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ULF wave coupling during geomagnetic storms in the South American sector: a multimission analysis

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Ultra-Low Frequency (ULF) waves are fundamental drivers of energy transport within the coupled Magnetosphere-Ionosphere system. While the generation mechanisms for Pc5 (1.7-6.7 mHz) and Pc3 (22-100 mHz) pulsations are global, driven respectively by Kelvin-Helmholtz instabilities or internal resonances, and upstream ion-cyclotron waves, their transmission to the ground at low latitudes is significantly modified by regional electrodynamics. The South American sector acts as a unique natural laboratory for this coupling due to the South American Magnetic Anomaly (SAMA) and the Equatorial Electrojet (EEJ). This study presents an initial investigation into the Space-Ground coupling efficiency of ULF waves, testing the hypothesis that the South American ionosphere functions as an active electrodynamic filter. We employ a multi-point observation strategy combining in-situ magnetic field data from the Swarm constellation and Van Allen Probes with ground-based magnetograms from the Embrace/INPE network. Focusing on selected geomagnetic storm events in 2015, we analyze Swarm passes traversing low-latitude L-shells (L < 2) over the South American sector. This configuration allows for a direct comparison between wave signatures observed at specific L-shells in space and the response at their corresponding magnetic footprints on the ground. Preliminary results reveal a distinct North-South asymmetry, with wave packets in the SAMA region exhibiting significantly higher amplitudes compared to their conjugate footprints in the Northern hemisphere. Concurrently, ground-based analysis indicates a distinct amplification of Pc5 wave power within the SAMA region during the recovery phase. Specifically, we assess whether particle precipitation in the SAMA enhances local conductivity and Field Line Resonance (FLR) efficiency, and whether the EEJ modulates these modes. This work aims to establish a framework for quantifying the active role of South American electrodynamics in modulating global magnetospheric energy transfer.

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