
Space Weather Technical Forecast

Issued on Monday, 19 June 2023 at 01:13 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 to persist 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 event was a short duration M1.3 at 18/0031UTC, originating from AR3335 in the southeast, and the second was a M2.5 flare, originating from AR3336, also located in the southeast quadrant.

There are currently twelve sunspots on the visible disc, four of which are unnumbered. The largest and most magnetically complex is AR3335, which contains two small delta spots in its central portion. The second largest region is AR3333, although it appears to be relatively stable. Two regions have recently appeared on the eastern limb, one in the south (AR3339), currently a simple Hsx/Alpha, the other one in the north (newly numbered AR3340), a small Cro/Beta. AR3338, in the northeast quadrant, has now become relatively large, with small spots constantly growing and disappearing in its trailing portion. All other regions are small and magnetically simple. Despite several CMEs being observed around the periphery of the disc, none of these are considered to be Earth-directed.

Solar Wind / Geomagnetic Activity: The solar wind, as measured by ACE at L1, was indicative of the waning influence from a fast solar wind stream. The solar wind speed saw a very gradual reducing trend, from approximately 500km/s down to around 380km/s. The solar wind density was below average, in single figures ppcc throughout. The IMF was weak throughout, its north-south component remaining unremarkable and between +3 and -6nT. The phi angle was mostly negative (towards the Sun) although it did become positive (away from the sun) for a little while. The net result of the above solar wind measures was mostly Quiet (Kp2) with Unsettled (Kp3) intervals.

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, rose from generally Moderate to High levels, with a peak of 3820 pfu at 18/1530UTC. The associated 24-hour fluence rose to reach above the Active threshold (1e8 integrated pfu), with 1.06e8 integrated pfu observed at 19/0001UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Isolated Moderate activity remains Likely throughout the period, mainly from AR3335 and perhaps AR3333. With no significant regions leaving the disc in the coming four days, solar activity levels should remain unchanged. They may even increase given the bright flux regions observed in STEREO A and SDO imagery, indicating the potential for further regions to emerge from the far side.

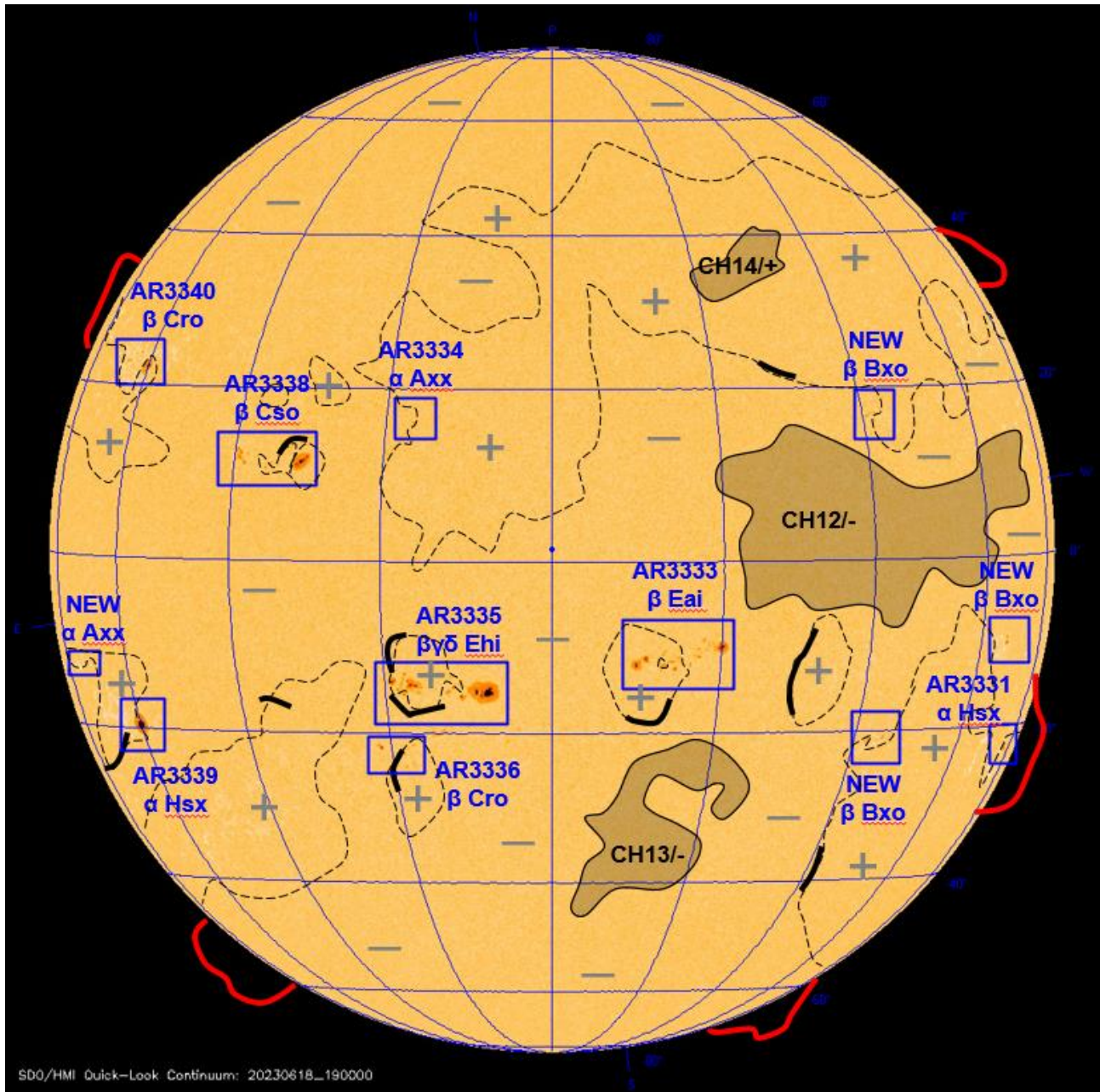
Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

Solar Wind / Geomagnetic Activity: Several CMEs were observed in coronagraph imagery but their analysis revealed that none are Earth-directed. Despite this, there is a chance for one of them to give a weak glancing blow on Day 3 (21 June). Earth is now under the waning influence of the fast speed stream associated with CH12/- otherwise, with possible enhancements to the solar wind speed on Days 3 and 4 (21-22 June), under the influence of the HSS originating from either CH13 (southern hemisphere) or CH14 (northern hemisphere), probably the latter as this feature is larger and more potent. All things considered, geomagnetic activity is expected to be mostly Quiet with a slight 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) has been revised to show a likely sharper and greater increase in magnitude, probably odds-on for exceedance of Active 24-hour fluence persisting through days 1 and 2 (19-20 June), before a gradual decline.

Figure 1. Solar Analysis Valid 18/1900 UTC.



Key: Filament ___, Prominence ___, Magnetic Field Line - - -, Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

Geomagnetic Storms:

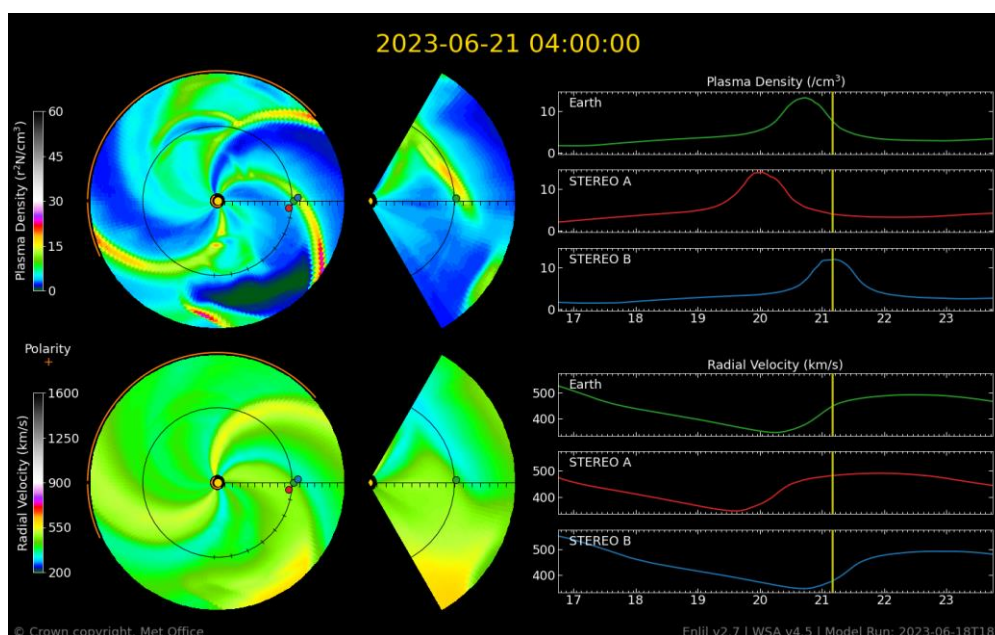
Despite several CMEs being observed in the past 24 hours, mainly around the periphery of the disc, none are considered to be Earth-directed.

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 slight 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 and 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 slight chance of Unsettled or Active intervals late on Day 3 (21 June) and into Day 4 (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	1	5	10
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Figure 2: MOSWOC Enlil shows arrival of the next CH HSS on 21-22 June – low confidence as CH13-14 were not evident on previous rotation.



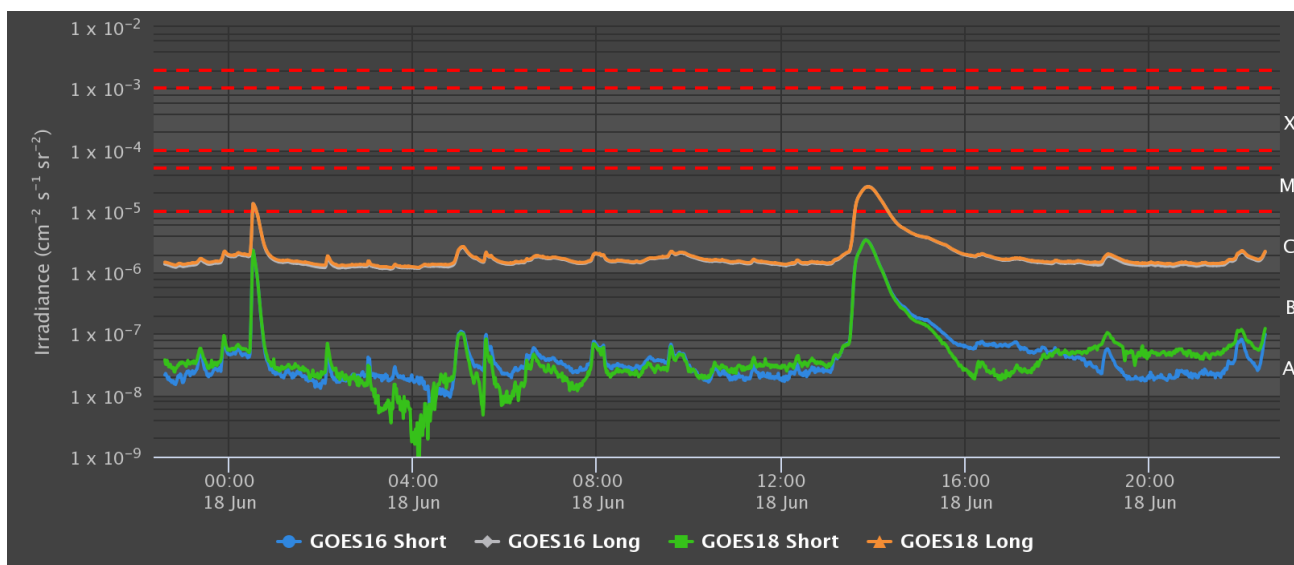
Radio Blackouts - X-Ray Flares:

There are currently twelve sunspot regions on the visible disc, four of which are unnumbered. The largest and most magnetically complex is AR3335, which contains one, perhaps two small and weak delta spots in its intermediate portion. The second largest region is AR3333, although it appears to be relatively stable. Two regions have recently appeared on the eastern limb, one in the south (AR3339), currently a simple Hsx/Alpha, the other one in the north (AR3340), a small Cro/Beta. AR3338, in the northeast quadrant, has become relatively large but remains surprisingly stable despite a recent proliferation of spots. All other regions are small and magnetically simple.

With no significant regions leaving the disc in the coming four days, solar activity levels should remain the same. They may even increase given the bright flux regions being observed in STEREO A and SDO imagery, indicating the potential for further regions to emerge from the far side. As there is not yet significant activity from over the east limb, flare probabilities are kept flat until these regions become visible and can be analysed. All things considered, isolated Moderate activity remains Likely throughout the period, mainly from AR3335 and perhaps AR3333.

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	60	60	60	60
Very Active	R3 to R5 X Class	No	5	5	5	5

Figure 3: GOES X-Ray flares



Solar Radiation Storms - (High Energy Protons):

The high energy (greater than 10MeV) proton flux is expected to remain at background levels. Slight chance of S1 given the sunspot groups on disc, although most of these are currently located in the eastern hemisphere and not in a geo-effective location.

Radiation Storms	Level ($\text{cm}^{-2} \text{sr}^{-1} \text{s}^{-1}$)	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	$\geq \text{S1}$	No	5	5	5	5
Very Active	$\geq \text{S3}$ *	No	1	1	1	1

* S3 $\geq 10 \text{ MeV} \geq 1000 \text{ pfu}$ and / or $\geq 50 \text{ MeV} \geq 10 \text{ pfu}$. (pfu = $\text{cm}^{-2}\text{sr}^{-1}\text{s}^{-1}$)

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

High energy electron flux (greater than 2MeV) is expected to Moderate to High levels throughout the period.

Electron fluence has responded to the potent fast wind, which emanated from CH12, which has now waned, allowing the 24-hour integrated fluence to reach the Active threshold, as the Van Allen belts recharge to register fully at GOES-16. The forecast is now for a significant upturn in flux and fluence, with exceedance of Active likely to persist through the coming days, before a possible decline to below threshold by Days 3 and 4 (21-22 June) as geomagnetic activity increases due to the potential arrival of the next HSS from either CH13 or CH14 by the end of the period. MOSWOC REFM is providing good guidance of electron fluence threshold at present.

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	90	90	80	70
Very Active	$\geq 2 \text{ MeV}$ $\geq 1 \times 10^9$	No	5	5	5	5

Figure 4: REFM electron fluence – observations and forecast

