Australian Government

Bureau of Meteorology

# SPACE WEATHER SERVICES

# SOLAR

# AND

# GEOPHYSICAL

# SUMMARY

May 2017

# Solar Activity

Solar activity was predominately at Very Low levels this month with only three other days at Low levels and no significant flares observed. However, a partial halo CME was observed on 23 May associated with a disappearing solar filament. This CME arrived at Earth late on 27 May. It was first observed by the DSCOVR spacecraft at 27/1450UT. Initially the density of the solar wind jump from ~5 to 23 particles/cm^3 and later peaked at 70 particles/cm^3 at 27/2027UT. The solar wind speed step up from ~300 to 365 km/s and later peaked at 385 km/s at 27/1827UT. The Interplanetary Magnetic Field B total initially jumped from ~3 to 10 nT and later peaked at 21 nT at 27/2049UT. The Bz component initially dipped to -7 nT an then proceeded to -20 at minimum.

| DATE | CLASS M FLARES | CLASS X FLARES | FLARE MAX | FADEOUT POSSIBLE ON DAYLIGHT HF CIRCUIT |
|---|---|---|---|---|

Total Number of M-flares 0, X-flares 0
Total Number of flares for May was 0

| FLARE ALERT | SWF ALERT |
|---|---|
| None issued | None issued |

PROTON ALERT

| BEGIN DATE | TIME | END DATE | TIME | ENERGY THRESHOLD |
|---|---|---|---|---|

None issued

# Ionospheric Activity

There was minor depressions in the northern Australian region most likely due to the low EUV levels from the Sun associated with the low sunspot number.
Although not indicated below northern Australia had enhanced MUFs due to the timing of the geomagnetic storm on 28 May and ionograms from stations such as Antarctica and Hobart between 28/08-21UT showed no foF2 layer.

Ionospheric depressions listed below are calculated using foF2 data from the SWS ionosonde network.

## IONOSPHERIC DISTURBANCES (MUFs for the Australian Region)

| | |
|---|---|
| 02 May 17 | Northern region MUFs Depressed by 20% |
| 04 May 17 | Northern region MUFs Depressed by 15% |
| 05 May 17 | Northern region MUFs Depressed by 15% |
| 06 May 17 | Northern region MUFs Depressed by 20% |
| 07 May 17 | Northern region MUFs Depressed by 15% |
| 08 May 17 | Northern region MUFs Depressed by 15% |
| 12 May 17 | Northern region MUFs Depressed by 15% |
| 13 May 17 | Northern region MUFs Depressed by 15% |
| 15 May 17 | Northern region MUFs Depressed by 15% |
| 17 May 17 | Northern region MUFs Depressed by 15% |
| 19 May 17 | Northern region MUFs Depressed by 15% |

## RADIO COMMUNICATIONS WARNINGS

| DATE | N°. | BEGIN | END |
|---|---|---|---|
| 10 May 17 | 25 | 10 May 17 | 10 May 17 |
| 15 May 17 | 26 | 15 May 17 | 17 May 17 |
| 15 May 17 | 27 | 16 May 17 | 18 May 17 |
| 19 May 17 | 28 | 19 May 17 | 21 May 17 |
| 24 May 17 | 29 | 26 May 17 | 27 May 17 |
| 27 May 17 | 30 | 28 May 17 | 29 May 17 |

# Geomagnetic Activity

The strongest disturbance for the month was observed on 28 May with a local A index of 21 reached. This activity was associated with a CME. Geomagnetic activity hit severe storm levels (kp=7) at 28/03-06UT interval and was at Storm levels of activity for the first half of the UT day, 28 May, due to the prolonged negative IMF Bz component (dipping to -20 nT), which lead to strong reconnection with the Earth's magnetic field.
Disturbances with Australian A indices greater than or equal to 16 are reported below. Increase in activity on 20 May was due to a recurrent coronal hole.

| DATE | GEOMAGNETIC DISTURBANCES (for the Australian region) |
|---|---|
| 20 May 17 | Mostly quiet to minor storm |
| 28 May 17 | Quiet to Minor Storm |

**GEOMAGNETIC WARNINGS AND ALERTS**

| DATE | N°. | BEGIN | END | ISSUED |
|---|---|---|---|---|
| 03 May 17 | 22 | 03 May 17 | 05 May 17 | Warning |
| 10 May 17 | 23 | 10 May 17 | 11 May 17 | Warning |
| 15 May 17 | 24 | 15 May 17 | 17 May 17 | Warning |
| 15 May 17 | 25 | 16 May 17 | 18 May 17 | Warning |
| 19 May 17 | 26 | 19 May 17 | 21 May 17 | Warning |
| 20 May 17 | | | | Alert |
| 23 May 17 | 27 | 26 May 17 | 27 May 17 | Warning |
| 27 May 17 | 28 | 28 May 17 | 28 May 17 | Warning |
| 28 May 17 | | | | Alert |

# Solar And Geophysical Indices

| DATE | 10cm FLUX | AUSTRALIAN A-INDEX | AUSTRALIAN T-INDEX | DATE | 10 cm FLUX | AUSTRALIAN A-INDEX | AUSTRALIAN T-INDEX |
|---|---|---|---|---|---|---|---|
| 1-May | 75 | 2 | 9 | 17-May | 71 | 6 | 11 |
| 2-May | 77 | 2 | 10 | 18-May | 72 | 4 | 14 |
| 3-May | 75 | 3 | 8 | 19-May | 72 | 11 | 10 |
| 4-May | 74 | 2 | 9 | 20-May | 72 | 17 | 26 |
| 5-May | 74 | 2 | 6 | 21-May | 74 | 7 | 18 |
| 6-May | 73 | 2 | 4 | 22-May | 74 | 8 | 8 |
| 7-May | 72 | 4 | 13 | 23-May | 76 | 5 | 10 |
| 8-May | 71 | 4 | 17 | 24-May | 78 | 1 | 8 |
| 9-May | 69 | 3 | 12 | 25-May | 76 | 0 | 3 |
| 10-May | 69 | 3 | 13 | 26-May | 80 | 0 | 4 |
| 11-May | 69 | 5 | 4 | 27-May | 82 | 5 | 7 |
| 12-May | 69 | 4 | 1 | 28-May | 79 | 21 | 38 |
| 13-May | 70 | 2 | 2 | 29-May | 76 | 6 | 11 |
| 14-May | 71 | 7 | 0 | 30-May | 74 | 3 | 7 |
| 15-May | 71 | 8 | 6 | 31-May | 74 | 2 | 3 |
| 16-May | 72 | 7 | 15 | | | | |

| DATE | 10cm FLUX | AUSTRALIAN A-INDEX | AUSTRALIAN T-INDEX | SUNSPOT NUMBER | | FLARES |
|---|---|---|---|---|---|---|
| | Monthly Average | Monthly Average | Monthly Average | Monthly Average | Yearly Average | >M1.0 |
| Jun-16 | 81.9 | 4.8 | 30.6 | 20.9 | 41.6 | 0 |
| Jul-16 | 83.1 | 5.7 | 26.8 | 32.5 | 38.6 | 7 |
| Aug-16 | 85 | 6.2 | 28.7 | 50.7 | 36 | 1 |
| Sep-16 | 87.8 | 9.1 | 28.9 | 44.7 | 33.2 | 0 |
| Oct-16 | 86.1 | 9.1 | 9.9 | 33.6 | 31.4 | 0 |
| Nov-16 | 78.7 | 6.4 | 3.8 | 21.4 | 29.9 | 2 |
| Dec-16 | 75.2 | 7.3 | 2.5 | 19.5 | 28.8 | 0 |
| Jan-17 | 77.6 | 6.7 | 0.5 | 25.8 | 28.9 | 0 |
| Feb-17 | 76.9 | 6.3 | 10 | 26.1 | 27.7 | 0 |
| Mar-17 | 74.7 | 8.4 | 11.1 | 17.7 | 25.9 | 0 |
| Apr-17 | 81 | 7.3 | 14.4 | 32.6 | 24.8 | 7 |
| May-17 | 73.6 | 5 | 9.9 | 18.8 | 24.6 | 0 |
| | | | | | Predicted Sunspot Numbers | |

SPECIAL NOTE

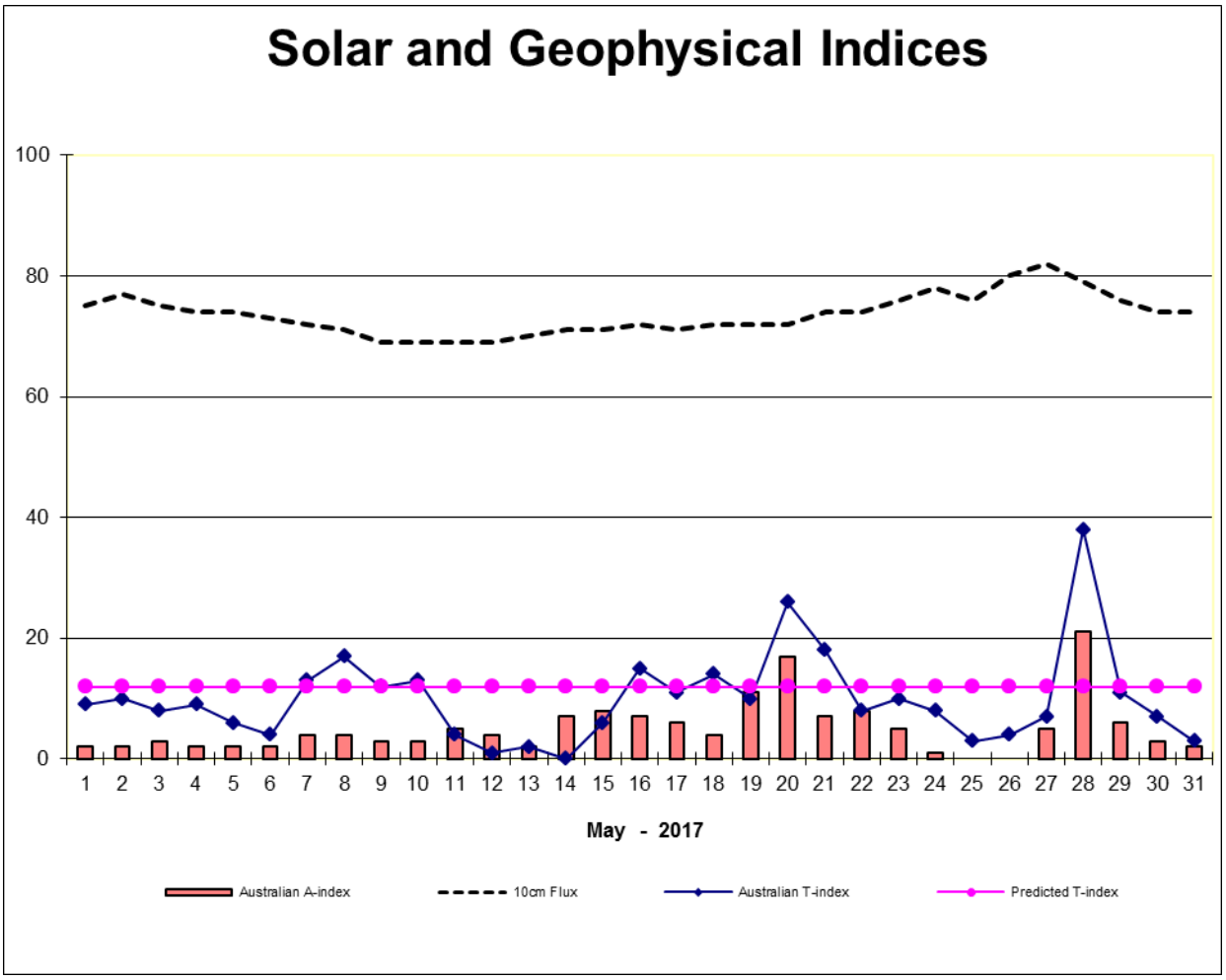
In June 2015, WDC-SILSO, Royal Observatory of Belgium, Brussels, adjusted their original observed sunspot numbers (Version 1.0) to a Version 2.0 series in which the sunspot numbers are higher. In the Version 1.0 data series, some of the sunspot numbers were weighted. The new (Version 2.0) sunspot numbers are unweighted sunspot number counts (for more information see: www.sidc.be/silso/home). The Bureau of Meteorology SWS solar cycle prediction is now based on the Version 2.0 values. As a result of this recalibration, the observed monthly and observed and predicted smoothed sunspot numbers are higher in the monthly table and solar cycle graph.

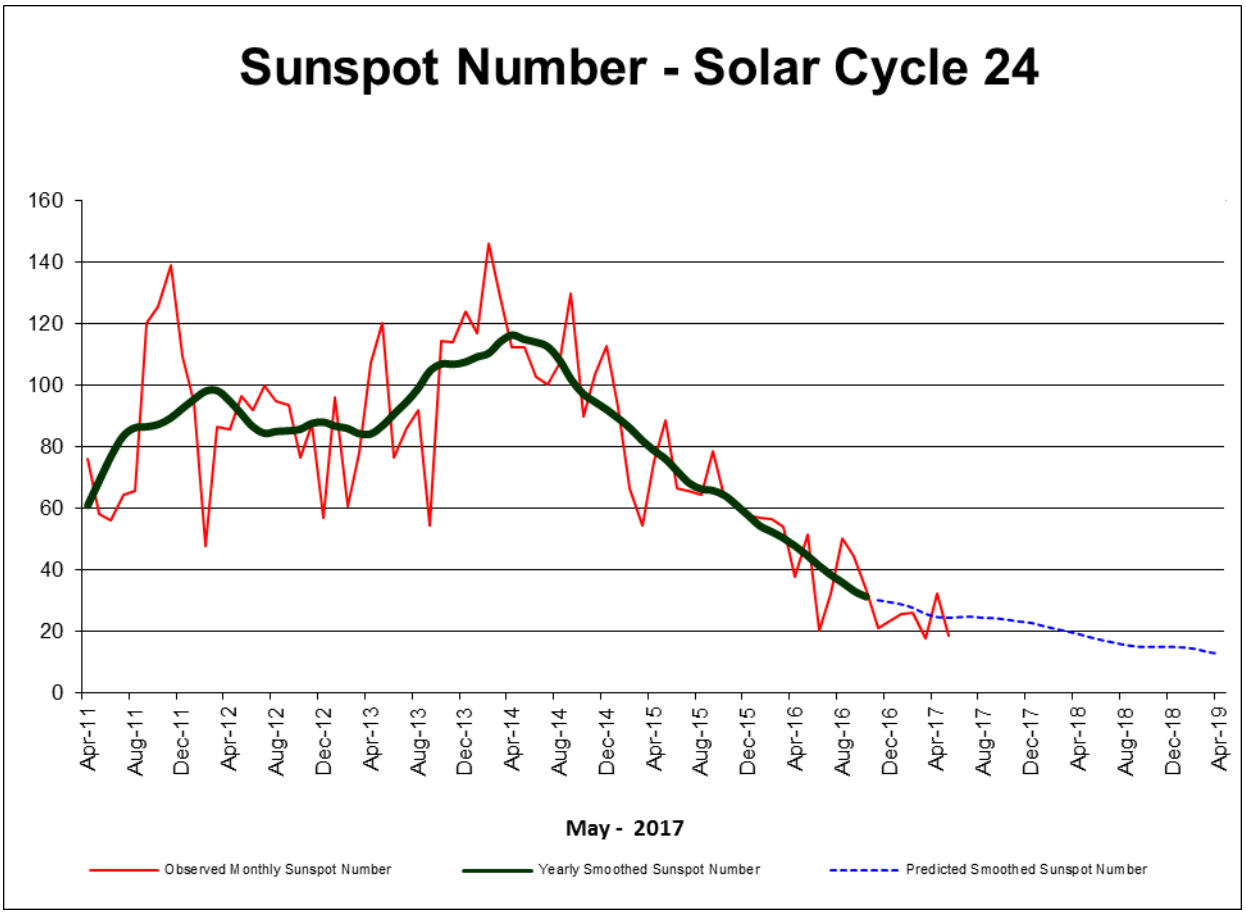
**IPS WORLD T-INDICES**

| Year | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2012 | 81 | 65 | 64 | 69 | 77 | 74 | 70 | 80 | 86 | 75 | 65 | 65 |
| 2013 | 74 | 62 | 69 | 84 | 92 | 82 | 81 | 76 | 68 | 76 | 86 | 90 |
| 2014 | 91 | 108 | 130 | 114 | 96 | 84 | 86 | 81 | 90 | 94 | 98 | 103 |
| 2015 | 92 | 101 | 91 | 97 | 85 | 79 | 71 | 48 | 40 | 43 | 53 | 50 |
| 2016 | 52 | 57 | 46 | 30 | 34 | 28 | 26 | 25 | 28 | 17 | 12 | 10 |
| 2017 | 14 | 19 | 11 | 8 | 2* | 10 | 9 | 8 | 7 | 7 | 6 | 6 |
| 2018 | 5 | 4 | 3 | 3 | 2 | 1 | 0 | 0 | -1 | -1 | -2 | -2 |
| 2019 | -3 | -3 | -4 | -4 | -5 | -5 | -5 | -5 | -4 | -4 | -3 | -3 |
| 2020 | -2 | -1 | 0 | 1 | 3 | 5 | 7 | 9 | 11 | 14 | 17 | 20 |
| 2021 | 23 | 26 | 28 | 32 | 35 | 38 | 40 | 42 | 44 | 46 | 49 | 50 |

SWS Predicted T-Indices

* T-Indices may have changed




Observed monthly sunspot numbers courtesy of WDC-SILSO, Royal Observatory of Belgium, Brussels
(www.sidc.be/silso/home)

# NOTES - notes - NOTES - notes - NOTES - notes

a. Times quoted in this publication are all Universal Time (UT).

b. The values of all indices are provisional. Final values are not available for several months.

c. M or X class flares refer to the X-ray classification system for solar flares. In this system, X class flares are more energetic than M class flares.

| FLARE CLASS | X-RAY FLUX DENSITY | |
|---|---|---|
| | Ergs/cm$^2$/sec | W/m$^2$ |
| M | 0.01-0.1 | $10^{-5}$ to $10^{-4}$ |
| X | >0.1 | > $10^{-4}$ |

d. Class M flares, particularly the less energetic ones, are likely to cause a fadeout on only the lowest frequencies. Class X flares are likely to cause a fadeout over the entire HF spectrum. It should be noted that a fadeout will only occur on those circuits having a reflection point in the daylight hemisphere of the earth. Circuits having only night hemisphere reflection points will not be affected no matter the energy of the solar flares.

e. The 10cm flux is the radio power of the sun at a frequency of 2800 MHz (wavelength 10.7 cm). This flux is a good indicator of solar activity and is widely used in place of the sunspot number. The values are measured by the Penticton radio observatory, Canada. Unlike the sunspot number, the 10cm flux never drops to zero even during solar minimum. With no sunspots visible on the solar disk, the 10cm flux will still have a value of around 67. The table below gives a (statistical) comparison between 10cm flux and sunspot number. The 10cm flux is measured in solar flux units ($10^{-22}$ W m$^{-2}$ Hz$^{-1}$).

| SUNSPOT No. | 10 cm FLUX |
|---|---|
| 0 | 67 |
| 20 | 78 |
| 40 | 93 |
| 60 | 110 |
| 100 | 147 |
| 150 | 195 |
| 200 | 243 |

f. Ionospheric disturbances refer to measurements made across Australia, but are generally applicable to mid-latitude Southern Hemisphere conditions. Spread F conditions indicate tilts in the ionosphere, which may result in multipath fading on some HF circuits.

g. The magnetic A-indices are for the Australian region. Large values for the A index correspond to disturbed conditions. Levels of magnetic disturbances are described in the following terms.

| A INDEX VALUE | DESCRIPTION |
|---|---|
| 0 up to 7 | Quiet |
| 8 up to 15 | Unsettled |
| 16 up to 24 | Active |
| 25 up to 35 | Minor Storm |
| 36 and above | Major Storm |

h. The Australian T-index is a measure of the average level of the ionospheric critical frequencies available on a particular day - the higher the value of the T-index, the higher the ionospheric critical frequencies (and Maximum Usable Frequencies on HF circuits) for that day. The T-index is based on data from Australian ionospheric stations and so is most applicable to HF circuits with reflection points in the Australian region.

i. The IPS Monthly T-index for ASAPS is derived from the observed monthly median values of foF2 for each hour at up to 40 ionospheric stations worldwide. These records become available from IPS stations in Australia very soon after each month, but the majority are received up to one year later. This means that the exact observed value of the monthly T-index is not available until some months later.

The predicted smoothed monthly T-indices are computed by using a statistical analysis of the observed monthly T-indices for all solar cycles since 1938.

The IPS T-indices for ASAPS may not be updated each month but only when sufficient new data becomes available.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