Estimation of Geomagnetically Induced Currents at Low Latitude and Equatorial Regions of Brazil During Two Great Magnetic Storms of 2015

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The South American longitudinal sector presents the unique feature of the presence of daytime equatorial electrojet currents (EEJ) and the South Atlantic Magnetic Anomaly (SAMA), where the global minimum intensity of the geomagnetic field is observed. Enhanced amplitudes are observed in the horizontal magnetic components recorded on the ground within the areas of influence of both the EEJ and the SAMA and therefore it is expected that significant enhancements of GIC magnitude also occur in these regions. We use here geomagnetic field variations data recorded by fluxgate magnetometers from the Brazilian space weather program (EMBRACE) to evaluate GIC effects during two strong geomagnetic storms in March (Dst = -222nT) and June (Dst = -204nT) 2015. Among the available geomagnetic stations, we selected those with information about the underground electrical conductivity structure and that can be approximated by 1-D models for calculation of the geoelectric field. GIC levels are estimated using a realistic local power grid model located in the central region of Brazil, artificially moved to the sites where the geomagnetic measurements are available. Maximum GIC amplitude of about 8 A was estimated at an equatorial station positioned over high resistivity underground, associated with the arrival of an interplanetary pressure pulse just behind two other pulses during the June storm. The results are also interpreted in terms of the ionospheric currents over the measurement sites and the conductivity distribution beneath these sites. It is observed that both EEJ and SAMA increase the GIC amplitudes, with the greatest effects associated with EEJ. In relation to the underlying conductivity structure, the higher GIC effects are associated with low conductance at crustal depths, with upper mantle depths showing minor effect.

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