

**Space Weather Highlights**  
**15 – 21 December 2003**

**SWO PRF 1477**  
**23 December 2003**

Solar activity was at very low to low levels this period. The period began on 15 December with very low level activity. From 16 – 21 December, activity was primarily at low levels. Region 525 (N09, L=291, class/area Dsi/130 on 21 December) underwent slow growth in both size and complexity during the period, and developed a beta-gamma magnetic configuration on 21 December. This region represents the third rotation of old Region 488 (previous rotation was Region 507). The majority of activity during the period came from Region 525, including two C8/Sf flares on 17 and 18 December, and the largest flare of the period, a C9/Sf at 0809 UTC on 19 December. Region 528 (N09, L=259, class/area Fho/390 on 21 December) rotated onto the visible disk on 18 December, and exhibited steady growth through most of the period. On 21 December, Region 528 was a moderate size beta-gamma spot group, producing occasional C-class activity.

Solar wind data were available from the NASA Advanced Composition Explorer (ACE) spacecraft during most of the summary period. Solar wind speeds were near 800 km/s at the beginning of the period due to a large transequatorial coronal hole. On 16 December, as the coronal hole rotated beyond a geoeffective position, wind speed began a steady decline to near 325 km/s by 19 December. Another, smaller elongated coronal hole rotated into a geoeffective position on 20 – 21 December with wind speeds reaching 625 km/s; however, Bz remained predominantly northward.

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 on 15 – 20 December.

The geomagnetic field ranged from unsettled to minor storm levels. The period began with activity at active to minor storm levels on 15 December. As the coronal hole high speed stream diminished, geomagnetic activity dropped to quiet to unsettled levels on 16 – 19 December. The onset of the second elongated coronal hole high speed stream produced unsettled to active conditions on 20 – 21 December.

**Space Weather Outlook**  
**24 December 2003 – 19 January 2004**

Solar activity is expected to range from very low to moderate levels. Moderate activity is possible from Regions 525 and 528 through 31 December. Expect mostly low activity levels in early January.

There is a small chance for a greater than 10 MeV proton event until the end of December.

The greater than 2 MeV electron flux at geosynchronous orbit is expected to reach high levels on 03 – 04 January and again on 07 – 14 January.

Geomagnetic activity is expected to range from quiet to major storm levels. Unsettled to minor storm periods are expected on 01 – 02 January due to high speed coronal hole streams. The large transequatorial coronal hole is expected to return on 04 – 12 January with major storm levels expected.



### *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
15 December	101	42	150	B2.0	0	0	0	0	0	0	0	0
16 December	106	71	340	B2.4	1	0	0	0	0	0	0	0
17 December	118	92	330	B3.8	4	0	0	1	0	0	0	0
18 December	123	114	510	B5.2	16	0	0	4	0	0	0	0
19 December	123	113	650	B4.6	9	0	0	7	0	0	0	0
20 December	130	104	630	B4.1	4	0	0	2	0	0	0	0
21 December	133	105	630	B4.0	5	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
	15 December	6.3E+6	1.3E+4	3.6E+3		8.4E+8
16 December	2.4E+6	1.1E+4	2.5E+3		9.0E+8	
17 December	2.4E+6	1.2E+4	2.6E+3		1.0E+9	
18 December	2.9E+6	1.2E+4	2.9E+3		1.3E+9	
19 December	4.4E+6	1.3E+4	3.0E+3		1.2E+9	
20 December	4.7E+6	1.3E+4	2.8E+3		2.3E+8	
21 December	7.1E+5	1.2E+4	2.8E+3		1.5E+7	

### *Daily Geomagnetic Data*

Date	Middle Latitude Fredericksburg		High Latitude College		Estimated Planetary	
	A	K-indices	A	K-indices	A	K-indices
	15 December	18	4-3-4-3-4-3-2-2	43	4-4-6-6-5-5-3-3	25
16 December	9	3-2-2-2-2-2-3-2	15	2-2-3-5-3-3-2-2	11	3-3-3-3-3-3-3-2
17 December	4	1-2-2-1-2-1-0-0	8	2-3-3-2-2-3-0-0	10	2-3-3-3-3-3-3-1
18 December	2	0-2-0-1-1-1-0-0	1	0-1-1-1-0-1-0-0	8	1-3-2-3-3-3-2-1
19 December	1	0-0-1-0-1-0-0-0	0	0-0-0-1-0-0-0-0	7	2-1-1-2-3-3-2-2
20 December	9	0-1-1-3-3-2-3-3	17	0-0-2-4-4-5-3-3	16	1-2-2-4-3-4-4-4
21 December	18	4-3-3-4-3-3-3-3	34	3-3-4-5-5-6-4-3	21	4-3-4-4-3-4-4-3

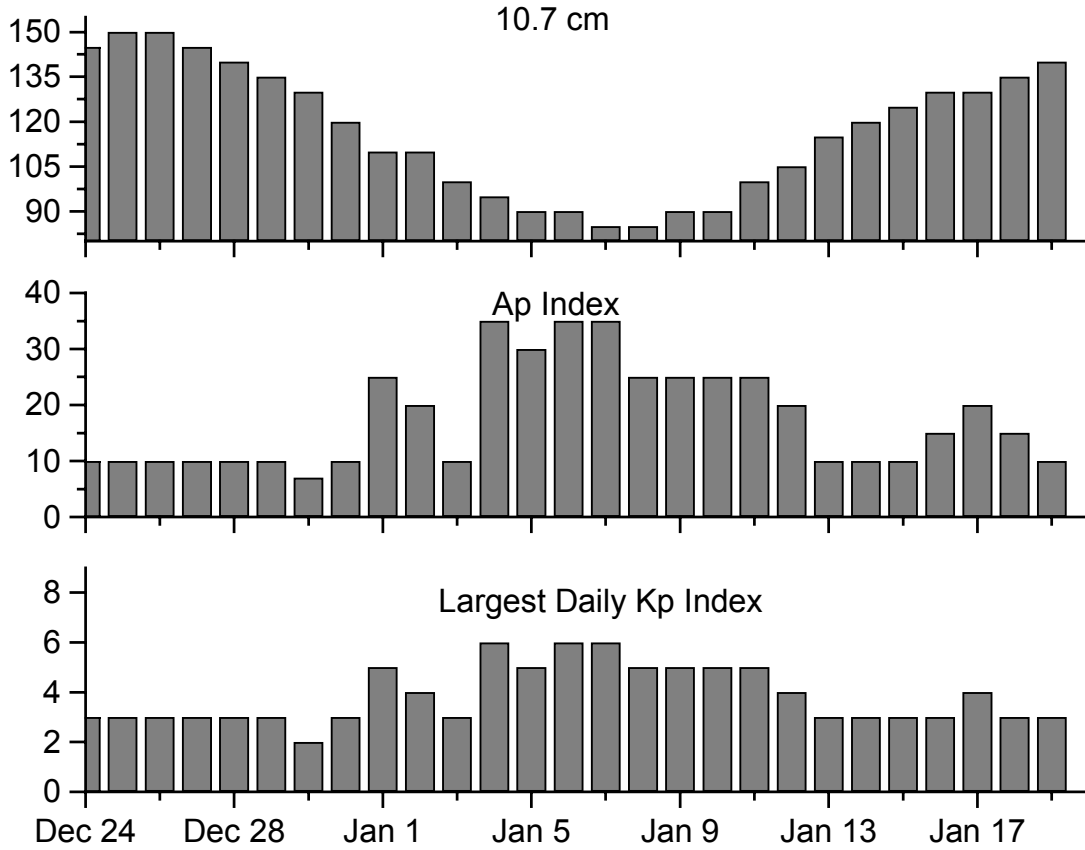


### *Alerts and Warnings Issued*

<u>Date &amp; Time of Issue</u>	<u>Type of Alert or Warning</u>	<u>Date &amp; Time of Event UT</u>
15 Dec 0004	245 MHz Radio Burst	14 Dec
15 Dec 0517	ALERT: Electron 2MeV Integral Flux > 1000pfu	15 Dec 0500
15 Dec 1455	EXTENDED WARNING: Geomagnetic K = 5	13 Dec 1705 – 15/2359
15 Dec 2354	WARNING: Geomagnetic K = 4	15 Dec 2356 – 16/1500
16 Dec 0517	ALERT: Electron 2MeV Integral Flux > 1000pfu	16 Dec 0500
17 Dec 0515	ALERT: Electron 2MeV Integral Flux > 1000pfu	17 Dec 0500
17 Dec 0601	ALERT: Geomagnetic K = 4	17 Dec 0558
17 Dec 1431	ALERT: STRATWARM	17 Dec
18 Dec 0516	ALERT: Electron 2MeV Integral Flux > 1000pfu	18 Dec 0500
18 Dec 1302	ALERT: STRATWARM	18 Dec
19 Dec 0519	ALERT: Electron 2MeV Integral Flux > 1000pfu	19 Dec 0500
19 Dec 1240	ALERT: STRATWARM	19 Dec
20 Dec 0031	245 MHz Radio Burst	19 Dec
20 Dec 0528	ALERT: Electron 2MeV Integral Flux > 1000pfu	20 Dec 0500
20 Dec 1044	WARNING: Geomagnetic K = 4	20 Dec 1043 – 21/1500
20 Dec 1047	ALERT: Geomagnetic K = 4	20 Dec 1045
20 Dec 1240	ALERT: STRATWARM	20 Dec
20 Dec 1751	WARNING: Geomagnetic K = 5	20 Dec 1751 – 2359
20 Dec 1756	ALERT: Geomagnetic K = 5	20 Dec 1753
20 Dec 2353	EXTENDED WARNING: Geomagnetic K = 5	20 Dec 1751 – 21/1500
21 Dec 0246	245 MHz Radio Burst	20 Dec
21 Dec 1159	ALERT: STRATWARM	21 Dec
21 Dec 1455	EXTENDED WARNING: Geomagnetic K = 4	20 Dec 1043 – 21/2359
21 Dec 2354	EXTENDED WARNING: Geomagnetic K = 4	20 Dec 1043 – 22/1600



### 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
24 Dec	145	10	3	07 Jan	85	35	6
25	150	10	3	08	85	25	5
26	150	10	3	09	90	25	5
27	145	10	3	10	90	25	5
28	140	10	3	11	100	25	5
29	135	10	3	12	105	20	4
30	130	7	2	13	115	10	3
31	120	10	3	14	120	10	3
01 Jan	110	25	5	15	125	10	3
02	110	20	4	16	130	15	3
03	100	10	5	17	130	20	4
04	95	35	6	18	135	15	3
05	90	30	5	19	140	10	3
06	90	35	6				



### *Energetic Events*

Date	Time		X-ray		Optical Information			Peak		Sweep Freq		
	Begin	Max	½ Max	Class	Integ Flux	Imp/ Brtns	Location Lat CMD	Rgn #	Radio Flux		Intensity	
									245	2695	II	IV

*No Events Observed*

### *Flare List*

Date	Time			X-ray Class.	Imp / Brtns	Optical		Rgn
	Begin	Max	End			Location Lat CMD		
15 December	0105	0113	0126	B5.6				
	0545	0552	0601	B4.9				
	0805	0809	0814	B3.0				
16 December	0107	0111	0120	B4.0				
	1313	1325	1332	C1.0				
17 December	0307	0307	0333	C8.6	Sf	N08E72		525
	0615	0623	0630	C1.8				
	0919	0928	0938	B8.2				
	1303	1309	1316	C1.0				521
	1432	1656	1715	B9.5				
	1841	1845	1900	B6.7				
	2011	2017	2023	C1.3				525
	2330	2339	2344	B8.8				
18 December	0028	0032	0039	C1.1				
	0101	0112	0126	C1.3				
	0146	0151	0155	C2.1				
	0412	0418	0427	C1.3				
	0525	0528	0535	B7.3				
	0839	0843	0847	C3.4				
	0925	0931	0935	C8.6	Sf	N08E53		525
	1053	1056	1107	B9.9				
	1142	1147	1150	C1.4				
	1200	1209	1211	C5.5				
	1234	1236	1240	C2.9	Sf	N10E47		525
	1343	1351	1359	C1.0				
	1420	1429	1437	C1.4				
	1624	1628	1632	B8.4				
	1836	1840	1843	C1.4				
	2018	2019	2022	C1.9	Sf	N11E47		525
2217	2217	2221	C3.5	Sf	N10E46		525	
2252	2257	2308	C1.7					
2342	2346	2354	C1.3					
19 December	0026	0027	0031	C2.5	Sf	N09E47		525
	0105	0105	0119	C4.6	Sf	N08E46		525
	0131	0139	0141	C2.0				
	0218	0220	0224		Sf	N09E46		525
	0619	0619	0625		Sf	N10E47		525



*Flare List - continued*

Date	Time			X-ray Class.	Optical		Rgn
	Begin	Max	End		Imp / Brtns	Location Lat CMD	
19 December	0659	0702	0706	C2.1	Sf	N09E43	525
	0809	0809	0835	C9.3	Sf	N08E40	525
	0922	0926	0928	B9.1			
	1220	1231	1239	C5.9			525
	1645	1646	1653	C5.4	Sf	N10E36	525
	2144	2149	2158	C2.3			525
	2207	2211	2214	C1.8			525
20 December	0010	0011	0020	C2.6	Sf	N08E32	525
	0156	0157	0205	C1.5	Sf	N08E31	525
	0204	0222	0243	C1.8			525
	1419	1431	1438	C1.8			525
	1726	1732	1740	B9.9			
21 December	0242	0244	0312	C4.5	Sf	N09E46	528
	0413	0414	0417	C2.0	Sf	S24E89	
	0620	0620	0626	B7.1	Sf	N08E12	525
	0728	0731	0734	B9.3			528
	1014	1018	1025	C2.1			525
	1253	1257	1301	C2.0			528
	2124	2130	2136	C1.1			528



### Region Summary

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 520

10 Dec	N03E75	006	0120	02	Hax	002	A											
11 Dec	N02E62	005	0100	03	Hax	001	A											
12 Dec	N02E47	007	0100	02	Hsx	001	A											
13 Dec	N02E33	008	0110	02	Hsx	001	A											
14 Dec	N02E19	009	0140	06	Dso	010	B											
15 Dec	N02E06	009	0080	06	Dso	005	B											
16 Dec	N01W07	008	0170	07	Dso	009	Bg											
17 Dec	N03W22	010	0110	07	Dso	004	B											
18 Dec	N03W35	010	0120	07	Dao	003	B											
19 Dec	N03W48	010	0100	07	Cso	003	B											
20 Dec	N03W61	010	0120	07	Cso	002	B											
21 Dec	N02W71	007	0080	02	Hsx	001	A											
								0	0	0	0	0	0	0	0	0	0	0

Still on Disk.

Absolute heliographic longitude: 009

#### Region 521

10 Dec	S11E82	359	0060	04	Dao	002	B											
11 Dec	S11E63	004	0110	08	Dso	003	B											
12 Dec	S12E48	004	0090	06	Cso	004	B											
13 Dec	S12E34	007	0080	06	Dso	004	B											
14 Dec	S12E21	007	0050	06	Dso	004	B											
15 Dec	S12E09	006	0040	06	Dso	003	B											
16 Dec	S11W05	006	0050	06	Dso	006	Bg											
17 Dec	S11W20	008	0020	07	Cro	005	B	1										
18 Dec	S12W34	009	0020	01	Hsx	003	A											
19 Dec	S12W47	009	0010	04	Bxo	002	B											
20 Dec	S12W60	009																
21 Dec	S12W73	009																
								1	0	0	0	0	0	0	0	0	0	

Still on Disk.

Absolute heliographic longitude: 006

#### Region 522

13 Dec	N16W50	091	0020	05	Cso	005	B											
14 Dec	N16W63	091	0030	05	Cso	004	B	1										
15 Dec	N15W76	091	0030	08	Cso	004	B											
16 Dec	N15W89	091																
								1	0	0	0	0	0	0	0	0	0	

Crossed West Limb.

Absolute heliographic longitude: 091



**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 523*

16 Dec	S15E72	289	0060	01	Hsx	002	A										
17 Dec	S15E58	290	0020	00	Axx	002	A										
18 Dec	S13E45	290	0040	03	Hax	002	A										
19 Dec	S17E34	288	0040	03	Cso	004	B										
20 Dec	S17E23	286	0020	03	Cso	002	B										
21 Dec	S17E09	287	0000	00	Axx	002	A										

0 0 0 0 0 0 0 0

Still on Disk.

Absolute heliographic longitude: 287

*Region 524*

16 Dec	S08E67	294	0030	01	Axx	002	A										
17 Dec	S08E54	294	0050	02	Hsx	001	A										
18 Dec	S07E39	296	0030	02	Hsx	002	A										
19 Dec	S08E25	297	0020	03	Cso	004	B										
20 Dec	S08E13	296	0010	03	Cso	002	B										
21 Dec	S08W03	299	0000	01	Bxo	002	B										

0 0 0 0 0 0 0 0

Still on Disk.

Absolute heliographic longitude: 299

*Region 525*

16 Dec	N10E68	293	0030	01	Axx	002	B										
17 Dec	N09E56	292	0070	04	Cso	005	B	2		1							
18 Dec	N09E44	291	0090	07	Dao	014	B	4		4							
19 Dec	N10E31	291	0180	10	Dki	014	B	7		7							
20 Dec	N09E17	292	0120	09	Dai	017	B	4		2							
21 Dec	N09E05	291	0130	09	Dsi	020	Bg	1		1							

18 0 0 15 0 0 0 0

Still on Disk.

Absolute heliographic longitude: 291

*Region 526*

17 Dec	N12W54	042	0030	01	Hrx	001	A										
18 Dec	N12W66	041	0020	01	Hsx	001	A										
19 Dec	N12W79	041															
20 Dec	N12W92	041															

0 0 0 0 0 0 0 0

Crossed West Limb.

Absolute heliographic longitude: 042





**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	4						
<i>Region 527</i>																					
17 Dec	S15W41	029	0030	04	Bxo	004	B														
18 Dec	S16W56	031	0020	04	Bxo	003	B														
19 Dec	S15W71	033	0010	01	Axx	001	A														
20 Dec	S15W84	033																			
												0	0	0	0	0	0	0	0	0	
Still on Disk.																					
Absolute heliographic longitude: 029																					
<i>Region 528</i>																					
18 Dec	N08E71	264	0170	03	Hax	006	A														
19 Dec	N09E62	260	0290	16	Fac	015	B	1													
20 Dec	N09E49	260	0360	18	Fsi	020	B														
21 Dec	N09E37	259	0390	18	Fho	019	Bg	2			1										
								3	0	0	1	0	0	0	0	0	0	0	0	0	
Still on Disk.																					
Absolute heliographic longitude: 259																					
<i>Region 529</i>																					
20 Dec	N09W18	327	0000	01	Axx	001	A														
21 Dec	N09W31	327																			
												0	0	0	0	0	0	0	0	0	
Still on Disk.																					
Absolute heliographic longitude: 327																					
<i>Region 530</i>																					
21 Dec	S20E64	232	0030	02	Hax	001	A														
												0	0	0	0	0	0	0	0	0	
Still on Disk.																					
Absolute heliographic longitude: 232																					

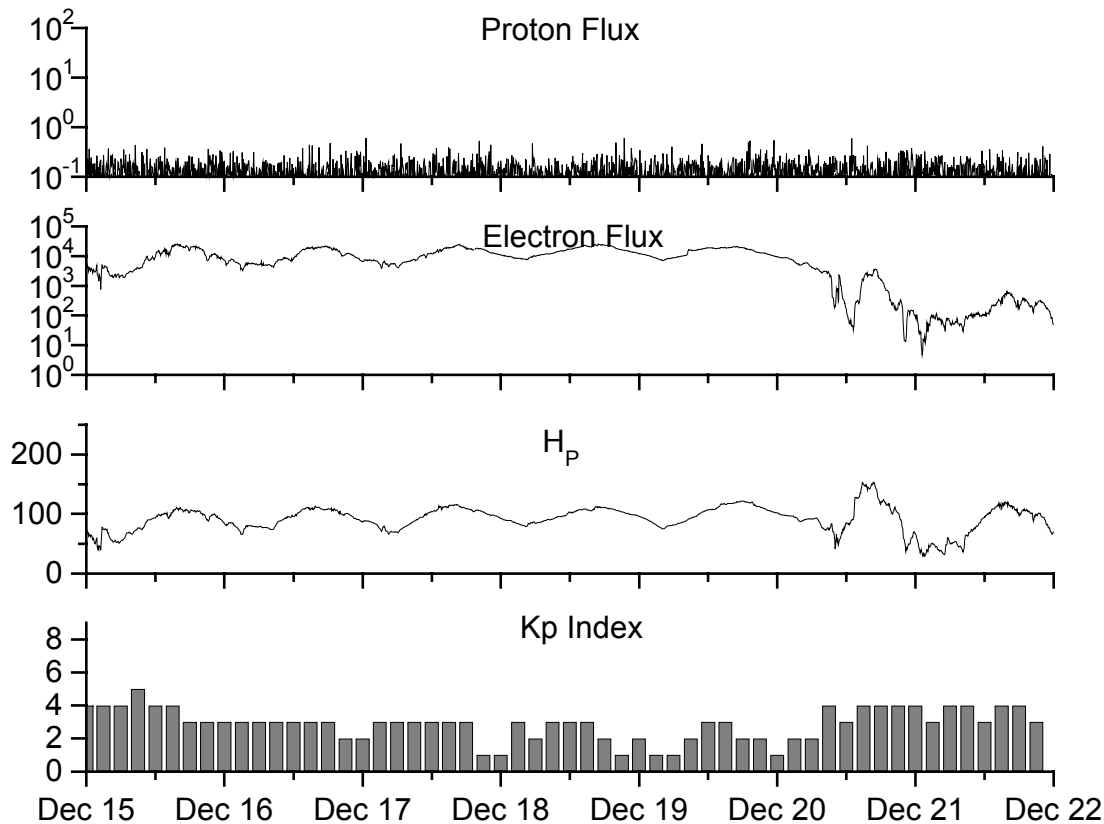


**Recent Solar Indices (preliminary)  
of the observed monthly mean values**

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>									
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	118.3	67.8	129.3	135.0	26	21.0
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	
November	118.9	67.2	0.57			153.1		31	

**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 15 December 2003*

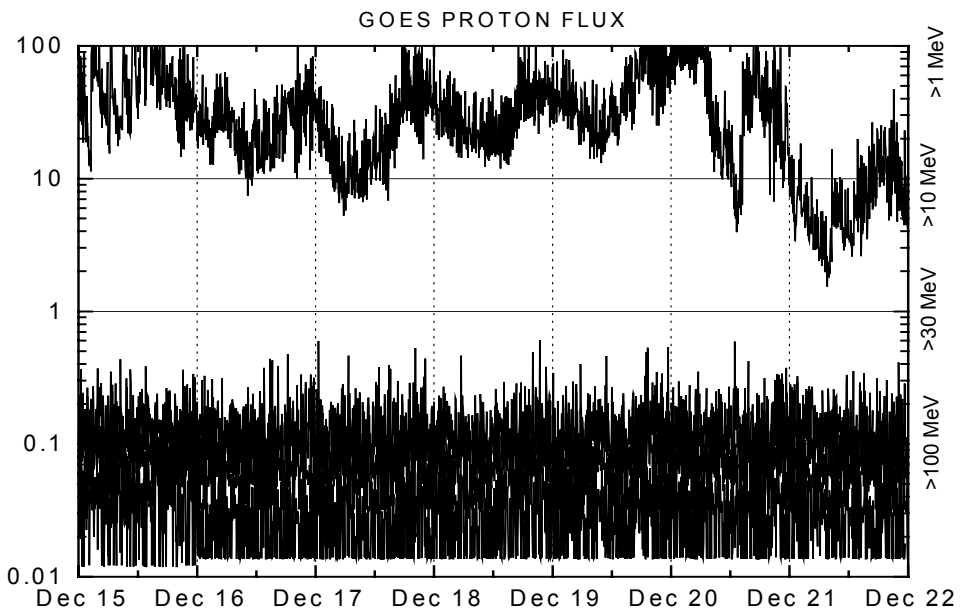
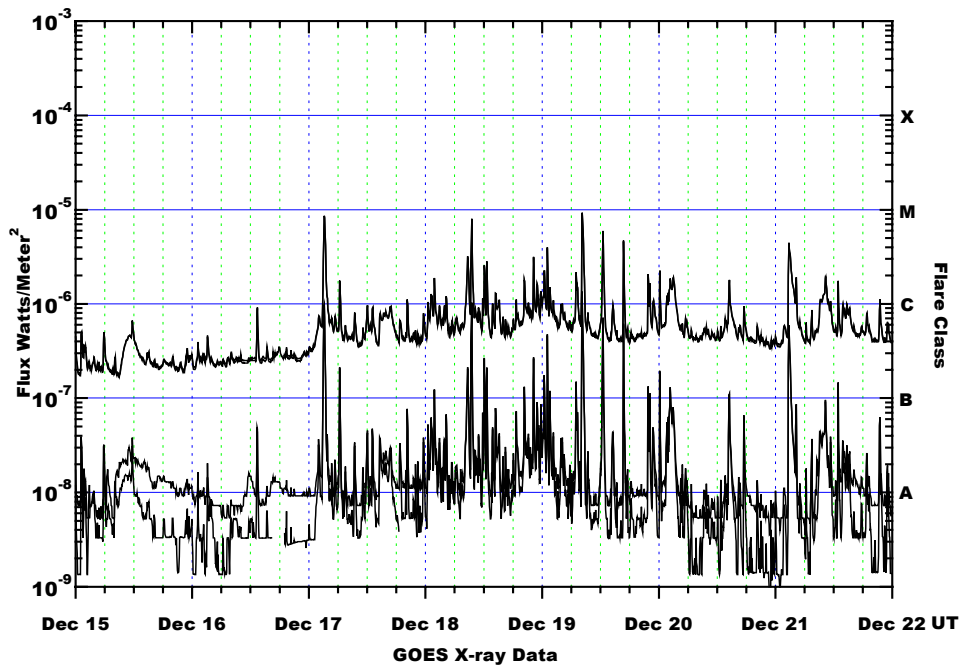
*Protons* plot contains the five-minute averaged integral proton flux (protons/cm<sup>2</sup>-sec-sr) as measured by GOES-11 (W113) for each of three energy thresholds: greater than 10, 50, and 100 MeV.

*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.

