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The Mild Space Weather in Solar Cycle 24

Abstract:

The space weather is extremely mild during solar cycle 24: the number of major geomagnetic storms and high-energy solar energetic particle events are at the lowest since the dawn of the space age. Solar wind measurements at 1 AU using Wind and ACE instruments have shown that there is a significant drop in the density, magnetic field, total pressure, and Alfvén speed in the inner heliosphere as a result of the low solar activity. The drop in large space weather events is disproportionately high because the number of energetic coronal mass ejections that cause these events has not decreased significantly. For example, the rate of halo CMEs, which is a good indicator of energetic CMEs, is similar to that in cycle 23, even though the sunspot number has declined by ~40%. The mild space weather seems to be a consequence of the anomalous expansion of CMEs due to the low ambient pressure in the heliosphere. The anomalous expansion results in the dilution of the magnetic contents of CMEs, so the geomagnetic storms are generally weak. CME-driven shocks propagating through the weak heliospheric field are less efficient in accelerating energetic particles, so the particles do not attain high energies. Finally, we would like to point out that extreme events such as the 2012 July 23 CMEs that occurred on the backside of the Sun and did not affect Earth except for a small proton event.