Solar Bulletin

THE AMERICAN ASSOCIATION OF VARIABLE STAR OBSERVERS - SOLAR DIVISION

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Daily Mean Sunspot Numbers, R_a, for September 1998

	simple average			**k-corrected**	
Day	**R_a avg**	**Std. Dev.**		**R_a k**	**Std. Dev.**
1	117	7.1		98	4.5
2	97	6.5		83	5.0
3	89	4.7		73	3.3
4	90	4.4		75	2.4
5	108	5.0		86	3.4
6	142	6.7		116	4.5
7	150	7.3		122	4.4
8	151	8.8		121	5.0
9	148	6.9		122	3.6
10	135	6.2		114	3.9
11	116	5.7		94	3.0
12	120	5.0		100	2.8
13	114	4.9		95	3.1
14	94	4.8		82	3.3
15	70	4.1		59	3.5
16	71	3.6		60	2.0
17	74	3.1		67	2.6
18	87	3.3		74	2.5
19	112	4.6		93	3.3
20	145	6.4		118	4.2
21	148	8.4		122	5.0
22	150	9.4		127	5.8
23	150	8.9		125	6.6
24	139	8.3		115	5.3
25	124	6.9		99	4.7
26	101	3.5		87	2.6
27	91	4.2		73	2.2
28	90	4.4		78	3.1
29	66	4.6		59	3.9
30	41	4.3		33	2.5

Monthly Mean R_a avg = 111.00
Monthly Mean R_a k = 92.33

(Based on 1,005 observations contributed by 61 observers)

*this report prepared by Grant Foster

Dear AAVSO Solar Observers,

With this month's solar bulletin we announce the retirement of chairman Betty Stephenson. In her own words:

> "As of this edition of the Solar Bulletin, I am retiring from the chairmanship of the Solar Division. At this time I would like to thank the many faithful observers, as well as the helpful people at AAVSO Headquarters."

On behalf of the AAVSO and personally, I thank Betty for her dedicated service in chairing the AAVSO Solar Division and editing the Solar Bulletin.

The new chairman of the AAVSO Solar Division will be Joseph Lawrence, who has been our SID Analyst and has contributed to our Solar Division for many years.

AAVSO has estimated sunspot numbers for over fifty years. This estimate has been computed utilizing a scale factor for each observer called the "k coefficient" or simply the "observer constant." However, for the last year and a half, the numbers have been computed as a simple average of the reported counts. It is necessary to return to the former method of using observer constants in order to keep the homogeneity of the existing sunspot data in the AAVSO.

In order to maintain continuity with recent reports and with historical data, this bulletin reports daily mean sunspot numbers computed by both methods. The computer programs for these computations were written by Grant Foster at AAVSO Headquarters. The column labeled "simple average" gives the daily means computed as a simple average of the reported sunspot counts, while the column labeled "k-corrected" gives the daily means computed using observer constants. We also begin this month to report the standard deviation of the averages themselves. This gives a good estimate of the accuracy of each reported value. For both the simple average and the corrected average, we report the standard deviation in the column labeled "Std. Dev."

Solar observers should now send all sunspot and SID data to our new Solar Division Chairman, Joseph Lawrence, 1808 N. Anthony Blvd., Fort Wayne, IN 46805. All data should be sent to Joseph by the 10th of the month following the month in which the observations were made.

We are currently in the process of digitizing all sunspot data since April 1997, so that we can compute daily means retroactively, using observer constants, for that time period.

We wish to express our deep and sincere gratitude to all of our sunspot observers whose efforts provide a very valuable service to astronomers around the globe.

Good observing,

Janet A. Mattei
Director, AAVSO

Sudden Ionospheric Disturbance Report

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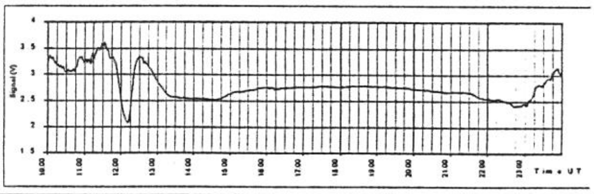

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Sudden Ionospheric Disturbances Recorded During September 1998

Date	Max	Imp	Date	Max	Imp	Date	Max	Imp	Date	Max	Imp
980901	0455	2	980905	0800	2	980911	1526	2	980925	1110	1-
980901	1155	2	980905	1415	1	980911	1604	2+	980925	1150	1+
980901	1235	1+	980905	1730	1+	980911	2049	1+	980925	1837	1-
980901	1817	2	980905	1910	1	980912	1255	1	980925	2325	2
980901	2029	1+	980906	0612	2+	980912	2035	1+	980926	0650	1
980901	2243	1	980906	1107	1-	980913	0904	2+	980926	1500	1-
980902	0915	2	980906	1555	1	980913	1305	1	980926	1620	1-
980902	0932	2	980906	1920	2	980913	1421	1	980926	1829	1-
980902	1530	2	980906	2000	2+	980913	1616	1	980927	0810	2
980902	1705	2+	980908	1040	1	980913	1826	1-	980927	1640	2
980902	2212	2	980908	1220	2	980920	0950	1-	980927	2346	2+
980903	0545	1	980909	0457	2	980921	1822	1+	980928	0551	2
980903	1425	2+	980909	1420	1	980922	2058	2+	980928	0655	2
980903	1550.	3	980909	1740	1	980923	0040	3	980928	1200	1-
980904	0948	1+	980909	1830	1-	980923	0657	2+	980928	1610	1+
980904	1455	1-	980910	2140	1-	980924	0815	1	980930	1338	3+
980904	2340	2	980911	0540	2	980924	0835	1-			

The events listed above meet at least one of the following criteria:
1) reported in at least two observers' reports.
2) visually analyzed with definiteness rating = 5 on submitted charts
3) reported by overseas observers with high definiteness rating

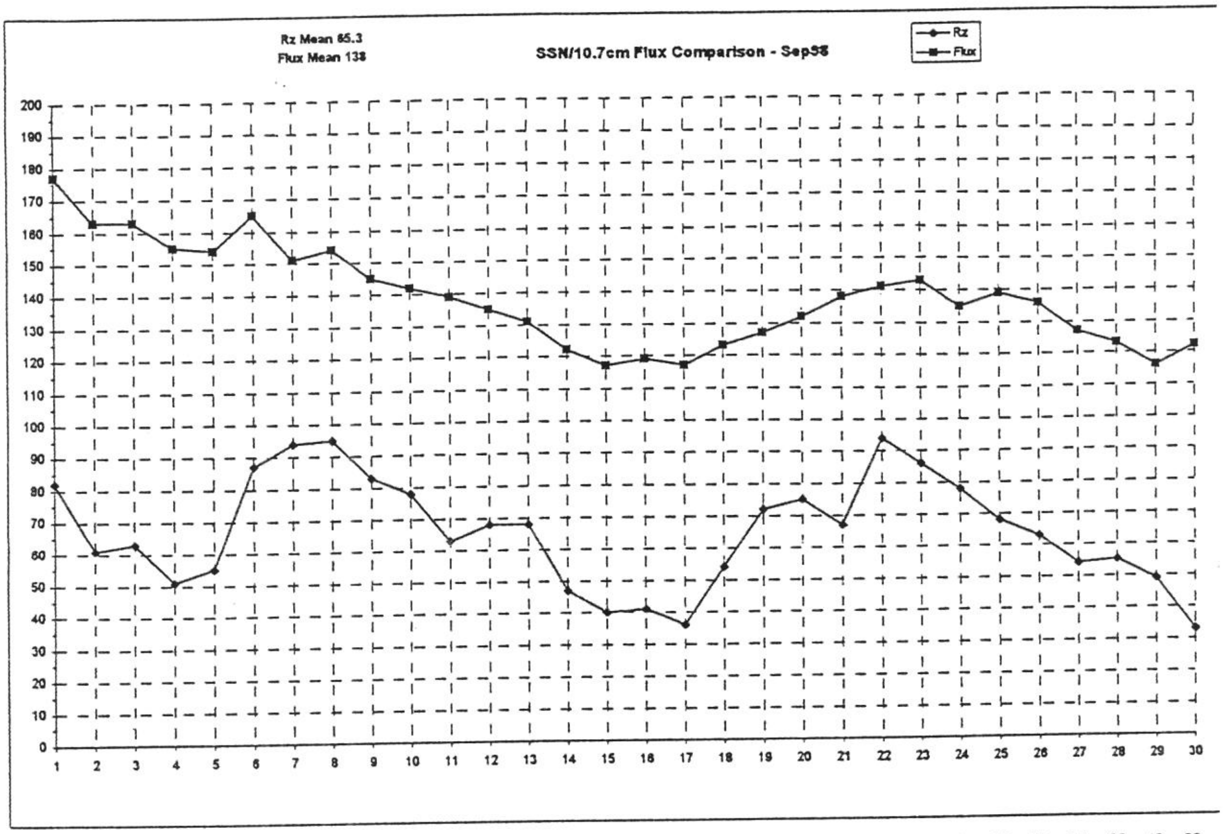
The following observers submitted reports and/or charts for September:
A-40 Parker, California * A-50 Winkler, Texas * A-52 Overbeek & Toldo, Republic of South Africa * A-62 Stokes, Ohio
A-63 Ellerbe, Spain * A-72 Witkowski, Florida * A-80 King, England * A-81 Landry, New Hampshire
A-82 Lawrence, Indiana * A-84 Moos, Switzerland. * A-90 Mandaville, Arizona

Gamma Ray Burst Disturbs Ionosphere

Distant stars produce only negligible effects on Earth's environment. However, on August 27 at 10:22 UT, an intense gamma ray burst impacted Earth's nighttime side and ionized the atmosphere to levels normally observed during daylight hours. The flash event lasted slightly more than 5 minutes and caused disturbances in VLF radio propagation for paths across the Pacific ocean and Asia. VLF receiving equipment operated by Stanford University for lightning research detected the flash event as an abrupt drop in VLF signal strength with a more gradual increase towards usual nighttime propagation levels. These receivers were located in the western United States and monitor stations in Hawaii (NPM), Washington (NLK), Maine (NAA) and Puerto Rico. Only the propagation paths from Hawaii and Washington were affected by the gamma ray flare. The flare originated from a star designated Soft Gamma Repeater (SGR) 1900+14. 'Magnetar' is the name given to this new class of star which packs the mass of our Sun into a ball less than 20km across and generates the most intense magnetic fields in the known universe. It is estimated that the SGR has a magnetic field 800 trillion times stronger than Earth's magnetic field and could pull the keys out of your pocket if it were located only halfway to the moon.

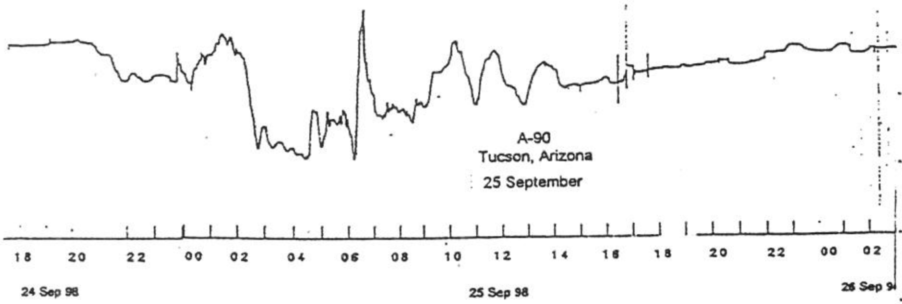
Any SID observer who monitors the VLF transmitter in Hawaii (NPM 21.4 kHz) is requested to review data plots for the period during the gamma ray event and report anomalous or abrupt signal strength drops to the SID Analyst. Results may be sent via e-mail or postal at the addresses given above.

Joseph Lawrence
AAVSO SID Analyst
Chairman of Solar Division



Rz	82	61	63	51	55	87	94	95	83	78	63	68	68	47	40	41	36	54	72	75	67	94	86	78	68	63	54	55	49	33
Flux	177	163	163	155	154	165	151	154	145	142	139	135	131	122	117	119	117	123	127	132	138	141	143	135	139	136	127	123	116	122

The graph above shows 10.7 cm flux plotted against Zurich sunspot numbers computed from observations of seven AAVSO sunspot observers who count according to the Zurich system. The Zurich reduction formula was used to reduce the counts to true Zurich Relative Sunspot Numbers, Rz. The graph was prepared by AAVSO sunspot observer, Tom Lizak.

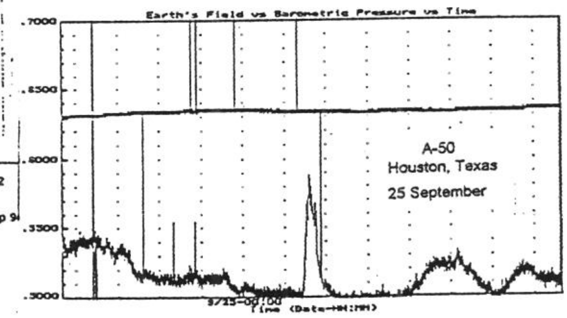


Horizontal component (H) at Oro Valley, Arizona (geographic 32° 23.4'N, 110° 56.8'W; magnetic latitude 40° N), 24-26 September 1998. Torsion variometer; observer J. Mandaville. Time scale in hours UTC.

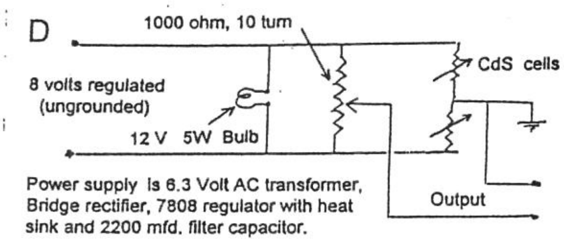
Vertical Scale: [= 50 nT

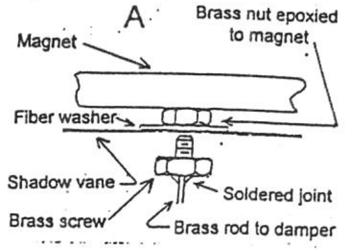
Disturbances between 16 and 18 hours, 25 September resulted from movement of motor vehicles near the observing site.

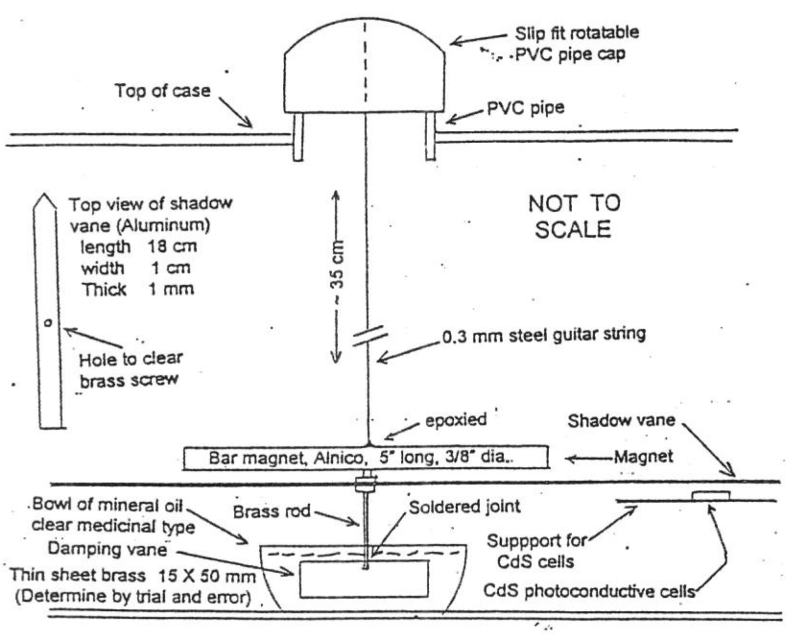
Note: This is the most intense magnetic storm so far monitored here by this observer. Main phase was entered about 0200 hours, 25 September. The spike between 06 and 07 hours had an amplitude of over 220 nT. The H field recovered gradually and had nearly reached normal level for the station by about 0300 hours, 26 September.

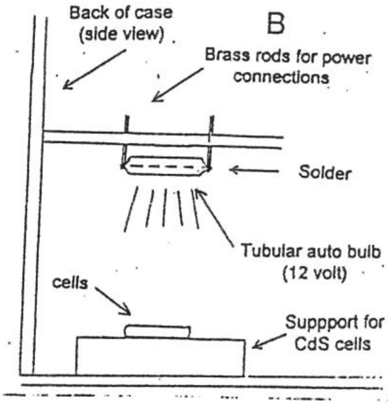


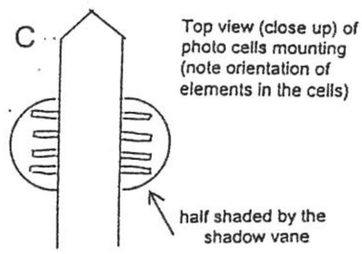
Two recordings above are of a strong magnetic storm on 25 September. Jim Mandaville, A-90, used the classic design by Al MacWilliams for his magnetometer. A big magnetic compass needle is suspended as a torsion pendulum that is balanced against the Earth's magnetic field. A shadow vane on one end of the compass needle shades two Cadmium Sulfide photoconductive cells equally. The cells are variable resistors and their resistance depends on how much light falls on them. They are made two elements of a four element Wheatstone bridge in which the bridge is a strip chart recorder. So long as the cells are shaded equally from light bulb above them no current flows in the bridge and the chart recorder draws a straight line. Solar activity such as a big solar flare can send charged particles to the Earth's magnetosphere changing the strength of the Earth's magnetic field which causes the torsion balanced compass needle to move and its shadow vane unbalances the light falling on the cells thereby unbalancing the bridge and causing current to flow in the chart recorder to record the magnetic storm. MacWilliams's simple design has been in use for over 20 years and although Jerry Winkler, A-50, replaced the photo sensitive resistor cells with modern Hall Effect sensors he was not able to improve on the sensitivity of the traditional design. The following page shows details of the MacWilliams design as built by A-90.











The Above drawing shows Jim Mandaville's magnetometer in sufficient detail that anyone wishing to build one could use it as a guide to build their own. Everything you need to know is shown in the drawing and the four details. The main drawing shows the simplicity of the device, a bar magnet suspended on a steel guitar string about 0.008 inches in diameter. Normally the magnet will line up with the Earth's magnetic field as any compass would and point North and South. The top end of the guitar string is fastened to the inside of a PVC pipe cap that can be rotated to wind up the guitar string to produce enough torque to force the magnet to point East and West instead of the North-South position it would prefer. It thus becomes a torsion balance in which its East-West position is balanced against the Earth's magnetic field. So long as the Earth's magnetic field remains constant the magnet remains stationary. Charged particles from solar flares set up currents in the magnetosphere which changes the strength of the magnetic field and therefore the position of the balanced magnetic compass needle.

Details B and C show how a shadow vane attached to the magnet shades two Cadmium Sulfide photo cells equally from light from the 12-volt bulb above them. Their resistance depends on how much light falls on them and so long as they are lit equally the Wheatstone bridge shown in detail D remains balanced and the strip chart recorder connected across the bridge draws a straight line. A magnetic storm upsets the torsion balance moving the shadow vane which unbalances the resistance of the CdS cells causing current to flow in the bridge so the strip chart recorder records the magnetic storm as shown on the recording on the previous page.

The Wheatstone bridge of which the two CdS photocells are a part is a simple device that drives the recorder without amplification and yet provides more sensitivity than is usually needed. it has the further advantage that the 1000 ohm resistor can be adjusted to provide a bias current to place the strip chart recorder's pen in the middle of the chart so both negative and positive changes produced by the magnetic storm are truly recorded.

Materials to build the magnetometer cost very little. Magnets are available from Edmund Scientific Company, 101 East Gloucester Pike, Barrington, NJ 08007 USA, The Cadmium Sulfide photocells and parts for the power supply can be found at Radio Shack. If anyone has difficulty finding the parts I will be glad to ship them the parts at cost. please contact me at my address above. If you are interested in recording magnetic storms on a computer rather than a strip chart recorder a kit to build an A/D converter and free software are available from Joseph lawrence at his address above.

C.H.H.