Unusual spectral and temporal characteristics of equatorial electrojet irregularities observed with the Jicamarca VHF radars

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Equatorial electrojet (EEJ) field-aligned irregularities have been studied intensively using radars and in-situ rocket-borne sensors since early 1960s. Their main characteristics are well known. For example, two types of echoes are usually observed: (1) those caused by gradient drift instabilities (type 2), and (2) Farley-Buneman instabilities (type 1). Type 2 echoes are characterized by wide spectral width and mean Doppler proportional to the electron drift velocity. Type 1 echoes are characterized by narrow spectra and its Doppler is believed to represent the ion-acoustic speed.

In this presentation we will present examples of spectral characteristics observed during unusual magnetic conditions. For example during counter EEJ (CEEJ) conditions we have observed spectral characteristics of (1) type 2 echoes, (2) type 1 echoes, and (3) pure two stream echoes. In addition, during the large 2003 Halloween storm, a concurrent three-type spectra echo was observed, characterized by two "ion acoustic" speeds of ~150-200 m/s difference in less than 5 km altitudinal difference.

We think the latter spectra is a combination of normal EEJ echoes, i.e., type 1 and type 2 echoes, both occurring in the unstable part of the density gradient at the lower heights; and pure two stream echoes occurring in the stable part of the density gradient at the upper heights. However, as mentioned before, these results are puzzling since velocity differences of ~100-150 m/s in less than 5 km are not expected. Explaining the observations as an increase in the nominal ion-acoustic speed through much higher temperatures than expected violates everything we know about the neutral atmospheric temperature near the mesopause. Another possible source would be zonal wind differences, but their effects are expected to account for less than 50 m/s differences.

Finally, we will show the day-to-day variability of type-I speeds. During strong electrojet conditions, these speeds are much larger than the expected ion-acoustic speeds. Recently, *St.-Maurice et al.* [2004] has included electron thermal fluctuations (which are caused by electron adiabatic heating) to derived instability threshold speeds that match the upper limit reached by observations at Pohnpei and other equatorial radars. Briefly, the inclusion of these thermal fluctuations could explain the observed large type 1 speeds, since the derived threshold speed increases rapidly with decreasing altitude reaching a value of ~1.5 times as large as the isothermal ion acoustic speed. It is important to note that this generalized theory does not explain the observations described in the previous paragraph, i.e., larger type-1 speeds (100-150 m/s) in less than 5 km, being larger at higher altitude.