Space Weather Highlights **SWPC PRF 2522**
25 December - 31 December 2023 **01 January 2024**

Solar activity was at low levels on 25-30 Dec with numerous C-class flares from Regions 3528 (N08, L=027, class/area Dai/200 on 23 Dec), 3529 (S19, L=345, class/area Dko/450 on 20 Dec), 3530 (N08, L=323, class/area Dao/180 on 20 Dec), 3533 (N14, L=305, class/area Dao/170 on 29 Dec), 3534 (S13, L=225, class/area Dao/150 on 30 Dec) and 3536 (N05, L=152, class/area Hax/080 on 31 Dec). Activity increased to strong levels (R3-strong) when new Region 3536 produced an X5.0 flare at 31/2155 UTC. This flare also produced complex radio burst signatures reported across discrete frequencies, including a 10 cm radio Burst of 3,100 sfu at 31/2143 UTC and a Type IV Sweep signature at 31/2142 UTC. In addition to the X-flare, Region 3536 produced an M1.0 flare at 31/1912 UTC.

Numerous CME signatures, mostly from the NW and SE limbs, were detected during the period, but none were determined to have an Earth-directed component.

The greater than 10 MeV proton flux at geosynchronous orbit was at slightly elevated levels to 2 pfu after 31/2310 UTC.

The greater than 2 MeV electron flux at geosynchronous orbit was at normal to moderate levels.

Geomagnetic field activity was at quiet levels the entire period. Total field strength ranged between 4-12 nT and Bz varied between +/-7 nT. Solar wind speeds peaked at near 500 km/s early on 27 Dec and declined to about 290 km/s early on 31 Dec. The phi angle was mostly in a positive orientation from 25 Dec to midday on 29 Dec. Orientation switched to a more negative angle from midday on 29 Dec through 31 Dec.

Space Weather Outlook
01 January - 27 January 2024

Solar activity is expected to be low with M-class (R1-R2/Minor-Moderate) flares likely, and a chance for X-class (R3/Strong) flares, over 01-14 Jan, particularly from new Region 3536. From 15-27 Jan, solar activity is expected to be at low levels, with a chance for moderate levels (R1-R2/Minor-Moderate).

There is a chance for the greater than 10 MeV proton flux to exceed the 10 pfu event threshold on 01 Jan, and a slight chance to reach 10 pfu on 02-15 Jan. No proton events are expected from 16-27 Jan.

The greater than 2 MeV electron flux at geosynchronous orbit is expected to reach high levels on 03-06 and 09-12 Jan due to multiple, anticipated CH HSSs. The remainder of the outlook period is likely to be at moderate levels.

Geomagnetic field activity is expected to be at active conditions on 01-02 Jan, with quiet to unsettled levels expected on 03-04, 08-10 and 27 Jan, due to CH HSSs. The remainder of the

outlook period is likely to be mostly quiet.

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 December	167	98	700	C1.0	7	0	0	6	0	0	0	0
26 December	154	94	640	B7.7	7	0	0	2	0	0	0	0
27 December	149	78	520	B7.6	4	0	0	1	0	0	0	0
28 December	147	83	430	B7.5	4	0	0	0	0	0	0	0
29 December	143	92	582	B7.7	11	0	0	1	0	0	0	0
30 December	140	48	470	B9.9	9	0	0	0	0	0	0	0
31 December	146	55	380	C1.1	10	1	1	0	0	0	1	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 December	3.8e+04	2.1e+04	3.1e+06
26 December	4.6e+05	2.6e+04	4.8e+06
27 December	6.7e+05	2.1e+04	9.4e+06
28 December	3.8e+05	2.0e+04	1.1e+07
29 December	6.8e+05	1.8e+04	6.9e+06
30 December	1.8e+05	1.8e+04	5.4e+06
31 December	6.8e+05	2.2e+04	4.2e+06

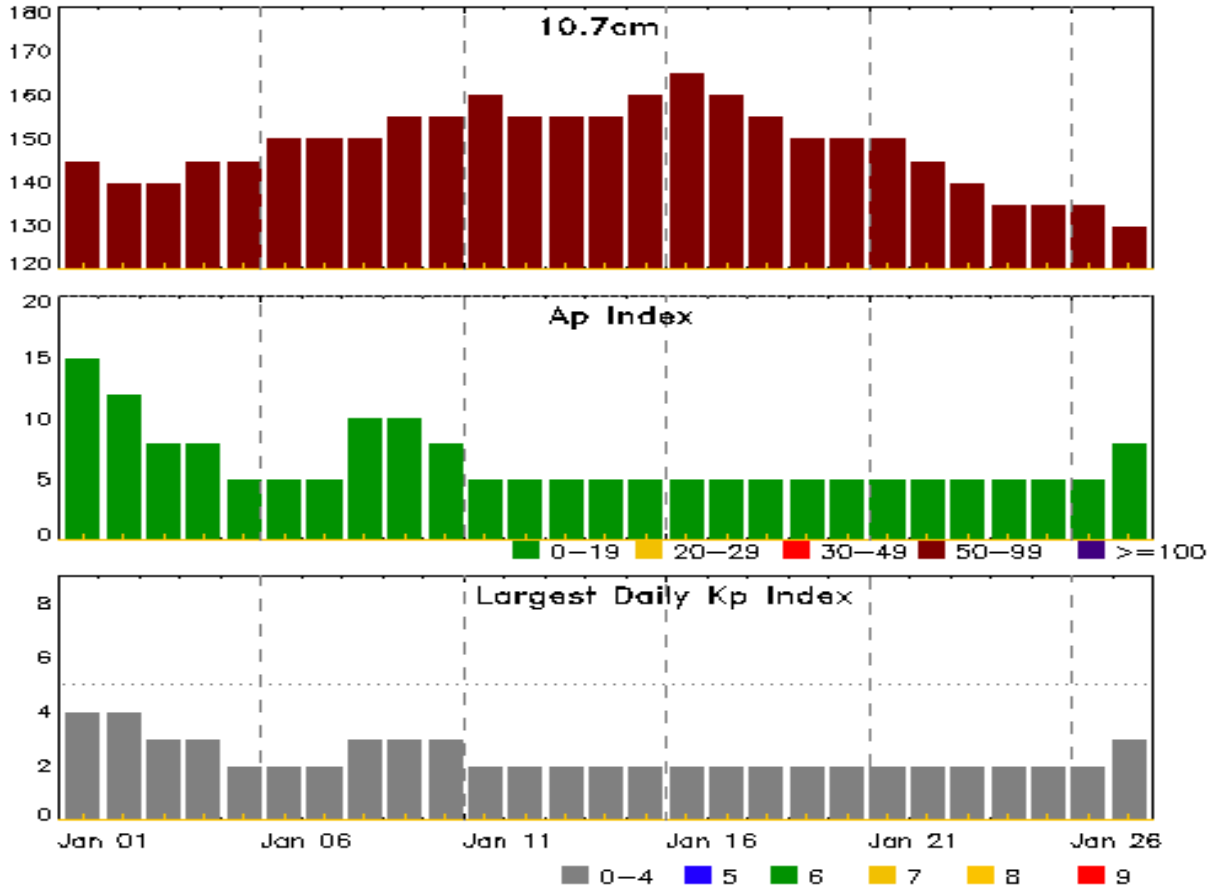
Daily Geomagnetic Data

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

Alerts and Warnings Issued

Date & Time of Issue UTC	Type of Alert or Warning	Date & Time of Event UTC
31 Dec 2151	ALERT: X-ray Flux exceeded M5	31/2145
31 Dec 2212	SUMMARY: 10cm Radio Burst	31/2139 - 2200
31 Dec 2215	SUMMARY: X-ray Event exceeded X1	31/2136 - 2208
31 Dec 2216	ALERT: Type IV Radio Emission	31/2142

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 Jan	145	15	4	15 Jan	160	5	2
02	140	12	4	16	165	5	2
03	140	8	3	17	160	5	2
04	145	8	3	18	155	5	2
05	145	5	2	19	150	5	2
06	150	5	2	20	150	5	2
07	150	5	2	21	150	5	2
08	150	10	3	22	145	5	2
09	155	10	3	23	140	5	2
10	155	8	3	24	135	5	2
11	160	5	2	25	135	5	2
12	155	5	2	26	135	5	2
13	155	5	2	27	130	8	3
14	155	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
31 Dec	1844	1912	1940	M1.0	0.026			3536				
31 Dec	2136	2155	2208	X5.0	0.550	3B	N04E73	3536	1500	3100		2

Flare List

	Time			Optical			
Date	Begin	Max	End	X-ray Class	Imp/ Brtns	Location Lat CMD	Rgn #
25 Dec	0052	0059	0107	C4.7	SF	N07W07	3530
25 Dec	0126	0135	0141	C3.6	SF	N07W07	3530
25 Dec	0224	0224	0226		SF	S23W29	3529
25 Dec	0309	0316	0324	C1.8			3533
25 Dec	0402	0402	0410		SF	S22E19	3531
25 Dec	0728	0738	0741	C2.2	SF	N05W70	3528
25 Dec	0741	0745	0749	C2.4			3528
25 Dec	2042	2054	2113	C1.3			3530
25 Dec	2343	2347	2353	C1.4	SF	N13W64	3521
26 Dec	0308	0314	0318	C2.4			3528
26 Dec	0415	0430	0444	C1.5			3528
26 Dec	0456	0501	0507	C4.5	SF	S21W52	3529
26 Dec	0525	0534	0541	C1.8			3529
26 Dec	0856	0926	0947	C3.2			3528
26 Dec	1047	1059	1108	C2.3	SF	S23W45	3529
26 Dec	1653	1707	1718	C1.5			3526
27 Dec	0309	0317	0330	C1.6			3529
27 Dec	0555	0606	0619	C1.2			3529
27 Dec	B1254	U1258	A1330	C1.2	SF	S12E64	3534
27 Dec	1935	1941	1949	C1.9			3534
28 Dec	1052	1058	1102	C1.8			3533
28 Dec	2027	2032	2039	C1.0			3534
28 Dec	2039	2052	2105	C2.1			
28 Dec	2242	2251	2301	C1.5			3533
29 Dec	0023	0033	0041	C2.5			3528
29 Dec	0041	0047	0054	C2.6			3528
29 Dec	0136	0140	0145	C1.5			3528
29 Dec	0213	0221	0242	C1.3			3533
29 Dec	0336	0340	0346	C1.3			3533

Flare List

Date	Time			Optical			
	Begin	Max	End	X-ray Class	Imp/ Brtns	Location Lat CMD	Rgn #
29 Dec	0426	0434	0445	C1.2			3533
29 Dec	0714	0724	0735	C1.4			3533
29 Dec	0749	0754	0803	C9.8	SF	N15W38	3533
29 Dec	1131	1145	1153	C1.8			3530
29 Dec	1205	1223	1257	C2.5			3530
29 Dec	2007	2017	2024	C6.6			3530
30 Dec	0001	0010	0019	C1.4			3530
30 Dec	0659	0710	0729	C1.9			3534
30 Dec	0729	0747	0757	C3.2			3530
30 Dec	1147	1155	1207	C1.7			
30 Dec	1444	1452	1457	C2.1			3530
30 Dec	1517	1520	1524	C5.7			3530
30 Dec	2123	2128	2132	C2.2			3530
30 Dec	2141	2150	2154	C6.1			3530
30 Dec	2356	0006	0015	C1.8			3536
31 Dec	0014	0019	0024	C2.1			3536
31 Dec	0238	0247	0304	C1.2			3531
31 Dec	0304	0313	0319	C4.2			3530
31 Dec	0813	0817	0828	C9.6			3536
31 Dec	0902	0912	0918	C8.3			3536
31 Dec	1155	1207	1228	C2.7			
31 Dec	1237	1255	1314	C5.5			3536
31 Dec	1738	1746	1751	C2.4			3536
31 Dec	1802	1816	1828	C3.8			3536
31 Dec	1828	1839	1844	C4.2			3536
31 Dec	1844	1912	1940	M1.0			3536
31 Dec	2135	2203	2317	X5.0	3B	N04E73	3536

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 3521												
15 Dec	N11E71	7	20	1	Hsx	1	A								
16 Dec	N12E57	8	30	1	Hsx	1	A								
17 Dec	N12E44	8	30	2	Hax	3	A								
18 Dec	N11E36	6	50	4	Dao	8	B								
19 Dec	N12E19	7	20	2	Cro	3	B	1			1				
20 Dec	N11E03	9	80	4	Dso	4	B	3			6				
21 Dec	N12W07	6	100	6	Dsi	8	BG	2			2				
22 Dec	N12W20	6	70	6	Csi	10	B								
23 Dec	N11W34	7	50	6	Cso	6	B								
24 Dec	N11W50	10	20	1	Hrx	2	A	1							
25 Dec	N11W64	10	30	1	Hax	1	A	1			1				
26 Dec	N11W77	9	30	1	Hsx	1	A								
27 Dec	N11W90	9	20	1	Hsx	1	A								
								8	0	0	10	0	0	0	0

Crossed West Limb.
Absolute heliographic longitude: 9

			Region 3523												
16 Dec	N21E62	3	20	1	Hrx	2	A								
17 Dec	N21E50	2	10	1	Hrx	1	A								
18 Dec	N22E38	1	10	3	Bxo	2	B								
19 Dec	N25E24	2	5	1	Axx	1	A								
20 Dec	N25E10	2	10	5	Bxo	2	B								
21 Dec	N25W04	3	plage												
22 Dec	N25W18	4	plage												
23 Dec	N25W32	5	plage												
24 Dec	N25W46	6	plage												
25 Dec	N25W60	6	plage												
26 Dec	N25W74	7	plage												
27 Dec	N25W88	8	plage												
								0	0	0	0	0	0	0	0

Crossed West Limb.
Absolute heliographic longitude: 3

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 3524													
16 Dec	N26E63	2	20	2	Hrx	2	A								
17 Dec	N26E49	3	20	2	Hrx	2	A	1							
18 Dec	N27E36	3	10	1	Axx	1	A	1			1				
19 Dec	N26E22	4	5	1	Axx	1	A								
20 Dec	N26E08	4	plage					2							
21 Dec	N27E05	354	10	4	Bxo	2	B	1							
22 Dec	N25W11	357	10	3	Axx	2	A								
23 Dec	N25W25	358	plage												
24 Dec	N25W39	359	plage												
25 Dec	N25W53	359	plage												
26 Dec	N25W67	359	plage												
27 Dec	N25W81	359	plage												
								5	0	0	1	0	0	0	0

Crossed West Limb.
Absolute heliographic longitude: 354

		Region 3525													
16 Dec	S09E45	20	20	3	Bxo	4	B								
17 Dec	S09E31	21	20	4	Cro	3	B								
18 Dec	S09E17	22	10	1	Axx	1	A								
19 Dec	S05E03	23	5	1	Axx	1	A								
20 Dec	S05W12	24	plage												
21 Dec	S05W27	26	plage												
22 Dec	S05W42	28	plage												
23 Dec	S05W57	30	plage												
24 Dec	S05W72	32	plage												
25 Dec	S05W87	33	plage												
								0	0	0	0	0	0	0	0

Crossed West Limb.
Absolute heliographic longitude: 23

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 3526													
17 Dec	N15E69	343	20	3	Cao	3	B	1			1				
18 Dec	N15E57	342	30	2	Cao	2	B	2							
19 Dec	N15E44	342	190	5	Dao	5	B								
20 Dec	N15E30	342	200	6	Cao	6	B	1			2				
21 Dec	N15E17	342	170	4	Cai	8	B	1							
22 Dec	N15E04	342	150	5	Dai	8	B	1			3				
23 Dec	N15W09	342	130	5	Cai	8	B								
24 Dec	N14W22	342	50	5	Cao	5	B								
25 Dec	N15W35	341	10	3	Bxo	2	B								
26 Dec	N13W50	342	10	2	Bxo	2	B	1							
27 Dec	N13W64	344	plage												
28 Dec	N13W78	345	plage												
								7	0	0	6	0	0	0	0

Crossed West Limb.
Absolute heliographic longitude: 342

		Region 3528													
18 Dec	N09E12	27	50	4	Dsi	9	BD	2			3				
19 Dec	N08E01	25	110	7	Dao	10	B	3			3	1			
20 Dec	N09W14	26	140	7	Dai	9	B								
21 Dec	N08W28	27	170	7	Dai	9	B	1			3				
22 Dec	N08W41	27	190	8	Dai	11	B	1							
23 Dec	N08W54	27	200	9	Dai	11	B								
24 Dec	N08W68	28	190	9	Dao	7	B				1				
25 Dec	N07W83	29	130	6	Dao	3	B	2			1				
26 Dec	N09W94	26	30	1	Hsx	1	A	3							
								12	0	0	11	1	0	0	0

Crossed West Limb.
Absolute heliographic longitude: 25

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 3529												
18 Dec	S20E56	343	60	5	Dsi	8	B								
19 Dec	S19E42	344	250	6	Dki	8	BG	2							
20 Dec	S19E27	345	450	8	Dko	6	BD				1				
21 Dec	S21E15	344	430	10	Dko	18	BG	3			2				
22 Dec	S20E01	345	420	11	Eho	8	B				1				
23 Dec	S20W12	345	420	12	Eko	5	B								
24 Dec	S21W25	345	400	14	Eho	7	BG	5	2		3	2			
25 Dec	S20W37	343	320	12	Eho	4	B				1				
26 Dec	S21W52	344	300	14	Eho	6	B	3			2				
27 Dec	S20W62	342	270	10	Dho	4	B	2							
28 Dec	S20W76	343	130	14	Eao	2	B								
29 Dec	S22W91	345	40	3	Dao	3	B								
								15	2	0	10	2	0	0	0

Crossed West Limb.
Absolute heliographic longitude: 345

			Region 3530												
19 Dec	N09E63	323	50	7	Cao	4	B								
20 Dec	N08E49	323	180	9	Dao	4	BG	1			1				
21 Dec	N08E36	323	30	8	Bxo	3	B								
22 Dec	N08E24	322	30	9	Cro	5	B				1				
23 Dec	N08E07	326	30	4	Cro	5	B	3			2				
24 Dec	N08W06	326	80	5	Dai	12	B	2			3				
25 Dec	N08W19	325	40	6	Cai	9	B	3			2				
26 Dec	N08W34	326	60	6	Dao	3	B								
27 Dec	N07W46	325	50	5	Cao	6	B								
28 Dec	N07W60	327	20	5	Cao	4	B								
29 Dec	N06W77	330	70	4	Dao	6	B	3							
30 Dec	N07W90	330	plage					6							
								18	0	0	9	0	0	0	0

Crossed West Limb.
Absolute heliographic longitude: 326

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 3531												
20 Dec	S20E68	304	60	3	Hax	1	A	1							
21 Dec	S21E55	304	70	2	Hsx	1	A								
22 Dec	S20E42	304	80	3	Hsx	1	A								
23 Dec	S20E29	304	90	3	Hax	1	A								
24 Dec	S20E16	304	120	3	Hax	2	A								
25 Dec	S20E03	302	160	4	Hax	3	A				1				
26 Dec	S19W10	302	200	8	Cso	7	B								
27 Dec	S19W22	301	150	6	Cso	2	B								
28 Dec	S20W36	303	140	7	Cso	2	B								
29 Dec	S20W53	306	210	9	Cso	2	B								
30 Dec	S20W66	307	200	2	Hsx	1	A								
31 Dec	S20W77	304	160	3	Hsx	1	A	1							
								2	0	0	1	0	0	0	0

Still on Disk.
Absolute heliographic longitude: 302

			Region 3532												
22 Dec	S15W58	44	10	3	Bxo	3	B								
23 Dec	S15W71	44	20	4	Bxo	2	B				1				
24 Dec	S15W83	43	plage												
								0	0	0	1	0	0	0	0

Crossed West Limb.
Absolute heliographic longitude: 44

			Region 3533												
22 Dec	N15E44	302	10	4	Bxo	5	B								
23 Dec	N15E29	304	20	4	Bxo	5	B								
24 Dec	N15E16	304	40	5	Cri	8	B								
25 Dec	N15E03	304	10	6	Bxo	6	B	1							
26 Dec	N15W09	301	10	5	Bxo	4	B								
27 Dec	N15W22	301	10	3	Axx	1	A								
28 Dec	N14W36	303	110	7	Dao	7	B	2							
29 Dec	N14W52	305	170	8	Dao	9	B	5			1				
30 Dec	N14W66	307	120	6	Cao	5	B								
31 Dec	N14W78	305	20	5	Bxo	2	B								
								8	0	0	1	0	0	0	0

Still on Disk.
Absolute heliographic longitude: 304

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 3534													
27 Dec	S12E60	218	20	3	Cro	4	B	2							
28 Dec	S12E47	220	20	8	Cro	5	B	1							
29 Dec	S13E30	223	90	9	Dao	9	B								
30 Dec	S13E15	226	150	9	Dao	12	B	1							
31 Dec	S13E03	224	120	8	Dao	10	B								
								4	0	0	0	0	0	0	0

Still on Disk.
Absolute heliographic longitude: 224

		Region 3535													
28 Dec	S05W18	285	10	3	Bxo	3	B								
29 Dec	S05W31	284	2	1	Axx	3	A								
30 Dec	S05W46	287	plage												
31 Dec	S05W60	287	plage												
								0	0	0	0	0	0	0	0

Still on Disk.
Absolute heliographic longitude: 285

		Region 3536													
30 Dec	N05E90	152	plage					1							
31 Dec	N05E75	152	80	3	Hax	2	A	7	1	1				1	
								8	1	1	0	0	0	1	0

Still on Disk.
Absolute heliographic longitude: 152

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/sites/default/files/images/u2/Usr_guide.pdf -- User Guide