328	0337	0430U	3	- 7.4	-40.4	- 7.9,+ 2.9
27	YUNN	0329	0341	0436	3	- 7.5		
27	YUNN	0929	0934	1004	3+	- 9.4		
28	LINT	0304	0313	0340	1-	- 0.6	- 6.4	- 0.4
28	YUNN	0816	0821	0851	2-	- 3.1		
29	LINT	0322	0330	0400	1-	- 0.5	- 4.3	- 0.4
29	LINT	0824	0829	0832D	1-	- 0.9		0
29	LINT	0832	0835	0837D	1-	- 0.9		0
29	LINT	0837	0840	0910	1	- 1.1		0.6

SUDDEN IONOSPHERIC DISTURBANCES (D REGION)

JANUARY 1989

Day	Sta	Start (UT)	Max (UT)	End (UT)	Imp	SPA LF	SPA VLF	SFA LF
29	YUNN	0930	0935	0950	3+	- 9.7		
30	YUNN	0043	0053	0113	3+	- 8.2		
30	LINT	0058	0112	0206D	3+	- 8.6	-24.5	- 2.4,+ 2.2
30	LINT	0206	0211	0237	1-	- 0.5	- 2.1	1.4
30	LINT	0350	0353	0501	2	- 5	-28.7	- 3.5,+ 0.6
30	YUNN	0352	0357	0429	2-	- 4.0		
30	LINT	0812	0835	0950	2+	- 5.1	- 1	1.9
31	LINT	0127	0132	0242	2+	- 6	-14.9	4
31	LINT	0306	0314	0430	2	- 4.4	-24.5	- 1.4,+ 0.9
31	LINT	0441	0446	0510	1-	- 0.7	- 3.2	0.8
31	LINT	0521	0533	0549	1-	- 0.9	- 4.3	0.7

COSMIC RAY NEUTRON INTENSITY

Real Counts : 256 Times (Tabulated Counts Plus 1500)

JANUARY 1989 U.T. Hours at End of Interval

Day	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	Mean	N
1	462	458	450	465	465	465	477	460	455	459	462	463	465	455	459	462	469	459	459	466	458	468	461	457	461.6	24
2	457	463	455	468	455	457	464	465	472	457	460	454	454	457	456	458	456	451	463	457	469	457	466	455	459.4	24
3	468	471	459	468	471	464	477	462	459	460	458	461	451	451	447	452	456	460	460	450	460	462	471	460	460.8	24
4	465	474	458	466	472	470	475	483	472	470	471	460	466	460	461	453	443	449	457	457	462	469	454	438	462.7	24
5	429	426	434	430	451	436	446	437	440	434	429	438	434	428	412	433	433	452	450	445	447	447	454	451	438.2	24
6	447	446	448	438	439	447	441	439	433	434	427	432	439	418	430	423	419	410	419	419	422	430	420	423	431.0	24
7	427	427	423	427	408	418	429	431	434	431	427	426	428	428	421	426	420	435	425	430	430	427	441	431	427.1	24
8	426	441	443	442	439	444	444	442	440	433	437	429	419	426	428	430	444	425	435	440	443	434	441	439	436.0	24
9	441	450	441	445	435	455	453	432	440	445	439	449	438	447	451	455	453	433	451	448	461	453	451	444	446.3	24
10	456	449	457	454	461	450	457	455	451	448	449	451	447	461	442	448	458	459	461	453	459	468	471	467	455.5	24
11	471	472	469	462	457	459	455	454	454	457	459	461	457	446	441	440	427	445	448	460	454	467	466	452	455.5	24
12	455	457	456	448	444	453	441	438	445	440	437	446	445	440	436	452	445	452	452	455	459	468	457	461	449.3	24
13	455	455	457	454	439	446	449	448	445	446	450	453	448	447	450	458	462	474	465	474	481	480	466	453	456.3	24
14	464	450	451	457	443	449	448	455	460	453	444	455	459	452	457	455	467	468	459	467	467	484	478	472	458.9	24
15	479	477	472	465	471	480	466	464	461	462	460	457	456	450	448	463	459	467	447	455	466	473	468	463	463.7	24
16	458	466	459	451	448	442	450	451	459	456	445	439	457	445	447	444	442	457	459	450	460	471	473	477	454.4	24
17	466	458	449	450	447	452	452	454	460	459	452	448	457	443	457	448	458	463	462	463	475	478	477	471	458.3	24
18	476	465	466	467	462	467	462	468	462	465	469	473	464	458	455	458	468	466	475	482	480	480	480	475	468.5	24
19	473	461	468	464	469	472	468	473	471	464	470	466	464	470	466	459	475	463	473	472	473	471	486	475	469.4	24
20	477	473	462	459	471	456	461	463	460	466	465	458	453	468	475	487	495	486	481	485	483	474	471	474	471.0	24
21	472	479	494	481	482	490	484	486	485	478	474	472	467	465	468	469	460	458	465	467	469	467	463	474	473.7	24
22	469	460	470	472	482	480	470	459	461	469	468	462	464	462	461	468	453	461	463	469	471	474	473	477	467.4	24
23	467	469	472	473	470	468	466	474	465	471	458	463	454	471	462	465	465	462	465	463	471	467	462	466	466.2	24
24	462	462	466	465	457	460	465	460	457	465	455	460	457	466	459	459	454	452	460	465	461	464	458	466	460.6	24
25	466	483	456	450	460	469	460	454	455	455	459	470	463	474	457	464	453	454	461	472	466	470	469	476	463.2	24
26	472	467	468	478	465	470	473	466	472	472	458	462	462	462	455	459	457	461	464	474	474	465	474	460	466.3	24
27	460	477	484	471	485	479	474	482	468	473	465	459	454	448	453	453	450	447	448	459	452	462	454	455	463.0	24
28	455	451	447	445	447	451	441	455	450	443	446	437	450	450	439	439	446	453	446	448	441	454	458	443	447.3	24
29	443	456	458	457	453	455	460	442	453	451	447	447	450	449	446	442	443	447	445	455	448	453	438	456	449.8	24
30	447	459	452	454	455	445	450	449	450	445	447	453	443	455	453	448	441	453	456	459	459	461	453	459	451.9	24
31	453	464	463	452	464	462	468	461	463	461	458	456	457	469	469	456	465	463	454	470	474	477	486	467	463.8	24

Monthly Mean=456.673

Monthly Mean Daily Variation For 31 Complete Days Deviation From Average: 456.673

(1-12)	1.97	3.52	1.62	0.68	0.33	1.75	2.10	0.17	-0.16	-1.13	-3.61	-3.13
(13-24)	-4.35	-4.38	-6.32	-4.22	-3.90	-2.32	-0.93	2.33	4.46	7.04	5.91	2.58

Harmonic Components (Order, Cos, Sin, Amplitude, Max..-Hr)

U.T.=(1 4.10 0.71 4.16 0.65) (2 -0.13 -2.11 2.11 8.89) (3 -0.29 -0.72 0.78 5.52) (4 -0.31 0.12 0.33 2.64)

B.T.=(1 -2.66 3.19 4.16 8.65) (2 -1.76 1.16 2.11 4.89) (3 -0.29 -0.72 0.78 5.52) (4 0.05 -0.33 0.33 4.64)

COSMIC RAY MESON INTENSITY

Real Relative Intensity : 0.1% Times (Tabulated Value Plus 1000)

JANUARY 1989

U.T. Hours at End of Interval

Day	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	Mean	N
1	32	32	33	34	35	35	35	32	33	34	32	33	34	34	35	35	34	35	32	36	32	32	35	33	33.6	24
2	33	34	33	34	35	34	34	30	31	33	33	36	34	36	35	38	37	38	40	37	37	39	39	38	35.3	24
3	39	41	42	42	41	40	40	41	41	40	38	41	40	38	41	37	41	38	38	35	36	35	40	37	39.3	24
4	41	42	42	40	42	42	41	39	41	38	36	38	41	40	36	35	34	35	34	36	35	33	36	32	37.9	24
5	32	33	34	33	35	34	35	32	35	32	31	33	32	31	32	31	31	31	33	29	30	30	31	31	32.1	24
6	33	32	33	33	31	31	33	33	32	30	30	29	28	28	30	25	25	28	23	24	22	24	25	25	28.6	24
7	25	29	28	29	28	28	27	27	29	27	27	29	29	27	28	24	29	27	27	27	25	25	25	29	27.3	24
8	26	29	30	30	30	28	26	28	28	26	25	24	24	26	23	21	23	23	25	24	24	27	26	27	26.0	24
9	28	29	29	29	28	28	28	30	32	31	30	29	31	30	30	29	31	33	34	36	35	36	37	35	31.2	24
10	37	37	37	36	34	34	36	34	37	35	36	35	36	38	39	37	38	38	39	41	40	40	41	42	37.4	24
11	42	43	44	41	44	42	41	41	40	42	41	43	43	44	41	41	36	39	41	42	40	41	40	42	41.4	24
12	44	44	43	39	41	40	41	39	37	39	36	41	39	37	40	39	38	38	40	42	38	40	39	40	39.8	24
13	39	40	41	41	42	39	41	40	39	38	40	40	40	41	40	43	44	43	42	44	45	43	43	42	41.3	24
14	42	41	43	41	41	39	39	40	40	38	40	40	40	38	40	39	41	37	36	37	37	37	39	39	39.3	24
15	39	40	42	40	37	38	38	38	36	38	36	37	36	37	36	38	37	37	37	37	38	38	37	37	37.3	24
16	39	39	37	37	34	37	35	34	35	36	37	35	36	36	37	36	36	38	38	38	38	38	40	40	36.9	24
17	41	39	40	36	36	37	35	35	35	35	34	34	35	37	35	36	39	37	37	37	37	38	38	38	36.7	24
18	39	37	38	37	37	38	38	36	34	36	38	38	37	35	33	36	34	36	36	35	34	35	37	34	36.2	24
19	36	37	33	39	36	35	35	31	34	31	33	36	34	36	34	35	35	34	38	37	39	37	37	38	35.4	24
20	38	37	36	36	33	32	30	34	34	34	33	33	34	35	37	37	34	37	35	36	33	31	32	33	34.3	24
21	34	35	37	37	37	39	39	37	38	39	39	39	39	38	37	37	35	32	33	33	32	32	32	33	36.0	24
22	36	36	37	36	36	38	37	37	38	37	36	34	38	34	32	31	31	32	33	32	32	32	35	37	34.9	24
23	39	38	37	39	40	38	40	38	37	36	37	37	35	36	36	34	36	36	37	36	36	37	37	36	37.0	24
24	35	38	35	36	37	40	36	35	34	35	35	34	35	35	35	33	33	31	32	32	34	30	30	36	34.4	24
25	36	35	36	34	39	34	35	36	39	35	36	39	40	40	40	39	41	41	41	40	42	39	44	45	38.6	24
26	43	45	45	46	42	43	42	44	43	42	44	44	44	43	42	46	43	45	46	42	42	42	43	43	43.5	24
27	44	44	46	46	47	50	45	46	46	43	40	41	41	42	41	39	37	39	40	40	40	37	41	38	42.4	24
28	41	39	40	41	37	41	37	40	37	38	39	37	38	37	40	37	38	39	37	37	35	36	36	35	38.0	24
29	37	37	37	38	38	37	36	37	35	34	35	34	35	34	32	32	34	34	32	33	33	32	34	33	34.7	24
30	34	35	35	36	35	34	35	34	33	34	33	34	32	33	33	35	35	35	34	37	38	37	38	39	34.9	24
31	41	38	40	41	40	42	41	41	39	40	41	40	41	40	40	40	42	43	39	39	37	38	38	38	40.0	24

Monthly Mean= 36.184

Monthly Mean Daily Variation for 31 Complete Days Deviations From Average: 36.184

(1-12)	0.75	1.07	1.33	1.14	0.85	0.82	0.30	-0.09	0.01	-0.51	-0.67	-0.15
(13-24)	-0.02	-0.18	-0.38	-0.86	-0.64	-0.41	-0.41	-0.35	-0.83	-0.99	0.11	0.11

Harmonic Components (ORDER, COS, SIN, AMPLITUDE, MAX.-Hr)

U.T.=(1 0.43 0.61 0.75 3.68) (2 0.06 0.44 0.44 2.72) (3 -0.10 0.11 0.14 2.92) (4 0.15 0.13 0.20 0.70)

B.T.=(1 -0.74 0.06 0.75 11.68) (2 0.35 -0.27 0.44 10.72) (3 -0.10 0.11 0.14 2.92) (4 -0.19 0.06 0.20 2.70)

GEOMAGNETIC ACTIVITY INDICES K AND A_K

JANUARY 1989 BGMO

Day	0-3	3-6	6-9	9-12	12-15	15-18	18-21	21-24	Sum	A_K
	Three-Hourly Indices K									
1	2	3	3	3	3	4	3	2	23	15
2 Q	2	2	2	2	3	1	2	1	15	7
3 Q	2	0	2	1	1	2	2	1	11	5
4 Q	0	0	3	3	3	2	3	5	19	14
5 D	5	5	4	4	3	6	5	2	34	38
6 Q	2	2	3	2	3	1	2	4	19	11
7	3	3	3	2	3	4	3	2	23	15
8	2	2	2	2	5	5	4	3	25	21
9	3	3	3	2	5	2	2	2	22	15
10	3	2	2	1	2	4	3	1	18	11
11 D	2	3	2	1	4	6	6	4	28	31
12	4	3	4	2	2	4	3	1	23	16
13	0	1	1	1	3	5	3	4	18	14
14	2	2	1	2	3	3	4	5	22	16
15 D	5	3	5	4	6	6	4	5	38	47
16 D	5	5	4	5	3	6	5	3	36	41
17	4	4	4	5	5	5	6	2	35	39
18	2	2	2	3	4	4	2	2	21	13
19 Q	2	1	2	2	2	1	3	2	15	7
20 D	3	2	3	4	8	7	5	4	36	65
21	2	1	2	3	4	5	3	3	23	17
22	3	5	5	3	4	5	3	2	30	28
23	3	3	4	3	3	4	3	3	26	18
24	2	2	1	2	3	2	2	2	16	8
25	2	2	3	2	2	2	3	1	17	9
26	2	1	1	3	2	3	2	2	16	8
27	2	3	3	2	3	3	1	1	18	10
28	2	3	1	1	2	4	4	1	18	12
29	1	1	2	3	3	4	3	1	18	11
30	1	3	2	4	3	4	1	1	19	13
31	2	3	3	2	4	4	5	5	28	24
									Sum	599
									Mean	19.3

MAGNETIC STORMS

JANUARY 1989 BGMO

Time of Magnetic Begining			Ending			Sudden Com. Amplitude			Deg. of	Maximum Acti. on K-scale 3hour k			Maximum Range		
Day	h	m	Day	h	Type	D	HnT	ZnT	Acti.	Day	Int.	Index	D	HnT	ZnT
4	23	05	5	23	SC	0.7	33		ms	5	6	6	11.4	178	19
8	05		9	16	GC				m	8	6	5	5.0	172	18
11	12	05	12	21	SC	0.2	16	1	ms	11	6	6	10.5	162	16
14	16		17	23	GC				ms	15	5	6	11.7	144	30
20	11	29	20	24	SC	0.8	21		s	20	5	8	13.2	317	28

用一种新方法预报月平滑太阳黑子相对数

张桂清

（中国科学院北京天文台）

一、方法和预报检验

本文用门限自回归模型（或称自激励门限自回归模型）模拟并预报月平滑太阳黑子相对数。

设 $\{x_t\}$ 是单变量观测时间序列，门限自回归模型为：

$$x=\begin{cases} a_0^{(1)}+\sum_{i=1}^{p_1}a_i^{(1)}x_{t-i}+\epsilon_t^{(1)} & ,x_{t-d}\le r_1 \\ a_0^{(2)}+\sum_{i=1}^{p_2}a_i^{(2)}x_{t-i}+\epsilon_t^{(2)} & ,r_1<x_{t-d}\le r_2 \\ \cdots & ,\quad\cdots \\ a_0^{(j)}+\sum_{i=1}^{p_j}a_i^{(j)}x_{t-i}+\epsilon_t^{(j)} & ,x_{t-d}>r_{j-1} \end{cases} \tag{1}$$

其中，r_1，r_2，……r_j 为门限值，d 为延迟参数，$\epsilon_t^{(j)}$ 为白噪声，p_j 为模型阶数，$a_i^{(j)}$ 为模型系数，在此，j=1，2，那么就只有一个门限值，记为 r。详见［1］、［2］和［3］。

在［3］中，用两种方法（本方法和二次曲线法）对 21 周的月平滑黑子相对数作了预报检验。每种方法建模之前，对月平滑黑子相对数作了开方处理。［3］中给出了两种方法的综合预报检验和预报。对 21 周的平均预报误差为 6.4，对应相同时段和预报步长，S. G. D. Part 1 上的平均预报误差为 5.6。

在此，只用门限自回归模型建模和预报。建模之前，对月平滑黑子相对数除作开方处理外，还作了差分处理。这样，就提高了本方法的预报精度。仍对 21 周作预报检验，平均误差仍为 6.4。对 20 周抽样预报检验的平均预报误差为 4. 2，对应相同时段和预报步长，S. G. D. Part 1 上的平均预报误差为 6.5 ［4］

二、估计预报误差置信区间面的确定。

假设相对预报误差服从 t 分布。那么，我们用［3］中给出的方法估计最大相对预报误差 $\hat{y}$。

设 $y_i^{(j)}$ 为第 j 次预报中第 i 步的相对预报误差， 那么， 第 j+1 次预报中第 i 步的相对预报误差的置信区间为 $[\bar{y}-\lambda\sqrt{\frac{S_i^2}{m}},\ \bar{y}+\lambda\sqrt{\frac{S_i^2}{m}}]$，这里，λ 可从 t 分布表中查出。显然，最大相对预报误差 $\hat{y}$ 为：

$$\hat{y}=\bar{y}+\lambda\left(\frac{s_i^2}{m}\right)^{\frac{1}{2}} \tag{2}$$

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$$s_i^2 = \frac{1}{m-1}\sum_{i=1}^{m}(y_i - \bar{y})^2 \tag{3}$$

$$\bar{y} = \frac{1}{m}\sum_{i=1}^{m} y_i \tag{4}$$

$$y_i = \frac{1}{r_i}\,|\,r_i - r_i'\,| \tag{5}$$

最大绝对预报误差 E′ 为：

$$E_i' = \hat{y}_i \times r_i' \tag{6}$$

这里， r_i 为实测值，r_i' 为预报值，m 为样本值，置信度取 90%。

月平滑黑子相对数的预报值 R′ 和预报误差 E′ 在下表中给出（1988,10—1989.09）。

Table 1

Time	88,10	88,11	88,12	89,01	89,02	89,03	89,04	89,05	89,06	89,07	89,08	89,09
R'	127.4	132.9	137.8	142.5	147.0	151.4	155.8	160.1	164.4	168.7	173.1	177.5
E'	1.3	1.3	5.5	11.4	13.2	18.2	24.9	25.6	31.2	32.1	36.3	35.5

在太阳耀斑一书中指出， 已经实施定量预报的人们同意预报结果不应强烈地依赖方法[5]。我们将视实际预报如何，不断总结经验，改善预报。

本文计算所用建模和预报的程序是在应用数学所概率统计室编写的："非线性门限自回归模型的建模和预报程序"（开环门限自回归模型）的框架下改编的"自激励门限自回归模型的建模和预报程序"。

（参考文献内容请参看下页英文稿）

THE PREDICTION OF THE SMOOTHED SUNSPOT NUMBERS BY A NEW METHOD

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1 The method and the predicting verification

A new method – the(Self - Excitation) Threshold Autoregressive method(SETAR) is used to fit and to predict the smoothed sunspot numbers.

Assuming that x_t is an observed time series, SETAR method will be defined as follows:

$$x = \begin{cases} a_0^{(1)} + \sum_{i=1}^{p_1} a_i^{(1)} x_{t-i} + \epsilon_t^{(1)} & , x_{t-d} \leq r_1 \\ a_0^{(2)} + \sum_{i=1}^{p_2} a_i^{(2)} x_{t-i} + \epsilon_t^{(2)} & , r_1 < x_{t-d} \leq r_2 \\ \cdots & , \quad \cdots \\ a_0^{(j)} + \sum_{i=1}^{p_j} a_i^{(j)} x_{t-i} + \epsilon_t^{(j)} & , x_{t-d} > r_{j-1} \end{cases} \tag{1}$$

Where, r_1, $r_2, \cdots$, r_j are the threshold values, d is a delay parameter, p_j is the step of the model, $a_i^{(j)}$ is the coefficient of the model, $\epsilon_t^{(j)}$ is the flat noise. In this paper $j = 1, 2$,and hence only one value for the threshold, r (see references [1],[2],[3]).

In reference [3] the predicting verifications of the smoothed sunspot numbers for cycle 21 were made by two methods and the synthetic verifications of the prediction for these two methods were shown. The smoothed sunspot numbers were processed by evolution before building the model and making the predictions. The average prediction error is 6.4 for our synthetic prediction, while 5.6 for the prediction presented in S.G.D. part 1 for the same periods and predcting steps.

In this paper only SETAR model is used for the prediction. Before building the model, the smoothed sunspot numbers were processed by the difference besides by the evolution. The precision of the predictions is comparable to the synthetic varifications. The forecasting varifications are performed for cycle 21. The average error of the predictions is still 6.4 for this method. For some random samples from solar cycle 20, the average forecasting error is 4.2 for our method,while 6.5 for the predicting error calculated from S.G.D. part 1 for the same periods and forecasting steps [4].

2 The estimation of the confidence limitation of the predicting error and the predictions for coming months

We assume that the relative predicting errors obey t distribution, then, the confident range of the predicting error can be determined by the following method [3].

If $y_i^{(j)}$ is the relative predicting error of the step i in the order j of the prediction, the confident limitation of the error of step i in the order $j+1$ of the prediction will be $[\bar{y}-\lambda(\frac{s_i^2}{m})^{\frac{1}{2}}, \bar{y}+\lambda(\frac{s_i^2}{m})^{\frac{1}{2}}]$, here λ can be found in the list of t distribution. Obviously, the maximum of the relative predicting error $\hat{y}$ is as follows:

$$\hat{y} = \bar{y} + \lambda(\frac{s_i^2}{m})^{\frac{1}{2}} \tag{2}$$

Where

$$s_i^2 = \frac{1}{m-1}\sum_{i=1}^{m}(y_i - \bar{y})^2 \tag{3}$$

$$\bar{y} = \frac{1}{m}\sum_{i=1}^{m} y_i \tag{4}$$

$$y_i = \frac{1}{r_i} \mid r_i - r_i^{'} \mid \tag{5}$$

Then, the maximum of the absolute error $E^{'}$ is as follow:

$$E^{'} = \hat{y} * r^{'} \tag{6}$$

And,r_i is the reality, $r_i^{'}$ is the prediction, m is the number of the sample,the confidence is equal to 90 per cent.

The predictions of the smoothed sunspot numbers and the maximums of predicting errors for the future are given in Table 1.

Table 1

Time	88,10	88,11	88,12	89,01	89,02	89,03	89,04	89,05	89,06	89,07	89,08	89,09
$R^{'}$	127.4	132.9	137.8	142.5	147.0	151.4	155.8	160.1	164.4	168.7	173.1	177.5
$E^{'}$	1.3	1.3	5.5	11.4	13.2	18.2	24.9	25.6	31.2	32.1	36.3	35.5

Reference [5] pointed out that those who have carried out quantitative prediction of flares agree that the results should not depend strongly on the method. So we will pay attention to the practical result of the prediction , continuously sum up experiences and improve the prediction.

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