

# Solar Bulletin

THE AMERICAN ASSOCIATION OF VARIABLE STAR OBSERVERS — SOLAR DIVISION

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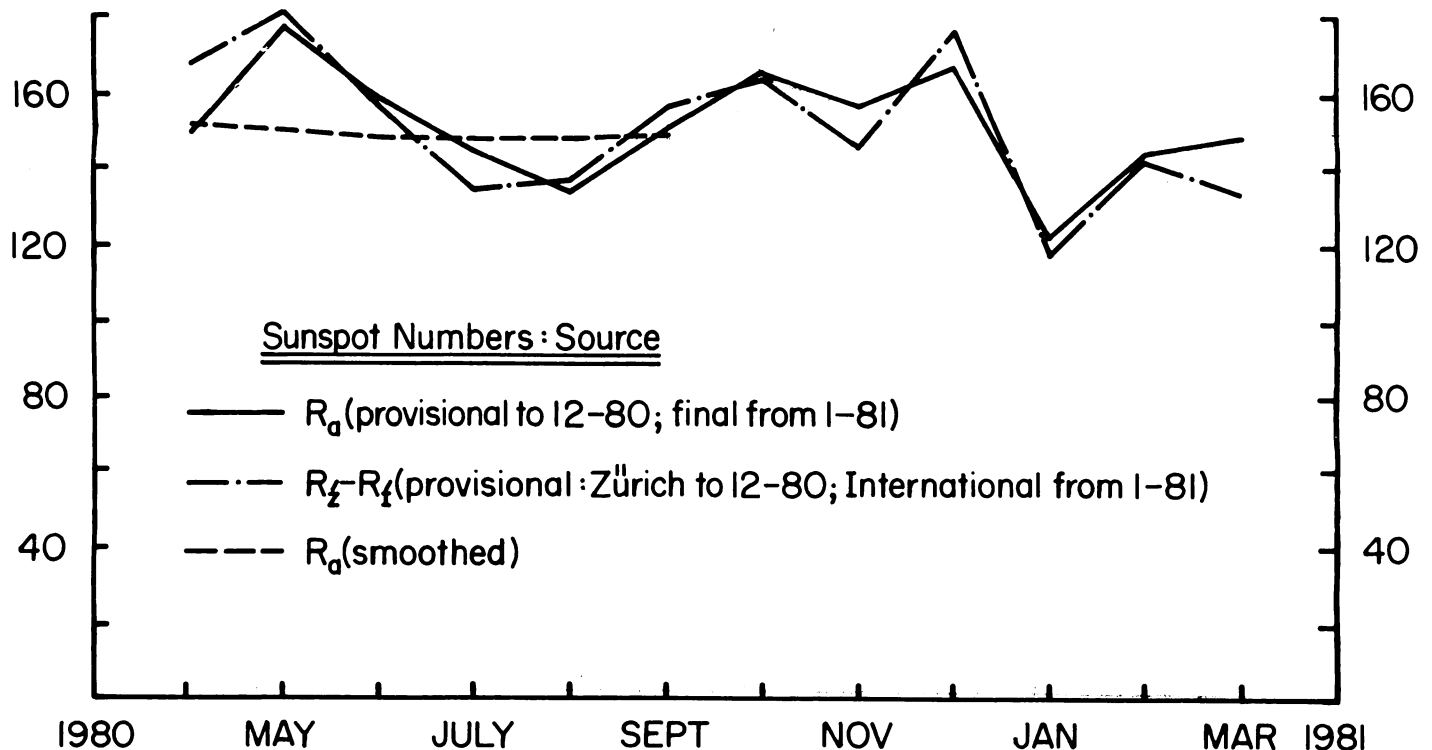
March 1981

## SOLAR ACTIVITY DURING MARCH 1981

Sunspot data are summarized in the graph at the bottom of this page, and in the table of daily numbers on page 2. The twelve-month smoothed mean of AAVSO sunspot numbers rose slightly from 147.0 for August 1980 to 149.1 for September 1980. The monthly mean increased from 143.7 for February 1981 to 149.2 for March 1981. Final daily AAVSO sunspot numbers varied even more widely than in past months, from a high of 197 (March 2) to a low of 95 (March 18). Much of this variability was again due to small, short-lived groups. Activity roughly centered in three quite extended regions, whose central meridian crossing dates were approximately March 2, 7, 21, and 29. Each of these regions contained from five to twelve sunspot groups, including several with complex magnetic structures and large numbers of spots.

The Sudden Enhancements of Signal (SEs) detected by 19 members of the AAVSO Indirect Solar Flare Patrol, and meeting criteria for listing, are given on page 2. The 182 flare-produced SEs in March are a new high for this cycle, exceeding by a wide margin the previous high of 148 observed in February. In this Bulletin there are 10 sections of records on pages 3 and 4, showing a variety of forms of SEs recorded by Patrol observers. Should such high levels of SEs continue, regular pages will be added in order to present and discuss actual exemplary recordings.

H $\alpha$  observers noted that there were days with continuous or nearly continuous flare activity for many hours at a time. Radio observers reported finding a new VLF transmission at approximately 26 kHz, perhaps replacing the one at 18.6 kHz.



## SUDDEN IONOSPHERIC DISTURBANCES (SESS) RECORDED DURING MARCH 1981

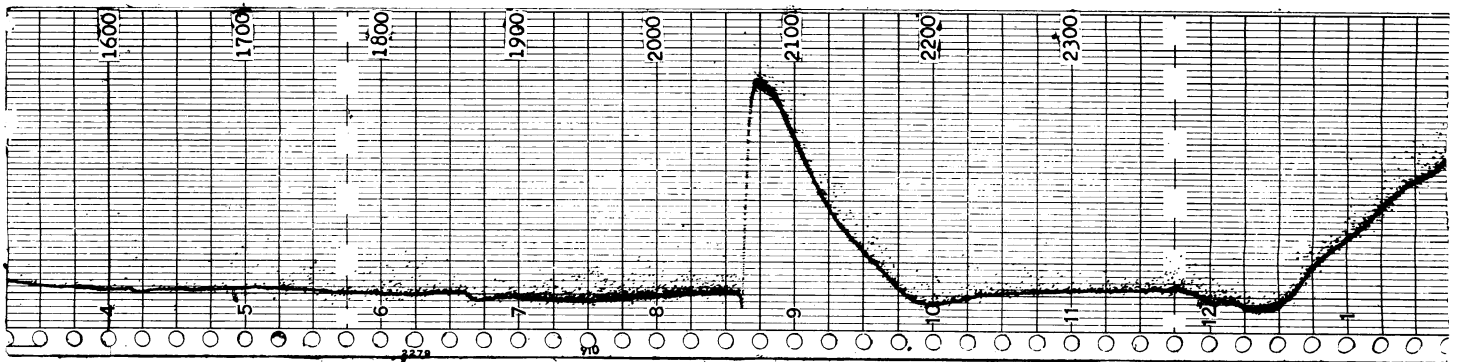
Records were received from A1, 3, 5, 19, 26, 28, 32, 37, 41, 43, 46, 48, 50, 51, 52, 54, 55, 56, 57

Day	Max	Imp	Def	Observers	Day	Max	Imp	Def	Observers	Day	Max	Imp	Def	Observers	
1	16:35	1	5	A1,5,19,26,31,37,46,48	15	17:45	2+	5	A1,3,19,26,28,31,32,46,50,51,55,56,57	25	16:17	1-	5	A1,26,31,51,54,55,56	
2	14:33	2+	5	A1,19,26,28,37,41,46,51	15	18:07	3+	5	A1,3,19,26,28,31,46,48,55,56,57	25	18:45	1-	5	A1,19,26,28,31,41,46,54,55	
2	18:53	3	5	A5,19,26,28,31,41,46,57	15	21:16	1+	5	A1,3,19,26,28,31,32,37,46,50,51,55,56,57	26	13:40	1+	5	A1,3,19,26,28,31,32,37,46,48,50,51,54,55,56	
2	21:23	2	5	A5,19,26,28,31,41,46,48,51,55,56,57	15	22:08	1+	5	A1,31,46,55,56,57	26	14:54	2+	5	A1,3,19,26,28,31,32,37,41,46,48,50,51,54,55,56	
2	22:24	1	5	A31,41,46,55,56,57	15	23:04	1-	5	A31,55,56,57	26	15:35	1-	5	A1,19,26,28,31,46,48,51,54,55	
2	22:41	2+	5	A19,26,31,41,46,55,56,57	16	05:37	1	5	A31	26	18:17	3	5	A1,3,19,26,28,31,32,46,48,51,54,55,56	
3	13:13	2+	5	A1,32,46,54	16	13:07	1	5	A1,26	26	19:45	1+	5	A1,3,19,26,28,31,32,46,48,51,54,55,56	
4	14:40	1-	5	A1,19,28,32,51	16	18:20	1	5	A19,26,31	26	23:52	1-	5	A31,55,56	
4	15:47	1-	5	A1,19,28,32,51	16	21:57	1+	5	A1,19,26,31,55,56,57	27	00:31	3	5	A1,3,43,46,55,56	
4	17:33	3+	5	A1,5,19,26,28,31,32,37,41,46,48,51,54,55,56,57	16	23:13	1-	5	A31,55,56	27	02:06	1+	5	A31,43,55,56	
4	18:15	1-	5	A1,19,26,28,31,41,46	16	23:18	1+	5	A31,55,56	27	02:30	1-	5	A31,43,55,56	
4	19:43	1	5	A1,26,31,46,52,55,56	18	14:04	1	5	A1,3,19,26,28,32,51	27	02:53	1+	5	A31,43,55,56	
4	20:46	1+	5	A1,31,37,56	18	18:22	1-	5	A1,19,26,28,31,41,46,48,51,52,54,55	27	16:36	1	5	A1,3,19,26,31,32,46,48,50,51,55	
5	01:11	1-	4	A31,43,56	18	19:04	2+	5	A1,3,19,28,31,32,41,46,48,50,51,52,54,55	28	04:19	1	5	A31,43,55,56	
5	04:44	1+	5	A31,43,55,56	18	19:54	1+	5	A1,19,26,28,31,41,46,48,50,51,52,54,55	28	05:40	1+	5	A31,43,55,56	
5	05:03	1+	5	A43	19	06:16	2	4	A31,56	28	15:15	2+	5	A1,3,5,19,26,28,31,32,41,46,48,50,51,54,55,56	
5	07:23	2	5	A43	19	13:35	1+	5	A1,19,26,28,32,46,48,51	28	19:35	1-	5	A1,3,19,26,28,31,32,46,48,55	
5	08:43	1+	4	A31,55,56	19	20:12	1+	5	A19,26,28,31,55,56,57	28	21:23	1-	4	A26,32	
5	17:35	1+	5	A1,26,28,31,46,48,51,54	19	23:15	1-	5	A31,56	29	02:59	2+	5	A31,43,56	
5	21:39	2+	5	A1,26,31,46,55,56,57	20	08:35	2+	5	A31,55,56	29	16:15	1-	5	A1,3,19,26,28,31,32,37,46,48,50,51,54,55,56	
5	23:07	2	5	A31,55,56	20	18:35	1-	5	A1,19,26,28,31,32,46,48,51,54,55,56,57	29	18:12	1	5	A1,3,19,26,28,31,46,48,51,54,55,56	
6	01:36	1+	5	A43	20	20:07	1+	5	A1,19,26,28,31,32,37,41,46,48,51,54,55,57	29	19:00	1-	5	A1,3,19,26,28,31,41,46,48,51,54,55,56	
6	02:10	1	5	A31,43,46,55,56	20	21:15	1	5	A26,31,57	29	19:18	1-	5	A1,19,26,28,31,41,46,48,55	
6	02:50	2+	5	A31,43,46,55,56	20	21:44	1-	5	A26,31,57	29	22:14	1-	5	A31,46	
6	03:10	1+	5	A31,43,46,55,56,57	20	23:10	2	5	A19,31,46,54,55,56,57	29	23:02	1+	5	A31,56	
6	16:32	2	5	A1,19,26,31,37,46,48,54,55,56	21	00:32	1	5	A31,46,56,57	29	23:19	1	5	A31,46,55,56	
6	18:29	1-	5	A1,19,31,56	21	01:38	1	5	A31,55,56	29	23:56	1-	5	A31,46,55	
6	18:44	1	5	A1,19,31,55,56	21	02:50	1+	5	A31,55,56	30	18:32	1	5	A31,37,55	
6	19:00	1	5	A1,19,31,55,56	21	03:39	1+	5	A31,55,56	30	23:10	1	5	A31,54,55	
6	19:45	2	5	A19,31,55,56	21	06:38	1	5	A31,52,55,56	31	13:51	2	4	A1	
6	22:08	2	5	A31,52,55,56	21	08:13	1	4	A54,55	31	21:40	1	5	A31,56	
6	22:48	1-	4	A31,52,56	21	13:03	2+	5	A1,3,19,26,28,32,41,46,48,51,54						
7	06:31	2	5	A31,43,55,56	21	13:36	1	5	A1,3,19,26,28,32,41,46,48,51,54						
7	17:57	2	5	A1,31,46,52,54,55,56	21	15:13	1+	5	A1,3,19,26,28,32,46,48,51,54						
7	19:14	1+	5	A1,31,46,55,56	21	16:16	3	5	A1,19,26,28,31,32,41,46,48,50,51,54,55,56,57						
8	02:15	1+	5	A31,43,55,56	21	21:36	1	5	A1,31,37,51,57						
8	16:13	1-	5	A1,19,31,32,46,51,54,55,56	21	21:45	1+	5	A1,19,26,31,32,37,46,48,51,54,55,56,57						
8	16:33	1+	5	A1,31,46,54,55,56	22	14:36	2	5	A1,3,19,26,28,31,32,46,48,51,54,55,56						
8	19:03	1+	5	A1,19,26,31,37,41,46	22	17:32	2	5	A1,3,5,19,26,28,31,32,37,46,48,50,51,54,55,56						
8	20:38	2	5	A1,31,32,46,51,54,55,56	22	18:49	1	5	A1,3,5,19,26,28,31,32,37,46,48,50,51,55						
9	16:38	1+	5	A1,19,26,31,37,48,56	22	19:53	3	5	A1,3,5,19,26,28,31,32,37,41,46,48,50,51,54,55,56						
9	19:03	3+	5	A1,19,26,31,32,37,41,46,51,54,55,56,57	22	20:47	1+	5	A1,3,5,19,26,28,31,32,41,46,48,50,51,56						
9	19:40	2	5	A1,19,31,37,41,46,54,55,56	22	21:47	1-	5	A1,19,26,31,32,37,41,50,51,55						
9	20:59	1	5	A31,54,55,56	22	22:06	1+	5	A1,3,5,19,26,28,31,37,41,46,48,50,51,54,55,56						
10	08:38	1	5	A31,55,56	22	22:22	2	5	A31,37,46,50,55,56						
10	14:29	2+	5	A1,19,31,55,56	22	23:55	2+	5	A31,52,55,56						
10	15:08	1+	5	A1,19,31	23	07:02	2+	5	A31,52,56						
10	23:27	1	5	A31,55,56	23	12:09	1	5	A1,19,26,28,46						
11	17:15	1	5	A1,19,26,31,46,54,55,56,57	23	17:43	2+	5	A1,5,19,26,28,31,37,41,46,48,50,51,54,55,56						
11	17:46	1-	5	A1,31,46,54,55,56	23	19:35	2	5	A1,3,5,19,26,28,31,32,37,41,46,48,50,51,54,55,56						
11	17:58	1-	5	A1,19,31,46,55,56	23	21:20	2+	5	A1,3,5,19,26,28,31,37,41,46,48,51,55,56						
11	19:02	2	5	A1,31,46,54,55,56	23	23:04	1-	5	A31						
11	20:33	1	5	A19,31,54,55,56	24	02:01	2+	5	A31,46,55,56						
11	21:15	1+	5	A1,31,55,56	24	06:30	1	5	A31,52,55,56						
12	07:40	1+	5	A31,46,56	24	07:31	1	5	A52,56						
12	09:23	2+	4	A31,55,56	24	16:24	1	5	A1,3,31,46,55						
12	09:46	2+	4	A31,55,56	24	17:36	1+	5	A1,3,19,31,32,41,46,50,54,55,56						
12	18:00	2+	5	A1,19,26,31,32,46,48,51,55,56,57	24	17:48	1	5	A1,3,19,31,41,46,55						
12	18:26	1-	5	A19,31,46,55	24	19:07	2+	5	A1,3,19,31,32,41,46,50,54,55,56						
12	22:45	1	5	A19,31,56,57	24	22:27	1-	5	A31,41,46,55,56						
13	17:17	3	5	A1,19,31,54,55,56	25	01:05	1	5	A31,43,46,55,56						
13	18:34	2	5	A1,19,26,31,46,48,54,55,56,57	25	03:06	1-	5	A31,43,55,56						
13	19:42	1+	5	A1,19,26,31,32,46,48,51,54,55,56,57	25	05:10	1	5	A31,43,55,56						
13	21:09	3	5	A1,3,19,26,31,32,46,48,51,53,55,56,57	25	06:25	2+	5	A31,52,55,56						
13	22:40	1+	5	A31,46,55,56,57	25	08:00	1	5	A31,43,52,56						
13	23:24	2+	5	A19,31,43,46,55,56,57											
14	15:23	1-	5	A1,3,19,31,32,48,53,54,55,56											
14	17:28	1+	5	A1,19,31,54,56											
14	18:50	1	5	A19,31,55,56											
14	19:48	2	5	A1,3,19,31,32,46,48,50,51,53,54,55,56,57											
14	20:42	1-	5	A31,46,55,57											
14	23:50	2+	5	A19,31,37,46,54,55,56,57											
15	01:54	1+	5	A31,46,55,56,57											
15	03:01	1	5	A55,56											
15	03:30	2	5	A31,55,56											
15	04:04	1+	5	A31,56,57											
15	09:20	3+	5	A31,55,56											
15	13:49	1+	5	A1,3,19,26,28,32,46,51											
15	14:18	2+	5	A1,3,19,26,28,32,46,48,50,51											
15	16:56	2	5	A31,55,56											

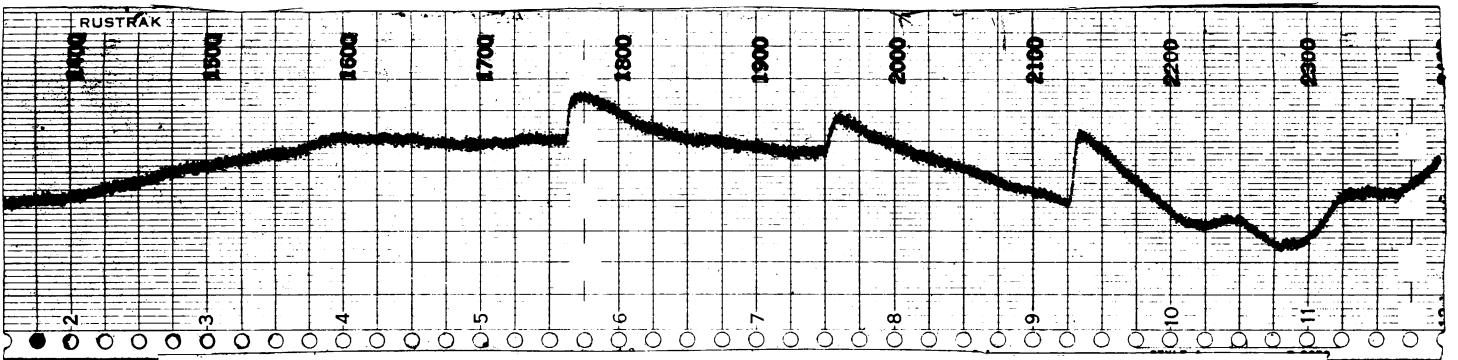
March 1981  
RELATIVE SUNSPOT NUMBERS (R):  
AAVSO (a), INTERNATIONAL (I)

Day	R <sub>a</sub> (final)	R <sub>I</sub> (prov)
1	187	147
2	197	182
3	179	169
4	174	183
5	167	141
6	150	138
7	133	130
8	153	142
9	153	124
10	152	127
11	146	130
12	139	128
13	135	127
14	144	128
15	132	110
16	135	128
17	127	109
18	95	95
19	102	86
20	128	120
21	143	135
22	155	134
23	150	121
24	143	125
25	147	142
26	149	133
27	150	126
28	157	135
29	180	160
30	171	184
31	151	108
Mean	149.2	133.8

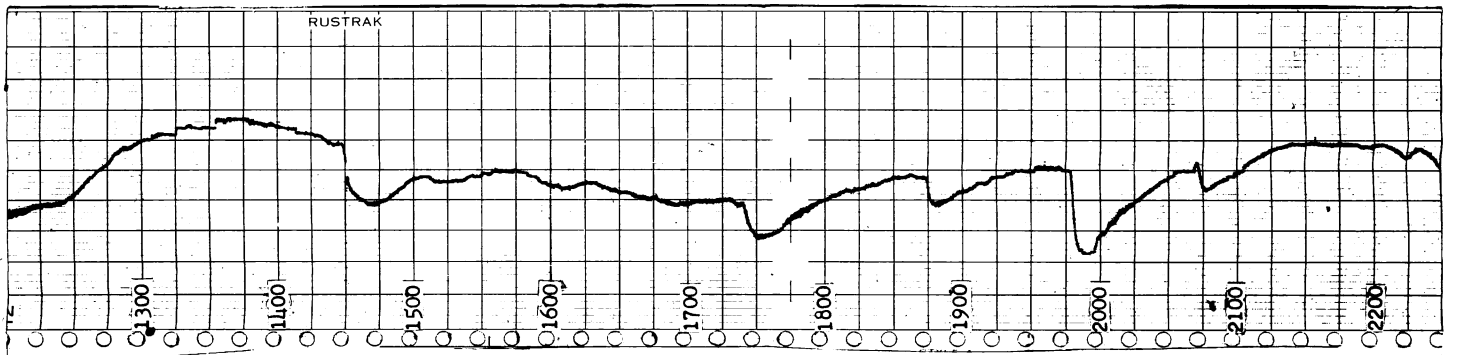
VARIETIES OF "SUDDEN ENHANCEMENTS OF SIGNAL"



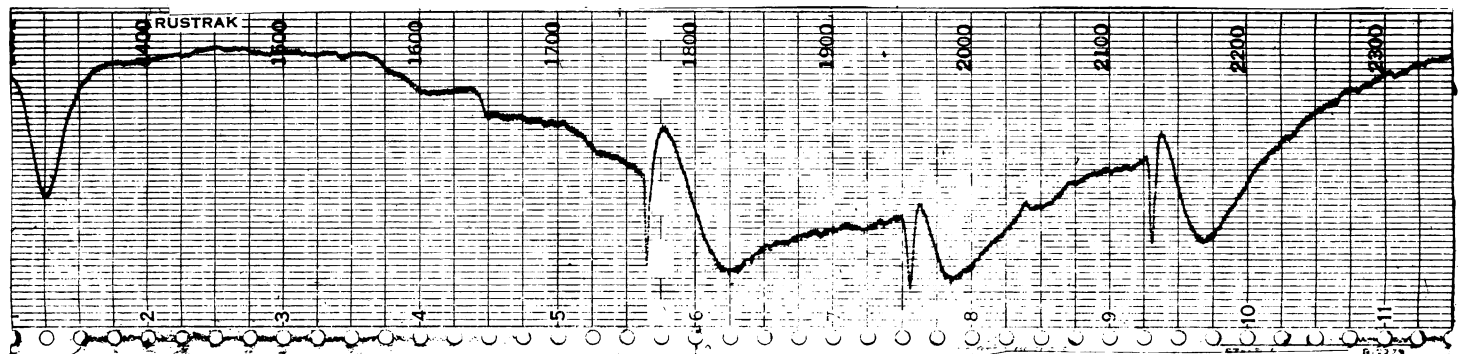
A19 March 25, 1981 37.2 kHz This large event is an example of a classic-shaped SES. Note the fast rise and slow, near-exponential drop. About two hours before (18:45), there had been a small "inverted" event.



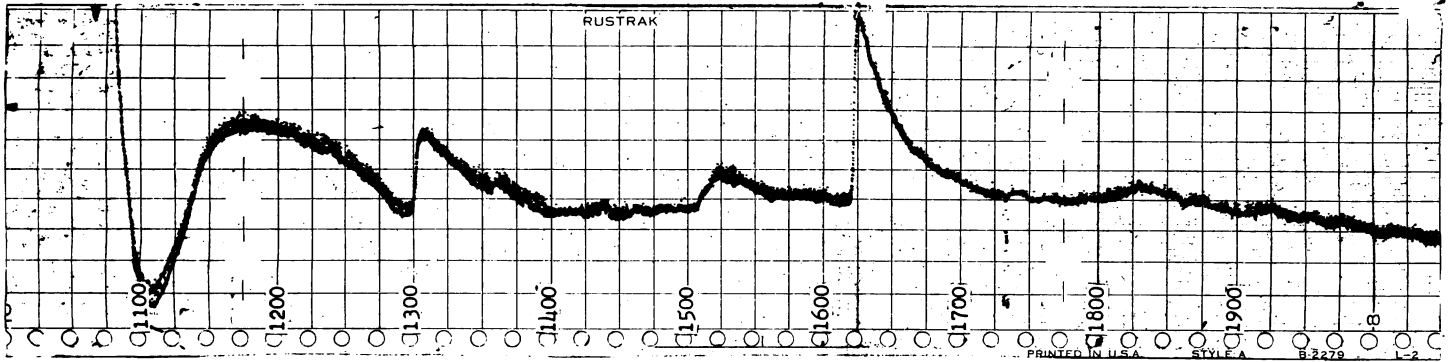
A26 March 23, 1981 21.4 kHz The three larger events are examples of medium-sized classic-shaped SESs. Note variation in form of event at different times of day.



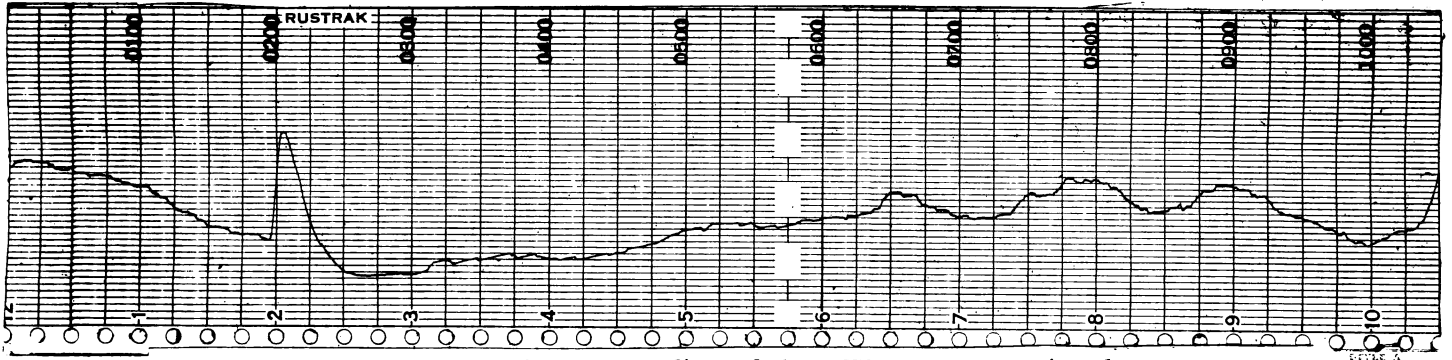
A28 March 22, 1981 21.4 kHz Compare the shapes of these SESs with those above. "Inverted" events can perhaps be caused by station sensitivity or recording equipment and setup, but seem to appear consistently on certain frequencies, and at limited times of year, in specific locations.



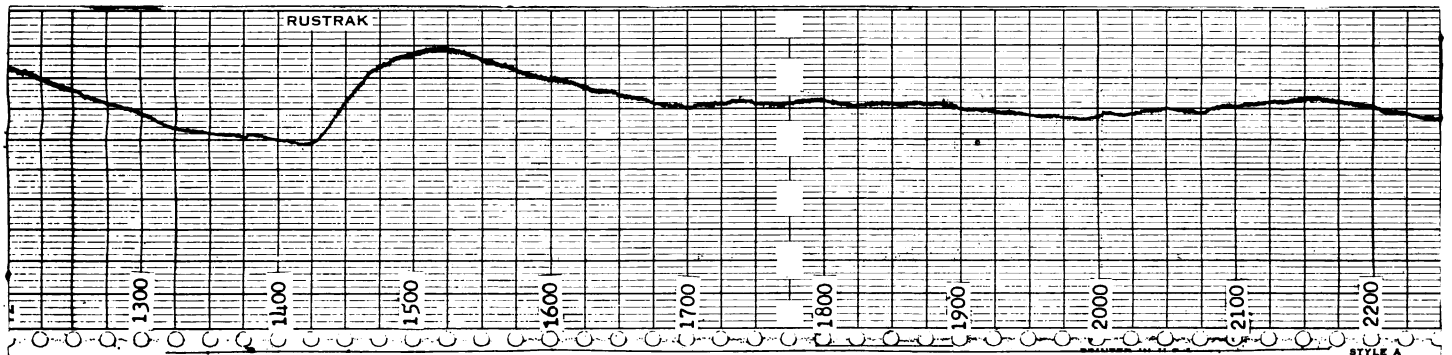
A31 March 23, 1981 60 kHz Here are three SESs showing partial inversion. Notice the initial sharp drop, then sharp increase in signal strength to a low peak, and the post-peak suppression.



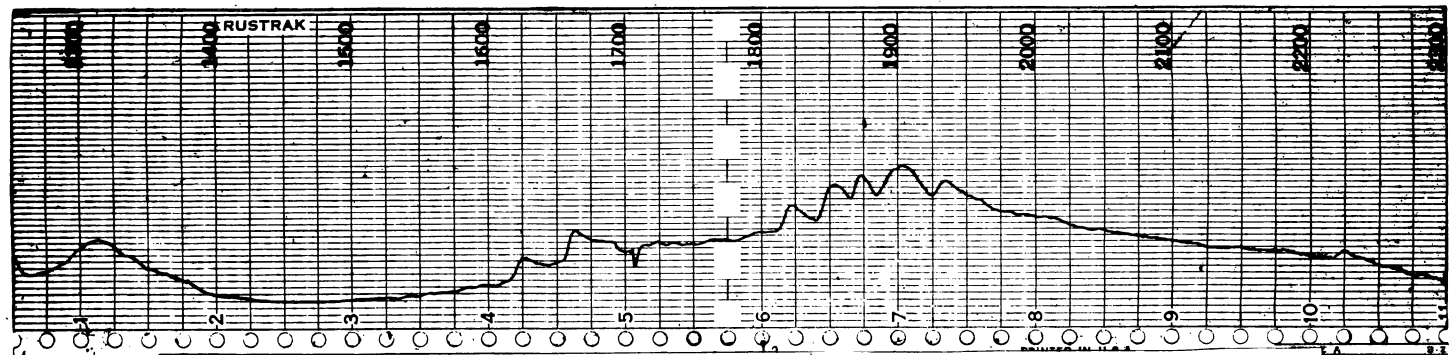
A51 March 21, 1981 21.4 kHz The event at 13:00 is a classic-shaped SES with a too-small-to-detect-by-itself SES occurring just afterwards at 13:30. Another regular event is shown at 15:04. The SES at 16:15 is a "spike" event; note the extra-quick rise and sharp peak, then a rather fast, nearly exponential drop.



A56 March 24, 1981 22.3 kHz The first of three SESs occurs approximately at sunset, local time, 7:00 PM. The next two (06:21, 07:23) are small, just distinguishable from the synodic waves typical on 22.3 kHz. These were small events, which shows how sensitive the 22.3 kHz signal can be after local sunset at the receiving station.



A32 March 10, 1981 17.8 kHz This type of event is "set off" by a medium-sized SES, but continues for hours on some frequencies. These events appear to occur most commonly on 17.8, 29.5, and 73.6 kHz.



A31 March 29, 1981 29.5 kHz The first two SESs here represent a quite common example of a double event. However, a series of five SESs such as the one beginning at 18:06 is rare. Notice the variation in the shapes of the events. Independent observations suggested that these multiple events were not an artifact of equipment, but actually solar-based.