Sreebala
P S
Department of Physics, University College, University of Kerala, Thiruvananthapuram-695034, Kerala, India
1. Prince P R, Department of Physics, University College, University of Kerala, Thiruvananthapuram-695034, Kerala, India
2. Devi R Nair, Department of Physics, University College, University of Kerala, Thiruvananthapuram-695034, Kerala, India
3. Aswini Thampi S L, Department of Physics, University College, University of Kerala, Thiruvananthapuram-695034, Kerala, India
4. Deepak Kathait, Department of Physics, University College, University of Kerala, Thiruvananthapuram-695034, Kerala, India
Oral
On May 10–12, 2024, one of the strongest G5 geomagnetic storms in recent years occurred, driven by flares, coronal mass ejections (CMEs), and interplanetary CMEs (ICMEs) from active regions AR 13664 and AR 13668. It was the strongest event since the 2003 Halloween storms, with peak Dst reaching -412nT and producing widespread auroras visible at latitudes as low as 34° in the northern hemisphere. This study attempts to investigate the variations in the evolution and propagation of these drivers right from their source region to Earth's atmosphere. We observe multiple ICMEs from this region, accelerating solar energetic particles towards Earth. Using multi-spacecraft observations, we trace the solar surface phenomena that caused these disturbances and make an attempt to establish a connection between the drivers, their interaction and later geomagnetic effects in the ionosphere. Ionospheric joule heating (JH) during the storm was very intense, which is the major energy sink of SW input to the magnetosphere-ionosphere system. The rate of JH energy dissipated to the inner magnetosphere during the storm, estimated from OpenGGCM model,which is in agreement with the energy of hemispheric integrated joule heating (ohmic dissipation from ionospheric currents in polar cap region driven by enhanced electric fields). We observed that electric field heating almost perfectly matches total energy dissipation in the OpenGGCM simulation. Our analysis shows that while the OpenGGCM-derived input sets the upper limit for storm-time forcing, the ultimate recovery of the ionosphere-thermosphere system is governed by radiative dissipation. Using TIE-GCM simulations, we integrated the 5.3?m Nitric Oxide (NO) radiative cooling rates to demonstrate how the ionosphere effectively discharges the magnetospheric energy load. Results indicate that during the recovery phase of the May 2024 storm, the dissipation rate exceeded the coupling rate, leading to a rapid thermal collapse. This study also explains the full energy flow from heliospheric to magnetospheric coupling to radiative loss, which helps improve thermospheric density and orbital drag predictions. Furthermore, this energy-balance framework provides a baseline for improving real-time forecasts of thermospheric overcooling events.
Meeting homepage
[NASA 5th Eddy Cross-Disciplinary Symposium]
[Download to PDF]
Abstract category
Solar Infuluence on Earth and Planetary System