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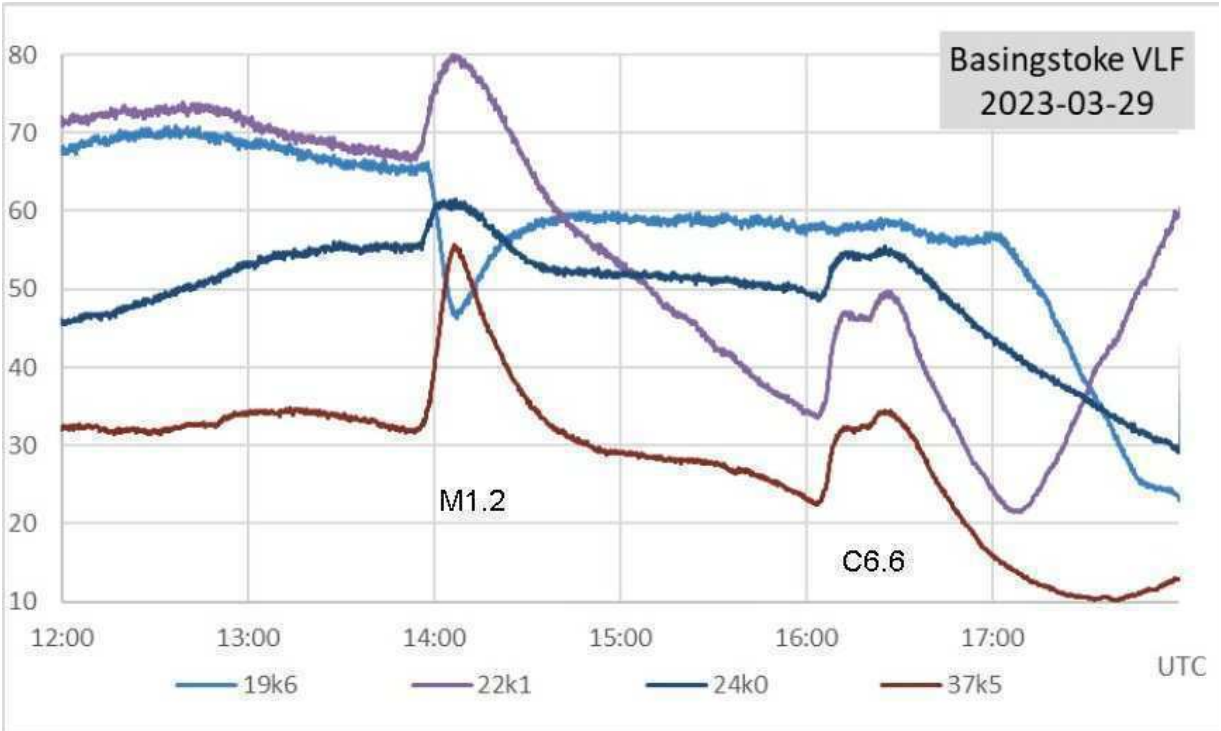
BAA Radio Astronomy Section. Director Paul Hearn.

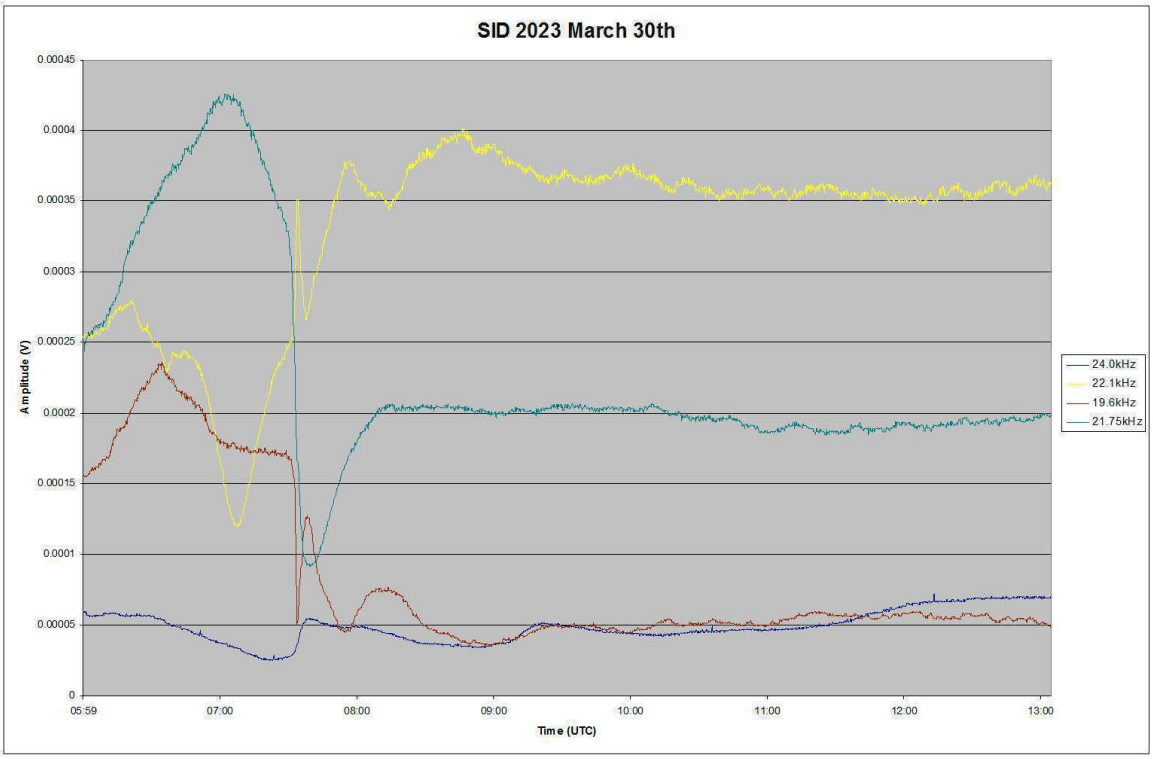
RADIO SKY NEWS 2023 MARCH.

VLF SID OBSERVATIONS.

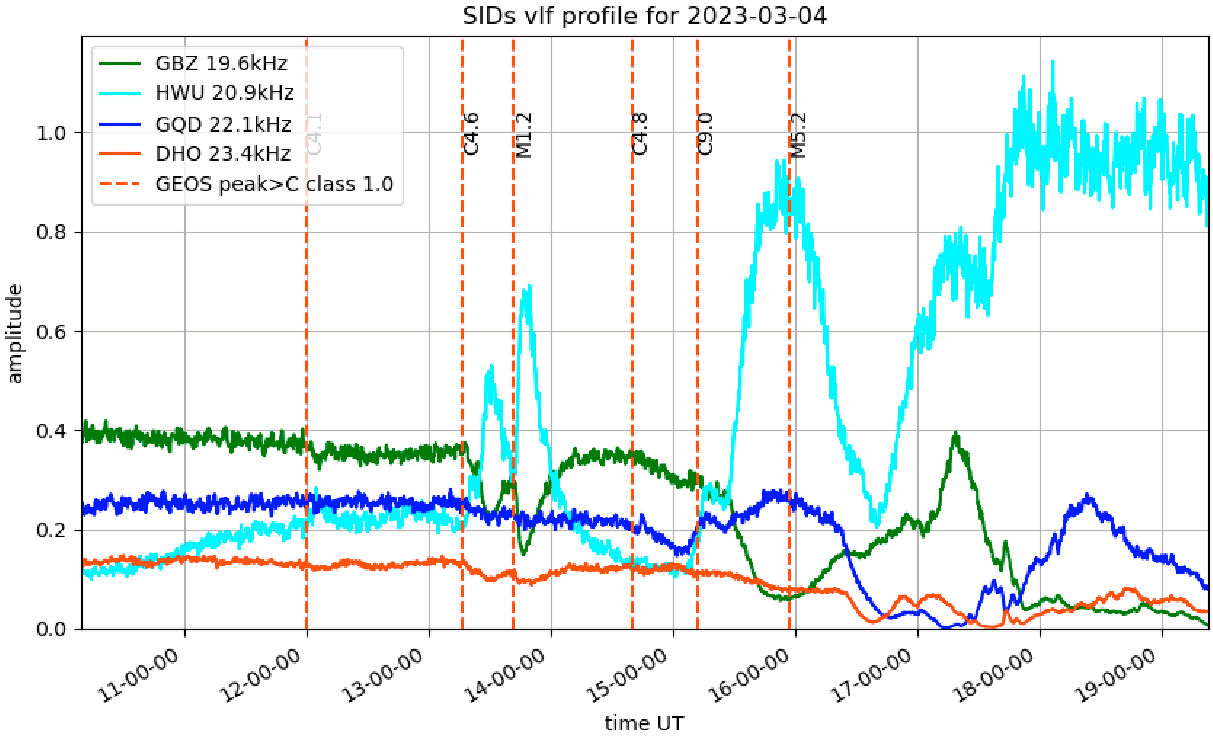
The sun has been a little less active in March, with fewer strong flares. There were 9 of M-class compared with 28 in February, and just a single X-class compared with two in February. The SIDs have however remained quite complex with multiple peaks making them tricky to analyse. The 23.4kHz has also been very unreliable, off-air from the 16th with just a short active period over night on the 29th - 30th. The X2.1 flare was rather late in the afternoon, peaking at 17:54UT, on the 3rd, and so lost in the sunset for most signals.



Paul Hyde recorded the very clean M1.2 flare on the 29th, followed by the twin-peaked C6.6 flare just before the sunset started. 19.6 kHz shows an inverted SID for the M1.2 flare compared to the other signals, but a very small response to the C6.6 flare in the same direction as the other signals. The difference in path length at 19.6 and 22.1kHz is very small, and both in the same direction, and so the difference in response is quite surprising.



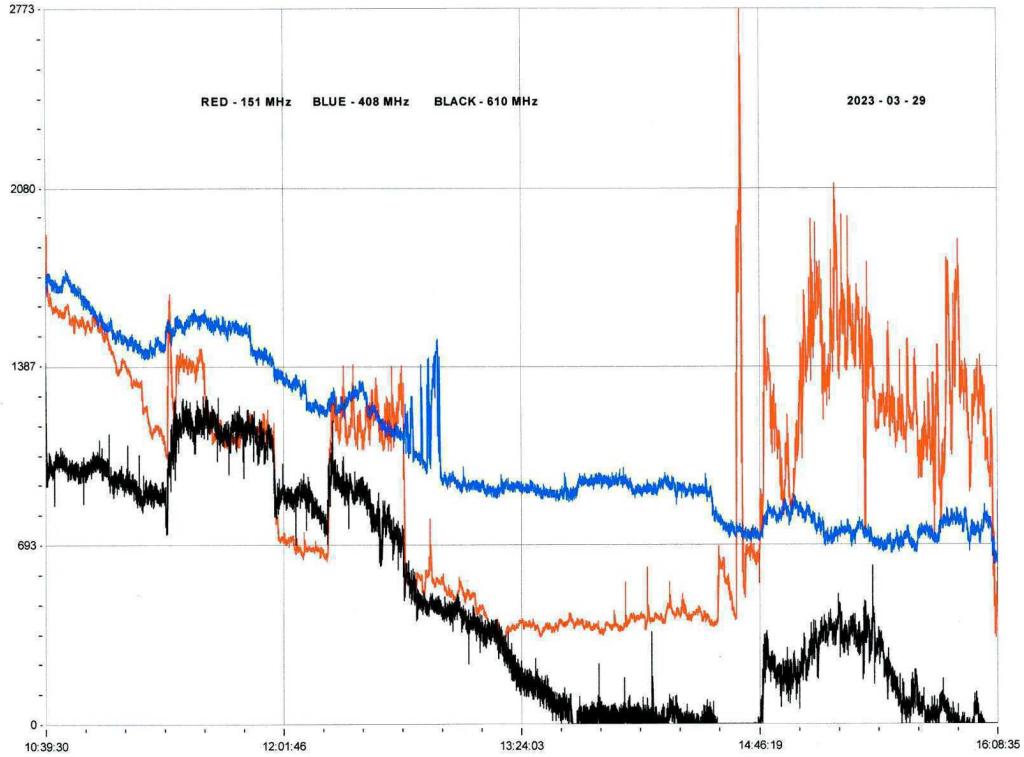
The strong M5.4 flare peaking at 07:40UT on the 30th was more widely recorded, shown here by Mark Edwards. The 22.1 and 19.6kHz signals again show SIDs in opposing directions, both spike-and-wave in this case. 24kHz also shows a small SID, despite the relatively early timing.

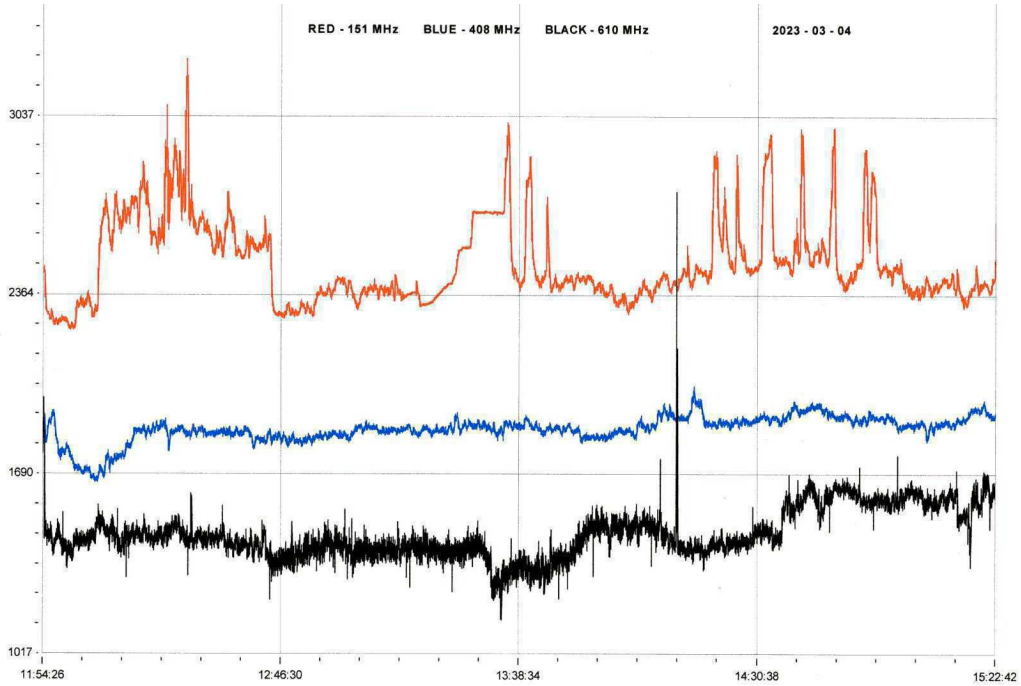


This recording by Mark Prescott shows activity on the 4th, showing a very complex series of SIDs. 20.1 and 19.6kHz also show opposing responses, 19.6kHz being the more responsive to the flares. The M5.2 flare was very slow, and has produced a strong SID on the southerly path at 20.9kHz shortly before the local sunset.

SOLAR EMISSIONS.

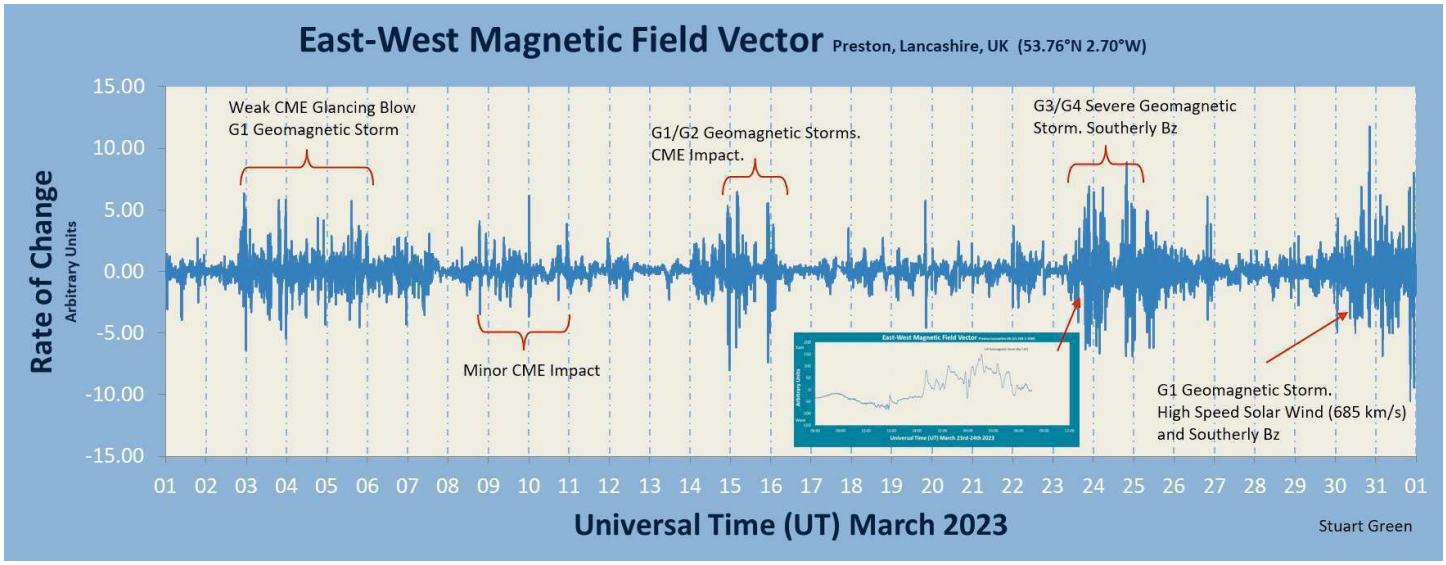
The sun is now within sight of Colin Clements' VHF and UHF aerials, with some strong activity recorded. The M1.2 flare on the 29th produced a strong emission at 151MHz (red), with a much smaller signal at 610MHz (black). 408MHz (blue) has not been affected:



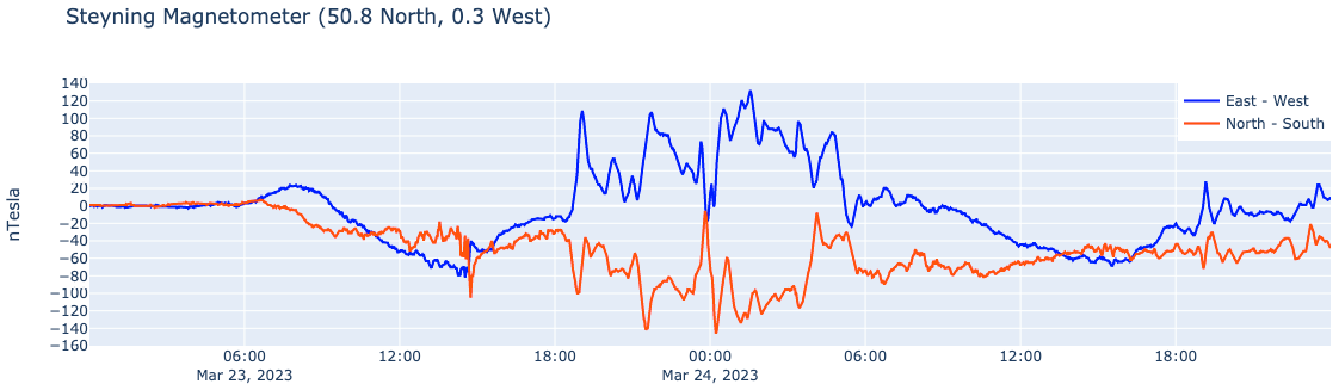


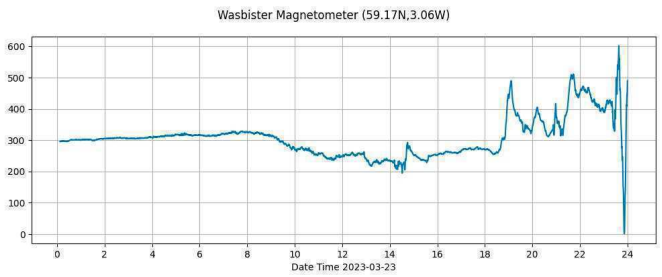
Colins's recording from the 4th again shows 408MHz and 610MHz quiet, but with strong emissions at 151MHz matching the C4.1, M1.2 and C4.8 flares. A strong 151MHz emission was also recorded all day on the 22nd. The SWPC bulletin lists only minor C-flares on the 22nd, none recorded as SIDs.

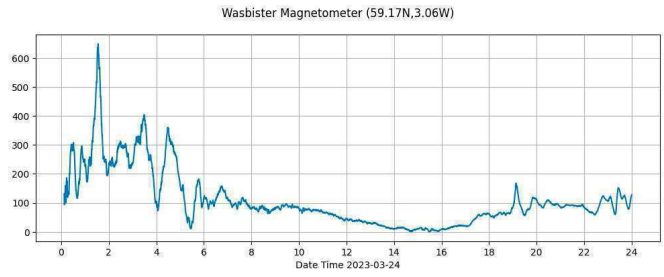
MAGNETIC OBSERVATIONS.



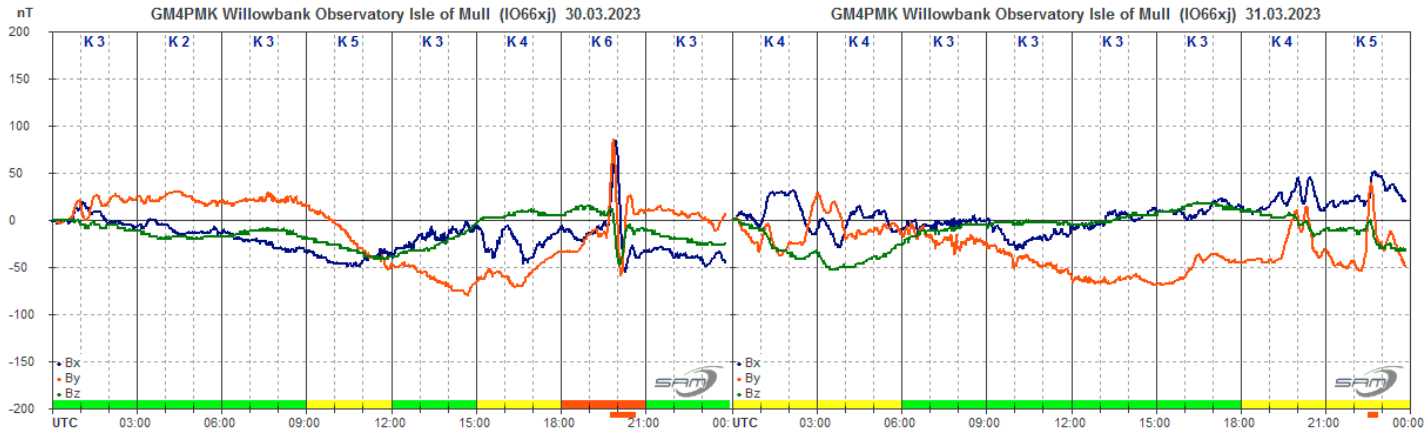
Stuart Green's summary of magnetic activity in March shows a few minor CME impacts. Most of the stronger flares were produced near the Sun's limb, and so produced only glancing blows. The most active period was overnight on the 23rd/24th, shown here by Nick Quinn and Callum Potter:





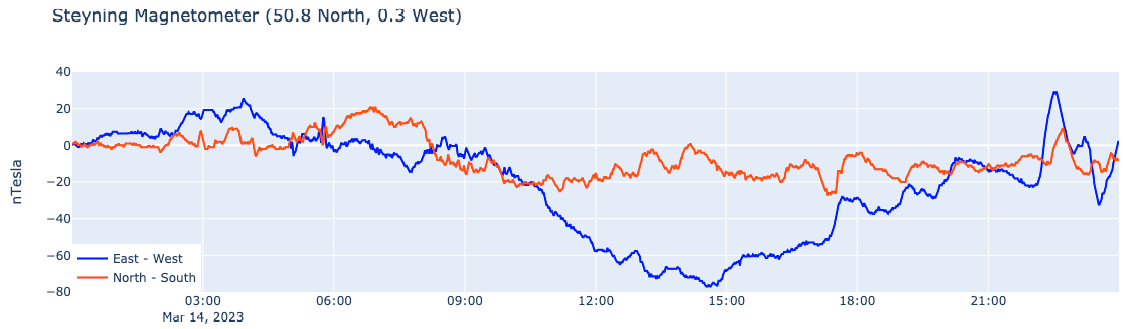


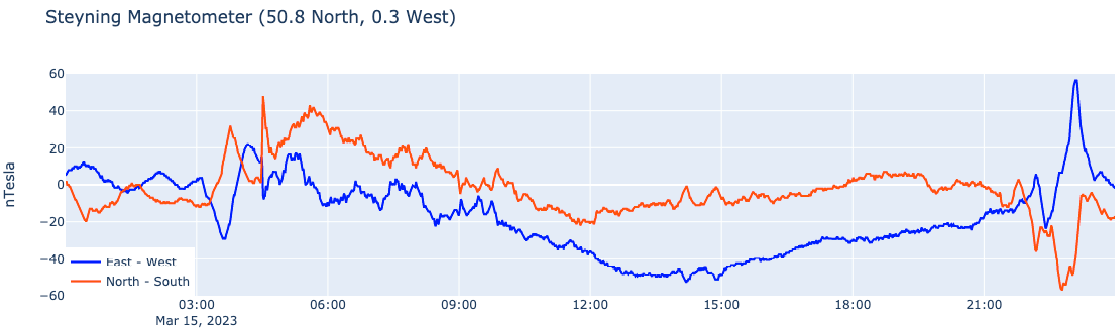
Nick Quinn (top panel) is near the south coast of England, location shown on the chart. Callum Potter is now our most northerly magnetic observer, having moved to the Orkney island of Rousay, location again shown on the chart (lower panel). The STCE bulletin lists solar flares on the 20th as the source of the disturbance, combining to produce a magnetic storm. Both recordings show an initial pulse at 14:30UT, which may be from the initial impact. Roger Blackwell's Mull magnetometer shows this pulse to be about 100nT, with +/-250nT recorded overnight. For those lucky enough to have clear skies, there was a widespread Aurora seen overnight. Mark Edwards also recorded effects at 37.5kHz related to this storm.



There was also a fairly strong disturbance on the evening of the 30th, shown in Roger Blackwell's recording. This is listed as due to the high speed wind from an equatorial coronal hole. The strong pulse at 20:00UT looks like a sudden impulse, and also shows in the recordings from Nick and Callum.

The 14th and 15th were also fairly active with disturbance from a filament eruption on the 12th. Nick Quinn's recordings show the activity:

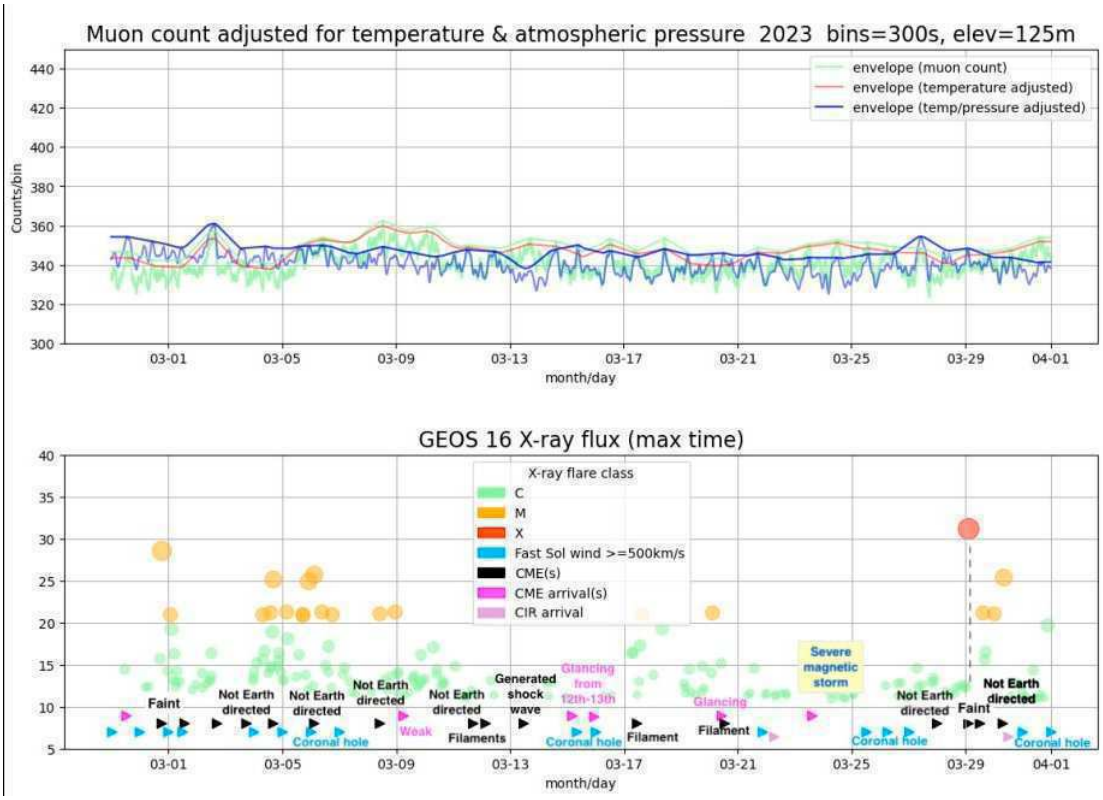


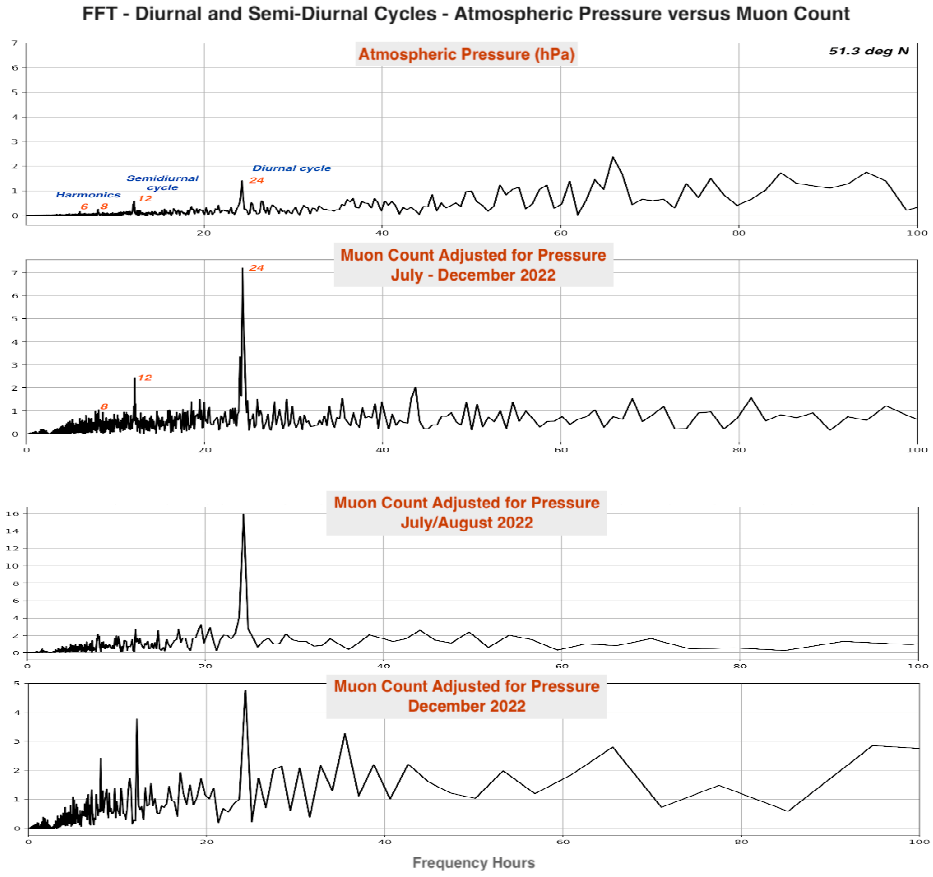


This activity faded out in the morning of the 16th, followed by very quiet conditions. There were periods of mild activity from the 2nd to 12th, mainly from coronal hole winds, with minor CME effects on the 9th. The coronal hole is the same one that produced the stronger disturbance on the 30th and 31st on its next appearance.

Magnetic observations received from Roger Blackwell, Colin Clements, Stuart Green, Callum Potter, Nick Quinn and John Cook.

MUONS.

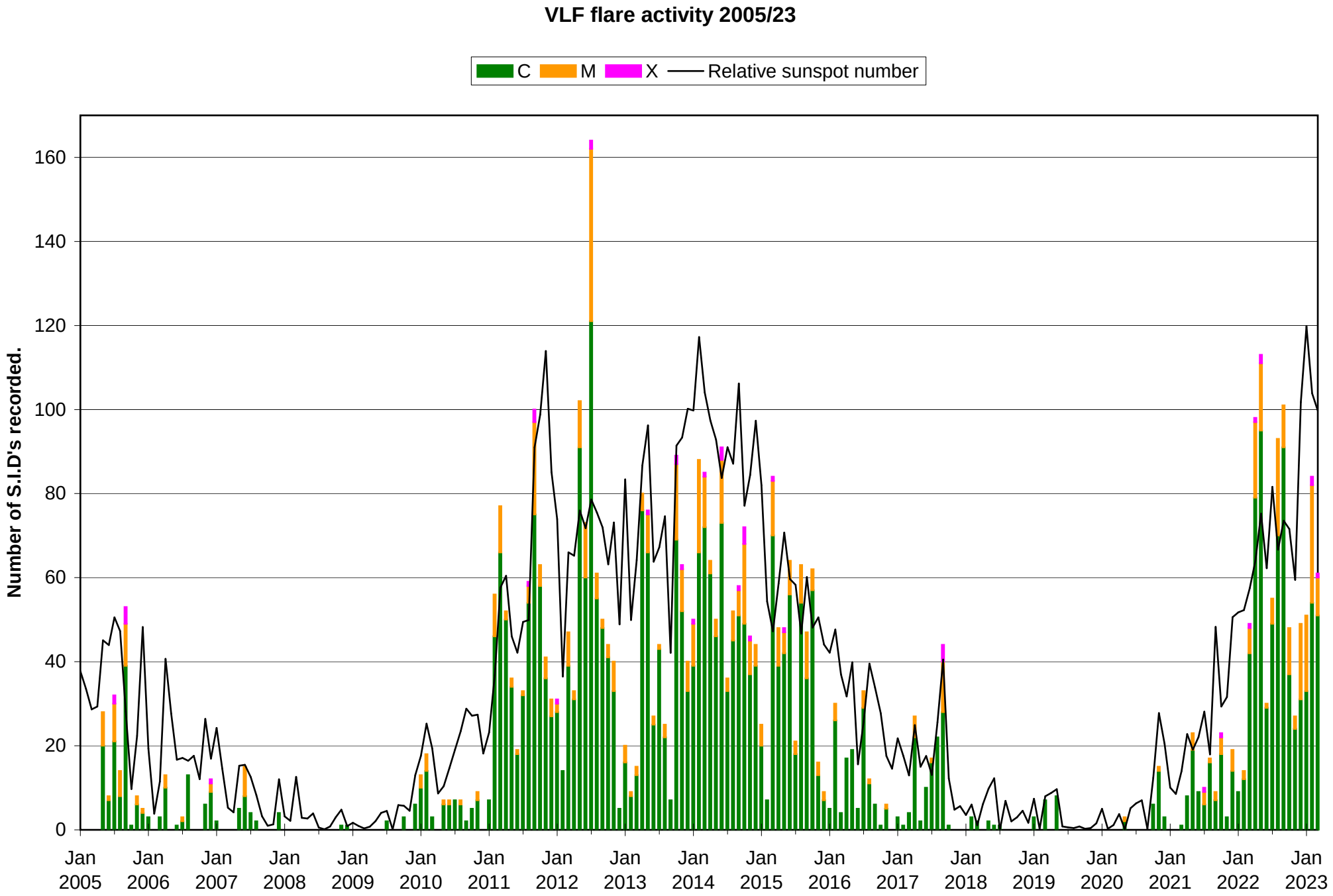

Muon count adjusted for temperature & atmospheric pressure 2023 bins=300s, elev=125m
envelope (muon count)
envelope (temperature adjusted)
envelope (temp/pressure adjusted)
Counts/bin
month/day
GEOS 16 X-ray flux (max time)
X-ray flare class
C
M
X
Fast Sol wind >=500km/s
CME(s)
CME arrival(s)
CIR arrival
Faint
Not Earth directed
Coronal hole
Weak
Filaments
Generated shock wave
Glancing from 12th-13th
Filament
Glancing
Severe magnetic storm
month/day


FFT - Diurnal and Semi-Diurnal Cycles - Atmospheric Pressure versus Muon Count
Atmospheric Pressure (hPa)
51.3 deg N
Harmonics
Semidiurnal cycle
Diurnal cycle
Muon Count Adjusted for Pressure
July - December 2022
Muon Count Adjusted for Pressure
July/August 2022
Muon Count Adjusted for Pressure
December 2022
Frequency Hours

The upper panel shows the muon counts for March, recorded by Mark Prescott, corrected for temperature and pressure as in previous reports. No notable events were recorded, and the counts are generally slightly lower than those recorded in February.

The lower panel shows a series of Fast Fourier Transforms (FFT) of the data. First is the atmospheric pressure recorded in 2022 July to December. The 24 hour diurnal cycle shows up, along with 12, 8 and 6 hour periods. Next is the adjusted muon counts over the same period. The diurnal period again shows up strongly, with weak harmonics. The same analysis but just for the summer months of July and August eliminates the harmonics. Repeating with December's data amplifies the harmonics relative to the 24 hour diurnal period. Tides are produced in the atmosphere as the sun warms it up and moves through the sky. This effect will be much stronger during the local summer months with the sun higher in the sky, compared with the winter. Mark's analysis of the data matches this effect very well, showing how the expanded, warmer, atmosphere generates more muons from the incoming cosmic radiation. A very interesting analysis.

I was very lucky to get a last minute place at the BAA Winchester weekend meeting over 14th–16th April. Our section director Paul Hearn gave a very good introductory talk on "An intergalactic hop through the electromagnetic spectrum" on Saturday morning. He also had a display table with Andrew Thomas showing some of the UKRAA equipment available for amateur radio astronomy. The display was very busy through the coffee break periods, with great interest being shown in the muon detection equipment. I hope to be able to include a display of our activities and observations again next year, as I have done at previous meetings. Winchester is always well attended, and a good opportunity to meet up with other members.


VLF flare activity 2005/23
C
M
X
Relative sunspot number
Number of S.I.D's recorded.
0
20
40
60
80
100
120
140
160
Jan 2005
Jan 2006
Jan 2007
Jan 2008
Jan 2009
Jan 2010
Jan 2011
Jan 2012
Jan 2013
Jan 2014
Jan 2015
Jan 2016
Jan 2017
Jan 2018
Jan 2019
Jan 2020
Jan 2021
Jan 2022
Jan 2023

BAA Radio Astronomy Section.

BARTELS DIAGRAM

ROTATION	KEY:	DISTURBED.	ACTIVE	SFE	B, C, M, X = FLARE MAGNITUDE.	Synodic rotation start (carrington's).

2552

	7	2235 8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	2020 October 1	2	3
F																											

2553

	4	2236 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
F													CC											C		BCCC	

2554

	31	2237 1	2020 November 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
F		B			B	CBCC	CBC	B			C	C											CC				C

2555

	27	28	2238 29	30	2020 December 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
F		C	CM							C	C							C									

2556

	24	25	2239 26	27	28	29	30	31	2021 January 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
F																											

2557

	20	21	22	2240 23	24	25	26	27	28	29	30	31	2021 February 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
F																											

2558

	16	17	18	2241 19	20	21	22	23	24	25	26	27	28	2021 March 1	2	3	4	5	6	7	8	9	10	11	12	13	14
F																						C					

2559

	15	16	17	2242 18	19	20	21	22	23	24	25	26	27	28	29	30	31	2021 April 1	2	3	4	5	6	7	8	9	10
F	B										B																

2560

	11	12	13	2243 14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	2021 May 1	2	3	4	5	6	7
F							B			C		CCCC															M

2561

	8	9	10	2244 11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	2021 June 1	2	3
F	CC	CC			C									C	CCMM	CCBM			CCCC		C						

2562

	4	5	6	7	2245 8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
F					CCC	CCB																C			CBC		CC

2563

2021 July	1	2	3	4	2246 5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
F			MCXM	MC					CCB							C		C									

2564

	28	29	30	31	2021 August 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
F																								CCC		C	

2565

	24	25	26	27	2248 28	29	30	31	2021 September 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
F	C			CCCC	MCCC	CC	C									CC	C										

2566

	20	21	22	23	24	2249 25	26	27	28	29	30	2021 October 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
F		C		MM			C		C		C									M							

2567

	17	18	19	20	21	2250 22	23	24	25	26	27	28	29	30	31	2021 November 1	2	3	4	5	6	7	8	9	10	11	12
F										CCCM	CCCC	CMMX	CC	CCC					CC								

2568

	13	14	15	16	17	2251 18	19	20	21	22	23	24	25	26	27	28	29	30	2021 December 1	2	3	4	5	6	7	8	9
F	C																						M				

2569

	10	11	12	13	14	2252 15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	2022 January 1	2	3	4	5
F						CCC	CC	C			CM	M	MCC		CC	CCCM											

2570

	6	7	8	9	10	11	2253 12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	1
F								C	C											C	CC		C	BCCC			C

2571

2022 February	2	3	4	5	6	7	2254 8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
F	CC		CC					C			MCCC		CCM														C

2572

2022 March	1	2	3	4	5	6	2255 7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
F	CM					C	C				CCCC	C		M	CCMC					CC		CC	CCCC	C		C	C

2573

	28	29	30	31	2022 April 1	2	3	2256 4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
F	CMC	MCCC	CCCC	CCCX	CCCC	CCMM	CC	C		C			C			CBCC			MMCC	CCCM	CCCM	MMCM	CCCC	CMCC	CC	CMC	C

2574

	24	25	26	27	28	29	30	2022 May 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
F		MCCC	CCCC	CCC	CC	MCCM	MMXM	CCCC		MCX	BMCM	CMMC	CC	CC	CCC	C	CCX	CCMM	CCCM	CCCC	CCCC	C	CMC	CCCC	CCCC	CMMM	CMM

2575

	21	22	23	24	25	26	27	2258 28	29	30	31	2022 June 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
F	CCC	CC	CC	CC	CCM	CC	CC	CC												CC	CCMC	C		C	CCCC		C

2576

	17	18	19	20	21	22	23	2259 24	25	26	27	28	29	30	2022 July 1	2	3	4	5	6	7	8	9	10	11	12	13
F	CCCC	CCC	C	CC	C	CC	CC	C	C								BC	C	CC			M	CCCC	CCCC	CM	CCCC	CCC

2577

	14	15	16	17	18	19	20	21	2260 22	23	24	25	26	27	28	29	30	31	2022 August 1	2	3	4	5	6	7	8	9
F	CMCM	CCC	MCM	CCCC		C	CCCC			CCCC	C		C	C						CC	C		CC				

2578

	10	11	12	13	14	15	16	17	2261 18	19	20	21	22	23	24	25	26	27	28	29	30	31	2022 September 1	2	3	4	5
F		C	CC	CCCC	C	CMMM	MCC	CCMM	CMMM	MCCC		C	C			CCCM	CMMM	CMMM	CCMM	CMMM	CCCM	C	CC	CCCC	CCCC	CCCC	CCMC

2579

	6	7	8	9	10	11	12	13	2262 14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	2022 October 1	2
F	CC				C	CCCC	CCCC	CCCC	MCCC		MM	M	CC	C	MCCC	M	CCCC	CCCM	CCCC		CCC	CCCC		CC	CCMM	CC	CMMC

2580

2022 October	3	4	5	6	7	8	9	10	2263 11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
F	CMMM	M	C		CM	C	CCCC	CM	MMCC	CC	C	M	C	C		C		CC		CB		CC	C	C			

2581

	30	31	2022 November 1	2	3	4	5	6	7	2264 8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
F								C	C			C	MCCM	CC	C	C	CCC	CC	CC	CCC	M			CCC			

2582

	26	27	28	29	30	2022 December 1	2	3	4	2265 5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
F				C			C	M				C				C			MMMM	CMCM	MMMC		CC	CCC	M	C	C

2583

	23	24	25	26	27	28	29	30	31	2023 January 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
F	CC	C		CCC	CM		CM	CCCM	C							CC	MCCM	MM	MCMM	MC	MCMC	MC	CCC	CM	C		MC

2584

	19	20	21	22	23	24	25	26	27	28	2267 29	30	31	2023 February 1	2	3	4	5	6	7	8	9	10	11	12	13	14
F	MMC	CC	CC	CMCM	C	CCC	MCM	CMCC		C		C	CC		C		C	C	C	CC	CM	MMMM	MCCM	MMXM	MMMM	CCCM	CCM

2585

	15	16	17	18	19	20	21	22	23	24	2268 25	26	27	28	2023 March 1	2	3	4	5	6	7	8	9	10	11	12	13
F	CCCC	C	CX	C	CC	CMCC	MCCM	CCCM	CMCC	CCM	CCMM	CC	CC		CC	CCCC	MCCX	CMMC	CCMC	MCCC	C	MC	CCC	CCCC	C		

2586

	14	15	16	17	18	19	20	21	22	23	2269 24	25	26	27	28	29	30	31	2023 April 1	2	3	4	5	6	7	8	9
F	C		C	CCCM	C	CCC	C	C			C		CC	CCC	CC	MC	M	CC									

BAA Radio Astronomy Section. **2023 MARCH.**

	Xray class	Observers	John Cook (23.4kHz/*22.1kHz*) Tuned radio frequency receiver, 0.58m frame aerial.				Roberto Battaiola 18.3kHz Modified AAVSO receiver.				Paul Hyde (22.1kHz/*24kHz*) Spectrum Lab / PC 1.5m frame aerial.				Mark Edwards (24.0/*18.3*/**37.5kHz**) Spectrum Lab / PC 2m loop aerial.				Colin Clements (21.75/*37.5kHz*) Tuned Radio Frequency receivers, 0.76m screened loop aerial.			
DAY			START	PEAK	END (UT)		START	PEAK	END (UT)		START	PEAK	END (UT)		START	PEAK	END (UT)		START	PEAK	END (UT)	
1	C3.0	1													09:06	09:13	09:17	1-				
1	C4.2	1	*13:36*	*13:56*	*14:25*	*2+*																
2	C3.1	5	10:29	10:31	?	-	10:27	10:32	10:34	1-	10:26	10:34	?	-	*10:30*	*10:30*	*10:39*	*1-*				
2	C3.2	5	10:39	10:42	10:54	1-	10:39	10:41	10:48	1-	10:38	10:42	10:52	1-	***10:40***	***10:42***	***10:47***	***1-***				
2	C3.7	6	11:43	11:47	12:01	1-	11:38	11:48	12:01	1	11:40	11:48	12:03	1	11:41	11:48	11:52	1-				
2	C6.5	8	12:06	12:11	12:35	1+	12:06	12:12	12:24	1-	12:06	12:12	12:30	1	12:08	12:12	12:29	1	12:09	12:14	12:35	1+
2	?	1													*12:47*	*12:52*	*12:58*	*1-*				
3	**M3.3**	10	10:11	10:35	11:50	3	10:10	10:20	10:42	1+	10:10	10:34	11:29	2+	09:53	10:34	11:28	3	10:13	10:36	12:00	3
3	?	2													*11:58*	*12:04*	*12:15*	*1-*				
3	C3.9	5					14:29	14:32	14:35	1-	14:27	14:33	14:42	1-	14:30	14:32	14:40	1-				
3	C9.1	10	14:54	15:01	?	-	14:54	15:04	15:38	2	14:53	15:05	15:44	2+	14:54	15:04	15:33	2	14:55	15:06	15:36	2
3	**X2.1**	2									17:44	17:53	18:50	2+	17:45	17:54	18:34	2+				
4	C6.7	5	08:20	08:22	08:36	1-					08:12	08:26	08:38	1+	*08:09*	*08:24*	*08:41*	*1+*	08:13	08:38	09:48	3
4	C4.1	3	11:59	12:01	12:08	1-									*12:00*	*12:03*	*12:15*	*1-*				
4	?	3									13:13	13:16	?	-	13:15	13:18	?	-				
4	?	7					13:15	13:27	13:35	1	13:20	13:25	?	-	13:21	13:27	?	-	13:24	13:29	13:40	1-
4	**M1.2**	9	13:14	13:38	14:09	2+	13:38	13:43	14:03	1	13:37	13:41	14:07	1+	13:38	13:42	14:09	1+	13:40	13:46	14:28	2+
4	C4.8	6	14:40	14:41	14:46	1-					14:37	14:39	14:49	1-	14:39	14:42	14:58	1	*14:16*	*14:37*	*15:17*	*2+*
4	?	5									14:58	15:12	?	-	15:04	15:15	?	-	15:05	15:15	15:24	1
4	**M5.2**	10	15:22	15:50	16:39	2+	15:14	15:55	16:06	2+	15:24	15:54	17:30	3+	15:21	15:49	17:00	3	15:24	15:50	16:29	2+
4	?	3									17:36	17:39	17:53	1-	17:15	17:18	17:23	1-				
4	?	1													18:45	18:47	18:52	1-				
4	C4.8	1													19:53	19:57	20:05	1-				
5	C3.6	6	11:29	11:32	11:42	1-	11:25	11:35	11:39	1-	11:26	11:34	11:56	1+	11:30	11:34	11:47	1-				
5	?	4	13:03	13:07	13:15	1-					13:00	13:10	13:22	1	13:02	13:06	13:15	1-				
5	?	2									13:27	13:40	?	-	13:29	13:39	?	-				
5	C6.2	9	13:28	13:42	14:22	2+	13:28	13:35	14:03	2	13:53	13:56	14:30	2	13:49	13:54	14:20	1+	13:26	13:52	14:35	2+
5	**M1.0**	4	16:36	16:42	16:56	1					16:40	16:45	16:59	1	16:36	16:43	16:55	1				
5	C3.8	1													19:28	19:32	19:35	1-				
6	**M1.3**	11	09:05	09:14	09:58	2+	08:59	09:10	09:49	2+	09:02	09:16	09:50	2+	09:03	09:12	09:44	2	09:10	09:17	09:38	1+
6	?	3									10:26	10:33	10:40	1-	*10:28*	*10:33*	*10:46*	*1-*				
6	C5.0	9	12:14	12:18	12:36	1	12:02	12:19	12:35	2	12:04	12:20	?	-	*12:06*	*12:19*	*12:41*	*2*	12:08	12:21	12:42	2
6	?	2									12:43	12:47	12:54	1-								
6	C4.2	8	14:21	14:25	14:31	1-	14:20	14:24	14:30	1-	14:20	14:27	?	-	*14:22*	*14:26*	*?*	-	14:25	14:30	14:36	1-
6	C7.2	9	14:33	14:43	14:51	1-	14:34	14:42	14:57	1	14:32	14:43	?	-	*14:33*	*14:42*	*14:59*	*1+*	14:36	14:45	14:58	1
6	?	3									14:58	15:01	?	-	*15:00*	*15:01*	*15:05*	*1-*				
6	?	3									15:13	15:21	15:35	1	***15:18***	***15:20***	***15:25***	***1-***				
7	C1.6	1													**12:49**	**12:53**	**12:57**	**1-**				
8	**M1.1**	9	09:59	10:11	11:34	3	09:57	10:19	10:52	2+	09:58	10:15	11:09	2+	09:49	10:11	11:04	2+	*10:01*	*10:17*	*11:07*	*2+*
8	?	1													***12:24***	***12:28***	***12:32***	***1-***				
8	C3.3	9	13:40	13:44	13:56	1-	13:37	13:45	13:55	1-	13:38	13:46	14:03	1	13:38	13:46	14:05	1+	*13:40*	*13:47*	*14:00*	*1*
9	C3.0	4	13:45	13:49	13:58	1-					13:44	13:53	14:04	1	13:46	13:54	?	-				
9	C3.5	1													14:07	14:14	14:29	1				
9	C3.7	2									14:53	14:58	15:10	1-	14:57	15:00	15:10	1-				
10	C4.5	6	10:00	10:05	10:17	1-	10:02	10:11	10:16	1-					10:04	10:09	10:17	1-				
10	C3.9	3									10:00	10:08	10:17	1-	10:19	10:23	10:33	1-				
10	?	1													*11:49*	*11:52*	*11:59*	*1-*				
10	C2.5	1													*13:18*	*13:28*	*13:37*	*1*				
10	C3.2	1													14:44	14:53	15:07	1				
11	C1.6	1													14:34	14:43	14:55	1				
14	C2.9	2													**11:11**	**11:21**	**11:30**	**1**				
16	C1.4	4					12:52	12:56	13:05	1-	12:46	12:54	13:08	1	12:52	12:56	13:11	1				
17	C6.4	1									06:41	06:49	06:58	1-								
17	C1.4	1													**10:34**	**10:40**	**10:44**	**1-**				
17	C3.0	2					12:20	12:38	12:49	1+					12:26	12:36	12:57	1+				
17	C7.3	5					13:01	13:17	14:06	2+	13:01	13:18	14:57	3	13:04	13:16	?	-				
17	?	1													13:23	13:33	?	-				
17	?	1													14:02	14:04	14:49	2+				
17	?	1													14:59	15:01	?	-				
17	**M1.0**	8	*15:06*	*15:08*	*15:40*	*2*	15:06	15:08	15:22	1-	15:04	15:08	15:35	1+	15:06	15:09	15:26	1	15:09	15:11	15:23	1-
18	C9.4	5	*07:13*	*07:17*	*07:25*	*1-*	07:15	07:17	07:23	1-					*07:14*	*07:17*	*07:25*	*1-*				
19	C1.5	1													**11:50**	**11:53**	**12:00**	**1-**				
19	C1.8	1													17:07	17:10	17:13	1-				
19	C4.9	1													18:07	18:10	18:24	1-				
20	C5.2	5					09:26	09:39	09:56	1+	09:27	09:41	10:06	2	*09:33*	*09:39*	*09:58*	*1*				
20	?	1													*12:21*	*12:30*	*12:46*	*1*				
21	C4.6	8									13:50	13:55	14:17	1+	13:52	13:55	14:17	1	13:56	13:59	14:33	2
24	C2.2	4													13:34	13:41	13:56	1	13:22	13:45	15:16	3
26	C1.3	1													***14:54***	***15:02***	***15:24***	***1+***				
26	C2.9	1													17:04	17:08	17:19	1-				
27	C2.5	1													***07:33***	***07:38***	***07:44***	***1-***				
27	C2.7	1													**10:52**	**10:57**	**?**	**-**				
27	?	1													**11:05**	**11:08**	**11:31**	**1+**				
27	C2.9	1													**18:57**	**19:04**	**19:09**	**1-**				
28	C1.7	1													***10:39***	***10:45***	***11:02***	***1***				
28	C1.6	1													15:10	15:11	15:17	1-				
29	**M1.2**	9	*14:03*	*14:06*	*14:25*	*1*					13:54	14:08	14:49	2+	13:58	14:06	14:48	2+	13:57	14:12	15:27	3
29	C6.6	4									16:03	16:15	?	-	16:08	16:16	?	-				
29	?	4									16:20	16:26	?	-	16:22	16:25	16:55	2				
30	**M5.4**	6	*07:32*	*07:38*	*07:54*	*1*					07:32	07:39	08:14	2	07:31	07:40	07:50	1				
31	C4.4	5	*09:08*	*09:10*	*09:19*	*1-*					09:06	09:12	09:22	1-	**09:07**	**09:10**	**09:20**	**1-**				
31	C1.6	1																	14:51	14:52	15:39	2+

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	Xray class		Steve Parkinson (Various) Tuned radio frequency receiver, frame aerials.				Andrew Thomas (20.9/*22.1*/**19.6kHz**) Tuned radio frequency receiver, 0.6m frame aerial.				Phil Rourke (23.4kHz) Spectrum Lab, 0.6m frame aerial.				Mark Prescott (20.9/*19.6*/**22.1kHz**) SpetrumLab/Starbase, Active mini-whip aerial.				John Elliott (18.3kHz) Tuned radio frequency receiver, 0.5m frame aerial.			
DAY			START	PEAK	END (UT)		START	PEAK	END (UT)		START	PEAK	END (UT)		START	PEAK	END (UT)		START	PEAK	END (UT)	
1	C3.0																					
1	C4.2																					
2	C3.1		10:28	10:30	10:37	1-																
2	C3.2		10:39	10:41	10:50	1-																
2	C3.7		11:41	11:48	12:01	1									11:45	11:50	?	-				
2	C6.5		12:07	12:11	12:33	1+	12:07	12:12	12:37	1+					12:11	12:15	12:37	1+				
2	?																					
3	**M3.3**		10:10	10:34	12:00	3	10:11	10:38	11:58	3	10:10	10:19	10:35	1	10:15	10:41	11:58	3				
3	?										?	11:09	11:59	-								
3	C3.9		14:29	14:32	14:41	1-					14:27	14:33	14:43	1-								
3	C9.1		14:53	15:04	15:30	2	**14:53**	**15:03**	**15:28**	**2**	14:53	15:04	16:00	2+	14:57	15:05	15:52	2+	14:50	15:00	15:30	2
3	**X2.1**																					
4	C6.7						*08:14*	*08:25*	*08:38*	*1*												
4	C4.1		11:59	12:01	12:08	1-																
4	?										12:45	13:18	?	-								
4	?		13:15	13:27	?	-					?	13:26	?	-	13:17	13:31	13:41	1				
4	**M1.2**		13:39	13:44	14:05	1+	13:14	13:44	14:09	2+	?	13:43	14:16	-	13:43	13:49	14:12					
4	C4.8		14:40	14:41	14:45	1-					14:38	14:41	14:50	1-								
4	?		15:05	15:13	?	-					15:00	15:13	?	-								
4	**M5.2**		15:23	15:32	?	-	15:06	15:47	16:25	2+	?	15:35	?	-	15:25	15:54	16:39	2+				
4	?										?	16:09	16:36	-								
4	?																					
4	C4.8																					
5	C3.6		11:27	11:34	11:45	1-					11:27	11:34	11:50	1								
5	?										12:59	13:07	13:20	1								
5	?																					
5	C6.2		13:29	13:40	14:15	2+	13:28	13:45	14:21	2+	13:28	13:38	14:22	2+	13:32	14:01	14:45	2+				
5	**M1.0**						16:37	16:41	16:54	1-												
5	C3.8																					
6	**M1.3**		09:04	09:14	09:49	2	09:02	09:15	10:14	2+	08:56	09:11	10:09	2+	09:08	09:18	10:06	2+	09:07	09:15	09:40	2
6	?		10:28	10:32	10:42	1-																
6	C5.0		12:07	12:19	?	-	12:08	12:18	12:34	1+	12:04	12:21	12:42	2	12:11	12:23	12:38	1+				
6	?		12:44	12:46	12:56	1-																
6	C4.2		14:22	14:25	?	-					14:21	14:25	?	-	14:24	14:29	?	-				
6	C7.2		14:34	14:42	?	-	14:21	14:41	14:52	1+	?	14:42	14:56	-	?	14:46	14:56	-				
6	?		14:59	15:01	?	-																
6	?		15:16	15:20	15:32	1-																
7	C1.6																					
8	**M1.1**		09:58	10:13	11:14	2+	*09:57*	*10:12*	*10:29*	*1+*					*10:04*	*10:18*	*11:30*	3	10:00	10:10	10:50	2+
8	?																					
8	C3.3		13:39	13:45	14:04	1	13:38	13:44	14:09	1+	13:38	13:45	13:59	1	13:43	13:49	14:16	2				
9	C3.0		13:45	13:54	14:08	1																
9	C3.5																					
9	C3.7																					
10	C4.5		10:01	10:06	?	-					09:58	10:05	10:49	2+	10:06	10:11	10:20	1-				
10	C3.9		10:18	10:22	10:31	1-																
10	?																					
10	C2.5																					
10	C3.2																					
11	C1.6																					
14	C2.9		11:12	11:21	11:35	1																
16	C1.4		12:51	12:56	13:15	1																
17	C6.4																					
17	C1.4																					
17	C3.0																					
17	C7.3						**13:02**	**13:34**	**14:57**	**3**					*13:15*	*13:32*	*14:52*	*3*				
17	?																					
17	?																					
17	?																					
17	**M1.0**		15:06	15:08	15:29	1	15:05	15:09	15:22	1-					*15:09*	*15:12*	*15:19*	*1-*				
18	C9.4						***07:13***	***07:17***	***07:22***	***1-***												
19	C1.5																					
19	C1.8																					
19	C4.9																					
20	C5.2		09:32	09:38	09:58	1+																
20	?																					
21	C4.6		13:52	13:55	14:25	2	**13:52**	**13:55**	**14:15**	**1**					13:56	13:59	14:13	1-	13:50	13:55	14:15	1
24	C2.2		13:32	13:39	14:00	1+									13:34	13:45	14:18	2				
26	C1.3																					
26	C2.9																					
27	C2.5																					
27	C2.7																					
27	?																					
27	C2.9																					
28	C1.7																					
28	C1.6																					
29	**M1.2**		13:56	14:10	14:45	2+	*13:53*	*14:08*	*14:57*	*2+*					*14:02*	*14:11*	*14:56*	*2+*	14:00	14:08	14:45	2
29	C6.6						*16:07*	*16:14*	*17:06*	*2+*					**16:10**	**16:17**	**?**	**-**				
29	?		16:07	16:29	16:50	2									**?**	**16:29**	**16:55**	**-**				
30	**M5.4**						*07:29*	*07:38*	*08:10*	*2*					*07:38*	*07:42*	*07:54*	*1-*				
31	C4.4		09:07	09:11	09:22	1-	*09:06*	*09:10*	*09:17*	*1-*												
31	C1.6																					

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	Xray class		Chris Bailey				Andrew Lutley (23.4kHz)			Peter Meadows (23.4kHz)							
			Spectrum Lab.				Tuned radio frequency receiver, 0.6m frame aerial.			Tuned radio frequency receiver, 0.6m frame aerial.							
DAY			START	PEAK	END (UT)		START	PEAK	END (UT)	START	PEAK	END (UT)	START	PEAK	END (UT)	START	PEAK	END (UT)
1	C3.0																	
1	C4.2																	
2	C3.1																	
2	C3.2																	
2	C3.7																	
2	C6.5																	
2	?																	
3	**M3.3**		10:10	10:33	11:30	2+												
3	?																	
3	C3.9																	
3	C9.1																	
3	**X2.1**																	
4	C6.7																	
4	C4.1																	
4	?																	
4	?																	
4	**M1.2**																	
4	C4.8																	
4	?																	
4	**M5.2**		14:56	15:50	17:15	3+												
4	?																	
4	?																	
4	C4.8																	
5	C3.6																	
5	?																	
5	?																	
5	C6.2																	
5	**M1.0**																	
5	C3.8																	
6	**M1.3**		09:02	09:14	09:45	2												
6	?																	
6	C5.0																	
6	?																	
6	C4.2																	
6	C7.2																	
6	?																	
6	?																	
7	C1.6																	
8	**M1.1**																	
8	?																	
8	C3.3																	
9	C3.0																	
9	C3.5																	
9	C3.7																	
10	C4.5																	
10	C3.9																	
10	?																	
10	C2.5																	
10	C3.2																	
11	C1.6																	
14	C2.9																	
16	C1.4																	
17	C6.4																	
17	C1.4																	
17	C3.0																	
17	C7.3																	
17	?																	
17	?																	
17	?																	
17	**M1.0**																	
18	C9.4		07:10	07:16	07:25	1-												
19	C1.5																	
19	C1.8																	
19	C4.9																	
20	C5.2		09:30	09:36	10:10	2												
20	?																	
21	C4.6		13:52	13:55	14:02	1-												
24	C2.2																	
26	C1.3																	
26	C2.9																	
27	C2.5																	
27	C2.7																	
27	?																	
27	C2.9																	
28	C1.7																	
28	C1.6																	
29	**M1.2**		14:00	14:06	14:26	1+												
29	C6.6																	
29	?																	
30	**M5.4**		07:30	07:38	07:58	1+												
31	C4.4																	
31	C1.6																	