Thaxted Astronomical Society

News
Features

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Sun Clock

https://www.dailymail.co.uk/sciencetech/article-8422783/New-sun-clock-predicts-Earths-star-wake-slumber-increase-solar-activity.html

New 'sun clock' predicts when Earth's star will wake from its slumber, helping experts prepare for extreme space weather events that knock out power grids and satellites

Daily Mail 15th June 2020 >

- **The sun is currently sleeping, but experts say an awakening is imminent**
- **When it wakes, it will increase solar activity and create extreme space weather**
- **Scientists have now designed a sun clock to predict when this will occur**
- **The team gathered sunspot observations over the past 200 years**
- **Then mapped solar activity over 18 solar cycles to a standardized 11-year cycle**
- **This allowed researchers to see the switch on and off times of the sun**

The sun is due for an awakening that would create extreme space weather that could have catastrophic effects– and experts may have a way to predict the event.

Using 200 years of observations, scientists designed a new sun clock that can better calculate the switch on and off times.

The technology uses the daily sunspot number record available since 1818 to map solar activity over 18 solar cycles to a standardized and 11-year cycle.

Predicting when solar activity is set to increase could potentially protect astronauts in orbit, as well as preventing technologies like satellites from being destroyed.

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Extreme space weather, or solar storms, occur when the sun shoots out boiling-hot plasma in the form of solar flares and winds.

Although the most solar storms are usually harmless, a large enough one hitting Earth could have catastrophic effects.

The event can spark magnetic storms in Earth's upper atmosphere that threaten computers, power grids and aviation technology, along with humans and satellites in space.

However, scientists with the University of Warwick have developed a sun clock to predict these extreme space events.

Professor Sandra Chapman said: 'Large events can happen at any time, but are much more likely around solar maximum. By cleanly ordering the observations we find that in 150 years of geomagnetic activity at earth, only a few percent occur during these quiet conditions.'

'The ability to estimate the risk of a future solar superstorm occurring is vital for space and ground-based technologies that are particularly sensitive to space weather, such as satellites, communications system, power distribution and aviation.

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'If you have a system sensitive to space weather you need to know how likely a big event is, and it is useful to know when we are in a quiet period as it allows maintenance and other activities that make systems temporarily more fragile.'

The team used sunspot observations over the past 200 years and mapped the sun's activity over 18 solar cycles to a standardized 11 year cycle – the sun starts a new solar cycle ever 11 years.

Halfway through the cycle, solar activity increases that produces more flareups and radiation – all of which can be measured by sunspots.

Sunspots are dark, cooler areas on the sun's surface and are more prominent halfway through the 11-year cycle.

And the team used the sunspots to develop the clock.

They used the daily sunspot number record available since 1818 to map solar activity, allowing them to see the precise switch on and switch off times of solar activity.

Once the clock is constructed from sunspot observations it can be used to order observations of solar activity and space weather.

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'Scientists spend their lives trying to read the book of nature. Sometimes we create a new way to transform the data and what appeared to be messy and complicated is suddenly beautifully simple,' said Chapman.

'In this instance, our sun clock method showed clear 'switch on' and 'switch off' times demarcating quiet and active intervals for space weather for the first time.'

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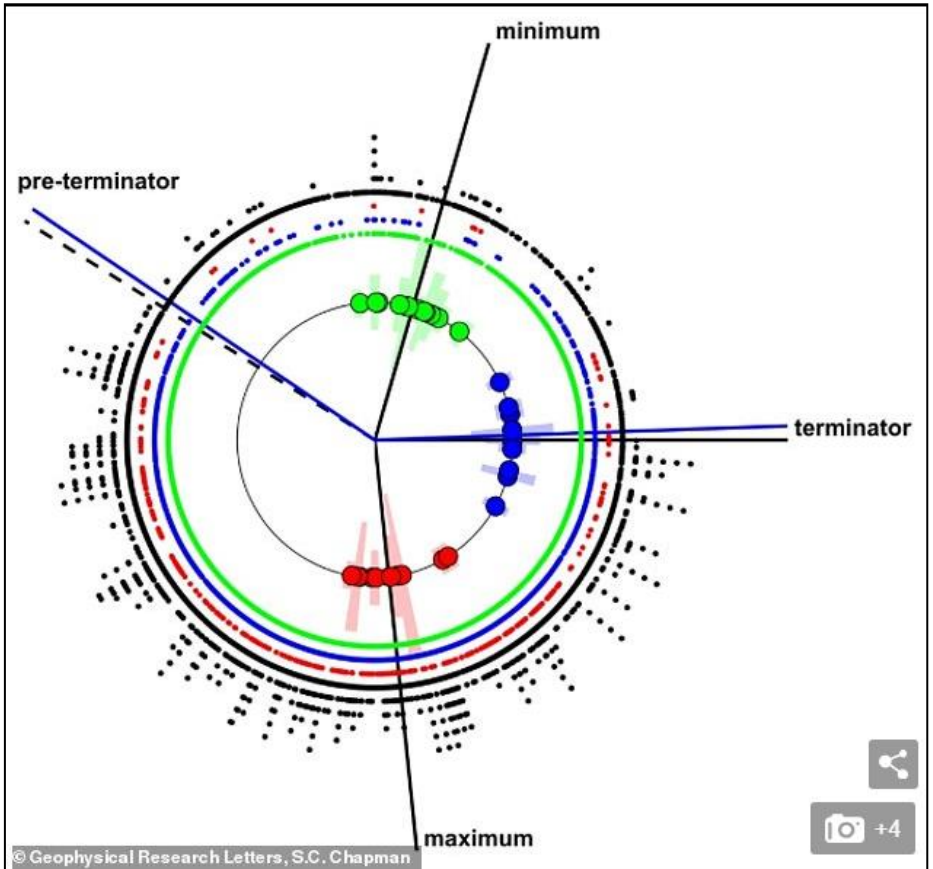

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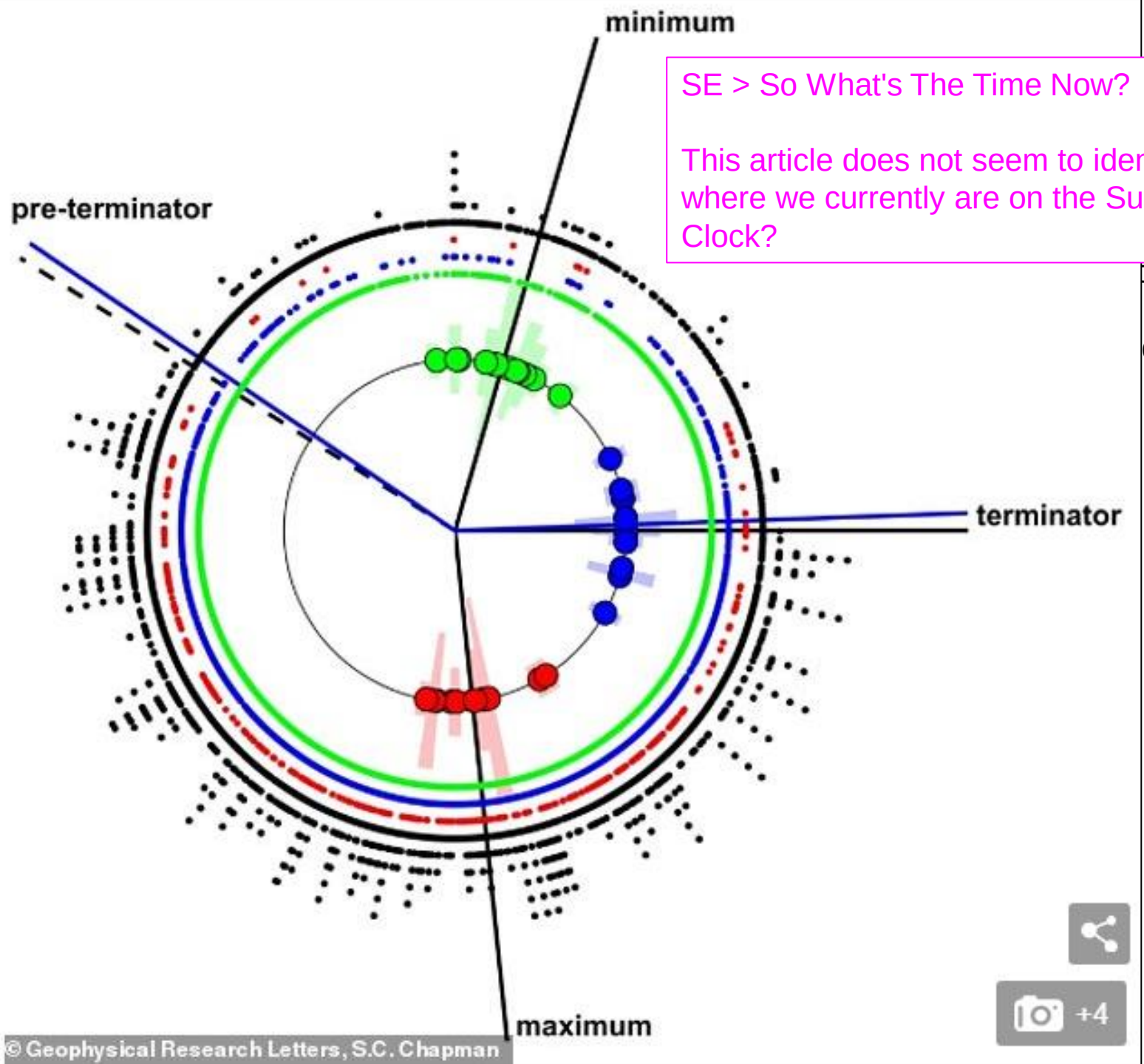

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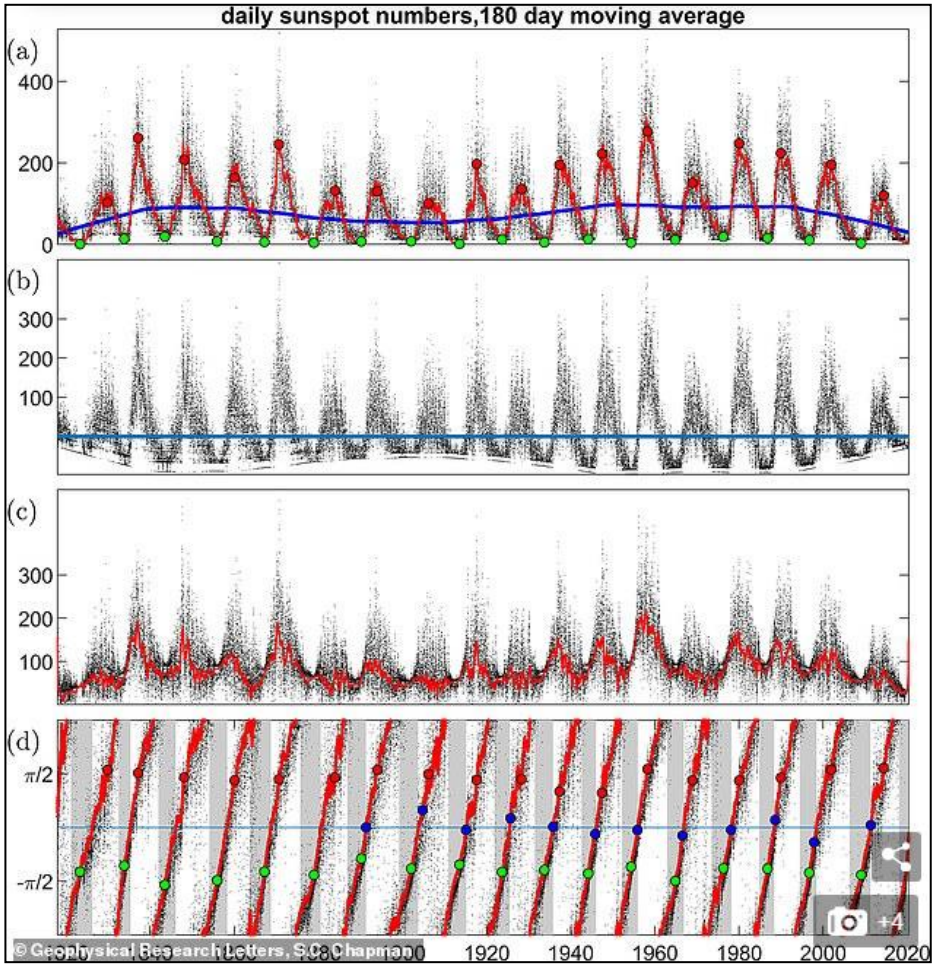

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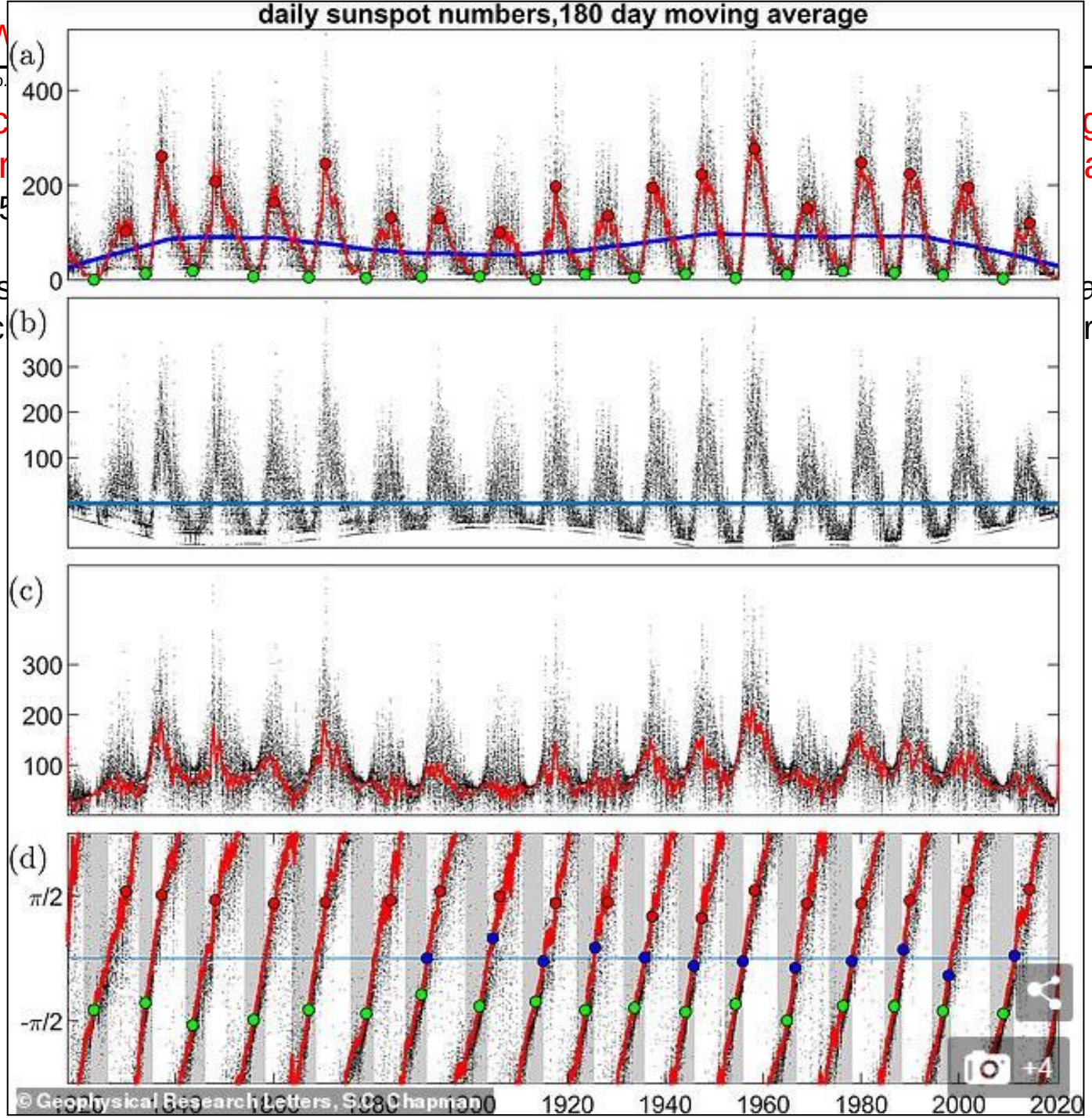

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SOLAR STORMS PRESENT A CLEAR DANGER TO ASTRONAUTS AND CAN DAMAGE SATELLITES

Solar storms, or solar activity, can be divided into four main components that can have impacts on Earth:

Solar flares: A large explosion in the sun's atmosphere. These flares are made of photons that travel out directly from the flare site. Solar flares impact Earth only when they occur on the side of the sun facing Earth.

Coronal Mass Ejections (CME's): Large clouds of plasma and magnetic field that erupt from the sun. These clouds can erupt in any direction, and then continue on in that direction, plowing through solar wind. These clouds only cause impacts to Earth when they're aimed at Earth.

High-speed solar wind streams: These come from coronal holes on the sun, which form anywhere on the sun and usually only when they are closer to the solar equator do the winds impact Earth.

Solar energetic particles: High-energy charged particles thought to be released primarily by shocks formed at the front of coronal mass ejections and solar flares. When a CME cloud plows through solar wind, solar energetic particles can be produced and because they are charged, they follow the magnetic field lines between the Sun and Earth.

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The damage caused by solar storms >

Solar flares can damage satellites and have an enormous financial cost.

The charged particles can also threaten airlines by disturbing Earth's magnetic field.

Very large flares can even create currents within electricity grids and knock out energy supplies.

When Coronal Mass Ejections strike Earth they cause geomagnetic storms and enhanced aurora.

They can disrupt radio waves, GPS coordinates and overload electrical systems.

A large influx of energy could flow into high voltage power grids and permanently damage transformers.

This could shut off businesses and homes around the world.