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Properties of Super Active Region 13664 in Context of the Extreme Geomagnetic Storm of 10-11 May 2024

Temporary perturbations in the Earth's magnetosphere and upper atmosphere driven by coronal mass ejections (CME) are called geomagnetic storms. It is important to understand the solar sources of geomagnetic storms in order to constrain physical drivers of space weather. A severe geomagnetic storm was observed during 10-11 May 2024. It was the strongest storm on record in the last two decades since 2003. It is believed to have occurred due to multiple Earth-directed intense CMEs which eventually hit the Earth during the aforementioned period. Most of these CMEs were associated with active region (AR) 13664. In our study, we investigate AR 13664 and compare it to other active regions in the historical context to ascertain the rarity of occurrence of such a complex active region and identify the properties that made it super active. We find that AR 13664 was significantly larger in size when compared to other sunspot groups archived by Royal Greenwich Observatory and National Oceanic and Atmospheric Administration (RGO/NOAA). Apart from its size, AR 13664 manifested high magnitudes of flare relevant physical properties simultaneously which led to intense flaring activity over its lifespan. In total, AR 13664 spawned 23 X-class flares over the period 30 April-11 June 2024 during which it completed roughly one and half solar rotation. Our investigations support the idea that energization of complex and large sized AR flux systems can induce intense flaring activity. We establish AR 13664 to be a super active region (SAR). Our study is important for identifying Super Active Regions given their potential to generate adverse space weather events.

Contribution Type

Theme

Connecting Solar Corona to Heliosphere

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