I am pleased to recommend the acceptance of this manuscript for publication. The author has presented a thorough and insightful analysis of the geomagnetic storm that occurred on April 23–24, 2023, a significant two-step event within Solar Cycle 25. Their use of data from near-meridional chains of magnetometer stations across both hemispheres provides a robust foundation for examining the latitudinal variations and underlying mechanisms of this severe geomagnetic disturbance. The clarity of the results and the depth of analysis reflect a high level of expertise and make a meaningful contribution to our understanding of geomagnetic storm dynamics.

The manuscript effectively highlights the detailed observations of geomagnetic field variations and their implications, particularly during the second step of the storm. The authors' approach to exploring the spatial and temporal characteristics of geomagnetic field disturbances is commendable. Their findings, which reveal significant increases in geomagnetic field strength and variations with latitude, add valuable insights into how such storms impact different regions of the Earth. The careful presentation and interpretation of these results enhance the manuscript's scientific value.

To further enrich the manuscript, I suggest incorporating comparisons with recent studies on this extreme space weather event. Kalpesh Ghag et al. (2024) offer a thorough examination of this geomagnetic storm and their analysis attributes the storm's intensity to the transformation of an ICME sheath into quasi-planar magnetic structures, which they demonstrate significantly enhances the southward magnetic field component, thereby intensifying geomagnetic activity [1]. Irina Despirak et al. (2024) further elucidate the sources and behaviors of geomagnetically induced currents (GICs) during this event, highlighting the influence of interplanetary shocks, magnetic clouds, and localized geomagnetic disturbances on GIC intensities [2]. Additionally, Souza et al. (2024) provides a thorough analysis of the effects of storm-time prompt penetration electric fields (PPEF) and traveling atmospheric disturbances (TADs) on TEC, foF2, and hmF2 during this geomagnetic storm, revealing significant shifts in the Equatorial Ionization Anomaly (EIA) and detailed characteristics of TAD propagation. Their findings effectively illustrate how these disturbances impact ionospheric and thermospheric conditions, contributing valuable insights to the understanding of space weather dynamics [3]. Habarulema et al. (2024) report a unique observation of missing high-frequency echoes from ionosondes during the same storm, attributing this anomaly to significant ionospheric depletion and gradients as detected by TIMED/GUVI and simulated by TIEGCM [4]. The references to Kamid Y.'s work, particularly the detailed discussion on the two-step development of geomagnetic storms [5], could provide valuable additional context and further enhance the manuscript's depth and historical grounding.

Overall, this manuscript is a significant contribution to the field of space weather research. The author has provided a detailed and insightful analysis of a complex geomagnetic storm, and their work is of high quality. I strongly

support its acceptance for publication, with the aforementioned suggestions for additional context and comparisons to further strengthen its impact.

References

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