

Estimating electron density from 150 km echoes: Analyzing JULIA historical data

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Abstract:

Equatorial ionospheric radars have observed strong coherent echoes at around 150 km altitude for about 60 years. These irregularities have a finite number of layers vertically organized with gaps between them which vary in altitude with the solar cycle. Although the exact physical mechanism that produces them is still not fully understood, mounting evidence suggests that the gaps correspond to heights where the local upper hybrid frequency is a multiple of the gyrofrequency. However, there is not an exact method to determine the multiplicity factor.

In this work, we developed a technique that uses the resonance condition to estimate electron densities from historical SNR data collected with the Jicamarca radar operating in JULIA (Jicamarca Unattended Long-term Investigations of the Ionosphere and Atmosphere) mode. The analysis was applied to signal-to-noise ratio maps with single and multiple gaps in its structure, considering heights from the upper gap as the main region for the analysis. We present a preliminary statistics-based climatology of the gaps based on 20 years of data. The data distribution around the gaps demonstrate that JULIA has promising capabilities and enough data to estimate electron densities in the valley region, which can be used as prior information to other estimation methods.

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References:

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