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# The British Astronomical Association

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Registered Charity No. 210769

Burlington House, Piccadilly, London, W1J 0DU

Telephone: 020 7734 4145

Fax No.: 020 7439 4629

Email: office@britastro.org

Website: www.britastro.org



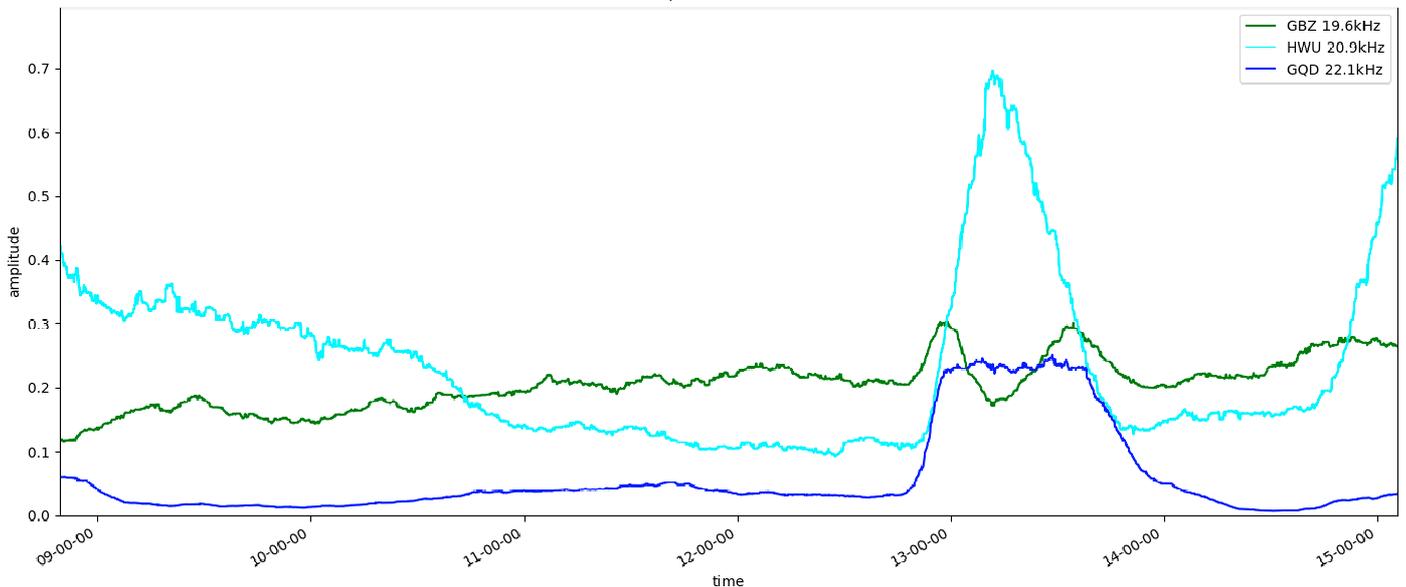
Please send all reports and observations to [jacook@jacook.plus.com](mailto:jacook@jacook.plus.com)

## BAA Radio Astronomy Section.

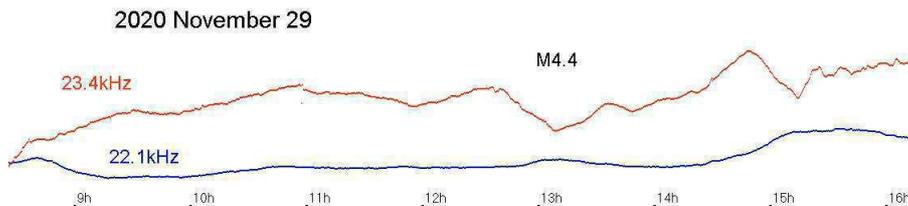
## 2020 NOVEMBER.

Activity in November was the highest so far recorded in 2020, and shows that solar cycle 25 is now well underway. There have been numerous B-class flares as well as plenty of smaller C-class, but we were also very lucky to catch a good M4.4 flare on the 29<sup>th</sup>. This is the second M-class flare so far, an M1.1 being recorded in May.

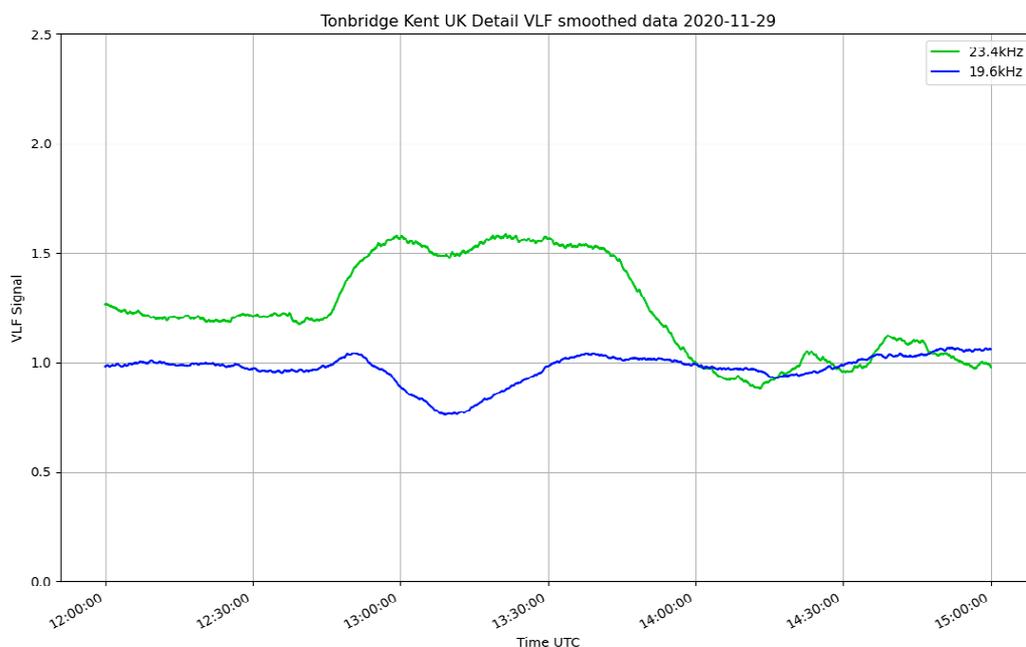
SIDs vlf profile for 2020-11-29



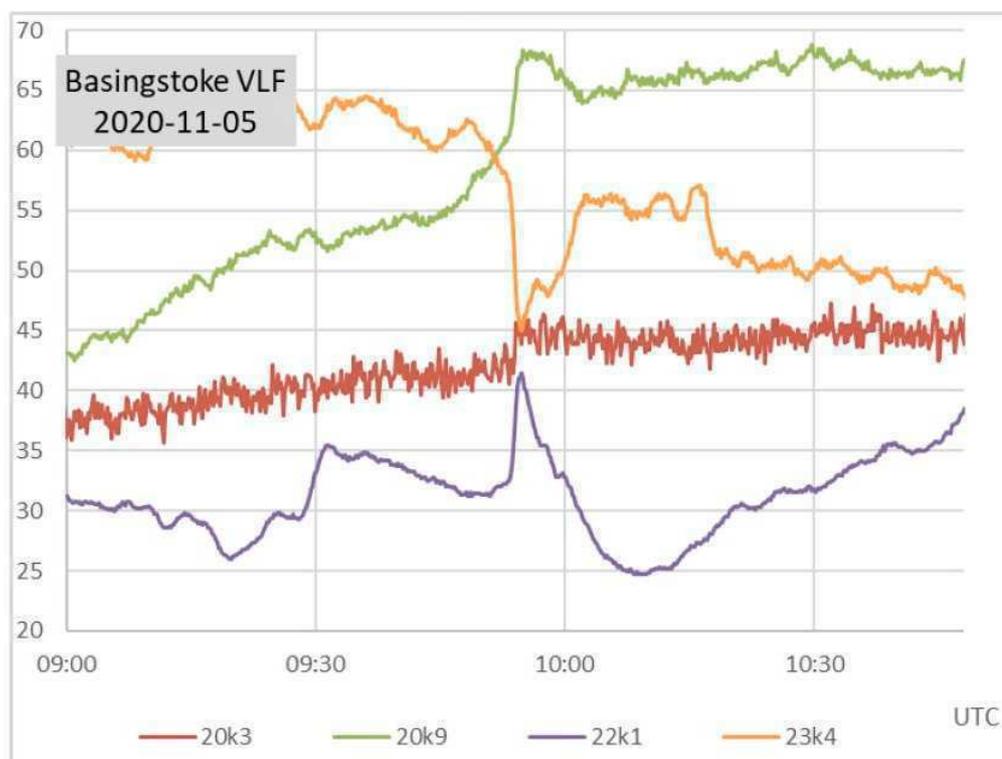
This recording by Mark Prescott shows the flare clearly, the 20.9kHz signal (light blue) showing a very symmetrical SID. 19.6kHz (green) shows a 'spike and wave' SID, often seen with stronger flares. This is due to the ground-wave / sky-wave interference pattern moving from adding to cancelling at the peak of the flare, and then reversing back again as the flare decays. The 22.1kHz SID is rather unusual, with a flat top. I have not seen one quite like that before. The flare itself had a normal peak, and a very long decay taking over four hours to drop below C-class.



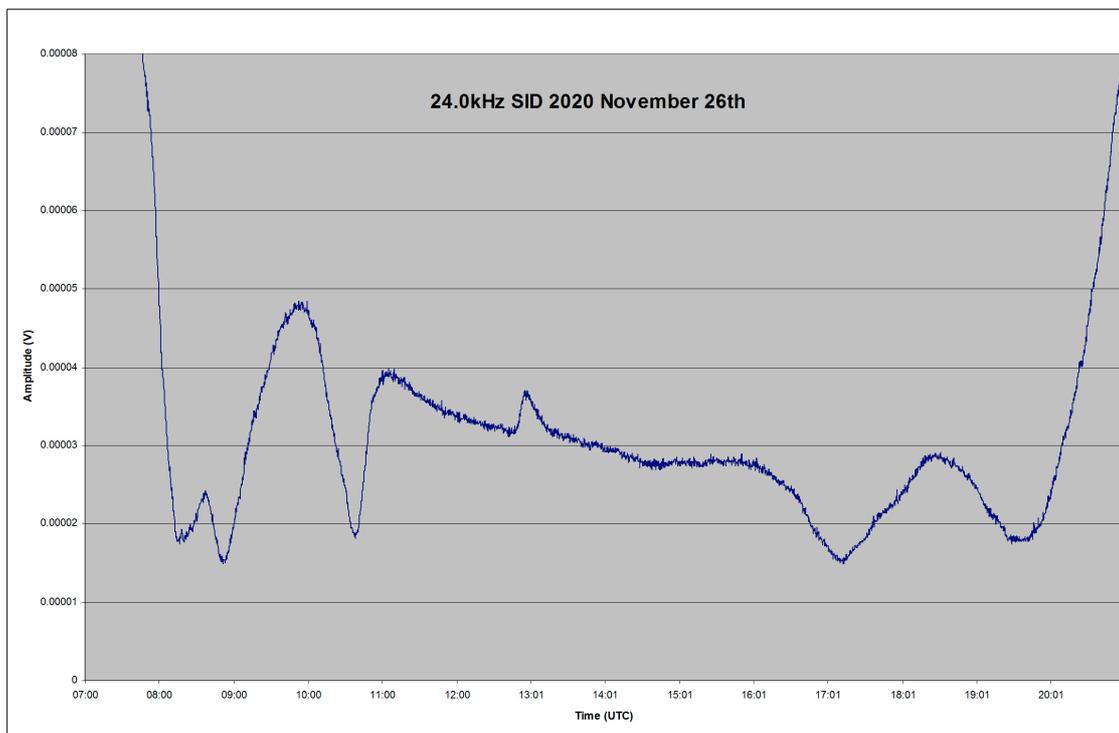
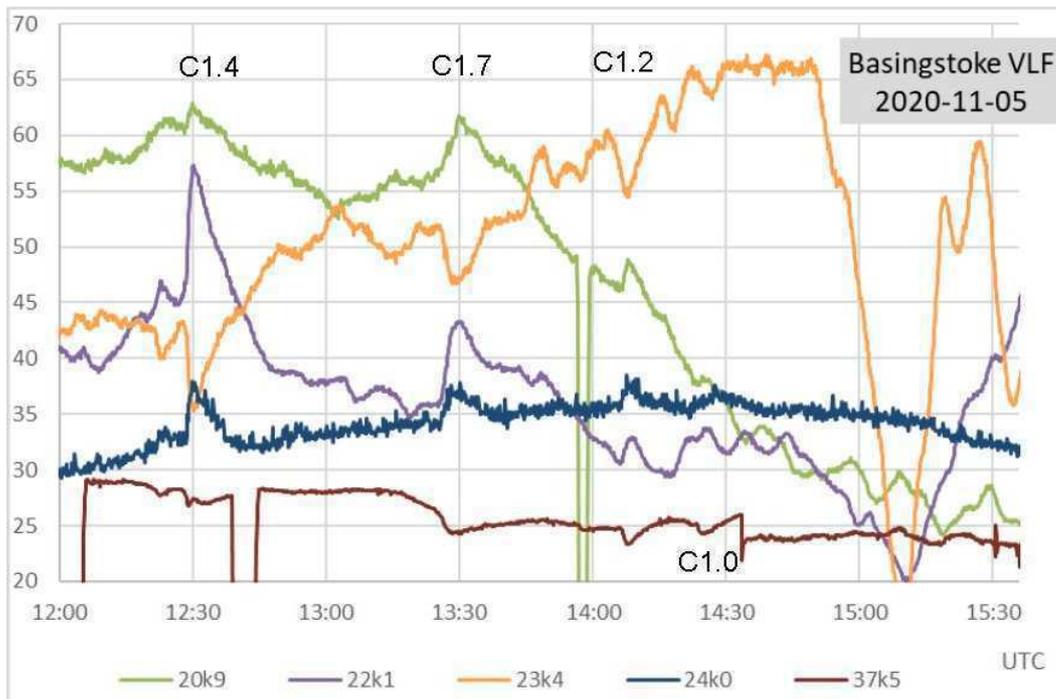
My own recording (above) shows a very weak response at 22.1kHz, but does show the long decay at 23.4kHz, the signal merging with the early sunset in late November.



This chart from Andrew Thomas shows a nearly flat top at 23.4kHz, but with a small dip around the peak time, like the 'spike and wave' SID but with a long decay time. I suspect that the 22.1kHz SID in Mark Prescott's recording may be due to the interference pattern just reaching the cancelling phase, but then remaining steady at that point until the long decay takes over.



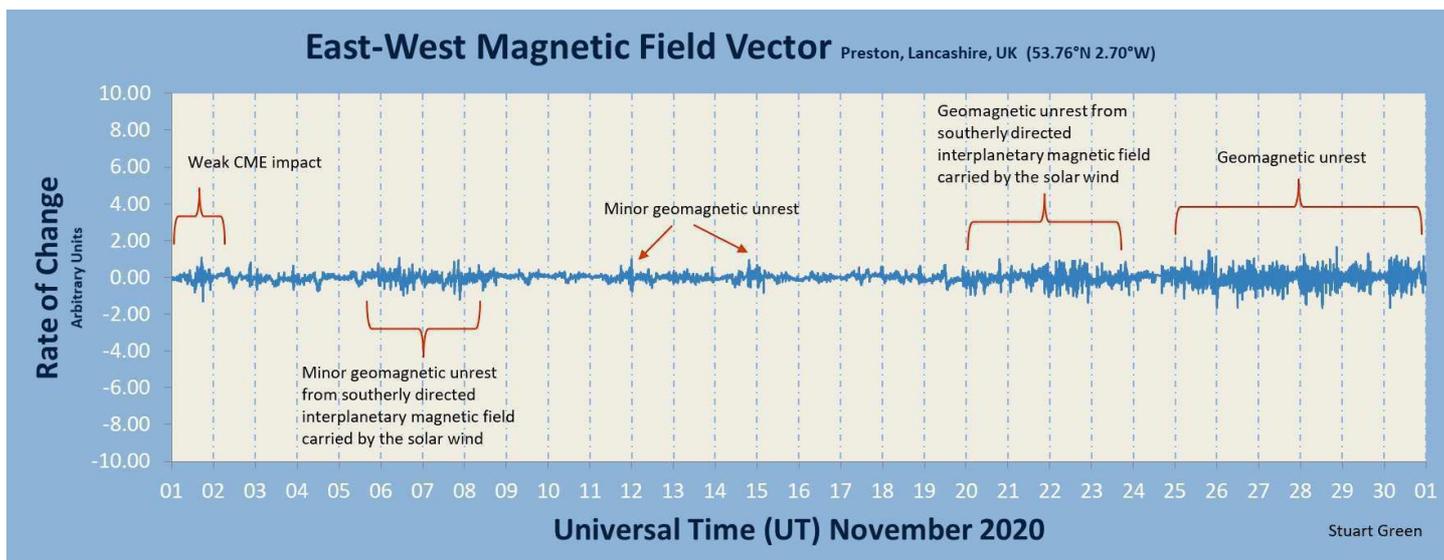
November 5<sup>th</sup> recorded the largest number of SIDs, although they were all from smaller C-class flares. This recording from Paul Hyde shows the C2.3 flare peaking at 09:55UT on four rather noisy signals. The longer path at 20.3kHz from Italy is particularly noisy, almost hiding the SID. This was the strongest flare recorded on the 5<sup>th</sup>, the remaining activity shown on the next page. The C1.4 flare at 12:30 shows a smaller peak at 12:23 that is not classified in the SWPC data. The later C1.0 flare is just visible at 37.5kHz, but well hidden on the other signals.



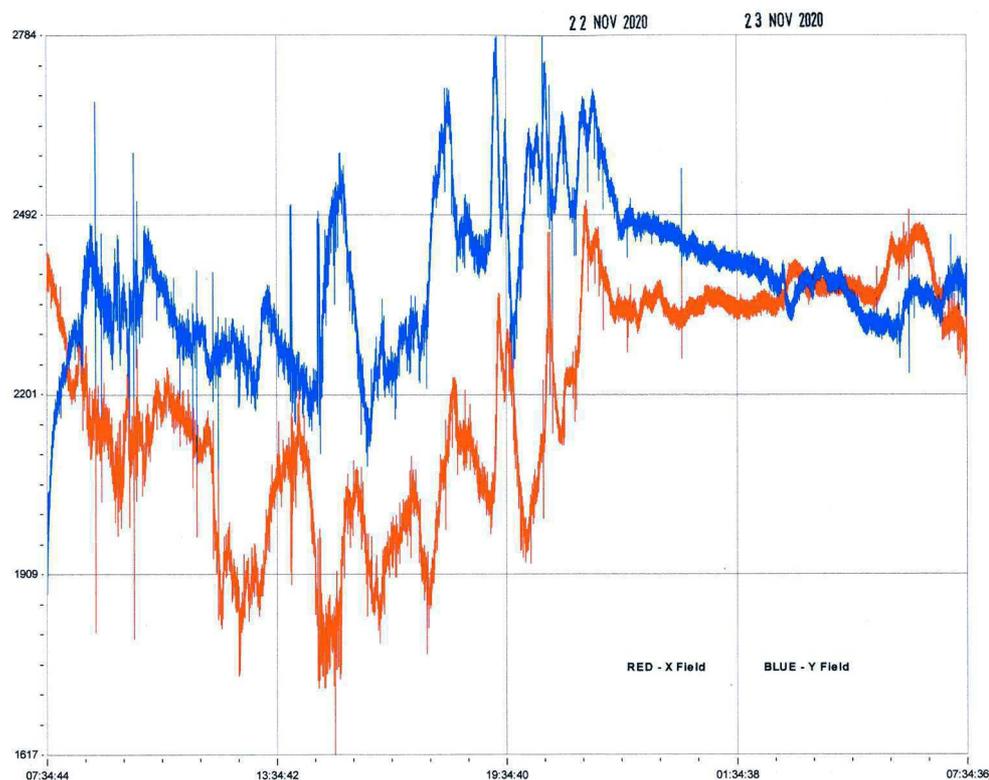
This recording by Mark Edwards shows a well defined SID peaking at 12:56UT at 24kHz, from a C2.3 flare on the 26<sup>th</sup>. For a change, we have a fairly noise-free signal all day, showing the sunrise and sunset effects.

## MAGNETIC OBSERVATIONS.

Most of the flaring activity reported above was from active regions close to the eastern limb of the sun as seen from Earth. There were a number of associated CMEs, the majority of which were aimed well away from Earth and so had little effect.



Stuart Green's summary of the month's activity shows a very weak CME impact on November 1<sup>st</sup>, with solar wind disturbances later in the month. Satellite images indicate that the CME was from a filament eruption seen on October 27<sup>th</sup>. The northern polar coronal hole seen over the last few months made another appearance on the 20<sup>th</sup> with a very mild disturbance, increasing in the evening of the 21<sup>st</sup>. The most active disturbance was on the 22<sup>nd</sup>, shown in this recording by Colin Clements:



The disturbance was particularly turbulent in the evening, with rapid variations of about  $\pm 50$ nT. This ended quite suddenly just before midnight, with only a mild disturbance recorded on the 23<sup>rd</sup>. It did recover for a while in the evening of the 25<sup>th</sup>.

A southern coronal hole produced a relatively slow solar wind that merged with the edge of some of the eastern limb CMEs mentioned earlier. This produced some more rapid magnetic variations on the 6<sup>th</sup>, but of very low amplitude. Minor disturbances continued on the 7<sup>th</sup>, as shown in the recording by Roger Blackwell on the next page:

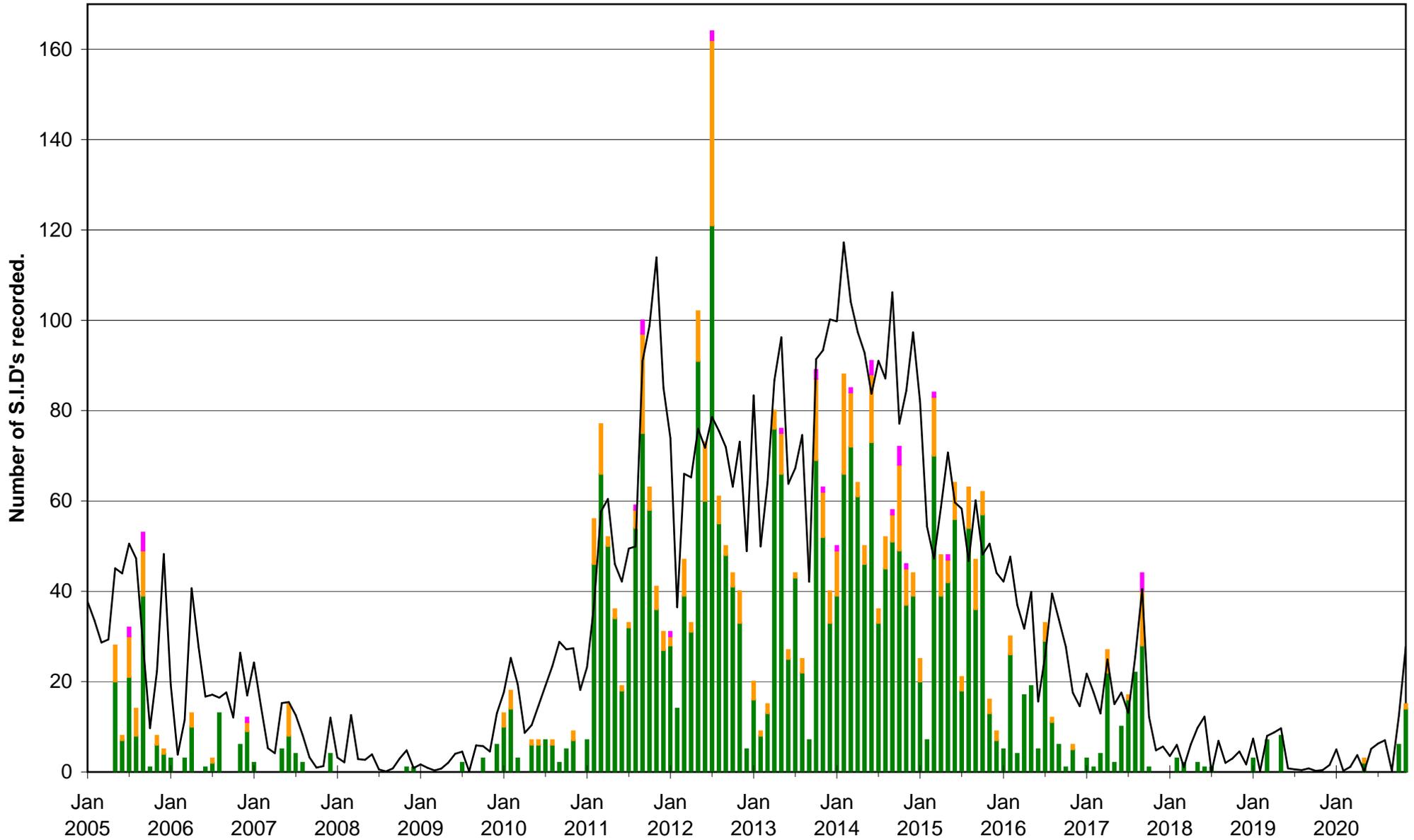
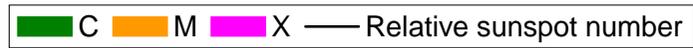


DAY	Xray class	Observers	John Cook (23.4kHz/22.1kHz)	Roberto Battaola 21.75kHz	Paul Hyde (22.1kHz/24kHz)	Mark Edwards (24.0/23.4/37.5kHz)	Colin Clements (23.4kHz/18.3kHz)					
			Tuned radio frequency receiver, 0.58m frame aerial.	Modified AAVSO receiver.	Spectrum Lab / PC 1.5m frame aerial.	Spectrum Lab / PC 2m loop aerial.	Tuned Radio Frequency receivers, 0.76m screened loop aerial.					
			START PEAK END (UT)	START PEAK END (UT)	START PEAK END (UT)	START PEAK END (UT)	START PEAK END (UT)					
1	B7.1	1										
1	B9.7	1				15:49 15:53 15:58	1-					
4	B8.1	1				11:45 11:46 11:55	1-					
5	C2.3	5			09:53 09:55 10:02	09:52 09:55 10:03						
5	B8.9	1				10:17 10:18 10:30	1-					
5	?	3			12:20 12:23 ?	12:22 12:23 12:26	1-					
5	C1.4	5			12:27 12:30 12:48	12:28 12:31 12:42	1-					
5	C1.7	4			13:26 13:30 13:38	13:25 13:29 13:37	1-					
5	C1.2	3			14:06 14:08 14:13	14:08 14:09 14:11	1-					
5	C1.0	2				14:23 14:25 14:32	1-					
6	C1.3	5			10:34 10:36 10:46	10:34 10:36 10:45	1-					
6	B9.2	1										
6	C1.8	4			15:20 15:22 15:29	15:22 15:22 15:26	1-					
7	B5.6	2				12:10 12:12 12:18	1-					
10	C1.3	1										
11	C2.6	1										
22	C1.3	1		09:22 09:29 09:36	1-							
22	C3.3	1										
26	C3.8	7	12:50 12:55 13:05	1-	12:44 12:53 13:15	1+	12:49 12:55 13:22	2	12:46 12:56 13:14	1+		
28	C2.9	4	13:32 13:36 ?	-			13:33 13:38 13:45	1-	13:34 13:36 13:48	1-		
29	C1.6	1					11:31 11:38 11:43	1-				
29	M4.4	11	12:40 13:08 13:35	2+	12:36 12:57 13:07	1+			12:42 13:08 13:44	2+	12:36 13:12 14:34	3

DAY	Xray class	Observers	Steve Parkinson (Various)	Andrew Thomas (19.6kHz)	Phil Rourke (23.4kHz)	John Wardle	Christopher Bailey 23.4kHz/45.9kHz					
			Tuned radio frequency receiver, frame aeriels.	Tuned radio frequency receiver, 0.6m frame aerial.	Tuned radio frequency receiver, 0.6m frame aerial.	SpectrumLab/Starbase, Active mini-whip aerial.	Spectrum Lab.					
			START PEAK END (UT)	START PEAK END (UT)	START PEAK END (UT)	START PEAK END (UT)	START PEAK END (UT)					
1	B7.1											
1	B9.7											
4	B8.1											
5	C2.3		09:53 09:54 09:56	1-		09:50 09:55 10:00						
5	B8.9											
5	?											
5	C1.4		12:28 12:30 12:35	1-		12:18 12:28 12:49	1+					
5	C1.7		13:25 13:28 13:42	1-								
5	C1.2											
5	C1.0											
6	C1.3		10:33 10:36 10:45	1-		10:33 10:39 10:53	1					
6	B9.2					11:52 12:00 12:11	1					
6	C1.8					15:20 15:27 15:34	1-					
7	B5.6					12:09 12:14 12:20	1-					
10	C1.3					19:44 19:57 20:11	1+					
11	C2.6					18:58 19:05 19:20	1					
22	C1.3											
22	C3.3					17:33 17:38 17:47	1-					
26	C3.8					12:51 12:58 13:09	1-					
28	C2.9					13:30 13:36 13:58	1+					
29	C1.6											
29	M4.4		12:42 13:09 14:00	2+	12:50 13:10 13:35	2	12:47 13:09 ?	-	12:43 13:10 13:50	2+	12:38 13:10 14:08	3

DAY	Xray class	Observers	Colin Briden (37.5kHz)	Andrew Lutley (23.4kHz)	Peter Meadows (23.4kHz)	John Elliott (18.3kHz)	Mark Prescott (20.9kHz)	
			Spectrum Lab / PC, 1.2m frame aerial.	Tuned radio frequency receiver, 0.6m frame aerial.	Tuned radio frequency receiver, 0.6m frame aerial.	Tuned radio frequency receiver, 0.5m frame aerial.	Raspberry Pi + sound card, 1m frame aerial.	
			START PEAK END (UT)	START PEAK END (UT)	START PEAK END (UT)	START PEAK END (UT)	START PEAK END (UT)	
1	B7.1		12:18 12:23 12:37	1				
1	B9.7							
4	B8.1							
5	C2.3		09:53 09:55 10:18	1				
5	B8.9							
5	?		12:21 12:23 12:27	1-				
5	C1.4		12:28 12:31 12:39	1-				
5	C1.7		13:25 13:30 13:43	1-				
5	C1.2		14:06 14:08 14:14	1-				
5	C1.0		14:21 14:25 14:33	1-				
6	C1.3		10:33 10:36 10:45	1-				
6	B9.2							
6	C1.8		15:20 15:22 ?	-				
7	B5.6							
10	C1.3							
11	C2.6							
22	C1.3							
22	C3.3							
26	C3.8		12:46 12:57 13:15	1+				
28	C2.9							
29	C1.6							
29	M4.4		? 13:10 13:38				12:48 13:11 13:46	2+

### VLF flare activity 2005/20



**BARTELS DIAGRAM**

ROTATION	KEY:	DISTURBED.	ACTIVE	SFE	B, C, M, X = FLARE MAGNITUDE.	Synodic rotation start (carrington's).
2516	F	9 10 11 12 13 14 15 16 17 18	19 20 21 22 23 24 25 26	27 28 29 30 31	2200	2018 February 1 2 3 4
2517	F	5 6 7 8 9 10 11 12 13 14	15 16 17 18 19 20 21 22 23 24 25 26 27 28	29 30 31	2201	2018 March 1 2 3
2518	F	4 5 6 7 8 9 10 11 12 13	14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30	31	2202	2018 April 1 2 3 4
2519	F	31 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18	19 20 21 22 23 24 25 26	27 28 29 30 31	2203	2018 May 1 2 3 4
2520	F	27 28 29 30 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23	24 25 26 27 28 29 30 31	2204	2018 June 1 2 3 4	
2521	F	24 25 26 27 28 29 30 31 1 2 3 4 5 6 7 8 9 10 11 12	13 14 15 16 17 18 19	2205	2018 July 1 2 3 4	
2522	F	20 21 22 23 24 25 26 27 28 29 30 1 2 3 4 5 6 7 8 9	10 11 12 13 14 15 16	2206	2018 August 1 2 3 4	
2523	F	17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 1 2 3 4 5	6 7 8 9 10 11 12	2207	2018 September 1 2 3 4 5	
2524	F	13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31	1 2 3 4 5 6 7 8	2208	2018 October 1 2 3 4 5	
2525	F	9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31	1 2 3 4 5	2209	2018 November 1 2 3 4 5	
2526	F	6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26	27 28 29 30 31	2210	2018 December 1 2 3 4 5	
2527	F	2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22	23 24 25 26 27 28	2211	2019 January 1 2 3 4 5	
2528	F	29 30 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25	26 27 28 29 30 31	2212	2019 February 1 2 3 4 5	
2529	F	26 27 28 29 30 31 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21	22 23 24 25 26 27 28 29 30 31	2213	2019 March 1 2 3 4 5	
2530	F	22 23 24 25 26 27 28 29 30 31 1 2 3 4 5 6 7 8 9 10 11 12	13 14 15 16 17	2214	2019 April 1 2 3 4 5	
2531	F	18 19 20 21 22 23 24 25 26 27 28 29 30 31 1 2 3 4 5 6 7 8 9 10 11 12	13 14 15 16	2215	2019 May 1 2 3 4 5	
2532	F	17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 1 2 3 4 5 6 7 8 9 10 11 12	13 14 15 16 17	2216	2019 June 1 2 3 4 5	
2533	F	13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 1 2 3 4 5 6 7 8 9	10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31	2217	2019 July 1 2 3 4 5	
2534	F	10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31	1 2 3 4 5	2218	2019 August 1 2 3 4 5	
2535	F	6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29	30 31	2219	2019 September 1 2 3 4 5	
2536	F	3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26	27 28 29	2220	2019 October 1 2 3 4 5	
2537	F	30 31 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22	23 24 25	2221	2019 November 1 2 3 4 5	
2538	F	26 27 28 29 30 31 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18	19 20 21	2222	2019 December 1 2 3 4 5	
2539	F	22 23 24 25 26 27 28 29 30 31 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16	17 18	2223	2020 January 1 2 3 4 5	
2540	F	19 20 21 22 23 24 25 26 27 28 29 30 31 1 2 3 4 5 6 7 8 9 10 11 12	13 14	2224	2020 February 1 2 3 4 5	
2541	F	15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 1 2 3 4 5 6 7 8 9 10 11	12	2225	2020 March 1 2 3 4 5	
2542	F	12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31	1 2 3 4 5 6 7	2226	2020 April 1 2 3 4 5	
2543	F	8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31	1 2 3	2227	2020 May 1 2 3 4 5	
2544	F	4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30	31	2228	2020 June 1 2 3 4 5	
2545	F	2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28	29	2229	2020 July 1 2 3 4 5	
2546	F	29 30 31 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24	25 26 27 28 29 30 31	2230	2020 August 1 2 3 4 5	
2547	F	25 26 27 28 29 30 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21	22 23 24 25 26 27 28 29 30 31	2231	2020 September 1 2 3 4 5	
2548	F	22 23 24 25 26 27 28 29 30 31 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17	18 19 20 21 22 23 24 25 26 27 28 29 30 31	2232	2020 October 1 2 3 4 5	
2549	F	18 19 20 21 22 23 24 25 26 27 28 29 30 1 2 3 4 5 6 7 8 9 10 11 12 13 14	15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31	2233	2020 November 1 2 3 4 5	
2550	F	15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 1 2 3 4 5 6 7 8 9 10	11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31	2234	2020 December 1 2 3 4 5	
2551	F	11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31	1 2 3 4 5 6	2235	2021 January 1 2 3 4 5	
2552	F	7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30	31	2236	2021 February 1 2 3 4 5	
2553	F	4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30	31	2237	2021 March 1 2 3 4 5	
2554	F	31 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26	27 28 29 30 31	2238	2021 April 1 2 3 4 5	
2555	F	27 28 29 30 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23	24 25 26 27 28 29 30 31	2239	2021 May 1 2 3 4 5	