Space Weather Highlights
27 March - 02 April 2023

SWPC PRF 2483
03 April 2023

Solar activity reached high levels due to significant flaring from Region 3256 (S22, L=001, class/area, Fho/340 on 28 Mar). Region 3256 produced: an X1.2 flare (R3-Strong) at 29/0233 UTC; an M5.4/1f flare (R2-Moderate) at 30/0737 UTC; an M1.2/1f flare (R1-Minor) at 29/1407 UTC; and an M1.1/1n flare (R1-Minor) at 29/2347 UTC. Region 3257 (S27, L=350, class/area, Hax/190 on 23 Mar) produced a C9.7/1f flare at 31/2057 UTC. Region 3270 (S23, L=237, class/area, Dao/80 on 02 Apr) provided several low level C-class flares late in the highlight period after its rapid development on 02 Apr.

No proton events were observed at geosynchronous orbit, however, the greater than 10 MeV proton flux became slightly elevated following the M5.4/1f flare from Region 3256 mentioned above. A peak value of 0.61 pfu was observed at the GOES-16 spacecraft at 30/1015 UTC, remaining well below the 10 pfu alert threshhold (S1-Minor).

The greater than 2 MeV electron flux at geosynchronous orbit reached high levels throughout the reporting period (27 Mar - 02 Apr).

Geomagnetic field activity reached G1 (Minor) geomagnetic storm levels on 31 Mar, with active levels on 30 Mar and 01-02 Apr, due to recurrent, negative-polarity CH HSS influence. Quiet to unsettled geomagnetic conditions were reported throughout the remainder of the reporting period.

Space Weather Outlook
03 April - 29 April 2023

Solar activity is expected to be at very low levels, with a chance for C-class flare activity, until the return of Region 3256 on 12 Apr. Region 3256 was responsible for X-class and M-class flare activity (R1-R3) on its previous transit across the visible solar disk.

No proton events are expected at geosynchronous orbit.

The greater than 2 MeV electron flux at geosynchronous orbit is expected to be at high levels on 03-06 and 23-29 Apr. Moderate levels are expected for the remainder of the outlook period.

Geomagnetic field activity is expected to reach G1-Minor storm levels on 20 and 27 Apr, active levels on 05, 10-11, 16, 18, 21, 26, 28-29 Apr due to influence from recurrent CH HSSs. Quiet to unsettled conditions are anticipated for the remainder of the outlook period.

Daily Solar Data

Date	Radio Flux 10.7cm	Sun spot No.	Sunspot Area (10^{-6} hemi.)	X-ray Background Flux	Flares							
					X-ray			Optical				
					C	M	X	S	1	2	3	4
27 March	158	128	650	B9.6	7	0	0	7	1	0	0	0
28 March	159	114	860	B9.7	7	0	0	7	0	0	0	0
29 March	148	135	560	B8.7	1	2	1	5	1	0	0	0
30 March	140	99	420	B7.5	3	1	0	2	3	0	0	0
31 March	129	61	480	B6.5	11	0	0	2	1	0	0	0
01 April	125	23	150	B5.9	1	0	0	1	0	0	0	0
02 April	127	54	210	B4.2	5	0	0	6	0	0	0	0

Daily Particle Data

Date	Proton Fluence (protons/cm ^{2} -day -sr)		Electron Fluence (electrons/cm^2 -day -sr)
	>1 MeV	>10 MeV	>2MeV
27 March	3.8e+04	2.2e+04	9.2e+07
28 March	6.5e+04	2.2e+04	8.2e+07
29 March	5.7e+04	2.2e+04	1.8e+08
30 March	2.6e+05	2.3e+04	3.1e+07
31 March	8.8e+04	2.1e+04	3.1e+07
01 April	8.5e+04	2.1e+04	1.2e+08
02 April	4.5e+04	2.1e+04	4.3e+07

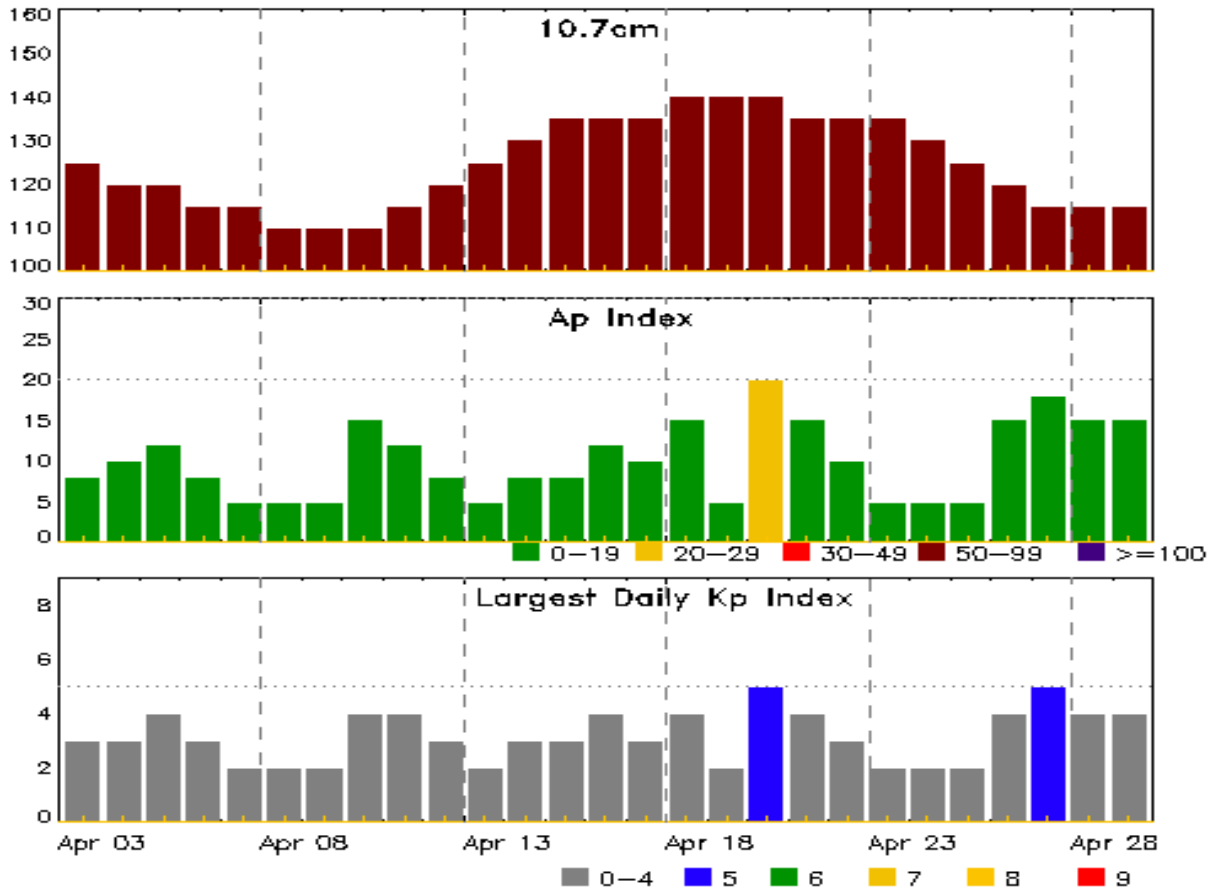
Daily Geomagnetic Data

Date	Middle Latitude Fredericksburg		High Latitude College		Estimated Planetary	
	A	K-indices	A	K-indices	A	K-indices
27 March	2	0-0-0-1-1-2-1-1	2	1-1-0-1-0-0-1-1	3	1-1-1-0-0-1-1-1
28 March	4	1-0-1-1-2-2-1-1	4	0-0-2-1-3-2-1-0	5	2-0-1-1-2-1-1-1
29 March	4	2-0-0-1-2-2-1-2	5	1-2-0-1-3-2-1-1	6	2-1-1-1-2-1-1-2
30 March	11	3-2-2-3-3-3-2-2	27	2-2-5-5-4-5-3-3	17	3-2-3-3-3-4-4-3
31 March	17	4-4-3-4-2-2-2-3	27	4-3-5-5-4-4-2-3	21	4-5-3-4-3-2-3-4
01 April	0	0-0-0-0-0-0-0-0	0	0-0-0-0-0-0-0-0	13	2-1-2-3-3-3-3-4
02 April	13	4-3-3-3-3-2-1-2	17	3-3-5-4-2-1-3-2	27	4-4-3-3-2-1-2-3

Alerts and Warnings Issued

Date & Time of Issue UTC	Type of Alert or Warning	Date & Time of Event UTC
27 Mar 0328	ALERT: Electron 2MeV Integral Flux >= 1000pfu	27/0305
27 Mar 0525	CONTINUED ALERT: Electron 2MeV Integral Flux >= 1000pfu	27/0305
28 Mar 1429	CONTINUED ALERT: Electron 2MeV Integral Flux >= 1000pfu	27/0305
29 Mar 0233	ALERT: X-ray Flux exceeded M5	29/0230
29 Mar 0249	SUMMARY: X-ray Event exceeded X1	29/0218 - 0240
29 Mar 0501	CONTINUED ALERT: Electron 2MeV Integral Flux >= 1000pfu	27/0305
30 Mar 0058	WARNING: Geomagnetic K = 4	30/0058 - 0900
30 Mar 0738	ALERT: X-ray Flux exceeded M5	30/0736
30 Mar 0752	ALERT: Type II Radio Emission	30/0735
30 Mar 0800	SUMMARY: X-ray Event exceeded M5	30/0724 - 0743
30 Mar 0803	ALERT: Type IV Radio Emission	30/0739
30 Mar 0855	EXTENDED WARNING: Geomagnetic K = 4	30/0058 - 1500
30 Mar 1447	EXTENDED WARNING: Geomagnetic K = 4	30/0058 - 31/0300
30 Mar 1801	ALERT: Geomagnetic K = 4	30/1759
30 Mar 2052	WARNING: Geomagnetic K = 5	30/2051 - 31/0600
30 Mar 2053	EXTENDED WARNING: Geomagnetic K = 4	30/0058 - 31/1500
31 Mar 0600	ALERT: Geomagnetic K = 5	31/0559
31 Mar 2118	ALERT: Electron 2MeV Integral Flux >= 1000pfu	31/2050
31 Mar 2258	WARNING: Geomagnetic K = 4	31/2300 - 01/0600
31 Mar 2315	ALERT: Geomagnetic K = 4	31/2315
01 Apr 1008	CONTINUED ALERT: Electron 2MeV Integral Flux >= 1000pfu	31/2050
01 Apr 1036	WARNING: Geomagnetic K = 4	01/1035 - 2100
01 Apr 2055	EXTENDED WARNING: Geomagnetic K = 4	01/1035 - 02/1200
01 Apr 2354	ALERT: Geomagnetic K = 4	01/2354
02 Apr 1155	EXTENDED WARNING: Geomagnetic K = 4	01/1035 - 02/2359

Twenty-seven Day Outlook



Date	Radio Flux 10.7cm	Planetary A Index	Largest Kp Index	Date	Radio Flux 10.7cm	Planetary A Index	Largest Kp Index
03 Apr	125	8	3	17 Apr	135	10	3
04	120	10	3	18	140	15	4
05	120	12	4	19	140	5	2
06	115	8	3	20	140	20	5
07	115	5	2	21	135	15	4
08	110	5	2	22	135	10	3
09	110	5	2	23	135	5	2
10	110	15	4	24	130	5	2
11	115	12	4	25	125	5	2
12	120	8	3	26	120	15	4
13	125	5	2	27	115	18	5
14	130	8	3	28	115	15	4
15	135	8	3	29	115	15	4
16	135	12	4				

Energetic Events

	Time			X-ray		Optical Information			Peak Radio Flux		Sweep Freq Intensity	
Date	Begin	Max	Half Max	Class	Integ Flux	Imp/ Brtns	Location Lat CMD	Rgn #	245	2695	II	IV
29 Mar	0218	0233	0240	X1.2	0.058			3256		140		
29 Mar	1347	1407	1415	M1.2	0.010	1F	S25W64	3256				
29 Mar	2335	2347	2358	M1.1	0.008	1N	S23W73	3256				
30 Mar	0724	0737	0743	M5.4	0.026	1F	S22W81	3256	590	120	2	2

Flare List

	Time			Optical			
Date	Begin	Max	End	X-ray Class	Imp/ Brtns	Location Lat CMD	Rgn #
27 Mar	0517	0521	0535	C1.3			
27 Mar	0536	0543	0549	C1.9			
27 Mar	0620	0636	0657	C4.6	SF	S22W33	3256
27 Mar	0727	0737	0745	C2.5	SF	S20W37	3256
27 Mar	0808	0810	0817		SF	S21W34	3256
27 Mar	B0915	U0915	A1001	C1.6	SF	S21W34	3256
27 Mar	B1038	U1043	A1049	C2.7	SF	S21W36	3256
27 Mar	1600	1609	1638		SF	S21W43	3256
27 Mar	1851	1905	1926	C2.9	SF	N24W69	3258
27 Mar	2020	2039	2102	C3.0	1N	S21W44	3256
28 Mar	0706	0718	0730	C1.9	SF	S23W46	3256
28 Mar	1037	1045	1052	C1.7	SF	N21W23	3265
28 Mar	1342	1351	1358		SF	S22W51	3256
28 Mar	1500	1509	1517	C1.6	SF	S21W56	3256
28 Mar	1537	1547	1558	C2.3	SF	S21W36	3256
28 Mar	1742	1744	1747		SF	S21W53	3256
28 Mar	1854	1907	1920	C2.6			
28 Mar	2026	2027	2029		SF	S24W54	3256
28 Mar	2138	2152	2206	C2.2			
28 Mar	2143	2143	2150		SF	N23W37	3265
28 Mar	2247	2312	2357	C2.7	SF	S22W57	3256
29 Mar	0022	0027	0031	C2.4			3256
29 Mar	0218	0233	0240	X1.2			3256
29 Mar	0603	0603	0605		SF	S23W60	3256
29 Mar	0713	0715	0721		SF	S23W60	3256
29 Mar	0723	0736	0742		SF	S21W62	3256
29 Mar	0817	0819	0821		SF	S23W60	3256

Flare List

Date	Time			Optical			
	Begin	Max	End	X-ray Class	Imp/ Brtns	Location Lat CMD	Rgn #
29 Mar	0837	0837	0839		SF	S23W60	3256
29 Mar	0902	0902	A0914		SF	S23W60	3256
29 Mar	1347	1407	1415	M1.2	1F	S21W68	3256
29 Mar	1558	1612	1614	C6.6	SF	S21W64	3256
29 Mar	2335	2347	2358	M1.1	1N	S23W73	3256
30 Mar	B0000	0000	0015		1N	S23W73	3256
30 Mar	0724	0737	0743	M5.4	1F	S22W81	3256
30 Mar	0846	0848	0852		SF	S23W73	3256
30 Mar	1416	1424	1430	C1.3			
30 Mar	1923	1944	2029	C2.8	1F	S21W29	3262
30 Mar	2308	2326	2344	C1.9	SF	N18W60	3265
31 Mar	0138	0147	0158	C1.3			3256
31 Mar	0233	0237	0241	C1.2			3256
31 Mar	0517	0517	0521		SF	N18W82	3263
31 Mar	0532	0536	0540	C1.2			3263
31 Mar	0902	0909	0914	C4.4			3260
31 Mar	0954	1000	1008	C1.0			
31 Mar	1103	1116	1124	C1.1			3256
31 Mar	1124	1132	1136	B9.8			3257
31 Mar	1351	1354	1400	C1.1			
31 Mar	1418	1446	1510	C1.6			
31 Mar	1718	1725	1732	C1.1			
31 Mar	2039	2057	2104	C9.7	1F	S24W90	3257
31 Mar	2114	2120	2139		SF	S18W42	3262
31 Mar	2334	2350	0012	C1.9	SF	S19E22	3267
01 Apr	0249	0328	0431	C6.7			
02 Apr	0756	0826	0905	C1.0			
02 Apr	1824	1830	1833		SF	S22W01	3270
02 Apr	1851	1856	1901	B9.7	SF	S23W01	3270
02 Apr	2018	2029	2039	C1.8	SF	S23W02	3270
02 Apr	2136	2147	2212	C1.3	SF	S23W03	3270
02 Apr	2158	2203	2212	C1.3			3270
02 Apr	2231	2244	2248		SF	S23W03	3270
02 Apr	2304	2313	2323	C3.4	SN	S22W03	3270

Region Summary

	Location		Sunspot Characteristics					Flares							
		Helio	Area	Extent	Spot	Spot	Mag	X-ray			Optical				
Date	Lat CMD	Lon	10^{-6} hemi.	(helio)	Class	Count	Class	C	M	X	S	1	2	3	4
			Region 3256												
17 Mar	S21E73	11	60	2	Hsx	1	A	4			1				
18 Mar	S22E66	9	250	15	Eho	2	B	2			2	1			
19 Mar	S22E54	6	270	15	Eko	3	B	4			4				
20 Mar	S20E39	4	250	15	Eho	6	B	2	1			1			
21 Mar	S23E25	8	240	5	Cso	6	B								
22 Mar	S22E07	10	270	5	Cho	4	B	1							
23 Mar	S22W04	9	230	5	Cso	4	B								
24 Mar	S23W18	10	240	15	Eao	15	B								
25 Mar	S23W31	10	300	15	Eho	18	BG								
26 Mar	S23W45	10	280	15	Eho	18	BG	2			1				
27 Mar	S21W59	11	250	12	Eho	11	BG	4			6	1			
28 Mar	S22W62	1	340	16	Fho	10	BG	4			5				
29 Mar	S22W74	359	210	11	Eso	9	BG	1	2	1	5	1			
30 Mar	S22W88	1	120	13	Cao	4	B		1		1	2			
								24	4	1	25	6	0	0	0

Crossed West Limb.
Absolute heliographic longitude: 9

			Region 3257												
18 Mar	S27E82	349	40	3	Dao	2	B								
19 Mar	S27E68	350	120	4	Hax	2	A	5			2				
20 Mar	S27E54	349	140	3	Dso	2	B								
21 Mar	S28E40	351	170	4	Hax	2	A	3							
22 Mar	S23E27	350	130	5	Cao	5	B	1			1				
23 Mar	S27E14	350	190	3	Hax	2	A								
24 Mar	S27E01	351	180	6	Hsx	2	A								
25 Mar	S27W11	350	180	4	Hax	2	A								
26 Mar	S28W24	349	160	5	Hax	5	A								
27 Mar	S28W34	346	50	2	Hax	3	A								
28 Mar	S28W47	346	50	3	Hax	2	A								
29 Mar	S28W59	344	30	1	Hsx	1	A								
30 Mar	S27W72	344	10	1	Axx	1	A								
31 Mar	S27W86	345	plage					1				1			
								10	0	0	3	1	0	0	0

Crossed West Limb.
Absolute heliographic longitude: 351

Region Summary - continued

	Location		Sunspot Characteristics					Flares							
		Helio	Area	Extent	Spot	Spot	Mag	X-ray			Optical				
Date	Lat CMD	Lon	10^{-6} hemi.	(helio)	Class	Count	Class	C	M	X	S	1	2	3	4
		Region 3258													
19 Mar	N18E32	26	10	1	Axx	2	A								
20 Mar	N19E18	25	10		Axx	2	A	1							
21 Mar	N18E04	26	plage					1							
22 Mar	N18W10	28	plage												
23 Mar	N18W24	29	plage												
24 Mar	N18W37	29	20	3	Cro	5	B								
25 Mar	N18W49	28	30	4	Cao	7	B	1							
26 Mar	N18W61	26	40	5	Cao	6	B								
27 Mar	N24W69	21	20	1	Hsx	1	A	1			1				
28 Mar	N25W87	26	30	2	Hsx	1	A								
								4	0	0	1	0	0	0	0

Crossed West Limb.
Absolute heliographic longitude: 26

		Region 3259													
19 Mar	S16E69	351	20	4	Bxo	4	B								
20 Mar	S21E56	354	20	2	Cro	3	B				1				
21 Mar	S23E31	359	30	4	Bxo	4	B								
22 Mar	S22E20	357	30	5	Bxo	6	B								
23 Mar	S22E07	357	20	5	Bxo	8	B								
24 Mar	S21W05	357	20	6	Cro	8	B	4			4				
25 Mar	S22W17	356	20	3	Cro	4	B								
26 Mar	S21W31	356	10	8	Bxo	7	B	1			1				
27 Mar	S17W32	343	10	1	Axx	1	A								
28 Mar	S17W46	345	plage												
29 Mar	S17W60	346	plage												
30 Mar	S17W74	347	plage												
31 Mar	S17W88	347	plage												
								5	0	0	6	0	0	0	0

Crossed West Limb.
Absolute heliographic longitude: 357

Region Summary - continued

	Location		Sunspot Characteristics					Flares							
		Helio	Area	Extent	Spot	Spot	Mag	X-ray			Optical				
Date	Lat CMD	Lon	10^{-6} hemi.	(helio)	Class	Count	Class	C	M	X	S	1	2	3	4
			Region 3260												
19 Mar	N22E70	348	60	2	Hsx	1	A								
20 Mar	N24E58	346	120	2	Hsx	1	A								
21 Mar	N24E41	349	160	2	Hsx	1	A								
22 Mar	N24E31	346	180	3	Cao	3	B	1							
23 Mar	N20E16	348	140	9	Cso	7	B								
24 Mar	N20E04	348	180	7	Cso	5	B	2			1				
25 Mar	N23W08	347	170	3	Cso	2	B				1				
26 Mar	N23W21	346	160	3	Cso	3	B				1				
27 Mar	N22W32	344	70	2	Hax	2	A								
28 Mar	N23W46	345	140	2	Hax	2	A								
29 Mar	N23W59	344	70	2	Hax	1	A								
30 Mar	N24W72	344	100	2	Hax	1	A								
31 Mar	N23W84	343	180	3	Hax	1	A	1							
								4	0	0	3	0	0	0	0

Crossed West Limb.
Absolute heliographic longitude: 348

			Region 3262												
22 Mar	S19E72	306	180	2	Hsx	1	A	1							
23 Mar	S18E56	308	130	2	Cao	2	B								
24 Mar	S19E43	309	130	3	Hax	2	A								
25 Mar	S19E30	308	130	2	Hsx	1	A				1				
26 Mar	S19E17	308	130	2	Hsx	1	A	2			2				
27 Mar	S20E06	306	60	3	Hsx	3	A								
28 Mar	S19W08	307	100	2	Hsx	1	A								
29 Mar	S19W20	306	60	3	Hsx	4	A								
30 Mar	S19W34	306	70	4	Hax	4	A	1				1			
31 Mar	S19W47	306	120	2	Hax	2	A				1				
01 Apr	S19W61	307	80	2	Hax	2	A								
02 Apr	S18W74	307	60	1	Hax	2	A								
								4	0	0	4	1	0	0	0

Still on Disk.
Absolute heliographic longitude: 306

Region Summary - continued

	Location		Sunspot Characteristics					Flares							
		Helio	Area	Extent	Spot	Spot	Mag	X-ray			Optical				
Date	Lat CMD	Lon	10^{-6} hemi.	(helio)	Class	Count	Class	C	M	X	S	1	2	3	4
			Region 3263												
25 Mar	N18W11	352	plage					2			1				
26 Mar	N18W26	352	plage								4				
27 Mar	N18W40	352	90	7	Dai	9	B								
28 Mar	N18W54	353	100	7	Dao	8	B								
29 Mar	N18W66	351	60	7	Cao	8	B								
30 Mar	N18W81	353	10		Bxo	2	B								
31 Mar	N18W95	354	plage					1			1				
								3	0	0	6	0	0	0	0

Crossed West Limb.
Absolute heliographic longitude: 352

			Region 3264												
24 Mar	N16E70	281	30	2	Hsx	1	A								
25 Mar	N16E56	283	50	2	Hsx	1	A								
26 Mar	N16E44	281	50	2	Hsx	1	A								
27 Mar	N15E32	279	10	1	Hsx	1	A								
28 Mar	N15E18	280	50	1	Hsx	1	A								
29 Mar	N15E05	279	30	3	Hsx	2	A								
30 Mar	N15W06	278	40	1	Hsx	1	A								
31 Mar	N16W19	278	80	2	Hsx	1	A								
01 Apr	N16W33	279	70	2	Hsx	1	A								
02 Apr	N16W46	279	60	1	Hsx	1	A								
								0	0	0	0	0	0	0	0

Still on Disk.
Absolute heliographic longitude: 279

			Region 3265												
26 Mar	N21W04	329	10	3	Bxo	4	B								
27 Mar	N20W15	327	90	5	Dao	7	B								
28 Mar	N19W30	329	50	6	Dso	9	B	1			2				
29 Mar	N20W43	329	60	7	Dso	4	B								
30 Mar	N21W59	331	60	9	Cso	4	B	1			1				
31 Mar	N21W71	330	90	4	Cso	2	B								
01 Apr	N21W85	331	plage												
								2	0	0	3	0	0	0	0

Crossed West Limb.
Absolute heliographic longitude: 329

Region Summary - continued

	Location		Sunspot Characteristics					Flares							
		Helio	Area	Extent	Spot	Spot	Mag	X-ray			Optical				
Date	Lat CMD	Lon	10^{-6} hemi.	(helio)	Class	Count	Class	C	M	X	S	1	2	3	4
			Region 3266												
29 Mar	N08E42	243	20	3	Bxo	4	B								
30 Mar	N09E27	245	10	2	Bxo	2	B								
31 Mar	N09E15	244	10	6	Bxo	5	B								
01 Apr	N09E01	245	plage												
02 Apr	N08W11	244	plage												
								0	0	0	0	0	0	0	0

Still on Disk.
Absolute heliographic longitude: 245

			Region 3267												
29 Mar	S18E46	239	10	1	Axx	1	A								
30 Mar	S17E33	239	plage												
31 Mar	S17E19	240	plage					1							
01 Apr	S17E05	241	plage								1				
02 Apr	S17W08	241	plage												
								1	0	0	1	0	0	0	0

Still on Disk.
Absolute heliographic longitude: 241

			Region 3268												
29 Mar	S24E21	264	10	2	Axx	1	A								
30 Mar	S24E09	263	plage												
31 Mar	S24W05	264	plage												
01 Apr	S24W19	265	plage												
02 Apr	S24W33	266	plage												
								0	0	0	0	0	0	0	0

Still on Disk.
Absolute heliographic longitude: 264

			Region 3269												
02 Apr	S25E42	191	10	1	Axx	2	A								
								0	0	0	0	0	0	0	0

Still on Disk.
Absolute heliographic longitude: 191

Region Summary - continued

	Location		Sunspot Characteristics					Flares							
		Helio	Area	Extent	Spot	Spot	Mag	X-ray			Optical				
Date	Lat CMD	Lon	10^{-6} hemi.	(helio)	Class	Count	Class	C	M	X	S	1	2	3	4
		Region 3270													
02 Apr	S23W04	237	80	6	Dao	9	B	4			6				
								4	0	0	6	0	0	0	0

Still on Disk.
Absolute heliographic longitude: 237

Preliminary Report and Forecast of Solar Geophysical Data (The Weekly)

Published every Monday by the Space Weather Prediction Center.

U.S. Department of Commerce
NOAA / National Weather Service
Space Weather Prediction Center
325 Broadway, Boulder CO 80305

Notice: The 27-day Outlook, Satellite Environment, X-ray and Proton plots have been redesigned. Comments and suggestions are welcome SWPC.Webmaster@noaa.gov

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https://www.ngdc.noaa.gov/stp/satellite/goes-r.html -- NCEI GOES data textarchive

https://www.swpc.noaa.gov/products/solar-cycle-progression -- Solar Cycle Progression web site

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