

Space Weather Generator & Interconnector Briefing for GC0183

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Agenda

- What is it
- Putting the Risk in Context
- Wider Impacts
- Examples of impacts
- Solar cycles
- Typical timescales
- Met Office

What is it

- Space weather refers to the environmental conditions in space, within our solar system, which are influenced by the Sun and the solar wind
- It includes phenomena such as solar flares, coronal mass ejections (CMEs) and high-energy particles
- These phenomena can have a significant effect on the functionality of satellites, power grids and more
- Rapid fluctuations in the Earth's magnetic field, particularly during geomagnetic storms, induce an electric field in the Earth's surface
- This electric field then drives electrical currents to flow through conductive structures; this is known as geomagnetically induced currents (GICs)

[5 minute video]

- [Bing Videos](#)

Putting the Risk in context

- UK Government's latest assessment (page 16):
- [National Risk Register - 2025 edition](#)
- Severe Space Weather: as likely as a pandemic, less likely than a national power outage
- Less impactful than either of those (but might possibly lead to national power outage if assets / capabilities affected by space weather?)

Wider impacts (NRR 2025)

- Impacts may include regional power disruptions, loss or disruption of Global Navigation Satellite Systems (for example Global Positioning System (GPS)) and some telecommunications (for example satellite communications and high frequency radio), disruption to aviation, an increase in background radiation doses at high altitudes and in space, and possible disruption to ground-based digital components
- In the event of electricity transformers needing to be replaced in remote coastal areas, recovery could take several months based upon current replacement transformer availability

Examples of impacts (i)

- Severe space weather events impacting national electricity systems have been experienced in various countries including the UK, New Zealand, South Africa, United States of America, Canada and Sweden
- UK in 1989 had damage to T connected transformers at Indian Queens and Norwich Main

Examples of impacts (ii)

- Coronal Mass Ejections (CMEs) can cause Geomagnetic Storms on Earth and induce extra currents in the ground that can degrade (and in rare cases destroy) transformers
- [Electric Power Transmission | NOAA / NWS Space Weather Prediction Center](#)



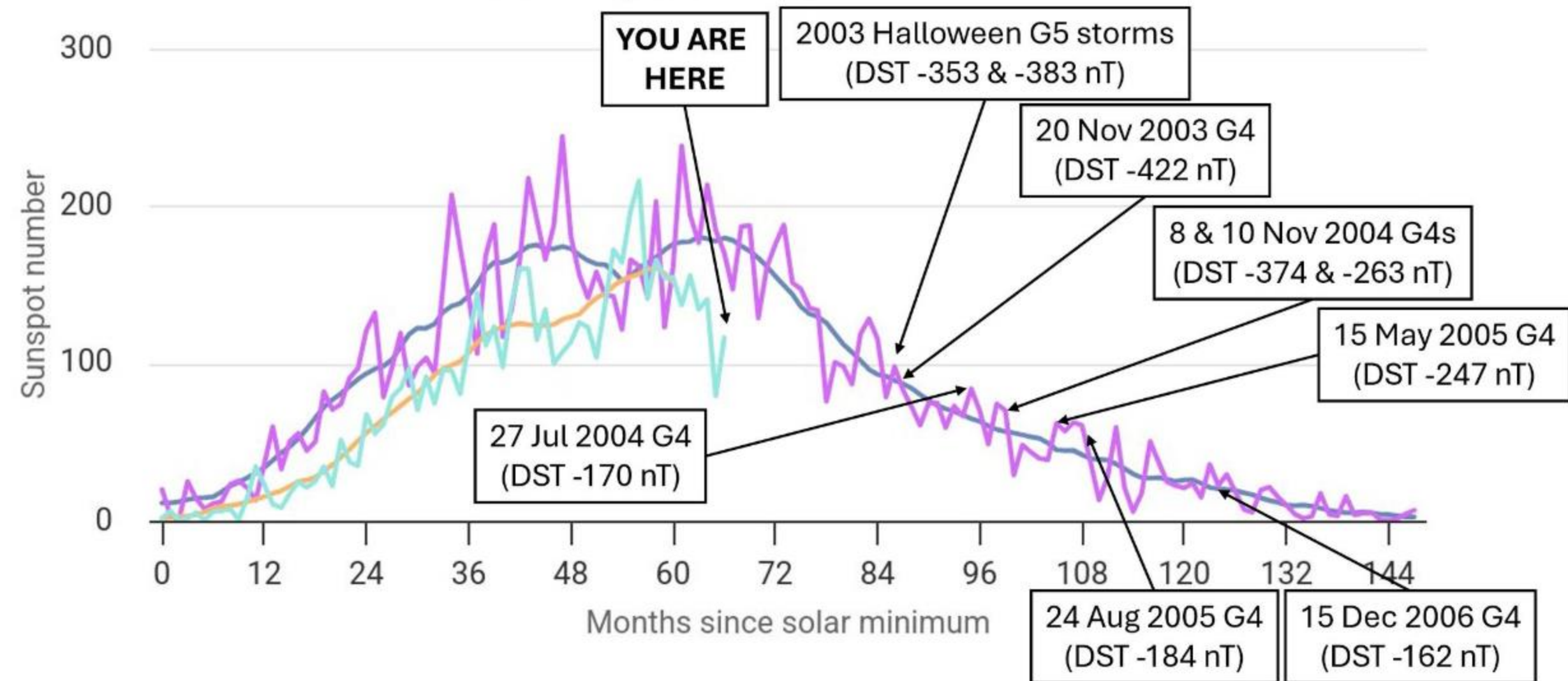
Risk factors

- **Latitude** (countries with a latitude between 40° and 70°, such as the UK, are most likely to experience geomagnetic activity)
- **Geology** (the resistivity of the rock strata the asset sits on)
- **Proximity to the coast** (nearer to / located at the coast, more at risk)
- **Electricity network configuration** (east/west circuits more at risk)
- **Transformer characteristics** (design and earthing/winding resistances, plus those which are single phase or three phase with five-limb are more at risk of damage from GIC effects, especially if they are operated close to their design loading)
- **Connection** (transformer connected to a vulnerable node on the transmission network are at higher risk)

Solar Cycles

- The Sun experiences 11-year cycles of solar activity. The peak of this solar cycle is known as the *Solar Maximum*.
- During the *Solar Maximum*, the number of sunspots on the surface of the Sun increases, this causes an increase in solar activity.
- The most recent *Solar Maximum* was reached in late 2024.
- Solar storms that lead to high levels of GICs are statistically more likely during periods close to the *Solar Maximum* and in the descending phase of the solar cycle (which can last 2-3 years, so from late 2024 to late 2027 after the *Solar Maximum*), but they can also occur at all other times in the solar activity cycle.

Solar cycle comparison



— SC1 — SC2 — SC3 — SC4 — SC5 — SC6 — SC7 — SC8
 — SC9 — SC10 — SC11 — SC12 — SC13 — SC14 — SC15 — SC16
 SC17 SC18 SC19 SC20 SC21 SC22 SC23 SC24

Typical timescales (NRR 2025)

- Reasonable worst-case scenario (based on a severe space weather event, approximately the same scale and magnitude as the Carrington Storm of 1859) lasting for 1-2 weeks.
- Includes a number of different solar phenomena including coronal mass ejections, solar flares, solar radiation storms and solar radio bursts.
- Each phenomenon would likely occur several times during a 2-week period, with each varying in magnitude, temporal and spatial extent.

Working Closely with the Met Office

- Met Office lead for UK Government on space weather
- Met Office Space Weather Operations Centre (MOSWOC) issues notifications when a large, complex region of the sun has been observed, with the potential to lead to severe space weather
- NESO and industry has been working closely with Met Office for the past 15 years on understanding space weather and its effects
- This has included developing the proposed '*Space Weather Industry Protocol*' (which has resulted in GC0183 being raised)