



Modern Grand Solar Minimum

Why in News

The magnitude of the Sun's solar activity is decreasing. This period of decreased solar activity is known as the **Modern Grand Solar Minimum** that will last from **2020 to 2053**.

Key Points

- **Measurement of Solar Activity:** This is done by observing the number of [Sunspots](#) at any given time. The number of sunspots is directly proportional to solar activity. More Sunspots mean more solar activity.
 - Sunspots (some as large as 50,000 km in diameter) are areas that **appear dark on the surface of the Sun (photosphere)**. They appear dark because they are **cooler than other parts of the Sun's surface**.
 - Sunspots are relatively cool because they form at areas where **magnetic fields are particularly strong**. These magnetic fields are so strong that they keep some of the heat within the Sun from reaching the surface.
- **Decrease in Sun Spots:** According to the United States **National Oceanic and Atmospheric Administration's (NOAA)**, 71% of the Sun had no Sun spots in 2020 through September 21, 2020 as compared to 77% in 2019.
- **Possible Reason:**
 - 2020 marks the beginning of the **11th solar cycle**. The beginning of a solar cycle is a **solar minimum**, or when the Sun has the sunspots and thus, least activity.
 - Solar Cycle is the periodic flipping of the magnetic field of the Sun that occurs every 11 years or so. The north and south poles of the Sun change positions.
 - The middle of the solar cycle is the **solar maximum**, or when the Sun has the most sunspots.
- **Maunder Minimum:** The last time such an event occurred was during the Maunder Minimum, from 1645 CE to 1710 CE. That period is a part of the **Little Ice Age (from 1300 to around 1850)**, when Earth went through a series of elongated cold periods.
 - During the Maunder Minimum, the solar irradiance went down by 0.22 % in 1710 CE when the period ended. This brought **down the temperatures in the Northern Hemisphere**, especially in Europe, by 1-1.5°C and led to frozen rivers, long cold winters and cold summers.
- **Impact:**
 - The surface temperatures on Earth may go down during the Modern Grand Solar Minimum due to a 70% reduction in solar magnetic activity.
 - Variations in solar irradiance lead to heating of the upper layer of the Earth's atmosphere and influences the **transport of solar energy towards the planet's surface**.
 - Decreased solar activity has complex impacts on the **abundance of ozone in the Earth's atmosphere**
 - It also affects the climatic cycles of Earth such as the **North Atlantic Oscillation (NAO)**.

- North Atlantic Oscillation (NAO) is an **irregular fluctuation of atmospheric pressure** over the North Atlantic Ocean that has a strong effect on winter weather in Europe, Greenland, northeastern North America, North Africa, and northern Asia.
 - It was in a negative phase during the Maunder Minimum.
- The sun's magnetic field shields the Earth from harmful cosmic and galactic rays. In the absence of the shielding more rays will reach the Earth and form high clouds in the atmosphere leading to the cooling.
- **Impact on Global Warming:**
 - It is possible that the cooling due to solar minimum may offset the rising temperatures due to global warming.
 - However, the **National Aeronautics and Space Administration (NASA)** has dismissed this and said the decrease in climate crisis would only be worth as much as three years of carbon dioxide growth in the atmosphere.
 - According to NASA, the impact of global warming would be **six times greater** than the cooling caused by the Grand Solar Minimum.
- **Other Related Events:** NASA had observed a family of sunspots in May 2020 that were associated with the biggest solar flare since October 2017.
 - A solar flare is a burst of activity on the sun's surface accompanied by an ejection of particles known as the coronal mass ejection.
 - Big solar flares can disrupt satellite communications and many other technological equipment in and around Earth.

Way Forward

- The sun's activity **is not completely understood**. It takes months to just decide about the Sun's activities from observations. Also, Sunspots are **mere symptoms and not causes of solar activity** so they can not be used as reliable measurements.
- Even with state-of-the-art models and top scientists reviewing them, the only conclusion that could be drawn was that the Sun will attain a **peak sunspot range of 95-130, and that this will happen sometime between 2023 and 2026, during the 25th solar cycle**.

Source: DTE

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