Study of Magnetic Field Spatial Variations in the Southern Hemisphere's Low Latitudes due to Different Interplanetary Structures Using the 3-D MHD SWMF/BATSRUS Model

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Interplanetary structures such as Coronal Mass Ejections (CME), Shocks, Corotating Interaction Regions (CIR) and Magnetic Clouds (MC) interfere directly on Space Weather conditions and can cause severe and intense disturbances in the Earth's magnetic field as measured in space and on the ground. During magnetically disturbed periods characterized by world-wide, abrupt variations of the geomagnetic field, large and intense current systems can be induced and amplified within the Earth even at low latitudes. Such current systems are known as geomagnetically induced currents (GIC) and can cause damage to power transmission lines, transformers and the degradation of pipelines. As part of an effort to estimate GIC intensities throughout the low to equatorial latitudes of the Brazilian territory, we used the 3-D MHD SWMF/BATSRUS code to estimate spatial variations of the geomagnetic field during periods when the magnetosphere is under the influence of CME and MC structures. Specifically, we used the CalcDeltaB tool (Rastatter et al., Space Weather, 2014) to provide a proxy for the spatial variations of the geomagnetic field, with a 1 minute cadence, at 31 virtual magnetometer stations located in the proposed study region. The stations are spatially arranged in a two-dimensional network with each station being 5 degrees apart in latitude and longitude. In a preliminary analysis, we found that prior to the arrival of each interplanetary structure, there is no appreciable variation in the components of the geomagnetic field between the virtual stations. However, when the interplanetary structures reach the magnetosphere, each station perceives the magnetic field variation differently, so that it is not possible to use a single station to represent the magnetic field perturbation throughout the Brazilian region. We discuss the minimum number and spacing between stations to adequately detail the geomagnetic field variations in this region.

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