

Modern Grand Solar Minimum

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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.

Studies By

- United States National Oceanic and Atmospheric Administration's (NOAA) Space Environment Centre.

Key Finding

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 will 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?

- The NAO is the dominant mode of winter climate variability in the North Atlantic region ranging from central North America to Europe and much into Northern Asia. The NAO is a large-scale seesaw in atmospheric mass between the subtropical high and the polar low. The corresponding index varies from year to year, but also exhibits a tendency to remain in one phase for intervals lasting several years.

- **Positive trends**

- A positive trend is when there is a low pressure in the north (Greenland) and high pressure in mid-latitude of the North Atlantic so that a large pressure gradient exists.
- It shows a stronger than usual subtropical high pressure center and a deeper than normal Icelandic low.
- The increased pressure difference results in more and stronger winter storms crossing the Atlantic Ocean on a more northerly track.
- This results in warm and wet winters in Europe and in cold and dry winters in northern Canada and Greenland.
- The eastern US experiences mild and wet winter conditions.

- **Negative trends**

- When both regions have low pressure and the gradient flattens out it is called a negative trend.
- The negative NAO index phase shows a weak subtropical high and a weak Icelandic low.
- The reduced pressure gradient results in fewer and weaker winter storms crossing on a more west-east pathway.
- They bring moist air into the Mediterranean and cold air to northern Europe

- The US east coast experiences more cold air outbreaks and hence snowy weather conditions.
- Greenland, however, will have milder winter temperatures