

Space Weather Technical Forecast

Issued on Tuesday, 27 June 2023 at 13:26 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 isolated R1/R2 Radio Blackouts. Slight chance of G1/Minor Geomagnetic Storm conditions on 27 June.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity was Moderate, with an impulsive M1.6 observed at 26/1622UTC originating from AR3354. There are nine sunspot regions on the visible disc, with AR3355 in the northeastern quadrant developing rapidly and briefly exhibiting a weak delta spot. AR3354 has weakened since the M-class flare. The remaining regions all appear relatively stable, but the newly emerging region on the southeast quadrant continues to be monitored. A CME from the northeast appear to not be Earth-directed, although an eruption from centre disc around 27/0200UTC will be analysed once sufficient satellite data becomes available.

Solar Wind / Geomagnetic Activity: The solar wind, as observed at L1 has followed a declining trend from 5500km/s to 450km/s in the fading influence from a CME on 22 June. Density has been around average. Total magnetic field strength was weak, below 6nT, with the north-south component, Bz also varying weakly. Phi angle was mainly negative (towards the Sun). Geomagnetic activity was Quiet to Unsettled.

Energetic Particles / Solar Radiation: High energy proton flux (greater than 10MeV), as observed by GOES16, was at background. High energy electron flux (greater than 2MeV), as observed by GOES16, ranged between background to moderate levels with a peak value of 583pfu at 26/1850 UTC. The associated 24-hour fluence remained well below the Active threshold, rising slightly at the end of the day with an observed value of 1.69e7 integrated pfu at 27/0000UTC.

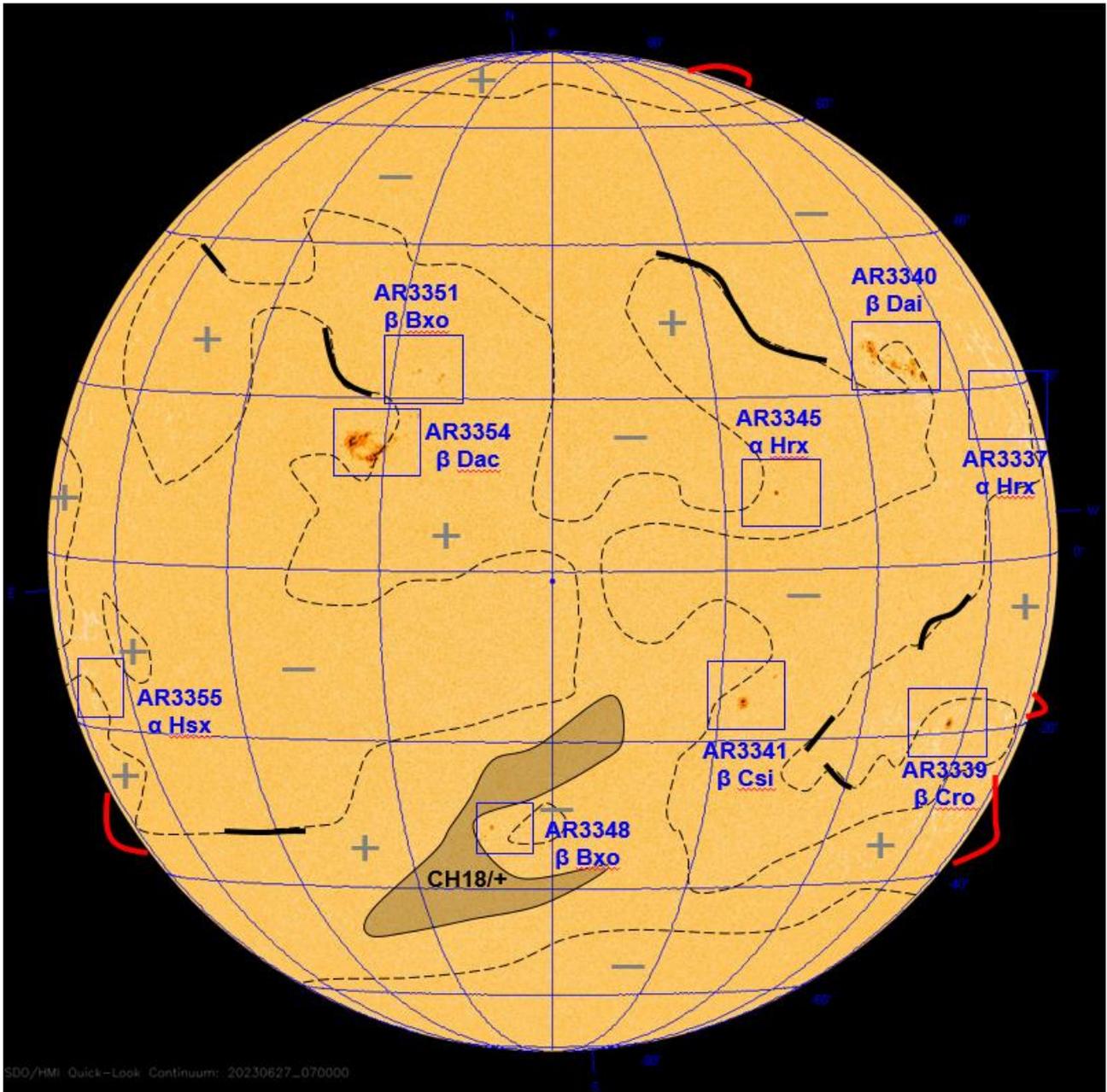
Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is expected to be Low to Moderate, with isolated M-class flares likely and a very slight chance of X-class flares.

Solar Wind / Geomagnetic Activity: No Earth-directed CMEs are currently expected within the forecast period but there is potential for a weak glancing blow on 27 June. Solar wind speeds are expected to decline through the period, with only a possible weak connection to coronal hole 18 in the southern hemisphere. Mainly Quiet to Unsettled geomagnetic activity is expected, with slight chance of Active to G1/Minor Storm intervals on 27 June.

Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux is expected to remain at background levels with a very slight chance of rising if any notable flare activity occurs, primarily from AR3340 but perhaps also from AR3354 later in the period. High energy electron flux (greater than 2MeV) is expected to see current background to moderate levels continue. The corresponding 24-hour integrated fluence expected to remain under the Active threshold throughout.

Figure 1. Solar Analysis Valid 27/0800UTC.



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:

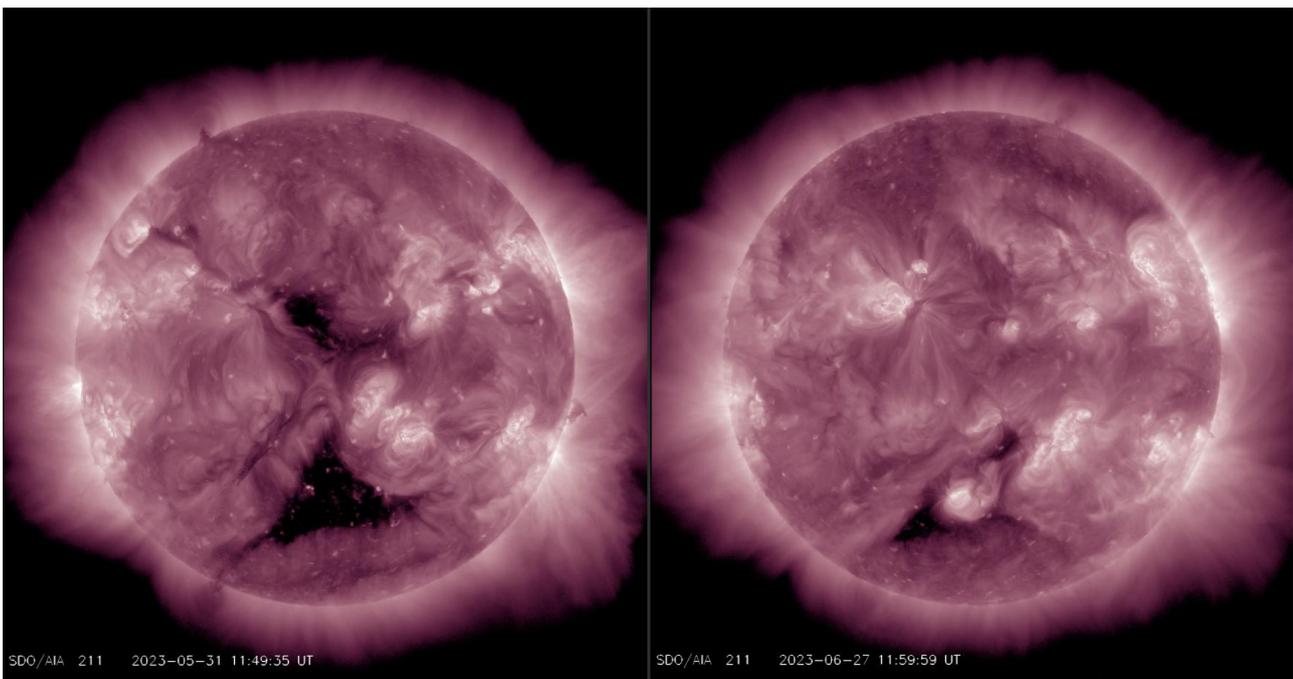
A CME which left the Sun on 22 June may affect the Earth during 27 June, but with very low confidence as Enlil is suggesting that this will only glance the Earth.

Solar wind speeds are gradually declining following the arrival of a CME on 22 June. Coronal hole 18 is a recurrent feature, which appears to have had limited effects on Earth on the last rotation, and is smaller on this rotation. Persistence indicates possible speeds of 500km/s, although this magnitude is likely to be further reduced on this rotation, with only a weak connection expected. No further coronal holes are visible on available imagery.

Geomagnetic activity is forecast to be mainly Quiet to Unsettled, with a slight chance of Active or G1/Minor Storms on 27 June, due to the possible, but low confidence CME glance.

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)
			(%)	(%)	(%)	(%)
Minor or Moderate	G1 to G2	No	10	5	1	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Figure 2: Comparison between the coronal hole in the southern hemisphere on the last rotation (left) and this rotation (right). The coronal hole is notably smaller on this occasion.



Radio Blackouts - X-Ray Flares:

There are nine sunspot regions on visible disc, with rapidly evolving AR3354, the most significant region on the disc in the northeast quadrant. This had a transient delta region, but is has since stabilised into a beta region. AR3340 in the northwest appears to have weakened slightly. The remaining regions all appear weak or declining, but AR3355 will be monitored as it rotates across the eastern limb. helioseismology suggests that a number of regions will rotate onto the visible disc through the next four days, although limited activity has been observed emanating from the far side of the Sun.

Solar activity is forecast to be Low to Moderate, with a slight chance of Strong flare activity.

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 3: AR3354 (Dac/Beta) in the northeast quadrant on both SDO AIA intensitygram and magnetogram imagery.

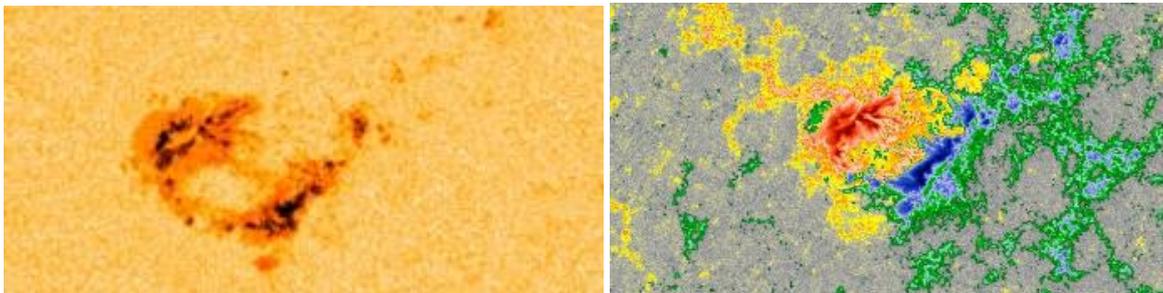
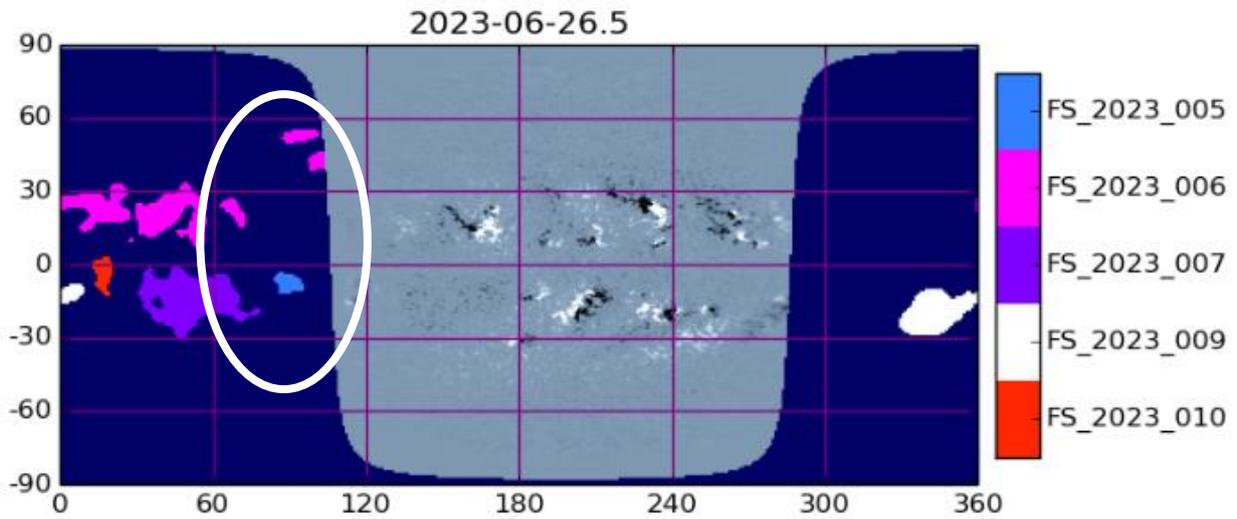


Figure 4: Stanford University helioseismology, with the regions circled due to rotate into the visible disc in the next four days.



Solar Radiation Storms - (High Energy Protons):

The high energy (greater than 10MeV) proton flux, as observed by GOES16, is at Background levels and expected to remain so throughout the period. However there is a daily slight chance of reaching the S1/Minor Storm threshold given the number and complexity of some sunspot regions, notably AR3340 but also AR3354 which has developed rapidly in size and complexity in the last 12 hours.

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	5	5	5	5
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 (≥ 2MeV):

High energy electron flux (greater than 2MeV) has been oscillating between moderate and low levels in the absence of significant inputs into the radiation belts. Geomagnetic activity has also been limited, with little reduction in the quantity of electrons in the radiation belts. Coronal hole 18 may connect weakly with the Earth later in the period, but is not expected to significantly affect the electron counts.

Electron fluence values are forecast to be below the Active threshold, but may increase slightly by the end of the forecast period. REFM is currently providing reasonable guidance on this aspect of the forecast.

GEO Electron Environment	Level (cm ⁻² sr ⁻¹ 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	≥ 2 MeV ≥ 1x10 ⁸	No	10	10	10	10
Very Active	≥ 2 MeV ≥ 1x10 ⁹	No	1	1	1	1