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Multi-index analysis of ionospheric disturbances driven by internal and external physical mechanisms during two space weather events

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Abstract

In this work, we present a study of the ionospheric disturbances observed over South America during two space weather events. To accomplish this, we examined maps of two ionospheric indices: the Disturbance Ionosphere indeX (DIX) and the Rate of Change of the Total Electron Content Index (ROTI). For this analysis, we have specifically chosen two significant space weather events of the solar cycle 24: an intense geomagnetic storm that took place on March 17-18, 2015 (St. Patrick's Day geomagnetic storm) and a preceding geomagnetic substorm that occurred on March 10-13, 2015. Our results reinforce that the ionosphere can undergo disturbances of different levels resulting from a combination of internal and external physical processes. For instance, the DIX showed the effects of disturbed electric fields during the intense geomagnetic storm. At the same time, ROTI maps showed unusual equatorial plasma bubbles (EPBs) near sunrise. On the other hand, the DIX showed changes in the equatorial ionization anomaly (EIA) crests during the substorm occurrence, whereas ROTI maps indicated a weakening of the night-time EPBs. We based these conclusions on observing the behavior of the indices before, during, and after the space weather events under study. Finally, observational data, such as All-Sky Imagers and Ionosondes, along with geomagnetic indices (e.g., Kp, AE), were also used to support our analysis.