Space Weather Highlights **SWPC PRF 2409**
25 October - 31 October 2021 **01 November 2021**

Solar activity ranged from low to high levels. Low levels occurred on 25, 27, and 30-31 Oct. Moderate levels were reached on 26 and 29 Oct as Region 2891 (N17, L=212, class/area Dki/350 on 29 Oct) produced M1 flare activity at 26/0247 UTC, 26/1557, and 29/0242 UTC. High levels were reached on 28 Oct as Region 2887 (S25, L=278, class/area Dki/440 on 24 Oct) produced an M1/1n flare at 28/0740 UTC, an M2/1f flare at 28/1028 UTC, and an X1/2n flare at 28/1535 UTC. Two CMEs were modelled during the period. The first was a CME off the SE limb beginning at 26/2024 UTC although the source region was unclear. It was speculated to come from Region 2887. WSA ENLIL modeling showed a potential glancing arrival late on 30 Oct. The second CME was associated with the X1 flare on 28 Oct. Type II (1457 km/s) and IV radio emissions were observed coinciding with the flare and WSA ENLIL modeling of the event showed an arrival of mid to late on 30 Oct as well, although parameterization of the event was difficult.

Coinciding with the X1 flare on 28 Oct was a greater than 10 MeV and 100 MeV proton event. The greater than 10 MeV event began at 28/1740 UTC, reached a peak flux of 29 pfu (S1-Minor) at 29/0250 UTC and ended at 30/1610 UTC. S1 thresholds were crossed once again beginning at 30/2100 UTC, reaching a peak flux of 11pfu at 30/2105 UTC and ending at 30/2130 UTC due to an enhancement from the 26 Oct CME. The greater than 100 MeV proton event began at 28/1635 UTC, reached a peak flux of 7.3 pfu at 28/1815 UTC and ended at 30/0440 UTC. The greater than 10 MeV proton flux continued to decline towards background levels on 31 Oct - 01 Nov.

The greater than 2 MeV electron flux at geosynchronous orbit was at normal to moderate levels throughout with a peak flux of 348 pfu observed at 25/1700 UTC

Geomagnetic field activity was at quiet levels on 25 Oct through late on 30 Oct under a nominal solar wind environment. Around 30/1800 UTC, a weak discontinuity was observed that was believed to be the arrival of the 26 Oct CME. Total field increased to 11 nT while the Bz component deflected southward to a maximum of -10 nT at 30/2045 UTC. Solar wind speed slowly increased to 400 km/s. A weak shock was observed beginning at 31/0914 UTC which is believed to be the arrival of a glancing blow from the 28 Oct CME. Total field increased from 4 nT to 13 nT while the Bz component briefly reached a maximum southward deflection of -11 nT at 31/1124 UTC. Solar wind speed continued to rise to a peak of 465 km/s at 31/1905 UTC. By 31/1500 UTC, total field had calmed to between 5-8 nT and remained there through the end of the period. The geomagnetic field responded with an isolated active period late on 30 Oct followed by unsettled to G1 (Minor) storming on 31 Oct.

Space Weather Outlook
01 November - 27 November 2021

Solar activity is expected to be at low levels with a chance for further M-class flare activity

(R1-R2, Minor-Moderate) on 01-08 Nov as Regions 2887 and 2891 transit across the visible disk. Very low to low levels are expected on 09-15 Nov. Low levels with a chance for M-class flares are likely again on 16-27 Nov as Regions 2887 and 2891 return to the visible disk on 16 Nov and 21 Nov, respectively.

No proton events are expected at geosynchronous orbit as Regions 2887 and 2891 decay and simplify magnetically.

The greater than 2 MeV electron flux at geosynchronous orbit is expected to be at normal to moderate levels with a chance for high levels on 02-03 Nov due to CME influence.

Geomagnetic field activity is expected to reach active levels on 01 Nov followed by quiet to unsettled levels on 02 Nov as CME effects diminish. Unsettled levels are expected once again on 04-05 Nov and 15-16 Nov due to recurrent CH HSS activity.

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
25 October	101	81	470	B2.8	3	0	0	1	0	0	0	0
26 October	109	95	820	B7.0	12	2	0	0	0	0	0	0
27 October	111	91	660	B5.8	18	0	0	5	3	0	0	0
28 October	112	96	700	B6.1	9	2	1	13	3	1	0	0
29 October	108	82	710	B3.6	5	1	0	4	2	0	0	0
30 October	107	76	470	B3.3	7	0	0	4	1	0	0	0
31 October	103	83	480	B3.5	4	0	0	5	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
25 October	2.2e+05	4.5e+04	1.6e+06
26 October	7.2e+04	4.4e+04	1.5e+06
27 October	7.0e+04	4.4e+04	1.6e+06
28 October	6.1e+05	4.8e+05	3.1e+06
29 October	3.2e+06	1.7e+06	1.8e+06
30 October	1.5e+07	1.1e+06	1.2e+06
31 October	2.1e+07	5.0e+05	1.2e+06

Daily Geomagnetic Data

Date	Middle Latitude Fredericksburg		High Latitude College		Estimated Planetary	
	A	K-indices	A	K-indices	A	K-indices
25 October	4	0-1-1-1-2-2-1-1	2	0-0-1-1-1-1-1-0	5	1-2-1-1-1-2-1-1
26 October	3	1-1-0-1-1-1-0-2	1	0-0-0-1-0-0-0-1	5	2-2-1-1-1-1-0-2
27 October	2	1-0-0-1-1-1-1-0	0	0-0-0-0-0-0-0-0	3	1-0-1-1-1-0-1-1
28 October	3	0-1-0-0-1-3-0-0	0	0-0-0-0-0-0-0-0	3	0-1-0-0-0-2-0-0
29 October	2	0-0-0-1-1-1-1-1	0	0-0-0-0-0-0-0-1	3	1-0-0-1-0-1-1-2
30 October	8	2-2-2-0-1-2-2-4	4	1-0-3-1-0-1-1-2	10	2-2-2-1-1-2-2-4
31 October	16	3-3-4-2-4-2-3-3	24	2-3-5-3-6-3-2-2	22	4-3-3-3-5-3-3-4

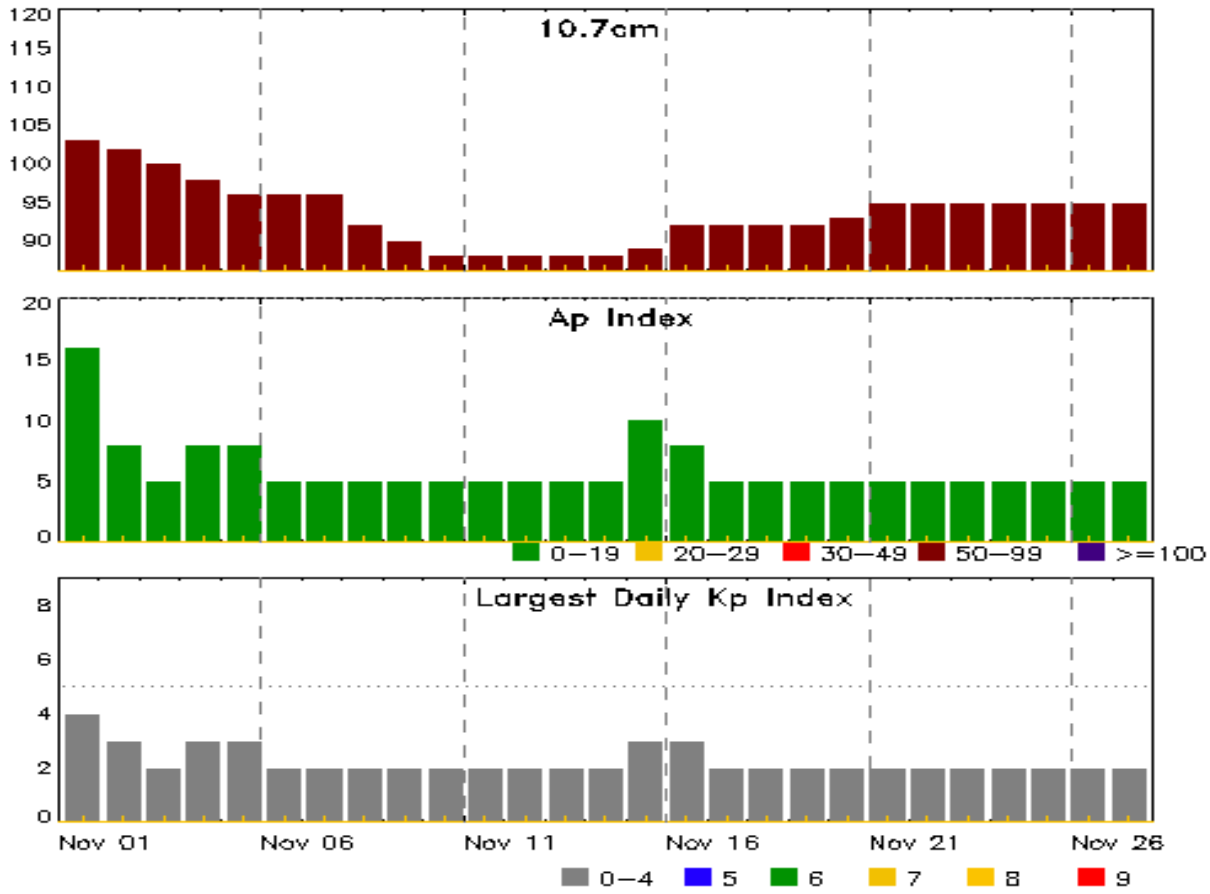
Alerts and Warnings Issued

Date & Time of Issue UTC	Type of Alert or Warning	Date & Time of Event UTC
28 Oct 1536	ALERT: X-ray Flux exceeded M5	28/1530
28 Oct 1553	ALERT: Type II Radio Emission	28/1529
28 Oct 1555	SUMMARY: X-ray Event exceeded X1	28/1517 - 1548
28 Oct 1557	ALERT: Type IV Radio Emission	28/1532
28 Oct 1651	ALERT: Proton Event 100MeV Integral Flux > 1pfu	28/1635
28 Oct 1747	WARNING: Proton 100MeV Integral Flux > 1pfu	28/1635 - 29/1200
28 Oct 1748	WARNING: Proton 10MeV Integral Flux > 10pfu	28/1745 - 29/1200
28 Oct 1757	ALERT: Proton Event 10MeV Integral Flux >= 10pfu	28/1740
28 Oct 2216	WATCH: Geomagnetic Storm Category G3 predicted	
29 Oct 1142	EXTENDED WARNING: Proton 100MeV Integral Flux > 1pfu	28/1635 - 29/2359
29 Oct 1142	EXTENDED WARNING: Proton 10MeV Integral Flux > 10pfu	28/1745 - 30/1200
29 Oct 1529	WATCH: Geomagnetic Storm Category G3 predicted	
29 Oct 2339	EXTENDED WARNING: Proton 100MeV Integral Flux > 1pfu	28/1635 - 30/1200
30 Oct 0926	CANCELLATION: Proton 100MeV Integral Flux > 1pfu	
30 Oct 0935	SUMMARY: Proton Event 100MeV Integral Flux > 1pfu	28/1635 - 30/0440
30 Oct 1120	EXTENDED WARNING: Proton 10MeV Integral Flux > 10pfu	28/1745 - 31/0600
30 Oct 2004	SUMMARY: Proton Event 10MeV Integral Flux >= 10pfu	28/1740 - 30/1610
30 Oct 2005	CANCELLATION: Proton 10MeV Integral Flux > 10pfu	
30 Oct 2106	WARNING: Proton 10MeV Integral Flux > 10pfu	30/2105 - 31/1200
30 Oct 2118	ALERT: Proton Event 10MeV Integral Flux >= 10pfu	30/2100
30 Oct 2149	WARNING: Geomagnetic K = 4	30/2150 - 31/1200
30 Oct 2242	ALERT: Geomagnetic K = 4	30/2237
30 Oct 2247	WARNING: Geomagnetic K = 5	30/2247 - 31/0900
31 Oct 1130	EXTENDED WARNING: Geomagnetic K = 4	30/2150 - 01/0900
31 Oct 1156	SUMMARY: Proton Event 10MeV Integral Flux >= 10pfu	30/2100 - 2130

Alerts and Warnings Issued

Date & Time of Issue UTC	Type of Alert or Warning	Date & Time of Event UTC
31 Oct 1313	ALERT: Geomagnetic K = 4	31/1307
31 Oct 1320	WARNING: Geomagnetic K = 5	31/1319 - 2359
31 Oct 1502	ALERT: Geomagnetic K = 5	31/1459

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
01 Nov	103	16	4	15 Nov	89	10	3
02	102	8	3	16	92	8	3
03	100	5	2	17	92	5	2
04	98	8	3	18	92	5	2
05	96	8	3	19	92	5	2
06	96	5	2	20	93	5	2
07	96	5	2	21	95	5	2
08	92	5	2	22	95	5	2
09	90	5	2	23	95	5	2
10	88	5	2	24	95	5	2
11	88	5	2	25	95	5	2
12	88	5	2	26	95	5	2
13	88	5	2	27	95	5	2
14	88	5	2				

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
26 Oct	0240	0247	0254	M1.3	0.006				2891				
26 Oct	1542	1557	1602	M1.0	0.005				2891				
28 Oct	0730	0740	0745	M1.4	0.005	1N	S30	W03	2887				
28 Oct	1019	1028	1037	M2.2	0.013	1F	S30	W02	2887				
28 Oct	1517	1535	1548	X1.0	0.091	2N	S26	W05	2887	4300		3	2
29 Oct	0222	0242	0253	M1.5	0.014	1N	N16	E54	2891				

Flare List

	Time			Optical			
Date	Begin	Max	End	X-ray Class	Imp/ Brtns	Location Lat CMD	Rgn #
25 Oct	0229	0237	0249	B4.5			2887
25 Oct	0526	0536	0547	B4.3			2887
25 Oct	0610	0621	0630	B6.3			2887
25 Oct	B0810	U0817	A0822		SF	S27E42	2887
25 Oct	1620	1623	1629	B5.4			2887
25 Oct	1635	1638	1642	B6.5			2890
25 Oct	1834	1841	1848	B5.0			2887
25 Oct	1947	1956	2001	C8.5			
25 Oct	2155	2203	2216	C4.4			
25 Oct	2331	2334	2338	C1.6			
26 Oct	0012	0019	0030	C1.9			2887
26 Oct	0048	0104	0113	C9.3			
26 Oct	0143	0150	0156	C3.5			2889
26 Oct	0240	0247	0254	M1.3			2891
26 Oct	0318	0324	0329	C2.0			2889
26 Oct	0427	0433	0437	C2.3			2889
26 Oct	0520	0525	0529	C1.9			
26 Oct	0556	0604	0610	C7.8			2887
26 Oct	0943	0952	1002	C5.0			2891
26 Oct	1111	1125	1131	C4.8			2891
26 Oct	1325	1338	1348	C3.1			2891
26 Oct	1542	1557	1602	M1.0			2891
26 Oct	2245	2252	2300	C1.2			2891
26 Oct	2310	2319	2325	C2.1			2891
27 Oct	0350	0357	0403	C1.0			2887

Flare List

Date	Time Begin	Time Max	Time End	X-ray Class	Optical Imp/ Brtns	Optical Location Lat CMD	Optical Rgn #
27 Oct	0522	0535	0541	C2.8			2887
27 Oct	0527	0607	0657		1F	S26E15	2887
27 Oct	0541	0545	0547	C3.1			2887
27 Oct	0547	0608	0619	C8.5			2887
27 Oct	0701	0710	0714	C1.5	SF	S26E15	2887
27 Oct	B0811	U0955	A1108		1F	S28E12	2887
27 Oct	0844	0849	0856	C1.7			
27 Oct	0938	0945	0950	B7.2			
27 Oct	0950	0954	0959	C2.8			2887
27 Oct	1014	1029	1036	C1.5			
27 Oct	1149	1159	1208	C1.6	SF	S24E37	2889
27 Oct	1211	1219	1225	C2.3			2889
27 Oct	1308	1317	1327		SF	N16E77	2891
27 Oct	1335	1342	1348	C1.1			2887
27 Oct	1404	1430	A1502		1F	S28E10	2887
27 Oct	1621	1636	1644	C2.1			2891
27 Oct	1757	1805	1813	C1.4			2891
27 Oct	1848	1858	1904	C2.1			2891
27 Oct	2044	2050	2058	C2.1			2891
27 Oct	2153	2159	2205	C1.1			
27 Oct	2207	2222	2227	C1.6	SF	S27E08	2887
27 Oct	2235	2244	2300	C1.1	SF	S26E08	2887
28 Oct	0132	0138	0145	C1.2	SF	S28E05	2887
28 Oct	0209	0218	0236		SF	S28E05	2887
28 Oct	0426	0427	0429		SF	N16E66	2891
28 Oct	0548	0550	0552		SF	S27E01	2887
28 Oct	0730	0740	0745	M1.4	1N	S30W03	2887
28 Oct	B0757	0758	0823		SF	S30E02	2887
28 Oct	0926	0927	0928		SF	N17E66	2891
28 Oct	0956	1000	1005	C1.1			2887
28 Oct	1019	1028	1037	M2.2	1F	S30W02	2887
28 Oct	B1144	U1154	1222	C1.2	SF	S26W03	2887
28 Oct	1226	1238	1249	C2.2	SF	N16E60	2891
28 Oct	1312	1321	1332	C3.3	1F	S27W05	2887
28 Oct	1346	1359	1405	C3.8	SF	S31W03	2887
28 Oct	1416	1429	1443		SF	N18E63	2891
28 Oct	1517	1535	1548	X1.0	2N	S26W05	2887
28 Oct	1616	1617	1617		SF	N17E58	2891

Flare List

Date	Time			Optical			
	Begin	Max	End	X-ray Class	Imp/ Brtns	Location Lat CMD	Rgn #
28 Oct	1807	1810	1814	C3.1	SF	N16E58	2891
28 Oct	1934	1945	2003	C3.1			2891
28 Oct	2102	2107	2111	C1.5			2891
28 Oct	2241	2246	2247		SF	S27W06	2887
29 Oct	0204	0213	0222	B6.9			2891
29 Oct	0222	0242	0253	M1.5	1N	N16E54	2891
29 Oct	0543	0558	0600	C4.8	1F	N17E53	2891
29 Oct	B0553	U0605	0630	C5.9	SF	N17E53	2891
29 Oct	0726	0745	0805	C1.1	SF	S27W15	2887
29 Oct	1046	1054	1110	B7.3			2891
29 Oct	1118	1126	1137	C1.5			2891
29 Oct	1207	1215	1220	B8.4			2887
29 Oct	1320	1330	1340	C2.5	SF	S29W18	2887
29 Oct	1814	1821	1825	B7.2			2891
29 Oct	1905	1914	1918	B8.5			2891
29 Oct	2200	2209	2226	B9.1	SF	N14E42	2891
29 Oct	2331	2338	2343	B7.6			2891
30 Oct	0227	0241	0258	B6.6			2891
30 Oct	0307	0315	0319	C3.9	1N	N14E38	2891
30 Oct	0520	0530	0538	B6.3			2887
30 Oct	0840	0847	0851	B6.6			2891
30 Oct	0914	0922	0932	C1.0			2891
30 Oct	0942	0949	1027	C1.6	SF	N15E35	2891
30 Oct	1333	1344	1348	C0.9	SF	N15E32	2891
30 Oct	1512	1529	1538	C3.1	SF	N16E34	2891
30 Oct	1618	1621	1625	C1.2	SF	N14E30	2891
30 Oct	1752	1756	1800	B7.9			2891
30 Oct	1927	1931	1937	B7.8			2887
30 Oct	1949	1957	2004	B6.6			2891
30 Oct	2122	2129	2135	C1.0			2887
30 Oct	2226	2231	2239	B6.2			2887
30 Oct	2345	2352	2358	B7.0			2887
31 Oct	0117	0121	0128	B8.5	SF	S29W36	2887
31 Oct	0258	0327	0338		SF	S28W42	2887
31 Oct	0320	0324	0330	C1.7	SF	N18E30	2891
31 Oct	0618	0624	0626		SF	N20E29	2891
31 Oct	0653	0706	0712	C2.9	SF	N19E28	2891
31 Oct	1816	1827	1832	C1.2			2887

Flare List

	Time			Optical			
Date	Begin	Max	End	X-ray Class	Imp/ Brtns	Location Lat CMD	Rgn #
31 Oct	1951	2000	2004	C3.2			2887
31 Oct	2130	2139	2147	B8.0			2887

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 2886												
18 Oct	S19E61	337	170	3	Hsx	1	A								
19 Oct	S19E47	338	185	3	Hsx	1	A								
20 Oct	S19E36	336	130	2	Hsx	1	A								
21 Oct	S19E22	336	100	2	Hsx	1	A								
22 Oct	S19E10	335	100	2	Hsx	1	A								
23 Oct	S19W02	334	120	2	Hsx	1	A								
24 Oct	S19W15	334	110	2	Hsx	1	A								
25 Oct	S19W29	335	110	1	Hsx	1	A								
26 Oct	S20W41	333	100	2	Hsx	1	A								
27 Oct	S19W55	334	90	2	Hsx	1	A								
28 Oct	S19W68	334	100	2	Hsx	1	A								
29 Oct	S19W81	334	100	3	Hsx	1	A								
								0	0	0	0	0	0	0	0

Crossed West Limb.
Absolute heliographic longitude: 334

			Region 2887												
22 Oct	S24E65	280	150	5	Dao	7	B								
23 Oct	S26E53	279	420	8	Dki	11	B				2				
24 Oct	S25E40	278	440	9	Dki	14	B								
25 Oct	S26E27	279	330	7	Dki	20	BG				1				
26 Oct	S26E15	277	370	8	Dhi	20	B	2							
27 Oct	S26E04	275	250	8	Dhi	26	BG	9			3	3			
28 Oct	S26W08	274	320	9	Dkc	28	BG	5	2	1	7	3	1		
29 Oct	S26W21	274	250	10	Dhi	22	BG	2			2				
30 Oct	S28W33	273	210	10	Dso	13	BG	1							
31 Oct	S28W47	273	150	8	Cso	8	B	2			2				
								21	2	1	17	6	1	0	0

Still on Disk.
Absolute heliographic longitude: 275

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 2888												
24 Oct	S15E66	253	20	1	Hsx	1	A								
25 Oct	S14E52	254	10		Axx	1	A								
26 Oct	S13E39	253	10	1	Axx	1	A								
27 Oct	S12E27	252	plage												
28 Oct	S12E13	253	plage												
29 Oct	S12W01	254	plage												
30 Oct	S12W15	255	plage												
31 Oct	S12W29	255	plage												
								0	0	0	0	0	0	0	0

Still on Disk.
Absolute heliographic longitude: 254

			Region 2889												
25 Oct	S25E58	248	10	5	Bxo	3	B								
26 Oct	S23E43	249	20	4	Bxo	4	B	3							
27 Oct	S24E31	248	40	4	Bxo	6	B	2			1				
28 Oct	S23E17	249	30	6	Bxo	4	B								
29 Oct	S23E03	250	10	3	Bxo	3	B								
30 Oct	S23W10	250	10	1	Axx	1	A								
31 Oct	S24W21	250	0		Axx	1	A								
								5	0	0	1	0	0	0	0

Still on Disk.
Absolute heliographic longitude: 250

			Region 2890												
25 Oct	S19W11	317	10	4	Bxo	6	B								
26 Oct	S18W25	317	40	5	Cro	5	B								
27 Oct	S18W39	318	30	5	Bxo	4	B								
28 Oct	S18W52	318	30	6	Bxo	3	B								
29 Oct	S18W64	317	plage												
30 Oct	S18W78	318	plage												
								0	0	0	0	0	0	0	0

Crossed West Limb.
Absolute heliographic longitude: 317

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 2891												
26 Oct	N20E78	214	280		Dso	4	B	5	2						
27 Oct	N17E67	212	250	4	Cao	4	B	4			1				
28 Oct	N18E56	210	220	9	Cai	10	B	4			6				
29 Oct	N17E41	212	350	9	Dki	16	B	3	1		2	2			
30 Oct	N16E29	211	240	11	Eac	20	B	6			4	1			
31 Oct	N17E16	210	200	9	Dac	20	B	2			3				
								24	3	0	16	3	0	0	0

Still on Disk.
Absolute heliographic longitude: 210

			Region 2892												
30 Oct	N27W15	255	10	3	Bxo	2	B								
31 Oct	N26W29	255	10	3	Bxo	3	B								
								0	0	0	0	0	0	0	0

Still on Disk.
Absolute heliographic longitude: 255

			Region 2893												
31 Oct	N16E70	156	120	2	Hsx	1	A								
								0	0	0	0	0	0	0	0

Still on Disk.
Absolute heliographic longitude: 156

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

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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.swpc.noaa.gov/products/weekly-highlights-and-27-day-forecast -- Current
ftp://ftp.swpc.noaa.gov/pub/warehouse -- Online archive from 1997
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
https://www.swpc.noaa.gov/content/contact-us -- Contact and Copyright information
https://www.swpc.noaa.gov/sites/default/files/images/u2/Usr_guide.pdf -- User Guide