Low latitude F region ionospheric phenomena

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Abstract:

Earth's atmosphere has played a pivotal role in the evolution of life on earth. A major feature of the upper atmosphere is the presence of substantial degree of ionization in layered structures- ionosphere; capable of radio wave propagation. Among the various ionospheric layers formed primarily by photoionization, the F-region stands out due to its persistence and complex structure. Its formation depends not only on ion production but also on the competing effects of recombination and diffusion, leading to the emergence of distinct F1 and F2 layers. Uniquely, the F-region is hypothesized to be geologically young, likely a product of Earth's oxygen-rich atmosphere, unlike CO_2-dominated planets.

Beyond ionization, the Sun also drives winds in the upper atmosphere. Analysis of drift data from the Jicamarca Radio Observatory's ISR enables us to understand the electrodynamical processes, where ion-neutral collisions generate electric fields and plasma drifts that shape the behavior of the F-region ionosphere. These in turn extend some of the dynamical effects throughout the ionosphere significantly affecting satellites, communication and navigation.