

Solar activity was at low levels. The period was dominated by low to mid-level C-class flare activity from a number of active regions, the largest of which was a C6/1f flare at 16/0903 UTC from Region 2468 (S15, L=128, class/area=Dao/120 on 10 Dec). Region 2468 was the most productive region on the visible disk throughout the summary period, however, an unnumbered region behind the northeast limb produced multiple mid-level C-class flares within quick succession and caused a slow increase in the background GOES-15 x-ray flux late in the period.

Two asymmetrical full-halo coronal mass ejections (CMEs) were observed in SOHO/LASCO C2 coronagraph imagery on 16 Dec. The first CME was observed in C2 imagery beginning at 16/0924 UTC and was associated with the C6/1F flare mentioned above. The second CME, associated with a filament eruption, was first observed in coronagraph imagery at 16/1436 UTC. Both CMEs were determined to be Earth-directed and arrived at Earth late on 19 Dec. See the geomagnetic summary below for further information on this event.

No proton events were observed at geosynchronous orbit.

The greater than 2 MeV electron flux at geosynchronous orbit reached high levels on 14 Dec and 19 Dec with moderate levels observed throughout the remainder of the period.

Geomagnetic field activity reached active to G1 (Minor) geomagnetic storm levels late on 14 Dec and early on 15 Dec due to the influence of a corotating interaction region followed by the onset of a negative polarity coronal hole high speed stream (CH HSS). Isolated active field conditions were observed early on 16 Dec and again late on 17 Dec due to weak substorming. The CMEs from 16 Dec presumably merged in the interplanetary medium and impacted the Earth at 19/1528 UTC. During the passage of the interplanetary shock, solar wind parameters aboard the ACE spacecraft became suddenly enhanced. Total field strength values initially increased from 5 nT to 17 nT and the Bz component went strongly southward shortly after the initial shock passage. The prolonged period of southward magnetic field (-Bz) associated with the passage of the 16 Dec CMEs caused periods of active conditions late on 19 Dec and active to G2 (Moderate) geomagnetic storm levels on 20 Dec. G2 storm conditions were observed between 20/0300-0600 UTC and 20/1500-2359 UTC.

### **Space Weather Outlook** **21 December - 16 January 2016**

Solar activity is expected to be low throughout the period with a chance for M-class flares (R1-R2 (Minor-Moderate) Radio Blackouts) on 21 Dec through 03 Jan to the increased flare activity from an unnumbered region behind the east limb.

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



on 21-27 Dec, moderate levels on 31 Dec-02 Jan, and 14-16 Jan. High flux levels are expected on 28-30 Dec and 03-13 Jan.

Geomagnetic field activity is expected to be at active to G2 (Moderate) geomagnetic storm levels early on 21 Dec due to the waning effects of the 16 Dec coronal mass ejections. G1 (Minor) geomagnetic storms are likely on 02, 06, and 10 Jan due to the influence of recurrent coronal hole high speed streams.



### *Daily Solar Data*

| Date        | Radio<br>Flux<br>10.7cm | Sun<br>spot<br>No. | Sunspot<br>Area<br>(10 <sup>-6</sup> hemi.) | X-ray<br>Background<br>Flux | Flares |   |   |         |   |   |   |   |
|-------------|-------------------------|--------------------|---|-----------------------------|--------|---|---|---------|---|---|---|---|
|             |                         |                    |   |                             | X-ray  |   |   | Optical |   |   |   |   |
|             |                         |                    |   |                             | C      | M | X | S       | 1 | 2 | 3 | 4 |
| 14 December | 124                     | 81                 | 480   | B3.7                        | 1      | 0 | 0 | 6       | 0 | 0 | 0 | 0 |
| 15 December | 119                     | 64                 | 660   | B3.2                        | 1      | 0 | 0 | 2       | 0 | 0 | 0 | 0 |
| 16 December | 126                     | 49                 | 580   | B3.9                        | 1      | 0 | 0 | 3       | 1 | 0 | 0 | 0 |
| 17 December | 118                     | 52                 | 650   | B2.8                        | 2      | 0 | 0 | 3       | 0 | 0 | 0 | 0 |
| 18 December | 117                     | 49                 | 570   | B2.8                        | 2      | 0 | 0 | 10      | 1 | 0 | 0 | 0 |
| 19 December | 119                     | 44                 | 460   | B3.5                        | 5      | 0 | 0 | 1       | 0 | 0 | 0 | 0 |
| 20 December | 117                     | 33                 | 430   | B5.8                        | 8      | 0 | 0 | 1       | 0 | 0 | 0 | 0 |

### *Daily Particle Data*

| Date        | Proton Fluence<br>(protons/cm <sup>2</sup> -day-sr) |         |          | Electron Fluence<br>(electrons/cm <sup>2</sup> -day-sr) |         |         |
|-------------|---|---------|----------|---|---------|---------|
|             | >1 MeV  | >10 MeV | >100 MeV | >0.6 MeV  | >2MeV   | >4 MeV  |
|             | 14 December   |         | 1.8e+06  | 1.3e+04   | 3.0e+03 |         |
| 15 December |   | 2.4e+05 | 1.1e+04  | 2.7e+03   |         | 2.7e+06 |
| 16 December |   | 1.8e+05 | 1.2e+04  | 3.0e+03   |         | 1.9e+07 |
| 17 December |   | 3.0e+05 | 1.2e+04  | 3.0e+03   |         | 2.8e+07 |
| 18 December |   | 2.6e+05 | 1.2e+04  | 3.0e+03   |         | 3.4e+07 |
| 19 December |   | 1.3e+06 | 1.2e+04  | 3.2e+03   |         | 3.6e+07 |
| 20 December |   | 2.0e+06 | 1.1e+04  | 2.7e+03   |         | 5.0e+05 |

### *Daily Geomagnetic Data*

| Date        | Middle Latitude<br>Fredericksburg |                 | High Latitude<br>College |                 | Estimated<br>Planetary |                 |
|-------------|-----------------------------------|-----------------|--------------------------|-----------------|------------------------|-----------------|
|             | A                                 | K-indices       | A                        | K-indices       | A                      | K-indices       |
|             | 14 December                       | 15              | 2-1-0-1-3-4-3-5          | 31              | 0-0-2-4-4-6-6-4        | 22              |
| 15 December | 13                                | 4-4-2-1-3-3-1-2 | 22                       | 4-3-2-3-5-5-2-2 | 17                     | 5-4-3-2-3-3-1-3 |
| 16 December | 5                                 | 3-2-1-0-2-1-1-1 | 5                        | 3-2-0-2-0-0-2-0 | 7                      | 4-3-1-0-1-0-1-1 |
| 17 December | 6                                 | 1-1-0-1-2-2-3-2 | 8                        | 0-0-0-3-3-3-3-2 | 7                      | 1-1-1-1-1-2-4-2 |
| 18 December | 4                                 | 1-0-1-1-1-2-1-2 | 3                        | 1-0-1-1-0-1-1-2 | 5                      | 2-1-1-1-1-1-1-3 |
| 19 December | 8                                 | 1-1-1-1-2-3-3-3 | 8                        | 0-0-0-2-1-4-3-3 | 12                     | 2-1-1-1-1-4-4-4 |
| 20 December | 33                                | 3-5-4-4-4-5-4-5 | 89                       | 2-6-6-7-7-7-6-5 | 27                     | 4-6-5-5-5-6-6-6 |



### *Alerts and Warnings Issued*

| Date & Time<br>of Issue UTC | Type of Alert or Warning                                       | Date & Time<br>of Event UTC |
|-----------------------------|--|-----------------------------|
| 14 Dec 0500                 | CONTINUED ALERT:<br>Electron 2MeV Integral Flux $\geq$ 1000pfu | 07/0945                     |
| 14 Dec 1536                 | WARNING: Geomagnetic K = 4                                     | 14/1536 - 15/0700           |
| 14 Dec 1630                 | ALERT: Geomagnetic K = 4                                       | 14/1629                     |
| 14 Dec 1724                 | WARNING: Geomagnetic K = 5                                     | 14/1724 - 15/0400           |
| 14 Dec 1759                 | ALERT: Geomagnetic K = 5                                       | 14/1759                     |
| 14 Dec 1941                 | WATCH: Geomagnetic Storm Category G1 predicted                 |                             |
| 14 Dec 2107                 | WATCH: Geomagnetic Storm Category G1 predicted                 |                             |
| 14 Dec 2202                 | ALERT: Geomagnetic K = 5                                       | 14/2200                     |
| 15 Dec 0302                 | ALERT: Geomagnetic K = 5                                       | 15/0259                     |
| 15 Dec 0338                 | EXTENDED WARNING: Geomagnetic K = 5                            | 14/1724 - 15/0900           |
| 15 Dec 0338                 | EXTENDED WARNING: Geomagnetic K = 4                            | 14/1536 - 15/1500           |
| 16 Dec 0107                 | WARNING: Geomagnetic K = 4                                     | 16/0110 - 1100              |
| 16 Dec 0217                 | ALERT: Geomagnetic K = 4                                       | 16/0216                     |
| 17 Dec 0828                 | WATCH: Geomagnetic Storm Category G1 predicted                 |                             |
| 17 Dec 1634                 | WATCH: Geomagnetic Storm Category G2 predicted                 |                             |
| 17 Dec 2000                 | WARNING: Geomagnetic K = 4                                     | 17/2000 - 18/0700           |
| 17 Dec 2102                 | ALERT: Geomagnetic K = 4                                       | 17/2059                     |
| 19 Dec 0011                 | WARNING: Geomagnetic K = 4                                     | 19/0010 - 2359              |
| 19 Dec 1331                 | ALERT: Type II Radio Emission                                  | 19/1257                     |
| 19 Dec 1540                 | WARNING: Geomagnetic Sudden Impulse expected                   | 19/1600 - 1700              |
| 19 Dec 1625                 | SUMMARY: Geomagnetic Sudden Impulse                            | 19/1617                     |
| 19 Dec 1627                 | WARNING: Geomagnetic K = 5                                     | 19/1625 - 2359              |
| 19 Dec 1725                 | ALERT: Electron 2MeV Integral Flux $\geq$ 1000pfu              | 19/1615                     |
| 19 Dec 1801                 | ALERT: Geomagnetic K = 4                                       | 19/1759                     |
| 19 Dec 2110                 | WATCH: Geomagnetic Storm Category G1 predicted                 |                             |
| 19 Dec 2246                 | EXTENDED WARNING: Geomagnetic K = 4                            | 19/0010 - 20/1200           |
| 19 Dec 2246                 | EXTENDED WARNING: Geomagnetic K = 5                            | 19/1625 - 20/0600           |
| 20 Dec 0456                 | EXTENDED WARNING: Geomagnetic K = 4                            | 19/0010 - 20/1500           |

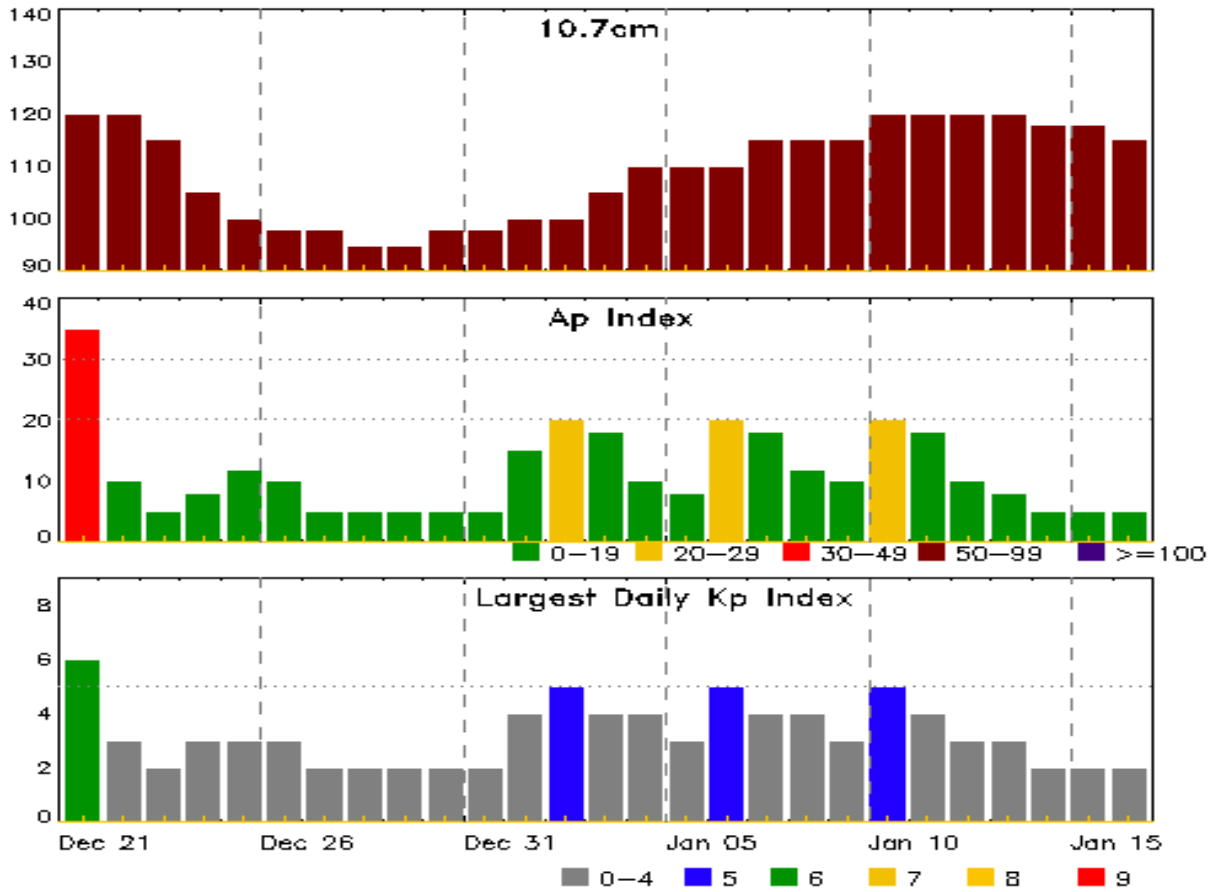


### *Alerts and Warnings Issued*

| <b>Date &amp; Time<br/>of Issue UTC</b> | <b>Type of Alert or Warning</b>                | <b>Date &amp; Time<br/>of Event UTC</b> |
|---|--|---|
| 20 Dec 0456                             | EXTENDED WARNING: Geomagnetic K = 5            | 19/1625 - 20/1200                       |
| 20 Dec 0456                             | ALERT: Geomagnetic K = 5                       | 20/0453                                 |
| 20 Dec 0501                             | WARNING: Geomagnetic K = 6                     | 20/0500 - 1000                          |
| 20 Dec 0521                             | ALERT: Geomagnetic K = 6                       | 20/0519                                 |
| 20 Dec 0701                             | ALERT: Geomagnetic K = 5                       | 20/0700                                 |
| 20 Dec 1154                             | ALERT: Geomagnetic K = 5                       | 20/1153                                 |
| 20 Dec 1154                             | EXTENDED WARNING: Geomagnetic K = 4            | 19/0010 - 20/1700                       |
| 20 Dec 1154                             | EXTENDED WARNING: Geomagnetic K = 5            | 19/1625 - 20/1500                       |
| 20 Dec 1347                             | ALERT: Geomagnetic K = 5                       | 20/1344                                 |
| 20 Dec 1422                             | WARNING: Geomagnetic K = 6                     | 20/1420 - 1900                          |
| 20 Dec 1422                             | EXTENDED WARNING: Geomagnetic K = 5            | 19/1625 - 20/2359                       |
| 20 Dec 1435                             | EXTENDED WARNING: Geomagnetic K = 4            | 19/0010 - 20/2359                       |
| 20 Dec 1606                             | ALERT: Geomagnetic K = 5                       | 20/1605                                 |
| 20 Dec 1627                             | ALERT: Geomagnetic K = 6                       | 20/1626                                 |
| 20 Dec 1853                             | ALERT: Geomagnetic K = 5                       | 20/1851                                 |
| 20 Dec 1854                             | EXTENDED WARNING: Geomagnetic K = 6            | 20/1420 - 2359                          |
| 20 Dec 2018                             | ALERT: Geomagnetic K = 6                       | 20/2017                                 |
| 20 Dec 2025                             | WATCH: Geomagnetic Storm Category G1 predicted |   |
| 20 Dec 2203                             | ALERT: Geomagnetic K = 5                       | 20/2200                                 |
| 20 Dec 2239                             | WATCH: Geomagnetic Storm Category G2 predicted |   |
| 20 Dec 2239                             | EXTENDED WARNING: Geomagnetic K = 4            | 19/0010 - 21/2100                       |
| 20 Dec 2239                             | EXTENDED WARNING: Geomagnetic K = 6            | 20/1420 - 21/0600                       |
| 20 Dec 2239                             | EXTENDED WARNING: Geomagnetic K = 5            | 19/1625 - 21/1200                       |
| 20 Dec 2344                             | ALERT: Geomagnetic K = 6                       | 20/2343                                 |



## Twenty-seven Day Outlook



| Date   | Radio Flux<br>10.7cm | Planetary<br>A Index | Largest<br>Kp Index | Date   | Radio Flux<br>10.7cm | Planetary<br>A Index | Largest<br>Kp Index |
|--------|----------------------|----------------------|---------------------|--------|----------------------|----------------------|---------------------|
| 21 Dec | 120                  | 35                   | 6                   | 04 Jan | 110                  | 10                   | 4                   |
| 22     | 120                  | 10                   | 3                   | 05     | 110                  | 8                    | 3                   |
| 23     | 115                  | 5                    | 2                   | 06     | 110                  | 20                   | 5                   |
| 24     | 105                  | 8                    | 3                   | 07     | 115                  | 18                   | 4                   |
| 25     | 100                  | 12                   | 3                   | 08     | 115                  | 12                   | 4                   |
| 26     | 98                   | 10                   | 3                   | 09     | 115                  | 10                   | 3                   |
| 27     | 98                   | 5                    | 2                   | 10     | 120                  | 20                   | 5                   |
| 28     | 95                   | 5                    | 2                   | 11     | 120                  | 18                   | 4                   |
| 29     | 95                   | 5                    | 2                   | 12     | 120                  | 10                   | 3                   |
| 30     | 98                   | 5                    | 2                   | 13     | 120                  | 8                    | 3                   |
| 31     | 98                   | 5                    | 2                   | 14     | 118                  | 5                    | 2                   |
| 01 Jan | 100                  | 15                   | 4                   | 15     | 118                  | 5                    | 2                   |
| 02     | 100                  | 20                   | 5                   | 16     | 115                  | 5                    | 2                   |
| 03     | 105                  | 18                   | 4                   |        |                      |                      |                     |



## *Energetic Events*

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

**No Events Observed**

## *Flare List*

| Date   | Time  |       |       | X-ray Class | Imp/ Brtns | Optical Location Lat CMD | Rgn # |
|--------|-------|-------|-------|-------------|------------|--------------------------|-------|
|        | Begin | Max   | End   |             |            |                          |       |
| 14 Dec | 0006  | 0014  | 0020  | C1.0        | SF         | N19E52                   | 2469  |
| 14 Dec | 0914  | 0914  | 0920  |             | SF         | N16E68                   | 2470  |
| 14 Dec | 0924  | 0928  | 0930  |             | SF         | S14E23                   | 2468  |
| 14 Dec | 0938  | 0939  | 0942  |             | SF         | N16E68                   | 2470  |
| 14 Dec | 0959  | 1012  | A1037 |             | SF         | N15E66                   | 2470  |
| 14 Dec | 1404  | 1408  | 1410  | B7.6        |            |                          | 2470  |
| 14 Dec | 1431  | 1441  | 1453  | B9.0        | SF         | S15E17                   | 2468  |
| 14 Dec | 1828  | 1831  | 1833  | B7.5        |            |                          |       |
| 14 Dec | 2221  | 2224  | 2226  | B5.7        |            |                          |       |
| 15 Dec | 2030  | 2034  | 2042  | B5.9        |            |                          | 2468  |
| 15 Dec | 2100  | 2102  | 2110  |             | SF         | S15E07                   | 2468  |
| 15 Dec | 2133  | 2200  | 2225  | C1.2        | SF         | S15E02                   | 2468  |
| 16 Dec | 0544  | 0548  | 0553  | B7.0        |            |                          |       |
| 16 Dec | 0801  | 0804  | 0817  |             | SF         | S14W03                   | 2468  |
| 16 Dec | 0834  | 0903  | 0923  | C6.6        | 1F         | S13W04                   | 2468  |
| 16 Dec | B1119 | U1120 | 1123  |             | SF         | N11E38                   | 2470  |
| 16 Dec | 1817  | 1817  | 1820  |             | SF         | N13E41                   | 2470  |
| 17 Dec | 0329  | 0341  | 0351  | B7.6        |            |                          | 2470  |
| 17 Dec | 0529  | 0533  | 0535  | C1.3        | SF         | N13E32                   | 2470  |
| 17 Dec | 1222  | 1235  | 1249  | C1.7        | SF         | N15E28                   | 2470  |
| 17 Dec | 2059  | 2104  | 2110  | B8.2        | SF         | S18W22                   | 2468  |
| 18 Dec | 0348  | 0400  | 0412  | C1.4        |            |                          | 2469  |
| 18 Dec | 0455  | 0509  | 0522  | C4.6        | 1F         | N18E07                   | 2469  |
| 18 Dec | 0503  | 0503  | 0506  |             | SF         | N13E10                   | 2470  |
| 18 Dec | 0850  | 0850  | 0853  |             | SF         | S08W74                   | 2465  |
| 18 Dec | 0914  | 0916  | 0918  |             | SF         | S07W74                   | 2465  |
| 18 Dec | 0951  | 0956  | 0959  |             | SF         | S08W76                   | 2465  |
| 18 Dec | 1007  | 1007  | 1009  |             | SF         | S08W76                   | 2465  |
| 18 Dec | 1128  | 1128  | 1132  |             | SF         | S08W77                   | 2465  |
| 18 Dec | 1131  | U1132 | A1156 |             | SF         | S20W30                   | 2468  |
| 18 Dec | 1529  | 1534  | 1538  | B6.1        | SF         | S17W33                   | 2468  |



## *Flare List*

| Date   | Time  |      |      | X-ray<br>Class | Optical       |                     | Rgn<br># |
|--------|-------|------|------|----------------|---------------|---------------------|----------|
|        | Begin | Max  | End  |                | Imp/<br>Brtns | Location<br>Lat CMD |          |
| 18 Dec | 1740  | 1746 | 1754 |                | SF            | S18W33              | 2468     |
| 18 Dec | 1804  | 1805 | 1818 |                | SF            | S18W34              | 2468     |
| 18 Dec | 2319  | 0118 | 0159 | B7.4           |               |                     | 2369     |
| 19 Dec | 0159  | 0204 | 0208 | C3.1           | SF            | S18W39              | 2468     |
| 19 Dec | 0443  | 0455 | 0507 | B8.3           |               |                     | 2468     |
| 19 Dec | 1040  | 1051 | 1101 | C1.6           |               |                     | 2470     |
| 19 Dec | 1238  | 1326 | 1357 | C1.7           |               |                     |          |
| 19 Dec | 1658  | 1710 | 1724 | C1.1           |               |                     | 2470     |
| 19 Dec | 2149  | 2228 | 2308 | C4.5           |               |                     |          |
| 20 Dec | 0357  | 0513 | 0555 | C3.8           |               |                     |          |
| 20 Dec | 0723  | 0756 | 0824 | C1.2           |               |                     |          |
| 20 Dec | 1026  | 1038 | 1047 | C1.2           |               |                     | 2470     |
| 20 Dec | 1117  | 1134 | 1157 | C1.6           |               |                     |          |
| 20 Dec | 1922  | 1944 | 1958 | C2.4           | SF            | S13W63              | 2468     |
| 20 Dec | 2141  | 2150 | 2208 | C2.3           |               |                     |          |
| 20 Dec | 2233  | 2244 | 2256 | C6.0           |               |                     |          |
| 20 Dec | 2348  | 2358 | 0005 | C5.4           |               |                     |          |





## Region Summary

| Date               | Location |     | Sunspot Characteristics         |                   |               |               | Flares       |       |   |   |         |   |   |   |   |   |  |  |
|--------------------|----------|-----|---------------------------------|-------------------|---------------|---------------|--------------|-------|---|---|---------|---|---|---|---|---|--|--|
|                    | Lat CMD  | Lon | Helio<br>10 <sup>-6</sup> hemi. | Extent<br>(helio) | Spot<br>Class | Spot<br>Count | Mag<br>Class | X-ray |   |   | Optical |   |   |   |   |   |  |  |
|                    |          |     |                                 |                   |               |               |              | C     | M | X | S       | 1 | 2 | 3 | 4 |   |  |  |
| <b>Region 2462</b> |          |     |                                 |                   |               |               |              |       |   |   |         |   |   |   |   |   |  |  |
| 03 Dec             | N09E68   | 214 | 10                              | 1                 | Hax           | 1             | A            |       |   |   |         |   |   |   |   |   |  |  |
| 04 Dec             | N09E54   | 216 | 40                              | 1                 | Hax           | 1             | A            | 1     |   |   |         | 1 |   |   |   |   |  |  |
| 05 Dec             | N09E42   | 215 | 30                              | 2                 | Hax           | 3             | A            |       |   |   |         |   |   |   |   |   |  |  |
| 06 Dec             | N09E29   | 215 | 10                              | 2                 | Axx           | 1             | A            |       |   |   |         |   |   |   |   |   |  |  |
| 07 Dec             | N09E16   | 215 | 10                              | 4                 | Hrx           | 2             | A            |       |   |   |         |   |   |   |   |   |  |  |
| 08 Dec             | N08E02   | 215 | 10                              | 1                 | Hrx           | 1             | A            |       |   |   |         |   |   |   |   |   |  |  |
| 09 Dec             | N10W10   | 214 | 0                               | 2                 | Axx           | 2             | A            |       |   |   |         |   |   |   |   |   |  |  |
| 10 Dec             | N10W24   | 215 | plage                           |                   |               |               |              |       |   |   |         |   |   |   |   |   |  |  |
| 11 Dec             | N10W38   | 216 | plage                           |                   |               |               |              |       |   |   |         |   |   |   |   |   |  |  |
| 12 Dec             | N10W52   | 217 | plage                           |                   |               |               |              |       |   |   |         |   |   |   |   |   |  |  |
| 13 Dec             | N10W66   | 217 | plage                           |                   |               |               |              |       |   |   |         |   |   |   |   |   |  |  |
| 14 Dec             | N10W80   | 218 | plage                           |                   |               |               |              |       |   |   |         |   |   |   |   |   |  |  |
|                    |          |     |                                 |                   |               |               |              | 1     | 0 | 0 | 1       | 0 | 0 | 0 | 0 | 0 |  |  |

Crossed West Limb.  
Absolute heliographic longitude: 215

|                    |        |     |       |    |     |   |   |   |   |   |    |   |   |   |   |   |  |  |
|--------------------|--------|-----|-------|----|-----|---|---|---|---|---|----|---|---|---|---|---|--|--|
| <b>Region 2463</b> |        |     |       |    |     |   |   |   |   |   |    |   |   |   |   |   |  |  |
| 03 Dec             | S09E76 | 206 | 20    | 4  | Hax | 1 | A |   |   |   |    |   |   |   |   |   |  |  |
| 04 Dec             | S09E62 | 208 | 80    | 6  | Dao | 4 | B | 1 |   |   |    | 5 |   |   |   |   |  |  |
| 05 Dec             | S11E52 | 205 | 130   | 10 | Dao | 7 | B | 1 |   |   |    | 5 |   |   |   |   |  |  |
| 06 Dec             | S11E39 | 205 | 110   | 12 | Eso | 6 | B | 1 |   |   |    | 4 |   |   |   |   |  |  |
| 07 Dec             | S11E24 | 207 | 80    | 12 | Eso | 6 | B | 1 |   |   |    | 1 |   |   |   |   |  |  |
| 08 Dec             | S09E06 | 211 | 50    | 5  | Hax | 3 | A | 2 |   |   |    |   |   |   |   |   |  |  |
| 09 Dec             | S09W07 | 211 | 30    | 4  | Hsx | 4 | A |   |   |   |    |   |   |   |   |   |  |  |
| 10 Dec             | S08W20 | 211 | 20    | 5  | Cro | 3 | B |   |   |   |    |   |   |   |   |   |  |  |
| 11 Dec             | S08W35 | 213 | 20    | 6  | Cro | 3 | B |   |   |   |    |   |   |   |   |   |  |  |
| 12 Dec             | S09W49 | 214 | 20    | 4  | Cro | 3 | B | 1 |   |   |    |   |   |   |   |   |  |  |
| 13 Dec             | S09W62 | 213 | 10    | 4  | Cro | 2 | B |   |   |   |    |   |   |   |   |   |  |  |
| 14 Dec             | S09W76 | 214 | 10    | 1  | Axx | 1 | A |   |   |   |    |   |   |   |   |   |  |  |
| 15 Dec             | S09W90 | 215 | plage |    |     |   |   |   |   |   |    |   |   |   |   |   |  |  |
|                    |        |     |       |    |     |   |   | 7 | 0 | 0 | 15 | 0 | 0 | 0 | 0 | 0 |  |  |

Crossed West Limb.  
Absolute heliographic longitude: 211



### *Region Summary - continued*

| Date               | Location |     | Sunspot Characteristics |              |         |       |       | Flares |       |   |   |         |   |   |   |   |
|--------------------|----------|-----|-------------------------|--------------|---------|-------|-------|--------|-------|---|---|---------|---|---|---|---|
|                    | Lat      | CMD | Helio                   | Area         | Extent  | Spot  | Spot  | Mag    | X-ray |   |   | Optical |   |   |   |   |
|                    |          |     | Lon                     | $10^6$ hemi. | (helio) | Class | Count | Class  | C     | M | X | S       | 1 | 2 | 3 | 4 |
| <b>Region 2464</b> |          |     |                         |              |         |       |       |        |       |   |   |         |   |   |   |   |
| 05 Dec             | S12E68   | 189 | 10                      | 1            | Axx     | 1     | A     | 1      |       |   |   |         |   |   |   |   |
| 06 Dec             | S12E53   | 191 | 10                      | 2            | Axx     | 1     | A     |        |       |   |   |         |   |   |   |   |
| 07 Dec             | S12E39   | 192 | 0                       |              | Axx     | 1     | A     |        |       |   |   |         |   |   |   |   |
| 08 Dec             | S12E18   | 192 | plage                   |              |         |       |       |        |       |   |   |         |   |   |   |   |
| 09 Dec             | S12E13   | 191 | plage                   |              |         |       |       |        |       |   |   |         |   |   |   |   |
| 10 Dec             | S10E03   | 188 | 10                      | 1            | Bxo     | 3     | B     |        |       |   |   |         |   |   |   |   |
| 11 Dec             | S10W10   | 188 | 20                      | 2            | Cro     | 3     | B     |        |       |   |   |         |   |   |   |   |
| 12 Dec             | S09W23   | 188 | 10                      | 3            | Bxo     | 3     | B     |        |       |   |   |         |   |   |   |   |
| 13 Dec             | S10W38   | 189 | plage                   |              |         |       |       |        |       |   |   |         |   |   |   |   |
| 14 Dec             | S10W52   | 190 | plage                   |              |         |       |       |        |       |   |   |         |   |   |   |   |
| 15 Dec             | S10W66   | 191 | plage                   |              |         |       |       |        |       |   |   |         |   |   |   |   |
| 16 Dec             | S10W80   | 192 | plage                   |              |         |       |       |        |       |   |   |         |   |   |   |   |
|                    |          |     |                         |              |         |       |       | 1      | 0     | 0 | 0 | 0       | 0 | 0 | 0 | 0 |

Crossed West Limb.

Absolute heliographic longitude: 188

|                    |        |     |       |   |     |   |   |   |   |   |   |   |   |   |   |   |
|--------------------|--------|-----|-------|---|-----|---|---|---|---|---|---|---|---|---|---|---|
| <b>Region 2465</b> |        |     |       |   |     |   |   |   |   |   |   |   |   |   |   |   |
| 07 Dec             | S05E58 | 173 | 40    | 2 | Hax | 1 | A | 1 |   |   |   |   |   |   |   |   |
| 08 Dec             | S05E50 | 167 | 80    | 6 | Cao | 6 | B |   |   |   |   |   |   |   |   |   |
| 09 Dec             | S06E35 | 169 | 90    | 5 | Cso | 6 | B |   |   |   |   |   |   |   |   |   |
| 10 Dec             | S05E24 | 167 | 80    | 7 | Cso | 5 | B |   |   |   |   | 1 |   |   |   |   |
| 11 Dec             | S05E09 | 169 | 50    | 2 | Hax | 2 | A | 1 |   |   |   | 2 | 1 |   |   |   |
| 12 Dec             | S05W05 | 170 | 30    | 2 | Hax | 3 | A | 2 |   |   |   | 1 |   |   |   |   |
| 13 Dec             | S06W17 | 168 | 20    | 5 | Cao | 4 | B |   |   |   |   |   |   |   |   |   |
| 14 Dec             | S06W31 | 169 | 10    | 2 | Axx | 2 | A |   |   |   |   |   |   |   |   |   |
| 15 Dec             | S06W45 | 170 | plage |   |     |   |   |   |   |   |   |   |   |   |   |   |
| 16 Dec             | S06W59 | 171 | plage |   |     |   |   |   |   |   |   |   |   |   |   |   |
| 17 Dec             | S06W74 | 173 | plage |   |     |   |   |   |   |   |   |   |   |   |   |   |
| 18 Dec             | S06W89 | 175 | plage |   |     |   |   |   |   |   |   | 5 |   |   |   |   |
|                    |        |     |       |   |     |   |   | 4 | 0 | 0 | 9 | 1 | 0 | 0 | 0 | 0 |

Crossed West Limb.

Absolute heliographic longitude: 170



### *Region Summary - continued*

| Date               | Location |     | Sunspot Characteristics |                        |         |       | Flares |       |       |   |   |         |   |   |   |
|--------------------|----------|-----|-------------------------|------------------------|---------|-------|--------|-------|-------|---|---|---------|---|---|---|
|                    | Lat      | CMD | Helio                   | Area                   | Extent  | Spot  | Spot   | Mag   | X-ray |   |   | Optical |   |   |   |
|                    |          |     | Lon                     | 10 <sup>-6</sup> hemi. | (helio) | Class | Count  | Class | C     | M | X | S       | 1 | 2 | 3 |
| <b>Region 2466</b> |          |     |                         |                        |         |       |        |       |       |   |   |         |   |   |   |
| 08 Dec             | S13E18   | 199 | 20                      | 6                      | Cro     | 8     | B      | 1     |       |   |   | 1       |   |   |   |
| 09 Dec             | S13E05   | 199 | 50                      | 5                      | Dai     | 12    | B      | 3     |       |   |   | 4       |   |   |   |
| 10 Dec             | S13W09   | 200 | 30                      | 6                      | Dao     | 8     | B      |       |       |   |   |         |   |   |   |
| 11 Dec             | S13W22   | 200 | 10                      | 4                      | Bxo     | 4     | B      |       |       |   |   |         |   |   |   |
| 12 Dec             | S13W35   | 200 | 10                      | 1                      | Axx     | 1     | A      | 1     |       |   |   |         |   |   |   |
| 13 Dec             | S13W49   | 200 | plage                   |                        |         |       |        |       |       |   |   |         |   |   |   |
| 14 Dec             | S13W63   | 201 | plage                   |                        |         |       |        |       |       |   |   |         |   |   |   |
| 15 Dec             | S13W77   | 202 | plage                   |                        |         |       |        |       |       |   |   |         |   |   |   |
|                    |          |     |                         |                        |         |       |        | 5     | 0     | 0 | 5 | 0       | 0 | 0 | 0 |

Died on Disk.

Absolute heliographic longitude: 199

|                    |        |     |       |   |     |   |   |   |   |   |   |   |   |   |   |
|--------------------|--------|-----|-------|---|-----|---|---|---|---|---|---|---|---|---|---|
| <b>Region 2467</b> |        |     |       |   |     |   |   |   |   |   |   |   |   |   |   |
| 09 Dec             | S06E16 | 188 | 20    | 3 | Cro | 3 | B |   |   |   |   |   |   |   |   |
| 10 Dec             | S05E01 | 190 | 20    | 4 | Cro | 4 | B |   |   |   |   |   |   |   |   |
| 11 Dec             | S05W15 | 193 | 0     |   | Axx | 1 | A |   |   |   |   |   |   |   |   |
| 12 Dec             | S05W30 | 195 | plage |   |     |   |   |   |   |   |   |   |   |   |   |
| 13 Dec             | S05W45 | 196 | plage |   |     |   |   |   |   |   |   |   |   |   |   |
| 14 Dec             | S05W59 | 197 | plage |   |     |   |   |   |   |   |   |   |   |   |   |
| 15 Dec             | S05W73 | 198 | plage |   |     |   |   |   |   |   |   |   |   |   |   |
| 16 Dec             | S05W87 | 199 | plage |   |     |   |   |   |   |   |   |   |   |   |   |
|                    |        |     |       |   |     |   |   | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Crossed West Limb.

Absolute heliographic longitude: 190



**Region Summary - continued**

| Date               | Location |           | Sunspot Characteristics    |                |            |            | Flares    |       |   |   |         |   |   |   |   |
|--------------------|----------|-----------|----------------------------|----------------|------------|------------|-----------|-------|---|---|---------|---|---|---|---|
|                    | Lat CMD  | Helio 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 | 4 |
| <b>Region 2468</b> |          |           |                            |                |            |            |           |       |   |   |         |   |   |   |   |
| 10 Dec             | S15E65   | 128       | 120                        | 4              | Dao        | 3          | B         | 1     |   |   | 1       |   |   |   |   |
| 11 Dec             | S14E52   | 126       | 70                         | 4              | Dao        | 4          | B         | 1     |   |   |         |   |   |   |   |
| 12 Dec             | S15E39   | 126       | 40                         | 3              | Dao        | 5          | B         | 2     |   |   | 1       |   |   |   |   |
| 13 Dec             | S15E26   | 125       | 40                         | 2              | Cao        | 4          | B         | 1     |   |   | 1       | 1 |   |   |   |
| 14 Dec             | S15E12   | 126       | 30                         | 2              | Cao        | 3          | B         |       |   |   | 2       |   |   |   |   |
| 15 Dec             | S15W02   | 127       | 10                         | 1              | Cro        | 3          | B         | 1     |   |   | 2       |   |   |   |   |
| 16 Dec             | S16W13   | 125       | 30                         | 4              | Cro        | 5          | B         | 1     |   |   | 1       | 1 |   |   |   |
| 17 Dec             | S17W27   | 126       | 20                         | 3              | Cro        | 3          | B         |       |   |   | 1       |   |   |   |   |
| 18 Dec             | S16W41   | 127       | 10                         | 1              | Axx        | 1          | A         |       |   |   | 4       |   |   |   |   |
| 19 Dec             | S15W54   | 126       | 10                         | 1              | Axx        | 1          | A         | 1     |   |   | 1       |   |   |   |   |
| 20 Dec             | S14W67   | 126       | 0                          | 1              | Axx        | 1          | A         | 1     |   |   | 1       |   |   |   |   |
|                    |          |           |                            |                |            |            |           | 9     | 0 | 0 | 15      | 2 | 0 | 0 | 0 |

Still on Disk.

Absolute heliographic longitude: 127

**Region 2469**

|        |        |     |       |    |     |   |   |   |   |   |   |   |   |   |   |
|--------|--------|-----|-------|----|-----|---|---|---|---|---|---|---|---|---|---|
| 12 Dec | N18E67 | 98  | 100   | 6  | Dso | 3 | B | 3 |   |   |   |   |   |   |   |
| 13 Dec | N18E56 | 95  | 90    | 6  | Dso | 8 | B |   |   |   | 1 |   |   |   |   |
| 14 Dec | N18E42 | 96  | 50    | 6  | Cao | 2 | B | 1 |   |   | 1 |   |   |   |   |
| 15 Dec | N18E28 | 97  | 30    | 1  | Hax | 1 | A |   |   |   |   |   |   |   |   |
| 16 Dec | N18E13 | 99  | 20    | 2  | Hax | 2 | A |   |   |   |   |   |   |   |   |
| 17 Dec | N18W01 | 100 | 20    | 2  | Hax | 2 | A |   |   |   |   |   |   |   |   |
| 18 Dec | N19W15 | 101 | 10    | 1  | Axx | 2 | A | 2 |   |   |   | 1 |   |   |   |
| 19 Dec | N19W28 | 100 | 0     | 21 | Axx | 1 | A |   |   |   |   |   |   |   |   |
| 20 Dec | N19W42 | 101 | plage |    |     |   |   |   |   |   |   |   |   |   |   |
|        |        |     |       |    |     |   |   | 6 | 0 | 0 | 2 | 1 | 0 | 0 | 0 |

Still on Disk.

Absolute heliographic longitude: 100



### *Region Summary - continued*

| Date               | Location |     | Sunspot Characteristics         |                   |               |               | Flares       |       |   |   |         |   |   |   |   |   |   |  |
|--------------------|----------|-----|---------------------------------|-------------------|---------------|---------------|--------------|-------|---|---|---------|---|---|---|---|---|---|--|
|                    | Lat CMD  | Lon | Helio<br>10 <sup>-6</sup> hemi. | Extent<br>(helio) | Spot<br>Class | Spot<br>Count | Mag<br>Class | X-ray |   |   | Optical |   |   |   |   |   |   |  |
|                    |          |     |                                 |                   |               |               |              | C     | M | X | S       | 1 | 2 | 3 | 4 |   |   |  |
| <b>Region 2470</b> |          |     |                                 |                   |               |               |              |       |   |   |         |   |   |   |   |   |   |  |
| 12 Dec             | N13E76   |     | 89                              | 80                | 4             | Hsx           | 1            | A     | 3 |   |         |   |   |   |   |   |   |  |
| 13 Dec             | N12E64   |     | 87                              | 270               | 6             | Dkc           | 6            | B     |   |   |         |   |   |   |   |   |   |  |
| 14 Dec             | N13E56   |     | 82                              | 360               | 10            | Dki           | 10           | B     |   |   |         |   | 3 |   |   |   |   |  |
| 15 Dec             | N13E43   |     | 82                              | 610               | 14            | Eko           | 16           | B     |   |   |         |   |   |   |   |   |   |  |
| 16 Dec             | N14E31   |     | 81                              | 530               | 15            | Eko           | 12           | B     |   |   |         |   | 2 |   |   |   |   |  |
| 17 Dec             | N15E18   |     | 81                              | 610               | 14            | Eko           | 17           | B     | 2 |   |         |   | 2 |   |   |   |   |  |
| 18 Dec             | N15E06   |     | 80                              | 550               | 14            | Eko           | 16           | B     |   |   |         |   | 1 |   |   |   |   |  |
| 19 Dec             | N14W08   |     | 80                              | 450               | 14            | Eho           | 12           | B     | 2 |   |         |   |   |   |   |   |   |  |
| 20 Dec             | N15W21   |     | 80                              | 430               | 13            | Eho           | 12           | B     | 1 |   |         |   |   |   |   |   |   |  |
|                    |          |     |                                 |                   |               |               |              |       | 8 | 0 | 0       | 8 | 0 | 0 | 0 | 0 | 0 |  |

Still on Disk.

Absolute heliographic longitude: 80

### **Region 2471**

|        |        |  |    |       |   |     |   |   |   |   |   |   |   |   |   |   |   |  |
|--------|--------|--|----|-------|---|-----|---|---|---|---|---|---|---|---|---|---|---|--|
| 14 Dec | S21E45 |  | 93 | 20    | 3 | Cro | 3 | B |   |   |   |   |   |   |   |   |   |  |
| 15 Dec | S21E30 |  | 95 | 10    | 3 | Bxo | 4 | B |   |   |   |   |   |   |   |   |   |  |
| 16 Dec | S21E16 |  | 96 | plage |   |     |   |   |   |   |   |   |   |   |   |   |   |  |
| 17 Dec | S21E02 |  | 97 | plage |   |     |   |   |   |   |   |   |   |   |   |   |   |  |
| 18 Dec | S21W12 |  | 98 | plage |   |     |   |   |   |   |   |   |   |   |   |   |   |  |
| 19 Dec | S21W26 |  | 98 | plage |   |     |   |   |   |   |   |   |   |   |   |   |   |  |
| 20 Dec | S21W40 |  | 99 | plage |   |     |   |   |   |   |   |   |   |   |   |   |   |  |
|        |        |  |    |       |   |     |   |   | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |  |

Still on Disk.

Absolute heliographic longitude: 97

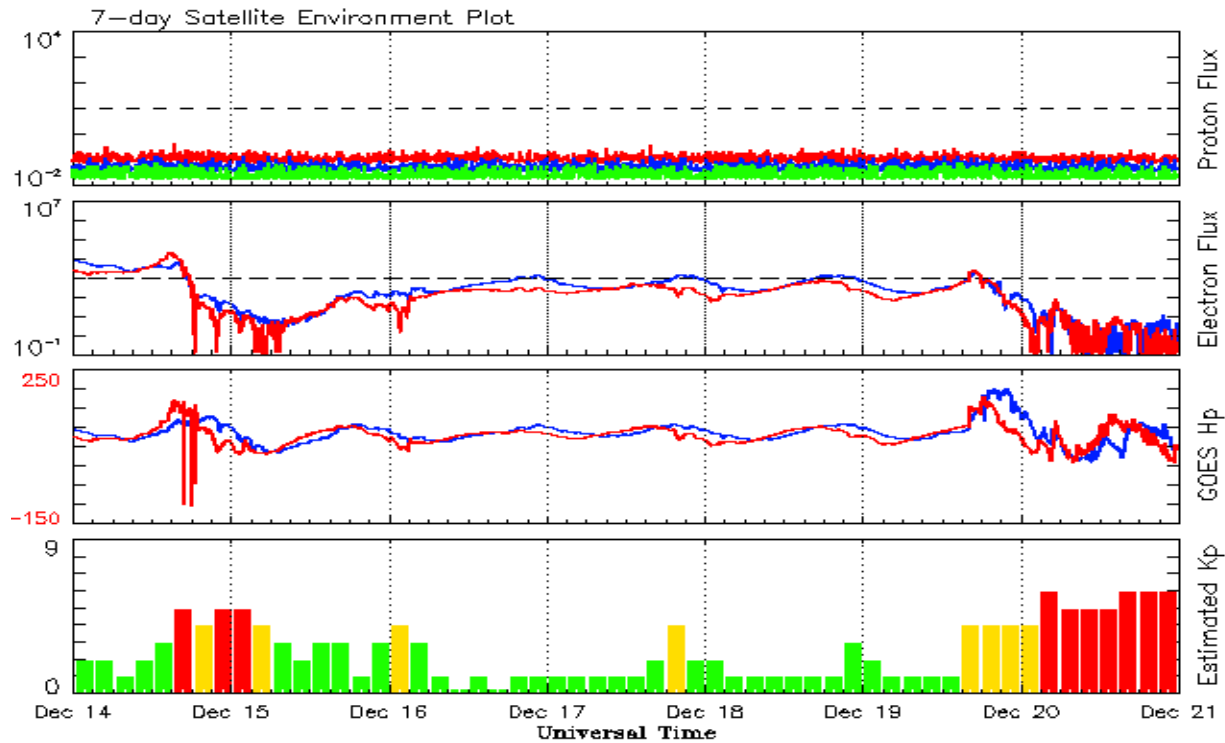


**Recent Solar Indices (preliminary)**  
**Observed monthly mean values**

| Month       | Sunspot Numbers |       |        |               |      | Radio Flux |        | Geomagnetic |        |
|-------------|-----------------|-------|--------|---------------|------|------------|--------|-------------|--------|
|             | Observed values |       | Ratio  | Smooth values |      | Penticton  | Smooth | Planetary   | Smooth |
|             | SEC             | RI    | RI/SEC | SEC           | RI   | 10.7 cm    | Value  | Ap          | Value  |
| <b>2013</b> |                 |       |        |               |      |            |        |             |        |
| December    | 118.2           | 90.3  | 0.76   | 115.4         | 75.9 | 147.7      | 135.9  | 5           | 7.5    |
| <b>2014</b> |                 |       |        |               |      |            |        |             |        |
| January     | 125.9           | 81.8  | 0.65   | 117.7         | 77.3 | 158.6      | 137.3  | 6           | 7.1    |
| February    | 174.6           | 102.3 | 0.59   | 119.5         | 78.3 | 170.3      | 138.6  | 12          | 6.9    |
| March       | 141.1           | 91.9  | 0.65   | 123.2         | 80.8 | 149.9      | 140.8  | 6           | 7.2    |
| April       | 130.5           | 67.5  | 0.65   | 124.8         | 69.8 | 144.3      | 143.5  | 9           | 7.5    |
| May         | 116.8           | 67.5  | 0.64   | 122.3         | 69.0 | 130.0      | 144.7  | 7           | 7.9    |
| June        | 107.7           | 61.7  | 0.66   | 121.4         | 68.5 | 122.2      | 145.5  | 7           | 8.4    |
| July        | 113.6           | 60.1  | 0.64   | 120.4         | 67.6 | 137.3      | 145.2  | 5           | 8.8    |
| August      | 106.2           | 64.1  | 0.70   | 115.1         | 65.0 | 124.7      | 142.8  | 9           | 8.9    |
| September   | 127.4           | 78.0  | 0.69   | 107.4         | 61.1 | 146.1      | 140.1  | 11          | 9.3    |
| October     | 92.0            | 54.0  | 0.66   | 101.7         | 58.4 | 153.7      | 138.4  | 10          | 9.9    |
| November    | 101.8           | 62.2  | 0.69   | 97.9          | 56.8 | 155.3      | 137.4  | 10          | 10.1   |
| December    | 120.0           | 67.7  | 0.65   | 95.2          | 55.3 | 158.7      | 137.0  | 12          | 10.5   |
| <b>2015</b> |                 |       |        |               |      |            |        |             |        |
| January     | 101.2           | 55.8  | 0.66   | 92.1          | 53.6 | 141.7      | 135.8  | 10          | 11.0   |
| February    | 70.6            | 40.0  | 0.63   | 88.3          | 51.7 | 128.8      | 133.8  | 10          | 11.5   |
| March       | 61.7            | 32.7  | 0.62   | 84.2          | 49.3 | 126.0      | 131.2  | 17          | 12.0   |
| April       | 72.5            | 45.2  | 0.75   | 80.5          | 47.3 | 129.2      | 127.3  | 12          | 12.4   |
| May         | 83.0            | 53.3  | 0.71   | 77.5          | 45.6 | 120.1      | 123.3  | 9           | 12.7   |
| June        | 77.3            | 39.9  | 0.53   |               |      | 123.2      |        | 14          |        |
| July        | 68.4            | 39.8  | 0.58   |               |      | 107.0      |        | 10          |        |
| August      | 61.6            | 38.8  | 0.63   |               |      | 106.2      |        | 16          |        |
| September   | 72.5            | 46.9  | 0.65   |               |      | 102.1      |        | 16          |        |
| October     | 59.5            | 37.0  | 0.62   |               |      | 104.1      |        | 15          |        |
| November    | 61.8            | 37.9  | 0.61   |               |      | 109.6      |        | 13          |        |

**Note:** Values are final except for the most recent 6 months which are considered preliminary.  
Cycle 24 started in Dec 2008 with an RI=1.7.





*Weekly Geosynchronous Satellite Environment Summary  
Week Beginning 14 December 2015*

The proton flux plot contains the five-minute averaged integral proton flux (protons/cm<sup>2</sup>-sec -sr) as measured by the SWPC Primary GOES satellite, near West 75, for each of three energy thresholds: greater than 10, 50, and 100 MeV.

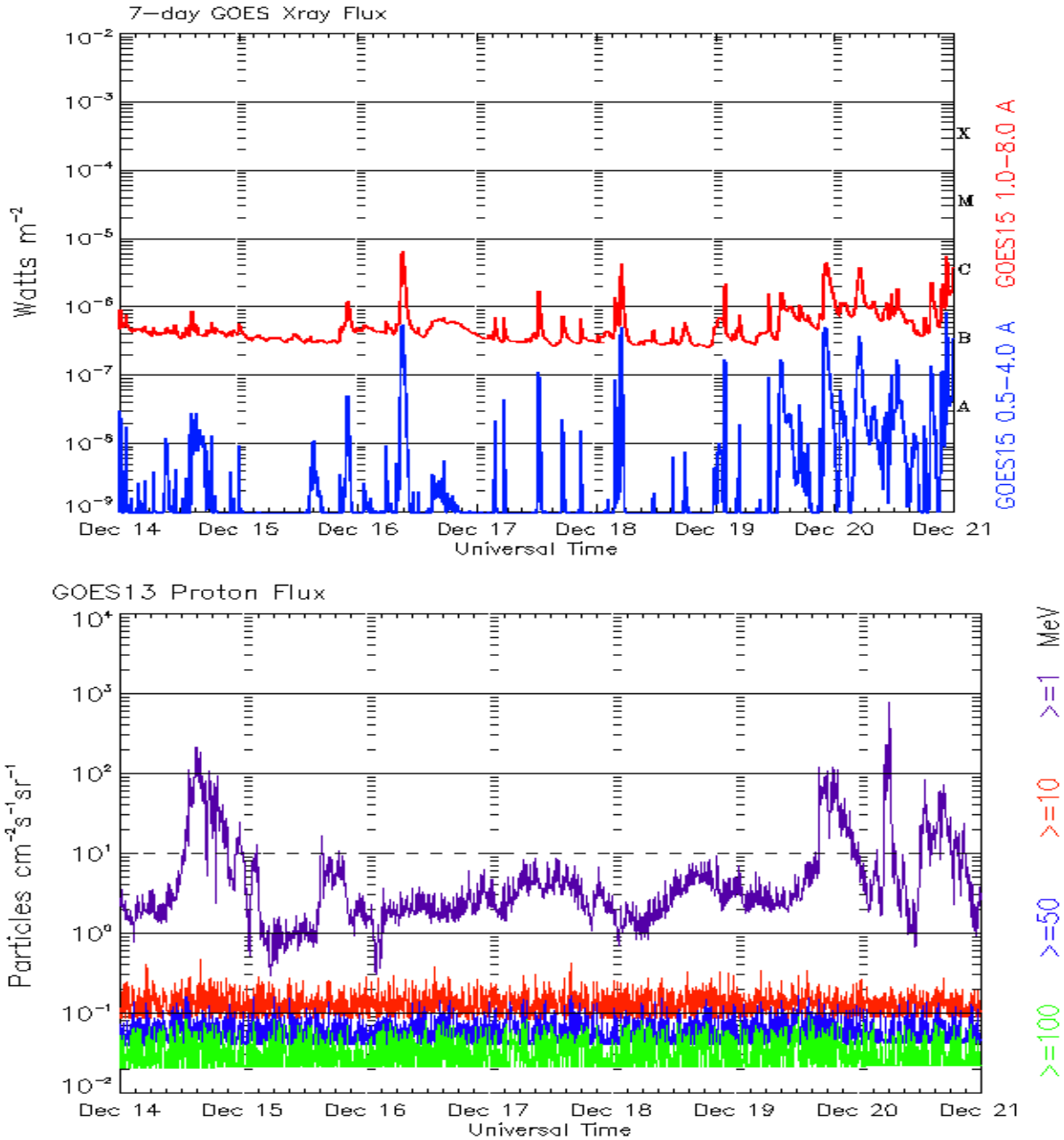
The electron flux plot contains the five-minute averaged integral electron flux (electrons/cm<sup>2</sup>-sec -sr) with energies greater than 2 MeV by the SWPC Primary GOES satellite.

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

The Estimated 3-hour Planetary Kp-index is derived at the NOAA Space Weather Prediction Center using data from the following ground-based magnetometers: Boulder, Colorado; Chambon la Foret, France; Fredericksburg, Virginia; Fresno, California; Hartland, UK; Newport, Washington; Sitka, Alaska. These data are made available thanks to the cooperative efforts between SWPC and data providers around the world, which currently includes the U.S. Geological Survey, the British Geological Survey, and the Institut de Physique du Globe de Paris.

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  
Week Beginning 14 December 2015*

The x-ray plots contains five-minute averages x-ray flux (Watt/m<sup>2</sup>) as measure by the SWPC primary GOES X-ray satellite, usually at West 105 longitude, 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.

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





## ***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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