

**Space Weather Highlights**  
**21 December – 27 December 2009**

**SWO PRF 1791**  
**29 December 2009**

Solar activity was at low levels during 21-23 December. Region 1036 (S27, L=209, class/area, Dso/070 on 22 December) produced numerous B-flares and C-flares, including a C7.2/sf event at 22/0456Z, with an associated slow-moving, partial-halo CME. A Type II radio sweep (estimated velocity 531 km/s) and discrete frequency radio bursts, the largest of which was 4900 sfu at 245 MHz, was associated with this flare. Region 1036 also produced a C6.4/sf at 23/1017Z. Region 1036 decayed to spotless plage on 25 December. Region 1035 (N31, L=248, class/area, Eho/310 on 21 December) was the largest region in area and sunspot number, but remained stable while rotating off the disk on 23 December. Solar activity was at very low levels for the rest of the period 24-27 December. On December 26, a new region was numbered as Region 1039 (S27, L=054, class/area, Dso/100 on 27 December).

No proton events were observed at geosynchronous orbit.

The greater than 2 MeV electron flux at geosynchronous orbit was at normal background levels during the period.

Geomagnetic field activity was at quiet levels during the entire period 21-27 December. Observations by the ACE spacecraft were consistent with the arrival of a partial-halo coronal mass ejection (CME) on 22 December. The solar wind speed increased to 354 km/s at 25/1708Z as the density increased to a peak of 13 p/cc. The interplanetary magnetic field (IMF) increased, with the total field reaching +10 nT at 25/1852Z. The southward component of the IMF ranged between -10 nT and +7 nT, with a peak of -10 nT at 25/1609Z.

**Space Weather Outlook**  
**30 December 2009 – 25 January 2010**

Solar activity is expected to be at predominantly very low levels during the first half of the period. Activity is expected to be at very low to low levels during the second half of the period.

No proton events are expected at geosynchronous orbit.

The greater than 2 MeV electron flux at geosynchronous orbit is expected to be at normal levels through the period.

The geomagnetic field is expected to be mostly at quiet levels for the forecast period.



### 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
21 December	83	42	180	A9.3	2	0	0	0	0	0	0	0
22 December	82	26	20	B1.0	5	0	0	2	0	0	0	0
23 December	78	23	70	A7.5	1	0	0	1	0	0	0	0
24 December	77	11	10	A4.0	0	0	0	0	0	0	0	0
25 December	76	0	0	A2.9	0	0	0	1	0	0	0	0
26 December	76	13	10	A4.1	0	0	0	0	0	0	0	0
27 December	77	17	100	A2.0	0	0	0	0	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)		
	>1 MeV	>10 MeV	>100 MeV	>.6 MeV	>2MeV	>4 MeV
	21 December	5.7e+05	2.0e+04	4.5e+03		3.5e+04
22 December	5.4e+05	2.0e+04	4.3e+03		4.3e+04	
23 December	6.4e+05	2.0e+04	4.4e+03		4.2e+04	
24 December	3.6e+05	2.0e+04	4.5e+03		3.6e+04	
25 December	6.1e+05	2.0e+04	4.5e+03		3.5e+04	
26 December	4.0e+05	2.0e+04	4.2e+03		3.5e+04	
27 December	3.7e+05	1.9e+04	4.2e+03		4.9e+04	

### Daily Geomagnetic Data

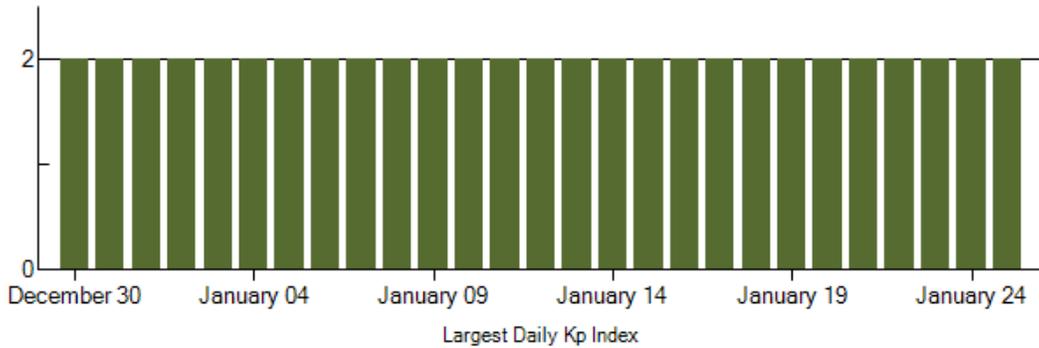
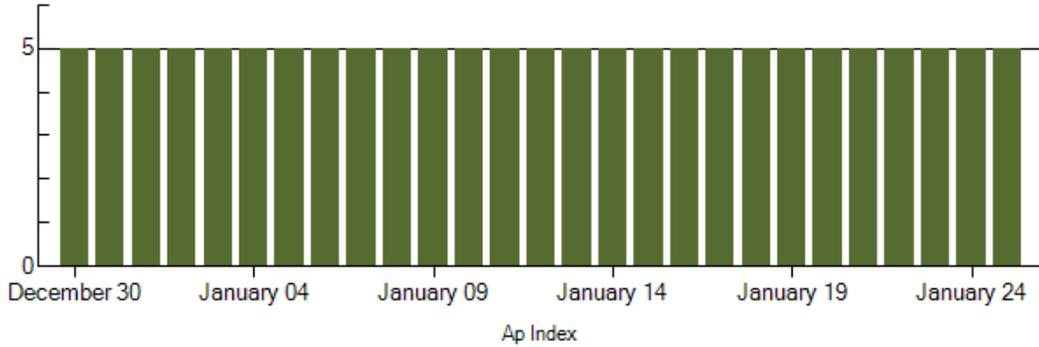
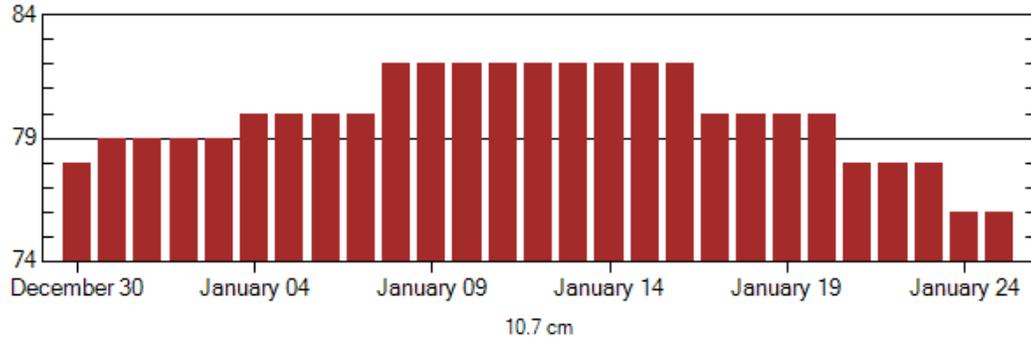
Date	Middle Latitude Fredericksburg		High Latitude College		Estimated Planetary	
	A	K-indices	A	K-indices	A	K-indices
	21 December	1	1-0-0-0-0-1-1-0	0	0-0-0-0-0-0-1-0	1
22 December	2	0-0-0-0-1-2-1-0	1	0-0-0-1-0-0-0-0	2	0-0-0-0-0-0-1-1
23 December	3	0-1-2-1-1-1-1-1	0	0-0-1-0-0-0-0-0	2	0-1-1-0-0-0-0-1
24 December	1	0-1-0-0-1-1-0-0	0	0-0-0-1-0-0-0-0	2	1-1-0-0-0-0-0-1
25 December	3	0-0-0-0-1-1-2-2	1	0-0-0-1-0-0-1-0	2	0-0-0-0-0-1-2-2
26 December	2	1-1-1-0-1-1-0-0	2	0-0-0-1-0-1-1-1	3	1-2-1-0-0-1-0-0
27 December	1	0-0-0-1-1-1-0-0	2	0-0-1-2-2-0-0-0	2	0-0-1-1-1-1-0-0

### Alerts and Warnings Issued

Date & Time of Issue	Type of Alert or Warning	Date & Time of Event UTC
22 Dec 0533	ALERT: Type II Radio Emission	22 Dec 0457
25 Dec 1619	WARNING: Geomagnetic Sudden Impulse expected	25 Dec 1710 - 1810



### 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
30 Dec	78	5	2	13 Jan	82	5	2
31	79	5	2	14	82	5	2
01 Jan	79	5	2	15	82	5	2
02	79	5	2	16	82	5	2
03	79	5	2	17	80	5	2
04	80	5	2	18	80	5	2
05	80	5	2	19	80	5	2
06	80	5	2	20	80	5	2
07	80	5	2	21	78	5	2
08	82	5	2	22	78	5	2
09	82	5	2	23	78	5	2
10	82	5	2	24	76	5	2
11	82	5	2	25	76	5	2
12	82	5	2				



***Energetic Events***

Date	Time		X-ray		Optical Information			Peak		Sweep Freq		
	Begin	Max	1/2 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		
21 December	0108	0113	0116	B1.6				
	0137	0142	0146	B1.8				
	0155	0159	0204	B2.9				
	0709	0717	0722	C2.5				
	0916	0926	0932	C1.0				
	1026	1040	1048	B3.9				
	1102	1111	1124	B8.6				
	1159	1202	1204	B6.1				
	1255	1302	1307	B2.9				
	1428	1456	1512	B8.4				
	1904	1907	1909	B1.6				
	2334	2338	2340	B4.1				
	22 December	0047	0051	0054	B1.7			
0145		0149	0151	B2.3				
0304		0307	0309	B1.3				
0356		0401	0404	B5.2				
0454		0457	0507	C7.2	SF	S26W46	1036	
0750		0757	0801		SF	S27W47	1036	
1125		1129	1134	B4.5				
1317		1321	1325	B2.7				
1400		1410	1420	C1.0				
1510		1526	1535	C1.1				
1735		1810	1820	B4.5				
2023		2027	2032	C1.3				
2145		2226	2235	C1.0				
23 December	0346	0348	0352	B8.6	SF	N16W56	1038	
	0945	0951	0954	B1.6				
	1017	1019	1023	C6.4	SF	S28W61	1036	
	1126	1133	1146	B3.2				
	1241	1248	1250	B3.5				
24 December	No Flares Observed							
25 December	2321	2326	2331	B1.0	SF	S28E55		



**Flare List - continued**

Date	Time			X-ray Class.	Imp/ Brtns	Optical	
	Begin	Max	End			Location Lat CMD	Rgn
26 December	0725	0730	0739	B1.4			
	0854	0910	0920	B1.9			
	1217	1220	1223	B1.0			
	1651	1657	1705	B4.8			
	1809	1812	1815	B1.7			
	1838	1843	1848	B4.6			
27 December	0721	0730	0733	B2.9			
	1128	1139	1157	B7.6			

**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
<i>Region 1034</i>												
09 Dec	N18E73	250	10	6	BXO	3	B					
10 Dec	N20E59	250	10	5	BXO	3	B					
11 Dec	N20E45	251	20	2	BXO	3	B					
12 Dec	N20E32	251	20	4	BXO	2	B					
13 Dec	N19E16	254	20	5	BXO	4	B					
14 Dec	N20E03	254	10	4	BXO	4	B					
15 Dec	N19W14	257	10	4	BXO	2	B					
16 Dec	N19W27	257										
17 Dec	N19W40	257										
18 Dec	N19W53	257										
19 Dec	N19W66	257										
20 Dec	N19W79	257										
21 Dec	N19W92	257										
								0	0	0	0	0

Crossed West Limb.

Absolute heliographic longitude: 254



**Region Summary- continued**

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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 1035</i>																	
14 Dec	N31E07	250	20	3	BXO	4	B					1					
15 Dec	N30W05	248	120	8	DAI	16	B										
16 Dec	N30W18	248	140	11	EAC	20	BD	3				3					
17 Dec	N30W32	249	210	12	EAC	14	B					1					
18 Dec	N30W45	249	310	13	ESI	10	B	1									
19 Dec	N30W56	247	220	12	EHO	8	B	1				2					
20 Dec	N31W70	248	310	13	EHO	4	B										
21 Dec	N31W85	249	90	18	FSO	2	B										
								5	0	0	7	0	0	0	0	0	

Crossed West Limb.

Absolute heliographic longitude: 248

<i>Region 1036</i>																	
19 Dec	S29W19	210	10	5	BXO	3	B										
20 Dec	S27W32	210	10	7	BXO	6	B										
21 Dec	S27W45	209	70	7	DSO	7	B										
22 Dec	S27W58	209	10	6	BXO	3	B	1				2					
23 Dec	S28W70	208	50	2	CSO	2	B	1				1					
24 Dec	S28W83	208															
25 Dec	S28W96	208															
								2	0	0	3	0	0	0	0	0	

Crossed West Limb.

Absolute heliographic longitude: 210

<i>Region 1037</i>																	
19 Dec	N18E54	137	10	6	BXO	2	B										
20 Dec	N18E41	137															
21 Dec	N18E28	137															
22 Dec	N18E15	137															
23 Dec	N18E02	137															
24 Dec	N18W11	137															
25 Dec	N18W24	137															
26 Dec	N18W37	137															
27 Dec	N18W50	137															
								0	0	0	0	0	0	0	0	0	

Still on Disk.

Absolute heliographic longitude: 137

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**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 1038</i>																		
20 Dec	N16W26	204	10	2	AXX	2	A											
21 Dec	N17W38	202	20	3	CSO	3	B											
22 Dec	N17W51	202	10	4	BXO	3	B											
23 Dec	N15W69	207	10	1	AXX	1	A											
24 Dec	N13W81	206	10	1	AXX	1	A											
25 Dec	N13W94	206																
								0	0	0	0	0	0	0	0			0
Crossed West Limb.																		
Absolute heliographic longitude: 204																		
<i>Region 1039</i>																		
26 Dec	S26E45	53	10	6	BXO	3	B											
27 Dec	S27E31	54	100	7	DSO	7	B											
								0	0	0	0	0	0	0	0			0
Still on Disk.																		
Absolute heliographic longitude: 54																		



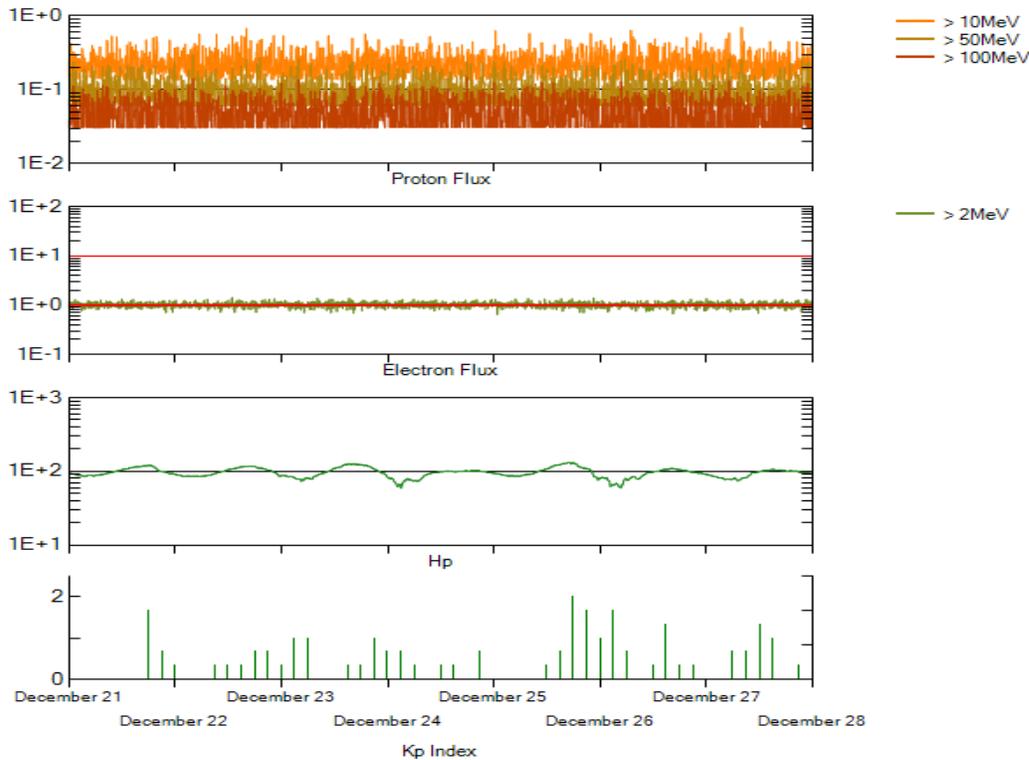
**Recent Solar Indices (preliminary)**  
**Of the observed monthly mean values**

Month	Sunspot Numbers					Radio Flux		Geomagnetic	
	Observed values SEC	Ratio RI	Ratio RI/SEC	Smooth values SEC	Smooth values RI	*Penticton 10.7 cm	Smooth Value	Planetary Ap	Smooth Value
<b>2007</b>									
December	16.2	10.1	0.62	8.1	4.9	78.5	70.8	6	7.8
<b>2008</b>									
January	5.1	3.3	0.65	6.9	4.2	74.3	70.3	8	7.8
February	3.8	2.1	0.55	5.9	3.6	71.1	69.9	11	7.6
March	15.9	9.3	0.58	5.3	3.3	72.9	69.8	11	7.5
April	4.9	2.9	0.59	5.3	3.4	70.2	69.8	9	7.3
May	5.7	3.2	0.56	5.7	3.5	68.4	69.8	6	7.2
June	4.2	3.4	0.81	5.2	3.3	65.9	69.4	7	7.0
July	1.0	0.8	0.80	4.5	2.8	65.7	68.8	5	6.8
August	0.0	0.5	**	4.4	2.7	66.3	68.6	5	6.3
September	1.5	1.1	0.73	3.7	2.3	67.1	68.4	6	5.8
October	5.2	2.9	0.56	2.9	1.9	68.3	68.2	7	5.4
November	6.8	4.1	0.60	2.7	1.8	68.6	68.3	4	5.1
December	1.3	0.8	0.62	2.7	1.7	69.2	68.5	4	4.9
<b>2009</b>									
January	2.8	1.3	0.46	3.0	1.8	69.8	68.7	4	4.7
February	2.5	1.4	0.56	3.1	1.9	70.0	68.8	5	4.7
March	0.7	0.7	1.00	3.4	2.0	69.2	69.0	5	4.6
April	1.2	1.2	1.00	3.7	2.2	69.7	69.3	4	4.3
May	3.9	2.9	0.74	3.8	2.3	70.5	69.7	4	4.1
June	6.6	2.6	0.39			68.6		4	
July	5.0	3.5	0.70			68.2		4	
August	0.3	0.0	0.00			67.4		5	
September	6.6	4.2	0.64			70.5		4	
October	7.0	4.6	0.66			72.3		3	
November	7.7	4.2	0.55			73.6		3	

**NOTE:** Values are final except for the most recent 6 months which are considered preliminary. Cycle 23 started in May 1996 with an RI=8.0. Cycle 23 maximum was April 2000 with an RI=120.8.

\*\* SWPC sunspot number was zero, so a ratio could not be computed.





*Weekly Geosynchronous Satellite Environment Summary  
Week Beginning 21 December 2009*

**GOES-11 designated Primary Proton and Electron Satellite.**

Protons plot contains the five-minute averaged integral proton flux (protons/cm<sup>2</sup>-sec -sr) as measured by GOES-11 (W135) for each of three energy thresholds: greater than 10, 50, and 100 MeV.

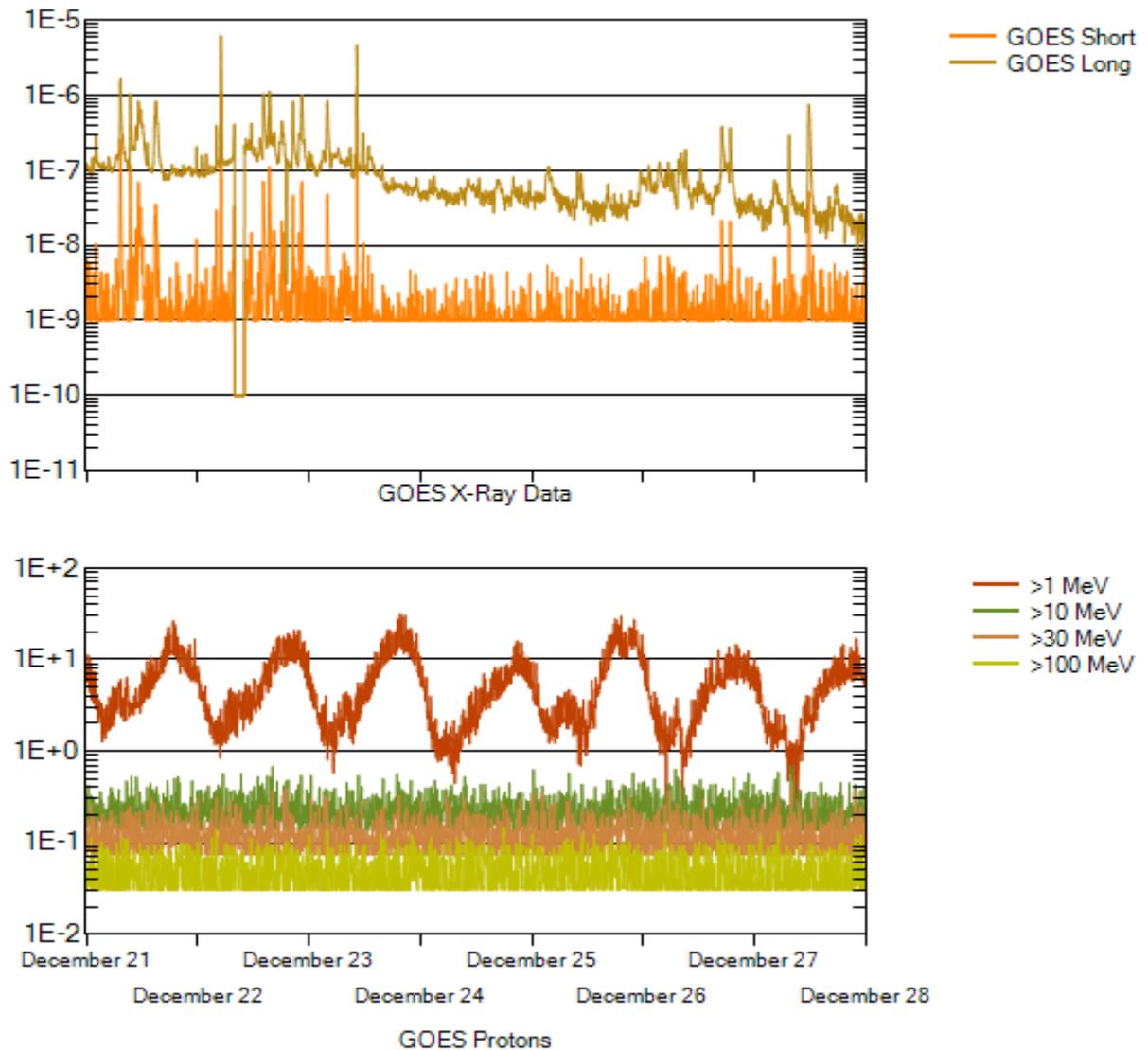
Electrons plot contains the five-minute averaged integral electron flux (electrons/cm<sup>2</sup>-sec -sr) with energies greater than 2 MeV at GOES-11.

Hp plot contains the five minute averaged magnetic field H - component in nanoteslas (nT) as measured by GOES-11. The H component is parallel to the spin axis of the satellite, which is nearly parallel to the Earth's rotation axis.

Kp 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 Hartland, UK. These data are made available through cooperation from the Geological Survey of Canada (GSC), British Geological Survey (BGS) and the US Geological Survey. These may differ from the final Kp values derived from a more extensive network of magnetometers.

The data included here are those now available in real time at the SWPC 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 Kp are "global" parameters that are applicable to a first order approximation over large areas. H parallel 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 14 (W105) in two wavelength bands, 0.05 - 0.4 and 0.1 - 0.8 nm. The letters A, B, C, M and X refer to x-ray event levels for the 0.1 - 0.8 nm band.

Proton plot contains the five-minute averaged integral proton flux (protons/cm<sup>2</sup>-sec-sr) as measured by GOES-11 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.

