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Equatorial counter electrojet longitudinal and seasonal variability in the American sector

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The equatorial electrojet (EEJ) is an electric current that flows eastwards in the ionospheric E-region, along the magnetic equator. Occasionally, it reverses during morning and afternoon hours, leading to periods of westward current that are known as counter electrojet (CEJ) events. The EEJ/CEJ magnetic signal can be isolated from other large-scale variations by using a pair of stations from the same longitude sector, one equatorial and other of low-latitude, and taking the difference between their H components.

Here, we present the first analysis of CEJ climatology and CEJ dependence on solar flux and lunar phase for the Brazilian sector, based on an extensive ground-based data set for the years 2008 to 2017 from the geomagnetic observatory Tatuoca (1.2°S, 48.5°W), and we compare it to the results found for Huancayo observatory(12.0°S, 75.3°W) in the Peruvian sector.

We found a predominance of morning CEJ events for both sectors. The afternoon CEJ occurrence rate in the Brazilian sector is twice as high as in the Peruvian sector. The afternoon CEJ occurrence rate strongly depends on season, with maximum rates occurring during the northern-hemisphere summer for the Brazilian sector and during the northern-hemisphere winter for the Peruvian sector. Significant discrepancies between the two sectors are also found for morning CEJ rates during the northern-hemisphere summer. These longitudinal differences are in agreement with a CEJ climatology derived from contemporary Swarm satellite data and can be attributed in part to the well-known longitudinal wave-4 structure in the background EEJ strength that results from nonmigrating solar tides and stationary planetary waves. Simulations with the Thermosphere-Ionosphere-Electrodynamics General Circulation Model show that the remaining longitudinal variability of CEJ rates during northern summer can be explained by the effect of migrating tides in the presence of the varying geomagnetic field in the South Atlantic Anomaly.