
Space Weather Technical Forecast

Issued on Monday, 19 June 2023 at 13:18 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales <https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales>

Space Weather Forecast Headline: Chance of R1/R2 Radio Blackouts throughout. Active fluence likely days 1 and 2.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Moderate over the past 24 hours, with two M-class flares. The first was a M2.5 flare, originating from the region of AR3335 and AR3336 in the southeast quadrant at 18/1353 UTC. At 19/0351 UTC a M1.5 flare was observed from the southeast limb. There are currently nine sunspot regions on the visible disc, with AR3331 recently transiting to the far side round the southwest limb. However, this has been replaced by a new region appearing round the limb in the southeast. Currently this is analysed as Hsx/Alpha but may reveal more complexity as it rotates further onto the visible disc. The largest and most magnetically complex region is AR3335 (Esi/Beta-Gamma) in the southeast, which appears to have simplified slightly with the loss of any delta spots. The second largest region is AR3333 (Eai/Beta-Gamma), in the southwest, but this has remained relatively stable during the period. AR3338 in the northeast has continued to develop and is now classified Eao/Beta. Another region which has shown development over the past 24 hours is the unnumbered region in the southeast, which is now classed Dro/Beta. All other regions remain small and magnetically simple, with little change during the period.

A slight dimming event was observed in association with the M2.5 flare and a CME can be seen in coronagraph imagery from 18/1400 UTC. Another dimming event was observed in the northwest around 19/0200 UTC. Both these events are initially thought not to have produced Earth directed CMEs but analysis is ongoing.

Solar Wind / Geomagnetic Activity: The solar wind, as measured by ACE at L1, has been at ambient to slightly elevated levels, with speeds ranging between 375 and 415 km/s. Density was below average (<5 ppcc). The IMF was weak throughout (5-8 nT), its north-south component remaining unremarkable and between +/- 6nT. The phi angle was mostly negative (towards the Sun). The net result of the above solar wind measures was Quiet to Unsettled geomagnetic activity (Kp 1-3).

Energetic Particles / Solar Radiation: High energy proton flux (greater than 10MeV), as observed by GOES16, was at Background levels.

High energy electron flux (greater than 2MeV), as observed by GOES16, started the period High, with a peak of 3840 pfu observed at 18/1430 UTC. It subsequently lowered, dropping below the High threshold at 18/1835 UTC, where it has diurnally cycled between Background and Moderate. The associated 24-hour fluence rose above the Active threshold (1e8 integrated pfu) between 18/1500 UTC and 19/0300 UTC, with a peak of 1.21e8 integrated pfu at 18/1800 UTC. Observed fluence at 19/0000 UTC was 1.06e8.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is expected to remain Low to Moderate with a chance of further isolated M-flares and a slight chance of an X-flare. AR3335, AR3333 and perhaps the new region emerging round the southeast limb are the most likely source regions for activity.

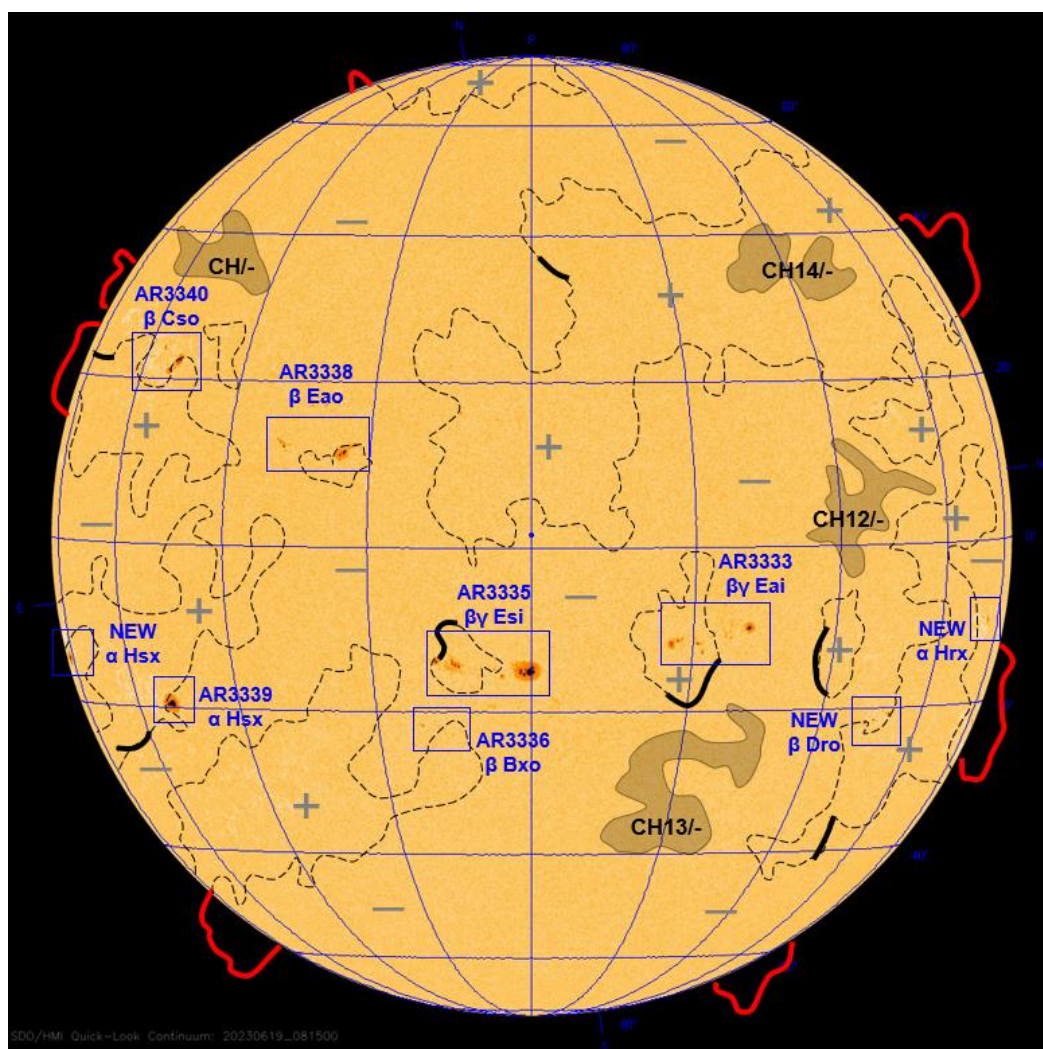
Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

Solar Wind / Geomagnetic Activity: No Earth-directed CMEs currently feature in the forecast. Earth is now under the waning influence of the fast speed stream associated with CH12/-, with winds soon returning to ambient levels. Slight enhancements to the solar wind speed are possible towards midweek, under the influence of the HSS originating from either CH13 (southern hemisphere) or CH14 (northern hemisphere), probably the latter as this feature is larger. All things considered, geomagnetic activity is expected to be mostly Quiet with a chance of Unsettled to Active intervals on days 3 and 4 (21-22 June).

Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux is expected to remain at Background levels, though a very Slight Chance of enhancement throughout given the current configuration of front-sided sunspot groups.

High energy electron flux (greater than 2MeV) is likely to reach Moderate to High levels over the coming days, but with a gradual decline. Electron fluence is likely to remain close to the Active (1e8 integrated pfu) threshold, but a decline in values is possible on days 3 and 4 (21-22 June) if geomagnetic activity increases.

Figure 1. Solar Analysis Valid 19/0800 UTC.



Key: Filament ____, Prominence ____, Magnetic Field Line - - -, Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α - β - $\beta\gamma$ - $\beta\gamma\delta$ and Zurich-McIntosh Axx etc.

Geomagnetic Storms:

Despite several CMEs being observed in the past 24 hours, mainly around the periphery of the disc, none are considered to be Earth-directed.

On the coronal hole side of things Earth is now under the waning influence of the fast speed stream associated with CH12/-. As such, geomagnetic activity should remain mostly Quiet with a chance of Unsettled intervals. There may be slight enhancements to the solar wind speed over the coming days, due to a possible connection with either CH13 (southern hemisphere) or CH14 (northern hemisphere), but geomagnetic activity should not exceed Unsettled to Active levels given their relatively small size and based on the lack of evidence from the previous rotation.

All things considered, geomagnetic activity is expected to be mostly Quiet with a chance of Unsettled or Active intervals on days 3 and 4 (21 and 22 June).

Geo-Magnetic Storm	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Minor or Moderate	G1 to G2	No	1	5	10	5
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Nil

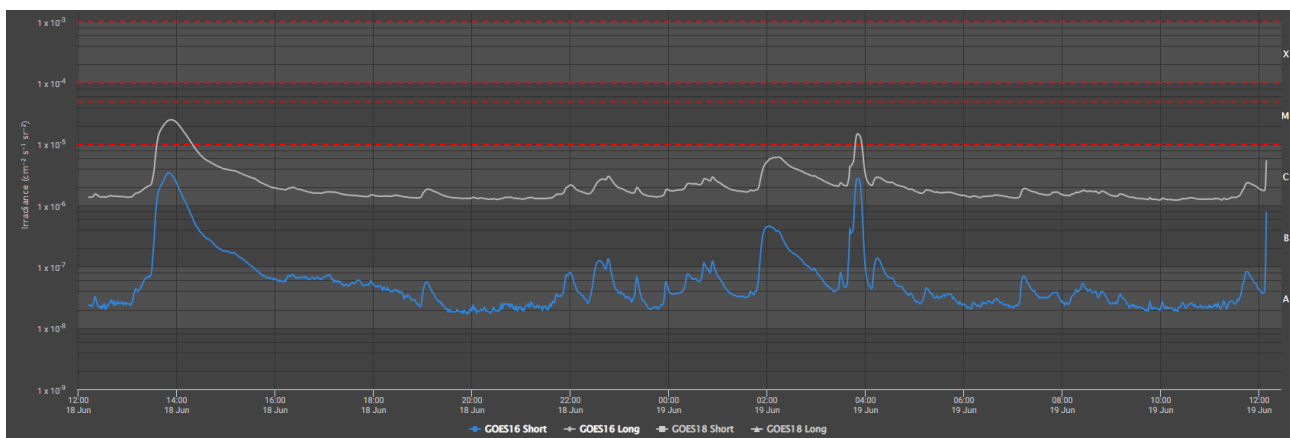
Radio Blackouts - X-Ray Flares:

There are currently nine sunspot regions on the visible disc, three of which are unnumbered. The largest and most magnetically complex is AR3335, which is in a magnetically complex Beta-Gamma formation, but appears to have lost its delta spots. The second largest region is AR3333, which also appears to be a Beta-Gamma, but has been relatively stable. AR3338 in the northeast has continued to develop over the past 24 hours and is now classified Eao/Beta. Another region which has shown development is the unnumbered region in the southeast, which is now classed Dro/Beta. A new region is currently appearing round the southeast limb, which looks to be the source region of an M1 flare at 19/0352 UTC. This region is currently analysed as Hsx/Alpha but may reveal more complexity as it comes further in to view. All other regions are small and magnetically simple.

No further significant regions are expected to depart or transit on to the disc over the coming days and thus solar activity is expected to remain Low to Moderate, with a chance of further M-class flares and slight chance of an X-class flare.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	50	50	50	50
Very Active	R3 to R5 X Class	No	5	5	5	5

Figure 2: GOES 16 X-ray flux



Solar Radiation Storms - (High Energy Protons):

The high energy (greater than 10MeV) proton flux is expected to remain at background levels. There is a slight chance of S1 given the sunspot groups progressing the westwards across the centre of the disc.

Radiation Storms	Level (cm ⁻² sr ⁻¹ s ⁻¹)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ S1	No	10	10	10	10
Very Active	≥ S3 *	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = cm⁻²sr⁻¹s⁻¹)

High Energy Electrons Event ($\geq 2\text{MeV}$):

High energy electron flux (greater than 2MeV) is expected to diurnally fluctuate between Background and Moderate/High levels, but possibly with an overall gradual decreasing trend. Electron fluence has responded to the fast wind of CH12, and is expected to stay close to the Active ($1\text{e}8$) threshold over the coming days. A decline in values is possible on days 3 and 4 (21-22 June) if geomagnetic activity increases due to the potential arrival of the next high speed stream from either CH13 or CH14.

GEO Electron Environment	Level ($\text{cm}^{-2} \text{sr}^{-1} \text{day}^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	$\geq 2 \text{ MeV}$ $\geq 1 \times 10^8$	Yes	80	70	60	30
Very Active	$\geq 2 \text{ MeV}$ $\geq 1 \times 10^9$	No	1	1	1	1

Figure 3: GOES-16 electron flux and fluence

