Solar Bulletin

THE AMERICAN ASSOCIATION OF VARIABLE STAR OBSERVERS - SOLAR DIVISION

Joseph D. Lawrence, Editor
1808 N. Anthony Blvd.
Fort Wayne, IN 46805 USA

email: lawrence@ipfw.edu
phone: 219.422.0230
ISSN 0271-8480

Volume 54 Number 11 November 1998

Daily Mean Sunspot Numbers, R_a for November 1998

(computational analysis performed by Grant Foster, AAVSO Headquarters)

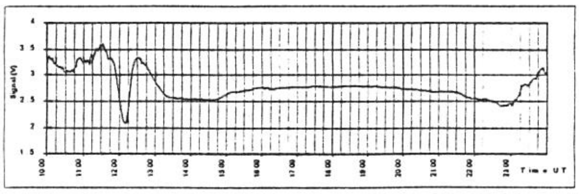
	simple average			k-corrected	
Day	R_a avg	Std. Dev.		R_a k	Std. Dev.
1	43	3.3		34	1.8
2	41	3.2		30	2.1
3	62	4.9		50	3.5
4	93	4.8		74	2.7
5	109	4.6		89	3.5
6	106	5.3		83	3.3
7	111	5.8		89	3.6
8	97	6.4		79	3.4
9	83	3.9		68	1.9
10	85	4.7		67	2.1
11	74	3.3		60	2.1
12	84	4.3		65	2.2
13	102	7.1		80	4.5
14	113	5.9		93	4.0
15	107	5.0		89	3.0
16	66	5.0		53	3.1
17	60	4.4		49	2.3
18	49	4.3		36	2.3
19	42	2.9		34	2.0
20	55	3.9		45	2.4
21	47	3.4		39	2.3
22	44	3.1		37	2.1
23	58	3.6		51	2.7
24	74	3.2		61	2.0
25	107	6.7		86	3.0
26	137	7.4		112	4.3
27	135	8.6		112	4.7
28	126	7.7		105	4.5
29	130	10.3		103	6.4
30	116	10.0		92	7.8

Monthly Mean R_a avg = 85.2
Monthly Mean R_a k = 68.8

(Based on 786 observations contributed by 56 observers)

Sudden Ionospheric Disturbance Report

Casper Hossfield, SID Coordinator
PO Box 23
New Milford, NY 10959 USA
casper@carroll.com
FAX 201.327.5246



Joseph Lawrence, SID Analyst
1808 N. Anthony Blvd.
Fort Wayne, IN 46805 USA
lawrence@ipfw.edu
FAX 219.451.6033

Sudden Ionospheric Disturbances Recorded During November 1998

Date	Max	Imp	Date	Max	Imp	Date	Max	Imp	Date	Max	Imp
981103	1925	2+	981107	1106	1+	981112	1520	1-	981124	0216	2+
981104	0406	1-	981107	1450	1-	981112	2150	1+	981124	0850	1+
981104	0719	1+	981107	1759	2+	981113	2120	2	981124	1030	1-
981104	0905	1	981108	1110	2	981114	1430	2	981124	1240	1-
981104	1045	1-	981108	1547	2+	981115	1315	2+	981124	2216	2
981104	1550	1	981108	1710	2+	981116	1205	1	981125	0600	1+
981105	0455	1+	981108	2006	2	981116	1610	2+	981125	1325	1-
981105	0610	1	981108	2257	2+	981116	2014	2	981125	1404	1+
981105	0806	1	981109	2116	1+	981116	2156	2+	981125	2102	2+
981105	1336	2	981110	0655	1	981116	2318	2	981126	1038	1
981105	1824	2+	981110	1332	1-	981118	1055	1	981126	1330	1
981105	1946	2+	981110	1532	1-	981120	1524	1+	981126	1730	2+
981105	2215	1	981110	1544	2	981121	0640	1	981127	0738	2+
981106	0445	1	981110	1730	1	981121	1135	1	981127	1059	1
981106	0710	1	981110	1755	1	981121	1618	1+	981127	1547	2
981106	0755	1	981110	1822	2+	981122	0640	2+	981127	1827	1-
981106	0835	1-	981110	2051	2+	981122	1010	1	981128	0545	3
981106	0849	1-	981111	0408	2	981122	1229	2+	981128	1530	1+
981106	0911	1	981111	0455	1+	981122	1305	2+	981128	1727	2+
981106	1110	1	981111	0648	1	981122	1427	1	981128	1818	1+
981106	1204	1	981111	0712	1	981122	1445	1	981129	0545	2
981106	1440	2+	981111	0740	1	981122	1625	3	981129	0639	1
981106	1510	2	981111	0956	1+	981122	1836	2+	981129	1130	1-
981106	1850	1-	981111	1018	1+	981122	2210	2+	981130	1017	1-
981106	1958	1	981111	1205	1-	981123	0639	2			
981106	2211	2	981112	0531	1+	981123	1038	1			
981107	0945	1	981112	1135	3	981123	1112	2			

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 November:
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-87 Hill, Massachusetts * A-90 Mandaville, Arizona * A-91 Anderson, Australia

High-Energy Cosmic Objects That Produce SIDs

Contributed by Dr. Gerald Fishman, NASA

The sun is not the only object in the sky that produces SIDs. On several occasions, distant high-energy objects far beyond the solar system have been observed to produce sudden ionospheric disturbances (SIDs). These objects include neutron star binary systems, gamma-ray bursts, and the newly discovered magnetars (see Sky and Telescope, Jan. 1999, p.22). The magnetars had previously been identified by their brief emission of soft gamma rays and referred to as "Soft Gamma Repeaters (SGRs). The SGR bursts are seen to repeat in random clusters. Three SGRs are known to exist in the Galaxy and one in a neighboring galaxy, the Large Magellanic Cloud. SGRs, gamma-ray bursts (GRBs) and other exotic high-energy sources produce large fluxes of x-rays and gamma-rays that can produce increased ionization in the lowest regions of the ionosphere. These disturbances are detectable by monitoring the propagation of distant VLF radio transmissions. In 1988, a paper in the British science journal Nature, described a SID produced by a gamma-ray burst (ref: Fishman and Inan, Nature, v. 331, pp.418-420, Feb. 4, 1988). Future issues of the SID bulletin will list some recent SGR and GRB events that may be detectable as night-time SIDs. Meanwhile, we would like to maintain a list of those VLF observers who can routinely perform night-time VLF observations and the VLF stations that are normally monitored. We are attempting to establish a global network of non-solar SID observers. SID program members interested in participating in this network should contact Joseph Lawrence , AAVSO SID Analyst, for additional details.

Dr. Gerald J. Fishman
Chief Scientist for Gamma-Ray Astronomy
NASA-MSFC
Fishman@msfc.nasa.gov

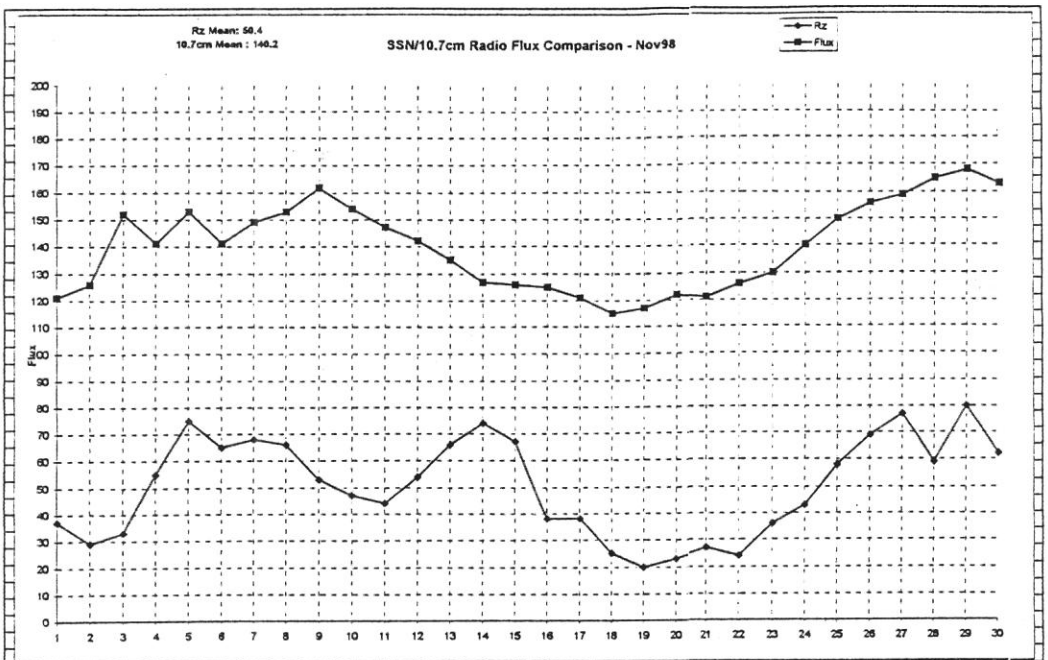
Editor's Comment: Dr. Fishman's proposal for using VLF monitoring stations to detect the effects of SGR and GRB events on Earth's ionosphere offers another opportunity to increase the scientific value of the AAVSO SID program. At present, many SID observers don't record during the night-time and certainly we don't analyze the traces for solar events during the night-time (for obvious reasons). In *Observing the Sun*, by Peter Taylor (1991), the possible detection of gamma-ray bursts by VLF receivers is discussed, but apparently for lack of interest the project was never enthusastically endorsed by the AAVSO SID program members.

Dr. Fishman has offered to form a collaboration in this project by providing the SID program a list of significant GRB events as detected by sensors on-board the Compton Gamma-Ray Observatory. I would encourage SID program members to begin recording during night-time hours and saving either stripchart traces or computer files for later analysis. Any non-solar SID or anomalous events recorded in night-time traces should be reported in the usual manner to the SID Analyst preferably in a report separate from your monthly solar SID results.

JDL

Sudden Ionosphere Disturbances recorded during November

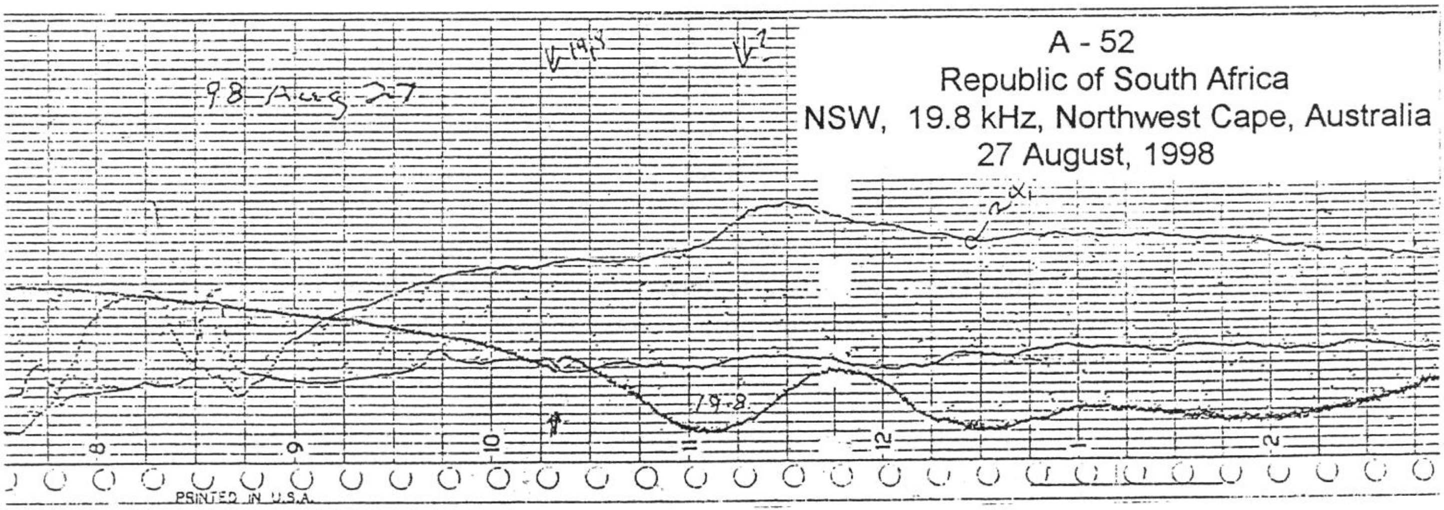
Prepared by
Casper H. Hossfield



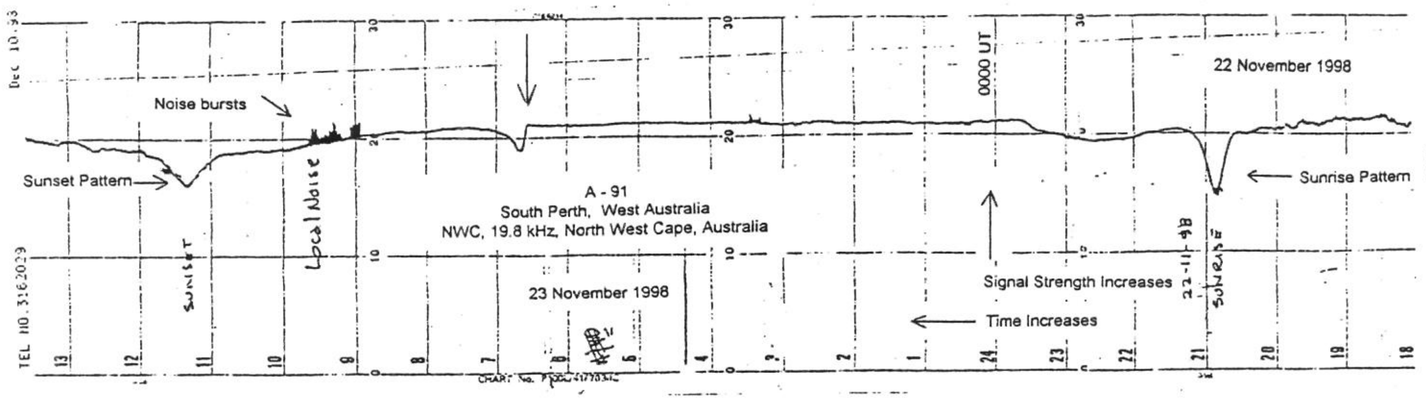
Rz	37	29	33	55	75	65	68	66	53	47	44	54	66	74	67
Flux	121	126	152	141	153	141	149	153	162	154	147	142	135	127	126

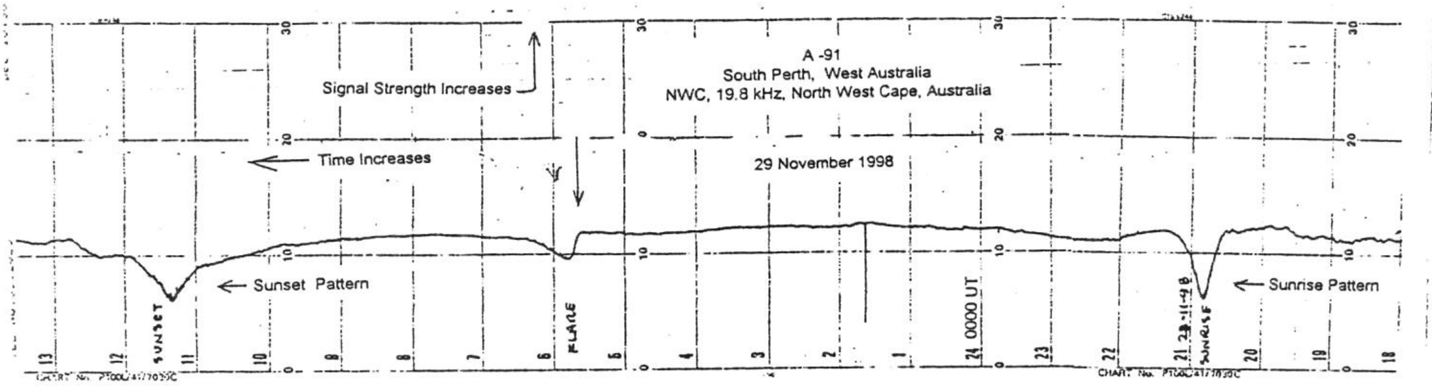
Rz	38	38	25	20	23	27	24	38	43	58	69	77	59	80	62
Flux	125	121	115	117	122	121	126	130	140	150	158	159	165	168	163

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.

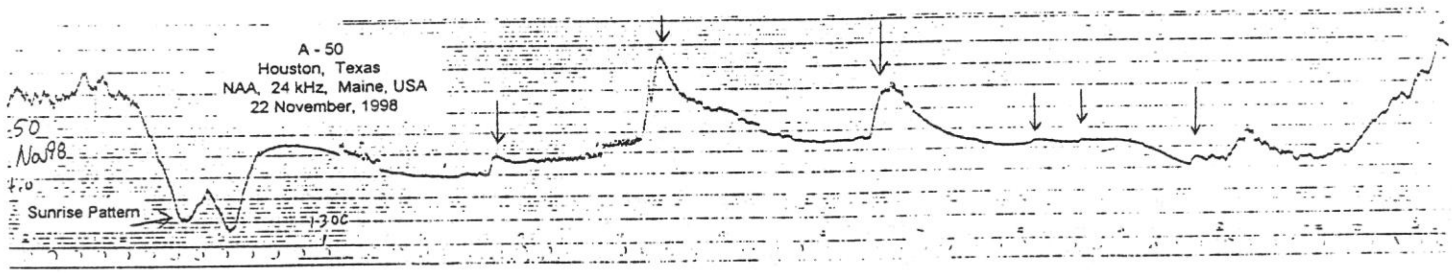


The above chart shows a recording of a gamma ray burst that occurred on 27 August 1998 at 1020 UT. It was made by A-50 in South Africa recording the 19.8 kHz signal in Northwest Cape, Australia. This was a very strong gamma ray burst that received wide news coverage including an SES recording in *Science*, the Journal of the AAAS. That recording was made in California recording NPM in Hawaii on 21.4 kHz. That SES occurred before sunrise in California so the SES was recorded on the nighttime trace as a sudden return of the D-layer of the ionosphere to daytime conditions. Danie Overbeek and Dominic Toldo who operate A-50 had no way of knowing they recorded a gamma ray burst because it looks exactly like a small SES on the daytime 19.8 Hz trace on the multiplexed chart that also records 24 Hz and 21.4 Hz as well as 19.8 kHz.. It was only after seeing the SES recorded by the group in California in *Science* that AAVSO asked our observers to check their charts. A-50 is the only observer who found it so far. The above shows the SES method is sensitive enough to record gamma ray bursts but being able to recognize them is another matter. Most gamma ray bursts last only for seconds which would determine the rise time. This would make them distinguishable from SESs which take minutes to rise to maximum. Bursts that last for seconds would be very much weaker, however, but it might be possible to find them on a very clean interference-free chart.

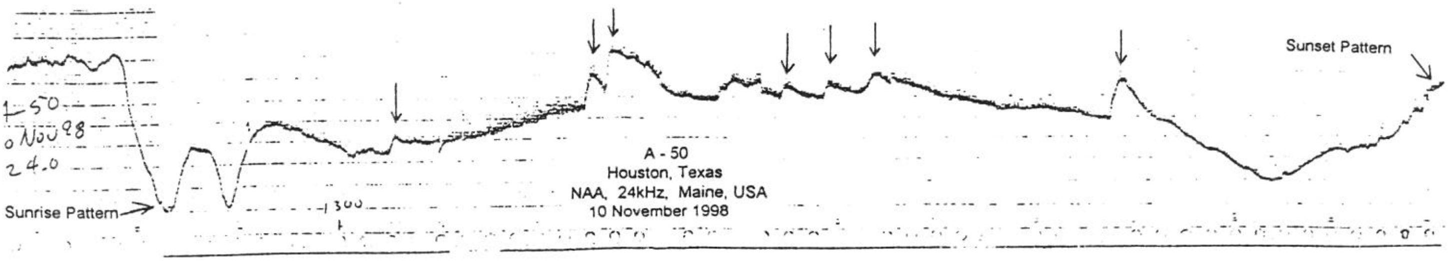




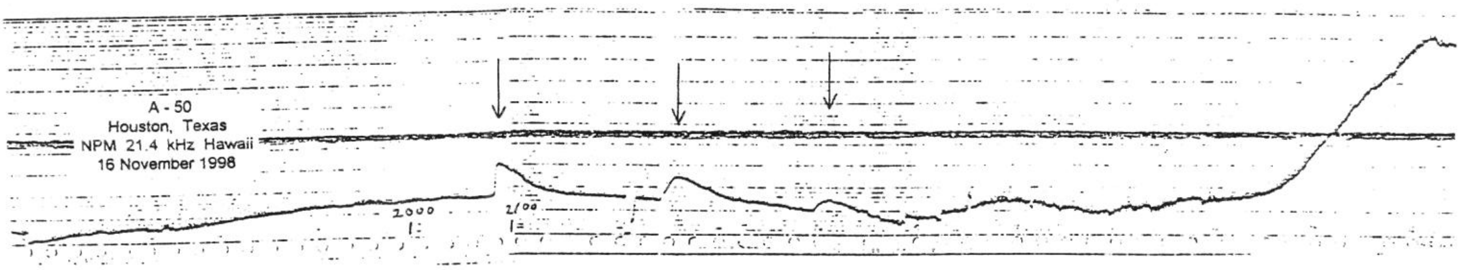
Two charts above were made by Len Anderson, A-91, who is our new observer in South Perth, West Australia. He uses a Polomar VLF converter, loop antenna and amplifier to record the 19.8 kHz signal at Northwest Cape which is about 1100 km due North of South Perth. The trace is unusual in that the sunrise and sunset patterns as well as the SESs are all inverted. Daytime and nighttime signal levels are about the same. This unusual trace seems to be quite sensitive and free of interference. We look forward to receiving more charts from A-91 who covers early UT hours that now provide 24 - hour coverage for AAVSO.

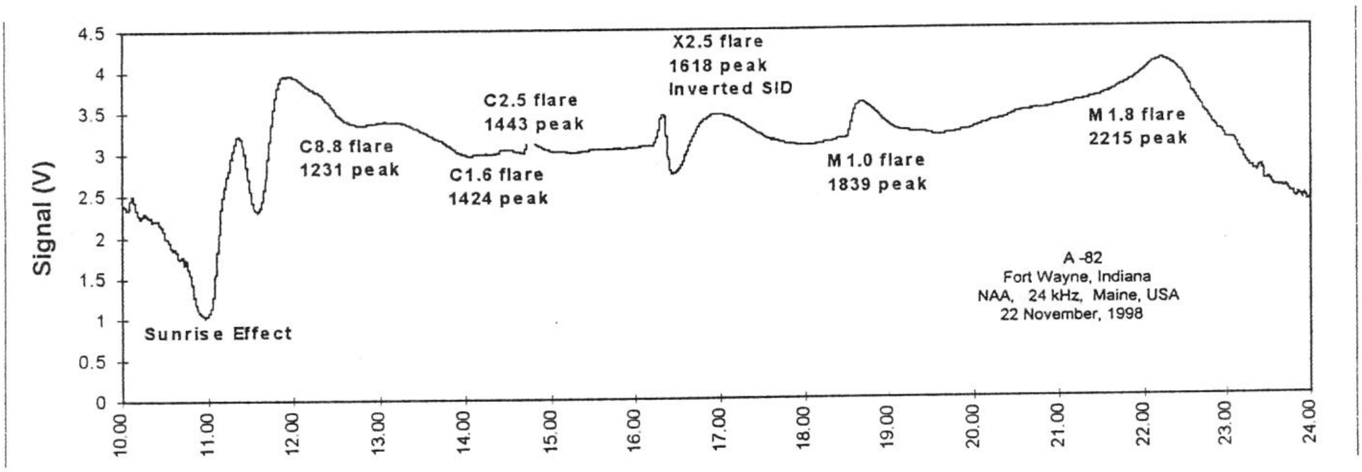


Another chart by A - 50 shows a X-2.5 flare starting at 1615 UT that produced an SES with a reversal in the rise to maximum. This is an interference pattern between the ground wave and a sky wave of the 24 kHz signal and is the same phenomenon that causes new observer, A-91's signal from Northwest Cape to be inverted. The flare changes the effective height of the D-layer of the ionosphere and therefore the distance the sky wave travels. This changes the phase relationship between the two waves. If the change is toward making them more in phase the signal is enhanced. If the change makes them more out of phase the signal strength is decreased and the SID is inverted. Usually inverted SIDs are recorded at distances around 1000 km or less and are more common on North - South propagation paths that are more parallel to the Earth's magnetic field. A-50 is about 3000 km from NAA. It is unusual to see an inversion at that distance. Dividing the signal into a ground wave and sky wave is a an oversimplification of what actually happens but it makes the change in the phase relationship easier to understand.



The above chart by Jerry Winkler, A-50, shows 10 November was an active day of solar flare activity with 7 events.





The above chart was made by Joseph Lawrence, our Solar Division Chairman. It too shows an inverted SID produced by the X-2.5 flare. It starts out as a normal SID but soon inverts and stays inverted for the rest of the SID. This is the more usual pattern. A- 50's small inversion within the rise to maximum with the rest of the SID normal is not often seen. All of A-91's SIDs are completely inverted and this is not unusual for a station at his distance south of the transmitter. Joseph is about 1500 km from NAA in Maine and reports having only recorded three inverted SIDs since 1993. I am about 850 km distant from NAA and my SIDs are often wholly or partially inverted.