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The Egyptian Space Agency (EgSA)
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Poster
The May 2024 geomagnetic storm, driven by extreme solar activity from Active Region AR 13664, stands as one of the most intense space weather events in recent history, with a minimum Dst index of ?412 nT. This study investigates the ionospheric response to this storm over Egypt, a region strategically located near the northern crest of the Equatorial Ionization Anomaly (EIA). Utilizing vertical total electron content (VTEC) data from 27 GNSS stations across Egypt, we analyzed the storm's impact on ionospheric dynamics, including VTEC variations and the detection of traveling ionospheric disturbances (TIDs). Solar disk observations from GOES-16 and SDO/HMI provided critical insights into the evolution of AR 13664, which produced 12 X-class solar flares and multiple coronal mass ejections (CMEs). GNSS-derived VTEC data were compared with predictions from the International Reference Ionosphere (IRI-2020) model to assess deviations during the storm. Geomagnetic indices, including the interplanetary magnetic field (Bz), solar wind speed (SWS), and Dst index, were analyzed to characterize the storm's phases and their effects on Earth’s magnetosphere. Key findings reveal significant VTEC depletion during the storm's main phase and strong enhancement during the recovery phase compared to the monthly average VTEC for May 2024 (VTECmm). Additionally, poleward-propagating TIDs were identified, highlighting their impact on radio communication and navigation systems. This study underscores the importance of advanced modeling and real-time monitoring to enhance space weather forecasting and mitigate the risks posed by extreme geomagnetic activity in low-latitude regions like Egypt.

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