On the ionospheric response to long duration recurring coronal holes, high speed streams and corotating interaction region during the decreasing phase of solar cycle 24

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Abstract

We present an analysis of the atmospheric/ionospheric response to Corotating Interaction Regions, CIRs and High- Speed Streams, HSSs-driven recurrent geomagnetic storms during the descending phase and solar minimum of the solar cycle 24 in South America. The descending phase of the solar cycle is characterized by the increased occurrence rate of coronal holes which emanated high-speed solar wind streams. As they propagate in the interplanetary space they interact with the preceding slow solar wind and form large structures called corotating interaction regions. As the coronal holes corotate with the period of the sun, it is observed similar periodicities and their harmonics (27, 13 and 9 days) in the interplanetary and geomagnetic indices and parameters. However other lowers periods can be observed. Although these interplanetary structures do not cause intense geomagnetic storms, they are responsible by a variety of phenomena such as: long duration auroral activity, referred as HILDCAAs, electric field-driven effects, such as prompt penetration or disturbance dynamo, particle precipitation, ionospheric storms/neutral composition changes, disturbed equatorward wind system and others. In the ionosphere we observe increase or decrease of the ionization, seen in the parameters as Total electron content, TEC, development of plasma irregularities in the equatorial region and the propagation of wave structures seen as meso-scale traveling ionospheric response, MSTIDs. In order to understand the relationship between the distinct features of the

coronal holes and the solar, interplanetary and geomagnetic indices and parameters such as, solar wind speed, Vsw, interplanetary magnetic field, B, auroral electrojet index, AE, symmetric ring current, SymH, we performed a spectral analysis and correlation study of these parameters. After that, we analyzed the ionospheric response in the distinct phases of the storms, which is highly variable especially due to the high Alfvenicity of the magnetic field and to the extended recovery phase of the storms. We discuss how a long duration recurrent coronal hole event during a moderate solar activity influence the equatorial and the low latitude ionosphere in the Brazilian sector. For the purpose of this study, we used instruments including GNSS receivers, ionosondes, magnetometers, and other ground-based systems. This study may be useful for ionospheric modelling and Space Weather forecast models.