

## **Space Weather Highlights 10 - 16 November 2003**

**SWO PRF 1472  
18 November 2003**

Solar activity ranged from low to moderate levels. The summary period began on 10 November with low level activity. Region 498 (S04, L=170, class/area Dao/220 on 11 November) exhibited a brief period of rapid growth on 10–11 November. During this rapid growth period, Region 498 produced moderate level activity with an M1/Sf flare at 1351 UTC on 11 November. Associated with this M1 flare was a Tenflare, a Type II (481 km/s) radio sweep, and a large CME, which was mostly westward directed and measured approximately 1100 km/s plane of sky speed. Activity returned to low levels on 12 November. As Region 498 rotated beyond the west limb on 13 November, new Region 501 (N03, L=002 class/area Dki/380 on 16 November) rotated onto the east limb as a magnetically complex group with a beta-gamma-delta configuration. Region 501 produced two M1 flares on 13 November, one at 0501 UTC and the other at 0929 UTC. The latter M1 flare was a long duration event with an associated Type II radio sweep (595 km/s). From 14–16 November, the region produced low level activity with numerous C-class flares, the largest of which was a C7/Sf at 1039 UTC on 16 November.

Solar wind data were available from the NASA Advanced Composition Explorer (ACE) spacecraft during most of the summary period. Solar wind speed was elevated near 550 km/s early on 10 November with an increasing trend. By 11 November, solar wind speed reached peak values near 800 km/s due to a coronal hole high speed stream. The Bz component of the IMF was on average slightly southward from 10–16 November with the characteristic north-south oscillation associated with coronal hole high speed streams. Bz reached peak values near  $-15$  nT. Other significant activity observed during the summary period included a shock passage measured by the NASA/ACE spacecraft at approximately 0520Z on 15 November. The shock produced a 100 km/s jump in solar wind speed and a four-hour period of southward Bz near  $-10$  nT.

There were no greater than 10 MeV proton events at geosynchronous orbit during the summary period.

The greater than 2 MeV electron flux at geosynchronous orbit reached high levels everyday during the period, 10 - 16 November.

Geomagnetic activity ranged from quiet to major storm levels. The dominant source of activity during the week was a large trans-equatorial coronal hole and associated high speed stream. Active to minor storm levels were observed every day during the week and major storm levels were observed on 11, 13, and 15 November. Major storm levels on 15 November were due to the combined effects of the high speed stream and shock passage.

## **Space Weather Outlook 19 November - 15 December 2003**

Solar activity is expected to range from very low to high levels. Old Regions 484 and 488 have returned as Regions 501 and 507 (N10, L=293) respectively. Old Region 486 (S22, L=290) which was very active last rotation is due to return to the visible disk on 19 November. Activity is expected to be at low to moderate levels with periods of high level activity during the first half of the period. Activity in the second half of the period is expected to be at very low to moderate levels.

Proton producing flares are possible from Region 501 and 507 during the first half of the period.

The greater than 2 MeV electron flux at geosynchronous orbit is expected to reach high levels on 19–21 November due to high speed stream effects. Late in the period as this large trans-equatorial coronal hole returns to a geoeffective position the electron flux is expected to reach high levels again (09–15 December).

The geomagnetic field is expected to range from quiet to major storm levels. Residual high speed stream effects are expected to diminish by 20 November. Transient effects from CMEs observed on 17–18 November will likely combine with high speed stream effects to produce major storm levels on 19–21 November. Additional geomagnetic activity is possible during the first half of the period, in association with major flares and CMEs expected from Regions 501 and 507.



### *Daily Solar Data*

Date	Radio Flux 10.7 cm	Sun spot No.	Sunspot Area (10 <sup>-6</sup> hemi.)	X-ray Background	Flares							
					X-ray Flux			Optical				
					C	M	X	S	1	2	3	4
10 November	95	47	210	B1.0	2	0	0	2	0	0	0	0
11 November	96	43	280	B1.8	1	1	0	1	0	0	0	0
12 November	99	39	220	B2.2	4	0	0	0	0	0	0	0
13 November	102	25	450	B3.2	2	2	0	0	0	0	0	0
14 November	99	34	350	B2.2	4	0	0	0	0	0	0	0
15 November	98	52	360	B1.9	3	0	0	1	0	0	0	0
16 November	104	54	390	B2.9	6	0	0	3	0	0	0	0

### *Daily Particle Data*

Date	Proton Fluence (protons/cm <sup>2</sup> -day-sr)			Electron Fluence (electrons/cm <sup>2</sup> -day-sr)		
	>1MeV	>10MeV	>100MeV	>.6MeV	>2MeV	>4MeV
10 November	2.0E+6	1.1E+5	3.2E+3		5.6E+7	
11 November	2.1E+7	8.9E+4	3.1E+3		5.4E+7	
12 November	1.5E+7	5.9E+4	3.1E+3		4.4E+8	
13 November	2.0E+7	5.2E+4	3.0E+3		5.0E+8	
14 November	8.1E+6	4.3E+4	2.6E+3		2.4E+8	
15 November	1.5E+7	3.1E+4	2.3E+3		2.4E+8	
16 November	1.5E+7	1.7E+4	2.0E+3		4.6E+8	

### *Daily Geomagnetic Data*

Date	Middle Latitude Fredericksburg		High Latitude College		Estimated Planetary	
	A	K-indices	A	K-indices	A	K-indices
	10 November	15	3-3-3-3-3-3-3-3	52	3-4-4-6-6-6-6-4	30
11 November	39	5-4-5-4-4-4-4-6	104	4-6-7-7-7-7-7-4	51	5-6-5-6-5-5-5-4
12 November	20	4-3-3-3-3-5-3-2	54	3-3-6-7-5-6-5-2	26	4-4-4-5-4-4-4-3
13 November	28	3-4-4-4-5-4-4-4	109	3-4-6-8-8-7-6-5	42	3-5-4-5-6-5-5-4
14 November	21	5-4-3-3-3-3-3-3	75	4-5-7-7-7-4-5-4	37	5-5-5-5-5-3-4-3
15 November	21	2-4-5-3-3-4-3-3	66	3-3-7-7-6-6-4-4	40	3-4-6-5-5-5-4-4
16 November	32	3-4-4-3-5-5-4-5	63	4-4-6-6-6-6-6-5	35	4-5-5-5-4-5-4-4

### *Alerts and Warnings Issued*

Date & Time of Issue	Type of Alert or Warning	Date & Time of Event UT
10 Nov 1105	WARNING: Geomagnetic K= 5	10 Nov 1108 - 1800
10 Nov 1349	ALERT: Electron 2MeV Integral Flux > 1000pfu	10 Nov 1055
10 Nov 1449	EXTENDED WARNING: Geomagnetic K= 4	08 Nov 1649 -11 Nov 1500
10 Nov 2001	WATCH: Geomagnetic A ≥ 20	13 Nov
10 Nov 2333	WARNING: Geomagnetic K= 5	10 Nov 2335 -11Nov 0300
11 Nov 0015	2 – 245 MHz Radio Bursts	10 Nov
11 Nov 0349	WARNING: Geomagnetic K= 5	11 Nov 0350 - 1500

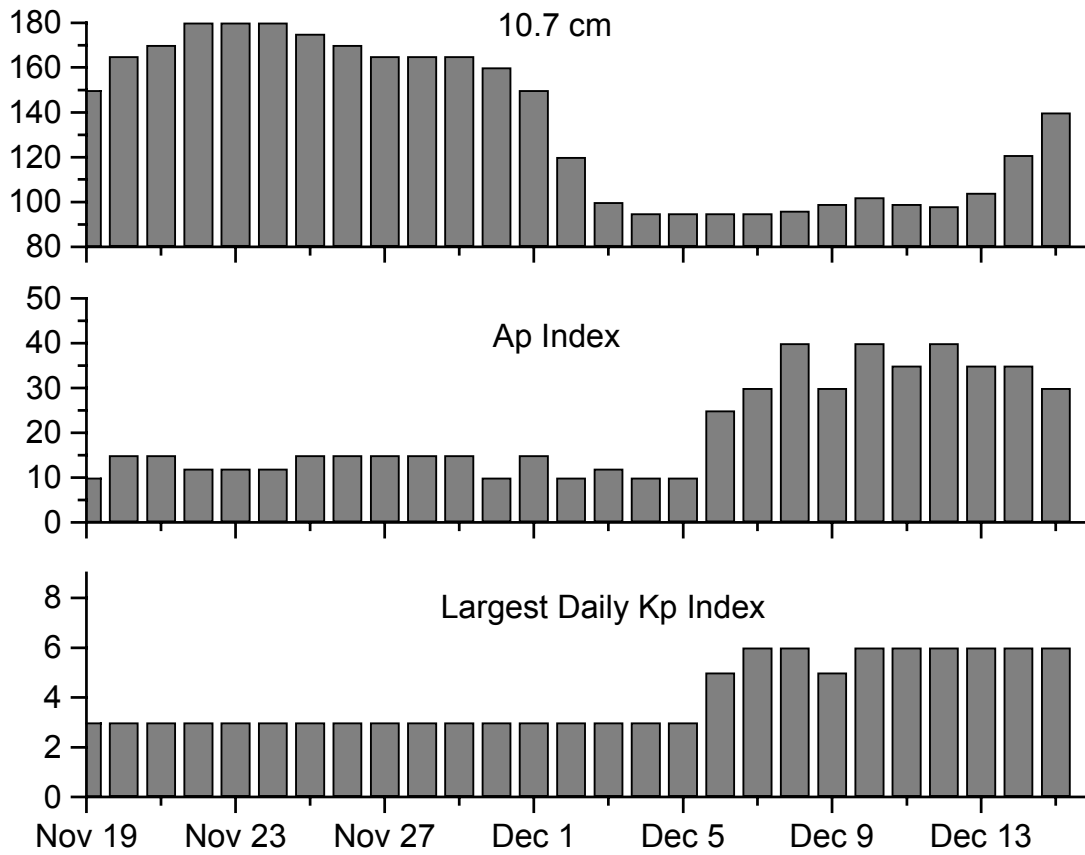


*Alerts and Warnings Issued - continued.*

<u>Date &amp; Time of Issue</u>	<u>Type of Alert or Warning</u>	<u>Date &amp; Time of Event UT</u>
11 Nov 0353	ALERT: Geomagnetic K = 5	11 Nov 0352
11 Nov 0359	ALERT: Geomagnetic K = 6	11 Nov 0357
11 Nov 0424	WARNING: Geomagnetic K $\geq$ 7	11 Nov 0424 - 0600
11 Nov 0438	ALERT: Geomagnetic K $\geq$ 7	11 Nov 0435
11 Nov 0517	ALERT: Geomagnetic K = 6	11 Nov 0515
11 Nov 0614	ALERT: Type II Radio Emission	11 Nov 0535
11 Nov 1337	ALERT: Electron 2MeV Integral Flux > 1000pfu	11 Nov 1320
11 Nov 1352	ALERT: Type II Radio Emission	11 Nov 1339
11 Nov 1427	SUMMARY: 10cm Radio Burst	11 Nov 1330
11 Nov 1446	EXTENDED WARNING: Geomagnetic K= 5	11 Nov 0350 - 2359
11 Nov 2122	WATCH: Geomagnetic A $\geq$ 20	14 Nov
11 Nov 2356	WARNING: Geomagnetic K = 4	11 Nov 2357 -12 Nov 1500
12 Nov 0012	2 – 245 MHz Radio Bursts	11 Nov
12 Nov 0056	WARNING: Geomagnetic K = 5	12 Nov 0057 - 1500
12 Nov 0104	ALERT: Geomagnetic K = 5	12 Nov 0101
12 Nov 0533	ALERT: Electron 2MeV Integral Flux > 1000pfu	12 Nov 0515
12 Nov 1433	EXTENDED WARNING: Geomagnetic K= 5	12 Nov 0057 - 2359
12 Nov 1901	SUMMARY: 10cm Radio Burst	12 Nov 1759
12 Nov 2154	WATCH: Geomagnetic A $\geq$ 20	15 Nov
12 Nov 2344	WARNING: Geomagnetic K = 4	12 Nov 2350 -13 Nov 1500
12 Nov 2356	EXTENDED WARNING: Geomagnetic K=4	12 Nov 2350 -13 Nov 2359
13 Nov 0012	2 – 245 MHz Radio Bursts	12 Nov
13 Nov 0443	ALERT: Geomagnetic K = 5	13 Nov 0441
13 Nov 0517	SUMMARY: 10cm Radio Burst	13 Nov 0457
13 Nov 0520	ALERT: Electron 2MeV Integral Flux > 1000pfu	13 Nov 0500
13 Nov 0948	SUMMARY: 10cm Radio Burst	13 Nov 0907
13 Nov 0949	ALERT: Type II Radio Emission	13 Nov 0924
13 Nov 1253	ALERT: Geomagnetic K = 5	13 Nov 1252
13 Nov 1553	ALERT: Geomagnetic K = 5	13 Nov 1550
13 Nov 2235	WARNING: Geomagnetic K = 5	13 Nov 2235 -14 Nov 1500
13 Nov 2258	WATCH: Geomagnetic A $\geq$ 20	16 Nov
13 Nov 2326	ALERT: Geomagnetic K = 5	13 Nov 2320
14 Nov 0058	ALERT: Geomagnetic K = 6	14 Nov 0054
14 Nov 0827	ALERT: Electron 2MeV Integral Flux > 1000pfu	14 Nov 0810
14 Nov 1713	WATCH: Geomagnetic A $\geq$ 20	17 Nov
14 Nov 1736	WARNING: Geomagnetic K = 4	14 Nov 1740 -15 Nov 1500
14 Nov 1859	ALERT: Geomagnetic K = 4	14 Nov 1858
14 Nov 1922	WARNING: Geomagnetic K = 5	14 Nov 1925 - 2359
15 Nov 0028	1 - 245 MHz Burst	14 Nov
15 Nov 0526	ALERT: Electron 2MeV Integral Flux > 1000pfu	15 Nov 0500
15 Nov 0704	WARNING: Geomagnetic K = 5	15 Nov 0704 - 1500
15 Nov 0707	ALERT: Geomagnetic K = 5	15 Nov 0707
15 Nov 0803	WARNING: Geomagnetic K = 6	15 Nov 0803 - 1500
15 Nov 0810	ALERT: Geomagnetic K = 6	15 Nov 0810
15 Nov 1453	EXT WARNING: Geomagnetic K = 5	15 Nov 0704 - 2359
15 Nov 1455	EXTENDED WARNING: Geomagnetic K = 4	14 Nov 1740 -16 Nov 1500
15 Nov 2052	WATCH: Geomagnetic A $\geq$ 20	18 Nov
15 Nov 2346	EXT WARNING: Geomagnetic K= 5	15 Nov 0704 -16 Nov 1500
16 Nov 0034	1 - 245 MHz Burst	15 Nov
16 Nov 0516	ALERT: Electron 2MeV Integral Flux > 1000pfu	16 Nov 0500
16 Nov 1457	EXT WARNING: Geomagnetic K = 5	15 Nov 0704 -17 Nov 1500



### Twenty-seven Day Outlook



Date	Radio Flux 10.7 cm	Planetary A Index	Largest Kp Index	Date	Radio Flux 10.7 cm	Planetary A Index	Largest Kp Index
19 Nov	150	10	3	03 Dec	100	12	3
20	165	15	3	04	95	10	3
21	170	15	3	05	95	10	3
22	180	12	3	06	95	25	6
23	180	12	3	07	95	30	6
24	180	12	3	08	96	40	5
25	175	15	3	09	99	30	6
26	170	15	3	10	102	40	6
27	165	15	3	11	99	35	6
28	165	15	3	12	98	40	6
29	165	15	3	13	104	35	6
30	160	10	3	14	121	35	6
01 Dec	150	15	3	15	140	30	6
02	120	10	3				



### *Energetic Events*

Date	Time		X-ray		Optical Information			Peak		Sweep Freq		
	Begin	Max	½ Max	Class	Integ Flux	Imp/ Brtns	Location		Radio Flux		Intensity	
							Lat	CMD	245	2695	II	IV
11 Nov	1321	1351	1417	M1.6	.032	Sf	S03W61		200	1100	2	
13 Nov	0454	0501	0506	M1.6	.006					100		
13 Nov	0903	0929	1002	M1.4	.035				450	130	3	

### *Flare List*

Date	Time			X-ray Class.	Optical Imp / Brtns	Location Lat CMD	Rgn
	Begin	Max	End				
10 November	0823	0828	0832	B2.1			
	1029	1032	1035	B1.9			
	1126	1130	1134	B1.9			
	1346	1350	1352	B5.0			
	1623	1633	1636	B2.9			
	1742	1749	1751	B4.3			
	1856	1901	1904	B8.0			
	B2013	U2015	2018	C1.5	Sf	S10W38	500
	2028	2032	2034	B3.2			
	2125	2129	2131	C1.9			
11 November	2239	2242	2244	B2.2			
	2317	2317	2321	B4.0	Sf	N00W51	498
	2325	2332	2334	B8.3			
	0526	0551	0622	B7.8			
	1335	1347	1426	M1.6	Sf	S03W61	498
	1523	1615	1717	C8.5			
	2129	2135	2152	B7.1			
12 November	0110	0115	0120	B4.1			
	0928	0938	0944	C1.8			
	1238	1250	1312	B5.2			
	1342	1352	1358	C2.3			
	1754	1819	1835	C3.2			
	2124	2128	2132	B6.1			
	2156	2201	2207	C1.0			
	2246	2249	2255	B4.9			
	2258	2301	2306	B5.7			
	13 November	0454	0501	0506	M1.6		
0903		0929	1002	M1.4			501
1102		1108	1114	C5.0			
1544		1600	1615	C1.6			
2024		2027	2052	B6.6			500
14 November	0045	0048	0051	B5.8			501
	0220	0226	0232	B6.3			501
	0237	0240	0245	B5.1			501



**Flare List - continued.**

Date	Time			X-ray Class.	Optical		Rgn
	Begin	Max	End		Imp / Brtns	Location Lat CMD	
14 November	0905	0914	0928	B5.0			501
	1030	1042	1046	C1.0			501
	1248	1257	1301	C1.4			501
	1344	1359	1409	C1.4			501
	1410	1415	1419	C1.7			501
	1708	1715	1732	B8.2			501
	2002	2005	2009	B3.4			501
	2019	2028	2031	B9.6			501
15 November	2249	2253	2255	B6.0			501
	0245	0250	0254	B6.2			
	0347	0357	0412	B7.0			
	0440	0444	0448	C1.2			501
	0930	0936	0943	B5.4			
	1307	1311	1316	B5.6			501
	1330	1334	1336	B3.5			501
	1552	1557	1600	B3.4			501
16 November	1716	1732	1744	C1.0			501
	1858	1909	1924	C2.0	Sf	N02E38	501
	0400	0407	0413	C1.1			
	0749	0754	0758	C1.9			
	0834	0839	0843	C1.0			
	B1018	U1020	1034	C7.0	Sf	N01E44	501
	1538	1539	1546	B4.7	Sf	N04E22	502
	1656	1659	1725	B6.5			
	1811	1814	1838	C4.9	Sf	N01E39	501
	1850	1853	1858	C2.6			501
2335	2348	0005	B9.9			501	

**Region Summary**

Date	Location		Sunspot Characteristics				Flares							
	Helio (° Lat ° CMD)	Lon	Area (10 <sup>-6</sup> hemi)	Extent (helio)	Spot Class	Spot Count	Mag Class	X-ray			Optical			
								C	M	X	S	1	2	3

*Region 498*

08 Nov	S03W26	168	0020	03	Dro	004	B										
09 Nov	S04W39	168	0030	03	Dso	006	B										
10 Nov	S04W49	165	0120	04	Dao	007	B					1					
11 Nov	S04W67	170	0220	06	Dao	005	B	1			1						
12 Nov	S02W80	170	0190	05	Dso	005	B										
13 Nov	S02W91	168	0110	05	Dao	002	B										
								0	1	0	2	0	0	0	0	0	0

Crossed West Limb.

Absolute heliographic longitude: 168



**Region Summary - continued.**

Date	Location		Sunspot Characteristics				Flares							
	( ° Lat ° CMD)	Helio	Area (10 <sup>-6</sup> hemi)	Extent (helio)	Spot Class	Spot Count	Mag Class	X-ray			Optical			
		Lon						C	M	X	S	1	2	3

*Region 499*

08 Nov	S17W19	161	0030	04	Dso	005	B											
09 Nov	S16W33	162	0040	07	Dao	004	B											
10 Nov	S17W46	162	0050	08	Dso	003	B											
11 Nov	S18W62	165	0030	05	Cro	003	B											
12 Nov	S16W74	164	0020	09	Dro	002	B											
13 Nov	S16W87	164																

Crossed West Limb.

Absolute heliographic longitude: 161

*Region 500*

09 Nov	S08W22	151	0030	04	Cao	007	B											
10 Nov	S09W36	152	0040	06	Cso	007	B	1			1							
11 Nov	S09W50	153	0030	07	Cro	005	B											
12 Nov	S07W61	151	0010	01	Bxo	002	B											
13 Nov	S07W74	151																
14 Nov	S07W87	151																

Crossed West Limb.

Absolute heliographic longitude: 151

*Region 501*

13 Nov	N05E65	012	0340	20	Fso	003	B				2							
14 Nov	N04E61	002	0340	08	Dki	011	Bg	4										
15 Nov	N03E48	002	0340	06	Dki	014	Bg	3			1							
16 Nov	N03E35	002	0380	05	Dki	020	Bg	3			2							

Still on Disk.

Absolute heliographic longitude: 002

*Region 502*

14 Nov	N05E41	022	0010	03	Bxo	003	B											
15 Nov	N04E27	023	0000	01	Axx	001	A											
16 Nov	N04E24	013																

Still on Disk.

Absolute heliographic longitude: 013



***Region Summary - continued.***

Date	Location		Sunspot Characteristics				Flares							
	( ° Lat ° CMD)	Helio	Area (10 <sup>-6</sup> hemi)	Extent (helio)	Spot Class	Spot Count	Mag Class	X-ray			Optical			
		Lon						C	M	X	S	1	2	3

*Region 503*

15 Nov	N17E09	041	0020	03	Dao	007	B										
16 Nov	N17W05	042	0010	05	Cso	003	B										
								0	0	0	0	0	0	0	0	0	0

Still on Disk.

Absolute heliographic longitude: 042

*Region 504*

16 Nov	N04W51	088	0000	01	Axx	001	A										
								0	0	0	0	0	0	0	0	0	0

Still on Disk.

Absolute heliographic longitude: 088



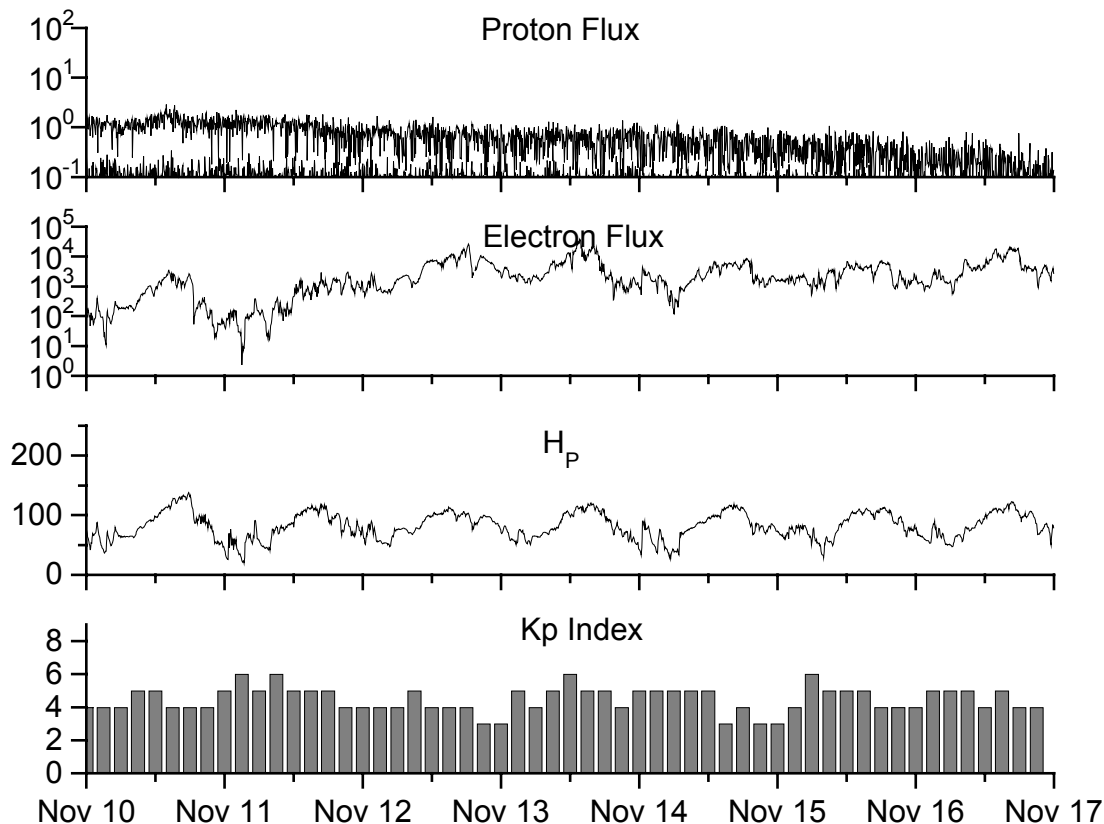


**Recent Solar Indices (preliminary)  
of the observed monthly mean values**

Month	Sunspot Numbers			Radio Flux		Geomagnetic			
	Observed values SWO	Ratio RI	Ratio RI/SWO	Smooth values SWO	Smooth values RI	*Penticton 10.7 cm	Smooth Value	Planetary Ap	Smooth Value
<b>2001</b>									
November	178.6	106.5	0.60	183.7	115.5	212.7	193.7	16	12.0
December	217.5	132.2	0.61	184.5	114.6	235.6	193.9	09	12.2
<b>2002</b>									
January	189.0	114.1	0.60	184.8	113.5	227.3	194.6	08	12.3
February	194.5	107.4	0.55	188.6	114.7	205.0	197.2	10	12.8
March	153.1	98.4	0.64	188.9	113.3	180.3	195.7	10	12.9
April	194.9	120.7	0.62	186.2	110.5	189.8	191.5	15	13.2
May	204.1	120.8	0.59	183.6	108.9	178.4	188.0	15	13.3
June	146.0	88.3	0.60	179.9	106.3	148.7	183.0	11	13.5
July	183.5	99.6	0.54	175.4	102.7	173.5	176.3	11	13.7
August	191.0	116.4	0.61	169.2	98.7	183.9	169.5	16	14.2
September	206.4	109.6	0.53	163.4	94.6	175.8	164.1	14	15.0
October	153.9	97.5	0.63	158.8	90.5	167.0	159.4	23	15.6
November	159.8	95.5	0.60	150.9	85.2	168.7	154.8	16	16.3
December	147.9	80.8	0.55	144.6	82.1	158.6	150.9	13	17.0
<b>2003</b>									
January	149.3	79.7	0.53	141.7	81.0	144.0	149.2	13	18.2
February	87.0	46.0	0.53	136.4	78.5	124.5	144.7	17	18.9
March	119.7	61.1	0.51	128.1	74.2	132.2	139.5	21	19.4
April	119.7	60.0	0.50	121.5	70.3	126.3	136.3	20	20.0
May	89.6	55.2	0.62			129.3		26	
June	118.4	77.4	0.65			129.4		24	
July	132.8	85.0	0.64			127.8		20	
August	114.3	72.7	0.64			122.1		23	
September	82.6	48.8	0.59			112.3		19	
October	118.9	65.6	0.55			153.1		32	

**NOTE:** All smoothed values after September 2002 and monthly values after March 2003 are preliminary estimates. The lowest smoothed sunspot index number for Cycle 22, RI = 8.0, occurred in May 1996. The highest smoothed sunspot number for Cycle 23, RI = 120.8, occurred April 2000. \*After June 1991, the 10.7 cm radio flux data source is Penticton, B.C. Canada. Prior to that, it was Ottawa.





*Weekly Geosynchronous Satellite Environment Summary*

*Week Beginning 10 November 2003*

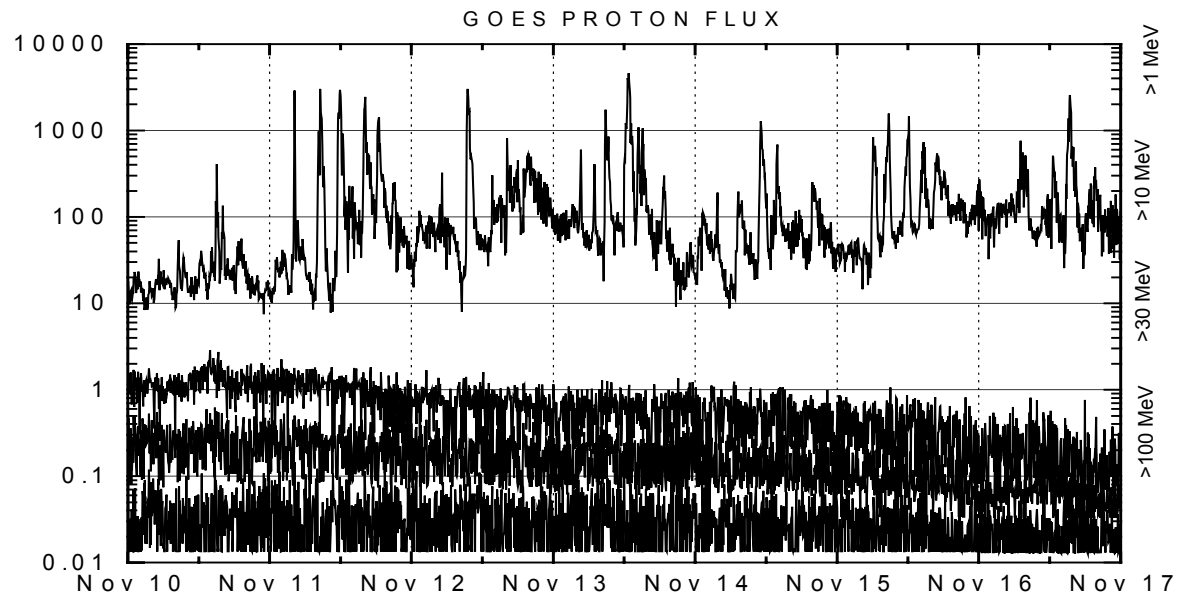
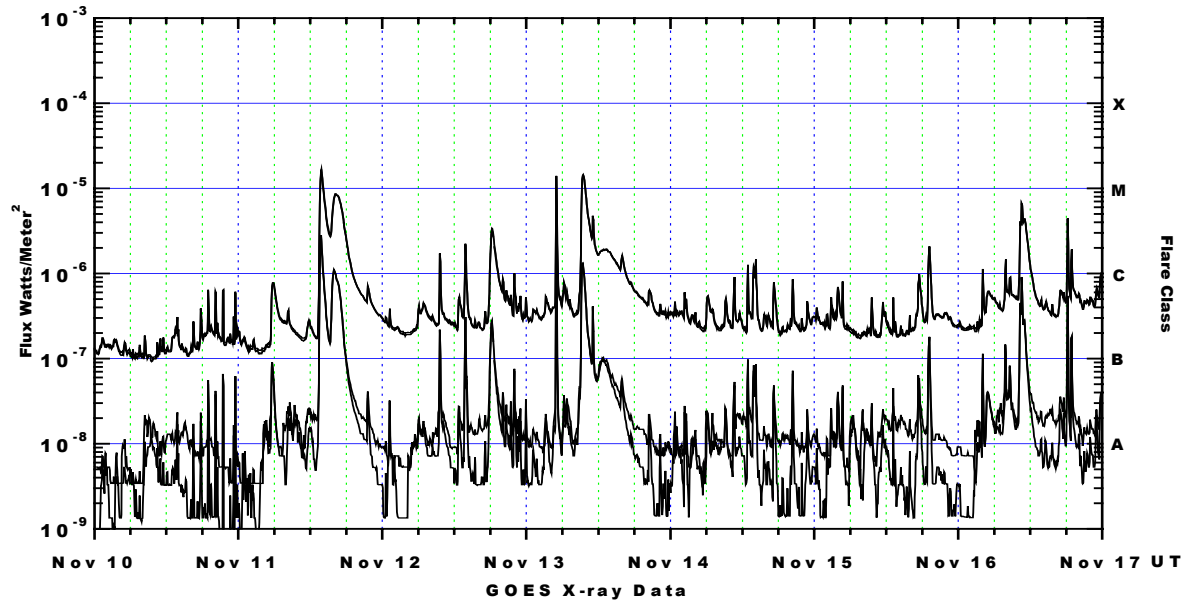
*Protons* plot contains the five-minute averaged integral proton flux (protons/cm<sup>2</sup>-sec-sr) as measured by GOES-11 (W113) for each of three energy thresholds: greater than 10, 50, and 100 MeV.

*Electrons* plot contains the five-minute averaged integral electron flux (electrons/cm<sup>2</sup>-sec-sr) with energies greater than 2 MeV at GOES-12.

*H<sub>p</sub>* plot contains the five minute averaged magnetic field H - component in nanoteslas (nT) as measured by GOES-12. The H component is parallel to the spin axis of the satellite, which is nearly parallel to the Earth's rotation axis.

*K<sub>p</sub>* plot contains the estimated planetary 3-hour K-index (derived by the Air Force Weather Agency) in real time from magnetometers at Meanook, Canada; Sitka, AK; Glenlea, Canada; St. Johns, Canada; Ottawa, Canada; Newport, WA; Fredericksburg, VA; Boulder, CO; Fresno, CA and Heartland, UK. These data are made available through cooperation from the Geological Survey of Canada (GSC) and the US Geological Survey. These may differ from the final K<sub>p</sub> values derived from a more extensive network of magnetometers. The data included here are those now available in real time at the SWO and are incomplete in that they do not include the full set of parameters and energy ranges known to cause satellite operating anomalies. The proton and electron fluxes and K<sub>p</sub> are "global" parameters that are applicable to a first order approximation over large areas. H<sub>p</sub> is subject to more localized phenomena and the measurements generally are applicable to within a few degrees of longitude of the measuring satellite.





*Weekly GOES Satellite X-ray and Proton Plots*

X-ray plot contains five-minute averaged x-ray flux (watts/m<sup>2</sup>) as measured by GOES 12 and 10 in two wavelength bands, .05 - .4 and .1 - .8 nm. The letters A, B, C, M and X refer to x-ray event levels for the .1 - .8 nm band.

Proton plot contains the five-minute averaged integral proton flux (protons/cm<sup>2</sup>-sec-sr) as measured by GOES-11 (W113) for each of the energy thresholds: >1, >10, >30 and >100 MeV. P10 event threshold is 10 pfu (protons/cm<sup>2</sup>-sec-sr) at greater than 10 MeV.



# Optical Flares



Space Environment Center



September 2003  
( Month 84 )

█ Preliminary data

Comparison of Cycles at current month in cycle

