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Forecasting Instability in the Postsunset Equatorial *F* Region Ionosphere

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We describe an ongoing effort to reproduce observations of plasma instability in the postsunset equatorial *F*-region ionosphere related to equatorial spread *F* phenomenology. The effort involves assembling comprehensive observations of ionospheric state parameters leading up to instability as well as the space-weather effects that follow and to connect the two theoretically using an appropriate direct numerical simulation (DNS) The ultimate goal of the effort is to reproduce the observations with sufficient accuracy and fidelity so as to be able to apply the same methods to forecasting.

Most of the data for the effort come from the Jicamarca Radio Observatory. We developed a special mode which measures electron number density, vertical ion drift, and zonal ion drift profiles simultaneously above the observatory using incoherent scatter. As small-scale irregularities, telltales of ESF, emerge in the ionosphere, the radar mode also observes coherent scatter in imaging mode (see Fig. 1 for example). Radar imagery reveals the morphology of intermediate- and large-scale ionospheric irregularities passing overhead in detail and with minimal ambiguity.

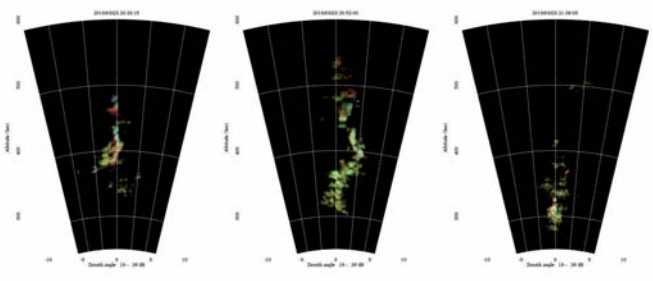

Figure 1. Coherent scatter radar imagery of ESF plumes over Jicamarca.

A DNS code is used to reproduce the emerging ionospheric irregularities on the basis of the state-parameter observations which are incorporated as initial conditions and to fix the forcing from neutral winds and the background electric field. Our code has two components: a fully three-dimensional potential solver based on s stabilized biconjugate gradient method and a time-advance system based on monotone upwind scheme for conversation laws (MUSCLs) with flux limiting.

We present results from a number of experimental campaign conducted in different seasons with different solar flux levels. Overall, the congruity between the radar observations and the numerical simulations inspires confidence regarding the prospects of practical ESF forecasts [1][2][3].

References

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