Relating the Interplanetary-Induced Electric Fields (IEFs) with the Low-Latitude Zonal Electric Fields (LLZEFs) under Geomagnetically Disturbed Conditions

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The overall ionospheric variability with periods ranging from long-term, secular changes, to days, hours and even minutes and seconds, is influenced by meteorological processes originating in the lower atmospheric layers, solar activity, and geomagnetic activity. In this talk, we study the "weather" aspects of the daytime low-latitude zonal electric fields (LLZEFs) at three longitude sectors, Peruvian, Philippine, and Indian, during intervals of increased geomagnetic activity, and relate them to changes in the dawn-to-dusk component of the interplanetary electric field (IEF) using a wavelet transform approach. Continuous Morlet wavelet and cross-wavelet amplitude spectra with reduced and increased frequency resolution were obtained in order to analyze and compare the oscillation activity corresponding to the LLZEFs and IEFs in the 10 min-10 hour and 1.25-12 day period ranges. For periods in the 10 min-10 hour range, four case studies were examined at the Peruvian sector when we have concurrent observations of Jicamarca zonal electric fields, and IEFs as calculated from the Advance Composition Explorer satellite solar wind velocity and interplanetary magnetic field data. We show that the wavelet method provides a powerful tool to study the frequency dependence of the two specific mechanisms of equatorial electric field variability which are dominant during geomagnetic storms, namely disturbance dynamo and prompt penetration. Periods in the 1.25-12 hour range were analyzed simultaneously at all three longitude sectors over the interval February 9-June 9, 2001, and related with similar periodicities in the IEF. Realistic daytime LLZEFs for the entire year of 2001 at all three sectors were estimated from equatorial electrojet magnetometer observations using a neural network-based plasma drift model. Our wavelet results suggest that the geomagnetic activity is an important source of LLZEF variability in this period range. In the context of interpreting our wavelet results, some examples of wavelet spectra of simulated signals are also presented and discussed.